# United States Court of Appeals
**FOR THE DISTRICT OF COLUMBIA CIRCUIT**

Argued March 25, 2008 Decided July 11, 2008

No. 05-1244

STATE OF NORTH CAROLINA,
PETITIONER

v.

ENVIRONMENTAL PROTECTION AGENCY,
RESPONDENT

UTILITY AIR REGULATORY GROUP, ET AL.,
INTERVENORS

Consolidated with
05-1246, 05-1249, 05-1250, 05-1251, 05-1252, 05-1253,
05-1254, 05-1256, 05-1259, 05-1260, 05-1262, 06-1217,
06-1222, 06-1224, 06-1226, 06-1227, 06-1228, 06-1229,
06-1230, 06-1232, 06-1233, 06-1235, 06-1236, 06-1237,
06-1238, 06-1240, 06-1241, 06-1242, 06-1243, 06-1245,
07-1115

On Petitions for Review of an Order of the
Environmental Protection Agency

*Robin L. Juni* argued the cause for petitioners on $SO_2$ Issues. *Bart E. Cassidy* argued the cause for petitioners on Title

NMED Exhibit 9a

IV Exempt Units Issues. With them on the briefs were *Peter H. Wyckoff*, *Jeffrey A. Knight*, *Lisa M. Jaeger*, *Brian J. McManus*, *William H. Lewis Jr.*, *Steven J. Shimberg*, *Deborah E. Jennings*, *Meredith DuBarry Huston*, *Michael R. Barr*, *Sheldon A. Zabel*, *Kathleen C. Bassi*, *Stephen J. Bonebrake*, *Sam Kalen*, *Kyle W. Danish*, and *Alvin Bruce Davis*. *Carol F. McCabe* entered an appearance.

*Marc D. Bernstein*, Special Deputies Attorney General, Attorney General's Office of State of North Carolina, argued the cause for petitioners on North Carolina Issues. With him on the briefs were *Roy Cooper*, Attorney General, *James C. Gulick*, Senior Deputy Attorney General, *J. Allen Jernigan*, Special Deputies Attorney General, and *John C. Evans*, Assistant Attorney General.

*William M. Bumpers*, *Robert A. Manning*, and *Michael W. Steinberg* argued the causes for petitioners on Border State Issues. With them on the briefs were *David A. Savage*, *Michael B. Heister*, *William H. Lewis Jr.*, and *Alvin Bruce Davis*. *James S. Alves* and *Winston K. Borkowski* entered appearances.

*Alvin B. Davis* argued the cause for petitioners on Fuel-Adjustment Issues. With him on the briefs was *David A. Savage*. *Joshua B. Frank* entered an appearance.

*Sheldon A. Zabel*, *Kathleen C. Bassi*, *Stephen J. Bonebrake*, and *Robert A. Manning* were on the briefs of petitioners Northern Indiana Public Service Company and Florida Association of Electric Utilities on $NO_x$-Related Claims.

*Angeline Purdy* and *Norman L. Rave, Jr.*, Attorneys, U.S. Department of Justice, argued the cause for respondents. With them on the brief were *John C. Cruden*, Deputy Assistant Attorney General, and *Steven E. Silverman* and *Geoffrey Wilcox*, Counsel, U.S. Environmental Protection Agency. *Paul D. Tanaka*, Attorney, U.S. Department of Justice, entered and appearance.

*Andrew M. Cuomo*, Attorney General, Attorney General's Office of the State of New York, *Barbara D. Underwood*, Solicitor General, *Daniel Chepaitis*, Assistant Solicitor General, *J. Jared Snyder*, Assistant Attorney General, *Richard Blumenthal*, Attorney General, Attorney General's Office of the State of Connecticut, *Stuart Rabner*, Attorney General, Attorney General's Office of the State of New Jersey, *Joseph R. Biden, III*, Attorney General, Attorney General's Office of the State of Delaware, *Lisa Madigan*, Attorney General, Attorney General's Office of the State of Illinois, *Douglas F. Gansler*, Attorney General, Attorney General's Office of the State of Maryland, *Martha Coakley*, Attorney General, Attorney General's Office of the Commonwealth of Massachusetts, *Kelly A. Ayotte*, Attorney General, Attorney General's Office of the State of New Hampshire, *Gary K. King*, Attorney General, Attorney General's Office fo the State of New Mexico, *Patrick C. Lynch*, Attorney General, Attorney General's Office of the State of Rhode Island, and *Linda Singer*, Attorney General at the time the brief was filed, Attorney General's Office for the District of Columbia, were on the brief of *amici* states in support of petitioner North Carolina. *Michael J. Myers*, Assistant Attorney General, Attorney General's Office of the State of New York, *Matthew I. Levine*, Assistant Attorney General, Attorney General's Office of the State of Connecticut, *Jean P. Reilly*, *Ruth E. Carter*, and *Kevin P. Auerbacher*, Assistant Attorneys General, Attorney General's Office of the State of New Jersey, and *James R. Milkey*, Assistant Attorney General, Attorney General's Office of the Commonwealth of Massachusetts, entered appearances.

*Kristen M. Campfield*, Attorney, was on the brief for amicus curiae Commonwealth of Pennsylvania, Department of

Environmental Protection, in support of petitioner ARIPPA and seeking remand.

*Sean H. Donahue*, *Vickie L. Patton*, and *John D. Walke* were on the joint brief of intervenors in support of respondent.

*Peter Glaser*, *Harold P. Quinn*, *Norman W. Fichthorn*, *C. Grady Moore III*, *P. Stephen Gidiere III*, *Claudia M. O'Brien*, and *Nathan H. Seltzer* were on the brief for industry intervenors.

Before: SENTELLE, *Chief Judge*, and ROGERS and BROWN, *Circuit Judges*.

Opinion for the Court filed PER CURIAM.

*PER CURIAM*: These consolidated petitions for review challenge various aspects of the Clean Air Interstate Rule. Because we find more than several fatal flaws in the rule and the Environmental Protection Agency ("EPA") adopted the rule as one, integral action, we vacate the rule in its entirety and remand to EPA to promulgate a rule that is consistent with this opinion.

## I. Background

### A. Title I of the Clean Air Act

Title I of the Clean Air Act ("CAA"), 42 U.S.C. §§ 7401 *et seq.*, requires EPA to issue national ambient air quality standards ("NAAQS") for each air pollutant that "cause[s] or contribute[s] to air pollution which may reasonably be anticipated to endanger public health or welfare [and] the presence of which in the ambient air results from numerous or diverse mobile or stationary sources . . . ," *id.* § 7408(a)(1)(A), (B). It also requires EPA to divide the country into areas designated as "nonattainment," "attainment," or "unclassifiable" for each air pollutant, depending on whether the area meets the NAAQS. *Id.* § 7407(c), (d). Title I gives states "the primary responsibility for assuring air quality" within their borders, *id.* § 7407(a), and requires each state to create a state implementation plan ("SIP") to meet the NAAQS for each air pollutant and submit it to EPA for its approval, *id.* § 7410. If a state is untimely in submitting a compliant SIP to EPA, EPA must promulgate a federal implementation plan ("FIP") for the state to follow. *Id.* § 7410(c)(1).

One provision of Title I requires SIPs to

> contain adequate provisions —(i) prohibiting, consistent with the provisions of this subchapter, any source or other type of emissions activity within the State from emitting any air pollutant in amounts which will—(I) contribute significantly to nonattainment in, or interfere with maintenance by, any other State with respect to any [NAAQS] . . . .

42 U.S.C. § 7410(a)(2)(D)(i)(I) (statutory provision to which we refer throughout this opinion as "section 110(a)(2)(D)(i)(I)"). In 1998, EPA relied on this provision to promulgate the $NO_x$ SIP Call, which imposed a duty on certain upwind sources to reduce their $NO_x$ emissions by a specified amount so that they no longer "'contribute significantly to nonattainment in, or interfere with maintenance by,' a downwind State." Finding of Significant Contribution and Rulemaking for Certain States in the Ozone Transport Assessment Group Region for Purposes of Reducing Regional Transport of Ozone, 63 Fed. Reg. 57,356, 57,358 (Oct. 27, 1998) ("$NO_x$ SIP Call"). The $NO_x$ SIP Call created an optional cap-and-trade program for nitrogen oxides ("$NO_x$"). *Id.* at 57,359. Like the $NO_x$ SIP Call, the Clean Air Interstate Rule—Rule To Reduce Interstate Transport of Fine Particulate Matter and Ozone (Clean Air Interstate Rule); Revisions to Acid

Rain Program; Revisions to the $NO_x$ SIP Call, 70 Fed. Reg. 25,162 (May 12, 2005) ("CAIR")—which is the rule at issue in these consolidated petitions for review, also derives its statutory authority from section 110(a)(2)(D)(i)(I).

B. Title IV of the Clean Air Act

Title IV of the CAA, 42 U.S.C. §§ 7651–7651*o*, aims to reduce acid rain deposition nationwide and in doing so creates a cap-and-trade program for sulfur dioxide ("$SO_2$") emitted by fossil fuel-fired combustion devices. Congress capped $SO_2$ emissions for affected units, or electric generating units ("EGUs"), at 8.9 million tons nationwide, *id.* § 7651b(a)(1), and distributed "allowances" among those units. One "allowance" is an authorization for an EGU to emit one ton of $SO_2$ in a year. *Id.* § 7651a(3). Title IV includes detailed provisions for allocating allowances among EGUs based for the most part on their share of total heat input of all Title IV EGUs during a 1985–87 baseline period. *Id.* §§ 7651a(4), 7651c, 7651d, 7651e, 7651h, 7651i. Whenever an EGU emits one ton of $SO_2$ in a year, it must surrender one allowance to EPA. *See id.* § 7651b(g). But Title IV also permits EGUs to transfer unused allowances to deficient EGUs throughout the nation or to "bank" excess allowances and use or sell them in future years. *Id.* § 7651b(b).

Title IV exempts EGUs that are "simple combustion turbines, or units which serve a generator with a nameplate capacity of 25 Mwe [megawatt electrical] or less," 42 U.S.C. § 7651a(8), those that are not fossil fuel-fired, *id.* § 7651a(15), those that do not sell electricity, *id.* § 7651a(17)(A)(i), and those that cogenerate steam and electricity unless they sell a certain amount of electricity, *id.* § 7651a(17)(C). It also provides that certain exempt units—"qualifying small power production facilities" and "qualifying cogeneration facilities," defined in 16

U.S.C. § 796(17)(C), (18)(B) (delegating power to FERC to define the terms), and certain "new independent power production facilities," defined in 42 U.S.C. § 7651*o*(a)(1)—may elect to become a part of Title IV. 42 U.S.C. § 7651d(g)(6)(A); *see id.* § 7651i (detailing "electing-in" provisions).

C. Clean Air Interstate Rule

Pursuant to its Title I authority to ensure that states have plans in place that implement the requirements in section 110(a)(2)(D)(i)(I), EPA promulgated CAIR. CAIR, 70 Fed. Reg. at 25,165. CAIR's purpose is to reduce or eliminate the impact of upwind sources on out-of-state downwind nonattainment of NAAQS for fine particulate matter ("$PM_{2.5}$"), a pollutant associated with respiratory and cardiovascular problems, and eight-hour ozone, a pollutant commonly known as smog. *Id.* at 25,162. For the most part, EPA defines sources at the state level. EPA determined that 28 states and the District of Columbia ("upwind states") contribute significantly to out-of-state downwind nonattainment of one or both NAAQS. *Id.* Because $SO_2$ "is a precursor to $PM_{2.5}$ formation, and $NO_x$ is a precursor to both ozone and $PM_{2.5}$ formation," CAIR requires upwind states "to revise their [SIPs] to include control measures to reduce emissions" of $SO_2$ and $NO_x$. *Id.* CAIR requires upwind states to reduce their emissions in two phases. *Id.* at 25,165. $NO_x$ reductions are to start in 2009, $SO_2$ reductions are to start in 2010, and the second reduction phase for each air pollutant is to start in 2015. *Id.* at 25,162. To implement CAIR's emission reductions, the rule also creates optional interstate trading programs for each air pollutant, to which, in the absence of approved SIPs, all upwind sources are now subject. *Id.*; *see* Rulemaking on Section 126 Petition from North Carolina To Reduce Interstate Transport of Fine Particulate Matter and Ozone; Federal Implementation Plans To Reduce Interstate Transport of Fine Particulate Matter and Ozone;

Revisions to the Clean Air Interstate Rule; Revisions to the Acid Rain Program, 71 Fed. Reg. 25,328, 25,328 (Apr. 28, 2006) ("FIP") (in the absence of approved SIPs for CAIR, applying the rule's model trading programs via EPA's Federal Implementation Plan to all sources in upwind states). In addition, CAIR revises Title IV's Acid Rain Program regulations governing the $SO_2$ cap-and-trade program and replaces the $NO_x$ SIP Call with the CAIR ozone-season $NO_x$ trading program.

At issue in much of this litigation is the definition of the term "contribute significantly." In other words, in order to promulgate CAIR, EPA had to determine what amount of emissions constitutes a "significant contribution" to another state's nonattainment problem. *See* 42 U.S.C. § 7410(a)(2)(D)(i)(I). CAIR uses several factors to define "contribute significantly," including one state's impact on another's air quality, the cost of "highly cost-effective" emissions controls, fairness, and equity in the balance between regional and local controls. CAIR, 70 Fed. Reg. at 25,174–75. The air quality factor is the threshold step in the analysis, determining whether an upwind state is subject to CAIR, and the other factors help EPA determine the quantitative level of emissions reductions required of upwind sources.

CAIR uses a different air quality threshold for each of the two pollutants it regulates. A state meets the air quality threshold for $PM_{2.5}$ (and is therefore subject to CAIR) if it contributes 0.2 micrograms per cubic meter ("$\mu g/m^3$") or more of $PM_{2.5}$ to out-of-state downwind areas that are in nonattainment. *Id.* at 25,174–75, 25,191. CAIR uses a more complicated process to define the air quality threshold for ozone NAAQS. CAIR first eliminates a state from inclusion in the CAIR ozone program if it has the following characteristics: (1) it contributes less than 2 parts per billion ("ppb") to a nonattainment area's ozone concentration as measured using either a "zero-out method" or a "source apportionment method," or (2) its relative contribution to the nonattainment area's excess ozone concentration (the number of particles exceeding 85 ppb) is less than one percent. *Id.* at 25,191; *see also* Rule to Reduce Interstate Transport of Fine Particulate Matter and Ozone (Clean Air Interstate Rule): Reconsideration, 71 Fed. Reg. 25,304, 25,320 (Apr. 28, 2006) ("Reconsideration"). States that survive the screening criteria are then assessed to determine if they contribute significantly to ozone nonattainment in another state using three metrics: (1) magnitude of contribution, (2) frequency of contribution, and (3) relative amount of contribution to the area's ozone concentration that exceeds attainment levels. CAIR, 70 Fed. Reg. at 25,191–92.

States that "contribute significantly" to nonattainment for ozone NAAQS are subject to CAIR's ozone-season limits for $NO_x$ and those that "contribute significantly" to nonattainment for $PM_{2.5}$ NAAQS are subject to CAIR's annual limits for $NO_x$ and $SO_2$. The ozone-season $NO_x$ limits are a percentage reduction in the annual limits for $NO_x$ calculated for $PM_{2.5}$ contributors. In order to eliminate a state's significant contribution to $PM_{2.5}$ NAAQS, CAIR sets an annual cap on $NO_x$ and $SO_2$ emissions in the region. Each state participating in CAIR's allowance-trading programs receives a budget of allowances, calculated according to a different formula for $SO_2$ and $NO_x$. If a state develops a SIP that opts out of the trading programs to which all its upwind sources are now subject in the absence of an approved SIP, *see* FIP, 71 Fed. Reg. at 25,328, the state must limit its emissions to a cap specified by CAIR.

CAIR sets each state's $NO_x$ emissions budget by allocating the regionwide $NO_x$ budget among CAIR states according to each state's proportion of oil-, gas-, and coal-fired facilities. CAIR, 70 Fed. Reg. at 25,230–31. The regionwide budget is equal to the upwind states' average annual heat input for EGUs from 1999 to 2002 multiplied by the uniform emissions rate if EGUs were to use "highly cost-effective" emissions controls. *Id.* at 25,231. For Phase One, which starts in 2009, the multiplier is 0.15 pounds per million British thermal units ("lb/mmBtu") and for Phase Two, which starts in 2015, the multiplier is 0.125 lb/mmBtu. *Id.* at 25,230. Even though EPA determined that emissions controls in both phases are "highly cost effective," it only deemed Phase Two to eliminate the upwind states' "significant contribution" to downwind nonattainment. *Id.* at 25,198. In 2009, EPA has supplemented the budget of 1.5 million tons of $NO_x$ emissions with a one-time Compliance Supplement Pool of 200,000 $NO_x$ allowances. *Id.* at 25,231–32. Like $SO_2$ allowances in Title IV, one CAIR $NO_x$ allowance permits an EGU to emit one ton of $NO_x$ in one year. State budgets are based on their average annual heat input, adjusted by fuel type (coal, gas, oil) during the 1999–2002 time period. *Id.* at 25,231. The use of fuel-adjustment factors means states with higher percentages of gas- and oil-fired facilities receive comparably fewer $NO_x$ allowances than states with higher percentages of coal-fired facilities. States have discretion to accomplish their $NO_x$ emissions caps as they see fit in their SIPs, but if a state takes part in the EPA-administered trading program for $NO_x$, it must follow EPA's rules for that program.

CAIR sets each state's $SO_2$ budget using a process similar to the one used for $NO_x$ budgets; it allocates the regionwide $SO_2$ budget among upwind states. However, EPA used a different method to determine the regionwide budget for $SO_2$. Instead of using 1999–2002 data, the agency summed all the Title IV allowances allotted to EGUs in the covered states and reduced them by 50% for 2010 (Phase One) and 65% for 2015 (Phase Two). *Id.* at 25,229. As stated above, Title IV allocates allowances among EGUs based for the most part on their share of the total heat input of all Title IV EGUs during a 1985–87 baseline period, not the later time period used for $NO_x$ allowances in CAIR. 42 U.S.C. §§ 7651a(4), 7651c, 7651d, 7651e, 7651h, 7651i. States subject to CAIR may opt into the EPA-administered trading program for $SO_2$, but if they do not opt in and at the same time choose to regulate EGUs, their SIPs must include a mechanism for retiring Title IV $SO_2$ allowances in excess of the budget CAIR allocates to each state. CAIR, 70 Fed. Reg. at 25,259. A state not participating in CAIR's trading program but regulating other sources of $SO_2$ in addition to EGUs, does not need to surrender quite as many of its Title IV $SO_2$ allowances. *Id.* Any surrendered allowance may not be used for Title IV compliance purposes and is forever out of circulation. *Id.* at 25,291. A state does not have to surrender any Title IV $SO_2$ allowances if it adopts a SIP that regulates only non-EGUs to accomplish its $SO_2$ cap, *id.* at 25,295, but EPA notes that EGUs are projected to contribute 70% of $SO_2$ emissions in 2010, *id.* at 25,214, making such a scenario unlikely.

EPA issued two additional rules clarifying CAIR that are also under review in this proceeding. One rule responds to various petitions for reconsideration, which are discussed in more detail below. Reconsideration, 71 Fed. Reg. 25,304. Another rule, *inter alia*, sets forth a FIP to regulate EGUs until upwind states implement EPA-approved SIPs that conform with CAIR requirements. FIP, 71 Fed. Reg. 25,328.

D. Petitions for Review

Section 307 of the CAA requires petitions for judicial review of CAIR to be filed within 60 days of the rule's publication in the Federal Register. 42 U.S.C. § 7607(b)(1). On May 12, 2005, EPA published CAIR and on April 28, 2006, EPA published its Reconsideration and FIP, which describes the Federal Implementation Plan required of sources while states formulate their SIPs. CAIR, 70 Fed. Reg. 25,162; Reconsideration, 71 Fed. Reg. 25,304; FIP, 71 Fed. Reg. 25,328. In the 60 days after EPA published CAIR and its Reconsideration, several petitions for review were filed in this Court.

Among those petitions are North Carolina's objections to EPA's trading programs, EPA's interpretation of the "interfere with maintenance" language in section 110(a)(2)(D)(i)(I), Phase Two's 2015 compliance date, the $NO_x$ Compliance Supplement Pool, EPA's interpretation of "will" in "will contribute significantly," and the air quality threshold for $PM_{2.5}$. Several electric utility companies ("$SO_2$ Petitioners") contest EPA's authority under Title I and Title IV to limit the number of Title IV allowances in circulation, to set state $SO_2$ budgets as percentage reductions in Title IV allowances, and to require units exempt from Title IV to acquire Title IV allowances. Petitioners Entergy Corporation and FPL Group, to which we refer as "Entergy," contest EPA's authority to base state $NO_x$ budgets on the number of coal-, oil-, and gas-fired facilities a state has compared to other states in the CAIR region. Electric utilities operating in Texas, Florida, and Minnesota and one municipality argue against the inclusion of all or part of those States in CAIR. And Florida Association of Electric Utilities petitions for review of EPA's 2009 start date for Phase One of $NO_x$ restrictions. We consider these petitions below.

## II. Analysis

Our jurisdiction derives from the CAA, which also establishes our standard of review. We "may reverse any such action found to be . . . arbitrary, capricious, an abuse of discretion, or otherwise not in accordance with law; . . . [or] in excess of statutory jurisdiction, authority, or limitations, or short of statutory right . . . ." 42 U.S.C. § 7607(d)(9). We refer to the review standard in 42 U.S.C. § 7607(d) instead of the similar standard of review set forth in the Administrative Procedure Act ("APA") because the CAA directs that its review standard apply to "such . . . actions as the Administrator may determine." *Id.* § 7607(d)(1)(V); *see* Supplemental Proposal for the Rule To Reduce Interstate Transport of Fine Particulate Matter and Ozone (Clean Air Interstate Rule), 69 Fed. Reg. 32,684, 32,686 (June 10, 2004) (applying section 307(d), 42 U.S.C. § 7607(d), "to all components of the rulemaking").

The petitions under review involve EPA's construction of the CAA, a statute it administers. Where the statute speaks to the direct question at issue, we afford no deference to the agency's interpretation of it and "must give effect to the unambiguously expressed intent of Congress." *Chevron U.S.A., Inc. v. Natural Res. Def. Council, Inc.*, 467 U.S. 837, 842–43 (1984). But where the statute does "not directly address[] the precise question at issue, . . . the question for the court is whether the agency's answer is based on a permissible construction of the statute," and we only reverse that determination if it is "arbitrary, capricious, or manifestly contrary to the statute." *Id.* at 843. An action is "arbitrary and capricious" if it

> has relied on factors which Congress has not intended it to consider, entirely failed to consider an important aspect of the problem, offered an explanation for its decision that runs counter to the evidence before the agency, or is so implausible that it could not be ascribed to a difference in view or the product of agency expertise.

*Motor Vehicle Mfrs. Ass'n v. State Farm Mut. Auto. Ins. Co.*, 463 U.S. 29, 43 (1983); *see Motor Vehicle Mfrs. Ass'n. v. EPA*, 768 F.2d 385, 389 n.6 (D.C. Cir. 1985) (noting that "the standard we apply (i.e., whether the EPA's actions were in excess of statutory authority or arbitrary and capricious) is the same under" the CAA and the APA).

A. North Carolina Issues

Petitioner North Carolina challenges CAIR's programs for pollution-trading, EPA's interpretation of the "interfere with maintenance" provision in section 110(a)(2)(D)(i)(I), the 2015 compliance deadline for Phase Two of CAIR, the $NO_x$ Compliance Supplement Pool, EPA's interpretation of the word "will" that precedes "contribute significantly" in section 110(a)(2)(D)(i)(I), and EPA's use of a 0.2 $\mu g/m^3$ air quality threshold for including upwind states in CAIR's $PM_{2.5}$ program. We grant North Carolina's petition as to the trading programs, the "interfere with maintenance" language, and the 2015 compliance deadline, deny its petition as to its interpretation of "will" and the air quality threshold, and take no action on the $NO_x$ Compliance Supplement Pool issue.

1. Pollution-Trading Programs

North Carolina challenges the lawfulness of CAIR's trading programs for $SO_2$ and $NO_x$. North Carolina contests the lack of reasonable measures in CAIR to assure that upwind states will abate their unlawful emissions as required by section 110(a)(2)(D)(i)(I), but does not submit that any trading is per se unlawful. EPA designed CAIR to eliminate the significant contribution of upwind states, as a whole, to downwind nonattainment. CAIR, 70 Fed. Reg. at 25,195. EPA did not purport to measure each state's significant contribution to specific downwind nonattainment areas and eliminate them in an isolated, state-by-state manner. Reasoning that capping emissions in each state would not achieve reductions in the most cost-effective manner, EPA decided to take a regionwide approach to CAIR and include voluntary emissions trading programs.

> In modeling the CAIR . . . EPA assumes interstate emissions trading. While EPA is not requiring States to participate in an interstate trading program for EGUs, we believe it is reasonable to evaluate control costs assuming States choose to participate in such a program since that will result in less expensive reductions.

*Id.* at 25,196. In CAIR's trading system, states are given initial emissions budgets, but sources can choose to sell or purchase emissions credits from sources in other states. As a result, states may emit more or less pollution than their caps would otherwise permit.

Because EPA evaluated whether its proposed emissions reductions were "highly cost effective," at the regionwide level assuming a trading program, it never measured the "significant contribution" from sources within an individual state to downwind nonattainment areas. Using EPA's method, such a regional reduction, although equivalent to the sum of reductions required by all upwind states to meet their budgets, would never equal the aggregate of each state's "significant contribution" for two reasons. State budgets alone, without trading, would not be "highly cost effective." And although EPA has measured the "air quality factor" to include states in CAIR, it has not measured the unlawful amount of pollution for each upwind-downwind linkage. "As noted earlier in the case of $SO_2$, EPA recognizes that the choice of method in setting State budgets, with a given regionwide total annual budget, makes little difference in terms of the levels of resulting regionwide annual $SO_2$ and $NO_x$ emissions reductions." *Id.* at 25,230–31. Thus EPA's apportionment decisions have nothing to do with each state's "significant contribution" because under EPA's method of analysis, state budgets do not matter for significant contribution purposes.

But according to Congress, individual state contributions to downwind nonattainment areas do matter. Section 110(a)(2)(D)(i)(I) prohibits sources "*within the State*" from "contribut[ing] significantly to nonattainment *in . . . any other State* . . ." (emphasis added). Yet under CAIR, sources in Alabama, which contribute to nonattainment of $PM_{2.5}$ NAAQS in Davidson County, North Carolina, would not need to reduce their emissions at all. *See* CAIR, 70 Fed. Reg. at 25,247 tbl. VI-8. Theoretically, sources in Alabama could purchase enough $NO_x$ and $SO_2$ allowances to cover all their current emissions, resulting in no change in Alabama's contribution to Davidson County, North Carolina's nonattainment. CAIR only assures that the entire region's significant contribution will be eliminated. It is possible that CAIR would achieve section 110(a)(2)(D)(i)(I)'s goals. EPA's modeling shows that sources contributing to North Carolina's nonattainment areas will at least reduce their emissions even after opting into CAIR's trading programs. 71 Fed. Reg. at 25,344–45. But EPA is not exercising its section 110(a)(2)(D)(i)(I) duty unless it is promulgating a rule that achieves something measurable toward the goal of prohibiting sources "within the State" from contributing to nonattainment or interfering with maintenance "in any other State."

In *Michigan v. EPA*, 213 F.3d 663 (D.C. Cir. 2000), we deferred to EPA's decision to apply uniform emissions controls to all upwind states despite different levels of contribution of $NO_x$ to nonattainment areas caused by the differing quantities of emissions produced in upwind states and the varying distances of upwind sources to downwind nonattainment areas. *Id.* at 679. We did so because these effects "flow[] ineluctably from the EPA's decision to draw the 'significant contribution' line on a basis of cost differentials" and "[o]ur upholding of that decision logically entails upholding this consequence." *Id.* But the flow of logic only goes so far. It stops at the point where EPA is no longer effectuating its statutory mandate. In *Michigan* we never passed on the lawfulness of the $NO_x$ SIP Call's trading program. *Id.* at 676 ("Of course we are able to assume the existence of EPA's allowance trading program only because no one has challenged its adoption."). It is unclear how EPA can assure that the trading programs it has designed in CAIR will achieve section 110(a)(2)(D)(i)(I)'s goals if we do not know what each upwind state's "significant contribution" is to another state. Despite *Michigan*'s approval of emissions controls that do not correlate directly with each state's relative contribution to a specific downwind nonattainment area, CAIR must include some assurance that it achieves something measurable towards the goal of prohibiting sources "within the State" from contributing to nonattainment or interfering with maintenance in "any other State."

Because CAIR is designed as a complete remedy to section 110(a)(2)(D)(i)(I) problems, as EPA claims, FIP, 71 Fed. Reg. at 25,340, CAIR must do more than achieve something measurable; it must actually require elimination of emissions from sources that contribute significantly and interfere with maintenance in downwind nonattainment areas. To do so, it must measure each state's "significant contribution" to downwind nonattainment even if that measurement does not directly correlate with each state's individualized air quality impact on downwind nonattainment relative to other upwind states. *See Michigan*, 213 F.3d at 679. Otherwise, the rule is not effectuating the statutory mandate of prohibiting emissions moving from one state to another, leaving EPA with no statutory authority for its action. Whether EPA could promulgate a section 110(a)(2)(D)(i)(I) remedy that would bar alternate relief, such as would be available under section 126, 42 U.S.C. § 7426, is a question that is not before the court.

2. "Interfere With Maintenance"

Section 110(a)(2)(D)(i)(I) requires EPA to ensure that SIPs "contain adequate provisions" prohibiting sources within a state from emitting air pollutants in amounts which will "contribute significantly to nonattainment in, *or* interfere with maintenance by, any other State with respect to any [NAAQS]." 42 U.S.C. § 7410(a)(2)(D)(i)(I) (emphasis added). North Carolina argues that EPA unlawfully ignored the "interfere with maintenance" language in section 110(a)(2)(D)(i)(I), divesting it of independent effect in CAIR. It contends that instead of limiting the beneficiaries of CAIR to downwind areas that were monitored to be in nonattainment when EPA promulgated CAIR *and* were modeled to be in nonattainment in 2009 and 2010, when CAIR goes into effect, CAIR, 70 Fed. Reg. at 25,244, EPA should have also included in CAIR upwind states, such as Georgia, that send pollution into downwind areas that are projected to barely meet attainment levels of NAAQS in 2010. North Carolina only contests EPA's interpretation of the "interfere with maintenance" prong as applied to EPA's determination of which states are beneficiaries of CAIR for the ozone NAAQS.

North Carolina explains that even though all of its counties are projected to attain NAAQS for ozone by 2010, several of its counties are at risk of returning to nonattainment due to interference from upwind sources. Specifically, it notes that Mecklenburg County, which projections show will have ozone levels of 82.5 ppb in 2010 (2.5 ppb below the 85.0 ppb NAAQS) without help from CAIR, could fall back into nonattainment because of the historic variability in the county's ozone levels. Technical Support Document for the Final Clean Air Interstate Rule, Air Quality Modeling, at Appendix E (March 2005)

("Technical Support Document"). EPA has stated that "historical data indicates that attaining counties with air quality levels within 3 ppb of the standard are at risk of returning to nonattainment." EPA, Corrected Response to Significant Public Comments on the Proposed Clean Air Interstate Rule, at 148 (April 2005) ("Corrected Response"). "The information also indicates that even if CAIR receptors were to [be] 3–5 ppb below the standard, they would have a reasonable likelihood of returning to nonattainment." *Id.* And in the case of Fulton County, Georgia, EPA determined that the "interfere with maintenance" provision justified imposing controls on upwind states in 2015 even though it is projected to attain the NAAQS by a margin of 7 or 8 ppb because its ozone levels have varied by at least that margin several times in the recent past. *Id.* at 150. North Carolina argues that EPA must utilize this "historic variability" standard to determine which downwind areas suffer interference with their maintenance in 2010, not just 2015. If it did so, EPA would see that Mecklenburg County, North Carolina, has varied by at least 3 ppb (the relevant margin between attainment and nonattainment for that county in 2010) six times in the recent past and consequently would include in CAIR any state, such as Georgia, that is contributing an unlawful amount of pollution to this downwind area. *Id.* at 1042.

EPA contends that it interpreted "interfere with maintenance" just as it did in the $NO_x$ SIP Call, in which it gave the term a meaning "much the same as" the one given to the preceding phrase, "contribute significantly to nonattainment." CAIR, 70 Fed. Reg. at 25,193 n.45. EPA maintains that "the 'interfere with maintenance' prong may come into play only in circumstances where EPA or the State can reasonably determine or project, based on available data, that an area in a downwind state will achieve attainment, but due to emissions growth or other relevant factors is likely to fall back into nonattainment."

*Id.* In the $NO_x$ SIP Call, it meant that areas monitored to be in attainment when that rule was promulgated but which were modeled to be in nonattainment in 2007, when the rule went into effect, were considered downwind areas with which upwind sources' emissions interfered. $NO_x$ SIP Call, 63 Fed. Reg. at 57,379. EPA states it gave effect to the "interfere with maintenance" prong in CAIR by using it as a basis for implementing further emissions reductions in Phase Two of CAIR, by which time some downwind states will have attained NAAQS. CAIR, 70 Fed. Reg. at 25,195.

First, we note that we did not consider EPA's interpretation of "interfere with maintenance" in *Michigan*. Thus any interpretation it used in that rulemaking cannot provide support for EPA's contention that its current interpretation, even if identical to that in the $NO_x$ SIP Call, comports with the statute. So we analyze EPA's interpretation of "interfere with maintenance" for the first time here. Despite using "interfere with maintenance" as a justification for imposing further emissions controls in 2015, CAIR gave no independent significance to the "interfere with maintenance" prong of section 110(a)(2)(D)(i)(I) to separately identify upwind sources interfering with downwind maintenance. Under EPA's reading of the statute, a state can never "interfere with maintenance" unless EPA determines that at one point it "contribute[d] significantly to nonattainment." EPA stated clearly on two occasions "that it would apply the interfere with maintenance provision in section 110(a)(2)(D) in conjunction with the significant contribution to nonattainment provision and so did not use the maintenance prong to separately identify upwind States subject to CAIR." FIP, 71 Fed. Reg. at 25,337 (citing CAIR, 70 Fed. Reg. at 25,193); *see also* Corrected Response, at 63. EPA reasoned that this interpretation "avoid[s] giving greater weight to the potentially lesser environmental effect" and strikes "a reasonable balance between controls in upwind states and in-state controls." FIP, 71 Fed. Reg. at 25,337. EPA stated that an interpretation that permitted states that are able to attain NAAQS on their own to benefit from CAIR "could even create a perverse incentive for downwind states to increase local emissions." *Id.*

All the policy reasons in the world cannot justify reading a substantive provision out of a statute. *See Whitman v. Am. Trucking Ass'ns*, 531 U.S. 457, 485 (2001). Areas that find themselves barely meeting attainment in 2010 due in part to upwind sources interfering with that attainment have no recourse under EPA's interpretation of the interference prong of section 110(a)(2)(D)(i)(I). 2010 is not insignificant because that is the deadline for downwind areas to attain ozone NAAQS. *See* 42 U.S.C. § 7511 (setting forth deadlines for attaining ozone NAAQS). An outcome that fails to give independent effect to the "interfere with maintenance" prong violates the plain language of section 110(a)(2)(D)(i)(I). The provision at issue is written in the disjunctive: SIPs must "contain adequate provisions prohibiting . . . any source or other type of emissions activity within the State from emitting any air pollutant in amounts which will contribute significantly to nonattainment in, *or* interfere with maintenance by, any other State . . . ." 42 U.S.C. § 7410(a)(2)(D)(i)(I) (emphasis added). "Canons of construction ordinarily suggest that terms connected by a disjunctive be given separate meanings, unless the context dictates otherwise . . . ." *Reiter v. Sonotone Corp.*, 442 U.S. 330, 339 (1979). There is no context in section 110(a)(2)(D)(i)(I) directing an alternate result; therefore EPA must give effect to both provisions in the statute.

EPA contends in its brief that CAIR is just one step in carrying out its section 110(a)(2)(D)(i)(I) duties, hinting that it may later choose to give independent effect to the "interfere with maintenance" language. There is some general language in the record to support this contention. *See* CAIR, 70 Fed. Reg. at 25,175 ("This overall plan is well within the ambit of EPA's authority to proceed with regulation on a step-by-step basis."). But more specific language in the rule belies this claim. "The [section 110(a)(2)(D)(i)(I)] violation is eliminated once a State adopts a SIP containing the CAIR trading programs (or a SIP containing other emission reduction options meeting the requirements specified in CAIR), or EPA promulgates a FIP to achieve those same reductions." FIP, 71 Fed. Reg. at 25,340. Because EPA describes CAIR as a complete remedy to a section 110(a)(2)(D)(i)(I) violation and does not give independent significance to the "interfere with maintenance" language to identify upwind states that interfere with downwind maintenance, it unlawfully nullifies that aspect of the statute and provides no protection for downwind areas that, despite EPA's predictions, still find themselves struggling to meet NAAQS due to upwind interference in 2010. For this reason, we grant North Carolina's petition on this issue. Although North Carolina challenged CAIR on the "interfere with maintenance" issue only with regard to ozone, the rule includes the same flaw with regard to $PM_{2.5}$. The court does not address North Carolina's separate contention that EPA failed to comply with notice-and-comment requirements regarding its proposed test for an "interfere with maintenance" violation, or the propriety of the test itself.

3. 2015 Compliance Deadline

North Carolina argues that the 2015 deadline for upwind states to eliminate their "significant contribution" to downwind nonattainment ignores the plain language of section 110(a)(2)(D)(i), 42 U.S.C. § 7410(a)(2)(D)(i), contradicts EPA's goal of "balanc[ing] the burden for achieving attainment between regional-scale and local-scale control programs," CAIR, 70 Fed. Reg. at 25,166, violates the Supreme Court's holding that EPA may not consider economic and technological infeasibility when approving a SIP, *Union Elec. Co. v. EPA*, 427 U.S. 246 (1976), and departs from the contrary approach it took in the $NO_x$ SIP Call without explanation, $NO_x$ SIP Call, 63 Fed. Reg. at 57,449.

North Carolina challenges the 2015 Phase Two deadline for upwind states to come into compliance with CAIR as incompatible with section 110(a)(2)(D)(i)(I)'s mandate that SIPs contain adequate provisions prohibiting significant contributions to nonattainment "consistent with the provisions of [Title I]." 42 U.S.C. § 7410(a)(2)(D)(i)(I). Title I dictates the deadlines for states to attain particular NAAQS. $PM_{2.5}$ attainment must be achieved "as expeditiously as practicable, but no later than 5 years from the date such area was designated nonattainment . . . except that the Administrator may extend the attainment date . . . for a period no greater than 10 years from the date of designation as nonattainment . . . ." 42 U.S.C. § 7502(a)(2)(A). North Carolina, along with the rest of the CAIR states, must meet $PM_{2.5}$ NAAQS by 2010. *See* 40 C.F.R. § 81.301 *et seq.* Ozone nonattainment areas must attain permissible levels of ozone "as expeditiously as practicable," but no later than the assigned date in the table the statute provides. 42 U.S.C. § 7511. North Carolina's statutory deadline is June 2010, but it could be even sooner if EPA upon repromulgating its regulations sets an earlier deadline. *See S. Coast Air Quality Mgmt. Dist. v. EPA*, 472 F.3d 882 (D.C. Cir. 2006). North Carolina argues that despite the statutory mandate that section 110(a)(2)(D)(i), 42 U.S.C. § 7410(a)(2)(D)(i), be consistent with the rest of Title I, which requires compliance with $PM_{2.5}$ and ozone NAAQS by 2010, CAIR gives states that "contribute significantly" to nonattainment until 2015 to comply based solely on reasons of feasibility. CAIR, 70 Fed. Reg. at 25,177; *see also* Corrected Response, at 58, 61; CAIR, 70 Fed. Reg. at 25,222–25 (citing feasibility restraints such as the difficulty of securing project financing and the limited amount of specialized boilermaker labor to install controls).

EPA contends that the phrase "consistent with the provisions of [Title I]" does not require incorporating Title I's NAAQS attainment deadlines into CAIR. It argues that section 110(a)(2)(D)(i)(I) does not mandate any particular time frame and that the language about consistency only requires EPA to make a rule consistent with *procedural* provisions in Title I, not substantive ones. It comes to this conclusion because the phrase "consistent with the provisions of this title" follows the word "prohibiting." Due to this placement, EPA argues that the phrase requiring consistency only modifies the word "prohibiting." EPA does not explain how it jumps from this observation to the conclusion that a phrase modifying the word "prohibiting" can only refer to procedural requirements. The word "procedural" is simply not in the statute. If there were any ambiguity as to Congress's intent in excluding the limiting language EPA proposes, an examination of the relevant language in the context of the whole CAA dispels any doubts as to its meaning. In the CAA, Congress differentiates between requiring consistency with provisions in a title and requiring consistency "with the *procedures* established" under a title. *Compare* 42 U.S.C. § 7410(a)(2)(D)(i), *with id.* § 7661b(c) (emphasis added). Section 110(a)(2)(D)(i), 42 U.S.C. § 7410(a)(2)(D)(i), is not limited to procedural provisions in Title I; thus it requires EPA to consider all provisions in Title I—both procedural and substantive—and to formulate a rule that is consistent with them.

Despite section 110(a)(2)(D)(i)'s requirement that prohibitions on upwind contributions to downwind nonattainment be "consistent with the provisions of [Title I]," EPA did not make any effort to harmonize CAIR's Phase Two deadline for upwind contributors to eliminate their significant contribution with the attainment deadlines for downwind areas.

42 U.S.C. § 7410(a)(2)(D)(i). As a result, downwind nonattainment areas must attain NAAQS for ozone and $PM_{2.5}$ without the elimination of upwind states' significant contribution to downwind nonattainment, forcing downwind areas to make greater reductions than section 110(a)(2)(D)(i)(I) requires. Because EPA ignored its statutory mandate to promulgate CAIR consistent with the provisions in Title I mandating compliance deadlines for downwind states in 2010, we grant North Carolina's petition challenging the 2015 Phase Two deadline. We need not address petitioner's other arguments against this provision.

EPA justified the deadline partly on the basis that additional reductions will be required through the year 2015 in order to satisfy the "interfere with maintenance" provision of the statute. Although this may be a valid reason to require maintenance-based emissions reductions beyond the year 2010, EPA does not explain why it did not coordinate the final CAIR deadline to provide a sufficient level of protection to downwind states projected to be in nonattainment as of 2010.

4. $NO_x$ Compliance Supplement Pool

North Carolina contends that the $NO_x$ Compliance Supplement Pool of 200,000 tons defies section 110(a)(2)(D)(i)(I)'s mandate to eliminate the significant contribution of upwind sources to downwind NAAQS nonattainment and that the Compliance Supplement Pool is an arbitrary exercise of power that contradicts EPA's own record findings.

Under CAIR without the Compliance Supplement Pool, states can only begin to bank CAIR $NO_x$ allowances in 2009, the year in which Phase One of the CAIR $NO_x$ limits go into effect. The Compliance Supplement Pool gives states an incentive to make emissions cuts early; states that can show "surplus" $NO_x$ emissions reductions in 2007 and 2008 can receive bankable (and tradeable) credits for those reductions. CAIR, 70 Fed. Reg. at 25,285. The 200,000 $NO_x$ credits are apportioned to states in accordance with their share of the 2009 regionwide $NO_x$ budget. *Id.* at 25,286. States may distribute the credits to sources based on "(1) [a] demonstration by the source to the State of $NO_x$ emissions reductions in surplus of any existing $NO_x$ emission control requirements; or (2) a demonstration to the State that the facility has a 'need' that would affect electricity grid reliability." *Id.* EPA created the Compliance Supplement Pool to "mitigat[e] some of the uncertainty regarding the EPA projections of resources to comply with CAIR" and to "provide[] incentives for early, surplus $NO_x$ reductions." *Id.*

North Carolina first argues that the Compliance Supplement Pool is unlawful because it permits states to emit $NO_x$ in excess of the 1.5 million ton annual regional $NO_x$ cap, which EPA measured to be the upwind states' significant contribution to downwind nonattainment in the years 2009 to 2014. *See* CAIR, 70 Fed. Reg. at 25,210. EPA contends that North Carolina's argument is flawed. EPA based its measurement of upwind states' "significant contribution" on the level of reductions that would be "highly cost effective" in 2015, not 2009. The Phase One deadline is simply EPA's measurement of the reductions that would be feasible by 2009; it is not an independent measurement of "significant contribution" in that year. *See id.* at 25,177. Thus any emissions that exceed the 1.5 million ton level due to the extra 200,000 allowances from the Compliance Supplement Pool do not affect the elimination of upwind states' "significant contribution." The elimination of upwind states' significant contribution will not happen until Phase Two's 2015 deadline.

Because we grant North Carolina's petition that CAIR's

Phase Two deadline of 2015 is unlawful, we will not pass judgment on the lawfulness of the Compliance Supplement Pool. As EPA explains, it created the Compliance Supplement Pool under the assumption that 2015 was an appropriate deadline for CAIR compliance. It is not. EPA does not argue that it can set a level of emissions that is an upwind state's "significant contribution" and then allow that state to exceed it. On remand, EPA must determine what level of emissions constitutes an upwind state's significant contribution to a downwind nonattainment area "consistent with the provisions of [Title I]," which include the deadlines for attainment of NAAQS, and set the emissions reduction levels accordingly.

5. EPA's Definition of "Will" in "Will Contribute Significantly"

North Carolina contends that EPA altered its definition of "will" from a term that meant certainty in the $NO_x$ SIP Call to one that denotes the future tense in CAIR and that EPA made this change without any explanation. *See* 42 U.S.C. § 7410(a)(2)(D)(i)(I). North Carolina also argues that EPA's interpretation of "will" violates the plain text of the statute. As a result, EPA did not consider upwind states for consideration in CAIR that contributed to monitored (or "certain") nonattainment in North Carolina counties at the time EPA promulgated CAIR; EPA only included upwind states that contributed to projected nonattainment in 2010.

In the $NO_x$ SIP Call, EPA stated "that the term 'will' means that SIPs are required to eliminate the appropriate amounts of emissions that presently, or that are expected in the future [to], contribute significantly to nonattainment downwind." $NO_x$ SIP Call, 63 Fed. Reg. at 57,375. This isolated phrase provides some support for North Carolina's contention that EPA considered upwind states that contributed to monitored nonattainment at the time it was promulgating the $NO_x$ SIP Call to be subject to the rule even if those states did not contribute to projected nonattainment in 2007, the year the rule went into effect. However, EPA later in the same rulemaking explained its approach to measuring nonattainment in more detail:

> In determining whether a downwind area has a nonattainment problem under the 1-hour standard to which an upwind area may be determined to be a significant contributor, EPA determined whether the downwind area currently has a nonattainment problem, and whether that area would continue to have a nonattainment problem as of the year 2007 assuming that in that area, all controls specifically required under the CAA were implemented, and all required or otherwise expected Federal measures were implemented. If, following implementation of such required CAA controls and Federal measures, the downwind area would remain in nonattainment, then EPA considered that area as having a nonattainment problem to which upwind areas may be determined to be significant contributors.

*Id.* at 57,377. In the $NO_x$ SIP Call, EPA interpreted "will" to indicate sources that presently *and* at some point in the future "will" contribute to nonattainment. Because the $NO_x$ SIP Call was to go into effect in 2007, that rule used 2007 as the relevant future year for measuring nonattainment. This approach is identical to the one EPA took in CAIR. Because CAIR goes into effect in 2009 and 2010 respectively, those are the future years used in the measurement. *See* CAIR, 70 Fed. Reg. at 25,241. North Carolina's claims about an arbitrary change in EPA's interpretation of "will" are unfounded because there was no change. And because "will" can mean either certainty or indicate the future tense, it was reasonable for EPA to choose to give effect to both interpretations of the word. Simply because CAIR does not include states based upon present-day violations that will be cured by 2010 does not mean that EPA may ignore present-day violations for which there may be another remedy, such as relief pursuant to section 126, 42 U.S.C. § 7426. Therefore we deny North Carolina's petition on this issue.

6. $PM_{2.5}$ Contribution Threshold

North Carolina argues that EPA acted arbitrarily by proposing an air quality threshold for $PM_{2.5}$ at 0.15 $\mu g/m^3$ but finally settling on an air quality threshold of 0.2 $\mu g/m^3$. The air quality threshold for $PM_{2.5}$ is the amount of $PM_{2.5}$ that sources in a state must contribute to a downwind nonattainment area to be regulated as an upwind state in CAIR's $PM_{2.5}$ program. North Carolina also challenges EPA's decision to truncate, rather than round, the numbers it compared to the threshold. As a result, states that contributed 0.19 $\mu g/m^3$ or less to a downwind nonattainment area were not linked with North Carolina by CAIR.

EPA contests North Carolina's standing to raise this issue. It notes that only two states would be affected if EPA were to use the 0.15 $\mu g/m^3$ threshold. Illinois, which is already subject to CAIR's requirements for $PM_{2.5}$ contributions, would be subject to the exact same requirements for an additional reason—its contributions to Catawba County, North Carolina. Technical Support Document, at Appendix H. This additional upwind-downwind "link" would not change any of Illinois's duties under CAIR; therefore it would not change any effects felt by Catawba County, North Carolina. The lower threshold would also subject Arkansas to CAIR's $PM_{2.5}$ controls. CAIR, 70 Fed. Reg. at 25,191; Technical Support Document, at 42 tbl. VII-1. EPA states that Arkansas does not contribute at threshold levels to nonattainment in North Carolina, but it cites no record support for this assertion.

North Carolina has standing to raise this issue for three reasons. First, if in repromulgating CAIR to comply with section 110(a)(2)(D)(i)(I), EPA removes or modifies its interstate trading options, Illinois would be barred outright from contributing significantly to North Carolina's nonattainment areas. Second, EPA does not provide support for its assertion that Arkansas does not contribute to nonattainment areas in North Carolina because it never modeled the State. North Carolina claims that models for sources in Louisiana, Missouri, and Texas, which are further from North Carolina than those in Arkansas, show that Arkansas contributes at the 0.15 $\mu g/m^3$ threshold to nonattainment areas in North Carolina. Third, because EPA designed CAIR to be a complete statutory remedy, whether North Carolina is linked with Illinois by CAIR under section 110(a)(2)(D)(i)(I) is likely to affect related remedies that North Carolina may have against Illinois, for example, pursuant to section 126, 42 U.S.C. § 7426. Although we cannot anticipate what a new rule will look like, there is a "substantial probability" that a favorable decision by this court would redress the injury North Carolina asserts.

Because North Carolina has demonstrated an injury-in-fact caused by the rule it is challenging which a favorable decision by this Court could likely remedy, we can turn to the merits of North Carolina's petition. North Carolina notes that EPA first considered a threshold of 0.1 $\mu g/m^3$. NPR, 69 Fed. Reg. at 4584. In the Notice of Proposed Rulemaking, EPA stated that a 0.1 $\mu g/m^3$ threshold "is the smallest one that can make the difference between compliance and violation of the NAAQS for an area very near the NAAQS . . . ." *Id.* EPA then decided that it is "on balance, more appropriate to adopt a small percentage value of the standard level" and chose the percentage of the NAAQS standard of 15.0 $\mu g/m^3$ that is closest to 0.1 $\mu g/m^3$, which was one percent. *Id.* One percent of 15.0 μg/$m^3$ is 0.15 μg/$m^3$, so EPA initially chose that number as the threshold. *Id.* However, EPA then "request[ed] comments on the use of higher or lower thresholds for this purpose." *Id.* In CAIR, EPA finally settled on a threshold value of 0.2 μg/$m^3$. It did so because EPA was "persuaded by commenters['] arguments on monitoring and modeling that the precision of the threshold should not exceed that of the NAAQS," which only measure $PM_{2.5}$ concentration to the tenths column. CAIR, 70 Fed. Reg. at 25,191; *see id.* at 25,190 (commenters). North Carolina believes it was arbitrary for EPA to round 0.15 μg/$m^3$ up to 0.2 μg/$m^3$ instead of reverting to the earlier 0.1 μg/$m^3$ number that "is the smallest one that can make the difference between compliance and violation of the NAAQS." *See* NPR, 69 Fed. Reg. at 4584.

EPA did not explain why it chose the larger number instead of the smaller number in the final rule; it only explained why it chose a number that ended at the tenths column. CAIR, 70 Fed. Reg. at 25,191. Based on EPA's reasoning in the Notice of Proposed Rulemaking, it may have made more sense to return to the 0.1 μg/$m^3$ threshold instead of "[r]ounding the proposal value of 0.15," which is what it did. *See id.* But EPA was concerned that the 0.15 μg/$m^3$ threshold it originally proposed was too low, requesting comments on "the use of higher or lower thresholds." NPR, 60 Fed. Reg. at 4584. And in raising the threshold number, EPA was responding to comments citing concerns about the "measurement precision of existing $PM_{2.5}$ monitors." CAIR, 70 Fed. Reg. at 25,190. We cannot say in this circumstance that EPA's decision to round the 0.15 μg/$m^3$ threshold to 0.2 μg/$m^3$ instead of reverting to the original threshold considered of 0.1 μg/$m^3$ was wholly unsupported by the record.

Likewise, we cannot say that EPA's decision to truncate rather than round the $PM_{2.5}$ contribution levels it compared to the 0.2 μg/$m^3$ threshold was arbitrary. The parties dispute which C.F.R. provision applies to the number it compares to the threshold—one mandating rounding, 40 C.F.R. pt. 50, App. N, § 4.3(a) (preferred by petitioner), or another mandating truncating, 40 C.F.R. pt. 50, App. N § 3.0(b) (preferred by EPA). The number EPA compares to the threshold, which is measured as "the average of annual means [of $PM_{2.5}$ contribution] from three successive years," is the contribution of $PM_{2.5}$ from one upwind state to a nonattainment area. CAIR, 70 Fed. Reg. at 25,190. Section 4.3(a) applies to annual $PM_{2.5}$ standard design values. Design values "are the metrics (i.e., statistics) that are compared to the NAAQS levels to determine compliance." 40 C.F.R. pt. 50 App. N § 1.0(c). Design values are composed of the average of annual means of $PM_{2.5}$ for three consecutive years, 40 C.F.R. pt. 50 App. N § 4.1(b), but design values are measurements of $PM_{2.5}$ levels in a stationary area—not levels of $PM_{2.5}$ moving from one area to another. Because the contribution level is not a design value, section 4.3(a)'s rounding mandate does not apply. Similarly, section 3.0(b)'s truncation mandate applies to $PM_{2.5}$ hourly and daily measurement data and says nothing about the contribution level EPA is assessing in CAIR.

Without a rule mandating any particular method, EPA is free to round or truncate the numbers it is comparing to the 0.2 μg/$m^3$ threshold as long as its choice is reasonable. EPA chose to truncate numbers because the "truncation convention for $PM_{2.5}$ is similar to that used in evaluating modeling results in applying the ozone significance screening criterion of 2 ppb in the $NO_x$ SIP call and the CAIR proposal, as well as today's final action." CAIR, 70 Fed. Reg. at 25,191 n.42 (internal citation omitted). EPA's choice to truncate the numbers is reasonable. As a result, we deny North Carolina's petition challenging the 0.2 μg/$m^3$ threshold and EPA's choice to truncate the numbers compared to it.

B. $SO_2$ and $NO_x$ Budgets

$SO_2$ Petitioners and petitioner Entergy challenge CAIR's budgets for the $SO_2$ and $NO_x$ trading programs. EPA set states' $SO_2$ budgets for 2010 to 50% (35% in 2015) of the allowances the states' EGUs receive under Title IV. $SO_2$ Petitioners argue EPA never explained how these budgets related to section 110(a)(2)(D)(i)(I)'s mandate of prohibiting significant contributions to downwind nonattainment. Therefore, they claim, the budgets and the regionwide cap, are "arbitrary, capricious, . . . or otherwise not in accordance with law," 42 U.S.C. § 7607(d)(9)(A). As for $NO_x$, EPA reduced states' budgets to the extent their EGUs burned oil or gas. Entergy claims EPA made this adjustment purely in the interests of fairness—an improper reason under section 110(a)(2)(D)(i)(I). We grant the petitions, agreeing EPA chose the budgets for both pollutants in an improper manner. In short, the fact that $SO_2$ and $NO_x$ are precursors to ozone and $PM_{2.5}$ pollution does not give EPA plenary authority to reduce emissions of these substances. Section 110(a)(2)(D)(i)(I) obligates states to prohibit emissions that contribute significantly to nonattainment or interfere with maintenance downwind, and EPA must exercise its authority under this provision to make measurable progress towards those goals.

1. $SO_2$ Budgets

We first address EPA's choice of $SO_2$ budgets. EPA claims to have based state budgets for $SO_2$ and $NO_x$ on the amount of emissions sources can eliminate by applying controls EPA deems "highly cost-effective controls"—an approach EPA says we approved in *Michigan v. EPA*, 213 F.3d 663 (D.C. Cir. 2000). We observe initially that state $SO_2$ budgets are unrelated to the criterion (the "air quality factor") by which EPA included states in CAIR's $SO_2$ program. Significant contributors, for purposes of inclusion only, are those states EPA projects will contribute at least 0.2 $\mu g/m^3$ of $PM_{2.5}$ to a nonattainment area in another state. While we would have expected EPA to require states to eliminate contributions above this threshold, EPA claims to have used the measure of significance we mentioned above: emissions that sources within a state can eliminate by applying "highly cost-effective controls." EPA used a similar approach in deciding which states to include in the $NO_x$ SIP Call, which *Michigan* did not disturb since "no one quarrel[ed] either with its use of multiple measures, or the way it drew the line at" the inclusion stage. 213 F.3d at 675. Likewise here, the $SO_2$ Petitioners do not quarrel with EPA drawing the line at 0.2 $\mu g/m^3$ or its different measure of significance for determining states' $SO_2$ budgets. Again, we do not disturb this approach.

Even so, EPA's method in setting the $SO_2$ budgets is not what *Michigan* approved. In that case, the petitioners argued section 110(a)(2)(D)(i)(I) does not permit EPA to consider the cost of reducing ozone. After reconciling petitioners' shifting (and somewhat conflicting) arguments, we answered a well-defined question: Could EPA, in selecting the "significant" level of "contribution" under section 110(a)(2)(D)(i)(I), choose a level corresponding to a certain reduction cost? *Michigan*, 213 F.3d at 676–77. Answering that question in the affirmative, we held EPA may "after [a state's] reduction of all [it] could . . . cost-effectively eliminate[ ]," consider "any remaining 'contribution'" insignificant. *Id.* at 677, 679.

*Michigan* also rejected claims that applying a uniform cost-criterion across states was irrational because both smaller and larger contributors had to make reductions achievable by the same highly cost-effective controls. This, we said, "flow[ed] ineluctably from the EPA's decision to draw the 'significant contribution' line on a basis of cost." *Id.* at 679. Upholding that decision "logically entail[ed] upholding this consequence." *Id.* And while EPA's approach did not necessarily ensure "aggregate health benefits" at roughly the lowest cost, EPA researched alternatives, and found none that significantly improved air quality or reduced cost. *Id.* Since no one offered a "material critique" of this research, we did not upset EPA's judgment. *Id.*

Here, EPA did not use cost in the manner *Michigan* approved. Even worse, EPA's choice of $SO_2$ budgets does not track the requirements of section 110(a)(2)(D)(i)(I). That much is evident from EPA's decision to base the budgets on allowances states' EGUs receive under Title IV. Those allowances are not, as EPA asserts, a "logical starting point" for setting CAIR's $SO_2$ emissions caps, CAIR, 70 Fed. Reg. at 25,229. Congress designed the Title IV allowance scheme using EGU data from 1985 to 1987 to address the national acid rain problem. Nowhere does EPA explain how reducing Title IV allowances will adequately prohibit states from contributing significantly to downwind nonattainment of the $PM_{2.5}$ NAAQS. And while "Congress chose a policy of not revisiting and revising these allocations and, apparently, believed that its allocation methodology would be appropriate for future time periods," Reconsideration, 71 Fed. Reg. at 25,308, it is unclear how the quantitative number of allowances created by 1990 legislation to address one substance, acid rain, could be relevant to 2015 levels of an air pollutant, $PM_{2.5}$.

EPA also explains that it chose Title IV as a starting point "to preserve the viability and emissions reductions of the highly successful title IV program." *Id.* This goal may be valid, but it is not among the objectives in section 110(a)(2)(D)(i)(I). And if it is somehow compatible with states' obligations to include "adequate provisions" in their SIPs, prohibiting emissions "within the State from . . . contribut[ing] significantly" to downwind nonattainment, then EPA should explain how. It has failed to do so. Apart from the arbitrary Title IV baseline, EPA has insufficiently explained how it arrived at the 50% and 65% reduction figures. Though unclear, these numbers appear to represent what EPA thought would be "'a cost-effective and equitable governmental approach to attainment with the NAAQS for [$PM_{2.5}$].'" CAIR, 70 Fed. Reg. at 25,199 (quoting Proposed CAIR, 69 Fed. Reg. 4566, 4612 (Jan. 30, 2004)).[1] As with the need to "preserve the viability" of the Title IV program, EPA's notions of what is an "equitable governmental approach to attainment" is not among the objectives of section 110(a)(2)(D)(i)(I). Nor does EPA even attempt to reconcile its choice of "equitable" emissions caps with those objectives.

Having chosen these equitable caps for the CAIR region, EPA then "ascertained the costs of these reductions and . . . determine[d] that they should be considered highly cost effective." *Id.* at 25,176. EPA's use of cost in this manner is not what we approved in *Michigan*. Whereas *Michigan* permits EPA to draw the "significant contribution" line based on the cost of reducing that "contribution," here EPA did not draw the line at all. It simply verified sources could meet the $SO_2$ caps with controls EPA dubbed "highly cost-effective." Nor would EPA necessarily cure this problem merely by beginning its analysis with cost. While EPA may require "termination of only a *subset of each state's contribution*," by having states "cut[ ] back the

[1] EPA briefly summarized a series of analyses and dialogues with various stakeholder groups in which the participants considered "regional and national strategies to reduce interstate transport of $SO_2$ and $NO_x$." *See* CAIR, 70 Fed. Reg. at 25,199. The most recent of these, EPA's analysis in support of the proposed Clear Skies Act, considered nationwide $SO_2$ caps of, coincidentally, "50 percent and 67 percent from . . . title IV cap levels." *Id.*

amount that could be eliminated with 'highly cost-effective controls,'" *Michigan*, 213 F.3d at 675 (emphasis added), EPA can't just pick a cost for a region, and deem "significant" any emissions that sources can eliminate more cheaply. Such an approach would not necessarily achieve something measurable toward the goal of prohibiting sources "within the State" from contributing significantly to downwind nonattainment.

Because EPA did not explain how the objectives in section 110(a)(2)(D)(i)(I) relate to its choice of $SO_2$ emissions caps based on Title IV allowances, we conclude that choice was "arbitrary, capricious, . . . or not otherwise in accordance with law," 42 U.S.C. § 7607(d)(9)(A).

2. $NO_x$ Budgets

Next, we address EPA's use of "fuel factors" to allocate the regional $NO_x$ cap among the CAIR states. EPA determined the cap by multiplying $NO_x$ emissions rates (0.15 mmBtu in 2010 and 0.125 mmBtu in 2015) by the heat input of states in the CAIR region. Then, EPA distributed to each state, as its budget of $NO_x$ emissions allowances, its proportionate share of the regional cap. But in determining these shares, EPA adjusted each state's heat input for the mix of fuels its power plants used: while a coal-fired EGU contributed its full heat input to the state total, an oil-fired EGU counted for only 60% of its heat input and a gas-fired EGU only 40%. Entergy argues this fuel adjustment was irrational because EPA made it purely for the sake of sharing the burden of emissions reductions fairly. We agree EPA's notion of fairness has nothing to do with states' section 110(a)(2)(D)(i)(I) obligations to prohibit significant contributions to downwind nonattainment.

EPA's $NO_x$ analysis began, inauspiciously, in a manner similar to its $SO_2$ decisions. But instead of beginning with "the existing title IV annual $SO_2$ cap," it began with the existing $NO_x$ SIP Call emissions rate of 0.15 pounds of $NO_x$ emitted per mmBtu of heat input. CAIR, 70 Fed. Reg. at 25,205. It is not clear why EPA considered this rate a useful starting point beyond the fact that such an emissions rate had been "considered in the past." *Id*. So far as we can tell, these numbers represent, like the $SO_2$ caps, EPA's effort "'to set up a reasonable balance of regional and local controls to provide a cost-effective and equitable governmental approach to attainment.'" *Id*. at 25,199 (quoting Proposed CAIR, 69 Fed. Reg. at 4612). Thus, rather than explaining how its planned emissions rates related to states' significant contributions to downwind nonattainment, EPA simply asserted they would create an equitable balance of controls. As with the $SO_2$ caps, EPA did not draw the "significant contribution" line on the basis of cost, *Michigan*, 213 F.3d at 676–77, or, for that matter, draw the significance line at all. Instead, EPA "determin[ed] the regionwide control level" and then "evaluat[ed] it to assure that it is highly cost-effective." CAIR, 70 Fed. Reg. at 25,206.

Nevertheless, Entergy does not challenge the regional $NO_x$ emissions rate. It argues that if EPA thinks a certain rate reflects a state's level of "significant contribution" to downwind nonattainment, then section 110(a)(2)(D)(i)(I) requires EPA to assign each state a budget equal to the emissions rate times the state's heat input. The fuel adjustment reduces a state's budget below that level if, say, its power plants use gas instead of coal, without any justification besides fairness. Remarkably, EPA does not deny that fairness is the only reason for the fuel adjustment. According to EPA, "[t]he factors would reflect the inherently higher emissions rate of coal-fired plants, and consequently the greater burden on coal plants to control emissions," thereby creating "a more equitable budget distribution." *Id*. at 25,231. Instead, EPA criticizes Entergy's preferred method of distributing credits as being equally unjustified. In the EPA's view, assigning credits without the fuel adjustment is just one of "a number of ways that EPA could have distributed the regionwide $NO_x$ emissions budget," among which the fuel adjustment is another, equally valid method, and EPA reasonably chose the fuel adjustment as the fairest method. Resp't's Br. 105.

Not all methods of developing state emission budgets are equally valid, because an agency may not "trespass beyond the bounds of its statutory authority by taking other factors into account" than those to which Congress limited it, nor "substitute new goals in place of the statutory objectives without explaining how [doing so comports with] the statute." *Indep. U.S. Tanker Owners Comm. v. Dole*, 809 F.2d 847, 854 (D.C. Cir. 1987); *see also Lead Indus. Ass'n v. EPA*, 647 F.2d 1130, 1150 (D.C. Cir. 1980). Section 110(a)(2)(D)(i)(I) addresses emissions "within the State" that contribute significantly to downwind pollution. Naturally we defer to EPA's interpretation of the Clean Air Act so far as it is reasonable, *Chevron*, 467 U.S. 837, and we have recognized that significance may include cost, *Michigan*, 213 F.3d at 677–79. However, EPA's interpretation cannot extend so far as to make one state's significant contribution depend on another state's cost of eliminating emissions.

Yet that is exactly what EPA has done. For example, Louisiana's EGUs use more gas and oil than most states' EGUs. Consequently, instead of the budget of 42,319 tons per year that would be Louisiana's proportional share of the regionwide cap without fuel adjustment, the State only received 29,593 tons per year. The rest of those credits went to states with more coal-fired EGUs than average, which necessarily received "larger $NO_x$ emissions budgets" than their unadjusted proportional shares. Resp't's Br. 103. EPA favored coal-fired EGUs in this way because they face a "greater burden . . . to control emissions" than gas- and oil-fired EGUs. CAIR, 70 Fed. Reg.

at 25,231. In essence, a state having mostly coal-fired EGUs gets more credits because Louisiana can control emissions more cheaply.

EPA responds by suggesting that any allocation of the $NO_x$ cap would amount to equitable burden-sharing because EPA did the analysis "on a regionwide basis," and therefore not even the unadjusted shares have any relation to states' significant contributions. Resp't's Br. 104; CAIR, 70 Fed. Reg. at 25,231.[2] If so, that is a weakness of CAIR generally. Having chosen not to evaluate contributing emissions on a state-by-state basis, EPA cannot now rely on the resulting paucity of data to justify its *ad hoc* approach to spreading the burden of reducing them. When a petitioner complains EPA is requiring a state to eliminate more than its significant contribution, it is inadequate for EPA to respond that it never measured individual states' significant contributions.

No doubt all this pother seems unnecessary to EPA, since it believed "the choice of method in setting State budgets . . . makes little difference in terms of the levels of resulting regionwide annual $SO_2$ and $NO_x$ emissions reductions." CAIR, 70 Fed. Reg. at 25,230–31. Since EPA planned a market for emissions credits, it assumed EGUs would trade credits as necessary to achieve the "least-cost outcome," which would not depend "on the relative levels of individual State budgets." *Id.* at 25,231. As we noted in *Michigan*, the market would only

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[2] To be sure, the unadjusted shares would not correspond much better to a state's downwind contribution in 2010 and 2015 because EPA based the regional cap on heat input data from 1999 to 2002 without accounting for the growth in states' economies. *See* CAIR, 70 Fed. Reg. 25,230–31. In any case, a budget allocation based on such shares would only be hypothetical at this point, so we express no opinion as to its propriety.

bear out that assumption if the transaction costs of trading emissions were small, which is hardly likely. 213 F.3d at 676 & n.3. But even if the state budgets affect only the distribution of the burden, not the regionwide aggregate of emissions, that distribution is important.[3] EPA contends the greatest reductions will take place where the greatest emissions are, because that is where most cost-effective reductions are available. Resp't's Br. 168. Of course, those states with the greatest emissions are those with mainly coal-fired EGUs, which are precisely the states that get extra credits under EPA's fuel-adjustment method. *See* CAIR, 70 Fed. Reg. at 25,231 n.88 ("States receiving larger budgets . . . are generally expected to be those having to make the most reductions."). Presumably those EGUs will make their greater reductions and sell them to other EGUs, in states the fuel-adjustment method docked, to recoup their investment in reductions. The net result will be that states with mainly oil- and gas-fired EGUs will subsidize reductions in states with mainly coal-fired EGUs. Again, EPA's approach contravenes section 110(a)(2)(D)(i)(I); the statute requires each state to prohibit emissions "within the State" that contribute significantly to downwind pollution, not to pay for other states to prohibit their own contributions.

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[3] In focusing on the beneficial regionwide results from trading, EPA completely ignores the fact that any state that elected not to participate in the $NO_x$ trading program would receive a maladjusted budget as a mandatory cap on its emissions. We do not focus on this problem because EPA had, by the time it promulgated CAIR, already found all the relevant states to have violated section 110(a)(2)(D), 42 U.S.C. § 7410(a)(2)(D), with respect to the CAIR pollutants, so that EPA's Federal Implementation Plan, incorporating the trading program, covers all of them until they submit SIPs complying with CAIR. FIP, 71 Fed. Reg. 25,328, 25,340 (Apr. 28, 2006); 70 Fed. Reg. 21,147 (Apr. 25, 2005) (finding of violation).

EPA's redistributional instinct may be laudatory, but section 110(a)(2)(D)(i)(I) gives EPA no authority to force an upwind state to share the burden of reducing other upwind states' emissions. Each state must eliminate its own significant contribution to downwind pollution. While CAIR should achieve something measurable towards that goal, it may not require some states to exceed the mark. Because the fuel-adjustment factors shifted the burden of emission reductions solely in pursuit of equity among upwind states—an improper reason—the resulting state budgets were arbitrary and capricious.

C. Title IV Allowances

$SO_2$ Petitioners and a trade association of waste-coal EGUs (together "$SO_2$ Petitioners") also challenge EPA's effort to "harmonize" CAIR's regulation of $SO_2$ with the existing program for trading $SO_2$ emissions allowances under Title IV of the CAA. Since EPA set states' $SO_2$ budgets for 2010 to 50% (35% in 2015) of the allowances the states' EGUs receive under Title IV, EGUs in the region would emit significantly less $SO_2$ under CAIR and could be expected to have substantial numbers of excess Title IV allowances to emit $SO_2$. Concerned about this sudden excess, EPA structured CAIR so that EGUs in states electing to trade give up 2 allowances per ton in 2010, and 2.68 allowances per ton in 2015. (Recall, a Title IV allowance gives the holder the right to emit one ton of $SO_2$ within the Title IV program.) States electing not to trade must have SIP provisions for retiring excess allowances. In addition, CAIR regulates waste-coal EGUs that do not receive Title IV allowances because they are exempt from Title IV. Thus, waste-coal EGUs in trading states must acquire Title IV allowances by purchasing allowances from EGUs in the Title IV program, or, as EPA suggests, by opting into the program.

$SO_2$ Petitioners argue EPA lacks authority to terminate or limit Title IV allowances, either through a trading program under section 110(a)(2)(D), 42 U.S.C. § 7410(a)(2)(D), or by requiring that SIPs have allowance retirement provisions. We agree and grant the petition on this issue. We do not, however, consider whether CAIR unlawfully forces waste-coal EGUs into the Title IV program, or irrationally includes waste-coal units while excluding other waste-burning units. That argument assumes EPA has the authority to terminate or limit Title IV allowances.

In demonstrating EPA's absence of authority, the $SO_2$ Petitioners cite a variety of Title IV provisions supposedly showing that Title IV allowances are fixed currency, the value of which EPA may not manipulate. However, the allowances are "limited authorization[s] to emit sulfur dioxide" and "[n]othing . . . in any . . . provision of law shall be construed to limit the authority of the United States to terminate or limit" such authorizations. 42 U.S.C. § 7651b(f). While EPA and petitioners quibble over whether EPA is the "United States" to which § 7651b(f) applies, both agree that this section does not grant EPA any authority.[4]

Thus, EPA claims section 110(a)(2)(D)(i)(I) gives it authority to set up a program for trading $SO_2$ emissions allowances, and to require EGUs to use Title IV allowances as currency. Once EGUs spend Title IV allowances in the CAIR market, EPA says it can terminate the authorization the allowances provide within the Title IV market. CAIR, 70 Fed. Reg. at 25,292. But whatever authority EPA may have to establish such a trading program, we find nothing in section

[4] In view of EPA's absence of authority to terminate or limit Title IV allowances, we express no opinion on the meaning of "United States" in this provision.

110(a)(2)(D)(i)(I) granting EPA authority to remove Title IV allowances from circulation in the Title IV market.

Environmental groups, intervening in support of EPA, argue section 301(a) of the CAA also provides EPA authority. That provision authorizes EPA "to prescribe such regulations as are necessary to carry out [its] functions under" the CAA. 42 U.S.C. § 7601(a). EPA does not rely on section 301(a), and for good reason: EPA cannot claim retiring excess Title IV allowances is "necessary" for EPA to ensure SIPs comply with section 110(a)(2)(D)(i)(I). Nor does section 301(a), 42 U.S.C. § 7601(a), "provide [EPA] Carte blanche authority to promulgate any rules, on any matter relating to the Clean Air Act, in any manner that the [EPA] wishes." *Citizens to Save Spencer County v. EPA*, 600 F.2d 844, 873 (D.C. Cir. 1979).

Lacking a statutory foundation, EPA appeals to "logic." Logically, says EPA, it was not "required to structure CAIR as a stand-alone program without taking account whatsoever of the effect this might have on the pre-existing" Title IV program. Resp't's Br. 82. Environmental intervenors add some legal flavoring here, analogizing EPA's action to a court's interpretative obligation to "fit, if possible, all parts" of a statute "into a harmonious whole," *FTC v. Mandel Bros.*, 359 U.S. 385, 389 (1959). Although it may be reasonable for EPA, in structuring a program under section 110(a)(2)(D)(i)(I), to consider the impact on the Title IV market, it does not follow that EPA has the authority to remove allowances from that market. Nor can EPA cure its absence of authority by foisting onto $SO_2$ Petitioners the burden of explaining why "two independent programs . . . would produce a better result." Resp't's Br. 87. Lest EPA forget, it is "a creature of statute," and has "only those authorities conferred upon it by Congress"; "if there is no statute conferring authority, a federal agency has none." *Michigan v. EPA*, 268 F.3d 1075, 1081 (D.C. Cir. 2001).

So too here: no statute confers authority on EPA to terminate or limit Title IV allowances, and EPA thus has none.

Similarly, EPA cannot require non-trading states to have SIP provisions for retiring excess Title IV allowances. Although such provisions are "related to harmonizing a State's choice of reduction requirements" with the Title IV program, Resp't's Br. 92, the CAA "gives [EPA] no authority to question the wisdom of a State's choices of emission limitations if they are part of a plan which *satisfies* the standards of § 110(a)(2)." *Train v. Natural Res. Def. Council*, 421 U.S. 60, 79 (1975) (emphasis added). SIPs prohibiting emissions within a state from contributing significantly to downwind nonattainment satisfy section 110(a)(2)(D)(i)(I). Because provisions retiring Title IV allowances are unrelated to achieving that goal, EPA cannot require states to adopt them.

D. Border State Issues

Under Title I of the CAA, there is a presumption of state-level regulation generally, *see, e.g.*, 42 U.S.C. § 7407(a); *Union Elec.*, 427 U.S. at 256, 267, and the text of section 110, 42 U.S.C. § 7410, establishes the state as the appropriate primary administrative unit to address interstate transport of emissions. To take action regarding a state pursuant to section 110(a)(2)(D)(i)(I) EPA need only have evidence that emissions "within the State" contribute significantly to another state's nonattainment or interfere with its maintenance of a national ambient air quality standard ("NAAQS"), unless there is evidence that exculpates part of the upwind state from that determination. *See Michigan*, 213 F.3d at 684. Thus, in developing a rule, EPA may select states as the unit of measurement. *Id.* The burden is on the party challenging inclusion of part of a state to present "finer-grained computations" showing that it is "innocent of material contributions" to the state's overall downwind pollution. *Id.*; *see Appalachian Power Co. v. EPA*, 249 F.3d 1032, 1050–51 (D.C. Cir. 2001). In response to such data, EPA must ensure that the contested area makes a "measurable contribution," *Michigan*, 213 F.3d at 684, such that it is "part of the problem" of the state's aggregate downwind impact, *Appalachian Power*, 249 F.3d at 1050.

Various utilities and one municipality,[5] but not the States themselves, challenge inclusion in CAIR of the upwind States of Texas, Florida, and Minnesota. The court denies all except Minnesota Power's petition.

1. Texas

The final rule included the State of Texas due to its maximum downwind contribution of 0.29 $\mu g/m^3$ to $PM_{2.5}$ nonattainment, which is above the air quality threshold of 0.2 $\mu g/m^3$. Petitioners unsuccessfully sought reconsideration of inclusion of that part of the State west of the north-south I-35/I-37 corridor ("West Texas"), submitting modeling that showed few emitting facilities were located in West Texas. Petitioners contend that under *Michigan*, 213 F.3d at 681–85, EPA, on its own initiative, should have excluded West Texas given the State's size, location, low emissions density, and logical intrastate dividing line, and that EPA's concern about "in-state pollution havens" developing in West Texas is unfounded. See Corrected Response, at 230. They also contend that EPA acted

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[5] Southwestern Public Service Company d/b/a Xcel Energy, Occidental Permian Ltd., and the City of Amarillo, Texas petition regarding the State of Texas. The Florida Association of Electric Utilities and FPL Group, Inc. petition regarding the State of Florida. Minnesota Power petitions regarding the State of Minnesota. In this part, we refer to "petitioners" generally.

unreasonably in denying reconsideration in view of the modeling data showing that sources in West Texas "demonstrably were not significant contributors to nonattainment in downwind states." Pet'rs' Br. at 14. However, the record establishes that EPA appropriately included all of the State in CAIR.

The record includes data showing that the State of Texas makes a maximum downwind contribution greater than the 0.2 $\mu g/m^3$ air quality threshold for inclusion. Petitioners have neither challenged this threshold nor presented data that would require EPA to determine whether West Texas makes a "measurable contribution." *See Michigan*, 213 F.3d at 684. Instead, their comments on the proposed rule and the August 2004 Notice of Data Availability speculated that West Texas's contribution level was likely to be less than 0.05 $\mu g/m^3$. Neither did petitioners claim that they were unable to present modeling without assistance from EPA and that such assistance was refused. After EPA released updated data in November 2004, petitioners did submit comments expressing concern about EPA's analysis, but again did not include any new modeling or indicate that they could not do so without EPA assistance that was denied. EPA effectively responded to petitioners' concerns by referring to the possibility that dividing the State could create "in-state pollution havens" in West Texas where exclusion from CAIR would lead to increased capacity with a consequent increase in emissions, Corrected Response, at 230; there is at least one western source connected to the eastern grid and a possibility that more could be integrated through the Electric Reliability Council of Texas. In these circumstances, EPA had no duty to divide the State or to model West Texas separately.

In seeking reconsideration, petitioners for the first time presented new modeling on West Texas. However, EPA found, as the record shows, that petitioners had already had a meaningful opportunity to comment on the inclusion of West Texas and had not shown that it was impracticable for them to present the new modeling sooner or that a new issue arose after the close of the comment period. *See* 42 U.S.C. § 7607(d)(7)(B). Although petitioners insist that they could not satisfy their evidentiary burden without receiving data from EPA, they do not explain why the data from August and November 2004 on which they commented was insufficient to allow them to do so. That they may have failed to realize that EPA had not already conducted more detailed, subregional modeling is beside the point; the lack of record discussion of West Texas should have alerted them to the need to present data to challenge its inclusion. Because petitioners did not request assistance duplicating EPA's modeling until after the final rule was promulgated, they fail to advance a reason for reconsideration or demonstrate prejudice due to EPA's late disclosure of data, *see, e.g.*, *West Virginia v. EPA*, 362 F.3d 861, 869 (D.C. Cir. 2004); *see also Am. Radio Relay League v. FCC*, 524 F.3d 227, 237–38 (D.C. Cir. 2008), which they also have not shown was any more than "supplementary" as to the State, *see Solite Corp. v. EPA*, 952 F.2d 473, 484 (D.C. Cir. 1991).[6]

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[6] Although petitioners object that EPA has not defined the "measurable contribution" standard, they do so only in their reply brief and did not present this issue to EPA; therefore, the court does not address it. *See* 42 U.S.C. § 7607(d)(7)(B); *S. Coast Air Quality Mgmt. Dist.*, 472 F.3d at 891. In any event, West Texas contributes 0.05 $\mu g/m^3$ of $PM_{2.5}$ to downwind areas, which is one-quarter of the amount of pollution needed for the State as a whole to meet the air quality threshold, and thus should qualify at least as a "material" amount "worthy of special concern." *See Michigan*, 213 F.3d at 682, 684; *Appalachian Power*, 249 F.3d at 1050.

2. Florida

The final rule included the State of Florida for ozone and $PM_{2.5}$. However, the proposed rule had included the State only for $PM_{2.5}$. Petitioners sought reconsideration contesting the inclusion of the State as a whole for ozone and the inclusion of southern subregions for ozone and for $PM_{2.5}$. Upon granting reconsideration as to ozone only, EPA affirmed its determination that the State should be included in CAIR. Petitioners now object to EPA's use of rounding at an initial screening stage for including the State for ozone as arbitrary and capricious. *See* 42 U.S.C. § 7607(d)(9)(A). Alternatively they contend that under *Michigan*, 213 F.3d 663, EPA was required to exclude parts of Southern Florida (south of latitude 28.67 for ozone and south of latitude 29.2 for $PM_{2.5}$) that do not make a significant contribution to nonattainment, or at least the area south of latitude 26 for both ozone and $PM_{2.5}$ because EPA initially had no data for this area. The record supports EPA's reasoned explanation for including the entire State for ozone and $PM_{2.5}$.

As an initial screening indicator of whether to include a state in CAIR for ozone, EPA considered whether the state's average contribution to ozone nonattainment in a downwind area was "less than one percent of total nonattainment in the downwind area."[7] CAIR, 70 Fed. Reg. at 25,191. If so, then EPA would not test the state further; if not, then EPA would perform additional analysis to determine whether the state should be included. EPA found the State of Florida's average percent of contribution to nonattainment in Fulton County,

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[7] The average percent contribution of nonattainment metric is calculated by dividing the concentration of total ozone in the nonattainment area into the state's contribution. *See* Reconsideration, 71 Fed. Reg. at 25,320 n.14.

Georgia to be 0.81 percent. Upon rounding up to one percent, EPA determined after further analysis that the State makes "large and frequent contributions . . . to elevated ozone concentrations in Fulton Co[unty]" and should be included for ozone. Reconsideration, 71 Fed. Reg. at 25,320. Although petitioners characterize this rounding as "creating the nonsense result of transforming a number . . . that is clearly 'less than one percent' to one," Pet'rs' Br. at 28, the court owes substantial deference to EPA's technical expertise, *see Appalachian Power*, 249 F.3d at 1051–52, absent a showing of legal or factual error.

Because petitioners challenge only the initial screening indicator and not the record evidence showing that the State of Florida meets the air quality threshold,[8] they can hardly protest that rounding did not serve the appropriate purpose of identifying the State for further analysis. EPA treated this State no differently than others at the initial screening stage. Even assuming the rounding convention were flawed, it was not dispositive of the State's inclusion in CAIR. Hence, no prejudice could be shown on the basis of that error alone. EPA reasonably explained that its use of the rounding convention is "commonplace" and "customary" as well as a reasonable means of creating a "conservative" initial indicator that "cast[s] a wider net, with further winnowing to occur in subsequent steps when more detailed analysis is applied." Reconsideration, 71 Fed. Reg. at 25,320. Petitioners neither identify error resulting from use of rounding at the initial screening stage nor offer any persuasive reason to question EPA's choice of a technical

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[8] Petitioners' additional reasons not to include the State of Florida are unpersuasive because they concede that the air quality threshold is a lawful basis for inclusion in CAIR. That Fulton County, Georgia may attain the ozone NAAQS by 2015 does not justify excluding the State of Florida as 2010 is the determinative year in CAIR to provide downwind relief.

convention that is reasonable on this record. *See* 42 U.S.C. § 7607(d)(9)(A).

Neither have petitioners shown that EPA should have excluded any part of Southern Florida. EPA was not obligated to measure pollution coming from each possible slice of the State. *See Michigan*, 213 F.3d at 684. The lack of information about a subregion conceivably might result in a miscalculation of the downwind contribution of the State as a whole, *see id.* at 682, but alone could not exonerate a subregion and does not undermine EPA's inclusion of the area south of latitude 26 for either ozone or $PM_{2.5}$. Given the rulemaking record, EPA appropriately determined that the State of Florida as a whole should be included.

In regard to inclusion of the area south of latitude 29.2 for $PM_{2.5}$, petitioners submitted no modeling or data during the comment period to show that it was "innocent" of contributing to the State's collective downwind pollution impact. *See id.* at 684; *Appalachian Power*, 249 F.3d at 1050–51. Instead, their first request to EPA for assistance in duplicating EPA's modeling results came after the final rule was promulgated. They offer no reason why they could not present such modeling during the comment period. EPA thus properly denied reconsideration on inclusion of the State for $PM_{2.5}$. *See* 42 U.S.C. § 7607(d)(7)(B).[9]

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[9] Petitioners did not present the issue of the "standard for a portion-of-a-state's contribution to nonattainment," Reply Br. at 20, to EPA; *see supra* note 6. In any event, their data does not show that the area south of latitude 29.2 is "innocent of material contributions" for $PM_{2.5}$. *See Michigan*, 213 F.3d at 684. The northern part of the State's contributions range from 0.11 to 0.20 $\mu g/m^3$ and the contributions from the southern area appear to be quite similar, ranging from 0.09 to 0.15 $\mu g/m^3$, with even the minimum in the

In regard to ozone, petitioners submitted data in support of their request for reconsideration of inclusion of the area south of latitude 28.67. EPA declined to exclude this area. First, EPA found that the data was unpersuasive inasmuch as it has authority to regulate an upwind area even if its "specific contribution may appear insubstantial" as long as it contributes a "measurable" amount of pollution to the State's "collective contribution to downwind nonattainment." Reconsideration, 71 Fed. Reg. at 25,321. The court agrees; EPA was not required to exclude an area that petitioners have drawn precisely in order to avoid the significance threshold. *See Michigan*, 213 F.3d at 684; *Appalachian Power*, 249 F.3d at 1050. Second, EPA found that the area south of latitude 28.67 is not "innocent of material contribution" but "contribute[s] [a] substantial portion[] of the total ozone loading from Florida to Fulton County[, Georgia]." Reconsideration, 71 Fed. Reg. at 25,321 (citing *Michigan*, 213 F.3d at 683–84). As the contested area contributes almost one-third of the State's entire downwind ozone contribution, petitioners' challenge to its inclusion fails. Petitioners' other concerns, such as the test for "measurable contribution" and the alleged departure from EPA precedent, were not presented to EPA and thus the court does not address them. *See supra* notes 6 & 9; 42 U.S.C. § 7607(d)(7)(B); *S. Coast Air Quality Mgmt. Dist.*, 472 F.3d at 891.

3. Minnesota

In the proposed rule, EPA included the State of Minnesota after determining that its downwind contribution of $PM_{2.5}$ was 0.39 $\mu g/m^3$, well above the air quality threshold of 0.2 $\mu g/m^3$ needed for inclusion in CAIR. In the preamble to the final rule, however, EPA indicated that it had recalculated Minnesota's

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southern range almost half the threshold for inclusion of the entire State.

contribution to be 0.21 $\mu g/m^3$, and included the State in CAIR. Upon reconsideration, EPA again recalculated and determined that the State's contribution was actually 0.20 $\mu g/m^3$, the exact threshold for inclusion.

Minnesota Power challenges the inclusion of the State for $PM_{2.5}$ as resting on two types of unaddressed flawed data resulting in an overstatement of emissions: (1) projecting units' emissions as of 2010 to be at a significantly higher rate than as of 2001, with some above the permitted level, and (2) misallocating energy production or heat input projections between units. In view of these claimed errors, Minnesota Power contends that EPA has failed to provide a "complete analytic defense," *Appalachian Power*, 249 F.3d at 1054 (quotation omitted), of its model's treatment of Minnesota. The court grants the petition because EPA's failure to address the claimed errors was unjustifiable. Although EPA maintains that this concern was not timely presented or with sufficient specificity to satisfy CAA § 307(d)(7)(B), 42 U.S.C. § 7607(d)(7)(B), and thus the issue has been forfeited, *see S. Coast Air Quality Mgmt. Dist.*, 472 F.3d at 891, the record is to the contrary.

Prior to the deadline for petitioning for reconsideration, Minnesota Power raised its emissions overstatement concern, and identified three units with disparities between 2001 actual and 2010 projected emissions. After EPA released additional analysis of the State that included changes based upon comments received about the Metropolitan Emission Reduction Proposal ("MERP"), Minnesota Power set forth by letter of May 10, 2005 to EPA claimed errors in the new analysis, including emissions measurements for the Boswell Energy Center, and the predominantly wood waste unit of Hibbard Energy Center.[10] The final rule was promulgated on May 12, 2005, and Minnesota Power timely petitioned for reconsideration to challenge the "moving target" of EPA's data and determination regarding the State, and referred to its May 2005 letter. Minn. Power, Pet. for Recon. at 7 (Aug. 5, 2005), docketed as EPA-HQ-OAR-2003-0053-2211. In granting reconsideration in December 2005, EPA again recalculated the State's contribution to be 0.20 $\mu g/m^3$, after removing about 16,500 tons of $NO_x$ and about 5,800 tons of $SO_2$ emissions, and requested comments on the corrected 2010 inputs. Minnesota Power submitted comments on January 13, 2006, again raising the measurement issue and attaching the May 10, 2005 letter describing as examples the claimed errors at the Boswell and Hibbard units and referring as well to error at the Sherco unit. Minnesota Power also met with EPA officials on February 2, 2006 regarding its measurement concerns.

Nothing in the CAA requires a petitioner's comments to be more specific or to raise every potential explanation for claimed disparities in order to receive a response to timely concerns. *See Appalachian Power Co. v. EPA*, 135 F.3d 791, 817–18 (D.C. Cir. 1998). EPA thus lacked discretion not to address the claimed errors in view of the timely May 2005 letter, petition for

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[10] The May 2005 letter stated that "[t]he total $SO_2$ emitted from Boswell unit 4 appears to be overstated by a factor of two or 4000 to 5000 tons" and that "$SO_2$ emissions from the Hibbard Energy Center appear to be significantly overstated, by over 2000 tons. This appears to be a result of how the units can burn a mix of wood waste, natural gas and coal . . . . 80% to 90% of energy input is from wood waste, making overstatement of emissions a prospect if coal combustion is presumed." Letter from Michael Cashin, Sr. Env'tl Eng'r, Minn. Power, to Sam Napolitano, Ofc. of Air & Radiation, EPA (May 10, 2005), docketed as attachment to EPA-HQ-OAR-2003-0053-2284.2 (Jan. 13, 2006).

reconsideration, and January 2006 comments. *See* 42 U.S.C. §§ 7607(d)(6)(B), (7)(B). EPA's suggestion that the May 2005 letter was part of a "data dump" in the reconsideration comments, Resp't's Br. at 53, ignores that the comments referred to the May 2005 letter on the first page. Even if EPA had previously overlooked the May 2005 letter,[11] as of January 2006 there was no need for EPA "to cull through" more than a few pages of comments to confront the claimed errors. *See Nat'l Ass'n of Clean Air Agencies v. EPA*, 489 F.3d 1221, 1231 (D.C. Cir. 2007) (quotation omitted).

EPA twice reanalyzed Minnesota's contribution to address the MERP issue, but never addressed the claimed measurement errors at the Boswell, Hibbard, or Sherco units. On reconsideration, EPA explained that it was not responding because it was "unable to find any [such] instances [of a double value]," i.e., overstated emissions. Reconsideration, 71 Fed. Reg. at 25,318. Yet a double value was identified by Minnesota Power at the Boswell unit and other substantial disparities were identified at the Hibbard and Sherco units in the May 2005 letter and January 2006 comments. EPA's suggestion that "many other factors . . . may change in the future" leading to greater projected than actual emissions, *id.*, is insufficient in view of the fact that these claimed errors, if confirmed by EPA, could affect inclusion of the State in CAIR. *See West Virginia v. EPA*, 362 F.3d at 869.

The inclusion of the State of Minnesota in CAIR was a borderline call, and the State's actual downwind contribution to $PM_{2.5}$ remains uncertain. EPA acknowledges on appeal that

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[11] It is unclear why the May 2005 letter did not become part of the rulemaking record until January 13, 2006 as EPA has not stated that it did not receive the letter. Regardless, the letter was timely presented with the reconsideration comments.

even after two recalculations it is still an open question "whether the information would . . . change[] [EPA's] determination" to include the State in CAIR. Resp't's Br. at 47. Minnesota Power estimates that corrected inputs could remove 25,911.4 tons of emissions and thus reduce the State's contribution below the threshold, to the amount of 0.1878 $\mu g/m^3$. Contrary to EPA's suggestion, Minnesota Power is not challenging the Integrated Planning Model itself, *see Appalachian Power*, 249 F.3d at 1052–53; rather, the claimed data disparities would require a response regardless of methodology. The claims of error involving the Boswell, Hibbard, and Sherco units, including the treatment of Hibbard as a coal rather than predominantly biomass unit, do not appear to be an improper request for a "selective[]" rather than "holistic[]" methodological approach. *See* Reconsideration, 71 Fed. Reg. at 25,318. Instead, Minnesota Power has presented these units as examples to illustrate that the overstatement objection requires a response from EPA. A remand is therefore appropriate. *See Appalachian Power*, 249 F.3d at 1054. On remand, EPA also should respond to Minnesota Power's concern about shifting of heat input allocations between units. *See* Pet'rs' Br. at 23–25.

E. Phase I Compliance Deadline

The Florida Association of Electric Utilities contends that EPA failed to provide adequate notice of the nullification of vintage 2009 $NO_x$ SIP Call allowances that resulted from its acceleration of the first-phase $NO_x$ compliance deadline from January 1, 2010 to January 1, 2009. However, in the NPRM EPA requested comments on the timing of each phase of CAIR, specifically asking "whether the first phase deadline should be as proposed, or adjusted earlier or later, in light of [] competing factors." 69 Fed. Reg. at 4623. EPA's Supplemental Proposal made the same request. *Id.* at 32,690. Because the issue of what allowances may be used in compliance with CAIR's

$NO_x$ program is directly linked with the start of the program, *see* CAIR, 70 Fed. Reg. at 25,285, the resulting nullification was a "logical outgrowth" of changing the compliance deadline. *Ne. Md. Waste Disposal Auth. v. EPA*, 358 F.3d 936, 951 (D.C. Cir. 2004). Petitioner has not demonstrated that it was impracticable to raise such objection within the comment period or that the grounds for such objection arose afterward, much less that such objection is of central relevance. 42 U.S.C. § 7607(d)(7)(B). Although petitioner vaguely alludes to EPA's "incorrect factual assumptions" as a reason mandating reconsideration of the compliance deadline, $NO_x$ Br. at 8, it fails to support this assertion. Therefore, petitioner fails to demonstrate a statutory ground that would require reconsideration.

In any event, EPA's change to the $NO_x$ compliance deadline was not arbitrary. EPA explained that the earlier date is better coordinated with the ozone and fine particulate attainment dates mandated by the CAA. CAIR, 70 Fed. Reg. at 25,216. Having determined that the earlier deadline is preferable, EPA concluded that the change is consistent with its CAA obligation "to require emission reductions for obtaining NAAQS to be achieved as soon as practicable." *Id.*

## III. Remedy

The petitioners disagree about the proper remedy, with positions ranging from Minnesota Power's demand that we vacate CAIR with respect to Minnesota to North Carolina's request that we vacate only the Compliance Supplement Pool but remand most of CAIR for EPA to make changes to the compliance date, the set of included states, and the trading program. Unfortunately, we cannot pick and choose portions of CAIR to preserve. "Severance and affirmance of a portion of an administrative regulation is improper if there is 'substantial doubt' that the agency would have adopted the severed portion on its own." *Davis County Solid Waste Mgmt. & Energy Recovery Special Serv. Dist. v. EPA*, 108 F.3d 1454, 1459 (D.C. Cir. 1997). Whether a regulation is severable "depends on the issuing agency's intent." *North Carolina v. FERC*, 730 F.2d 790, 795–96 (D.C. Cir. 1984). EPA has been quite consistent that CAIR was one, integral action. It developed both the $SO_2$ and $NO_x$ programs assuming all states would participate in the trading programs as implemented in CAIR's Model Rule, and it modeled the crucial cost-effectiveness of the caps "assum[ing] interstate emissions trading." CAIR, 70 Fed. Reg. at 25,196. The model also took into account "the use of the existing title IV bank of $SO_2$ allowances." *Id.* Moreover, EPA justified the $SO_2$ and $NO_x$ portions of CAIR as complementary measures to mitigate $PM_{2.5}$ pollution. *See id.* at 25,184. In sum, CAIR is a single, regional program, as EPA has always maintained, and all its components must stand or fall together.

Indeed, they must fall. We have, in reviewing EPA actions under 42 U.S.C. § 7607(d)(9), ordinarily applied the two-part test of *Allied-Signal, Inc. v. Nuclear Regulatory Comm'n*, 988 F.2d 146, 150–151 (D.C. Cir. 1993), under which this answer "depends on 'the seriousness of the order's deficiencies (and thus the extent of doubt whether the agency chose correctly) and the disruptive consequences of an interim change.'" *See Davis County*, 108 F.3d at 1459 (applying *Allied-Signal* in § 7607(d)(9) review). We are sensitive to the risk of interfering with environmental protection, which is one potential disruptive consequence, *see Nat'l Lime Ass'n v. EPA*, 233 F.3d 625, 635 (D.C. Cir. 2000). But the threat of disruptive consequences cannot save a rule when its fundamental flaws "foreclose EPA from promulgating the same standards on remand," *Natural Res. Def. Council v. EPA*, 489 F.3d 1250, 1261–62 (D.C. Cir. 2007).

We must vacate CAIR because very little will "survive[ ] remand in anything approaching recognizable form." *Id.* at

1261. EPA's approach—regionwide caps with no state-specific quantitative contribution determinations or emissions requirements—is fundamentally flawed. Moreover, EPA must redo its analysis from the ground up. It must consider anew which states are included in CAIR, after giving some significance to the phrase "interfere with maintenance" in section 110(a)(2)(D), 42 U.S.C. § 7410(a)(2)(D). It must decide what date, whether 2015 or earlier, is as expeditious as practicable for states to eliminate their significant contributions to downwind nonattainment. The trading program is unlawful, because it does not connect states' emissions reductions to any measure of their own significant contributions. To the contrary, it relates their $SO_2$ reductions simply to their Title IV allowances, tampering unlawfully with the Title IV trading program. The $SO_2$ regionwide caps are entirely arbitrary, since EPA based them on irrelevant factors like the existence of the Title IV program. The allocation of state budgets from the $NO_x$ caps is similarly arbitrary because EPA distributed allowances simply in the interest of fairness. It is possible that after rebuilding, a somewhat similar CAIR may emerge; after all, EPA already promulgated the apparently similar $NO_x$ SIP Call eight years ago. But as we have explained, the similarities with the $NO_x$ SIP Call are only superficial, and CAIR's flaws are deep. No amount of tinkering with the rule or revising of the explanations will transform CAIR, as written, into an acceptable rule. Of course the Federal Implementation Plan EPA imposed is intimately connected to CAIR, and we vacate the FIP as well.[12]

Finally, we note that in the absence of CAIR, the $NO_x$ SIP Call trading program will continue, because EPA terminated the

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[12] EPA published its decision on North Carolina's petition under 42 U.S.C. § 7426 in the same notice as the FIP, but that decision is subject to challenge in a separate case still pending. Today's decision takes no action with respect to that petition.

program only as part of the CAIR rulemaking. CAIR, 70 Fed. Reg. at 25,317 (codified at 40 C.F.R. § 51.121(r)). The continuation of the $NO_x$ SIP Call should mitigate any disruption that might result from our vacating CAIR at least with regard to $NO_x$. In addition, downwind states retain their statutory right to petition for immediate relief from unlawful interstate pollution under section 126, 42 U.S.C. § 7426.

To summarize, we grant the petitions of Entergy, $SO_2$ Petitioners, and Minnesota Power. We grant North Carolina's petition with respect to the "interfere with maintenance" language, CAIR's 2015 compliance date, and the unrestricted trading of allowances; we deny it with respect to EPA's definition of "will" in "will contribute significantly," and the $PM_{2.5}$ contribution threshold. We deny the petitions of the Florida and Texas petitioners, and the Florida Association of Electric Utilities. Accordingly, we vacate CAIR and its associated FIP and remand both to the EPA.

*So ordered.*

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
RESEARCH TRIANGLE PARK, NC 27711

October 27, 2017

OFFICE OF
AIR QUALITY PLANNING
AND STANDARDS

**MEMORANDUM**

**SUBJECT:** Supplemental Information on the Interstate Transport State Implementation Plan Submissions for the 2008 Ozone National Ambient Air Quality Standards under Clean Air Act Section 110(a)(2)(D)(i)(I)

**FROM:** Stephen D. Page
Director

**TO:** Regional Air Division Directors, Regions 1–10

The purpose of this memorandum is to provide supplemental information to states and the Environmental Protection Agency Regional offices as they develop or review state implementation plans (SIPs) that address section 110(a)(2)(D)(i)(I) of the Clean Air Act (CAA), also called the "good neighbor" provision, as it pertains to the 2008 ozone National Ambient Air Quality Standards (NAAQS) of 75 parts per billion (ppb).[1] Specifically, we are providing future year ozone design values and contribution modeling outputs for monitors in the United States based on updated air quality modeling (for 2023) and monitoring data.[2] The EPA's updated modeling indicates that there are no monitoring sites, outside of California, that are projected to have nonattainment or maintenance problems with respect to the 2008 ozone NAAQS of 75 ppb in 2023.

The EPA's goal in providing this information is to assist states' efforts to develop, supplement or resubmit good neighbor SIPs for the 2008 ozone NAAQS to fully address their interstate transport obligations. While the information in this memorandum and the associated air quality analysis data can inform the development of these SIPs, the information provided by this memorandum is not a final determination regarding states' remaining obligations under the good neighbor provision. Any such determination would be made through notice-and-comment rulemaking.

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[1] This memorandum supplements the EPA's original memorandum on this subject, *Information on the Interstate Transport "Good Neighbor" Provision for the 2008 Ozone National Ambient Air Quality Standards (NAAQS) under Clean Air Act (CAA) Section 110(a)(2)(D)(i)(I).* Memorandum from Stephen D. Page, Director, U.S. EPA Office of Air Quality Planning and Standards, to Regional Air Division Directors, Regions 1–10. January 22, 2015. Available at *https://www.epa.gov/sites/production/files/2015-10/documents/goodneighborprovision2008naaqs.pdf.* This memorandum also supplements analyses provided in the 2016 Cross-State Air Pollution Rule Update for the 2008 ozone NAAQS, 81 FR 74504 (October 26, 2016).

[2] Attachment A contains the projected 2023 ozone design values for monitors in the United States.

In addition to summarizing the EPA's review of relevant air quality projections as they relate to interstate transport obligations for the 2008 ozone NAAQS, this memorandum includes background on the good neighbor provision and the four-step interstate transport framework that the EPA has previously used, and continues to use, to address the good neighbor provision for regional pollutants, such as ozone. This background may further assist states in developing SIPs using these projections.

**The Good Neighbor Provision**

Under CAA sections 110(a)(l) and 110(a)(2), each state is required to submit a SIP that provides for the implementation, maintenance and enforcement of each primary or secondary NAAQS. Section 110(a)(1) requires each state to make this new SIP submission within 3 years after promulgation of a new or revised NAAQS. This type of SIP submission is commonly referred to as an “infrastructure SIP.” Section 110(a)(2) identifies specific elements that each plan submission must meet. Conceptually, an infrastructure SIP provides assurance that the submitting state’s SIP contains the necessary structural requirements to implement the new or revised NAAQS, whether by demonstrating that the state’s SIP already contains or sufficiently addresses the necessary provisions, or by making a substantive SIP revision to update the plan provisions.

In particular, CAA section 110(a)(2)(D)(i)(I) requires each state to submit to the EPA new or revised SIPs that “contain adequate provisions ... prohibiting, consistent with the provisions of this subchapter, any source or other type of emissions activity within the State from emitting any air pollutant in amounts which will ... contribute significantly to nonattainment in, or interfere with maintenance by, any other state with respect to any such national primary or secondary ambient air quality standard.” The EPA often refers to section 110(a)(2)(D)(i)(I) as the “good neighbor” provision and to SIP revisions addressing this requirement as good neighbor SIPs. Where a state does not submit a good neighbor SIP, or if the EPA disapproves the SIP, the CAA obligates the EPA to promulgate a federal implementation plan (FIP).

In applying the good neighbor provision for the 2008 ozone NAAQS, the EPA finalized in 2016 the Cross-State Air Pollution Rule Update for the 2008 ozone NAAQS (CSAPR Update).[3] The CSAPR Update applied to 22 eastern states, each of which the EPA found had failed to submit an approvable SIP addressing the good neighbor provision for the 2008 ozone NAAQS.[4] Through the CSAPR Update, the EPA promulgated FIPs for these 22 states by requiring power plants in those states to participate in an allowance trading program to partially address the requirements of the good neighbor provision by implementing emissions reductions that were achievable for the 2017 ozone season. Some states have already submitted or may be developing SIPs to adopt the CSAPR Update regulations and replace the CSAPR Update FIPs. However, the EPA acknowledged in the CSAPR Update that the rule may not fully address the requirements of the good neighbor provision for the 2008 ozone NAAQS for most of the states included and that

[3] *See* 81 FR 74504 (October 26, 2016).

[4] The CSAPR Update provided a full FIP for Tennessee and partial FIPs for Alabama, Arkansas, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maryland, Michigan, Mississippi, Missouri, New Jersey, New York, Ohio, Oklahoma, Pennsylvania, Texas, Virginia, West Virginia, and Wisconsin. The CSAPR Update did not promulgate FIPs for western states.

further analysis was needed of air quality and oxides of nitrogen ($NO_X$) reductions after 2017.[5] Additionally, a few western states, not regulated in the CSAPR Update, do not yet have approved SIPs. As noted earlier, the EPA believes that the information conveyed through this memorandum can assist states in their efforts to develop, supplement or resubmit good neighbor SIPs for the 2008 ozone NAAQS to fully address their interstate transport obligations.

**Framework to Address the Good Neighbor Provision**

Through the development and implementation of several previous rulemakings,[6] the EPA, working in partnership with states, established the following four-step interstate transport framework to address the requirements of the good neighbor provision for ozone and fine particulate matter ($PM_{2.5}$) NAAQS: (1) identify downwind air quality problems, (2) identify upwind states that contribute enough to those downwind air quality problems to warrant further review and analysis, (3) identify the emissions reductions necessary to prevent an identified upwind state from contributing significantly to those downwind air quality problems, and (4) adopt permanent and enforceable measures needed to achieve those emissions reductions.

The EPA most recently applied each step in this framework to address the good neighbor provision requirements for the 2008 ozone NAAQS in the CSAPR Update.[7] Two aspects of the CSAPR Update (*i.e.*, selection of the analytic year and the scope of the CSAPR Update good neighbor remedy) are influential in the development of analyses discussed in this memorandum. First, in the CSAPR Update, the EPA selected 2017 as both the analytic year and the implementation year because the 2017 ozone season was the last full season from which data could be used to determine attainment with the 2008 ozone NAAQS by the July 20, 2018, attainment date for nonattainment areas classified as Moderate. Second, given the time constraints for implementing $NO_X$ reduction strategies for the 2008 ozone NAAQS (*i.e.*, in the 2017 ozone season), the EPA, in the CSAPR Update, did not analyze or attempt to quantify further electric generating units (EGU) or non-EGU ozone season $NO_X$ reductions available after 2017. Because the EPA's analysis showed persisting ozone transport problems after implementation of the CSAPR Update and because the EPA did not assess available emissions reductions after 2017, at the time of promulgation, the EPA could not definitively conclude, without further analysis, that the CSAPR Update fully addressed the requirements of the good neighbor provision. Therefore, the EPA explained in the final rule that the CSAPR Update may only provide a partial remedy to address interstate emissions transport for the 2008 ozone NAAQS for 21 of the covered states.[8] As a result, these states (or the EPA) must take additional

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[5] The EPA also determined that the following 14 eastern states evaluated in the CSAPR Update had no emissions reduction obligations under the good neighbor provision for the 2008 ozone NAAQS: Connecticut, Florida, Georgia, Maine, Massachusetts, Minnesota, Nebraska, New Hampshire, North Carolina, North Dakota, Rhode Island, South Carolina, South Dakota, and Vermont. The EPA has already approved good neighbor SIPs for the 2008 ozone NAAQS for a number of these states and has pending actions to approve other SIPs.

[6] *See* for example, Finding of Significant Contribution and Rulemaking for Certain States in the Ozone Transport Assessment Group Region for Purposes of Reducing Regional Transport of Ozone (also known as the $NO_X$ SIP Call). 63 FR 57356 (October 27, 1998); Clean Air Interstate Rule (CAIR) Final Rule. 70 FR 25162 (May 12, 2005); CSAPR Final Rule. 76 FR 48208 (August 8, 2011); CSAPR Update. 81 FR 74504 (October 26, 2016). Each of these rulemakings also incorporated allowance trading programs to implement emissions reductions.

[7] *See* details on the CSAPR Update analysis and methodology in the final rule at 81 FR 74504 (October 26, 2016).

[8] The CSAPR Update provided a FIP fully addressing the good neighbor provision for Tennessee and FIPs that may only partially address the good neighbor provision for Alabama, Arkansas, Illinois, Indiana, Iowa, Kansas,

steps to fully satisfy the good neighbor provision, or show why no additional emissions reductions are necessary. It is for this reason that the EPA is now conducting and releasing our additional modeling for an analytic year after 2017.

**Applying the Interstate Transport Framework to the EPA's 2023 Modeling for the 2008 Ozone NAAQS**

This section explains the EPA's choice of 2023 as the analytic year and our application of the interstate transport framework to our updated modeling. As we discuss in the following paragraphs, the EPA's analysis indicates that no areas in the United States, outside of California, are expected to have problems attaining and maintaining the 2008 ozone NAAQS in 2023.

**Step 1.** Identification of Potential Downwind Nonattainment and Maintenance Receptors

One of the first steps in the modeling process is selecting a future analytic year. In determining the appropriate future analytic year for purposes of assessing remaining interstate transport obligations for the 2008 ozone NAAQS, the EPA considered two primary factors. First, the EPA considered the downwind attainment dates for the 2008 ozone NAAQS. In *North Carolina v. EPA*, the D.C. Circuit held that emissions reductions required by the good neighbor provision should be evaluated considering the relevant attainment dates of downwind nonattainment areas impacted by interstate transport.[9] The next attainment dates for the 2008 ozone NAAQS will be July 20, 2021, for nonattainment areas classified as Serious and July 20, 2027, for nonattainment areas classified as Severe.[10] Because the various attainment deadlines are in July, which is in the middle of the ozone monitoring season for all states, data from the calendar year prior to the attainment date (*e.g.*, data from 2020 for the 2021 attainment date and from 2026 for the 2027 attainment date) are the last data that can be used to demonstrate attainment with the NAAQS. In all cases, the statute provides that areas should attain as expeditiously as practicable.[11]

Second, the EPA considered the timeframes that may be required for implementing further emissions reductions as expeditiously as practicable. Generally, emissions levels are expected to decline in the future through implementation of existing local, state and federal emissions reduction programs. This is an important consideration because the U.S. Supreme Court and the D.C. Circuit Court have both held that the EPA may not require emissions reductions greater than necessary to achieve attainment and maintenance of the NAAQS in downwind areas.[12] Therefore, if new controls cannot be implemented feasibly for several years when air quality will likely be cleaner, the EPA should evaluate air quality in a future year to ensure that any potential emissions reductions would not over-control relative to the identified ozone problem.

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Kentucky, Louisiana, Maryland, Michigan, Mississippi, Missouri, New Jersey, New York, Ohio, Oklahoma, Pennsylvania, Texas, Virginia, West Virginia, and Wisconsin. The CSAPR Update did not promulgate FIPs for western states.

[9] 531 F.3d 896, 911–12 (D.C. Cir. 2008) (holding that the EPA must coordinate interstate transport compliance deadlines with downwind attainment deadlines).

[10] While there are no areas (outside of California) that are classified as either Serious or Severe, these classifications (and the associated attainment dates) are required under the statute in the event that the many downwind Moderate nonattainment areas fail to attain by their attainment date of July 20, 2018.

[11] *See* CAA section 181(a)(1).

[12] *EPA v. EME Homer City Generation, L.P.,* 134 S. Ct. 1584, 1600–01 (2014); *EME Homer City Generation, L.P. v. EPA,* 795 F.3d 118, 127 (D.C. Cir. 2015).

Accordingly, it is reasonable to evaluate downwind air quality, and identify any remaining receptors, in the year in which the EPA expects additional emissions reductions, if any, to be implemented.

While the CSAPR Update included emissions reductions associated with EGU control strategies that could be implemented on a shorter timeframe (*i.e.*, by the 2017 ozone season), the EPA concluded that additional emissions reductions from EGUs would likely require the installation of new post-combustion controls. For this analysis, the EPA assumed that the analytic year should reflect the time needed to plan for, install, and test new EGU and non-EGU emissions controls across multiple states. This assumption was based on previous interstate ozone transport analyses showing that multiple upwind states are typically linked to downwind ozone problems.[13] Further, the EPA assumed that new emissions controls would likely be considered on multiple upwind source categories, including those that currently do not report emissions to the EPA under Part 75 and, therefore, may have relatively more uncertainty associated with their emissions levels, existing control efficiencies and further emissions reduction potential. The scope and uncertainty associated with potential new EGU and non-EGU controls led the EPA to assume that it could take up to 4 years for new controls to be fully operational following promulgation of a final rule. For example, the EPA believes that it is reasonable to assume that the installation of these new post-combustion controls for state- or regional-level fleets of EGUs or controls for non-EGU point sources may take up to 4 years following promulgation of a final rule.[14] In addition and not accounting for time needed for permitting or determining and installing appropriate monitoring equipment, the EPA's most recent assessment of non-EGU controls indicates the timing for installing controls is uncertain.[15]

For purposes of conducting updated modeling, to determine in what year future emissions reductions might be implemented, the EPA, therefore, considered the timeframe in which a future rulemaking that might require such emissions reductions would likely be finalized. The EPA is subject to several statutory and court-ordered deadlines to address the requirements of the good neighbor provision for the 2008 ozone NAAQS for several states. The next such deadline is a court-ordered deadline of June 30, 2018, for the EPA to address these requirements for Kentucky,[16] followed by several statutory deadlines in 2018 and 2019.[17] The notice-and-comment rulemakings that must be undertaken to address these requirements, whether in the context of SIPs or FIPs, are unlikely to be completed any earlier than mid-2018 and are likely to continue into 2019. Accordingly, given that the EPA believes that it is reasonable to assume that installation of new emissions controls for EGUs and non-EGUs that could be required under

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[13] *See* 81 FR 74504 (October 26, 2016).
[14] *See* 81 FR 74562 (October 26, 2016).
[15] For the EPA's most current assessment of controls for non-EGU emissions sources, *see Assessment of Non-EGU NOx Emission Controls, Cost of Controls, and Time for Compliance Final Technical Support Document (TSD) for the Cross-State Air Pollution Rule for the 2008 Ozone NAAQS* (Docket ID No.: EPA-HQ-OAR-2015-0500) available at *https://www.epa.gov/sites/production/files/2017-05/documents/final_assessment_of_non-egu_nox_emission_controls_cost_of_controls_and_time_for _compliance_final_tsd.pdf).*
[16] Order, *Sierra Club v. EPA,* Case No. 3:15-cv-04328-JD (N.D. Cal. May 23, 2017).
[17] The EPA has deadlines to promulgate FIPs for Indiana, Ohio and New Jersey by July 15, 2018; for Maryland by August 19, 2018; for Louisiana, Texas and Wisconsin by September 12, 2018; for New York by September 26, 2018; for Utah by November 18, 2018, and for Wyoming by March 6, 2019.

these rulemaking efforts may take up to 4 years, the EPA believes that such reductions are unlikely to be implemented for a full ozone season until 2023.

While 2023 is later than the attainment date for nonattainment areas classified as Serious (July 20, 2021), as explained above, it is unlikely that emissions control requirements could be promulgated and implemented by the Serious area attainment date. Likewise, the EPA also believes that it would not be reasonable to assume that emissions reductions could be postponed to the attainment date for nonattainment areas classified as Severe (July 20, 2027) because the statute instructs states to attain the NAAQS as expeditiously as practicable. Accordingly, the EPA believes that 2023 is a reasonable year to assess downwind air quality to evaluate any remaining requirements under the good neighbor provision for the 2008 ozone NAAQS.[18] Thus, in selecting its future analytic year for the air quality modeling, the EPA balanced considerations such as attainment dates in downwind states, including the obligation to attain as expeditiously as practicable, the EPA's obligation to avoid unnecessary over-control of upwind state emissions, the timeframe in which any necessary emissions reductions could be feasibly implemented, and the timeframe required for rulemaking to impose any such emissions reductions that might be required.

After selecting 2023 as the appropriate analytic year, the EPA performed nationwide photochemical modeling for 2023 to identify nonattainment and maintenance receptors relevant for the 2008 ozone NAAQS. The EPA used as a starting point for this updated air quality modeling some of the data used in the January 2017 Notice of Data Availability (NODA).[19] Although the EPA initially provided the NODA to assist states in developing SIPs to address their good neighbor obligations for the 2015 ozone NAAQS, the emissions files and other modeling input files are independent of the level of the NAAQS.[20] As discussed below, because the EPA began its updated analyses with the data from the January 2017 NODA, we also were able to incorporate some of the stakeholder feedback provided through the public comment process on the NODA.

We are providing an overview of the January 2017 NODA files to help states and the EPA Regional offices better understand the updated air quality modeling for potential application to the 2008 ozone NAAQS. The transport assessment discussed in the January 2017 NODA used a 2011-based modeling platform to develop base year and future year emissions inventories as inputs into the air quality model. The platform also included meteorology for 2011, base year emissions for 2011 and future year base case emissions for 2023. The EPA performed air quality modeling to project ozone design values for 2023 and used these projections to identify nonattainment and maintenance receptors. The EPA then used ozone source apportionment modeling for 2023 to quantify contributions from emissions in each state to ozone concentrations at each of the projected nonattainment and maintenance receptors in that future year. As part of the NODA process and the ensuing 90-day comment period, the EPA made available and took

[18] Using the 2023 analytic year also allowed the EPA to begin the updated analysis using the data sets originally developed for the January 2017 NODA, which we revised in response to stakeholder feedback. Accordingly, the EPA initiated its analysis more quickly than if a different year had been chosen, which might have delayed subsequent rulemaking actions and therefore emissions reductions.

[19] 82 FR 1733 (January 6, 2017).

[20] Good neighbor SIPs for the 2015 ozone NAAQS are due within 3 years of promulgation of the revised NAAQS, or by October 2018.

comment on (1) the emissions inventories for 2011 and 2023, supporting data used to develop those inventories, methods and data used to process emissions inventories into a form that can be used for air quality modeling and (2) air quality modeling results for 2011 and 2023, base period (*i.e.*, 2009-2013) average and maximum design value concentrations, projected 2023 average and maximum ozone design value concentrations and projected 2023 ozone contributions from state-specific anthropogenic emissions and other contribution categories to ozone concentrations at individual ozone monitoring sites. The EPA received comments on the transport modeling NODA from nearly 50 commenters, including 21 state air agencies, 3 multi-state groups and 23 industry groups.

Following the close of the NODA public comment period on April 6, 2017, the EPA began incorporating stakeholder feedback into its EGU and non-EGU emissions projections and its modeling platform. After incorporating many of the suggested updates, the EPA hosted conference calls with these same stakeholders to announce our intent to update the ozone transport air quality modeling and to review updates to the 2011 and projected 2023 emissions inventories (including specific changes to the oil and gas projection methodology),[21] describe incorporated changes to the EGU emissions projections[22] and changes to the modeling platform described here.

Regarding emissions inventories, the updated 2023 modeling reflects revisions to the January 2017 NODA approach for projecting future year emissions from EGUs. The approach used in this modeling is consistent with the EGU projections that the EPA used in the CSAPR Update, specifically the EGU projection called the "budget-setting base case."[23] In brief, the EPA used the CSAPR Update budget-setting approach to develop this projection in support of the updated 2023 ozone transport modeling that is the subject of this memorandum. The EGU projection begins with 2016 reported Part 75 sulfur dioxide ($SO_2$) and $NO_X$ data for units reporting under the Acid Rain and CSAPR programs. These were the most recent ozone season data available at the time of the EPA's analysis. The EPA then extended these observed emissions levels forward to 2023, and made unit-specific adjustments to emissions to account for upcoming retirements, post-combustion control retrofits, coal-to-gas conversions, combustion controls upgrades, new units, CSAPR Update compliance, state rules and Best Available Retrofit Technology (BART) requirements.[24] The resulting estimated EGU emissions values for this application of 2023 air quality modeling are based on the latest reported operational data combined with known and anticipated fleet and pollution controls changes. For emissions from units not reporting under

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[21] *See* the TSD: *Additional Updates to Emissions Inventories for the Version 6.3, 2011 Emissions Modeling Platform for the Year* 2023, October 2017. Available at *https://www.epa.gov/air-emissions-modeling/2011-version-63-platform*.
[22] *See* Section 4.1 of the TSD: *Additional Updates to Emissions Inventories for the Version 6.3, 2011 Emissions Modeling Platform for the Year 2023, October 2017* for details on the development of the EGU engineering analytics emissions estimates for the 2023 Flat File.
[23] *See* the preamble to the final CSAPR Update for more details on the development and use of the budget-setting base case.
[24] The EPA uses the U.S. Energy Information Association (EIA) Form 860 as a source for upcoming controls, retirements, and new units.

Part 75, the EPA largely relied on unadjusted 2011 National Emissions Inventory (NEI) data for its 2023 assumptions.[25]

Another important emissions inventory update includes a revised methodology for estimating 2023 emissions from the oil and gas sector. The projection factors used in the updated 2023 oil and gas emissions incorporate state-level factors based on historic growth from 2011-2015 and region-specific factors that represent the projected growth from 2015 to 2023. The 2011-2015 state-level factors were based on historic state oil and gas production data published by the EIA, while the 2015-2023 factors are based on projected oil and gas production in EIA's 2017 Annual Energy Outlook (AEO) Reference Case without the Clean Power Plan for the six EIA supply regions. Details on the revised methodology that the EPA used to project oil and gas emissions to 2023, as well as changes to the base year 2011 and future year 2023 emissions inventories for other sectors, can be found in the technical support document, titled *Additional Updates to Emissions Inventories for the Version 6.3, 2011 Emissions Modeling Platform for the Year 2023, October 2017*.[26]

The EPA used the Comprehensive Air Quality Model with Extensions (CAMx v6.40)[27] for modeling the updated emissions in 2011 and 2023.[28] The EPA used outputs from the 2011 and 2023 model simulations to project base period 2009-2013 average and maximum ozone design values to 2023 at monitoring sites nationwide. The EPA's modeling guidance[29] recommends that model predictions from the "3 x 3" array of grid cells surrounding the location of the monitoring site be used in the projection of future year design values. The EPA used this approach for projecting design values for the updated 2023 modeling. In addition, in light of comments on the January 2017 NODA and other analyses, the EPA also projected 2023 design values based on a modified version of this approach for those monitoring sites located in coastal areas. In brief, in the alternative approach, the EPA eliminated from the design value calculations those modeling data in grid cells not containing a monitoring site that are dominated by water (*i.e.*, more than 50 percent of the land use in the grid cell is water).[30] The base period and 2023 average and maximum design values at individual monitoring sites for both the "3 x 3" approach and the alternative approach affecting coastal sites are available at *https://www.epa.gov/airmarkets/october-2017-memo-and-information-*

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[25] For non-$SO_2$ and non-$NO_X$ pollutants for units reporting under Part 75, the EPA used 2016 reported heat input to create a scaler for 2011 data. For instance, if heat input increased by 10 percent during that time frame for a particular unit, then its emissions for these pollutants were assumed to do the same.
[26] Available at *https://www.epa.gov/air-emissions-modeling/2011-version-63-platform*.
[27] CAMx v6.40 was the most recent public release version of CAMx at the time the EPA updated its modeling in fall 2017. ("Comprehensive Air Quality Model with Extensions version 6.40 User's Guide" Ramboll Environ, December 2016. *http://www.camx.com/*.)
[28] For the updated modeling, the EPA used the construct of the modeling platform (*i.e.*, modeling domain and non-emissions inputs) that we used for the NODA modeling, except that the photolysis rates files were updated to be consistent with CAMx v6.40. The NODA Air Quality Modeling Technical Support Document describing the modeling platform is available at *https://www.epa.gov/airmarkets/notice-data-availability-preliminary-interstate-ozone-transport-modeling-data-2015-ozone*.
[29] *http://www.epa.gov/ttn/scram/guidance/guide/Draft_O3-PM-RH_Modeling_Guidance-2014.pdf.*
[30] A model grid cell is identified as a "water" cell if more than 50 percent of the grid cell is water based on the 2006 National Land Cover Database. Grid cells that meet this criterion are treated as entirely over water in the Weather Research Forecast (WRF) modeling used to develop the 2011 meteorology for the EPA's air quality modeling.

*interstate-transport-sips-2008-ozone-naaqs*. This file also contains 2014-2016 measured design values.

When identifying areas with potential downwind air quality problems, the EPA's updated modeling used the same "receptor" definitions as those developed during the CSAPR rulemaking process and used in the CSAPR Update.[31] That is, the EPA identified nonattainment receptors as those monitoring sites with current measured values exceeding the NAAQS that also have projected (*i.e.*, in 2023) average design values exceeding the NAAQS. The EPA identified maintenance receptors as those monitoring sites with current measured values below the NAAQS and projected average and maximum design values exceeding the NAAQS. The EPA also identified as maintenance receptors those monitoring sites with projected average design values below the NAAQS but with projected maximum design values exceeding the NAAQS. As with past application of receptor definitions, the EPA considered all nonattainment receptors to also be maintenance receptors because a monitoring site with a projected average design value above the standard necessarily also has a projected maximum design value above the standard. Attachment A contains the projected 2023 ozone design value for monitors in the United States.

The EPA's 2023 updated modeling, using either the "3 x 3" approach or the alternative approach affecting coastal sites, indicates that there are no monitoring sites, outside of California, that are projected to have nonattainment or maintenance problems with respect to the 2008 ozone NAAQS in 2023.[32]

**Step 2.** Identification of States Contributing to Potential Downwind Nonattainment and Maintenance Receptors

Although the EPA has completed nationwide contribution modeling for 2023, this information may not be necessary for most states to develop good neighbor SIPs for the 2008 ozone NAAQS in light of the information described previously. The EPA does, however, plan to make its contribution modeling outputs available to the states and will coordinate with multi-jurisdictional organizations regarding the release of this information.

**Conclusion**

The EPA believes that states may consider using this national modeling to develop SIPs that fully address requirements of the good neighbor provision for the 2008 ozone NAAQS.[33] States may also be able to use this information to address other CAA obligations. States could include in any such submission state-specific information to support their reliance on the 2023 modeling data. Further, states may supplement the information provided in this memorandum with any additional information that they believe is relevant to addressing the good neighbor provision requirements. States may also choose to use information different from that provided in this document or on the EPA's website to identify nonattainment and maintenance receptors relevant

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[31] *See* 81 FR 74530-74532 (October 26, 2016).

[32] This information is available at ***https://www.epa.gov/airmarkets/october-2017-memo-and-information-interstate-transport-sips-2008-ozone-naaqs***.

[33] For a state already subject to a CSAPR Update FIP to get full SIP approval, the state would need to address in their SIP submission the reductions that it would achieve by implementing the FIP. One way states could accomplish this would be by submitting a CSAPR Update SIP using the guidance provided in the preamble to the CSAPR Update at 81 FR 74569 (October 26, 2016).

to development of their good neighbor SIPs. If this is the case, states should submit that information along with a full explanation and technical analysis for the EPA's evaluation. The EPA Regional offices and states should work together to accomplish the goal of developing, submitting and reviewing approvable SIPs that fully address the good neighbor provision for the 2008 ozone NAAQS.

Please share this information with the air agencies in your Region.

**For Further Information**
If you have any questions concerning this memorandum, please contact Norm Possiel at (919) 541-5692, *possiel.norm@epa.gov* for modeling information or Beth Palma at (919) 541-5432, *palma.elizabeth@epa.gov* for any other information.

Attachment

**Attachment A**

**Projected Ozone Design Values at Individual Monitoring Sites Based on the EPA's Updated 2023 Transport Modeling**

This attachment contains projected ozone design values at individual monitoring sites nationwide based on EPA's updated transport modeling for 2023. The scenario name for the updated modeling is "2023en." All of the data are in units of "ppb."

The following data are provided in the table below.

(1) Base period 2009 – 2013 average and maximum design values based on 2009 – 2013 measured data.

(2) Projected 2023 average and maximum design values based on the "3x3" approach recommended in EPA's photochemical modeling guidance.

(3) Projected 2023 average and maximum design values based on a modified "3x3" approach in which model predictions in grid cells without monitors that are predominately water are excluded from the projection calculations ("No Water"). Note that the modified approach only affects the projection of design values for monitoring sites in or near coastal areas.

(4) 2016 ozone design values based on 2014 – 2016 measured data (N/A indicates that a 2016 design value is not available). The following web site has additional information on the 2016 design values: *https://www.epa.gov/air-trends/air-quality-design-values#report*.

Note, a value of 75.9 ppb (or less) is considered to be in attainment of the 2008 ozone NAAQS, and a value of 76.0 ppb (or higher) is considered to be in violation of the 2008 ozone NAAQS.

| Site | St | County | 2009-2013 Avg | 2009-2013 Max | 2023en "3x3" Avg | 2023en "3x3" Max | 2023en "No Water" Avg | 2023en "No Water" Max | 2014-2016 |
|---|---|---|---|---|---|---|---|---|---|
| 10030010 | AL | Baldwin | 70.0 | 72 | 53.4 | 54.9 | 55.4 | 57.0 | 65 |
| 10331002 | AL | Colbert | 65.0 | 67 | 45.5 | 46.9 | 45.5 | 46.9 | 59 |
| 10499991 | AL | DeKalb | 66.0 | 66 | 50.7 | 50.7 | 50.7 | 50.7 | 63 |
| 10510001 | AL | Elmore | 66.3 | 68 | 49.5 | 50.7 | 49.5 | 50.7 | N/A |
| 10550011 | AL | Etowah | 61.7 | 62 | 46.2 | 46.4 | 46.2 | 46.4 | 61 |
| 10690004 | AL | Houston | 63.7 | 65 | 49.2 | 50.2 | 49.2 | 50.2 | 59 |
| 10730023 | AL | Jefferson | 72.3 | 75 | 54.9 | 56.9 | 54.9 | 56.9 | 68 |
| 10731003 | AL | Jefferson | 72.0 | 75 | 55.2 | 57.5 | 55.2 | 57.5 | 66 |
| 10731005 | AL | Jefferson | 75.3 | 77 | 56.8 | 58.1 | 56.8 | 58.1 | N/A |
| 10731009 | AL | Jefferson | 72.0 | 74 | 56.1 | 57.7 | 56.1 | 57.7 | N/A |
| 10731010 | AL | Jefferson | 73.7 | 76 | 55.4 | 57.2 | 55.4 | 57.2 | 64 |
| 10732006 | AL | Jefferson | 75.0 | 77 | 55.7 | 57.1 | 55.7 | 57.1 | 66 |
| 10735002 | AL | Jefferson | 72.0 | 74 | 54.2 | 55.7 | 54.2 | 55.7 | N/A |
| 10735003 | AL | Jefferson | 71.0 | 73 | 55.0 | 56.5 | 55.0 | 56.5 | N/A |
| 10736002 | AL | Jefferson | 76.7 | 80 | 58.8 | 61.3 | 58.8 | 61.3 | 68 |
| 10890014 | AL | Madison | 70.7 | 73 | 52.8 | 54.5 | 52.8 | 54.5 | 64 |
| 10970003 | AL | Mobile | 69.0 | 71 | 53.2 | 54.7 | 53.2 | 54.7 | 63 |

| Site | St | County | 2009-2013 Avg | 2009-2013 Max | 2023en "3x3" Avg | 2023en "3x3" Max | 2023en "No Water" Avg | 2023en "No Water" Max | 2014-2016 |
|---|---|---|---|---|---|---|---|---|---|
| 10972005 | AL | Mobile | 73.0 | 73 | 56.6 | 56.6 | 57.3 | 57.3 | 65 |
| 11011002 | AL | Montgomery | 67.3 | 69 | 49.6 | 50.8 | 49.6 | 50.8 | 62 |
| 11030011 | AL | Morgan | 68.7 | 71 | 54.2 | 56.0 | 54.2 | 56.0 | 64 |
| 11130002 | AL | Russell | 66.0 | 67 | 49.9 | 50.6 | 49.9 | 50.6 | 62 |
| 11170004 | AL | Shelby | 73.3 | 75 | 54.0 | 55.3 | 54.0 | 55.3 | 67 |
| 11190002 | AL | Sumter | 61.0 | 61 | 49.2 | 49.2 | 49.2 | 49.2 | N/A |
| 11250010 | AL | Tuscaloosa | 58.7 | 59 | 45.1 | 45.4 | 45.1 | 45.4 | 60 |
| 40038001 | AZ | Cochise | 72.0 | 73 | 69.4 | 70.4 | 69.4 | 70.4 | 65 |
| 40051008 | AZ | Coconino | 69.0 | 69 | 64.2 | 64.2 | 64.2 | 64.2 | 69 |
| 40058001 | AZ | Coconino | 71.0 | 72 | 66.3 | 67.2 | 66.3 | 67.2 | 67 |
| 40070010 | AZ | Gila | 74.5 | 75 | 64.2 | 64.6 | 64.2 | 64.6 | 71 |
| 40130019 | AZ | Maricopa | 76.7 | 79 | 69.3 | 71.4 | 69.3 | 71.4 | 73 |
| 40131004 | AZ | Maricopa | 79.7 | 81 | 69.8 | 71.0 | 69.8 | 71.0 | 75 |
| 40131010 | AZ | Maricopa | 69.7 | 72 | 60.4 | 62.3 | 60.4 | 62.3 | 73 |
| 40132001 | AZ | Maricopa | 74.7 | 76 | 66.1 | 67.2 | 66.1 | 67.2 | 68 |
| 40132005 | AZ | Maricopa | 76.0 | 77 | 65.3 | 66.2 | 65.3 | 66.2 | 77 |
| 40133002 | AZ | Maricopa | 73.3 | 75 | 65.6 | 67.2 | 65.6 | 67.2 | 70 |
| 40133003 | AZ | Maricopa | 75.7 | 77 | 66.2 | 67.3 | 66.2 | 67.3 | 70 |
| 40134003 | AZ | Maricopa | 74.7 | 76 | 67.8 | 69.0 | 67.8 | 69.0 | 70 |
| 40134004 | AZ | Maricopa | 72.7 | 74 | 63.7 | 64.8 | 63.7 | 64.8 | 69 |
| 40134005 | AZ | Maricopa | 69.7 | 71 | 61.3 | 62.4 | 61.3 | 62.4 | N/A |
| 40134008 | AZ | Maricopa | 76.3 | 77 | 65.2 | 65.8 | 65.2 | 65.8 | 71 |
| 40134010 | AZ | Maricopa | 71.0 | 72 | 60.8 | 61.7 | 60.8 | 61.7 | 66 |
| 40134011 | AZ | Maricopa | 65.0 | 66 | 57.6 | 58.5 | 57.6 | 58.5 | 59 |
| 40137003 | AZ | Maricopa | 70.7 | 72 | 62.4 | 63.6 | 62.4 | 63.6 | 67 |
| 40137020 | AZ | Maricopa | 73.7 | 75 | 64.4 | 65.5 | 64.4 | 65.5 | 72 |
| 40137021 | AZ | Maricopa | 76.7 | 77 | 65.9 | 66.2 | 65.9 | 66.2 | 76 |
| 40137022 | AZ | Maricopa | 73.3 | 75 | 63.0 | 64.4 | 63.0 | 64.4 | 74 |
| 40137024 | AZ | Maricopa | 73.3 | 74 | 64.1 | 64.7 | 64.1 | 64.7 | 71 |
| 40139508 | AZ | Maricopa | 74.0 | 76 | 62.5 | 64.2 | 62.5 | 64.2 | 73 |
| 40139702 | AZ | Maricopa | 74.7 | 77 | 63.9 | 65.9 | 63.9 | 65.9 | 72 |
| 40139704 | AZ | Maricopa | 74.5 | 76 | 64.0 | 65.3 | 64.0 | 65.3 | N/A |
| 40139706 | AZ | Maricopa | 74.0 | 75 | 63.6 | 64.5 | 63.6 | 64.5 | 70 |
| 40139997 | AZ | Maricopa | 76.0 | 77 | 68.1 | 69.0 | 68.1 | 69.0 | 75 |
| 40170119 | AZ | Navajo | 68.7 | 70 | 60.2 | 61.3 | 60.2 | 61.3 | 64 |
| 40190021 | AZ | Pima | 71.3 | 73 | 61.4 | 62.9 | 61.4 | 62.9 | 68 |
| 40191011 | AZ | Pima | 67.0 | 68 | 57.3 | 58.1 | 57.3 | 58.1 | 62 |
| 40191018 | AZ | Pima | 68.3 | 69 | 59.4 | 60.0 | 59.4 | 60.0 | 64 |
| 40191020 | AZ | Pima | 69.7 | 71 | 59.2 | 60.3 | 59.2 | 60.3 | 64 |

| Site | St | County | 2009-2013 Avg | 2009-2013 Max | 2023en "3x3" Avg | 2023en "3x3" Max | 2023en "No Water" Avg | 2023en "No Water" Max | 2014-2016 |
|---|---|---|---|---|---|---|---|---|---|
| 40191028 | AZ | Pima | 67.0 | 68 | 57.5 | 58.3 | 57.5 | 58.3 | 64 |
| 40191030 | AZ | Pima | 68.7 | 70 | 59.2 | 60.3 | 59.2 | 60.3 | 63 |
| 40191032 | AZ | Pima | 66.3 | 67 | 57.0 | 57.6 | 57.0 | 57.6 | 64 |
| 40191034 | AZ | Pima | 64.0 | 65 | 56.8 | 57.6 | 56.8 | 57.6 | 61 |
| 40213001 | AZ | Pinal | 73.0 | 74 | 62.6 | 63.4 | 62.6 | 63.4 | 70 |
| 40213003 | AZ | Pinal | 68.3 | 69 | 59.7 | 60.3 | 59.7 | 60.3 | 65 |
| 40213007 | AZ | Pinal | 68.3 | 69 | 61.5 | 62.1 | 61.5 | 62.1 | 65 |
| 40217001 | AZ | Pinal | 70.3 | 72 | 61.2 | 62.6 | 61.2 | 62.6 | 65 |
| 40218001 | AZ | Pinal | 76.0 | 76 | 65.3 | 65.3 | 65.3 | 65.3 | 71 |
| 40278011 | AZ | Yuma | 76.5 | 77 | 70.4 | 70.8 | 70.4 | 70.8 | 74 |
| 50350005 | AR | Crittenden | 77.3 | 79 | 60.3 | 61.6 | 60.3 | 61.6 | 67 |
| 51010002 | AR | Newton | 68.0 | 69 | 53.1 | 53.9 | 53.1 | 53.9 | 59 |
| 51130003 | AR | Polk | 72.3 | 73 | 60.8 | 61.3 | 60.8 | 61.3 | 62 |
| 51190007 | AR | Pulaski | 72.3 | 73 | 53.0 | 53.5 | 53.0 | 53.5 | 64 |
| 51191002 | AR | Pulaski | 75.7 | 77 | 55.6 | 56.6 | 55.6 | 56.6 | 64 |
| 51191008 | AR | Pulaski | 73.0 | 75 | 55.0 | 56.5 | 55.0 | 56.5 | N/A |
| 51430005 | AR | Washington | 71.0 | 73 | 57.1 | 58.8 | 57.1 | 58.8 | 59 |
| 60010007 | CA | Alameda | 73.3 | 76 | 64.2 | 66.6 | 64.2 | 66.6 | 74 |
| 60010009 | CA | Alameda | 45.7 | 49 | 44.3 | 47.5 | 44.3 | 47.5 | 55 |
| 60010011 | CA | Alameda | 45.0 | 45 | 44.0 | 44.0 | 44.0 | 44.0 | 49 |
| 60012001 | CA | Alameda | 56.0 | 56 | 52.9 | 52.9 | 52.9 | 52.9 | 66 |
| 60050002 | CA | Amador | 72.0 | 74 | 58.6 | 60.3 | 58.6 | 60.3 | 73 |
| 60070007 | CA | Butte | 76.3 | 77 | 62.0 | 62.6 | 62.0 | 62.6 | 75 |
| 60070008 | CA | Butte | 65.0 | 66 | 53.4 | 54.2 | 53.4 | 54.2 | 66 |
| 60090001 | CA | Calaveras | 75.0 | 77 | 61.1 | 62.7 | 61.1 | 62.7 | 76 |
| 60111002 | CA | Colusa | 61.0 | 62 | 52.5 | 53.4 | 52.5 | 53.4 | 63 |
| 60130002 | CA | Contra Costa | 70.7 | 73 | 62.9 | 64.9 | 62.9 | 64.9 | 67 |
| 60131002 | CA | Contra Costa | 71.7 | 74 | 62.7 | 64.8 | 62.7 | 64.8 | 68 |
| 60131004 | CA | Contra Costa | 51.0 | 51 | 49.7 | 49.7 | 49.7 | 49.7 | 54 |
| 60170010 | CA | El Dorado | 81.0 | 82 | 64.4 | 65.2 | 64.4 | 65.2 | 85 |
| 60170012 | CA | El Dorado | 68.3 | 69 | 60.7 | 61.4 | 60.7 | 61.4 | N/A |
| 60170020 | CA | El Dorado | 82.7 | 84 | 65.9 | 66.9 | 65.9 | 66.9 | 82 |
| 60190007 | CA | Fresno | 94.7 | 95 | 79.2 | 79.4 | 79.2 | 79.4 | 86 |
| 60190011 | CA | Fresno | 93.0 | 96 | 78.6 | 81.2 | 78.6 | 81.2 | 89 |
| 60190242 | CA | Fresno | 91.7 | 95 | 79.4 | 82.2 | 79.4 | 82.2 | 86 |
| 60192009 | CA | Fresno | 77.0 | 77 | 65.1 | 65.1 | 65.1 | 65.1 | 76 |
| 60194001 | CA | Fresno | 90.7 | 92 | 73.3 | 74.4 | 73.3 | 74.4 | 91 |
| 60195001 | CA | Fresno | 97.0 | 99 | 79.6 | 81.2 | 79.6 | 81.2 | 94 |
| 60210003 | CA | Glenn | 64.3 | 65 | 56.0 | 56.6 | 56.0 | 56.6 | 64 |

| Site | St | County | 2009-2013 Avg | 2009-2013 Max | 2023en "3x3" Avg | 2023en "3x3" Max | 2023en "No Water" Avg | 2023en "No Water" Max | 2014-2016 |
|---|---|---|---|---|---|---|---|---|---|
| 60250005 | CA | Imperial | 74.7 | 76 | 73.3 | 74.6 | 73.3 | 74.6 | 76 |
| 60251003 | CA | Imperial | 81.0 | 82 | 79.0 | 80.0 | 79.0 | 80.0 | 76 |
| 60254003 | CA | Imperial | 72.0 | 73 | 67.6 | 68.5 | 68.4 | 69.4 | N/A |
| 60254004 | CA | Imperial | 71.3 | 73 | 63.1 | 64.6 | 66.3 | 67.9 | 67 |
| 60270101 | CA | Inyo | 71.7 | 72 | 67.3 | 67.6 | 67.3 | 67.6 | 70 |
| 60290007 | CA | Kern | 91.7 | 96 | 77.7 | 81.3 | 77.7 | 81.3 | 87 |
| 60290008 | CA | Kern | 86.3 | 88 | 71.3 | 72.8 | 71.3 | 72.8 | 81 |
| 60290011 | CA | Kern | 80.0 | 81 | 69.5 | 70.4 | 69.5 | 70.4 | 84 |
| 60290014 | CA | Kern | 87.7 | 89 | 74.1 | 75.2 | 74.1 | 75.2 | 84 |
| 60290232 | CA | Kern | 87.3 | 89 | 73.7 | 75.2 | 73.7 | 75.2 | 77 |
| 60295002 | CA | Kern | 90.0 | 91 | 75.9 | 76.8 | 75.9 | 76.8 | 87 |
| 60296001 | CA | Kern | 84.3 | 86 | 70.9 | 72.4 | 70.9 | 72.4 | 81 |
| 60311004 | CA | Kings | 87.0 | 90 | 71.7 | 74.2 | 71.7 | 74.2 | 84 |
| 60370002 | CA | Los Angeles | 80.0 | 82 | 73.3 | 75.1 | 73.3 | 75.1 | 88 |
| 60370016 | CA | Los Angeles | 94.0 | 97 | 86.1 | 88.9 | 86.1 | 88.9 | 96 |
| 60370113 | CA | Los Angeles | 65.0 | 68 | 60.3 | 63.1 | 60.3 | 63.1 | 70 |
| 60371002 | CA | Los Angeles | 80.0 | 81 | 69.4 | 70.3 | 69.4 | 70.3 | N/A |
| 60371103 | CA | Los Angeles | 63.7 | 65 | 59.1 | 60.3 | 59.1 | 60.3 | 71 |
| 60371201 | CA | Los Angeles | 90.0 | 90 | 79.8 | 79.8 | 79.8 | 79.8 | 85 |
| 60371302 | CA | Los Angeles | 58.0 | 58 | 57.2 | 57.2 | 57.2 | 57.2 | 67 |
| 60371602 | CA | Los Angeles | 63.5 | 64 | 61.6 | 62.1 | 61.6 | 62.1 | 76 |
| 60371701 | CA | Los Angeles | 84.0 | 85 | 78.1 | 79.1 | 78.1 | 79.1 | 90 |
| 60372005 | CA | Los Angeles | 79.5 | 82 | 72.3 | 74.6 | 72.3 | 74.6 | 83 |
| 60374002 | CA | Los Angeles | 58.5 | 59 | 56.1 | 56.6 | 56.1 | 56.6 | N/A |
| 60376012 | CA | Los Angeles | 97.3 | 99 | 85.9 | 87.4 | 85.9 | 87.4 | 96 |
| 60379033 | CA | Los Angeles | 90.0 | 91 | 76.3 | 77.2 | 76.3 | 77.2 | 88 |
| 60390004 | CA | Madera | 79.3 | 81 | 68.6 | 70.1 | 68.6 | 70.1 | 83 |
| 60392010 | CA | Madera | 85.0 | 86 | 72.1 | 72.9 | 72.1 | 72.9 | 83 |
| 60410001 | CA | Marin | 52.3 | 53 | 47.6 | 48.2 | 47.2 | 47.9 | 61 |
| 60430003 | CA | Mariposa | 77.3 | 78 | 69.8 | 70.4 | 69.8 | 70.4 | 74 |
| 60430006 | CA | Mariposa | 77.0 | 78 | 64.6 | 65.5 | 64.6 | 65.5 | 75 |
| 60470003 | CA | Merced | 82.7 | 84 | 69.9 | 71.0 | 69.9 | 71.0 | 82 |
| 60530002 | CA | Monterey | 57.0 | 58 | 49.0 | 49.9 | 49.0 | 49.9 | 59 |
| 60530008 | CA | Monterey | 58.0 | 60 | 48.6 | 50.3 | 48.6 | 50.3 | 60 |
| 60531003 | CA | Monterey | 52.3 | 54 | 45.1 | 46.5 | 45.1 | 46.5 | 55 |
| 60550003 | CA | Napa | 62.3 | 65 | 51.9 | 54.2 | 51.9 | 54.2 | 62 |
| 60570005 | CA | Nevada | 77.7 | 79 | 62.3 | 63.3 | 62.3 | 63.3 | 83 |
| 60570007 | CA | Nevada | 76.0 | 78 | 60.7 | 62.3 | 60.7 | 62.3 | N/A |
| 60590007 | CA | Orange | 63.7 | 64 | 61.1 | 61.4 | 61.1 | 61.4 | 70 |

| Site | St | County | 2009-2013 Avg | 2009-2013 Max | 2023en "3x3" Avg | 2023en "3x3" Max | 2023en "No Water" Avg | 2023en "No Water" Max | 2014-2016 |
|---|---|---|---|---|---|---|---|---|---|
| 60591003 | CA | Orange | 61.3 | 62 | 58.1 | 58.8 | 57.8 | 58.4 | 69 |
| 60592022 | CA | Orange | 72.0 | 74 | 60.3 | 61.9 | 60.3 | 61.9 | 77 |
| 60595001 | CA | Orange | 69.7 | 71 | 68.3 | 69.6 | 68.3 | 69.6 | 74 |
| 60610003 | CA | Placer | 83.0 | 85 | 66.1 | 67.7 | 66.1 | 67.7 | 83 |
| 60610004 | CA | Placer | 74.0 | 75 | 58.9 | 59.7 | 58.9 | 59.7 | 76 |
| 60610006 | CA | Placer | 84.0 | 86 | 68.6 | 70.2 | 68.6 | 70.2 | 80 |
| 60650004 | CA | Riverside | 85.0 | 85 | 76.7 | 76.7 | 76.7 | 76.7 | N/A |
| 60650012 | CA | Riverside | 97.3 | 99 | 83.6 | 85.1 | 83.6 | 85.1 | 93 |
| 60650016 | CA | Riverside | 77.0 | 77 | 62.8 | 62.8 | 62.8 | 62.8 | 77 |
| 60651016 | CA | Riverside | 100.7 | 101 | 85.2 | 85.5 | 85.2 | 85.5 | 97 |
| 60652002 | CA | Riverside | 84.3 | 85 | 72.4 | 73.0 | 72.4 | 73.0 | 81 |
| 60655001 | CA | Riverside | 92.3 | 93 | 79.5 | 80.1 | 79.5 | 80.1 | 87 |
| 60656001 | CA | Riverside | 94.0 | 98 | 78.3 | 81.6 | 78.3 | 81.6 | 91 |
| 60658001 | CA | Riverside | 97.0 | 98 | 87.0 | 87.9 | 87.0 | 87.9 | 94 |
| 60658005 | CA | Riverside | 92.7 | 94 | 83.2 | 84.4 | 83.2 | 84.4 | 91 |
| 60659001 | CA | Riverside | 88.3 | 91 | 73.7 | 75.9 | 73.7 | 75.9 | 86 |
| 60659003 | CA | Riverside | 67.0 | 68 | 60.2 | 61.1 | 60.2 | 61.1 | 66 |
| 60670002 | CA | Sacramento | 76.7 | 77 | 64.8 | 65.0 | 64.8 | 65.0 | 77 |
| 60670006 | CA | Sacramento | 78.7 | 81 | 66.6 | 68.6 | 66.6 | 68.6 | 77 |
| 60670010 | CA | Sacramento | 70.3 | 71 | 60.4 | 61.0 | 60.4 | 61.0 | 69 |
| 60670011 | CA | Sacramento | 72.5 | 74 | 61.3 | 62.6 | 61.3 | 62.6 | 68 |
| 60670012 | CA | Sacramento | 93.3 | 95 | 74.5 | 75.9 | 74.5 | 75.9 | 83 |
| 60670014 | CA | Sacramento | 69.3 | 70 | 58.8 | 59.4 | 58.8 | 59.4 | 71 |
| 60675003 | CA | Sacramento | 86.3 | 88 | 69.9 | 71.3 | 69.9 | 71.3 | 79 |
| 60690002 | CA | San Benito | 62.0 | 66 | 52.0 | 55.4 | 52.0 | 55.4 | 63 |
| 60690003 | CA | San Benito | 70.0 | 70 | 59.9 | 59.9 | 59.9 | 59.9 | 69 |
| 60710001 | CA | San Bernardino | 77.0 | 78 | 68.0 | 68.9 | 68.0 | 68.9 | 80 |
| 60710005 | CA | San Bernardino | 105.0 | 107 | 96.2 | 98.1 | 96.2 | 98.1 | 108 |
| 60710012 | CA | San Bernardino | 95.0 | 97 | 84.1 | 85.8 | 84.1 | 85.8 | 91 |
| 60710306 | CA | San Bernardino | 83.7 | 85 | 76.2 | 77.4 | 76.2 | 77.4 | 86 |
| 60711004 | CA | San Bernardino | 96.7 | 98 | 89.8 | 91.0 | 89.8 | 91.0 | 101 |
| 60711234 | CA | San Bernardino | 69.0 | 69 | 64.1 | 64.1 | 64.1 | 64.1 | 69 |
| 60712002 | CA | San Bernardino | 101.0 | 103 | 93.1 | 95.0 | 93.1 | 95.0 | 97 |
| 60714001 | CA | San Bernardino | 94.3 | 97 | 86.0 | 88.5 | 86.0 | 88.5 | 90 |
| 60714003 | CA | San Bernardino | 105.0 | 107 | 94.1 | 95.8 | 94.1 | 95.8 | 101 |
| 60719002 | CA | San Bernardino | 92.3 | 94 | 80.0 | 81.4 | 80.0 | 81.4 | 86 |
| 60719004 | CA | San Bernardino | 98.7 | 99 | 88.4 | 88.7 | 88.4 | 88.7 | 104 |
| 60730001 | CA | San Diego | 61.3 | 63 | 58.0 | 59.6 | 58.0 | 59.6 | 61 |
| 60731001 | CA | San Diego | 63.0 | 64 | 56.4 | 57.3 | 56.2 | 57.0 | 67 |

| Site | St | County | 2009-2013 Avg | 2009-2013 Max | 2023en "3x3" Avg | 2023en "3x3" Max | 2023en "No Water" Avg | 2023en "No Water" Max | 2014-2016 |
|---|---|---|---|---|---|---|---|---|---|
| 60731002 | CA | San Diego | 70.3 | 72 | 55.9 | 57.3 | 55.9 | 57.3 | N/A |
| 60731006 | CA | San Diego | 81.0 | 82 | 69.4 | 70.2 | 69.4 | 70.2 | 81 |
| 60731008 | CA | San Diego | 64.7 | 67 | 55.1 | 57.1 | 54.9 | 56.8 | 70 |
| 60731010 | CA | San Diego | 56.3 | 59 | 53.2 | 55.8 | 53.2 | 55.8 | 62 |
| 60731016 | CA | San Diego | 68.0 | 69 | 59.8 | 60.7 | 59.8 | 60.7 | 68 |
| 60731018 | CA | San Diego | 69.7 | 71 | 59.2 | 60.3 | 59.2 | 60.3 | N/A |
| 60732007 | CA | San Diego | 57.7 | 58 | 54.0 | 54.2 | 54.0 | 54.2 | N/A |
| 60771002 | CA | San Joaquin | 68.0 | 69 | 59.1 | 60.0 | 59.1 | 60.0 | 68 |
| 60773005 | CA | San Joaquin | 79.0 | 80 | 67.2 | 68.1 | 67.2 | 68.1 | 79 |
| 60790005 | CA | San Luis Obispo | 64.3 | 66 | 54.1 | 55.5 | 54.1 | 55.5 | 62 |
| 60792006 | CA | San Luis Obispo | 54.3 | 57 | 45.4 | 47.7 | 45.4 | 47.7 | 57 |
| 60793001 | CA | San Luis Obispo | 53.3 | 55 | 45.4 | 46.9 | 45.4 | 46.9 | 55 |
| 60794002 | CA | San Luis Obispo | 58.7 | 62 | 49.0 | 51.7 | 49.0 | 51.7 | 62 |
| 60798002 | CA | San Luis Obispo | 62.3 | 63 | 52.3 | 52.9 | 52.3 | 52.9 | 63 |
| 60798005 | CA | San Luis Obispo | 78.0 | 79 | 66.0 | 66.8 | 66.0 | 66.8 | 73 |
| 60798006 | CA | San Luis Obispo | 75.0 | 76 | 64.0 | 64.9 | 64.0 | 64.9 | 68 |
| 60811001 | CA | San Mateo | 54.0 | 56 | 54.0 | 56.1 | 54.0 | 56.1 | 59 |
| 60830008 | CA | Santa Barbara | 57.7 | 59 | 50.1 | 51.3 | 50.2 | 51.4 | 61 |
| 60830011 | CA | Santa Barbara | 56.0 | 57 | 49.0 | 49.9 | 48.6 | 49.4 | 63 |
| 60831008 | CA | Santa Barbara | 50.3 | 52 | 42.1 | 43.5 | 42.1 | 43.5 | 54 |
| 60831013 | CA | Santa Barbara | 62.7 | 64 | 53.2 | 54.3 | 53.2 | 54.3 | 62 |
| 60831014 | CA | Santa Barbara | 67.0 | 69 | 57.5 | 59.2 | 57.5 | 59.2 | 64 |
| 60831018 | CA | Santa Barbara | 55.0 | 56 | 47.5 | 48.3 | 47.1 | 47.9 | 60 |
| 60831021 | CA | Santa Barbara | 66.7 | 71 | 58.6 | 62.4 | 57.6 | 61.3 | 63 |
| 60831025 | CA | Santa Barbara | 68.3 | 73 | 59.4 | 63.4 | 59.5 | 63.6 | 67 |
| 60832004 | CA | Santa Barbara | 53.0 | 54 | 45.5 | 46.4 | 45.5 | 46.4 | 56 |
| 60832011 | CA | Santa Barbara | 55.7 | 57 | 48.9 | 50.0 | 48.6 | 49.7 | 63 |
| 60833001 | CA | Santa Barbara | 59.7 | 62 | 51.1 | 53.0 | 51.1 | 53.0 | 62 |
| 60834003 | CA | Santa Barbara | 60.3 | 61 | 52.2 | 52.8 | 51.9 | 52.5 | 60 |
| 60850002 | CA | Santa Clara | 68.3 | 71 | 56.7 | 58.9 | 56.7 | 58.9 | 66 |
| 60850005 | CA | Santa Clara | 60.7 | 63 | 57.3 | 59.5 | 57.3 | 59.5 | 63 |
| 60851001 | CA | Santa Clara | 66.0 | 70 | 60.0 | 63.7 | 60.0 | 63.7 | 67 |
| 60852006 | CA | Santa Clara | 71.3 | 74 | 60.1 | 62.3 | 60.1 | 62.3 | 70 |
| 60852009 | CA | Santa Clara | 62.0 | 62 | 57.9 | 57.9 | 57.9 | 57.9 | N/A |
| 60870007 | CA | Santa Cruz | 53.0 | 55 | 47.1 | 48.9 | 47.1 | 48.9 | 57 |
| 60890004 | CA | Shasta | 60.0 | 64 | 48.8 | 52.0 | 48.8 | 52.0 | 70 |
| 60890007 | CA | Shasta | 67.0 | 69 | 55.1 | 56.7 | 55.1 | 56.7 | 68 |
| 60890009 | CA | Shasta | 68.0 | 69 | 55.3 | 56.2 | 55.3 | 56.2 | N/A |
| 60893003 | CA | Shasta | 66.3 | 68 | 57.2 | 58.7 | 57.2 | 58.7 | 65 |

| Site | St | County | 2009-2013 Avg | 2009-2013 Max | 2023en "3x3" Avg | 2023en "3x3" Max | 2023en "No Water" Avg | 2023en "No Water" Max | 2014-2016 |
|---|---|---|---|---|---|---|---|---|---|
| 60950004 | CA | Solano | 59.0 | 61 | 52.0 | 53.8 | 52.0 | 53.8 | 63 |
| 60950005 | CA | Solano | 67.3 | 69 | 56.0 | 57.4 | 56.0 | 57.4 | 64 |
| 60953003 | CA | Solano | 68.0 | 69 | 56.7 | 57.5 | 56.7 | 57.5 | 67 |
| 60970003 | CA | Sonoma | 48.0 | 50 | 39.0 | 40.6 | 39.0 | 40.6 | N/A |
| 60990005 | CA | Stanislaus | 75.0 | 75 | 65.2 | 65.2 | 65.2 | 65.2 | 81 |
| 60990006 | CA | Stanislaus | 87.0 | 88 | 74.8 | 75.7 | 74.8 | 75.7 | 83 |
| 61010003 | CA | Sutter | 65.0 | 66 | 53.4 | 54.3 | 53.4 | 54.3 | 65 |
| 61030004 | CA | Tehama | 75.3 | 76 | 62.3 | 62.9 | 62.3 | 62.9 | 79 |
| 61030007 | CA | Tehama | 72.5 | 73 | 59.7 | 60.1 | 59.7 | 60.1 | 67 |
| 61070006 | CA | Tulare | 81.7 | 85 | 69.1 | 71.9 | 69.1 | 71.9 | 84 |
| 61070009 | CA | Tulare | 94.7 | 96 | 76.1 | 77.2 | 76.1 | 77.2 | 89 |
| 61072002 | CA | Tulare | 85.0 | 88 | 68.9 | 71.4 | 68.9 | 71.4 | 80 |
| 61072010 | CA | Tulare | 89.0 | 90 | 73.1 | 73.9 | 73.1 | 73.9 | 83 |
| 61090005 | CA | Tuolumne | 73.3 | 74 | 60.6 | 61.2 | 60.6 | 61.2 | 79 |
| 61110007 | CA | Ventura | 71.7 | 76 | 62.9 | 66.7 | 62.9 | 66.7 | 69 |
| 61110009 | CA | Ventura | 74.0 | 77 | 63.7 | 66.2 | 63.7 | 66.2 | 74 |
| 61111004 | CA | Ventura | 76.7 | 77 | 66.1 | 66.4 | 66.1 | 66.4 | 74 |
| 61112002 | CA | Ventura | 81.0 | 83 | 70.5 | 72.2 | 70.5 | 72.2 | 77 |
| 61113001 | CA | Ventura | 60.7 | 63 | 53.3 | 55.3 | 53.3 | 55.3 | 63 |
| 61130004 | CA | Yolo | 68.7 | 70 | 56.5 | 57.6 | 56.5 | 57.6 | 64 |
| 61131003 | CA | Yolo | 69.0 | 69 | 59.5 | 59.5 | 59.5 | 59.5 | 69 |
| 80013001 | CO | Adams | 76.0 | 76 | 70.8 | 70.8 | 70.8 | 70.8 | 67 |
| 80050002 | CO | Arapahoe | 76.7 | 79 | 69.3 | 71.3 | 69.3 | 71.3 | N/A |
| 80050006 | CO | Arapahoe | 73.5 | 74 | 65.0 | 65.4 | 65.0 | 65.4 | 67 |
| 80130011 | CO | Boulder | 74.7 | 77 | 65.5 | 67.5 | 65.5 | 67.5 | N/A |
| 80310014 | CO | Denver | 71.0 | 73 | 66.2 | 68.0 | 66.2 | 68.0 | N/A |
| 80310025 | CO | Denver | 65.0 | 65 | 61.8 | 61.8 | 61.8 | 61.8 | N/A |
| 80350004 | CO | Douglas | 80.7 | 83 | 71.1 | 73.2 | 71.1 | 73.2 | 77 |
| 80410013 | CO | El Paso | 71.0 | 74 | 64.0 | 66.7 | 64.0 | 66.7 | 66 |
| 80410016 | CO | El Paso | 72.7 | 74 | 65.4 | 66.6 | 65.4 | 66.6 | 64 |
| 80450012 | CO | Garfield | 65.0 | 66 | 62.4 | 63.3 | 62.4 | 63.3 | 63 |
| 80590002 | CO | Jefferson | 74.0 | 74 | 66.7 | 66.7 | 66.7 | 66.7 | N/A |
| 80590005 | CO | Jefferson | 75.7 | 78 | 67.5 | 69.5 | 67.5 | 69.5 | 72 |
| 80590006 | CO | Jefferson | 80.3 | 83 | 71.3 | 73.7 | 71.3 | 73.7 | 77 |
| 80590011 | CO | Jefferson | 78.7 | 82 | 70.9 | 73.9 | 70.9 | 73.9 | 80 |
| 80590013 | CO | Jefferson | 74.5 | 75 | 65.6 | 66.1 | 65.6 | 66.1 | 70 |
| 80671004 | CO | La Plata | 73.0 | 74 | 66.0 | 66.9 | 66.0 | 66.9 | N/A |
| 80677001 | CO | La Plata | 68.7 | 69 | 61.9 | 62.2 | 61.9 | 62.2 | 68 |
| 80690007 | CO | Larimer | 75.7 | 77 | 66.8 | 68.0 | 66.8 | 68.0 | 69 |

| Site | St | County | 2009-2013 Avg | 2009-2013 Max | 2023en "3x3" Avg | 2023en "3x3" Max | 2023en "No Water" Avg | 2023en "No Water" Max | 2014-2016 |
|---|---|---|---|---|---|---|---|---|---|
| 80690011 | CO | Larimer | 78.0 | 80 | 71.2 | 73.0 | 71.2 | 73.0 | 75 |
| 80690012 | CO | Larimer | 71.0 | 71 | 64.2 | 64.2 | 64.2 | 64.2 | N/A |
| 80691004 | CO | Larimer | 68.7 | 72 | 63.3 | 66.3 | 63.3 | 66.3 | 70 |
| 80770020 | CO | Mesa | 67.0 | 68 | 63.1 | 64.1 | 63.1 | 64.1 | 63 |
| 80830006 | CO | Montezuma | 67.3 | 68 | 59.8 | 60.4 | 59.8 | 60.4 | 62 |
| 80830101 | CO | Montezuma | 68.3 | 69 | 59.3 | 59.9 | 59.3 | 59.9 | 65 |
| 81030005 | CO | Rio Blanco | 63.5 | 64 | 59.8 | 60.3 | 59.8 | 60.3 | 61 |
| 81230009 | CO | Weld | 74.7 | 76 | 70.2 | 71.4 | 70.2 | 71.4 | 70 |
| 90010017 | CT | Fairfield | 80.3 | 83 | 69.8 | 72.1 | 68.9 | 71.2 | 80 |
| 90011123 | CT | Fairfield | 81.3 | 83 | 66.4 | 67.8 | 66.4 | 67.8 | 78 |
| 90013007 | CT | Fairfield | 84.3 | 89 | 71.2 | 75.2 | 71.0 | 75.0 | 81 |
| 90019003 | CT | Fairfield | 83.7 | 87 | 72.7 | 75.6 | 73.0 | 75.9 | 85 |
| 90031003 | CT | Hartford | 73.7 | 75 | 60.7 | 61.7 | 60.7 | 61.7 | 75 |
| 90050005 | CT | Litchfield | 70.3 | 71 | 57.2 | 57.8 | 57.2 | 57.8 | 74 |
| 90070007 | CT | Middlesex | 79.3 | 81 | 64.7 | 66.1 | 64.7 | 66.1 | 79 |
| 90090027 | CT | New Haven | 74.3 | 78 | 62.3 | 65.4 | 61.9 | 65.0 | 76 |
| 90099002 | CT | New Haven | 85.7 | 89 | 71.2 | 73.9 | 69.9 | 72.6 | 76 |
| 90110124 | CT | New London | 80.3 | 84 | 66.4 | 69.5 | 67.3 | 70.4 | 72 |
| 90131001 | CT | Tolland | 75.3 | 77 | 61.4 | 62.8 | 61.4 | 62.8 | 73 |
| 100010002 | DE | Kent | 74.3 | 78 | 58.3 | 61.2 | 57.6 | 60.5 | 66 |
| 100031007 | DE | New Castle | 76.3 | 80 | 59.2 | 62.0 | 59.2 | 62.0 | 68 |
| 100031010 | DE | New Castle | 78.0 | 78 | 61.2 | 61.2 | 61.2 | 61.2 | 74 |
| 100031013 | DE | New Castle | 77.7 | 80 | 60.8 | 62.6 | 60.8 | 62.6 | 70 |
| 100051002 | DE | Sussex | 77.3 | 81 | 59.7 | 62.6 | 59.7 | 62.6 | 65 |
| 100051003 | DE | Sussex | 77.7 | 81 | 62.4 | 65.1 | 61.1 | 63.7 | 69 |
| 110010041 | DC | DC | 76.0 | 80 | 58.7 | 61.7 | 58.7 | 61.7 | N/A |
| 110010043 | DC | DC | 80.7 | 84 | 62.3 | 64.8 | 62.3 | 64.8 | 70 |
| 120013011 | FL | Alachua | 63.7 | 65 | 51.0 | 52.0 | 51.0 | 52.0 | 58 |
| 120030002 | FL | Baker | 61.7 | 63 | 50.5 | 51.6 | 50.5 | 51.6 | 59 |
| 120050006 | FL | Bay | 68.0 | 69 | 51.7 | 52.4 | 52.6 | 53.4 | 62 |
| 120090007 | FL | Brevard | 64.0 | 64 | 52.2 | 52.2 | 51.6 | 51.6 | 58 |
| 120094001 | FL | Brevard | 64.0 | 65 | 52.6 | 53.4 | 51.7 | 52.5 | 61 |
| 120110033 | FL | Broward | 58.0 | 59 | 53.6 | 54.5 | 53.6 | 54.5 | 59 |
| 120112003 | FL | Broward | 58.0 | 58 | 50.7 | 50.7 | 52.6 | 52.6 | N/A |
| 120118002 | FL | Broward | 59.3 | 60 | 53.1 | 53.7 | 55.7 | 56.3 | 62 |
| 120210004 | FL | Collier | 59.5 | 60 | 49.8 | 50.2 | 51.2 | 51.6 | 57 |
| 120230002 | FL | Columbia | 62.7 | 64 | 51.6 | 52.7 | 51.6 | 52.7 | N/A |
| 120310077 | FL | Duval | 63.3 | 66 | 49.8 | 51.9 | 51.2 | 53.3 | N/A |
| 120310100 | FL | Duval | 64.3 | 67 | 50.3 | 52.5 | 50.4 | 52.5 | N/A |

| Site | St | County | 2009-2013 Avg | 2009-2013 Max | 2023en "3x3" Avg | 2023en "3x3" Max | 2023en "No Water" Avg | 2023en "No Water" Max | 2014-2016 |
|---|---|---|---|---|---|---|---|---|---|
| 120310106 | FL | Duval | 63.0 | 64 | 51.4 | 52.2 | 51.4 | 52.2 | N/A |
| 120330004 | FL | Escambia | 68.7 | 70 | 54.0 | 55.0 | 55.8 | 56.8 | 64 |
| 120330018 | FL | Escambia | 72.0 | 73 | 56.2 | 57.0 | 58.8 | 59.6 | 64 |
| 120550003 | FL | Highlands | 63.3 | 64 | 52.8 | 53.4 | 52.8 | 53.4 | 60 |
| 120570081 | FL | Hillsborough | 71.7 | 73 | 60.6 | 61.7 | 60.8 | 61.9 | 68 |
| 120571035 | FL | Hillsborough | 68.3 | 69 | 57.5 | 58.1 | 58.4 | 59.0 | 66 |
| 120571065 | FL | Hillsborough | 70.7 | 72 | 59.9 | 61.0 | 60.7 | 61.8 | 66 |
| 120573002 | FL | Hillsborough | 71.5 | 72 | 58.5 | 58.9 | 58.5 | 58.9 | 66 |
| 120590004 | FL | Holmes | 62.3 | 63 | 47.8 | 48.3 | 47.8 | 48.3 | 60 |
| 120619991 | FL | Indian River | 65.0 | 65 | 53.3 | 53.3 | 54.1 | 54.1 | 61 |
| 120690002 | FL | Lake | 65.7 | 66 | 53.5 | 53.7 | 54.1 | 54.3 | 63 |
| 120712002 | FL | Lee | 63.7 | 64 | 53.4 | 53.7 | 53.6 | 53.8 | 60 |
| 120713002 | FL | Lee | 61.3 | 62 | 50.7 | 51.3 | 51.7 | 52.3 | 59 |
| 120730012 | FL | Leon | 64.3 | 66 | 49.3 | 50.6 | 49.3 | 50.6 | 60 |
| 120730013 | FL | Leon | 64.0 | 65 | 49.2 | 50.0 | 49.2 | 50.0 | N/A |
| 120813002 | FL | Manatee | 64.0 | 65 | 53.3 | 54.2 | 53.0 | 53.8 | 59 |
| 120814012 | FL | Manatee | 67.0 | 67 | 55.4 | 55.4 | 55.5 | 55.5 | N/A |
| 120830003 | FL | Marion | 65.0 | 66 | 52.7 | 53.5 | 52.7 | 53.5 | 61 |
| 120830004 | FL | Marion | 62.0 | 63 | 49.6 | 50.4 | 49.6 | 50.4 | 58 |
| 120860027 | FL | Miami-Dade | 64.0 | 65 | 58.5 | 59.4 | 60.3 | 61.2 | 62 |
| 120860029 | FL | Miami-Dade | 63.3 | 64 | 56.4 | 57.0 | 57.7 | 58.4 | 61 |
| 120910002 | FL | Okaloosa | 66.0 | 67 | 51.2 | 52.0 | 51.3 | 52.1 | 62 |
| 120950008 | FL | Orange | 71.0 | 72 | 58.0 | 58.8 | 58.0 | 58.8 | 62 |
| 120952002 | FL | Orange | 71.7 | 73 | 60.0 | 61.1 | 60.0 | 61.1 | 62 |
| 120972002 | FL | Osceola | 66.0 | 66 | 53.2 | 53.2 | 53.2 | 53.2 | 63 |
| 120990009 | FL | Palm Beach | 62.7 | 63 | 54.1 | 54.4 | 54.1 | 54.4 | N/A |
| 120990020 | FL | Palm Beach | 61.7 | 62 | 54.0 | 54.2 | 54.3 | 54.5 | N/A |
| 121010005 | FL | Pasco | 66.7 | 67 | 53.9 | 54.1 | 53.9 | 54.1 | 61 |
| 121012001 | FL | Pasco | 65.3 | 67 | 55.6 | 57.1 | 55.7 | 57.1 | 62 |
| 121030004 | FL | Pinellas | 66.7 | 67 | 57.1 | 57.3 | 57.1 | 57.3 | 61 |
| 121030018 | FL | Pinellas | 65.3 | 66 | 57.8 | 58.4 | 56.9 | 57.5 | 61 |
| 121035002 | FL | Pinellas | 64.3 | 65 | 54.9 | 55.5 | 54.8 | 55.4 | 59 |
| 121056005 | FL | Polk | 67.3 | 68 | 55.1 | 55.7 | 55.1 | 55.7 | 63 |
| 121056006 | FL | Polk | 68.3 | 69 | 56.0 | 56.6 | 56.0 | 56.6 | 62 |
| 121130015 | FL | Santa Rosa | 71.7 | 74 | 55.4 | 57.2 | 55.3 | 57.1 | 64 |
| 121151005 | FL | Sarasota | 71.3 | 72 | 58.7 | 59.3 | 58.7 | 59.2 | 62 |
| 121151006 | FL | Sarasota | 67.7 | 68 | 55.2 | 55.4 | 55.2 | 55.5 | 62 |
| 121152002 | FL | Sarasota | 66.0 | 67 | 54.5 | 55.3 | 54.6 | 55.5 | 61 |
| 121171002 | FL | Seminole | 67.3 | 69 | 55.1 | 56.5 | 55.1 | 56.5 | 61 |

| Site | St | County | 2009-2013 Avg | 2009-2013 Max | 2023en "3x3" Avg | 2023en "3x3" Max | 2023en "No Water" Avg | 2023en "No Water" Max | 2014-2016 |
|---|---|---|---|---|---|---|---|---|---|
| 121272001 | FL | Volusia | 59.7 | 60 | 46.6 | 46.9 | 48.3 | 48.6 | 59 |
| 121275002 | FL | Volusia | 63.3 | 64 | 50.4 | 51.0 | 51.6 | 52.1 | 59 |
| 121290001 | FL | Wakulla | 63.7 | 65 | 50.8 | 51.8 | 50.0 | 51.0 | N/A |
| 130210012 | GA | Bibb | 72.3 | 73 | 51.3 | 51.8 | 51.3 | 51.8 | 65 |
| 130510021 | GA | Chatham | 63.3 | 64 | 49.7 | 50.3 | 49.7 | 50.3 | 57 |
| 130550001 | GA | Chattooga | 66.3 | 67 | 50.1 | 50.7 | 50.1 | 50.7 | 62 |
| 130590002 | GA | Clarke | 70.7 | 73 | 50.6 | 52.3 | 50.6 | 52.3 | 64 |
| 130670003 | GA | Cobb | 76.0 | 78 | 55.4 | 56.9 | 55.4 | 56.9 | N/A |
| 130730001 | GA | Columbia | 68.7 | 70 | 50.6 | 51.5 | 50.6 | 51.5 | 61 |
| 130770002 | GA | Coweta | 65.0 | 67 | 46.4 | 47.8 | 46.4 | 47.8 | 66 |
| 130850001 | GA | Dawson | 66.3 | 68 | 47.7 | 48.9 | 47.7 | 48.9 | 65 |
| 130890002 | GA | DeKalb | 77.3 | 80 | 56.1 | 58.1 | 56.1 | 58.1 | 71 |
| 130970004 | GA | Douglas | 73.3 | 75 | 52.9 | 54.2 | 52.9 | 54.2 | 68 |
| 131210055 | GA | Fulton | 81.0 | 83 | 59.2 | 60.6 | 59.2 | 60.6 | 75 |
| 131270006 | GA | Glynn | 60.0 | 61 | 47.4 | 48.2 | 47.6 | 48.4 | 56 |
| 131350002 | GA | Gwinnett | 76.7 | 78 | 54.5 | 55.4 | 54.5 | 55.4 | 72 |
| 131510002 | GA | Henry | 80.0 | 82 | 57.7 | 59.2 | 57.7 | 59.2 | 74 |
| 132130003 | GA | Murray | 70.3 | 72 | 51.2 | 52.5 | 51.2 | 52.5 | 65 |
| 132150008 | GA | Muscogee | 66.0 | 67 | 50.2 | 50.9 | 50.2 | 50.9 | 62 |
| 132230003 | GA | Paulding | 70.7 | 72 | 54.3 | 55.3 | 54.3 | 55.3 | 63 |
| 132450091 | GA | Richmond | 70.0 | 72 | 51.9 | 53.4 | 51.9 | 53.4 | 62 |
| 132470001 | GA | Rockdale | 77.0 | 79 | 54.4 | 55.8 | 54.4 | 55.8 | 74 |
| 132611001 | GA | Sumter | 64.7 | 66 | 50.4 | 51.4 | 50.4 | 51.4 | 60 |
| 160010017 | ID | Ada | 67.5 | 68 | 59.4 | 59.8 | 59.4 | 59.8 | 67 |
| 160010019 | ID | Ada | 62.0 | 62 | 54.2 | 54.2 | 54.2 | 54.2 | N/A |
| 160230101 | ID | Butte | 62.3 | 63 | 59.6 | 60.2 | 59.6 | 60.2 | 60 |
| 160550003 | ID | Kootenai | 56.0 | 56 | 47.9 | 47.9 | 47.9 | 47.9 | N/A |
| 170010007 | IL | Adams | 67.0 | 69 | 54.5 | 56.2 | 54.5 | 56.2 | 62 |
| 170190007 | IL | Champaign | 71.0 | 71 | 57.7 | 57.7 | 57.7 | 57.7 | 63 |
| 170230001 | IL | Clark | 66.0 | 66 | 53.8 | 53.8 | 53.8 | 53.8 | 64 |
| 170310001 | IL | Cook | 72.0 | 74 | 63.2 | 64.9 | 63.2 | 64.9 | 69 |
| 170310032 | IL | Cook | 77.7 | 81 | 58.8 | 61.3 | 66.6 | 69.5 | 70 |
| 170310064 | IL | Cook | 71.3 | 75 | 53.9 | 56.7 | 61.1 | 64.3 | N/A |
| 170310076 | IL | Cook | 71.7 | 74 | 62.7 | 64.7 | 62.7 | 64.7 | 69 |
| 170311003 | IL | Cook | 69.7 | 72 | 53.3 | 55.1 | 62.4 | 64.4 | 69 |
| 170311601 | IL | Cook | 71.3 | 74 | 61.5 | 63.9 | 61.5 | 63.9 | 69 |
| 170314002 | IL | Cook | 71.7 | 74 | 55.8 | 57.6 | 62.3 | 64.3 | 66 |
| 170314007 | IL | Cook | 65.7 | 68 | 49.2 | 50.9 | 58.0 | 60.0 | 71 |
| 170314201 | IL | Cook | 75.7 | 78 | 56.7 | 58.4 | 66.8 | 68.8 | 71 |

| Site | St | County | 2009-2013 Avg | 2009-2013 Max | 2023en "3x3" Avg | 2023en "3x3" Max | 2023en "No Water" Avg | 2023en "No Water" Max | 2014-2016 |
|---|---|---|---|---|---|---|---|---|---|
| 170317002 | IL | Cook | 76.0 | 80 | 55.7 | 58.6 | 66.8 | 70.3 | 72 |
| 170436001 | IL | DuPage | 66.3 | 68 | 57.9 | 59.4 | 57.9 | 59.4 | 68 |
| 170491001 | IL | Effingham | 68.3 | 70 | 55.5 | 56.9 | 55.5 | 56.9 | 64 |
| 170650002 | IL | Hamilton | 74.3 | 78 | 60.7 | 63.8 | 60.7 | 63.8 | 65 |
| 170831001 | IL | Jersey | 76.0 | 79 | 58.4 | 60.7 | 58.4 | 60.7 | 68 |
| 170859991 | IL | Jo Daviess | 68.0 | 68 | 56.4 | 56.4 | 56.4 | 56.4 | 65 |
| 170890005 | IL | Kane | 69.7 | 71 | 62.8 | 63.9 | 62.8 | 63.9 | 68 |
| 170971007 | IL | Lake | 79.3 | 82 | 57.5 | 59.5 | 63.4 | 65.6 | 73 |
| 171110001 | IL | McHenry | 69.7 | 71 | 61.8 | 62.9 | 61.8 | 62.9 | 68 |
| 171132003 | IL | McLean | 70.3 | 72 | 56.0 | 57.4 | 56.0 | 57.4 | 64 |
| 171150013 | IL | Macon | 71.3 | 73 | 58.0 | 59.4 | 58.0 | 59.4 | 66 |
| 171170002 | IL | Macoupin | 71.3 | 73 | 53.8 | 55.1 | 53.8 | 55.1 | 64 |
| 171190008 | IL | Madison | 77.0 | 80 | 59.5 | 61.8 | 59.5 | 61.8 | 71 |
| 171191009 | IL | Madison | 78.3 | 80 | 59.9 | 61.2 | 59.9 | 61.2 | 67 |
| 171193007 | IL | Madison | 76.7 | 79 | 59.3 | 61.0 | 59.3 | 61.0 | 71 |
| 171199991 | IL | Madison | 76.0 | 76 | 56.7 | 56.7 | 56.7 | 56.7 | 67 |
| 171430024 | IL | Peoria | 61.7 | 63 | 51.3 | 52.4 | 51.3 | 52.4 | 64 |
| 171431001 | IL | Peoria | 70.7 | 72 | 58.8 | 59.8 | 58.8 | 59.8 | N/A |
| 171570001 | IL | Randolph | 67.7 | 70 | 54.7 | 56.6 | 54.7 | 56.6 | 67 |
| 171613002 | IL | Rock Island | 58.3 | 60 | 49.2 | 50.6 | 49.2 | 50.6 | 62 |
| 171630010 | IL | Saint Clair | 74.7 | 77 | 56.9 | 58.7 | 56.9 | 58.7 | 68 |
| 171670014 | IL | Sangamon | 72.0 | 72 | 56.8 | 56.8 | 56.8 | 56.8 | 63 |
| 171971011 | IL | Will | 64.0 | 65 | 55.6 | 56.5 | 55.6 | 56.5 | 64 |
| 172012001 | IL | Winnebago | 67.3 | 68 | 57.5 | 58.0 | 57.5 | 58.0 | 68 |
| 180030002 | IN | Allen | 68.3 | 70 | 55.2 | 56.6 | 55.2 | 56.6 | 63 |
| 180030004 | IN | Allen | 69.3 | 71 | 56.1 | 57.4 | 56.1 | 57.4 | 63 |
| 180110001 | IN | Boone | 72.3 | 74 | 59.4 | 60.8 | 59.4 | 60.8 | 66 |
| 180150002 | IN | Carroll | 69.0 | 71 | 56.8 | 58.5 | 56.8 | 58.5 | 64 |
| 180190008 | IN | Clark | 78.0 | 81 | 62.1 | 64.5 | 62.1 | 64.5 | 70 |
| 180350010 | IN | Delaware | 68.7 | 70 | 54.4 | 55.5 | 54.4 | 55.5 | 59 |
| 180390007 | IN | Elkhart | 67.7 | 70 | 54.6 | 56.5 | 54.6 | 56.5 | 61 |
| 180431004 | IN | Floyd | 76.0 | 79 | 61.7 | 64.1 | 61.7 | 64.1 | 69 |
| 180550001 | IN | Greene | 77.0 | 78 | 63.5 | 64.3 | 63.5 | 64.3 | 66 |
| 180570006 | IN | Hamilton | 71.0 | 72 | 57.2 | 58.0 | 57.2 | 58.0 | 63 |
| 180590003 | IN | Hancock | 66.7 | 69 | 53.4 | 55.2 | 53.4 | 55.2 | N/A |
| 180630004 | IN | Hendricks | 67.0 | 68 | 55.5 | 56.3 | 55.5 | 56.3 | 60 |
| 180690002 | IN | Huntington | 65.0 | 66 | 53.0 | 53.8 | 53.0 | 53.8 | 58 |
| 180710001 | IN | Jackson | 66.0 | 67 | 53.0 | 53.8 | 53.0 | 53.8 | 66 |
| 180810002 | IN | Johnson | 69.0 | 70 | 56.0 | 56.8 | 56.0 | 56.8 | 60 |

| Site | St | County | 2009-2013 Avg | 2009-2013 Max | 2023en "3x3" Avg | 2023en "3x3" Max | 2023en "No Water" Avg | 2023en "No Water" Max | 2014-2016 |
|---|---|---|---|---|---|---|---|---|---|
| 180839991 | IN | Knox | 73.0 | 73 | 59.2 | 59.2 | 59.2 | 59.2 | 65 |
| 180890022 | IN | Lake | 66.7 | 69 | 55.2 | 57.1 | 58.3 | 60.3 | 67 |
| 180890030 | IN | Lake | 69.7 | 73 | 58.9 | 61.7 | 61.9 | 64.8 | N/A |
| 180892008 | IN | Lake | 68.0 | 68 | 57.5 | 57.5 | 60.4 | 60.4 | 65 |
| 180910005 | IN | LaPorte | 79.3 | 83 | 65.4 | 68.5 | 67.2 | 70.4 | N/A |
| 180910010 | IN | LaPorte | 69.7 | 72 | 59.2 | 61.2 | 58.9 | 60.9 | 63 |
| 180950010 | IN | Madison | 68.3 | 70 | 54.2 | 55.5 | 54.2 | 55.5 | 57 |
| 180970050 | IN | Marion | 72.7 | 74 | 59.1 | 60.2 | 59.1 | 60.2 | 69 |
| 180970057 | IN | Marion | 69.0 | 71 | 57.8 | 59.4 | 57.8 | 59.4 | 65 |
| 180970073 | IN | Marion | 72.0 | 74 | 59.1 | 60.7 | 59.1 | 60.7 | 65 |
| 180970078 | IN | Marion | 69.7 | 72 | 58.3 | 60.3 | 58.3 | 60.3 | N/A |
| 181090005 | IN | Morgan | 69.0 | 70 | 55.1 | 55.9 | 55.1 | 55.9 | 64 |
| 181230009 | IN | Perry | 72.7 | 75 | 53.6 | 55.3 | 53.6 | 55.3 | 67 |
| 181270024 | IN | Porter | 70.3 | 72 | 57.6 | 59.0 | 61.8 | 63.3 | 69 |
| 181270026 | IN | Porter | 63.0 | 64 | 54.4 | 55.3 | 54.4 | 55.3 | 66 |
| 181290003 | IN | Posey | 70.3 | 71 | 56.5 | 57.0 | 56.5 | 57.0 | 66 |
| 181410010 | IN | St. Joseph | 62.7 | 64 | 51.2 | 52.3 | 51.2 | 52.3 | 62 |
| 181410015 | IN | St. Joseph | 69.3 | 73 | 56.9 | 59.9 | 56.9 | 59.9 | 68 |
| 181411007 | IN | St. Joseph | 64.0 | 64 | 52.5 | 52.5 | 52.5 | 52.5 | N/A |
| 181450001 | IN | Shelby | 74.0 | 75 | 60.6 | 61.4 | 60.6 | 61.4 | 62 |
| 181630013 | IN | Vanderburgh | 71.7 | 73 | 56.2 | 57.3 | 56.2 | 57.3 | 69 |
| 181630021 | IN | Vanderburgh | 74.0 | 74 | 58.6 | 58.6 | 58.6 | 58.6 | 70 |
| 181670018 | IN | Vigo | 65.7 | 68 | 52.5 | 54.3 | 52.5 | 54.3 | 65 |
| 181670024 | IN | Vigo | 64.0 | 64 | 51.3 | 51.3 | 51.3 | 51.3 | 61 |
| 181730008 | IN | Warrick | 71.0 | 73 | 54.9 | 56.5 | 54.9 | 56.5 | 68 |
| 181730009 | IN | Warrick | 69.7 | 72 | 55.0 | 56.8 | 55.0 | 56.8 | 66 |
| 181730011 | IN | Warrick | 71.0 | 74 | 54.2 | 56.5 | 54.2 | 56.5 | 67 |
| 190170011 | IA | Bremer | 64.0 | 65 | 50.9 | 51.7 | 50.9 | 51.7 | 60 |
| 190450021 | IA | Clinton | 66.7 | 68 | 55.9 | 57.0 | 55.9 | 57.0 | 63 |
| 190850007 | IA | Harrison | 66.7 | 68 | 53.9 | 54.9 | 53.9 | 54.9 | 62 |
| 190851101 | IA | Harrison | 67.7 | 69 | 54.7 | 55.7 | 54.7 | 55.7 | 62 |
| 191130028 | IA | Linn | 64.3 | 66 | 54.1 | 55.5 | 54.1 | 55.5 | 61 |
| 191130033 | IA | Linn | 64.0 | 65 | 51.9 | 52.7 | 51.9 | 52.7 | 61 |
| 191130040 | IA | Linn | 62.7 | 64 | 52.8 | 53.9 | 52.8 | 53.9 | 61 |
| 191370002 | IA | Montgomery | 65.3 | 67 | 54.1 | 55.5 | 54.1 | 55.5 | 60 |
| 191471002 | IA | Palo Alto | 66.7 | 68 | 55.2 | 56.3 | 55.2 | 56.3 | 61 |
| 191530030 | IA | Polk | 59.7 | 61 | 48.1 | 49.2 | 48.1 | 49.2 | 60 |
| 191630014 | IA | Scott | 63.0 | 63 | 52.4 | 52.4 | 52.4 | 52.4 | 63 |
| 191630015 | IA | Scott | 66.0 | 67 | 55.7 | 56.5 | 55.7 | 56.5 | 60 |

| Site | St | County | 2009-2013 Avg | 2009-2013 Max | 2023en "3x3" Avg | 2023en "3x3" Max | 2023en "No Water" Avg | 2023en "No Water" Max | 2014-2016 |
|---|---|---|---|---|---|---|---|---|---|
| 191690011 | IA | Story | 61.3 | 62 | 49.1 | 49.7 | 49.1 | 49.7 | 60 |
| 191770006 | IA | Van Buren | 65.7 | 68 | 53.0 | 54.9 | 53.0 | 54.9 | 60 |
| 191810022 | IA | Warren | 63.7 | 65 | 51.8 | 52.9 | 51.8 | 52.9 | 58 |
| 200910010 | KS | Johnson | 72.7 | 76 | 59.0 | 61.7 | 59.0 | 61.7 | 60 |
| 201030003 | KS | Leavenworth | 72.0 | 74 | 56.3 | 57.8 | 56.3 | 57.8 | 63 |
| 201070002 | KS | Linn | 70.0 | 72 | 55.4 | 57.0 | 55.4 | 57.0 | N/A |
| 201730010 | KS | Sedgwick | 76.3 | 78 | 61.9 | 63.2 | 61.9 | 63.2 | 65 |
| 201730018 | KS | Sedgwick | 75.7 | 77 | 61.6 | 62.6 | 61.6 | 62.6 | 65 |
| 201770013 | KS | Shawnee | 71.7 | 74 | 56.0 | 57.8 | 56.0 | 57.8 | 63 |
| 201910002 | KS | Sumner | 76.3 | 78 | 63.0 | 64.4 | 63.0 | 64.4 | 64 |
| 201950001 | KS | Trego | 72.3 | 74 | 64.3 | 65.9 | 64.3 | 65.9 | 63 |
| 202090021 | KS | Wyandotte | 65.7 | 70 | 52.8 | 56.3 | 52.8 | 56.3 | 63 |
| 210130002 | KY | Bell | 63.3 | 65 | 49.3 | 50.6 | 49.3 | 50.6 | 61 |
| 210150003 | KY | Boone | 68.0 | 70 | 53.5 | 55.1 | 53.5 | 55.1 | 63 |
| 210190017 | KY | Boyd | 70.0 | 72 | 57.7 | 59.3 | 57.7 | 59.3 | 66 |
| 210290006 | KY | Bullitt | 72.3 | 75 | 58.0 | 60.1 | 58.0 | 60.1 | 66 |
| 210373002 | KY | Campbell | 76.7 | 79 | 61.3 | 63.1 | 61.3 | 63.1 | 70 |
| 210430500 | KY | Carter | 67.0 | 69 | 53.6 | 55.2 | 53.6 | 55.2 | 61 |
| 210470006 | KY | Christian | 70.7 | 73 | 55.6 | 57.4 | 55.6 | 57.4 | 62 |
| 210590005 | KY | Daviess | 76.3 | 79 | 57.1 | 59.1 | 57.1 | 59.1 | 65 |
| 210610501 | KY | Edmonson | 72.0 | 75 | 56.3 | 58.6 | 56.3 | 58.6 | 64 |
| 210670012 | KY | Fayette | 71.3 | 74 | 57.0 | 59.1 | 57.0 | 59.1 | 67 |
| 210890007 | KY | Greenup | 69.7 | 72 | 57.4 | 59.2 | 57.4 | 59.2 | 63 |
| 210910012 | KY | Hancock | 73.7 | 76 | 54.1 | 55.8 | 54.1 | 55.8 | 68 |
| 210930006 | KY | Hardin | 70.3 | 73 | 54.2 | 56.3 | 54.2 | 56.3 | 65 |
| 211010014 | KY | Henderson | 76.3 | 79 | 59.7 | 61.8 | 59.7 | 61.8 | 69 |
| 211110027 | KY | Jefferson | 77.0 | 80 | 62.5 | 64.9 | 62.5 | 64.9 | 69 |
| 211110051 | KY | Jefferson | 78.5 | 79 | 64.4 | 64.8 | 64.4 | 64.8 | 69 |
| 211110067 | KY | Jefferson | 85.0 | 85 | 70.1 | 70.1 | 70.1 | 70.1 | 74 |
| 211130001 | KY | Jessamine | 70.0 | 72 | 55.3 | 56.9 | 55.3 | 56.9 | 65 |
| 211390003 | KY | Livingston | 72.3 | 75 | 57.1 | 59.2 | 57.1 | 59.2 | 65 |
| 211451024 | KY | McCracken | 73.7 | 77 | 59.3 | 62.0 | 59.3 | 62.0 | 63 |
| 211850004 | KY | Oldham | 82.0 | 86 | 63.5 | 66.6 | 63.5 | 66.6 | 70 |
| 211930003 | KY | Perry | 65.3 | 68 | 54.3 | 56.5 | 54.3 | 56.5 | 58 |
| 211950002 | KY | Pike | 65.7 | 68 | 53.1 | 55.0 | 53.1 | 55.0 | 60 |
| 211990003 | KY | Pulaski | 66.7 | 69 | 51.1 | 52.9 | 51.1 | 52.9 | 62 |
| 212130004 | KY | Simpson | 69.3 | 71 | 52.9 | 54.2 | 52.9 | 54.2 | 64 |
| 212218001 | KY | Trigg | 69.0 | 69 | 54.8 | 54.8 | 54.8 | 54.8 | N/A |
| 212270008 | KY | Warren | 64.0 | 64 | 49.5 | 49.5 | 49.5 | 49.5 | N/A |

| Site | St | County | 2009-2013 Avg | 2009-2013 Max | 2023en "3x3" Avg | 2023en "3x3" Max | 2023en "No Water" Avg | 2023en "No Water" Max | 2014-2016 |
|---|---|---|---|---|---|---|---|---|---|
| 212299991 | KY | Washington | 69.0 | 69 | 54.4 | 54.4 | 54.4 | 54.4 | 64 |
| 220050004 | LA | Ascension | 74.7 | 77 | 63.5 | 65.4 | 63.5 | 65.4 | 71 |
| 220150008 | LA | Bossier | 77.3 | 80 | 63.4 | 65.6 | 63.4 | 65.6 | 65 |
| 220170001 | LA | Caddo | 74.7 | 76 | 61.0 | 62.0 | 61.0 | 62.0 | 64 |
| 220190002 | LA | Calcasieu | 72.7 | 75 | 66.5 | 68.6 | 66.5 | 68.6 | 68 |
| 220190008 | LA | Calcasieu | 67.7 | 69 | 61.7 | 62.8 | 61.7 | 62.8 | N/A |
| 220190009 | LA | Calcasieu | 72.0 | 74 | 63.6 | 65.4 | 63.6 | 65.4 | 64 |
| 220330003 | LA | E. Baton Rouge | 78.7 | 82 | 67.8 | 70.6 | 67.8 | 70.6 | 72 |
| 220330009 | LA | E. Baton Rouge | 75.0 | 77 | 64.1 | 65.8 | 64.1 | 65.8 | 66 |
| 220330013 | LA | E. Baton Rouge | 71.0 | 72 | 60.5 | 61.4 | 60.5 | 61.4 | N/A |
| 220470009 | LA | Iberville | 73.3 | 75 | 63.5 | 65.0 | 63.5 | 65.0 | N/A |
| 220470012 | LA | Iberville | 76.0 | 77 | 65.7 | 66.6 | 65.7 | 66.6 | N/A |
| 220511001 | LA | Jefferson | 73.7 | 76 | 66.0 | 68.0 | 66.6 | 68.6 | 68 |
| 220550007 | LA | Lafayette | 71.0 | 72 | 59.8 | 60.7 | 59.8 | 60.7 | 66 |
| 220570004 | LA | Lafourche | 72.3 | 74 | 64.1 | 65.6 | 64.1 | 65.6 | 65 |
| 220630002 | LA | Livingston | 74.0 | 76 | 63.3 | 65.0 | 63.3 | 65.0 | 70 |
| 220710012 | LA | Orleans | 69.3 | 70 | 62.1 | 62.7 | 62.2 | 62.8 | N/A |
| 220730004 | LA | Ouachita | 63.3 | 66 | 52.8 | 55.1 | 52.8 | 55.1 | N/A |
| 220770001 | LA | Pointe Coupee | 75.3 | 77 | 63.3 | 64.7 | 63.3 | 64.7 | 68 |
| 220870004 | LA | St. Bernard | 69.0 | 69 | 61.8 | 61.8 | 61.9 | 61.9 | 66 |
| 220890003 | LA | St. Charles | 70.0 | 72 | 62.7 | 64.5 | 63.0 | 64.8 | N/A |
| 220930002 | LA | St. James | 68.0 | 69 | 60.0 | 60.9 | 60.0 | 60.9 | 65 |
| 220950002 | LA | St. John the Baptist | 74.0 | 75 | 66.3 | 67.2 | 66.3 | 67.2 | 66 |
| 221030002 | LA | St. Tammany | 73.3 | 74 | 64.1 | 64.7 | 64.0 | 64.6 | 68 |
| 221210001 | LA | West Baton Rouge | 70.3 | 72 | 60.0 | 61.5 | 60.0 | 61.5 | 66 |
| 230010014 | ME | Androscoggin | 61.0 | 62 | 49.4 | 50.2 | 49.3 | 50.1 | 60 |
| 230052003 | ME | Cumberland | 69.3 | 70 | 56.2 | 56.8 | 56.7 | 57.3 | 65 |
| 230090102 | ME | Hancock | 71.7 | 74 | 61.3 | 63.2 | 59.9 | 61.8 | 66 |
| 230090103 | ME | Hancock | 66.3 | 69 | 55.0 | 57.3 | 55.3 | 57.5 | 62 |
| 230112005 | ME | Kennebec | 62.7 | 64 | 50.5 | 51.5 | 50.5 | 51.5 | 59 |
| 230130004 | ME | Knox | 67.7 | 69 | 54.7 | 55.7 | 54.8 | 55.8 | 63 |
| 230173001 | ME | Oxford | 54.3 | 55 | 43.7 | 44.3 | 43.7 | 44.3 | N/A |
| 230194008 | ME | Penobscot | 57.7 | 59 | 46.6 | 47.6 | 46.6 | 47.6 | 58 |
| 230230006 | ME | Sagadahoc | 61.0 | 61 | 48.7 | 48.7 | 48.7 | 48.7 | N/A |
| 230310038 | ME | York | 60.3 | 62 | 48.2 | 49.6 | 48.2 | 49.6 | 58 |
| 230310040 | ME | York | 64.3 | 65 | 51.5 | 52.0 | 51.5 | 52.0 | 61 |
| 230312002 | ME | York | 73.7 | 75 | 60.1 | 61.2 | 59.6 | 60.7 | 67 |

| Site | St | County | 2009-2013 Avg | 2009-2013 Max | 2023en "3x3" Avg | 2023en "3x3" Max | 2023en "No Water" Avg | 2023en "No Water" Max | 2014-2016 |
|---|---|---|---|---|---|---|---|---|---|
| 240030014 | MD | Anne Arundel | 83.0 | 87 | 63.4 | 66.4 | 63.4 | 66.4 | N/A |
| 240051007 | MD | Baltimore | 79.0 | 82 | 63.9 | 66.3 | 63.9 | 66.3 | 72 |
| 240053001 | MD | Baltimore | 80.7 | 84 | 64.9 | 67.6 | 65.3 | 67.9 | 72 |
| 240090011 | MD | Calvert | 79.7 | 83 | 64.2 | 66.9 | 63.2 | 65.9 | 69 |
| 240130001 | MD | Carroll | 76.3 | 79 | 58.8 | 60.9 | 58.8 | 60.9 | 68 |
| 240150003 | MD | Cecil | 83.0 | 86 | 64.5 | 66.8 | 64.5 | 66.8 | 76 |
| 240170010 | MD | Charles | 79.0 | 83 | 61.6 | 64.7 | 61.6 | 64.7 | 70 |
| 240199991 | MD | Dorchester | 75.0 | 75 | 60.7 | 60.7 | 59.4 | 59.4 | 66 |
| 240210037 | MD | Frederick | 76.3 | 79 | 59.6 | 61.8 | 59.6 | 61.8 | 67 |
| 240230002 | MD | Garrett | 72.0 | 75 | 55.1 | 57.4 | 55.1 | 57.4 | 65 |
| 240251001 | MD | Harford | 90.0 | 93 | 71.4 | 73.8 | 70.9 | 73.3 | 73 |
| 240259001 | MD | Harford | 79.3 | 82 | 61.8 | 63.9 | 62.2 | 64.3 | 73 |
| 240290002 | MD | Kent | 78.7 | 82 | 61.2 | 63.7 | 61.2 | 63.7 | 70 |
| 240313001 | MD | Montgomery | 75.7 | 77 | 60.0 | 61.0 | 60.0 | 61.0 | 68 |
| 240330030 | MD | Prince George's | 79.0 | 82 | 60.5 | 62.8 | 60.5 | 62.8 | 69 |
| 240338003 | MD | Prince George's | 82.3 | 87 | 63.2 | 66.8 | 63.2 | 66.8 | 71 |
| 240339991 | MD | Prince George's | 80.0 | 80 | 61.0 | 61.0 | 61.0 | 61.0 | 68 |
| 240430009 | MD | Washington | 72.7 | 75 | 56.0 | 57.8 | 56.0 | 57.8 | 66 |
| 245100054 | MD | Baltimore (City) | 73.7 | 75 | 59.9 | 61.0 | 59.4 | 60.4 | 69 |
| 250010002 | MA | Barnstable | 73.0 | 75 | 59.6 | 61.3 | 60.5 | 62.2 | N/A |
| 250034002 | MA | Berkshire | 69.0 | 71 | 56.1 | 57.7 | 56.1 | 57.7 | N/A |
| 250051002 | MA | Bristol | 74.0 | 74 | 61.6 | 61.6 | 61.2 | 61.2 | N/A |
| 250070001 | MA | Dukes | 77.0 | 80 | 64.1 | 66.6 | 64.1 | 66.6 | N/A |
| 250092006 | MA | Essex | 71.0 | 71 | 57.5 | 57.5 | 58.4 | 58.4 | 65 |
| 250094005 | MA | Essex | 70.0 | 70 | 57.2 | 57.2 | 57.2 | 57.2 | 64 |
| 250095005 | MA | Essex | 69.3 | 70 | 56.2 | 56.8 | 56.2 | 56.8 | 62 |
| 250130008 | MA | Hampden | 73.7 | 74 | 59.3 | 59.5 | 59.3 | 59.5 | 70 |
| 250150103 | MA | Hampshire | 64.7 | 66 | 51.9 | 53.0 | 51.9 | 53.0 | N/A |
| 250154002 | MA | Hampshire | 71.3 | 72 | 57.0 | 57.5 | 57.0 | 57.5 | 70 |
| 250170009 | MA | Middlesex | 67.3 | 68 | 54.0 | 54.5 | 54.0 | 54.5 | 63 |
| 250171102 | MA | Middlesex | 67.0 | 67 | 53.4 | 53.4 | 53.4 | 53.4 | N/A |
| 250213003 | MA | Norfolk | 72.3 | 73 | 59.6 | 60.2 | 59.6 | 60.2 | 67 |
| 250250041 | MA | Suffolk | 68.3 | 70 | 56.4 | 57.8 | 55.5 | 56.9 | N/A |
| 250250042 | MA | Suffolk | 60.7 | 61 | 49.6 | 49.9 | 50.1 | 50.4 | 56 |
| 250270015 | MA | Worcester | 68.3 | 70 | 54.6 | 55.9 | 54.6 | 55.9 | 64 |
| 250270024 | MA | Worcester | 69.0 | 70 | 54.9 | 55.7 | 54.9 | 55.7 | 64 |
| 260050003 | MI | Allegan | 82.7 | 86 | 69.0 | 71.8 | 69.0 | 71.7 | 75 |
| 260190003 | MI | Benzie | 73.0 | 75 | 60.9 | 62.6 | 60.6 | 62.3 | 69 |
| 260210014 | MI | Berrien | 79.7 | 82 | 67.4 | 69.3 | 66.9 | 68.8 | 74 |

| Site | St | County | 2009-2013 Avg | 2009-2013 Max | 2023en "3x3" Avg | 2023en "3x3" Max | 2023en "No Water" Avg | 2023en "No Water" Max | 2014-2016 |
|---|---|---|---|---|---|---|---|---|---|
| 260270003 | MI | Cass | 76.7 | 78 | 62.0 | 63.1 | 62.0 | 63.1 | 70 |
| 260370001 | MI | Clinton | 69.3 | 71 | 56.2 | 57.6 | 56.2 | 57.6 | 67 |
| 260490021 | MI | Genesee | 73.0 | 76 | 60.1 | 62.5 | 60.1 | 62.5 | 68 |
| 260492001 | MI | Genesee | 72.3 | 74 | 58.8 | 60.2 | 58.8 | 60.2 | 69 |
| 260630007 | MI | Huron | 71.3 | 74 | 59.5 | 61.7 | 59.0 | 61.2 | 68 |
| 260650012 | MI | Ingham | 70.3 | 72 | 56.8 | 58.2 | 56.8 | 58.2 | 67 |
| 260770008 | MI | Kalamazoo | 73.7 | 75 | 59.9 | 60.9 | 59.9 | 60.9 | 69 |
| 260810020 | MI | Kent | 73.0 | 75 | 59.8 | 61.4 | 59.8 | 61.4 | 69 |
| 260810022 | MI | Kent | 72.7 | 74 | 58.3 | 59.3 | 58.3 | 59.3 | 67 |
| 260910007 | MI | Lenawee | 75.5 | 76 | 60.6 | 61.0 | 60.6 | 61.0 | 67 |
| 260990009 | MI | Macomb | 76.7 | 78 | 65.1 | 66.2 | 64.5 | 65.6 | 72 |
| 260991003 | MI | Macomb | 77.3 | 79 | 66.7 | 68.1 | 66.7 | 68.1 | 67 |
| 261010922 | MI | Manistee | 72.3 | 74 | 60.2 | 61.6 | 60.5 | 61.9 | 68 |
| 261050007 | MI | Mason | 73.3 | 75 | 60.7 | 62.1 | 60.7 | 62.1 | 70 |
| 261130001 | MI | Missaukee | 68.3 | 70 | 56.9 | 58.3 | 56.9 | 58.3 | 67 |
| 261210039 | MI | Muskegon | 79.7 | 82 | 65.6 | 67.5 | 65.8 | 67.7 | 75 |
| 261250001 | MI | Oakland | 76.3 | 78 | 64.1 | 65.6 | 64.1 | 65.6 | 69 |
| 261390005 | MI | Ottawa | 76.0 | 78 | 62.3 | 64.0 | 62.3 | 64.0 | 70 |
| 261470005 | MI | St. Clair | 75.3 | 77 | 63.7 | 65.1 | 62.5 | 63.9 | 73 |
| 261530001 | MI | Schoolcraft | 71.7 | 75 | 59.4 | 62.1 | 59.4 | 62.1 | 70 |
| 261610008 | MI | Washtenaw | 73.3 | 76 | 60.7 | 62.9 | 60.7 | 62.9 | 67 |
| 261630001 | MI | Wayne | 71.7 | 74 | 60.5 | 62.4 | 60.5 | 62.4 | 65 |
| 261630019 | MI | Wayne | 78.7 | 81 | 69.0 | 71.0 | 69.0 | 71.0 | 72 |
| 270031001 | MN | Anoka | 67.0 | 67 | 55.1 | 55.1 | 55.1 | 55.1 | 60 |
| 270031002 | MN | Anoka | 66.3 | 67 | 57.3 | 57.9 | 57.3 | 57.9 | 63 |
| 270353204 | MN | Crow Wing | 62.0 | 62 | 50.7 | 50.7 | 50.7 | 50.7 | 59 |
| 270495302 | MN | Goodhue | 62.5 | 63 | 52.2 | 52.6 | 52.2 | 52.6 | 61 |
| 270834210 | MN | Lyon | 64.5 | 65 | 54.1 | 54.5 | 54.1 | 54.5 | 62 |
| 270953051 | MN | Mille Lacs | 59.7 | 60 | 48.6 | 48.8 | 48.9 | 49.2 | 60 |
| 271095008 | MN | Olmsted | 63.5 | 64 | 52.3 | 52.7 | 52.3 | 52.7 | 61 |
| 271377550 | MN | Saint Louis | 49.7 | 50 | 42.0 | 42.2 | 42.2 | 42.5 | 53 |
| 271390505 | MN | Scott | 63.5 | 65 | 54.3 | 55.5 | 54.3 | 55.5 | 60 |
| 271453052 | MN | Stearns | 61.5 | 62 | 52.7 | 53.1 | 52.7 | 53.1 | 60 |
| 271713201 | MN | Wright | 63.5 | 64 | 54.6 | 55.0 | 54.6 | 55.0 | 61 |
| 280110001 | MS | Bolivar | 71.7 | 74 | 60.9 | 62.9 | 60.9 | 62.9 | 62 |
| 280330002 | MS | DeSoto | 72.3 | 74 | 55.4 | 56.7 | 55.4 | 56.7 | 64 |
| 280450003 | MS | Hancock | 66.3 | 67 | 53.4 | 53.9 | 53.9 | 54.4 | 63 |
| 280470008 | MS | Harrison | 72.3 | 75 | 55.9 | 58.0 | 57.7 | 59.9 | 67 |
| 280490010 | MS | Hinds | 67.0 | 68 | 50.0 | 50.7 | 50.0 | 50.7 | N/A |

| Site | St | County | 2009-2013 Avg | 2009-2013 Max | 2023en "3x3" Avg | 2023en "3x3" Max | 2023en "No Water" Avg | 2023en "No Water" Max | 2014-2016 |
|---|---|---|---|---|---|---|---|---|---|
| 280590006 | MS | Jackson | 71.7 | 73 | 56.9 | 58.0 | 57.1 | 58.2 | 67 |
| 280750003 | MS | Lauderdale | 62.7 | 63 | 50.0 | 50.2 | 50.0 | 50.2 | 57 |
| 280810005 | MS | Lee | 65.0 | 66 | 49.7 | 50.5 | 49.7 | 50.5 | 59 |
| 281619991 | MS | Yalobusha | 63.0 | 63 | 51.4 | 51.4 | 51.4 | 51.4 | 57 |
| 290030001 | MO | Andrew | 73.3 | 75 | 58.3 | 59.6 | 58.3 | 59.6 | 63 |
| 290190011 | MO | Boone | 69.0 | 72 | 54.0 | 56.3 | 54.0 | 56.3 | 64 |
| 290270002 | MO | Callaway | 67.7 | 70 | 53.5 | 55.3 | 53.5 | 55.3 | 64 |
| 290370003 | MO | Cass | 70.0 | 72 | 56.3 | 57.9 | 56.3 | 57.9 | 63 |
| 290390001 | MO | Cedar | 71.7 | 74 | 58.0 | 59.9 | 58.0 | 59.9 | 61 |
| 290470003 | MO | Clay | 77.0 | 79 | 61.9 | 63.5 | 61.9 | 63.5 | 65 |
| 290470005 | MO | Clay | 75.3 | 77 | 59.8 | 61.1 | 59.8 | 61.1 | 64 |
| 290470006 | MO | Clay | 77.7 | 80 | 61.7 | 63.5 | 61.7 | 63.5 | 67 |
| 290490001 | MO | Clinton | 78.0 | 80 | 61.3 | 62.9 | 61.3 | 62.9 | 67 |
| 290770036 | MO | Greene | 69.3 | 71 | 54.5 | 55.8 | 54.5 | 55.8 | 59 |
| 290770042 | MO | Greene | 71.7 | 74 | 56.4 | 58.2 | 56.4 | 58.2 | 60 |
| 290970004 | MO | Jasper | 76.7 | 78 | 60.2 | 61.2 | 60.2 | 61.2 | 61 |
| 290990019 | MO | Jefferson | 76.3 | 79 | 58.7 | 60.8 | 58.7 | 60.8 | 70 |
| 291130003 | MO | Lincoln | 77.0 | 80 | 59.6 | 62.0 | 59.6 | 62.0 | 65 |
| 291370001 | MO | Monroe | 68.7 | 71 | 55.8 | 57.7 | 55.8 | 57.7 | 59 |
| 291570001 | MO | Perry | 74.3 | 77 | 59.7 | 61.9 | 59.7 | 61.9 | 67 |
| 291831002 | MO | Saint Charles | 82.3 | 86 | 63.2 | 66.1 | 63.2 | 66.1 | 72 |
| 291831004 | MO | Saint Charles | 77.7 | 80 | 61.9 | 63.8 | 61.9 | 63.8 | 71 |
| 291860005 | MO | Sainte Genevieve | 72.3 | 75 | 57.4 | 59.5 | 57.4 | 59.5 | 66 |
| 291890005 | MO | Saint Louis | 72.0 | 74 | 54.4 | 55.9 | 54.4 | 55.9 | 65 |
| 291890014 | MO | Saint Louis | 79.0 | 82 | 60.5 | 62.8 | 60.5 | 62.8 | 71 |
| 292130004 | MO | Taney | 69.0 | 70 | 55.3 | 56.1 | 55.3 | 56.1 | 57 |
| 295100085 | MO | St. Louis City | 75.7 | 79 | 58.7 | 61.2 | 58.7 | 61.2 | 65 |
| 300870001 | MT | Rosebud | 55.5 | 56 | 51.6 | 52.1 | 51.6 | 52.1 | 56 |
| 310550019 | NE | Douglas | 67.0 | 67 | 56.2 | 56.2 | 56.2 | 56.2 | 62 |
| 310550028 | NE | Douglas | 58.7 | 60 | 49.3 | 50.3 | 49.3 | 50.3 | 59 |
| 310550035 | NE | Douglas | 64.0 | 66 | 53.1 | 54.7 | 53.1 | 54.7 | N/A |
| 311090016 | NE | Lancaster | 53.3 | 55 | 43.4 | 44.7 | 43.4 | 44.7 | 60 |
| 320010002 | NV | Churchill | 56.7 | 58 | 51.9 | 53.1 | 51.9 | 53.1 | 67 |
| 320030043 | NV | Clark | 74.7 | 76 | 67.7 | 68.8 | 67.7 | 68.8 | 73 |
| 320030071 | NV | Clark | 75.3 | 76 | 68.7 | 69.4 | 68.7 | 69.4 | 71 |
| 320030073 | NV | Clark | 74.7 | 76 | 68.2 | 69.4 | 68.2 | 69.4 | 73 |
| 320030075 | NV | Clark | 76.0 | 77 | 67.4 | 68.3 | 67.4 | 68.3 | 75 |
| 320030538 | NV | Clark | 71.0 | 72 | 62.9 | 63.8 | 62.9 | 63.8 | N/A |

| Site | St | County | 2009-2013 Avg | 2009-2013 Max | 2023en "3x3" Avg | 2023en "3x3" Max | 2023en "No Water" Avg | 2023en "No Water" Max | 2014-2016 |
|---|---|---|---|---|---|---|---|---|---|
| 320030540 | NV | Clark | 71.0 | 71 | 62.9 | 62.9 | 62.9 | 62.9 | 70 |
| 320030601 | NV | Clark | 72.0 | 72 | 65.7 | 65.7 | 65.7 | 65.7 | 67 |
| 320031019 | NV | Clark | 74.3 | 75 | 66.8 | 67.4 | 66.8 | 67.4 | 70 |
| 320032002 | NV | Clark | 71.7 | 73 | 63.4 | 64.5 | 63.4 | 64.5 | 73 |
| 320190006 | NV | Lyon | 68.5 | 69 | 62.1 | 62.5 | 62.1 | 62.5 | 69 |
| 320310016 | NV | Washoe | 66.0 | 67 | 59.2 | 60.1 | 59.2 | 60.1 | 70 |
| 320310020 | NV | Washoe | 67.0 | 68 | 60.1 | 61.0 | 60.1 | 61.0 | 68 |
| 320310025 | NV | Washoe | 66.3 | 67 | 60.0 | 60.6 | 60.0 | 60.6 | 67 |
| 320311005 | NV | Washoe | 67.3 | 68 | 59.9 | 60.5 | 59.9 | 60.5 | 69 |
| 320312002 | NV | Washoe | 61.7 | 62 | 54.3 | 54.5 | 55.2 | 55.5 | 62 |
| 320312009 | NV | Washoe | 67.0 | 68 | 60.1 | 61.0 | 60.1 | 61.0 | 69 |
| 320330101 | NV | White Pine | 72.0 | 74 | 65.8 | 67.7 | 65.8 | 67.7 | 64 |
| 325100002 | NV | Carson City | 66.0 | 66 | 60.2 | 60.2 | 60.2 | 60.2 | N/A |
| 330012004 | NH | Belknap | 62.3 | 63 | 50.4 | 51.0 | 50.0 | 50.6 | 58 |
| 330050007 | NH | Cheshire | 62.3 | 63 | 49.7 | 50.2 | 49.7 | 50.2 | 61 |
| 330074001 | NH | Coos | 69.3 | 70 | 57.1 | 57.7 | 57.1 | 57.7 | 67 |
| 330074002 | NH | Coos | 59.7 | 61 | 49.3 | 50.4 | 49.3 | 50.4 | 57 |
| 330090010 | NH | Grafton | 59.7 | 60 | 48.1 | 48.4 | 48.1 | 48.4 | 57 |
| 330111011 | NH | Hillsborough | 66.3 | 67 | 53.6 | 54.2 | 53.6 | 54.2 | 63 |
| 330115001 | NH | Hillsborough | 69.0 | 70 | 55.5 | 56.3 | 55.5 | 56.3 | 68 |
| 330131007 | NH | Merrimack | 64.7 | 65 | 51.6 | 51.8 | 51.6 | 51.8 | 61 |
| 330150014 | NH | Rockingham | 66.0 | 66 | 53.6 | 53.6 | 53.4 | 53.4 | 65 |
| 330150016 | NH | Rockingham | 66.3 | 67 | 53.8 | 54.4 | 53.6 | 54.2 | 67 |
| 330150018 | NH | Rockingham | 68.0 | 68 | 55.1 | 55.1 | 55.1 | 55.1 | 65 |
| 340010006 | NJ | Atlantic | 74.3 | 76 | 58.5 | 59.9 | 58.6 | 60.0 | 64 |
| 340030006 | NJ | Bergen | 77.0 | 78 | 64.1 | 65.0 | 64.1 | 65.0 | 74 |
| 340071001 | NJ | Camden | 82.7 | 87 | 66.3 | 69.8 | 66.3 | 69.8 | 69 |
| 340110007 | NJ | Cumberland | 72.0 | 75 | 57.0 | 59.4 | 57.0 | 59.4 | 68 |
| 340130003 | NJ | Essex | 78.0 | 82 | 64.3 | 67.6 | 64.3 | 67.6 | 70 |
| 340150002 | NJ | Gloucester | 84.3 | 87 | 68.2 | 70.4 | 68.2 | 70.4 | 74 |
| 340170006 | NJ | Hudson | 77.0 | 78 | 65.4 | 66.3 | 64.6 | 65.4 | 72 |
| 340190001 | NJ | Hunterdon | 78.0 | 80 | 62.0 | 63.6 | 62.0 | 63.6 | 72 |
| 340210005 | NJ | Mercer | 78.3 | 81 | 63.2 | 65.4 | 63.2 | 65.4 | 72 |
| 340219991 | NJ | Mercer | 76.0 | 76 | 60.4 | 60.4 | 60.4 | 60.4 | 73 |
| 340230011 | NJ | Middlesex | 81.3 | 85 | 65.0 | 68.0 | 65.0 | 68.0 | 74 |
| 340250005 | NJ | Monmouth | 80.0 | 83 | 65.4 | 67.8 | 64.1 | 66.5 | 70 |
| 340273001 | NJ | Morris | 76.3 | 78 | 62.4 | 63.8 | 62.4 | 63.8 | 69 |
| 340290006 | NJ | Ocean | 82.0 | 85 | 65.8 | 68.2 | 65.8 | 68.2 | 73 |
| 340315001 | NJ | Passaic | 73.3 | 75 | 61.3 | 62.7 | 61.3 | 62.7 | 70 |

| Site | St | County | 2009-2013 Avg | 2009-2013 Max | 2023en "3x3" Avg | 2023en "3x3" Max | 2023en "No Water" Avg | 2023en "No Water" Max | 2014-2016 |
|---|---|---|---|---|---|---|---|---|---|
| 340410007 | NJ | Warren | 66.0 | 66 | 54.0 | 54.0 | 54.0 | 54.0 | 64 |
| 350010023 | NM | Bernalillo | 68.0 | 70 | 59.0 | 60.7 | 59.0 | 60.7 | 65 |
| 350010024 | NM | Bernalillo | 69.3 | 70 | 60.1 | 60.7 | 60.1 | 60.7 | N/A |
| 350010027 | NM | Bernalillo | 70.0 | 71 | 63.4 | 64.3 | 63.4 | 64.3 | N/A |
| 350010029 | NM | Bernalillo | 68.7 | 70 | 59.2 | 60.3 | 59.2 | 60.3 | 65 |
| 350010032 | NM | Bernalillo | 70.0 | 70 | 60.6 | 60.6 | 60.6 | 60.6 | N/A |
| 350011012 | NM | Bernalillo | 72.0 | 74 | 64.2 | 66.0 | 64.2 | 66.0 | 64 |
| 350011013 | NM | Bernalillo | 68.7 | 69 | 61.1 | 61.3 | 61.1 | 61.3 | N/A |
| 350130008 | NM | Dona Ana | 64.7 | 67 | 60.8 | 63.0 | 60.8 | 63.0 | 66 |
| 350130017 | NM | Dona Ana | 66.7 | 68 | 63.1 | 64.3 | 63.1 | 64.3 | N/A |
| 350130020 | NM | Dona Ana | 67.7 | 69 | 62.8 | 64.0 | 62.8 | 64.0 | 66 |
| 350130021 | NM | Dona Ana | 71.0 | 72 | 67.1 | 68.1 | 67.1 | 68.1 | 72 |
| 350130022 | NM | Dona Ana | 70.3 | 75 | 66.3 | 70.8 | 66.3 | 70.8 | 68 |
| 350130023 | NM | Dona Ana | 64.3 | 65 | 58.7 | 59.3 | 58.7 | 59.3 | 65 |
| 350151005 | NM | Eddy | 70.3 | 71 | 67.7 | 68.4 | 67.7 | 68.4 | 67 |
| 350171003 | NM | Grant | 65.0 | 67 | 61.9 | 63.8 | 61.9 | 63.8 | N/A |
| 350250008 | NM | Lea | 62.7 | 66 | 59.9 | 63.0 | 59.9 | 63.0 | 66 |
| 350290003 | NM | Luna | 63.0 | 67 | 58.2 | 61.9 | 58.2 | 61.9 | N/A |
| 350431001 | NM | Sandoval | 61.7 | 63 | 55.4 | 56.5 | 55.4 | 56.5 | 64 |
| 350439004 | NM | Sandoval | 63.0 | 63 | 58.8 | 58.8 | 58.8 | 58.8 | N/A |
| 350450009 | NM | San Juan | 65.3 | 68 | 56.7 | 59.0 | 56.7 | 59.0 | 62 |
| 350450018 | NM | San Juan | 71.0 | 71 | 62.0 | 62.0 | 62.0 | 62.0 | 66 |
| 350451005 | NM | San Juan | 66.0 | 68 | 55.3 | 57.0 | 55.3 | 57.0 | 62 |
| 350490021 | NM | Santa Fe | 64.3 | 66 | 60.5 | 62.1 | 60.5 | 62.1 | 63 |
| 350610008 | NM | Valencia | 68.5 | 70 | 60.1 | 61.4 | 60.1 | 61.4 | 64 |
| 360010012 | NY | Albany | 68.0 | 70 | 55.4 | 57.0 | 55.4 | 57.0 | 64 |
| 360050133 | NY | Bronx | 74.0 | 76 | 68.0 | 69.9 | 63.3 | 65.0 | 70 |
| 360130006 | NY | Chautauqua | 73.3 | 76 | 59.6 | 61.7 | 58.5 | 60.7 | 68 |
| 360130011 | NY | Chautauqua | 74.0 | 76 | 60.2 | 61.8 | 59.4 | 61.0 | N/A |
| 360150003 | NY | Chemung | 66.5 | 67 | 54.9 | 55.3 | 54.9 | 55.3 | N/A |
| 360270007 | NY | Dutchess | 72.0 | 74 | 58.6 | 60.2 | 58.6 | 60.2 | 68 |
| 360290002 | NY | Erie | 71.3 | 73 | 58.3 | 59.7 | 58.2 | 59.6 | 69 |
| 360310002 | NY | Essex | 70.3 | 73 | 57.5 | 59.8 | 57.5 | 59.8 | 62 |
| 360310003 | NY | Essex | 67.3 | 69 | 55.1 | 56.5 | 55.1 | 56.5 | 65 |
| 360410005 | NY | Hamilton | 66.0 | 67 | 53.7 | 54.5 | 53.7 | 54.5 | 60 |
| 360430005 | NY | Herkimer | 62.0 | 63 | 50.5 | 51.3 | 50.5 | 51.3 | 63 |
| 360450002 | NY | Jefferson | 71.7 | 74 | 59.0 | 60.9 | 59.4 | 61.3 | 63 |
| 360530006 | NY | Madison | 67.0 | 67 | 55.0 | 55.0 | 55.0 | 55.0 | N/A |
| 360610135 | NY | New York | 73.3 | 76 | 65.3 | 67.8 | 64.2 | 66.5 | 69 |

| Site | St | County | 2009-2013 Avg | 2009-2013 Max | 2023en "3x3" Avg | 2023en "3x3" Max | 2023en "No Water" Avg | 2023en "No Water" Max | 2014-2016 |
|---|---|---|---|---|---|---|---|---|---|
| 360631006 | NY | Niagara | 72.3 | 75 | 60.5 | 62.8 | 59.5 | 61.7 | 66 |
| 360650004 | NY | Oneida | 61.5 | 64 | 50.5 | 52.5 | 50.5 | 52.5 | N/A |
| 360671015 | NY | Onondaga | 69.3 | 72 | 57.8 | 60.1 | 57.8 | 60.1 | 64 |
| 360715001 | NY | Orange | 67.0 | 69 | 55.3 | 56.9 | 55.3 | 56.9 | 66 |
| 360750003 | NY | Oswego | 68.0 | 70 | 55.7 | 57.4 | 55.6 | 57.2 | 60 |
| 360790005 | NY | Putnam | 70.0 | 71 | 58.4 | 59.2 | 58.4 | 59.2 | 68 |
| 360810124 | NY | Queens | 78.0 | 80 | 70.1 | 71.9 | 70.2 | 72.0 | 69 |
| 360830004 | NY | Rensselaer | 67.0 | 67 | 54.4 | 54.4 | 54.4 | 54.4 | N/A |
| 360850067 | NY | Richmond | 81.3 | 83 | 71.9 | 73.4 | 67.1 | 68.5 | 76 |
| 360870005 | NY | Rockland | 75.0 | 76 | 62.0 | 62.8 | 62.0 | 62.8 | 72 |
| 360910004 | NY | Saratoga | 67.0 | 68 | 54.3 | 55.1 | 54.3 | 55.1 | 63 |
| 361010003 | NY | Steuben | 65.3 | 67 | 54.4 | 55.9 | 54.4 | 55.9 | 59 |
| 361030002 | NY | Suffolk | 83.3 | 85 | 72.5 | 74.0 | 74.0 | 75.5 | 72 |
| 361030004 | NY | Suffolk | 78.0 | 80 | 66.3 | 68.0 | 65.2 | 66.9 | 72 |
| 361030009 | NY | Suffolk | 78.7 | 80 | 68.5 | 69.7 | 67.6 | 68.7 | N/A |
| 361111005 | NY | Ulster | 69.0 | 69 | 57.4 | 57.4 | 57.4 | 57.4 | N/A |
| 361173001 | NY | Wayne | 65.0 | 67 | 53.4 | 55.0 | 53.4 | 55.0 | 64 |
| 361192004 | NY | Westchester | 75.3 | 76 | 68.1 | 68.8 | 63.8 | 64.4 | 74 |
| 370030004 | NC | Alexander | 66.7 | 68 | 51.3 | 52.3 | 51.3 | 52.3 | N/A |
| 370110002 | NC | Avery | 63.3 | 65 | 48.1 | 49.3 | 48.1 | 49.3 | 62 |
| 370119991 | NC | Avery | 63.0 | 63 | 48.9 | 48.9 | 48.9 | 48.9 | 64 |
| 370210030 | NC | Buncombe | 66.7 | 68 | 48.8 | 49.8 | 48.8 | 49.8 | 63 |
| 370270003 | NC | Caldwell | 66.0 | 67 | 49.6 | 50.3 | 49.6 | 50.3 | 64 |
| 370330001 | NC | Caswell | 70.7 | 73 | 53.9 | 55.7 | 53.9 | 55.7 | 63 |
| 370370004 | NC | Chatham | 64.0 | 66 | 47.4 | 48.9 | 47.4 | 48.9 | N/A |
| 370510008 | NC | Cumberland | 68.7 | 70 | 51.1 | 52.0 | 51.1 | 52.0 | 61 |
| 370511003 | NC | Cumberland | 70.7 | 72 | 51.5 | 52.4 | 51.5 | 52.4 | N/A |
| 370590003 | NC | Davie | 71.0 | 73 | 53.5 | 55.0 | 53.5 | 55.0 | N/A |
| 370630015 | NC | Durham | 70.0 | 72 | 49.8 | 51.3 | 49.8 | 51.3 | 62 |
| 370650099 | NC | Edgecombe | 70.0 | 71 | 51.3 | 52.0 | 51.3 | 52.0 | N/A |
| 370670022 | NC | Forsyth | 75.3 | 78 | 56.6 | 58.6 | 56.6 | 58.6 | 67 |
| 370670028 | NC | Forsyth | 69.7 | 72 | 52.0 | 53.7 | 52.0 | 53.7 | N/A |
| 370670030 | NC | Forsyth | 72.7 | 76 | 55.0 | 57.5 | 55.0 | 57.5 | 68 |
| 370671008 | NC | Forsyth | 72.3 | 75 | 54.5 | 56.5 | 54.5 | 56.5 | 67 |
| 370690001 | NC | Franklin | 69.3 | 71 | 50.2 | 51.5 | 50.2 | 51.5 | N/A |
| 370750001 | NC | Graham | 70.3 | 72 | 54.4 | 55.7 | 54.4 | 55.7 | 64 |
| 370770001 | NC | Granville | 70.7 | 72 | 51.2 | 52.1 | 51.2 | 52.1 | 64 |
| 370810013 | NC | Guilford | 74.0 | 76 | 55.0 | 56.5 | 55.0 | 56.5 | 65 |
| 370870008 | NC | Haywood | 61.0 | 61 | 48.6 | 48.6 | 48.6 | 48.6 | 62 |

| Site | St | County | 2009-2013 Avg | 2009-2013 Max | 2023en "3x3" Avg | 2023en "3x3" Max | 2023en "No Water" Avg | 2023en "No Water" Max | 2014-2016 |
|---|---|---|---|---|---|---|---|---|---|
| 370870036 | NC | Haywood | 67.7 | 69 | 53.8 | 54.8 | 53.8 | 54.8 | 65 |
| 370990005 | NC | Jackson | 67.0 | 67 | 53.1 | 53.1 | 53.1 | 53.1 | N/A |
| 371010002 | NC | Johnston | 71.7 | 74 | 51.5 | 53.2 | 51.5 | 53.2 | 65 |
| 371070004 | NC | Lenoir | 67.7 | 69 | 51.7 | 52.7 | 51.7 | 52.7 | 63 |
| 371090004 | NC | Lincoln | 72.7 | 75 | 55.4 | 57.1 | 55.4 | 57.1 | 67 |
| 371170001 | NC | Martin | 66.3 | 67 | 50.7 | 51.2 | 50.7 | 51.2 | 60 |
| 371190041 | NC | Mecklenburg | 80.0 | 83 | 60.8 | 63.1 | 60.8 | 63.1 | 69 |
| 371191005 | NC | Mecklenburg | 75.0 | 77 | 56.4 | 57.9 | 56.4 | 57.9 | N/A |
| 371191009 | NC | Mecklenburg | 79.7 | 83 | 58.2 | 60.6 | 58.2 | 60.6 | N/A |
| 371239991 | NC | Montgomery | 66.0 | 66 | 47.2 | 47.2 | 47.2 | 47.2 | 61 |
| 371290002 | NC | New Hanover | 63.0 | 64 | 46.0 | 46.8 | 46.9 | 47.6 | 60 |
| 371450003 | NC | Person | 71.0 | 74 | 57.5 | 59.9 | 57.5 | 59.9 | 63 |
| 371470006 | NC | Pitt | 69.7 | 71 | 52.6 | 53.6 | 52.6 | 53.6 | 62 |
| 371570099 | NC | Rockingham | 71.0 | 73 | 56.2 | 57.8 | 56.2 | 57.8 | 66 |
| 371590021 | NC | Rowan | 75.3 | 78 | 54.5 | 56.5 | 54.5 | 56.5 | 65 |
| 371590022 | NC | Rowan | 75.0 | 77 | 53.7 | 55.2 | 53.7 | 55.2 | N/A |
| 371730002 | NC | Swain | 60.7 | 62 | 48.7 | 49.7 | 48.7 | 49.7 | 60 |
| 371790003 | NC | Union | 71.0 | 73 | 50.9 | 52.4 | 50.9 | 52.4 | 68 |
| 371830014 | NC | Wake | 70.3 | 72 | 51.3 | 52.6 | 51.3 | 52.6 | 65 |
| 371830016 | NC | Wake | 73.0 | 75 | 54.2 | 55.7 | 54.2 | 55.7 | N/A |
| 371990004 | NC | Yancey | 69.7 | 71 | 53.0 | 54.0 | 53.0 | 54.0 | 65 |
| 390030009 | OH | Allen | 73.0 | 74 | 59.6 | 60.4 | 59.6 | 60.4 | 66 |
| 390071001 | OH | Ashtabula | 77.3 | 79 | 60.7 | 62.1 | 61.3 | 62.7 | 70 |
| 390090004 | OH | Athens | 69.0 | 69 | 55.5 | 55.5 | 55.5 | 55.5 | N/A |
| 390170004 | OH | Butler | 77.0 | 79 | 62.2 | 63.8 | 62.2 | 63.8 | 72 |
| 390170018 | OH | Butler | 79.7 | 82 | 63.0 | 64.9 | 63.0 | 64.9 | 71 |
| 390179991 | OH | Butler | 77.0 | 77 | 59.7 | 59.7 | 59.7 | 59.7 | 69 |
| 390230001 | OH | Clark | 75.0 | 76 | 58.6 | 59.4 | 58.6 | 59.4 | 69 |
| 390230003 | OH | Clark | 74.0 | 75 | 58.6 | 59.4 | 58.6 | 59.4 | 67 |
| 390250022 | OH | Clermont | 78.7 | 82 | 60.2 | 62.7 | 60.2 | 62.7 | 70 |
| 390271002 | OH | Clinton | 78.7 | 82 | 59.3 | 61.8 | 59.3 | 61.8 | 70 |
| 390350034 | OH | Cuyahoga | 77.7 | 80 | 57.0 | 58.7 | 62.1 | 63.9 | 69 |
| 390350060 | OH | Cuyahoga | 68.5 | 70 | 52.4 | 53.6 | 54.1 | 55.3 | 64 |
| 390350064 | OH | Cuyahoga | 70.0 | 73 | 56.1 | 58.5 | 57.4 | 59.9 | 64 |
| 390355002 | OH | Cuyahoga | 76.7 | 80 | 56.9 | 59.4 | 61.0 | 63.7 | 68 |
| 390410002 | OH | Delaware | 73.0 | 74 | 58.5 | 59.3 | 58.5 | 59.3 | 67 |
| 390479991 | OH | Fayette | 72.0 | 72 | 55.6 | 55.6 | 55.6 | 55.6 | 68 |
| 390490029 | OH | Franklin | 80.3 | 82 | 65.3 | 66.7 | 65.3 | 66.7 | 71 |
| 390490037 | OH | Franklin | 75.0 | 76 | 60.8 | 61.6 | 60.8 | 61.6 | 66 |

| Site | St | County | 2009-2013 Avg | 2009-2013 Max | 2023en "3x3" Avg | 2023en "3x3" Max | 2023en "No Water" Avg | 2023en "No Water" Max | 2014-2016 |
|---|---|---|---|---|---|---|---|---|---|
| 390490081 | OH | Franklin | 71.0 | 73 | 57.7 | 59.4 | 57.7 | 59.4 | 67 |
| 390550004 | OH | Geauga | 74.7 | 78 | 59.0 | 61.6 | 59.0 | 61.6 | 71 |
| 390570006 | OH | Greene | 73.0 | 74 | 55.4 | 56.2 | 55.4 | 56.2 | 68 |
| 390610006 | OH | Hamilton | 82.0 | 85 | 65.0 | 67.4 | 65.0 | 67.4 | 72 |
| 390610010 | OH | Hamilton | 76.3 | 80 | 60.4 | 63.3 | 60.4 | 63.3 | 72 |
| 390610040 | OH | Hamilton | 78.7 | 80 | 63.2 | 64.3 | 63.2 | 64.3 | 71 |
| 390810017 | OH | Jefferson | 70.3 | 72 | 57.9 | 59.3 | 57.9 | 59.3 | 65 |
| 390830002 | OH | Knox | 73.7 | 75 | 57.6 | 58.6 | 57.6 | 58.6 | 67 |
| 390850003 | OH | Lake | 80.0 | 83 | 58.0 | 60.2 | 63.5 | 65.8 | 75 |
| 390850007 | OH | Lake | 71.7 | 73 | 53.0 | 54.0 | 56.1 | 57.2 | 67 |
| 390870011 | OH | Lawrence | 65.0 | 67 | 51.8 | 53.4 | 51.8 | 53.4 | 64 |
| 390870012 | OH | Lawrence | 70.0 | 72 | 57.6 | 59.2 | 57.6 | 59.2 | 67 |
| 390890005 | OH | Licking | 74.3 | 76 | 57.5 | 58.8 | 57.5 | 58.8 | 67 |
| 390930018 | OH | Lorain | 71.7 | 75 | 54.6 | 57.1 | 58.8 | 61.5 | 66 |
| 390950024 | OH | Lucas | 68.0 | 70 | 53.9 | 55.5 | 55.3 | 57.0 | 67 |
| 390950027 | OH | Lucas | 66.7 | 68 | 55.4 | 56.5 | 55.4 | 56.5 | 64 |
| 390950034 | OH | Lucas | 73.7 | 76 | 58.9 | 60.7 | 60.2 | 62.1 | N/A |
| 390970007 | OH | Madison | 74.3 | 76 | 56.5 | 57.8 | 56.5 | 57.8 | 68 |
| 390990013 | OH | Mahoning | 70.7 | 73 | 57.0 | 58.8 | 57.0 | 58.8 | 63 |
| 391030004 | OH | Medina | 69.0 | 69 | 55.9 | 55.9 | 55.9 | 55.9 | 64 |
| 391090005 | OH | Miami | 73.3 | 74 | 57.2 | 57.8 | 57.2 | 57.8 | 67 |
| 391130037 | OH | Montgomery | 76.7 | 78 | 60.6 | 61.6 | 60.6 | 61.6 | 70 |
| 391331001 | OH | Portage | 68.3 | 71 | 54.8 | 57.0 | 54.8 | 57.0 | 61 |
| 391351001 | OH | Preble | 72.3 | 74 | 58.0 | 59.3 | 58.0 | 59.3 | 67 |
| 391510016 | OH | Stark | 76.7 | 79 | 60.9 | 62.7 | 60.9 | 62.7 | 69 |
| 391510022 | OH | Stark | 72.0 | 73 | 57.3 | 58.1 | 57.3 | 58.1 | 64 |
| 391514005 | OH | Stark | 72.3 | 75 | 57.2 | 59.3 | 57.2 | 59.3 | 66 |
| 391530020 | OH | Summit | 72.0 | 74 | 58.8 | 60.4 | 58.8 | 60.4 | 61 |
| 391550009 | OH | Trumbull | 71.0 | 73 | 56.1 | 57.7 | 56.1 | 57.7 | N/A |
| 391550011 | OH | Trumbull | 76.3 | 79 | 60.8 | 63.0 | 60.8 | 63.0 | 68 |
| 391650007 | OH | Warren | 77.7 | 79 | 59.5 | 60.5 | 59.5 | 60.5 | 72 |
| 391670004 | OH | Washington | 71.3 | 74 | 56.4 | 58.5 | 56.4 | 58.5 | 65 |
| 391730003 | OH | Wood | 71.3 | 73 | 58.6 | 60.0 | 58.6 | 60.0 | 63 |
| 400019009 | OK | Adair | 73.7 | 76 | 58.6 | 60.4 | 58.6 | 60.4 | 61 |
| 400159008 | OK | Caddo | 74.7 | 77 | 61.2 | 63.1 | 61.2 | 63.1 | N/A |
| 400170101 | OK | Canadian | 75.7 | 76 | 60.4 | 60.6 | 60.4 | 60.6 | 65 |
| 400219002 | OK | Cherokee | 73.7 | 76 | 57.9 | 59.7 | 57.9 | 59.7 | 60 |
| 400270049 | OK | Cleveland | 75.0 | 76 | 61.8 | 62.7 | 61.8 | 62.7 | 66 |
| 400310651 | OK | Comanche | 74.7 | 77 | 62.6 | 64.5 | 62.6 | 64.5 | 65 |

| Site | St | County | 2009-2013 Avg | 2009-2013 Max | 2023en "3x3" Avg | 2023en "3x3" Max | 2023en "No Water" Avg | 2023en "No Water" Max | 2014-2016 |
|---|---|---|---|---|---|---|---|---|---|
| 400370144 | OK | Creek | 77.0 | 78 | 58.5 | 59.2 | 58.5 | 59.2 | 64 |
| 400430860 | OK | Dewey | 72.3 | 74 | 63.4 | 64.9 | 63.4 | 64.9 | 65 |
| 400719010 | OK | Kay | 73.0 | 77 | 60.3 | 63.6 | 60.3 | 63.6 | 63 |
| 400871073 | OK | McClain | 74.0 | 75 | 60.2 | 61.0 | 60.2 | 61.0 | 66 |
| 400892001 | OK | McCurtain | 68.0 | 68 | 58.9 | 58.9 | 58.9 | 58.9 | N/A |
| 400979014 | OK | Mayes | 76.3 | 78 | 56.6 | 57.9 | 56.6 | 57.9 | 62 |
| 401090033 | OK | Oklahoma | 76.7 | 78 | 62.7 | 63.8 | 62.7 | 63.8 | 67 |
| 401090096 | OK | Oklahoma | 76.0 | 77 | 61.5 | 62.4 | 61.5 | 62.4 | 65 |
| 401091037 | OK | Oklahoma | 78.3 | 79 | 64.4 | 65.0 | 64.4 | 65.0 | 68 |
| 401159004 | OK | Ottawa | 74.0 | 76 | 57.7 | 59.3 | 57.7 | 59.3 | 54 |
| 401210415 | OK | Pittsburg | 73.3 | 75 | 61.8 | 63.3 | 61.8 | 63.3 | 60 |
| 401359021 | OK | Sequoyah | 72.0 | 72 | 58.7 | 58.7 | 58.7 | 58.7 | 60 |
| 401430137 | OK | Tulsa | 79.0 | 80 | 61.0 | 61.7 | 61.0 | 61.7 | N/A |
| 401430174 | OK | Tulsa | 75.3 | 77 | 59.0 | 60.3 | 59.0 | 60.3 | N/A |
| 401430178 | OK | Tulsa | 76.7 | 78 | 60.9 | 61.9 | 60.9 | 61.9 | 63 |
| 401431127 | OK | Tulsa | 78.3 | 80 | 62.1 | 63.5 | 62.1 | 63.5 | N/A |
| 410050004 | OR | Clackamas | 64.0 | 66 | 55.0 | 56.8 | 55.0 | 56.8 | 65 |
| 410090004 | OR | Columbia | 51.3 | 53 | 45.3 | 46.8 | 45.3 | 46.8 | 54 |
| 410170122 | OR | Deschutes | 58.5 | 59 | 52.8 | 53.2 | 52.8 | 53.2 | N/A |
| 410290201 | OR | Jackson | 61.7 | 63 | 53.5 | 54.7 | 53.5 | 54.7 | 59 |
| 410390060 | OR | Lane | 58.0 | 59 | 48.3 | 49.2 | 48.3 | 49.2 | 61 |
| 410391007 | OR | Lane | 60.0 | 61 | 49.7 | 50.5 | 49.7 | 50.5 | 61 |
| 410470004 | OR | Marion | 59.3 | 61 | 49.7 | 51.1 | 49.7 | 51.1 | 65 |
| 410510080 | OR | Multnomah | 56.7 | 57 | 51.2 | 51.5 | 51.2 | 51.5 | 55 |
| 410591003 | OR | Umatilla | 61.3 | 62 | 51.2 | 51.8 | 51.2 | 51.8 | 65 |
| 410671004 | OR | Washington | 57.7 | 59 | 50.6 | 51.8 | 50.6 | 51.8 | 59 |
| 420030008 | PA | Allegheny | 76.3 | 79 | 65.5 | 67.8 | 65.5 | 67.8 | 67 |
| 420030010 | PA | Allegheny | 73.7 | 75 | 63.3 | 64.4 | 63.3 | 64.4 | N/A |
| 420030067 | PA | Allegheny | 75.7 | 78 | 63.0 | 65.0 | 63.0 | 65.0 | 68 |
| 420031008 | PA | Allegheny | 80.7 | 82 | 67.1 | 68.2 | 67.1 | 68.2 | 70 |
| 420050001 | PA | Armstrong | 74.3 | 75 | 60.6 | 61.2 | 60.6 | 61.2 | 70 |
| 420070002 | PA | Beaver | 70.7 | 72 | 59.5 | 60.6 | 59.5 | 60.6 | 70 |
| 420070005 | PA | Beaver | 74.7 | 77 | 63.0 | 64.9 | 63.0 | 64.9 | 68 |
| 420070014 | PA | Beaver | 72.3 | 74 | 61.0 | 62.5 | 61.0 | 62.5 | 65 |
| 420110006 | PA | Berks | 71.7 | 75 | 56.2 | 58.8 | 56.2 | 58.8 | 66 |
| 420110011 | PA | Berks | 76.3 | 79 | 58.9 | 61.0 | 58.9 | 61.0 | 71 |
| 420130801 | PA | Blair | 72.7 | 75 | 60.3 | 62.3 | 60.3 | 62.3 | 63 |
| 420170012 | PA | Bucks | 80.3 | 83 | 64.6 | 66.8 | 64.6 | 66.8 | 77 |
| 420210011 | PA | Cambria | 70.3 | 72 | 58.0 | 59.4 | 58.0 | 59.4 | 63 |

| Site | St | County | 2009-2013 Avg | 2009-2013 Max | 2023en "3x3" Avg | 2023en "3x3" Max | 2023en "No Water" Avg | 2023en "No Water" Max | 2014-2016 |
|---|---|---|---|---|---|---|---|---|---|
| 420270100 | PA | Centre | 71.0 | 73 | 59.1 | 60.8 | 59.1 | 60.8 | 63 |
| 420279991 | PA | Centre | 72.0 | 72 | 59.8 | 59.8 | 59.8 | 59.8 | 65 |
| 420290100 | PA | Chester | 76.3 | 79 | 58.7 | 60.8 | 58.7 | 60.8 | 73 |
| 420334000 | PA | Clearfield | 72.3 | 74 | 60.3 | 61.8 | 60.3 | 61.8 | 64 |
| 420430401 | PA | Dauphin | 69.0 | 69 | 54.7 | 54.7 | 54.7 | 54.7 | 66 |
| 420431100 | PA | Dauphin | 74.7 | 77 | 58.3 | 60.1 | 58.3 | 60.1 | 67 |
| 420450002 | PA | Delaware | 75.7 | 78 | 60.3 | 62.1 | 60.3 | 62.1 | 72 |
| 420490003 | PA | Erie | 74.0 | 76 | 59.1 | 60.7 | 59.5 | 61.1 | 66 |
| 420550001 | PA | Franklin | 67.0 | 68 | 53.2 | 53.9 | 53.2 | 53.9 | 60 |
| 420590002 | PA | Greene | 69.0 | 71 | 56.5 | 58.1 | 56.5 | 58.1 | 67 |
| 420630004 | PA | Indiana | 75.7 | 79 | 62.7 | 65.4 | 62.7 | 65.4 | 70 |
| 420690101 | PA | Lackawanna | 71.0 | 72 | 55.8 | 56.6 | 55.8 | 56.6 | 67 |
| 420692006 | PA | Lackawanna | 68.7 | 71 | 54.0 | 55.8 | 54.0 | 55.8 | N/A |
| 420710007 | PA | Lancaster | 77.0 | 80 | 60.1 | 62.4 | 60.1 | 62.4 | 69 |
| 420710012 | PA | Lancaster | 78.0 | 82 | 60.2 | 63.3 | 60.2 | 63.3 | 66 |
| 420730015 | PA | Lawrence | 71.0 | 73 | 58.0 | 59.6 | 58.0 | 59.6 | 68 |
| 420750100 | PA | Lebanon | 76.0 | 76 | 58.6 | 58.6 | 58.6 | 58.6 | 71 |
| 420770004 | PA | Lehigh | 76.0 | 78 | 59.5 | 61.1 | 59.5 | 61.1 | 70 |
| 420791100 | PA | Luzerne | 65.0 | 66 | 49.9 | 50.6 | 49.9 | 50.6 | N/A |
| 420791101 | PA | Luzerne | 64.3 | 66 | 49.9 | 51.2 | 49.9 | 51.2 | 64 |
| 420810100 | PA | Lycoming | 67.0 | 69 | 53.9 | 55.5 | 53.9 | 55.5 | 64 |
| 420850100 | PA | Mercer | 76.3 | 79 | 60.0 | 62.1 | 60.0 | 62.1 | 69 |
| 420890002 | PA | Monroe | 66.7 | 70 | 52.9 | 55.6 | 52.9 | 55.6 | 65 |
| 420910013 | PA | Montgomery | 76.3 | 78 | 61.0 | 62.4 | 61.0 | 62.4 | 72 |
| 420950025 | PA | Northampton | 74.3 | 77 | 58.5 | 60.6 | 58.5 | 60.6 | 70 |
| 420958000 | PA | Northampton | 69.7 | 71 | 54.8 | 55.9 | 54.8 | 55.9 | 69 |
| 420990301 | PA | Perry | 68.3 | 70 | 54.8 | 56.2 | 54.8 | 56.2 | N/A |
| 421010004 | PA | Philadelphia | 66.0 | 70 | 53.9 | 57.1 | 53.9 | 57.1 | 61 |
| 421010024 | PA | Philadelphia | 83.3 | 87 | 67.3 | 70.3 | 67.3 | 70.3 | 77 |
| 421011002 | PA | Philadelphia | 80.0 | 80 | 64.7 | 64.7 | 64.7 | 64.7 | N/A |
| 421119991 | PA | Somerset | 65.0 | 65 | 50.8 | 50.8 | 50.8 | 50.8 | N/A |
| 421174000 | PA | Tioga | 69.7 | 71 | 57.3 | 58.3 | 57.3 | 58.3 | 63 |
| 421250005 | PA | Washington | 70.0 | 72 | 57.6 | 59.2 | 57.6 | 59.2 | 68 |
| 421250200 | PA | Washington | 70.7 | 73 | 57.6 | 59.4 | 57.6 | 59.4 | 65 |
| 421255001 | PA | Washington | 70.3 | 71 | 57.9 | 58.5 | 57.9 | 58.5 | 68 |
| 421290006 | PA | Westmoreland | 71.7 | 74 | 60.1 | 62.0 | 60.1 | 62.0 | N/A |
| 421290008 | PA | Westmoreland | 71.0 | 73 | 58.0 | 59.6 | 58.0 | 59.6 | 68 |
| 421330008 | PA | York | 72.3 | 74 | 56.9 | 58.3 | 56.9 | 58.3 | 66 |
| 421330011 | PA | York | 74.3 | 77 | 58.0 | 60.1 | 58.0 | 60.1 | N/A |

| Site | St | County | 2009-2013 Avg | 2009-2013 Max | 2023en "3x3" Avg | 2023en "3x3" Max | 2023en "No Water" Avg | 2023en "No Water" Max | 2014-2016 |
|---|---|---|---|---|---|---|---|---|---|
| 440030002 | RI | Kent | 73.7 | 74 | 60.4 | 60.7 | 60.4 | 60.7 | 70 |
| 440071010 | RI | Providence | 74.0 | 76 | 60.1 | 61.8 | 59.5 | 61.1 | 68 |
| 440090007 | RI | Washington | 76.3 | 78 | 63.6 | 65.0 | 62.6 | 64.0 | 70 |
| 450010001 | SC | Abbeville | 62.0 | 64 | 45.3 | 46.8 | 45.3 | 46.8 | N/A |
| 450030003 | SC | Aiken | 64.3 | 67 | 47.6 | 49.7 | 47.6 | 49.7 | 60 |
| 450070005 | SC | Anderson | 70.0 | 73 | 52.1 | 54.4 | 52.1 | 54.4 | 60 |
| 450150002 | SC | Berkeley | 62.3 | 64 | 47.4 | 48.7 | 47.4 | 48.7 | N/A |
| 450190046 | SC | Charleston | 64.7 | 66 | 49.6 | 50.6 | 49.8 | 50.8 | N/A |
| 450210002 | SC | Cherokee | 67.3 | 70 | 49.2 | 51.2 | 49.2 | 51.2 | N/A |
| 450250001 | SC | Chesterfield | 64.3 | 66 | 48.4 | 49.6 | 48.4 | 49.6 | 60 |
| 450290002 | SC | Colleton | 61.0 | 64 | 46.4 | 48.7 | 46.4 | 48.7 | N/A |
| 450310003 | SC | Darlington | 68.0 | 70 | 52.1 | 53.6 | 52.1 | 53.6 | 62 |
| 450370001 | SC | Edgefield | 63.0 | 63 | 46.2 | 46.2 | 46.2 | 46.2 | N/A |
| 450450016 | SC | Greenville | 68.0 | 69 | 50.5 | 51.2 | 50.5 | 51.2 | N/A |
| 450451003 | SC | Greenville | 65.3 | 67 | 48.9 | 50.2 | 48.9 | 50.2 | N/A |
| 450730001 | SC | Oconee | 64.5 | 65 | 48.6 | 48.9 | 48.6 | 48.9 | 63 |
| 450770002 | SC | Pickens | 69.7 | 71 | 52.5 | 53.5 | 52.5 | 53.5 | N/A |
| 450790007 | SC | Richland | 70.0 | 70 | 51.2 | 51.2 | 51.2 | 51.2 | N/A |
| 450790021 | SC | Richland | 60.0 | 62 | 44.1 | 45.6 | 44.1 | 45.6 | N/A |
| 450791001 | SC | Richland | 71.7 | 73 | 52.4 | 53.4 | 52.4 | 53.4 | N/A |
| 450830009 | SC | Spartanburg | 73.7 | 75 | 54.6 | 55.5 | 54.6 | 55.5 | N/A |
| 450910006 | SC | York | 64.0 | 65 | 47.7 | 48.4 | 47.7 | 48.4 | 59 |
| 460330132 | SD | Custer | 61.7 | 63 | 57.6 | 58.8 | 57.6 | 58.8 | 58 |
| 460710001 | SD | Jackson | 57.0 | 59 | 52.2 | 54.0 | 52.2 | 54.0 | 58 |
| 460930001 | SD | Meade | 58.5 | 60 | 52.0 | 53.3 | 52.0 | 53.3 | 57 |
| 460990008 | SD | Minnehaha | 66.0 | 68 | 55.3 | 56.9 | 55.3 | 56.9 | 64 |
| 461270003 | SD | Union | 62.5 | 64 | 52.6 | 53.9 | 52.6 | 53.9 | N/A |
| 470010101 | TN | Anderson | 70.7 | 73 | 54.3 | 56.0 | 54.3 | 56.0 | 63 |
| 470090101 | TN | Blount | 76.7 | 79 | 59.0 | 60.7 | 59.0 | 60.7 | 67 |
| 470090102 | TN | Blount | 66.3 | 68 | 50.8 | 52.1 | 50.8 | 52.1 | 60 |
| 470259991 | TN | Claiborne | 62.0 | 62 | 48.0 | 48.0 | 48.0 | 48.0 | 63 |
| 470370011 | TN | Davidson | 66.0 | 69 | 52.6 | 54.9 | 52.6 | 54.9 | 66 |
| 470370026 | TN | Davidson | 67.0 | 67 | 52.7 | 52.7 | 52.7 | 52.7 | 67 |
| 470651011 | TN | Hamilton | 72.3 | 75 | 54.9 | 57.0 | 54.9 | 57.0 | 65 |
| 470654003 | TN | Hamilton | 73.3 | 76 | 55.4 | 57.4 | 55.4 | 57.4 | 68 |
| 470890002 | TN | Jefferson | 74.7 | 78 | 56.9 | 59.4 | 56.9 | 59.4 | 68 |
| 470930021 | TN | Knox | 69.0 | 71 | 52.6 | 54.2 | 52.6 | 54.2 | 64 |
| 470931020 | TN | Knox | 71.7 | 74 | 54.2 | 55.9 | 54.2 | 55.9 | 66 |
| 471050109 | TN | Loudon | 72.3 | 75 | 55.9 | 58.0 | 55.9 | 58.0 | N/A |

| Site | St | County | 2009-2013 Avg | 2009-2013 Max | 2023en "3x3" Avg | 2023en "3x3" Max | 2023en "No Water" Avg | 2023en "No Water" Max | 2014-2016 |
|---|---|---|---|---|---|---|---|---|---|
| 471210104 | TN | Meigs | 71.3 | 74 | 54.4 | 56.5 | 54.4 | 56.5 | N/A |
| 471490101 | TN | Rutherford | 68.5 | 70 | 52.8 | 53.9 | 52.8 | 53.9 | N/A |
| 471550101 | TN | Sevier | 74.3 | 76 | 57.6 | 58.9 | 57.6 | 58.9 | 68 |
| 471570021 | TN | Shelby | 76.7 | 79 | 59.2 | 61.0 | 59.2 | 61.0 | 67 |
| 471570075 | TN | Shelby | 78.0 | 78 | 60.5 | 60.5 | 60.5 | 60.5 | 66 |
| 471571004 | TN | Shelby | 75.0 | 78 | 57.2 | 59.5 | 57.2 | 59.5 | 66 |
| 471632002 | TN | Sullivan | 71.7 | 74 | 59.2 | 61.1 | 59.2 | 61.1 | 66 |
| 471632003 | TN | Sullivan | 70.3 | 72 | 58.7 | 60.1 | 58.7 | 60.1 | 64 |
| 471650007 | TN | Sumner | 76.7 | 79 | 59.9 | 61.7 | 59.9 | 61.7 | 67 |
| 471650101 | TN | Sumner | 73.0 | 75 | 57.0 | 58.5 | 57.0 | 58.5 | N/A |
| 471870106 | TN | Williamson | 70.3 | 73 | 53.9 | 55.9 | 53.9 | 55.9 | 61 |
| 471890103 | TN | Wilson | 71.7 | 74 | 55.1 | 56.8 | 55.1 | 56.8 | 64 |
| 480271047 | TX | Bell | 74.5 | 75 | 63.8 | 64.2 | 63.8 | 64.2 | 67 |
| 480290032 | TX | Bexar | 76.7 | 78 | 66.3 | 67.4 | 66.3 | 67.4 | 73 |
| 480290052 | TX | Bexar | 78.7 | 81 | 68.4 | 70.4 | 68.4 | 70.4 | 73 |
| 480290059 | TX | Bexar | 68.3 | 70 | 59.4 | 60.9 | 59.4 | 60.9 | 64 |
| 480391004 | TX | Brazoria | 88.0 | 89 | 74.0 | 74.9 | 74.0 | 74.9 | 75 |
| 480391016 | TX | Brazoria | 71.7 | 73 | 61.3 | 62.4 | 61.3 | 62.4 | 64 |
| 480430101 | TX | Brewster | 70.0 | 71 | 67.9 | 68.9 | 67.9 | 68.9 | 62 |
| 480610006 | TX | Cameron | 62.7 | 64 | 56.7 | 57.9 | 56.7 | 57.9 | 57 |
| 480850005 | TX | Collin | 82.7 | 84 | 68.2 | 69.2 | 68.2 | 69.2 | 74 |
| 481130069 | TX | Dallas | 79.7 | 84 | 66.2 | 69.8 | 66.2 | 69.8 | 71 |
| 481130075 | TX | Dallas | 82.0 | 83 | 69.0 | 69.9 | 69.0 | 69.9 | 72 |
| 481130087 | TX | Dallas | 80.0 | 81 | 66.9 | 67.8 | 66.9 | 67.8 | 64 |
| 481210034 | TX | Denton | 84.3 | 87 | 69.7 | 72.0 | 69.7 | 72.0 | 80 |
| 481211032 | TX | Denton | 82.7 | 84 | 67.7 | 68.8 | 67.7 | 68.8 | 76 |
| 481390016 | TX | Ellis | 75.7 | 77 | 63.5 | 64.6 | 63.5 | 64.6 | 63 |
| 481391044 | TX | Ellis | 70.0 | 72 | 59.3 | 61.0 | 59.3 | 61.0 | 62 |
| 481410029 | TX | El Paso | 65.0 | 65 | 61.1 | 61.1 | 61.1 | 61.1 | 62 |
| 481410037 | TX | El Paso | 71.0 | 72 | 67.6 | 68.5 | 67.6 | 68.5 | 71 |
| 481410044 | TX | El Paso | 69.0 | 70 | 65.7 | 66.6 | 65.7 | 66.6 | 67 |
| 481410055 | TX | El Paso | 66.3 | 68 | 63.1 | 64.7 | 63.1 | 64.7 | 64 |
| 481410057 | TX | El Paso | 66.0 | 66 | 62.6 | 62.6 | 62.6 | 62.6 | 66 |
| 481410058 | TX | El Paso | 69.3 | 71 | 65.4 | 67.0 | 65.4 | 67.0 | 68 |
| 481671034 | TX | Galveston | 77.3 | 80 | 67.5 | 69.9 | 67.3 | 69.6 | 76 |
| 481830001 | TX | Gregg | 77.7 | 79 | 65.1 | 66.2 | 65.1 | 66.2 | 66 |
| 482010024 | TX | Harris | 80.3 | 83 | 70.4 | 72.8 | 70.4 | 72.8 | 79 |
| 482010026 | TX | Harris | 77.3 | 80 | 67.9 | 70.2 | 67.6 | 70.0 | 68 |
| 482010029 | TX | Harris | 83.0 | 84 | 68.7 | 69.5 | 68.7 | 69.5 | 69 |

| Site | St | County | 2009-2013 Avg | 2009-2013 Max | 2023en "3x3" Avg | 2023en "3x3" Max | 2023en "No Water" Avg | 2023en "No Water" Max | 2014-2016 |
|---|---|---|---|---|---|---|---|---|---|
| 482010046 | TX | Harris | 75.7 | 77 | 66.4 | 67.5 | 66.4 | 67.5 | 67 |
| 482010047 | TX | Harris | 78.3 | 79 | 66.7 | 67.3 | 66.7 | 67.3 | 74 |
| 482010051 | TX | Harris | 80.3 | 81 | 67.5 | 68.1 | 67.5 | 68.1 | 71 |
| 482010055 | TX | Harris | 81.3 | 83 | 68.3 | 69.8 | 68.3 | 69.8 | 75 |
| 482010062 | TX | Harris | 76.7 | 78 | 66.0 | 67.1 | 66.0 | 67.1 | 65 |
| 482010066 | TX | Harris | 77.0 | 79 | 64.7 | 66.4 | 64.7 | 66.4 | 76 |
| 482010070 | TX | Harris | 77.0 | 77 | 66.5 | 66.5 | 66.5 | 66.5 | N/A |
| 482010416 | TX | Harris | 78.7 | 80 | 66.7 | 67.8 | 66.7 | 67.8 | 72 |
| 482011015 | TX | Harris | 74.3 | 77 | 65.2 | 67.6 | 65.0 | 67.4 | 65 |
| 482011034 | TX | Harris | 81.0 | 82 | 70.8 | 71.6 | 70.8 | 71.6 | 73 |
| 482011035 | TX | Harris | 78.3 | 80 | 68.4 | 69.9 | 68.4 | 69.9 | 69 |
| 482011039 | TX | Harris | 82.0 | 84 | 71.8 | 73.6 | 71.8 | 73.5 | 67 |
| 482011050 | TX | Harris | 78.3 | 80 | 68.3 | 69.8 | 68.0 | 69.5 | 70 |
| 482030002 | TX | Harrison | 72.7 | 74 | 59.9 | 61.0 | 59.9 | 61.0 | 62 |
| 482150043 | TX | Hidalgo | 61.0 | 62 | 55.3 | 56.2 | 55.3 | 56.2 | 55 |
| 482151048 | TX | Hidalgo | 59.5 | 60 | 53.8 | 54.2 | 53.8 | 54.2 | N/A |
| 482210001 | TX | Hood | 76.7 | 77 | 63.4 | 63.7 | 63.4 | 63.7 | 69 |
| 482311006 | TX | Hunt | 71.7 | 74 | 59.1 | 61.0 | 59.1 | 61.0 | 60 |
| 482450009 | TX | Jefferson | 73.3 | 75 | 63.5 | 65.0 | 63.5 | 65.0 | 64 |
| 482450011 | TX | Jefferson | 76.0 | 76 | 66.5 | 66.5 | 66.2 | 66.2 | 67 |
| 482450022 | TX | Jefferson | 71.3 | 72 | 61.1 | 61.7 | 61.1 | 61.7 | 68 |
| 482450101 | TX | Jefferson | 78.0 | 80 | 68.4 | 70.2 | 68.2 | 70.0 | 65 |
| 482450102 | TX | Jefferson | 69.7 | 71 | 60.8 | 62.0 | 61.0 | 62.2 | 62 |
| 482450628 | TX | Jefferson | 70.7 | 73 | 61.9 | 63.9 | 61.6 | 63.6 | N/A |
| 482451035 | TX | Jefferson | 71.0 | 72 | 62.0 | 62.8 | 62.2 | 63.0 | 68 |
| 482510003 | TX | Johnson | 79.0 | 79 | 65.8 | 65.8 | 65.8 | 65.8 | 72 |
| 482570005 | TX | Kaufman | 70.7 | 74 | 60.5 | 63.4 | 60.5 | 63.4 | 61 |
| 483091037 | TX | McLennan | 72.7 | 74 | 61.9 | 63.0 | 61.9 | 63.0 | 63 |
| 483390078 | TX | Montgomery | 77.3 | 79 | 65.7 | 67.1 | 65.7 | 67.1 | 72 |
| 483491051 | TX | Navarro | 71.0 | 72 | 61.4 | 62.2 | 61.4 | 62.2 | 61 |
| 483550025 | TX | Nueces | 71.0 | 72 | 62.9 | 63.8 | 63.5 | 64.4 | 64 |
| 483550026 | TX | Nueces | 70.7 | 72 | 62.9 | 64.1 | 62.9 | 64.1 | 63 |
| 483611001 | TX | Orange | 72.7 | 75 | 63.7 | 65.7 | 64.5 | 66.6 | 61 |
| 483611100 | TX | Orange | 68.7 | 69 | 60.7 | 60.9 | 60.7 | 60.9 | N/A |
| 483670081 | TX | Parker | 78.7 | 79 | 65.8 | 66.0 | 65.8 | 66.0 | 73 |
| 483970001 | TX | Rockwall | 77.0 | 77 | 64.0 | 64.0 | 64.0 | 64.0 | 66 |
| 484230007 | TX | Smith | 75.0 | 75 | 62.3 | 62.3 | 62.3 | 62.3 | 65 |
| 484390075 | TX | Tarrant | 82.0 | 83 | 67.8 | 68.7 | 67.8 | 68.7 | 72 |
| 484391002 | TX | Tarrant | 81.0 | 82 | 67.5 | 68.4 | 67.5 | 68.4 | 74 |

| Site | St | County | 2009-2013 Avg | 2009-2013 Max | 2023en "3x3" Avg | 2023en "3x3" Max | 2023en "No Water" Avg | 2023en "No Water" Max | 2014-2016 |
|---|---|---|---|---|---|---|---|---|---|
| 484392003 | TX | Tarrant | 87.3 | 90 | 72.5 | 74.8 | 72.5 | 74.8 | 73 |
| 484393009 | TX | Tarrant | 86.0 | 86 | 70.6 | 70.6 | 70.6 | 70.6 | 75 |
| 484393011 | TX | Tarrant | 80.7 | 83 | 68.0 | 70.0 | 68.0 | 70.0 | 65 |
| 484530014 | TX | Travis | 73.7 | 75 | 62.9 | 64.0 | 62.9 | 64.0 | 66 |
| 484530020 | TX | Travis | 72.0 | 73 | 60.8 | 61.6 | 60.8 | 61.6 | 66 |
| 484690003 | TX | Victoria | 68.7 | 70 | 61.4 | 62.6 | 61.4 | 62.6 | 65 |
| 490030003 | UT | Box Elder | 67.7 | 69 | 59.8 | 60.9 | 60.9 | 62.1 | 67 |
| 490050004 | UT | Cache | 64.3 | 67 | 57.9 | 60.3 | 57.9 | 60.3 | N/A |
| 490071003 | UT | Carbon | 69.0 | 69 | 61.1 | 61.1 | 61.1 | 61.1 | 66 |
| 490110004 | UT | Davis | 69.3 | 71 | 61.3 | 62.8 | 60.0 | 61.5 | 74 |
| 490131001 | UT | Duchesne | 68.0 | 68 | 62.0 | 62.0 | 62.0 | 62.0 | N/A |
| 490352004 | UT | Salt Lake | 74.0 | 76 | 65.5 | 67.2 | 65.4 | 67.1 | N/A |
| 490353006 | UT | Salt Lake | 76.0 | 76 | 65.8 | 65.8 | 65.8 | 65.8 | 75 |
| 490370101 | UT | San Juan | 68.7 | 69 | 63.6 | 63.9 | 63.6 | 63.9 | 64 |
| 490450003 | UT | Tooele | 72.0 | 73 | 63.9 | 64.8 | 63.5 | 64.4 | N/A |
| 490490002 | UT | Utah | 70.0 | 73 | 62.5 | 65.2 | 62.7 | 65.4 | 71 |
| 490495010 | UT | Utah | 69.3 | 70 | 61.9 | 62.5 | 62.3 | 62.9 | 73 |
| 490530006 | UT | Washington | 67.0 | 67 | 61.4 | 61.4 | 61.4 | 61.4 | N/A |
| 490530130 | UT | Washington | 71.7 | 73 | 65.8 | 67.0 | 65.8 | 67.0 | N/A |
| 490570002 | UT | Weber | 71.7 | 72 | 64.0 | 64.3 | 64.0 | 64.3 | 71 |
| 490571003 | UT | Weber | 72.7 | 74 | 64.1 | 65.2 | 65.3 | 66.5 | 72 |
| 500030004 | VT | Bennington | 63.7 | 65 | 51.3 | 52.4 | 51.3 | 52.4 | 63 |
| 500070007 | VT | Chittenden | 61.0 | 62 | 49.6 | 50.4 | 49.6 | 50.4 | 61 |
| 510030001 | VA | Albemarle | 66.7 | 68 | 52.9 | 53.9 | 52.9 | 53.9 | N/A |
| 510130020 | VA | Arlington | 81.7 | 86 | 64.9 | 68.3 | 64.9 | 68.3 | 72 |
| 510330001 | VA | Caroline | 72.0 | 74 | 56.0 | 57.6 | 56.0 | 57.6 | N/A |
| 510360002 | VA | Charles | 75.7 | 79 | 59.4 | 62.0 | 59.4 | 62.0 | 63 |
| 510410004 | VA | Chesterfield | 72.0 | 75 | 56.8 | 59.2 | 56.8 | 59.2 | 62 |
| 510590030 | VA | Fairfax | 82.3 | 86 | 65.1 | 68.1 | 65.1 | 68.1 | 70 |
| 510610002 | VA | Fauquier | 62.7 | 64 | 49.5 | 50.5 | 49.5 | 50.5 | 59 |
| 510690010 | VA | Frederick | 66.7 | 69 | 51.4 | 53.2 | 51.4 | 53.2 | 61 |
| 510719991 | VA | Giles | 63.0 | 63 | 47.1 | 47.1 | 47.1 | 47.1 | 62 |
| 510850003 | VA | Hanover | 73.7 | 76 | 56.9 | 58.6 | 56.9 | 58.6 | 62 |
| 510870014 | VA | Henrico | 75.0 | 78 | 58.8 | 61.2 | 58.8 | 61.2 | N/A |
| 511071005 | VA | Loudoun | 73.0 | 75 | 57.8 | 59.4 | 57.8 | 59.4 | 67 |
| 511130003 | VA | Madison | 70.7 | 72 | 57.0 | 58.0 | 57.0 | 58.0 | 63 |
| 511390004 | VA | Page | 66.3 | 68 | 53.2 | 54.6 | 53.2 | 54.6 | N/A |
| 511479991 | VA | Prince Edward | 62.0 | 62 | 50.3 | 50.3 | 50.3 | 50.3 | 60 |
| 511530009 | VA | Prince William | 70.0 | 72 | 56.2 | 57.8 | 56.2 | 57.8 | 65 |

| Site | St | County | 2009-2013 Avg | 2009-2013 Max | 2023en "3x3" Avg | 2023en "3x3" Max | 2023en "No Water" Avg | 2023en "No Water" Max | 2014-2016 |
|---|---|---|---|---|---|---|---|---|---|
| 511611004 | VA | Roanoke | 67.3 | 70 | 53.4 | 55.5 | 53.4 | 55.5 | 62 |
| 511630003 | VA | Rockbridge | 62.3 | 64 | 50.2 | 51.6 | 50.2 | 51.6 | 58 |
| 511650003 | VA | Rockingham | 66.0 | 68 | 53.7 | 55.3 | 53.7 | 55.3 | 60 |
| 511790001 | VA | Stafford | 73.0 | 76 | 55.4 | 57.7 | 57.1 | 59.4 | 63 |
| 511970002 | VA | Wythe | 64.3 | 66 | 51.9 | 53.3 | 51.9 | 53.3 | 61 |
| 515100009 | VA | Alexandria City | 80.0 | 83 | 63.4 | 65.8 | 63.4 | 65.8 | N/A |
| 516500008 | VA | Hampton City | 74.0 | 76 | 58.2 | 59.8 | 56.9 | 58.4 | 64 |
| 518000004 | VA | Suffolk City | 71.3 | 73 | 58.7 | 60.1 | 56.2 | 57.5 | 60 |
| 518000005 | VA | Suffolk City | 69.7 | 71 | 54.7 | 55.7 | 54.7 | 55.7 | 61 |
| 530110011 | WA | Clark | 56.0 | 57 | 50.4 | 51.3 | 50.4 | 51.3 | 59 |
| 530330010 | WA | King | 55.0 | 57 | 50.0 | 51.8 | 50.0 | 51.8 | 55 |
| 530330017 | WA | King | 57.0 | 59 | 48.9 | 50.6 | 48.9 | 50.6 | 58 |
| 530330023 | WA | King | 65.0 | 67 | 54.9 | 56.6 | 54.9 | 56.6 | 67 |
| 530531010 | WA | Pierce | 53.3 | 54 | 46.2 | 46.8 | 46.2 | 46.8 | N/A |
| 530630001 | WA | Spokane | 58.7 | 60 | 51.8 | 53.0 | 51.8 | 53.0 | N/A |
| 530630021 | WA | Spokane | 59.0 | 60 | 53.1 | 54.0 | 53.1 | 54.0 | N/A |
| 530630046 | WA | Spokane | 58.7 | 60 | 51.0 | 52.1 | 51.0 | 52.1 | 59 |
| 530670005 | WA | Thurston | 55.7 | 56 | 48.3 | 48.6 | 48.3 | 48.6 | 57 |
| 540030003 | WV | Berkeley | 68.0 | 70 | 52.6 | 54.2 | 52.6 | 54.2 | 63 |
| 540110006 | WV | Cabell | 69.3 | 72 | 57.0 | 59.2 | 57.0 | 59.2 | 64 |
| 540219991 | WV | Gilmer | 60.0 | 60 | 49.5 | 49.5 | 49.5 | 49.5 | 59 |
| 540250003 | WV | Greenbrier | 64.7 | 66 | 53.1 | 54.1 | 53.1 | 54.1 | 59 |
| 540291004 | WV | Hancock | 73.0 | 75 | 60.2 | 61.8 | 60.2 | 61.8 | N/A |
| 540390010 | WV | Kanawha | 72.3 | 74 | 60.1 | 61.5 | 60.1 | 61.5 | N/A |
| 540610003 | WV | Monongalia | 69.7 | 72 | 58.0 | 59.9 | 58.0 | 59.9 | 64 |
| 540690010 | WV | Ohio | 72.3 | 74 | 59.3 | 60.7 | 59.3 | 60.7 | 68 |
| 541071002 | WV | Wood | 68.3 | 71 | 54.5 | 56.6 | 54.5 | 56.6 | 68 |
| 550090026 | WI | Brown | 68.3 | 70 | 56.8 | 58.2 | 58.0 | 59.4 | 66 |
| 550210015 | WI | Columbia | 67.0 | 69 | 55.3 | 57.0 | 55.3 | 57.0 | 67 |
| 550250041 | WI | Dane | 66.3 | 69 | 55.8 | 58.1 | 55.8 | 58.1 | 65 |
| 550270001 | WI | Dodge | 71.5 | 72 | 61.5 | 61.9 | 61.5 | 61.9 | 68 |
| 550290004 | WI | Door | 75.7 | 78 | 63.6 | 65.5 | 63.3 | 65.2 | 72 |
| 550350014 | WI | Eau Claire | 62.0 | 62 | 50.0 | 50.0 | 50.0 | 50.0 | 61 |
| 550390006 | WI | Fond du Lac | 70.0 | 72 | 59.8 | 61.5 | 59.8 | 61.5 | 66 |
| 550410007 | WI | Forest | 64.7 | 67 | 53.3 | 55.2 | 53.3 | 55.2 | 63 |
| 550550002 | WI | Jefferson | 68.5 | 70 | 58.1 | 59.4 | 58.1 | 59.4 | N/A |
| 550590019 | WI | Kenosha | 81.0 | 84 | 58.7 | 60.9 | 64.8 | 67.2 | 77 |
| 550610002 | WI | Kewaunee | 75.0 | 78 | 64.0 | 66.5 | 64.5 | 67.1 | 69 |
| 550630012 | WI | La Crosse | 63.3 | 65 | 52.0 | 53.4 | 52.0 | 53.4 | 62 |

| Site | St | County | 2009-2013 Avg | 2009-2013 Max | 2023en "3x3" Avg | 2023en "3x3" Max | 2023en "No Water" Avg | 2023en "No Water" Max | 2014-2016 |
|---|---|---|---|---|---|---|---|---|---|
| 550710007 | WI | Manitowoc | 78.7 | 80 | 65.6 | 66.7 | 67.6 | 68.7 | 72 |
| 550730012 | WI | Marathon | 63.3 | 65 | 51.3 | 52.7 | 51.3 | 52.7 | 65 |
| 550790010 | WI | Milwaukee | 69.7 | 72 | 55.8 | 57.6 | 60.6 | 62.6 | 64 |
| 550790026 | WI | Milwaukee | 74.7 | 78 | 60.4 | 63.1 | 66.5 | 69.4 | 68 |
| 550790085 | WI | Milwaukee | 80.0 | 82 | 65.4 | 67.0 | 71.2 | 73.0 | 71 |
| 550870009 | WI | Outagamie | 69.3 | 72 | 59.1 | 61.4 | 59.1 | 61.4 | 67 |
| 550890008 | WI | Ozaukee | 76.3 | 80 | 65.7 | 68.8 | 67.2 | 70.5 | 71 |
| 550890009 | WI | Ozaukee | 74.7 | 77 | 62.2 | 64.1 | 63.6 | 65.5 | 73 |
| 551010017 | WI | Racine | 77.7 | 81 | 57.5 | 59.9 | 62.2 | 64.8 | N/A |
| 551050024 | WI | Rock | 69.5 | 72 | 58.9 | 61.1 | 58.9 | 61.1 | N/A |
| 551110007 | WI | Sauk | 65.0 | 67 | 54.2 | 55.8 | 54.2 | 55.8 | 64 |
| 551170006 | WI | Sheboygan | 84.3 | 87 | 70.8 | 73.1 | 72.8 | 75.1 | 79 |
| 551199991 | WI | Taylor | 63.0 | 63 | 51.1 | 51.1 | 51.1 | 51.1 | 61 |
| 551270005 | WI | Walworth | 69.3 | 71 | 59.7 | 61.2 | 59.7 | 61.2 | 70 |
| 551330027 | WI | Waukesha | 66.7 | 69 | 58.1 | 60.1 | 58.1 | 60.1 | 66 |
| 560050123 | WY | Campbell | 63.7 | 65 | 59.3 | 60.5 | 59.3 | 60.5 | 58 |
| 560050456 | WY | Campbell | 63.0 | 64 | 59.1 | 60.1 | 59.1 | 60.1 | 60 |
| 560070100 | WY | Carbon | 63.0 | 64 | 58.7 | 59.6 | 58.7 | 59.6 | 60 |
| 560130232 | WY | Fremont | 65.0 | 66 | 61.2 | 62.1 | 61.2 | 62.1 | 61 |
| 560210100 | WY | Laramie | 68.0 | 68 | 62.4 | 62.4 | 62.4 | 62.4 | 63 |
| 560350700 | WY | Sublette | 64.0 | 64 | 59.9 | 59.9 | 59.9 | 59.9 | 61 |
| 560370200 | WY | Sweetwater | 63.7 | 64 | 57.9 | 58.2 | 57.9 | 58.2 | 55 |
| 560370300 | WY | Sweetwater | 66.0 | 66 | 60.0 | 60.0 | 60.0 | 60.0 | 66 |
| 560391011 | WY | Teton | 65.3 | 66 | 62.6 | 63.3 | 62.4 | 63.1 | 60 |
| 560410101 | WY | Uinta | 64.3 | 65 | 58.0 | 58.6 | 58.0 | 58.6 | 61 |

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
RESEARCH TRIANGLE PARK, NC 27711

MAR 27 2018

OFFICE OF
AIR QUALITY PLANNING
AND STANDARDS

**MEMORANDUM**

**SUBJECT:** Information on the Interstate Transport State Implementation Plan Submissions for the 2015 Ozone National Ambient Air Quality Standards under Clean Air Act Section 110(a)(2)(D)(i)(I)

**FROM:** Peter Tsirigotis
Director

**TO:** Regional Air Division Directors, Regions 1–10

The purpose of this memorandum is to provide information to states and the Environmental Protection Agency Regional offices as they develop or review state implementation plans (SIPs) that address section 110(a)(2)(D)(i)(I) of Clean Air Act (CAA), also called the "good neighbor" provision, as it pertains to the 2015 ozone National Ambient Air Quality Standards (NAAQS). Specifically, this memorandum includes EPA's air quality modeling data for ozone for the year 2023, including newly available contribution modeling results, and a discussion of elements previously used to address interstate transport. In addition, the memorandum is accompanied by Attachment A, which provides a preliminary list of potential flexibilities in analytical approaches for developing a good neighbor SIP that may warrant further discussion between EPA and states.

The information in this memorandum provides an update to the contribution modeling analyses provided in EPA's January 2017 Notice of Data Availability (NODA) of ozone transport modeling data for the 2015 ozone NAAQS and builds upon information provided in the October 2017 interstate transport memorandum.[1] The October 2017 memorandum provided projected ozone design values for 2023 based on EPA's updated nationwide ozone modeling with the primary goal of assisting states in completing good neighbor transport actions for the 2008 ozone NAAQS.

[1] *See* Notice of Availability of the Environmental Protection Agency's Preliminary Interstate Ozone Transport Modeling Data for the 2015 Ozone National Ambient Air Quality Standard (NAAQS), 82 FR 1733 (January 6, 2017). This memorandum also supplements the information provided in the memorandum, *Supplemental Information on the Interstate Transport State Implementation Plan Submissions for the 2008 Ozone National Ambient Air Quality Standards under Clean Air Act Section 110(a)(2)(D)(i)(I).* Memorandum from Stephen D. Page, Director, U.S. EPA Office of Air Quality Planning and Standards, to Regional Air Division Directors, Regions 1–10. October 27, 2017. Available at *https://www.epa.gov/sites/production/files/2017-10/documents/final_2008_o3_naaqs_transport_memo_10-27-17b.pdf.* (The October 27, 2017, memorandum includes links to all supporting documentation, including modeling and emissions technical support documents.)



NMED Exhibit 9c

EPA's goal in providing this information is to assist states' efforts to develop good neighbor SIPs for the 2015 ozone NAAQS to address their interstate transport obligations. While the information in this memorandum and the associated air quality analysis data could be used to inform the development of these SIPs, the information is not a final determination regarding states' obligations under the good neighbor provision. Any such determination would be made through notice-and-comment rulemaking.

**The Good Neighbor Provision**

Under CAA sections 110(a)(l) and 110(a)(2), each state is required to submit a SIP that provides for the implementation, maintenance and enforcement of each primary and secondary NAAQS. Section 110(a)(1) requires each state to make this new SIP submission within 3 years after promulgation of a new or revised NAAQS. This type of SIP submission is commonly referred to as an "infrastructure SIP." Section 110(a)(2) identifies specific elements that each plan submission must meet. Conceptually, an infrastructure SIP provides assurance that a state's SIP contains the necessary structural requirements to implement the new or revised NAAQS, whether by demonstrating that the state's SIP already contains or sufficiently addresses the necessary provisions, or by making a substantive SIP revision to update the plan provisions to meet the new standards.

In particular, CAA section 110(a)(2)(D)(i)(I) requires each state to submit to EPA new or revised SIPs that "contain adequate provisions ... prohibiting, consistent with the provisions of this subchapter, any source or other type of emissions activity within the State from emitting any air pollutant in amounts which will ... contribute significantly to nonattainment in, or interfere with maintenance by, any other state with respect to any such national primary or secondary ambient air quality standard." EPA often refers to section 110(a)(2)(D)(i)(I) as the good neighbor provision and to SIP revisions addressing this requirement as good neighbor SIPs.

On October 1, 2015, EPA promulgated a revision to the ozone NAAQS, lowering the level of both the primary and secondary standards to 70 parts per billion (ppb).[2] Pursuant to CAA section 110(a), good neighbor SIPs are, therefore, due by October 1, 2018. As noted earlier, EPA intends that the information conveyed through this memorandum should assist states in their efforts to develop good neighbor SIPs for the 2015 ozone NAAQS to address their interstate transport obligations.

**Framework to Address the Good Neighbor Provision**

Through the development and implementation of several previous rulemakings, including most recently the Cross-State Air Pollution Rule (CSAPR) Update,[3] EPA, working in partnership with states, established the following four-step framework to address the requirements of the good neighbor provision for ozone and fine particulate matter ($PM_{2.5}$) NAAQS: (1) identify downwind air quality problems; (2) identify upwind states that contribute enough to those downwind air

[2] National Ambient Air Quality Standards for Ozone Final Rule, 80 FR 65292 (October 26, 2015).

[3] *See* Finding of Significant Contribution and Rulemaking for Certain States in the Ozone Transport Assessment Group Region for Purposes of Reducing Regional Transport of Ozone (also known as the $NO_X$ SIP Call), 63 FR 57356 (October 27, 1998); Clean Air Interstate Rule (CAIR) Final Rule, 70 FR 25162 (May 12, 2005); CSAPR Final Rule, 76 FR 48208 (August 8, 2011); CSAPR Update for the 2008 Ozone NAAQS (CSAPR Update) Final Rule, 81 FR 74504 (October 26, 2016).

quality problems to warrant further review and analysis; (3) identify the emissions reductions necessary (if any), considering cost and air quality factors, to prevent an identified upwind state from contributing significantly to those downwind air quality problems; and (4) adopt permanent and enforceable measures needed to achieve those emissions reductions. EPA notes that, in applying this framework or other approaches consistent with the CAA, various analytical approaches may be used to assess each step. EPA has undertaken several previous regional rulemakings applying this framework, and its analytical approaches have varied over time due to continued evolution of relevant tools and information, as well as their specific application.

This memo presents information regarding EPA's latest analysis for purposes of assisting states in developing SIPs for the 2015 ozone NAAQS, and, in doing so, generally follows approaches that EPA has taken in its regional rulemaking actions addressing prior ozone NAAQS. EPA also notes that, in developing their own rules, states have flexibility to follow the familiar four-step transport framework (using EPA's analytical approach or somewhat different analytical approaches within these steps) or alternative frameworks, so long as their chosen approach has adequate technical justification and is consistent with the requirements of the CAA. In various discussions, states and other stakeholders have suggested specific approaches that may warrant further consideration, and have indicated that they may be exploring other approaches as well. Over the next few months, EPA will be working with states to evaluate potential additional flexibilities for states to consider as they develop their good neighbor SIPs for the 2015 ozone NAAQS. Such potential flexibilities could apply to modeling conducted by states or to states' use of EPA's updated modeling presented here. Attachment A provides a preliminary list of potential flexibilities that may warrant further discussion. EPA looks forward to discussing these and other potential flexibilities with states over the next few months, which will help inform states' development of their good neighbor SIP submittals, as well as EPA's development of further information on good neighbor SIPs.

**Air Quality Modeling Projection of 2023 Ozone Design Values**

As noted previously and as described in more detail in both the 2017 NODA and the October 2017 memorandum, EPA uses modeling to identify potential downwind air quality problems. A first step in the modeling process is selecting a future analytic year that considers both the relevant attainment dates of downwind nonattainment areas impacted by interstate transport[4] and the timeframes that may be required for implementing further emissions reductions as expeditiously as practicable.[5] For the 2015 ozone NAAQS, EPA selected 2023 as the analytic year in our modeling analyses primarily because it aligns with the anticipated attainment year for Moderate ozone nonattainment areas.[6]

[4] *North Carolina v. EPA*, 531 F.3d 896, 911–12 (D.C. Cir. 2008) (holding that compliance timeframes for necessary emission reductions must consider downwind attainment deadlines).

[5] *See* October 2017 memorandum, pp. 4-6 (discussion of timing of controls).

[6] On November 16, 2017 (82 FR 54232), EPA established initial air quality designations for most areas in the United States. On December 22, 2017 (83 FR 651), EPA responded to state and tribal recommendations by indicating the anticipated area designations for the remaining portions of the U.S. In addition, EPA proposed the maximum attainment dates for nonattainment areas in each classification, which for Moderate ozone nonattainment is 6 years (81 FR 81276, November 17, 2016). Based on the expected timing for final designations, 6 years from the likely effective date for designations would be summer 2024. Therefore, the 2023 ozone season would be the last full ozone season before the 2024 attainment date.

As noted in the aforementioned October 2017 memorandum, EPA then used the Comprehensive Air Quality Model with Extensions (CAMx v6.40)[7] to model emissions in 2011 and 2023, based on updates provided to EPA from states and other stakeholders.[8] EPA used outputs from the 2011 and 2023 model simulations to project base period 2009-2013 average and maximum ozone design values to 2023 at monitoring sites nationwide. In projecting these future year design values, EPA applied its own modeling guidance,[9] which recommends using model predictions from the "3 x 3" array of grid cells surrounding the location of the monitoring site.[10] In light of comments on the January 2017 NODA and other analyses, EPA also projected 2023 design values based on a modified version of the "3 x 3" approach for those monitoring sites located in coastal areas. Briefly, in this alternative approach, EPA incorporated the flexibility of eliminating from the design value calculations those modeling data in grid cells that are dominated by water (*i.e.*, more than 50 percent of the area in the grid cell is water) and that do not contain a monitoring site (*i.e.*, if a grid cell is more than 50 percent water but contains an air quality monitor, that cell would remain in the calculation).[11] For each individual monitoring site, the base period 2009-2013 average and maximum design values, 2023 projected average and maximum design values based on both the "3 x 3" approach and the alternative approach affecting coastal sites, and 2014-2016 measured design values are provided in an attachment to the October 27 memorandum. The same information is available in Excel format at *https://www.epa.gov/airmarkets/october-2017-memo-and-information-interstate-transport-sips-2008-ozone-naaqs*.

In the CSAPR Update rulemaking process, EPA considered a combination of monitoring data and modeling projections to identify receptor sites that are projected to have problems attaining or maintaining the NAAQS.[12] Specifically, EPA identified nonattainment receptors as those monitoring sites with current measured values exceeding the NAAQS that also have projected (*i.e.*, in 2023) average design values exceeding the NAAQS. EPA identified maintenance receptors as those monitoring sites with maximum design values exceeding the NAAQS. This included sites with current measured values below the NAAQS with projected average and maximum design values exceeding the NAAQS, and monitoring sites with projected average design values below the NAAQS but with projected maximum design values exceeding the NAAQS. The projected 2023 ozone design values and 2014-2016 measured design values for monitors in the United States have not changed since they were first presented in the October 2017 memorandum.

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[7] CAMx v6.40 was the most recent public release version of CAMx at the time EPA updated its modeling in fall 2017. ("Comprehensive Air Quality Model with Extension version 6.40 User's Guide" Ramboll Environ, December 2016. *http://www.camx.com/*.)

[8] For the updated modeling, EPA used the construct of the modeling platform (*i.e.*, modeling domain and non-emissions inputs) that we used for the NODA modeling, except that the photolysis rates files were updated to be consistent with CAMx v6.40. The NODA Air Quality Modeling Technical Support Document describing the modeling platform is available at *https://www.epa.gov/airmarkets/notice-data-availability-preliminary-interstate-ozone-transport-modeling-data-2015-ozone*.

[9] *http://www.epa.gov/ttn/scram/guidance/guide/Draft_O3-PM-RH_Modeling_Guidance-2014.pdf.*

[10] EPA's modeling uses 12 kilometer$^2$ grid cells.

[11] A model grid cell is identified as a "water" cell if more than 50 percent of the grid cell is water based on the 2006 National Land Cover Database. Grid cells that meet this criterion are treated as entirely over water in the Weather Research Forecast (WRF) modeling used to develop the 2011 meteorology for EPA's air quality modeling.

[12] *See* 81 FR 74530-74532 (October 26, 2016).

In this memorandum, EPA is identifying 2023 potential nonattainment and maintenance receptors with respect to the 2015 NAAQS, following its approach taken for previous NAAQS. This information is based on applying the CSAPR method for identifying potential nonattainment and maintenance receptors, and presents the design values in two ways: first, following the "3 x 3" approach to evaluating all sites, and second, following the modified approach for coastal monitoring sites in which "overwater" modeling data were not included in the calculation of future year design values. After incorporating these approaches, the modeling results suggest, based on the approach used for previous NAAQS, 11 monitoring sites outside of California as potential nonattainment receptors and 14 monitoring sites outside of California as potential maintenance receptors. *See* Attachment B for this receptor information.

**Air Quality Modeling of 2023 Contributions**

After identifying potential downwind air quality problems by projecting base period 2009-2013 average and maximum ozone design values to 2023 at monitoring sites nationwide, EPA next performed nationwide, state-level ozone source apportionment modeling using the CAMx Anthropogenic Precursor Culpability Analysis (APCA) technique[13] to provide information regarding the expected contribution of 2023 base case nitrogen oxides ($NO_X$) and volatile organic compound (VOC) emissions from all sources in each state to projected 2023 ozone concentrations at each air quality monitoring site. In the source apportionment model run, EPA tracked the ozone formed from each of the following contribution categories (*i.e.*, "tags"):

- States – anthropogenic $NO_X$ and VOC emissions from each of the contiguous 48 states and the District of Columbia tracked individually (EPA combined emissions from all anthropogenic sectors in a given state);
- Biogenics – biogenic $NO_X$ and VOC emissions domain-wide (*i.e.*, not by state);
- Initial and Boundary Concentrations – concentrations transported into the modeling domain from the lateral boundaries;
- Tribal Lands – the emissions from those tribal lands for which EPA has point source inventory data in the 2011 NEI (EPA did not model the contributions from individual tribes);
- Canada and Mexico – anthropogenic emissions from sources in those portions of Canada and Mexico included in the modeling domain (EPA did not separately model contributions from Canada or Mexico);
- Fires – combined emissions from wild and prescribed fires domain-wide (*i.e.*, not by state); and
- Offshore – combined emissions from offshore marine vessels and offshore drilling platforms (*i.e.*, not by state).

EPA performed the CAMx source apportionment model simulation for the period May 1 through September 30 using the 2023 future base case emissions and 2011 meteorology for this

[13] As part of this technique, ozone formed from reactions between biogenic and anthropogenic VOC and $NO_X$ are assigned to the anthropogenic emissions.

time period.[14] EPA processed hourly contributions[15] from each tag to obtain the 8-hour average contributions corresponding to the time period of the 8-hour daily maximum concentration on each day in the 2023 model simulation. This step was performed for those model grid cells containing monitoring sites to obtain 8-hour average contributions for each day at the location of each site. EPA then processed the model-predicted contributions on each day at each monitoring site location to identify the contributions on the subset of days in the 2023 modeling with the top 10 model-predicted maximum daily 8-hour average concentrations. The daily 8-hour average contributions on the top 10 concentration days in 2023 were applied in a relative sense to quantify the contributions to the 2023 average design value at each site.

In the CSAPR and CSAPR Update modeling efforts, EPA had used a slightly different approach by basing the average future year contribution on future year modeled values that exceeded the NAAQS or the top 5 days, whichever was greater. While technically sound, EPA's previous approach resulted in different contributions for an individual linkage depending on the level of the NAAQS. For the modeling effort described in this memorandum, EPA considered comments on the January 2017 NODA and developed and incorporated the flexibility of calculating the contribution metric using contributions on the top 10 future year days. As some commenters have indicated, this approach makes the contribution metric values more consistent across monitoring sites and more robust in terms of being independent of the level of the NAAQS. The contributions from each tag to each monitoring site identified as a potential nonattainment or maintenance receptor in 2023 are provided in Attachment C.[16]

**Conclusion**

States may consider using this national modeling to develop SIPs that address requirements of the good neighbor provision for the 2015 ozone NAAQS. When doing so, EPA recommends that states include in any such submission state-specific information to support their reliance on the 2023 modeling data. Further, states may supplement the information provided in this memorandum with any additional information that they believe is relevant to addressing the good neighbor provision requirements. States may also choose to use other information to identify nonattainment and maintenance receptors relevant to development of their good neighbor SIPs. If this is the case, states should submit that information along with a full explanation and technical analysis. EPA encourages collaboration among states linked to a common receptor and among linked upwind and downwind states in developing and implementing a regionally consistent approach. We recommend that states reach out to EPA Regional offices and work together to accomplish the goal of developing, submitting, and reviewing approvable SIPs that address the good neighbor provision for the 2015 ozone NAAQS.

Finally, as indicated previously in this memorandum, in addition to the flexibilities already incorporated into EPA's modeling effort (*i.e.*, considering the removal of modeled values in "over water" grid cells and EPA's modified approach for calculating the contribution metric), EPA is

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[14] *See* the October 2017 memorandum for a description of these model inputs.

[15] Ozone contributions from anthropogenic emissions under "NOx-limited" and "VOC-limited" chemical regimes were combined to obtain the net contribution from NOx and VOC anthropogenic emissions in each state.

[16] Given stakeholder input on the 2017 NODA and other analyses, EPA elected to represent the contribution information in this memorandum using the alternative approach for projecting design values for sites in coastal areas.

evaluating whether states may have additional flexibilities as they work to prepare and submit approvable good neighbor SIPs for the 2015 ozone NAAQS (*see* Attachment A). EPA looks forward to discussing these and other potential flexibilities with states over the next few months, which will help inform states' development of their good neighbor SIP submittals, as well as EPA's development of further information on good neighbor SIPs.

Please share this information with the air agencies in your Region.

**For Further Information**

If you have any questions concerning this memorandum, please contact Norm Possiel at (919) 541-5692, *possiel.norm@epa.gov* for modeling information or Beth Palma at (919) 541-5432, *palma.elizabeth@epa.gov* for any other information.

Attachments

A. Preliminary List of Potential Flexibilities Related to Analytical Approaches for Developing a Good Neighbor State Implementation Plan
B. Projected Ozone Design Values at Potential Nonattainment and Maintenance Receptors Based on EPA's Updated 2023 Transport Modeling
C. Contributions to 2023 8-hour Ozone Design Values at Projected 2023 Nonattainment and Maintenance Sites

**Attachment A**

**Preliminary List of Potential Flexibilities Related to Analytical Approaches for Developing a Good Neighbor State Implementation Plan**

The Environmental Protection Agency believes states may be able to consider certain approaches as they develop good neighbor state implementation plans (SIPs) addressing the 2015 ozone National Ambient Air Quality Standards (NAAQS). To that end, EPA has reviewed comments provided in various forums, including comments on EPA's January 2017 Notice of Data Availability (NODA) regarding ozone transport modeling data for the 2015 ozone NAAQS, and seeks feedback from interested stakeholders on the following concepts. This list is organized in the familiar four-step transport framework discussed on pages 2-3 of the memorandum above, but EPA is open to alternative frameworks to address good neighbor obligations or considerations outside the four-step process. The purpose of this attachment is to identify potential flexibilities to inform SIP development and seek feedback on these concepts. EPA is not at this time making any determination that the ideas discussed below are consistent with the requirements of the CAA, nor are we specifically recommending that states use these approaches. Determinations regarding states' obligations under the good neighbor provision would be made through notice-and-comment rulemaking.

EPA has identified several guiding principles to consider when evaluating the appropriateness of the concepts introduced in this attachment, including:

- Supporting states' position as "first actors" in developing SIPs that address section 110(a)(2)(D) of the CAA;
- Consistency with respect to EPA's SIP actions is legally required by the statute and regulations (*see* CAA § 301(a)(2) and 40 CFR part 56) and is a particularly acute issue with respect to regional transport issues in which multiple states may be implicated;
- Compliance with statutory requirements and legal precedent from court decisions interpreting the CAA requirements;
- Encouraging collaboration among states linked to a common receptor and among linked upwind and downwind states in developing and applying a regionally consistent approach to identify and implement good neighbor obligations; and
- The potential value of considering different modeling tools or analyses in addition to EPA's, provided that any alternative modeling is performed using a credible modeling system which includes "state-of-the-science" and "fit for purpose" models, inputs, and techniques that are relevant to the nature of the ozone problem. The use of results from each alternative technique should be weighed in accordance with the scientific foundation, construct and limitations of the individual techniques.

EPA intends to reflect on feedback received on these concepts and communicate closely with air agencies as they prepare and submit SIPs to address the good neighbor provisions for the 2015 ozone NAAQS.

**Analytics**

- Consideration of appropriate alternate base years to those used in EPA's most recent modeling (*e.g.*, appropriate alternative base years should be selected consistent with EPA's air quality modeling guidance suggesting that years with meteorology conducive to ozone formation are appropriate).
- Consideration of an alternate future analytic year. EPA has identified 2023 as an appropriate analytic year to consider when evaluating transport obligations for the 2015 ozone NAAQS; however, another year may also be appropriate.
- Use of alternative power sector modeling consistent with EPA's emission inventory guidance.
- Consideration of state-specific information in identifying emissions sources [*e.g.*, electric generating units (EGUs) and non-EGUs] and controls (*e.g.*, combustion/process controls, post-combustion controls) that are appropriate to evaluate.

**Step 1 – Identify downwind air quality problems**

- Identification of maintenance receptors.
  - Evaluate alternative methodologies to give independent meaning to the term "interfere with maintenance" under CAA section 110(a)(2)(D)(i)(I).
  - Identify maintenance receptors that are at risk of exceeding the NAAQS (even if they do not currently violate the standard) using an alternative approach that does not rely on the projection of maximum design values.
  - Identify maintenance receptors where current, presumably "clean," measured data are shown through analysis to occur during meteorological conditions conducive to ozone formation such that exceedances are unlikely to reoccur in the future.
- Consideration of downwind air quality context.
  - Consider the role of designations issued in FY 2018 based on approved air quality monitors.
  - Assess current and projected local emissions reductions and whether downwind areas have considered and/or used available mechanisms for regulatory relief.
- Consideration of model performance.
  - Consider removal of certain data from modeling analysis for the purposes of projecting design values and calculating the contribution metric where data removal is based on model performance and technical analyses support the exclusion.

**Step 2 – Identify upwind states that contribute to those downwind air quality problems to warrant further review and analysis**

- Considerations related to determining contributions.
  - EPA has used the Anthropogenic Precursor Culpability Analysis (APCA) approach for the purpose of quantifying contribution to downwind receptors. We have received questions regarding the use of other modeling approaches (*e.g.*, Ozone Source Apportionment Technology, Decoupled Direct Method, and zero-out brute force sensitivity runs) to help quantify ozone impacts from upwind states.
- Considerations related to evaluating contributions (contributions contained in Attachment C are not based upon a particular significance threshold).
  - Establishing a contribution threshold based on variability in ozone design values that leverage some of the analytics and statistical data created to support the development of the Significant Impact Level for ozone.

- Consideration of different contribution thresholds for different regions based on regional differences in the nature and extent of the transport problem.
- An evaluation of "collective contribution" in the receptor region to determine the extent to which a receptor is "transport influenced." The results of this analysis could be applied before assessing whether an individual state is linked to a downwind receptor (*i.e.*, above the contribution threshold).

**Step 3 – Identifying air quality, cost, and emission reduction factors to be evaluated in a multifactor test to identify emissions that significantly contribute to nonattainment or interfere with maintenance of the NAAQS downwind, if any**

- Consideration of international emissions, in a manner consistent with EPA's Ozone Cooperative Compliance Task Force efforts to fully understand the role of background ozone levels and appropriately account for international transport.[17]
  - Develop consensus on evaluation of the magnitude of international ozone contributions relative to domestic, anthropogenic ozone contributions for receptors identified in step 1. As contained in Attachment C, EPA recognizes that a number of non-U.S. and non-anthropogenic sources contribute to downwind nonattainment and maintenance receptors.
  - Consider whether the air quality, cost, or emission reduction factors should be weighted differently in areas where international contributions are relatively high.
- For states that are found to significantly contribute to nonattainment or interfere with maintenance of the NAAQS downwind, apportioning responsibility among states.
  - Consider control stringency levels derived through "uniform-cost" analysis of $NO_X$ reductions.
  - Consider whether the relative impact (*e.g.*, parts per billion/ton) between states is sufficiently different such that this factor warrants consideration in apportioning responsibility.
- Considerations for states linked to maintenance receptors.
  - Consider whether the remedy for upwind states linked to maintenance receptors could be less stringent than for those linked to nonattainment receptors.
  - For example, consider whether upwind states could satisfy linkage(s) to maintenance receptors based on recent historic or base case emissions levels.

**Step 4 – Adopt permanent and enforceable measures needed to achieve emissions reductions (translating the control levels identified in Step 3 into enforceable emissions limits)**

- EPA welcomes concepts from stakeholders regarding Step 4, including potential EPA actions that could serve as a model as well as the relationship to previous transport rules.

[17] See *Final Report on Review of Agency Actions that Potentially Burden the Safe, Efficient Development of Domestic Energy Resources Under Executive Order 13783* (October 25, 2017) and *Report to Congress on Administrative Options to Enable States to Enter into Cooperative Agreements to Provide Regulatory Relief for Implementing Ozone Standards* (August 14, 2017).

## Attachment B

## Projected Ozone Design Values at Potential Nonattainment and Maintenance Receptors Based on EPA's Updated 2023 Transport Modeling

This attachment contains projected ozone design values at those individual monitoring sites that are projected to be potential nonattainment or maintenance receptors based on the Environmental Protection Agency's updated transport modeling for 2023. The scenario name for the updated modeling is "2023en." The data are in units of parts per billion (ppb).

The following data are provided in the table below:

1. Base period 2009 – 2013 average and maximum design values based on 2009 – 2013 measured data.

2. Projected 2023 average and maximum design values based on the "3 x 3" approach and a modified "3 x 3" approach in which model predictions in grid cells that are predominately water and that do not contain monitors are excluded from the projection calculations ("No Water"). Note that the modified approach only affects the projection of design values for monitoring sites in or near coastal areas.

3. 2016 ozone design values based on 2014 – 2016 measured data (N/A indicates that a 2016 design value is not available). The following Web site has additional information on the 2016 design values: *https://www.epa.gov/air-trends/air-quality-design-values#report*.

Note: A value of 70.9 ppb (or less) is considered to be in attainment of the 2015 ozone NAAQS, and a value of 71.0 ppb (or higher) is considered to be in violation of the 2015 ozone NAAQS.

Note also: Site 550790085 in Milwaukee Co., WI would be a nonattainment receptor using projected design values based on the "No Water" cell approach, but would not be a receptor with the "3 x 3" approach. Conversely, site 360850067 in Richmond Co., NY would be a nonattainment receptor using the "3 x 3" approach, but would not be a receptor with the "No Water" cell approach.

| Site ID | St | County | 2009-2013 Avg | 2009-2013 Max | 2023en "3x3" Avg | 2023en "3x3" Max | 2023en "No Water" Avg | 2023en "No Water" Max | 2014-2016 |
|---|---|---|---|---|---|---|---|---|---|
| 40130019 | AZ | Maricopa | 76.7 | 79 | 69.3 | 71.4 | 69.3 | 71.4 | 73 |
| 40131004 | AZ | Maricopa | 79.7 | 81 | 69.8 | 71.0 | 69.8 | 71.0 | 75 |
| 60190007 | CA | Fresno | 94.7 | 95 | 79.2 | 79.4 | 79.2 | 79.4 | 86 |
| 60190011 | CA | Fresno | 93.0 | 96 | 78.6 | 81.2 | 78.6 | 81.2 | 89 |
| 60190242 | CA | Fresno | 91.7 | 95 | 79.4 | 82.2 | 79.4 | 82.2 | 86 |
| 60194001 | CA | Fresno | 90.7 | 92 | 73.3 | 74.4 | 73.3 | 74.4 | 91 |
| 60195001 | CA | Fresno | 97.0 | 99 | 79.6 | 81.2 | 79.6 | 81.2 | 94 |
| 60250005 | CA | Imperial | 74.7 | 76 | 73.3 | 74.6 | 73.3 | 74.6 | 76 |
| 60251003 | CA | Imperial | 81.0 | 82 | 79.0 | 80.0 | 79.0 | 80.0 | 76 |
| 60290007 | CA | Kern | 91.7 | 96 | 77.7 | 81.3 | 77.7 | 81.3 | 87 |

| Site ID | St | County | 2009-2013 Avg | 2009-2013 Max | 2023en "3x3" Avg | 2023en "3x3" Max | 2023en "No Water" Avg | 2023en "No Water" Max | 2014-2016 |
|---|---|---|---|---|---|---|---|---|---|
| 60290008 | CA | Kern | 86.3 | 88 | 71.3 | 72.8 | 71.3 | 72.8 | 81 |
| 60290014 | CA | Kern | 87.7 | 89 | 74.1 | 75.2 | 74.1 | 75.2 | 84 |
| 60290232 | CA | Kern | 87.3 | 89 | 73.7 | 75.2 | 73.7 | 75.2 | 77 |
| 60295002 | CA | Kern | 90.0 | 91 | 75.9 | 76.8 | 75.9 | 76.8 | 87 |
| 60296001 | CA | Kern | 84.3 | 86 | 70.9 | 72.4 | 70.9 | 72.4 | 81 |
| 60311004 | CA | Kings | 87.0 | 90 | 71.7 | 74.2 | 71.7 | 74.2 | 84 |
| 60370002 | CA | Los Angeles | 80.0 | 82 | 73.3 | 75.1 | 73.3 | 75.1 | 88 |
| 60370016 | CA | Los Angeles | 94.0 | 97 | 86.1 | 88.9 | 86.1 | 88.9 | 96 |
| 60371201 | CA | Los Angeles | 90.0 | 90 | 79.8 | 79.8 | 79.8 | 79.8 | 85 |
| 60371701 | CA | Los Angeles | 84.0 | 85 | 78.1 | 79.1 | 78.1 | 79.1 | 90 |
| 60372005 | CA | Los Angeles | 79.5 | 82 | 72.3 | 74.6 | 72.3 | 74.6 | 83 |
| 60376012 | CA | Los Angeles | 97.3 | 99 | 85.9 | 87.4 | 85.9 | 87.4 | 96 |
| 60379033 | CA | Los Angeles | 90.0 | 91 | 76.3 | 77.2 | 76.3 | 77.2 | 88 |
| 60392010 | CA | Madera | 85.0 | 86 | 72.1 | 72.9 | 72.1 | 72.9 | 83 |
| 60470003 | CA | Merced | 82.7 | 84 | 69.9 | 71.0 | 69.9 | 71.0 | 82 |
| 60650004 | CA | Riverside | 85.0 | 85 | 76.7 | 76.7 | 76.7 | 76.7 | N/A |
| 60650012 | CA | Riverside | 97.3 | 99 | 83.6 | 85.1 | 83.6 | 85.1 | 93 |
| 60651016 | CA | Riverside | 100.7 | 101 | 85.2 | 85.5 | 85.2 | 85.5 | 97 |
| 60652002 | CA | Riverside | 84.3 | 85 | 72.4 | 73.0 | 72.4 | 73.0 | 81 |
| 60655001 | CA | Riverside | 92.3 | 93 | 79.5 | 80.1 | 79.5 | 80.1 | 87 |
| 60656001 | CA | Riverside | 94.0 | 98 | 78.3 | 81.6 | 78.3 | 81.6 | 91 |
| 60658001 | CA | Riverside | 97.0 | 98 | 87.0 | 87.9 | 87.0 | 87.9 | 94 |
| 60658005 | CA | Riverside | 92.7 | 94 | 83.2 | 84.4 | 83.2 | 84.4 | 91 |
| 60659001 | CA | Riverside | 88.3 | 91 | 73.7 | 75.9 | 73.7 | 75.9 | 86 |
| 60670012 | CA | Sacramento | 93.3 | 95 | 74.5 | 75.9 | 74.5 | 75.9 | 83 |
| 60675003 | CA | Sacramento | 86.3 | 88 | 69.9 | 71.3 | 69.9 | 71.3 | 79 |
| 60710005 | CA | San Bernardino | 105.0 | 107 | 96.2 | 98.1 | 96.2 | 98.1 | 108 |
| 60710012 | CA | San Bernardino | 95.0 | 97 | 84.1 | 85.8 | 84.1 | 85.8 | 91 |
| 60710306 | CA | San Bernardino | 83.7 | 85 | 76.2 | 77.4 | 76.2 | 77.4 | 86 |
| 60711004 | CA | San Bernardino | 96.7 | 98 | 89.8 | 91.0 | 89.8 | 91.0 | 101 |
| 60712002 | CA | San Bernardino | 101.0 | 103 | 93.1 | 95.0 | 93.1 | 95.0 | 97 |
| 60714001 | CA | San Bernardino | 94.3 | 97 | 86.0 | 88.5 | 86.0 | 88.5 | 90 |
| 60714003 | CA | San Bernardino | 105.0 | 107 | 94.1 | 95.8 | 94.1 | 95.8 | 101 |
| 60719002 | CA | San Bernardino | 92.3 | 94 | 80.0 | 81.4 | 80.0 | 81.4 | 86 |
| 60719004 | CA | San Bernardino | 98.7 | 99 | 88.4 | 88.7 | 88.4 | 88.7 | 104 |
| 60990006 | CA | Stanislaus | 87.0 | 88 | 74.8 | 75.7 | 74.8 | 75.7 | 83 |
| 61070006 | CA | Tulare | 81.7 | 85 | 69.1 | 71.9 | 69.1 | 71.9 | 84 |
| 61070009 | CA | Tulare | 94.7 | 96 | 76.1 | 77.2 | 76.1 | 77.2 | 89 |

| Site ID | St | County | 2009-2013 Avg | 2009-2013 Max | 2023en "3x3" Avg | 2023en "3x3" Max | 2023en "No Water" Avg | 2023en "No Water" Max | 2014-2016 |
|---|---|---|---|---|---|---|---|---|---|
| 61072002 | CA | Tulare | 85.0 | 88 | 68.9 | 71.4 | 68.9 | 71.4 | 80 |
| 61072010 | CA | Tulare | 89.0 | 90 | 73.1 | 73.9 | 73.1 | 73.9 | 83 |
| 61112002 | CA | Ventura | 81.0 | 83 | 70.5 | 72.2 | 70.5 | 72.2 | 77 |
| 80050002 | CO | Arapahoe | 76.7 | 79 | 69.3 | 71.3 | 69.3 | 71.3 | N/A |
| 80350004 | CO | Douglas | 80.7 | 83 | 71.1 | 73.2 | 71.1 | 73.2 | 77 |
| 80590006 | CO | Jefferson | 80.3 | 83 | 71.3 | 73.7 | 71.3 | 73.7 | 77 |
| 80590011 | CO | Jefferson | 78.7 | 82 | 70.9 | 73.9 | 70.9 | 73.9 | 80 |
| 80690011 | CO | Larimer | 78.0 | 80 | 71.2 | 73.0 | 71.2 | 73.0 | 75 |
| 81230009 | CO | Weld | 74.7 | 76 | 70.2 | 71.4 | 70.2 | 71.4 | 70 |
| 90010017 | CT | Fairfield | 80.3 | 83 | 69.8 | 72.1 | 68.9 | 71.2 | 80 |
| 90013007 | CT | Fairfield | 84.3 | 89 | 71.2 | 75.2 | 71.0 | 75.0 | 81 |
| 90019003 | CT | Fairfield | 83.7 | 87 | 72.7 | 75.6 | 73.0 | 75.9 | 85 |
| 90099002 | CT | New Haven | 85.7 | 89 | 71.2 | 73.9 | 69.9 | 72.6 | 76 |
| 240251001 | MD | Harford | 90.0 | 93 | 71.4 | 73.8 | 70.9 | 73.3 | 73 |
| 260050003 | MI | Allegan | 82.7 | 86 | 69.0 | 71.8 | 69.0 | 71.7 | 75 |
| 261630019 | MI | Wayne | 78.7 | 81 | 69.0 | 71.0 | 69.0 | 71.0 | 72 |
| 360810124 | NY | Queens | 78.0 | 80 | 70.1 | 71.9 | 70.2 | 72.0 | 69 |
| 360850067 | NY | Richmond | 81.3 | 83 | 71.9 | 73.4 | 67.1 | 68.5 | 76 |
| 361030002 | NY | Suffolk | 83.3 | 85 | 72.5 | 74.0 | 74.0 | 75.5 | 72 |
| 480391004 | TX | Brazoria | 88.0 | 89 | 74.0 | 74.9 | 74.0 | 74.9 | 75 |
| 481210034 | TX | Denton | 84.3 | 87 | 69.7 | 72.0 | 69.7 | 72.0 | 80 |
| 482010024 | TX | Harris | 80.3 | 83 | 70.4 | 72.8 | 70.4 | 72.8 | 79 |
| 482011034 | TX | Harris | 81.0 | 82 | 70.8 | 71.6 | 70.8 | 71.6 | 73 |
| 482011039 | TX | Harris | 82.0 | 84 | 71.8 | 73.6 | 71.8 | 73.5 | 67 |
| 484392003 | TX | Tarrant | 87.3 | 90 | 72.5 | 74.8 | 72.5 | 74.8 | 73 |
| 550790085 | WI | Milwaukee | 80.0 | 82 | 65.4 | 67.0 | 71.2 | 73.0 | 71 |
| 551170006 | WI | Sheboygan | 84.3 | 87 | 70.8 | 73.1 | 72.8 | 75.1 | 79 |

## Attachment C

## Contributions to 2023 8-hour Ozone Design Values at Projected 2023 Nonattainment and Maintenance Sites

This attachment contains tables with the projected ozone contributions from 2023 anthropogenic nitrogen oxide and volatile organic compound emissions in each state to each potential nonattainment receptor and maintenance receptor (based on the 2015 ozone National Ambient Air Quality Standards) in the United States, following the approach for identification of such receptors EPA has used in the past, with slight modification.[18] In addition to the state contributions, we have included the contributions from each of the other categories tracked in the contribution modeling, including point source emissions on Tribal lands, anthropogenic emissions in Canada and Mexico, emissions from offshore sources, fires, biogenics, and contributions from initial and boundary concentrations.

The contribution information is provided in a three-part table for all of the projected receptors throughout the country, except California, and a separate three-part table for the projected receptors in California. For each monitoring site, we provide the site ID, county name, and state name in the first three columns of the table. This information is followed by columns containing the projected 2023 average and maximum design values based on the "No Water" cell approach. Next, in Parts 1 and 2 of each table, we provide the contributions from each state and the District of Columbia, individually. Finally, in Part 3 of each table, we provide the contributions from the Tribal lands, Canada and Mexico, offshore, fires, initial and boundary concentrations (Boundary), and biogenics categories. The units of the 2023 design values and contributions are parts per billion (ppb). Note that the contributions presented in these tables may not sum exactly to the 2023 average design value due to truncation of the contributions to two places to the right of the decimal.

[18] For the purposes of creating the contribution tables, data are provided for sites identified as potential nonattainment and maintenance receptors using projected design values based on the "No Water" cell approach. In addition, we provide the contributions to the Richmond Co., NY site that would be a nonattainment receptor in the "3 x 3" approach.

# Contributions to 2023 Nonattainment and Maintenance Sites Outside of California (Part 1)

| Site ID | County | State | 2023en Average | 2023en Maximum | AL | AZ | AR | CA | CO | CT | DE | DC | FL | GA | ID | IL | IN | IA | KS | KY | LA | ME | MD | MA | MI | MN | MS | MO | MT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 40130019 | Maricopa | AZ | 69.3 | 71.4 | 0.00 | 25.19 | 0.00 | 1.87 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 40131004 | Maricopa | AZ | 69.8 | 71.0 | 0.00 | 27.40 | 0.00 | 2.03 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 80050002 | Arapahoe | CO | 69.3 | 71.3 | 0.00 | 0.29 | 0.00 | 1.20 | 22.94 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.19 | 0.00 | 0.00 | 0.00 | 0.28 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.02 |
| 80350004 | Douglas | CO | 71.1 | 73.2 | 0.00 | 0.38 | 0.01 | 1.27 | 24.71 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.18 | 0.00 | 0.00 | 0.00 | 0.26 | 0.00 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 |
| 80590006 | Jefferson | CO | 71.3 | 73.7 | 0.01 | 0.49 | 0.03 | 1.32 | 25.52 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.13 | 0.00 | 0.00 | 0.00 | 0.27 | 0.00 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.03 | 0.03 |
| 80590011 | Jefferson | CO | 70.9 | 73.9 | 0.01 | 0.30 | 0.02 | 1.50 | 24.72 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.12 | 0.00 | 0.00 | 0.00 | 0.32 | 0.00 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.02 | 0.02 |
| 80690011 | Larimer | CO | 71.2 | 73.0 | 0.00 | 0.46 | 0.00 | 1.55 | 21.74 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.13 | 0.00 | 0.00 | 0.00 | 0.10 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.07 |
| 81230009 | Weld | CO | 70.2 | 71.4 | 0.01 | 0.49 | 0.02 | 0.95 | 24.44 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.06 | 0.00 | 0.00 | 0.00 | 0.09 | 0.00 | 0.06 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.01 | 0.04 |
| 90010017 | Fairfield | CT | 68.9 | 71.2 | 0.08 | 0.03 | 0.07 | 0.03 | 0.07 | 8.70 | 0.18 | 0.04 | 0.02 | 0.09 | 0.01 | 0.39 | 0.44 | 0.11 | 0.09 | 0.34 | 0.05 | 0.01 | 1.18 | 0.06 | 0.50 | 0.17 | 0.03 | 0.21 | 0.03 |
| 90013007 | Fairfield | CT | 71.0 | 75.0 | 0.14 | 0.05 | 0.13 | 0.05 | 0.09 | 4.64 | 0.35 | 0.06 | 0.05 | 0.17 | 0.01 | 0.72 | 0.97 | 0.16 | 0.13 | 0.89 | 0.11 | 0.01 | 1.80 | 0.12 | 0.70 | 0.15 | 0.07 | 0.38 | 0.02 |
| 90019003 | Fairfield | CT | 73.0 | 75.9 | 0.14 | 0.05 | 0.13 | 0.05 | 0.09 | 3.71 | 0.40 | 0.08 | 0.05 | 0.17 | 0.01 | 0.67 | 0.83 | 0.17 | 0.13 | 0.79 | 0.11 | 0.00 | 2.17 | 0.10 | 0.63 | 0.14 | 0.07 | 0.37 | 0.02 |
| 90099002 | New Haven | CT | 69.9 | 72.6 | 0.06 | 0.04 | 0.08 | 0.05 | 0.08 | 9.10 | 0.30 | 0.04 | 0.02 | 0.07 | 0.02 | 0.46 | 0.50 | 0.16 | 0.14 | 0.32 | 0.08 | 0.01 | 1.37 | 0.18 | 0.73 | 0.19 | 0.04 | 0.29 | 0.04 |
| 240251001 | Harford | MD | 70.9 | 73.3 | 0.31 | 0.07 | 0.17 | 0.07 | 0.12 | 0.00 | 0.03 | 0.65 | 0.11 | 0.32 | 0.02 | 0.84 | 1.35 | 0.23 | 0.23 | 1.52 | 0.19 | 0.00 | 22.60 | 0.00 | 0.79 | 0.13 | 0.08 | 0.59 | 0.04 |
| 260050003 | Allegan | MI | 69.0 | 71.7 | 0.35 | 0.08 | 1.64 | 0.09 | 0.18 | 0.00 | 0.00 | 0.00 | 0.09 | 0.18 | 0.03 | 19.62 | 7.11 | 0.77 | 0.77 | 0.58 | 0.70 | 0.00 | 0.01 | 0.00 | 3.32 | 0.11 | 0.40 | 2.61 | 0.06 |
| 261630019 | Wayne | MI | 69.0 | 71.0 | 0.11 | 0.07 | 0.27 | 0.13 | 0.17 | 0.00 | 0.00 | 0.00 | 0.05 | 0.09 | 0.05 | 2.37 | 2.51 | 0.44 | 0.44 | 0.65 | 0.22 | 0.00 | 0.02 | 0.00 | 20.39 | 0.31 | 0.09 | 0.92 | 0.08 |
| 360810124 | Queens | NY | 70.2 | 72.0 | 0.11 | 0.06 | 0.09 | 0.08 | 0.11 | 0.57 | 0.38 | 0.05 | 0.07 | 0.16 | 0.03 | 0.73 | 0.69 | 0.26 | 0.19 | 0.42 | 0.13 | 0.00 | 1.56 | 0.24 | 1.26 | 0.17 | 0.04 | 0.38 | 0.05 |
| 360850067 | Richmond | NY | 67.1 | 68.5 | 0.24 | 0.08 | 0.13 | 0.09 | 0.12 | 0.27 | 0.43 | 0.05 | 0.09 | 0.28 | 0.02 | 0.80 | 0.92 | 0.23 | 0.21 | 0.84 | 0.16 | 0.00 | 1.74 | 0.03 | 0.98 | 0.12 | 0.08 | 0.46 | 0.03 |
| 361030002 | Suffolk | NY | 74.0 | 75.5 | 0.12 | 0.06 | 0.12 | 0.08 | 0.11 | 0.83 | 0.22 | 0.04 | 0.04 | 0.12 | 0.03 | 0.64 | 0.69 | 0.20 | 0.20 | 0.49 | 0.13 | 0.01 | 1.24 | 0.04 | 0.94 | 0.18 | 0.06 | 0.39 | 0.06 |
| 480391004 | Brazoria | TX | 74.0 | 74.9 | 0.35 | 0.08 | 0.90 | 0.21 | 0.30 | 0.00 | 0.00 | 0.00 | 0.21 | 0.14 | 0.08 | 1.00 | 0.32 | 0.40 | 0.47 | 0.14 | 3.80 | 0.00 | 0.00 | 0.00 | 0.22 | 0.34 | 0.63 | 0.88 | 0.10 |
| 481210034 | Denton | TX | 69.7 | 72.0 | 0.49 | 0.07 | 0.58 | 0.13 | 0.27 | 0.00 | 0.00 | 0.00 | 0.27 | 0.34 | 0.06 | 0.23 | 0.16 | 0.10 | 0.40 | 0.11 | 1.92 | 0.00 | 0.01 | 0.00 | 0.08 | 0.11 | 0.33 | 0.24 | 0.07 |
| 482010024 | Harris | TX | 70.4 | 72.8 | 0.39 | 0.04 | 0.29 | 0.12 | 0.13 | 0.00 | 0.00 | 0.00 | 0.39 | 0.26 | 0.05 | 0.34 | 0.13 | 0.17 | 0.17 | 0.10 | 3.06 | 0.00 | 0.00 | 0.00 | 0.06 | 0.06 | 0.50 | 0.38 | 0.05 |
| 482011034 | Harris | TX | 70.8 | 71.6 | 0.32 | 0.03 | 0.54 | 0.10 | 0.15 | 0.00 | 0.00 | 0.00 | 0.53 | 0.16 | 0.04 | 0.51 | 0.12 | 0.27 | 0.32 | 0.05 | 3.38 | 0.00 | 0.00 | 0.00 | 0.17 | 0.23 | 0.39 | 0.63 | 0.05 |
| 482011039 | Harris | TX | 71.8 | 73.5 | 0.37 | 0.04 | 0.99 | 0.12 | 0.20 | 0.00 | 0.00 | 0.00 | 0.23 | 0.13 | 0.05 | 0.88 | 0.24 | 0.33 | 0.33 | 0.11 | 4.72 | 0.00 | 0.00 | 0.00 | 0.27 | 0.20 | 0.79 | 0.88 | 0.07 |
| 484392003 | Tarrant | TX | 72.5 | 74.8 | 0.37 | 0.08 | 0.78 | 0.15 | 0.33 | 0.00 | 0.00 | 0.00 | 0.18 | 0.26 | 0.07 | 0.29 | 0.18 | 0.19 | 0.69 | 0.13 | 1.71 | 0.00 | 0.01 | 0.00 | 0.13 | 0.15 | 0.27 | 0.38 | 0.10 |
| 550790085 | Milwaukee | WI | 71.2 | 73.0 | 0.14 | 0.04 | 0.40 | 0.07 | 0.08 | 0.00 | 0.00 | 0.00 | 0.06 | 0.06 | 0.03 | 15.10 | 5.28 | 0.79 | 0.35 | 0.77 | 0.72 | 0.00 | 0.03 | 0.00 | 2.01 | 0.40 | 0.28 | 0.93 | 0.10 |
| 551170006 | Sheboygan | WI | 72.8 | 75.1 | 0.14 | 0.08 | 0.51 | 0.12 | 0.11 | 0.00 | 0.00 | 0.00 | 0.07 | 0.07 | 0.04 | 15.73 | 7.11 | 0.45 | 0.46 | 0.81 | 0.84 | 0.00 | 0.03 | 0.00 | 2.06 | 0.28 | 0.30 | 1.37 | 0.06 |

# Contributions to 2023 Nonattainment and Maintenance Sites Outside of California (Part 2)

| Site ID | County | State | 2023en Average | 2023en Maximum | NE | NV | NH | NJ | NM | NY | NC | ND | OH | OK | OR | PA | RI | SC | SD | TN | TX | UT | VT | VA | WA | WV | WI | WY |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 40130019 | Maricopa | AZ | 69.3 | 71.4 | 0.00 | 0.09 | 0.00 | 0.00 | 0.09 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.22 | 0.06 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.01 |
| 40131004 | Maricopa | AZ | 69.8 | 71.0 | 0.00 | 0.14 | 0.00 | 0.00 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.06 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.11 | 0.06 | 0.00 | 0.00 | 0.03 | 0.00 | 0.00 | 0.00 |
| 80050002 | Arapahoe | CO | 69.3 | 71.3 | 0.34 | 0.33 | 0.00 | 0.00 | 0.22 | 0.00 | 0.00 | 0.00 | 0.00 | 0.12 | 0.11 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 0.30 | 1.23 | 0.00 | 0.00 | 0.04 | 0.00 | 0.00 | 1.04 |
| 80350004 | Douglas | CO | 71.1 | 73.2 | 0.32 | 0.32 | 0.00 | 0.00 | 0.22 | 0.00 | 0.00 | 0.00 | 0.00 | 0.12 | 0.10 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 0.36 | 1.08 | 0.00 | 0.00 | 0.04 | 0.00 | 0.00 | 1.00 |
| 80590006 | Jefferson | CO | 71.3 | 73.7 | 0.41 | 0.31 | 0.00 | 0.00 | 0.70 | 0.00 | 0.00 | 0.00 | 0.00 | 0.24 | 0.10 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 1.02 | 0.83 | 0.00 | 0.00 | 0.04 | 0.00 | 0.00 | 0.81 |
| 80590011 | Jefferson | CO | 70.9 | 73.9 | 0.36 | 0.38 | 0.00 | 0.00 | 0.38 | 0.00 | 0.00 | 0.00 | 0.00 | 0.18 | 0.10 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 0.94 | 1.04 | 0.00 | 0.00 | 0.03 | 0.00 | 0.00 | 1.03 |
| 80690011 | Larimer | CO | 71.2 | 73.0 | 0.25 | 0.37 | 0.00 | 0.00 | 0.52 | 0.00 | 0.00 | 0.00 | 0.00 | 0.05 | 0.10 | 0.00 | 0.00 | 0.00 | 0.03 | 0.00 | 0.40 | 1.05 | 0.00 | 0.00 | 0.10 | 0.00 | 0.00 | 0.88 |
| 81230009 | Weld | CO | 70.2 | 71.4 | 0.27 | 0.24 | 0.00 | 0.00 | 0.77 | 0.00 | 0.00 | 0.00 | 0.00 | 0.08 | 0.04 | 0.00 | 0.00 | 0.00 | 0.03 | 0.00 | 1.05 | 0.54 | 0.00 | 0.00 | 0.05 | 0.00 | 0.00 | 0.58 |
| 90010017 | Fairfield | CT | 68.9 | 71.2 | 0.06 | 0.00 | 0.01 | 6.24 | 0.04 | 17.31 | 0.29 | 0.07 | 1.04 | 0.15 | 0.00 | 5.11 | 0.01 | 0.06 | 0.03 | 0.15 | 0.30 | 0.03 | 0.01 | 1.27 | 0.02 | 0.68 | 0.26 | 0.07 |
| 90013007 | Fairfield | CT | 71.0 | 75.0 | 0.07 | 0.01 | 0.02 | 6.94 | 0.06 | 14.12 | 0.40 | 0.07 | 1.84 | 0.21 | 0.00 | 6.32 | 0.02 | 0.11 | 0.02 | 0.31 | 0.44 | 0.04 | 0.01 | 1.51 | 0.01 | 1.10 | 0.24 | 0.08 |
| 90019003 | Fairfield | CT | 73.0 | 75.9 | 0.07 | 0.01 | 0.02 | 7.75 | 0.06 | 15.80 | 0.43 | 0.06 | 1.60 | 0.21 | 0.01 | 6.56 | 0.02 | 0.12 | 0.02 | 0.28 | 0.45 | 0.04 | 0.01 | 1.91 | 0.01 | 1.14 | 0.20 | 0.08 |
| 90099002 | New Haven | CT | 69.9 | 72.6 | 0.09 | 0.01 | 0.03 | 5.06 | 0.04 | 15.03 | 0.32 | 0.15 | 1.17 | 0.24 | 0.01 | 4.87 | 0.02 | 0.04 | 0.04 | 0.12 | 0.41 | 0.04 | 0.02 | 1.26 | 0.04 | 0.61 | 0.25 | 0.10 |
| 240251001 | Harford | MD | 70.9 | 73.3 | 0.13 | 0.01 | 0.00 | 0.07 | 0.09 | 0.16 | 0.42 | 0.07 | 2.77 | 0.35 | 0.02 | 4.32 | 0.00 | 0.11 | 0.04 | 0.43 | 0.74 | 0.05 | 0.00 | 5.05 | 0.04 | 2.78 | 0.24 | 0.12 |
| 260050003 | Allegan | MI | 69.0 | 71.7 | 0.16 | 0.02 | 0.00 | 0.00 | 0.16 | 0.00 | 0.05 | 0.09 | 0.19 | 1.31 | 0.01 | 0.05 | 0.00 | 0.04 | 0.05 | 0.65 | 2.39 | 0.06 | 0.00 | 0.04 | 0.05 | 0.11 | 1.95 | 0.12 |
| 261630019 | Wayne | MI | 69.0 | 71.0 | 0.17 | 0.03 | 0.00 | 0.01 | 0.08 | 0.06 | 0.20 | 0.12 | 3.81 | 0.62 | 0.05 | 0.18 | 0.00 | 0.05 | 0.04 | 0.27 | 1.12 | 0.09 | 0.00 | 0.16 | 0.07 | 0.23 | 1.08 | 0.18 |
| 360810124 | Queens | NY | 70.2 | 72.0 | 0.12 | 0.02 | 0.06 | 8.57 | 0.07 | 13.55 | 0.35 | 0.12 | 1.88 | 0.32 | 0.02 | 7.16 | 0.04 | 0.09 | 0.05 | 0.13 | 0.58 | 0.07 | 0.07 | 1.56 | 0.03 | 1.01 | 0.38 | 0.14 |
| 360850067 | Richmond | NY | 67.1 | 68.5 | 0.12 | 0.02 | 0.00 | 10.53 | 0.09 | 6.57 | 0.37 | 0.09 | 2.05 | 0.36 | 0.01 | 10.41 | 0.00 | 0.10 | 0.04 | 0.36 | 0.70 | 0.07 | 0.00 | 1.67 | 0.02 | 1.54 | 0.30 | 0.12 |
| 361030002 | Suffolk | NY | 74.0 | 75.5 | 0.12 | 0.02 | 0.01 | 8.88 | 0.06 | 18.11 | 0.23 | 0.20 | 1.76 | 0.34 | 0.03 | 6.86 | 0.00 | 0.05 | 0.05 | 0.22 | 0.60 | 0.07 | 0.02 | 0.99 | 0.06 | 0.81 | 0.25 | 0.14 |
| 480391004 | Brazoria | TX | 74.0 | 74.9 | 0.23 | 0.06 | 0.00 | 0.00 | 0.08 | 0.00 | 0.04 | 0.06 | 0.06 | 0.90 | 0.05 | 0.01 | 0.00 | 0.04 | 0.05 | 0.28 | 26.00 | 0.14 | 0.00 | 0.02 | 0.06 | 0.02 | 0.40 | 0.27 |
| 481210034 | Denton | TX | 69.7 | 72.0 | 0.15 | 0.04 | 0.00 | 0.00 | 0.13 | 0.01 | 0.09 | 0.03 | 0.08 | 1.23 | 0.03 | 0.04 | 0.00 | 0.09 | 0.03 | 0.14 | 26.69 | 0.10 | 0.00 | 0.05 | 0.05 | 0.04 | 0.08 | 0.25 |
| 482010024 | Harris | TX | 70.4 | 72.8 | 0.08 | 0.03 | 0.00 | 0.00 | 0.05 | 0.00 | 0.14 | 0.04 | 0.05 | 0.20 | 0.03 | 0.02 | 0.00 | 0.14 | 0.02 | 0.26 | 25.62 | 0.08 | 0.00 | 0.06 | 0.03 | 0.05 | 0.07 | 0.14 |
| 482011034 | Harris | TX | 70.8 | 71.6 | 0.16 | 0.03 | 0.00 | 0.00 | 0.04 | 0.00 | 0.09 | 0.04 | 0.05 | 0.68 | 0.02 | 0.01 | 0.00 | 0.10 | 0.03 | 0.09 | 25.66 | 0.07 | 0.00 | 0.03 | 0.02 | 0.03 | 0.22 | 0.15 |
| 482011039 | Harris | TX | 71.8 | 73.5 | 0.19 | 0.03 | 0.00 | 0.00 | 0.06 | 0.00 | 0.04 | 0.06 | 0.05 | 0.58 | 0.03 | 0.01 | 0.00 | 0.03 | 0.04 | 0.30 | 22.82 | 0.08 | 0.00 | 0.02 | 0.04 | 0.01 | 0.28 | 0.20 |
| 484392003 | Tarrant | TX | 72.5 | 74.8 | 0.30 | 0.04 | 0.00 | 0.00 | 0.14 | 0.01 | 0.09 | 0.05 | 0.10 | 1.71 | 0.05 | 0.05 | 0.00 | 0.08 | 0.07 | 0.15 | 27.64 | 0.15 | 0.00 | 0.05 | 0.09 | 0.05 | 0.13 | 0.28 |
| 550790085 | Milwaukee | WI | 71.2 | 73.0 | 0.06 | 0.01 | 0.00 | 0.00 | 0.08 | 0.02 | 0.04 | 0.23 | 0.87 | 0.76 | 0.02 | 0.33 | 0.00 | 0.02 | 0.03 | 0.31 | 1.22 | 0.04 | 0.00 | 0.12 | 0.09 | 0.59 | 13.39 | 0.09 |
| 551170006 | Sheboygan | WI | 72.8 | 75.1 | 0.06 | 0.03 | 0.00 | 0.00 | 0.14 | 0.02 | 0.04 | 0.10 | 1.10 | 0.95 | 0.04 | 0.41 | 0.00 | 0.02 | 0.02 | 0.31 | 1.65 | 0.06 | 0.00 | 0.10 | 0.07 | 0.64 | 9.09 | 0.12 |

## Contributions to 2023 Nonattainment and Maintenance Sites Outside of California (Part 3)

| Site ID | County | State | 2023en Average | 2023en Maximum | Tribal | Canada/ Mexco | Offshore | Fire | Boundary | Biogenic |
|---|---|---|---|---|---|---|---|---|---|---|
| 40130019 | Maricopa | AZ | 69.3 | 71.4 | 0.06 | 3.29 | 0.37 | 0.49 | 34.74 | 2.52 |
| 40131004 | Maricopa | AZ | 69.8 | 71.0 | 0.06 | 2.70 | 0.34 | 0.56 | 33.85 | 2.24 |
| 80050002 | Arapahoe | CO | 69.3 | 71.3 | 0.22 | 0.55 | 0.14 | 0.46 | 34.84 | 4.24 |
| 80350004 | Douglas | CO | 71.1 | 73.2 | 0.21 | 0.71 | 0.16 | 0.47 | 34.74 | 4.19 |
| 80590006 | Jefferson | CO | 71.3 | 73.7 | 0.21 | 0.90 | 0.17 | 0.66 | 31.41 | 5.40 |
| 80590011 | Jefferson | CO | 70.9 | 73.9 | 0.16 | 0.70 | 0.16 | 0.45 | 32.96 | 4.74 |
| 80690011 | Larimer | CO | 71.2 | 73.0 | 0.25 | 0.78 | 0.19 | 1.74 | 34.54 | 5.71 |
| 81230009 | Weld | CO | 70.2 | 71.4 | 0.23 | 1.04 | 0.15 | 1.57 | 31.11 | 6.08 |
| 90010017 | Fairfield | CT | 68.9 | 71.2 | 0.00 | 1.64 | 0.65 | 0.20 | 16.73 | 3.28 |
| 90013007 | Fairfield | CT | 71.0 | 75.0 | 0.01 | 1.35 | 1.93 | 0.34 | 17.17 | 4.01 |
| 90019003 | Fairfield | CT | 73.0 | 75.9 | 0.01 | 1.37 | 1.96 | 0.33 | 17.00 | 4.09 |
| 90099002 | New Haven | CT | 69.9 | 72.6 | 0.01 | 1.58 | 2.15 | 0.22 | 17.17 | 4.13 |
| 240251001 | Harford | MD | 70.9 | 73.3 | 0.01 | 0.79 | 0.32 | 0.42 | 15.28 | 5.32 |
| 260050003 | Allegan | MI | 69.0 | 71.7 | 0.02 | 0.54 | 0.36 | 0.93 | 11.85 | 8.91 |
| 261630019 | Wayne | MI | 69.0 | 71.0 | 0.02 | 3.13 | 0.17 | 0.44 | 20.06 | 6.93 |
| 360810124 | Queens | NY | 70.2 | 72.0 | 0.01 | 1.73 | 1.39 | 0.25 | 17.87 | 4.45 |
| 360850067 | Richmond | NY | 67.1 | 68.5 | 0.01 | 1.44 | 0.83 | 0.35 | 15.46 | 4.75 |
| 361030002 | Suffolk | NY | 74.0 | 75.5 | 0.01 | 1.85 | 1.24 | 0.30 | 18.94 | 4.49 |
| 480391004 | Brazoria | TX | 74.0 | 74.9 | 0.02 | 0.44 | 2.31 | 2.05 | 24.02 | 5.60 |
| 481210034 | Denton | TX | 69.7 | 72.0 | 0.01 | 0.92 | 1.23 | 0.87 | 24.69 | 6.42 |
| 482010024 | Harris | TX | 70.4 | 72.8 | 0.01 | 0.28 | 4.83 | 0.77 | 27.83 | 2.66 |
| 482011034 | Harris | TX | 70.8 | 71.6 | 0.01 | 0.24 | 3.91 | 1.75 | 25.71 | 3.44 |
| 482011039 | Harris | TX | 71.8 | 73.5 | 0.01 | 0.47 | 4.04 | 2.09 | 24.67 | 4.50 |
| 484392003 | Tarrant | TX | 72.5 | 74.8 | 0.02 | 1.24 | 1.18 | 1.34 | 24.38 | 6.44 |
| 550790085 | Milwaukee | WI | 71.2 | 73.0 | 0.01 | 0.82 | 0.43 | 0.37 | 16.67 | 6.70 |
| 551170006 | Sheboygan | WI | 72.8 | 75.1 | 0.01 | 0.69 | 0.55 | 0.64 | 17.53 | 7.51 |

# Contributions to 2023 Nonattainment and Maintenance Sites in California (Part 1)

| Site ID | County | State | 2023 Average | 2023 Maximum | AL | AZ | AR | CA | CO | CT | DE | DC | FL | GA | ID | IL | IN | IA | KS | KY | LA | ME | MD | MA | MI | MN | MS | MO | MT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 60190007 | Fresno | CA | 79.2 | 79.4 | 0.00 | 0.16 | 0.00 | 35.68 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 60190011 | Fresno | CA | 78.6 | 81.2 | 0.00 | 0.15 | 0.00 | 35.20 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 60190242 | Fresno | CA | 79.4 | 82.2 | 0.00 | 0.21 | 0.00 | 31.98 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 60194001 | Fresno | CA | 73.3 | 74.4 | 0.00 | 0.03 | 0.00 | 34.20 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 60195001 | Fresno | CA | 79.6 | 81.2 | 0.00 | 0.12 | 0.00 | 35.79 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 60250005 | Imperial | CA | 73.3 | 74.6 | 0.00 | 0.62 | 0.00 | 9.28 | 0.08 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 60251003 | Imperial | CA | 79.0 | 80.0 | 0.00 | 0.67 | 0.00 | 11.34 | 0.07 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 60290007 | Kern | CA | 77.7 | 81.3 | 0.00 | 0.07 | 0.00 | 29.99 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 60290008 | Kern | CA | 71.3 | 72.8 | 0.00 | 0.17 | 0.00 | 26.44 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 60290014 | Kern | CA | 74.1 | 75.2 | 0.00 | 0.11 | 0.00 | 31.54 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 60290232 | Kern | CA | 73.7 | 75.2 | 0.00 | 0.03 | 0.00 | 32.66 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 60295002 | Kern | CA | 75.9 | 76.8 | 0.00 | 0.13 | 0.00 | 28.33 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 60296001 | Kern | CA | 70.9 | 72.4 | 0.00 | 0.16 | 0.00 | 28.50 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 60370002 | Los Angeles | CA | 73.3 | 75.1 | 0.00 | 0.23 | 0.00 | 39.68 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 60370016 | Los Angeles | CA | 86.1 | 88.9 | 0.00 | 0.27 | 0.00 | 46.61 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 60371201 | Los Angeles | CA | 79.8 | 79.8 | 0.00 | 0.37 | 0.00 | 35.55 | 0.06 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 60371701 | Los Angeles | CA | 78.1 | 79.1 | 0.00 | 0.27 | 0.00 | 42.09 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 60372005 | Los Angeles | CA | 72.3 | 74.6 | 0.00 | 0.32 | 0.00 | 37.39 | 0.06 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 60376012 | Los Angeles | CA | 85.9 | 87.4 | 0.00 | 0.42 | 0.00 | 39.86 | 0.08 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 60379033 | Los Angeles | CA | 76.3 | 77.2 | 0.00 | 0.34 | 0.00 | 25.79 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 60392010 | Madera | CA | 72.1 | 72.9 | 0.00 | 0.20 | 0.00 | 28.39 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 60470003 | Merced | CA | 69.9 | 71.0 | 0.00 | 0.10 | 0.00 | 28.52 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 60650004 | Riverside | CA | 76.7 | 76.7 | 0.00 | 0.22 | 0.00 | 41.92 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 60650012 | Riverside | CA | 83.6 | 85.1 | 0.00 | 0.21 | 0.00 | 38.65 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 60651016 | Riverside | CA | 85.2 | 85.5 | 0.00 | 0.22 | 0.00 | 35.47 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 60652002 | Riverside | CA | 72.4 | 73.0 | 0.00 | 0.27 | 0.00 | 16.57 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 60655001 | Riverside | CA | 79.5 | 80.1 | 0.00 | 0.20 | 0.00 | 24.70 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 60656001 | Riverside | CA | 78.3 | 81.6 | 0.00 | 0.17 | 0.00 | 39.14 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 60658001 | Riverside | CA | 87.0 | 87.9 | 0.00 | 0.27 | 0.00 | 47.69 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 60658005 | Riverside | CA | 83.2 | 84.4 | 0.00 | 0.25 | 0.00 | 45.60 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 60659001 | Riverside | CA | 73.7 | 75.9 | 0.00 | 0.16 | 0.00 | 37.28 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 60670012 | Sacramento | CA | 74.5 | 75.9 | 0.00 | 0.01 | 0.00 | 35.91 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 60675003 | Sacramento | CA | 69.9 | 71.3 | 0.00 | 0.00 | 0.00 | 34.18 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 60710005 | San Bernardino | CA | 96.2 | 98.1 | 0.00 | 0.23 | 0.00 | 48.09 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 60710012 | San Bernardino | CA | 84.1 | 85.8 | 0.00 | 0.46 | 0.00 | 24.28 | 0.06 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 60710306 | San Bernardino | CA | 76.2 | 77.4 | 0.00 | 0.14 | 0.00 | 29.72 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 60711004 | San Bernardino | CA | 89.8 | 91.0 | 0.00 | 0.35 | 0.00 | 47.69 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 60712002 | San Bernardino | CA | 93.1 | 95.0 | 0.00 | 0.14 | 0.00 | 51.11 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 60714001 | San Bernardino | CA | 86.0 | 88.5 | 0.00 | 0.21 | 0.00 | 41.23 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 60714003 | San Bernardino | CA | 94.1 | 95.8 | 0.00 | 0.10 | 0.00 | 52.53 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 60719002 | San Bernardino | CA | 80.0 | 81.4 | 0.00 | 0.45 | 0.00 | 22.21 | 0.08 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 60719004 | San Bernardino | CA | 88.4 | 88.7 | 0.00 | 0.10 | 0.00 | 49.35 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 60990006 | Stanislaus | CA | 74.8 | 75.7 | 0.00 | 0.03 | 0.00 | 34.16 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 61070006 | Tulare | CA | 69.1 | 71.9 | 0.00 | 0.06 | 0.00 | 7.37 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 61070009 | Tulare | CA | 76.1 | 77.2 | 0.00 | 0.07 | 0.00 | 23.74 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 61072002 | Tulare | CA | 68.9 | 71.4 | 0.00 | 0.12 | 0.00 | 30.91 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 61072010 | Tulare | CA | 73.1 | 73.9 | 0.00 | 0.03 | 0.00 | 30.19 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 61112002 | Ventura | CA | 70.5 | 72.2 | 0.00 | 0.32 | 0.00 | 29.51 | 0.06 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |

# Contributions to 2023 Nonattainment and Maintenance Sites in California (Part 2)

| Site ID | County | State | 2023 Average | 2023 Maximum | NE | NV | NH | NJ | NM | NY | NC | ND | OH | OK | OR | PA | RI | SC | SD | TN | TX | UT | VT | VA | WA | WV | WI | WY |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 60190007 | Fresno | CA | 79.2 | 79.4 | 0.00 | 0.51 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.29 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.03 | 0.08 | 0.00 | 0.00 | 0.05 | 0.00 | 0.00 | 0.01 |
| 60190011 | Fresno | CA | 78.6 | 81.2 | 0.00 | 0.44 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.27 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.03 | 0.09 | 0.00 | 0.00 | 0.05 | 0.00 | 0.00 | 0.01 |
| 60190242 | Fresno | CA | 79.4 | 82.2 | 0.00 | 0.64 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.35 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.03 | 0.10 | 0.00 | 0.00 | 0.07 | 0.00 | 0.00 | 0.01 |
| 60194001 | Fresno | CA | 73.3 | 74.4 | 0.00 | 0.27 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.31 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.07 | 0.00 | 0.00 | 0.00 |
| 60195001 | Fresno | CA | 79.6 | 81.2 | 0.00 | 0.38 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.33 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.05 | 0.00 | 0.00 | 0.00 |
| 60250005 | Imperial | CA | 73.3 | 74.6 | 0.00 | 0.09 | 0.00 | 0.00 | 0.12 | 0.00 | 0.00 | 0.00 | 0.00 | 0.03 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.20 | 0.05 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.04 |
| 60251003 | Imperial | CA | 79.0 | 80.0 | 0.00 | 0.25 | 0.00 | 0.00 | 0.11 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.06 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.09 | 0.06 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.03 |
| 60290007 | Kern | CA | 77.7 | 81.3 | 0.00 | 0.29 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.37 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.10 | 0.00 | 0.00 | 0.15 | 0.00 | 0.00 | 0.03 |
| 60290008 | Kern | CA | 71.3 | 72.8 | 0.00 | 0.31 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.34 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.02 | 0.00 | 0.00 | 0.10 | 0.00 | 0.00 | 0.01 |
| 60290014 | Kern | CA | 74.1 | 75.2 | 0.00 | 0.38 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.34 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.08 | 0.00 | 0.00 | 0.00 |
| 60290232 | Kern | CA | 73.7 | 75.2 | 0.00 | 0.27 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.39 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.02 | 0.00 | 0.00 | 0.17 | 0.00 | 0.00 | 0.00 |
| 60295002 | Kern | CA | 75.9 | 76.8 | 0.00 | 0.31 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.25 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.06 | 0.00 | 0.00 | 0.05 | 0.00 | 0.00 | 0.02 |
| 60296001 | Kern | CA | 70.9 | 72.4 | 0.00 | 0.58 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.26 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.02 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 |
| 60370002 | Los Angeles | CA | 73.3 | 75.1 | 0.00 | 0.12 | 0.00 | 0.00 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.13 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.16 | 0.03 | 0.00 | 0.00 | 0.04 | 0.00 | 0.00 | 0.01 |
| 60370016 | Los Angeles | CA | 86.1 | 88.9 | 0.00 | 0.14 | 0.00 | 0.00 | 0.06 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.15 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.18 | 0.03 | 0.00 | 0.00 | 0.05 | 0.00 | 0.00 | 0.02 |
| 60371201 | Los Angeles | CA | 79.8 | 79.8 | 0.00 | 0.17 | 0.00 | 0.00 | 0.06 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.10 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.13 | 0.09 | 0.00 | 0.00 | 0.05 | 0.00 | 0.00 | 0.03 |
| 60371701 | Los Angeles | CA | 78.1 | 79.1 | 0.00 | 0.11 | 0.00 | 0.00 | 0.07 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.15 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.19 | 0.03 | 0.00 | 0.00 | 0.05 | 0.00 | 0.00 | 0.02 |
| 60372005 | Los Angeles | CA | 72.3 | 74.6 | 0.00 | 0.08 | 0.00 | 0.00 | 0.08 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.10 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.21 | 0.06 | 0.00 | 0.00 | 0.04 | 0.00 | 0.00 | 0.02 |
| 60376012 | Los Angeles | CA | 85.9 | 87.4 | 0.00 | 0.18 | 0.00 | 0.00 | 0.09 | 0.00 | 0.00 | 0.00 | 0.00 | 0.03 | 0.16 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.21 | 0.08 | 0.00 | 0.00 | 0.07 | 0.00 | 0.00 | 0.04 |
| 60379033 | Los Angeles | CA | 76.3 | 77.2 | 0.00 | 0.15 | 0.00 | 0.00 | 0.06 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.19 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.15 | 0.04 | 0.00 | 0.00 | 0.07 | 0.00 | 0.00 | 0.02 |
| 60392010 | Madera | CA | 72.1 | 72.9 | 0.00 | 0.65 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.34 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.12 | 0.00 | 0.00 | 0.06 | 0.00 | 0.00 | 0.02 |
| 60470003 | Merced | CA | 69.9 | 71.0 | 0.00 | 0.39 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.42 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.07 | 0.00 | 0.00 | 0.00 |
| 60650004 | Riverside | CA | 76.7 | 76.7 | 0.00 | 0.14 | 0.00 | 0.00 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.13 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.13 | 0.03 | 0.00 | 0.00 | 0.03 | 0.00 | 0.00 | 0.01 |
| 60650012 | Riverside | CA | 83.6 | 85.1 | 0.00 | 0.24 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.15 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.03 | 0.02 | 0.00 | 0.00 | 0.08 | 0.00 | 0.00 | 0.00 |
| 60651016 | Riverside | CA | 85.2 | 85.5 | 0.00 | 0.28 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.09 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.02 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 |
| 60652002 | Riverside | CA | 72.4 | 73.0 | 0.00 | 0.18 | 0.00 | 0.00 | 0.06 | 0.00 | 0.00 | 0.00 | 0.00 | 0.04 | 0.07 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.22 | 0.04 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.02 |
| 60655001 | Riverside | CA | 79.5 | 80.1 | 0.00 | 0.11 | 0.00 | 0.00 | 0.06 | 0.00 | 0.00 | 0.00 | 0.00 | 0.04 | 0.12 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.26 | 0.03 | 0.00 | 0.00 | 0.07 | 0.00 | 0.00 | 0.02 |
| 60656001 | Riverside | CA | 78.3 | 81.6 | 0.00 | 0.19 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.10 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.04 | 0.07 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.02 |
| 60658001 | Riverside | CA | 87.0 | 87.9 | 0.00 | 0.15 | 0.00 | 0.00 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.17 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.12 | 0.03 | 0.00 | 0.00 | 0.06 | 0.00 | 0.00 | 0.01 |
| 60658005 | Riverside | CA | 83.2 | 84.4 | 0.00 | 0.14 | 0.00 | 0.00 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.17 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.11 | 0.03 | 0.00 | 0.00 | 0.06 | 0.00 | 0.00 | 0.01 |
| 60659001 | Riverside | CA | 73.7 | 75.9 | 0.00 | 0.15 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.16 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.05 | 0.00 | 0.00 | 0.04 | 0.00 | 0.00 | 0.01 |
| 60670012 | Sacramento | CA | 74.5 | 75.9 | 0.00 | 0.30 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.57 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.20 | 0.00 | 0.00 | 0.00 |
| 60675003 | Sacramento | CA | 69.9 | 71.3 | 0.00 | 0.44 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.45 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.14 | 0.00 | 0.00 | 0.00 |
| 60710005 | San Bernardino | CA | 96.2 | 98.1 | 0.00 | 0.25 | 0.00 | 0.00 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.20 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.13 | 0.03 | 0.00 | 0.00 | 0.07 | 0.00 | 0.00 | 0.01 |
| 60710012 | San Bernardino | CA | 84.1 | 85.8 | 0.00 | 0.15 | 0.00 | 0.00 | 0.07 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.11 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.12 | 0.06 | 0.00 | 0.00 | 0.04 | 0.00 | 0.00 | 0.03 |
| 60710306 | San Bernardino | CA | 76.2 | 77.4 | 0.00 | 0.06 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.14 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.04 | 0.01 | 0.00 | 0.00 | 0.04 | 0.00 | 0.00 | 0.00 |
| 60711004 | San Bernardino | CA | 89.8 | 91.0 | 0.00 | 0.14 | 0.00 | 0.00 | 0.08 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.15 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.22 | 0.04 | 0.00 | 0.00 | 0.05 | 0.00 | 0.00 | 0.02 |
| 60712002 | San Bernardino | CA | 93.1 | 95.0 | 0.00 | 0.16 | 0.00 | 0.00 | 0.03 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.23 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.13 | 0.01 | 0.00 | 0.00 | 0.08 | 0.00 | 0.00 | 0.00 |
| 60714001 | San Bernardino | CA | 86.0 | 88.5 | 0.00 | 0.19 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.15 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.03 | 0.01 | 0.00 | 0.00 | 0.05 | 0.00 | 0.00 | 0.00 |
| 60714003 | San Bernardino | CA | 94.1 | 95.8 | 0.00 | 0.21 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.25 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.12 | 0.08 | 0.00 | 0.00 | 0.15 | 0.00 | 0.00 | 0.01 |
| 60719002 | San Bernardino | CA | 80.0 | 81.4 | 0.00 | 0.14 | 0.00 | 0.00 | 0.10 | 0.00 | 0.00 | 0.00 | 0.00 | 0.05 | 0.10 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.28 | 0.05 | 0.00 | 0.00 | 0.04 | 0.00 | 0.00 | 0.04 |
| 60719004 | San Bernardino | CA | 88.4 | 88.7 | 0.00 | 0.20 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.23 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.11 | 0.07 | 0.00 | 0.00 | 0.14 | 0.00 | 0.00 | 0.01 |
| 60990006 | Stanislaus | CA | 74.8 | 75.7 | 0.00 | 0.24 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.47 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.05 | 0.00 | 0.00 | 0.11 | 0.00 | 0.00 | 0.01 |
| 61070006 | Tulare | CA | 69.1 | 71.9 | 0.00 | 0.05 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.11 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.03 | 0.00 | 0.00 | 0.00 |
| 61070009 | Tulare | CA | 76.1 | 77.2 | 0.00 | 0.11 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.21 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.00 | 0.00 | 0.00 | 0.07 | 0.00 | 0.00 | 0.00 |
| 61072002 | Tulare | CA | 68.9 | 71.4 | 0.00 | 0.21 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.32 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.16 | 0.00 | 0.00 | 0.00 |
| 61072010 | Tulare | CA | 73.1 | 73.9 | 0.00 | 0.20 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.40 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.00 | 0.00 | 0.17 | 0.00 | 0.00 | 0.00 |
| 61112002 | Ventura | CA | 70.5 | 72.2 | 0.00 | 0.18 | 0.00 | 0.00 | 0.05 | 0.00 | 0.00 | 0.00 | 0.00 | 0.02 | 0.16 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.13 | 0.08 | 0.00 | 0.00 | 0.08 | 0.00 | 0.00 | 0.03 |



NMED Exhibit 9c

## Contributions to 2023 Nonattainment and Maintenance Sites in California (Part 3)

| Site ID | County | State | 2023 Average | 2023 Maximum | Tribal | Canada/ Mexco | Offshore | Fire | Boundary | Biogenic |
|---|---|---|---|---|---|---|---|---|---|---|
| 60190007 | Fresno | CA | 79.2 | 79.4 | 0.00 | 0.29 | 1.19 | 1.39 | 32.52 | 6.85 |
| 60190011 | Fresno | CA | 78.6 | 81.2 | 0.01 | 0.33 | 1.13 | 1.62 | 32.34 | 6.78 |
| 60190242 | Fresno | CA | 79.4 | 82.2 | 0.00 | 0.31 | 1.24 | 1.48 | 34.92 | 7.88 |
| 60194001 | Fresno | CA | 73.3 | 74.4 | 0.00 | 0.12 | 1.68 | 0.87 | 27.76 | 7.90 |
| 60195001 | Fresno | CA | 79.6 | 81.2 | 0.00 | 0.20 | 1.75 | 1.12 | 32.10 | 7.66 |
| 60250005 | Imperial | CA | 73.3 | 74.6 | 0.01 | 19.87 | 1.17 | 0.71 | 38.68 | 2.11 |
| 60251003 | Imperial | CA | 79.0 | 80.0 | 0.01 | 18.74 | 1.14 | 0.61 | 43.58 | 2.08 |
| 60290007 | Kern | CA | 77.7 | 81.3 | 0.00 | 0.30 | 1.59 | 3.27 | 33.68 | 7.70 |
| 60290008 | Kern | CA | 71.3 | 72.8 | 0.01 | 0.67 | 1.96 | 1.05 | 32.77 | 7.30 |
| 60290014 | Kern | CA | 74.1 | 75.2 | 0.00 | 0.31 | 1.68 | 0.85 | 31.31 | 7.37 |
| 60290232 | Kern | CA | 73.7 | 75.2 | 0.00 | 0.13 | 1.67 | 1.11 | 29.43 | 7.73 |
| 60295002 | Kern | CA | 75.9 | 76.8 | 0.00 | 0.35 | 1.34 | 3.80 | 33.45 | 7.68 |
| 60296001 | Kern | CA | 70.9 | 72.4 | 0.00 | 0.50 | 1.59 | 0.63 | 30.55 | 7.98 |
| 60370002 | Los Angeles | CA | 73.3 | 75.1 | 0.01 | 1.47 | 3.53 | 0.82 | 24.67 | 2.15 |
| 60370016 | Los Angeles | CA | 86.1 | 88.9 | 0.01 | 1.73 | 4.14 | 0.97 | 28.98 | 2.53 |
| 60371201 | Los Angeles | CA | 79.8 | 79.8 | 0.02 | 1.74 | 4.20 | 1.29 | 32.92 | 2.83 |
| 60371701 | Los Angeles | CA | 78.1 | 79.1 | 0.01 | 1.82 | 4.16 | 0.97 | 25.57 | 2.35 |
| 60372005 | Los Angeles | CA | 72.3 | 74.6 | 0.01 | 1.76 | 4.10 | 1.17 | 24.34 | 2.37 |
| 60376012 | Los Angeles | CA | 85.9 | 87.4 | 0.02 | 2.27 | 4.69 | 1.22 | 32.85 | 3.43 |
| 60379033 | Los Angeles | CA | 76.3 | 77.2 | 0.01 | 1.82 | 3.52 | 0.45 | 40.73 | 2.75 |
| 60392010 | Madera | CA | 72.1 | 72.9 | 0.00 | 0.23 | 1.22 | 1.30 | 32.12 | 7.30 |
| 60470003 | Merced | CA | 69.9 | 71.0 | 0.00 | 0.37 | 1.94 | 1.12 | 30.92 | 5.97 |
| 60650004 | Riverside | CA | 76.7 | 76.7 | 0.01 | 1.37 | 3.64 | 0.72 | 25.79 | 2.34 |
| 60650012 | Riverside | CA | 83.6 | 85.1 | 0.00 | 1.30 | 3.33 | 0.31 | 36.48 | 2.66 |
| 60651016 | Riverside | CA | 85.2 | 85.5 | 0.00 | 1.60 | 3.00 | 3.09 | 38.71 | 2.54 |
| 60652002 | Riverside | CA | 72.4 | 73.0 | 0.01 | 2.29 | 1.39 | 2.24 | 46.66 | 2.08 |
| 60655001 | Riverside | CA | 79.5 | 80.1 | 0.01 | 2.71 | 2.67 | 3.03 | 42.81 | 2.40 |
| 60656001 | Riverside | CA | 78.3 | 81.6 | 0.00 | 1.13 | 4.03 | 0.53 | 30.14 | 2.55 |
| 60658001 | Riverside | CA | 87.0 | 87.9 | 0.01 | 1.76 | 4.77 | 0.77 | 28.27 | 2.68 |
| 60658005 | Riverside | CA | 83.2 | 84.4 | 0.01 | 1.68 | 4.56 | 0.73 | 27.04 | 2.57 |
| 60659001 | Riverside | CA | 73.7 | 75.9 | 0.00 | 1.71 | 4.96 | 1.03 | 25.56 | 2.43 |
| 60670012 | Sacramento | CA | 74.5 | 75.9 | 0.00 | 0.12 | 0.88 | 1.16 | 29.33 | 5.92 |
| 60675003 | Sacramento | CA | 69.9 | 71.3 | 0.00 | 0.06 | 0.79 | 1.26 | 26.47 | 6.04 |
| 60710005 | San Bernardino | CA | 96.2 | 98.1 | 0.00 | 1.36 | 3.68 | 0.44 | 38.71 | 2.77 |
| 60710012 | San Bernardino | CA | 84.1 | 85.8 | 0.02 | 1.33 | 1.83 | 0.33 | 53.12 | 1.93 |
| 60710306 | San Bernardino | CA | 76.2 | 77.4 | 0.00 | 0.67 | 2.10 | 0.50 | 40.62 | 2.02 |
| 60711004 | San Bernardino | CA | 89.8 | 91.0 | 0.01 | 2.03 | 4.00 | 0.95 | 31.07 | 2.74 |
| 60712002 | San Bernardino | CA | 93.1 | 95.0 | 0.00 | 1.58 | 4.58 | 0.75 | 31.34 | 2.82 |
| 60714001 | San Bernardino | CA | 86.0 | 88.5 | 0.00 | 0.91 | 2.69 | 0.37 | 37.56 | 2.45 |
| 60714003 | San Bernardino | CA | 94.1 | 95.8 | 0.00 | 0.98 | 4.15 | 0.69 | 31.70 | 2.90 |
| 60719002 | San Bernardino | CA | 80.0 | 81.4 | 0.01 | 2.80 | 2.23 | 3.20 | 45.72 | 2.29 |
| 60719004 | San Bernardino | CA | 88.4 | 88.7 | 0.00 | 0.92 | 3.90 | 0.65 | 29.78 | 2.72 |
| 60990006 | Stanislaus | CA | 74.8 | 75.7 | 0.00 | 0.34 | 2.19 | 1.77 | 30.24 | 5.06 |
| 61070006 | Tulare | CA | 69.1 | 71.9 | 0.00 | 0.33 | 0.55 | 4.43 | 53.61 | 2.46 |
| 61070009 | Tulare | CA | 76.1 | 77.2 | 0.00 | 0.43 | 1.44 | 3.40 | 39.41 | 7.08 |
| 61072002 | Tulare | CA | 68.9 | 71.4 | 0.00 | 0.25 | 1.58 | 0.95 | 26.88 | 7.42 |
| 61072010 | Tulare | CA | 73.1 | 73.9 | 0.00 | 0.15 | 1.78 | 1.17 | 30.26 | 8.67 |
| 61112002 | Ventura | CA | 70.5 | 72.2 | 0.02 | 1.65 | 4.60 | 1.01 | 29.69 | 2.75 |

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
RESEARCH TRIANGLE PARK, NC 27711

OFFICE OF
AIR QUALITY PLANNING
AND STANDARDS

AUG 31 2018

**MEMORANDUM**

**SUBJECT:** Analysis of Contribution Thresholds for Use in Clean Air Act Section 110(a)(2)(D)(i)(I) Interstate Transport State Implementation Plan Submissions for the 2015 Ozone National Ambient Air Quality Standards

**FROM:** Peter Tsirigotis
Director

**TO:** Regional Air Division Directors, Regions 1–10

The purpose of this memorandum is to provide analytical information regarding the degree to which certain air quality threshold amounts capture the collective amount of upwind contribution from upwind states to downwind receptors for the 2015 ozone National Ambient Air Quality Standards (NAAQS). It also interprets that information to make recommendations about what thresholds may be appropriate for use in state implementation plan (SIP) revisions addressing the good neighbor provision for that NAAQS. This document does not substitute for provisions or regulations of the Clean Air Act (CAA), nor is it a regulation itself. Rather, it provides recommendations for states using the included analytical information in developing SIP submissions, and for the Environmental Protection Agency (EPA) Regional offices in acting on them. Thus, it does not impose binding, enforceable requirements on any party. State air agencies retain the discretion to develop good neighbor SIP revisions that differ from this guidance.

Following these recommendations does not ensure that the EPA will approve a SIP revision in all instances where the recommendations are followed, as the guidance may not apply to the facts and circumstances underlying a particular SIP. Final decisions by the EPA to approve a particular SIP revision will only be made based on the requirements of the statute and will only be made following an air agency's final submission of the SIP revision to the EPA, and after appropriate notice and opportunity for public review and comment. Interested parties may raise comment about the appropriateness of the application of this guidance to a particular SIP revision. The EPA and air agencies should consider whether the recommendations in this guidance are appropriate for each situation.



NMED Exhibit 9d

## Introduction

CAA section 110(a)(2)(D)(i)(I), otherwise known as the good neighbor provision, requires SIPs to prohibit emissions "which will contribute significantly to nonattainment in, or interfere with maintenance by, any other state with respect to any" NAAQS. The EPA has historically used a 4-step framework to address upwind state obligations under the good neighbor provision for regional pollutants like ozone, which includes the following steps: (1) identify downwind areas, referred to as "receptors," expected to have problems attaining or maintaining the NAAQS; (2) identify upwind states that contribute to those downwind air quality problems and warrant further review and analysis; (3) identify the emissions reductions (if any) necessary to eliminate an upwind state's significant contribution to nonattainment and/or interference with maintenance of the NAAQS in the downwind areas, considering cost and air quality factors; and (4) adopt permanent and enforceable measures needed to achieve those emissions reductions. The EPA notes that, in developing their SIP revisions for the 2015 ozone NAAQS, states have flexibility to follow this framework or develop alternative frameworks to evaluate interstate transport obligations, so long as a state's chosen approach has adequate technical justification and is consistent with the requirements of the CAA

At Step 2, the EPA has used an air quality screening threshold to determine whether or not a state contributes to a downwind air quality problem in amounts that warrant further evaluation as part of a multi-factor analysis in Step 3. Upwind states that impact a downwind receptor by less than the screening threshold do not contribute to the downwind air quality problem at Step 2. The EPA has previously determined that such states do not significantly contribute to nonattainment or interfere with maintenance of the NAAQS under the good neighbor provision without additional analysis. Upwind states that impact a downwind receptor at or above the threshold are identified as contributing to a downwind air quality problem (i.e., they are said to be "linked" to that downwind receptor). The Step 3 analysis is then used to determine if the linked upwind state's contribution is "significant" or will "interfere with maintenance" of the NAAQS at the downwind receptor(s).[1]

Determining an appropriate screening threshold is a critical component of designing and then applying Step 2. Each time EPA sets a new or revised NAAQS, states and EPA can evaluate collective contribution to identify an appropriate threshold for that NAAQS. This assessment uses data and air quality analyses that are specifically applicable to the NAAQS being considered and the relevant air quality conditions (e.g., pollutant concentrations and the magnitude of interstate transport). As a result, conclusions made with respect to one NAAQS are not by default applicable to another NAAQS. In previous federal actions,[2] EPA's analysis of collective contribution concluded that a screening threshold equivalent to 1 percent of the 1997 and 2008 ozone NAAQS was appropriate at Step 2. In this document, we evaluate data pertinent to several alternative thresholds that could be applicable to the development of SIP revisions to address the 2015 ozone

[1] Note that upwind states that are linked to a downwind receptor at Step 2 may nevertheless be found to not significantly contribute to nonattainment or interfere with maintenance at the receptor depending on the outcome of the Step 3 analysis.

[2] In the Cross-State Air Pollution Rule (CSAPR), the EPA used 0.80 parts per billion (ppb) as the threshold, which is 1 percent of the 1997 ozone NAAQS. 76 FR 48208, 48238 (August 8, 2011). Most recently, in the Cross-State Air Pollution Rule Update for the 2008 Ozone NAAQS (CSAPR Update), the EPA used 0.75 ppb as the threshold, which is 1 percent of the 2008 ozone NAAQS. 81 FR 74504, 74518 (October 26, 2016).

NAAQS of 70 ppb. We compare a threshold equivalent to 1 percent of the 2015 ozone NAAQS (i.e., a threshold of 0.70 ppb), consistent with EPA's previously applied screening thresholds at Step 2, as well as two alternative thresholds: 1 ppb and 2 ppb. The purpose of this analysis is to examine the amount of collective upwind contribution—i.e., the sum of contributions from states that are linked to each receptor—for each of these alternative thresholds. The data provided in this analysis are drawn from the results of EPA's updated 2023 modeling, which was released in a memorandum in March 2018.[3] The analysis presented here is similar to the analysis of alternative thresholds conducted to select the screening thresholds used in both the CSAPR and CSAPR Update rulemakings.[4,5] Based on the data and analysis summarized here, the EPA believes that a threshold of 1 ppb may be appropriate for states to use to develop SIP revisions addressing the good neighbor provision for the 2015 ozone NAAQS.

**Methodology for Analyzing Alternative Thresholds**

The EPA's 2023 state-by-state contribution modeling is used to calculate the absolute and relative amount of total upwind "collective contribution" captured by each of the three alternative thresholds evaluated in this analysis: 0.70 ppb (1 percent of the 2015 ozone NAAQS), 1 ppb, and 2 ppb. The ozone concentration and collective contribution data for each alternative threshold are provided in several tables, as described below. In the analysis of alternative screening thresholds, the EPA focused on data for the receptors outside of California since no other states were projected to impact any of the receptors in California at or above a threshold equivalent to 1 percent of the 2015 ozone NAAQS.[6] Data are therefore provided for each of the 2023 nonattainment and maintenance receptors outside of California identified using the CSAPR methodology for determining future year receptors.[7] In Table 1 below, we provide the projected 2023 average design value and the sum of the contributions from all upwind states (i.e., total upwind contribution) for each of these receptors. Table 1 further provides data on the amount of the total upwind contribution (ppb) that is captured by each of the three thresholds (i.e., the collective contribution) and at each receptor considered in this analysis. In Table 2 below, we express the amount of contribution captured at each alternative threshold considered in this analysis as a percent of the amount of the total upwind contribution. Finally, in Table 3 below, we compare the net amount of contribution captured at the 1 ppb and 2 ppb thresholds as a percentage of the amount of contribution captured at the 0.70 ppb, 1 percent threshold.

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[3] Information on the Interstate Transport State Implementation Plan Submissions for the 2015 Ozone National Ambient Air Quality Standards under Clean Air Act Section 110(a)(2)(D)(i)(I) (March 2018). *https://www.epa.gov/airmarkets/march-2018-memo-and-supplemental-information-regarding-interstate-transport-sips-2015.*

[4] Air Quality Modeling Technical Support Document for the Final Cross State Air Pollution Rule Update (August 2016). *https://www.epa.gov/airmarkets/air-quality-modeling-technical-support-document-final-cross-state-air-pollution-rule.*

[5] Air Quality Modeling Final Rule Technical Support Document (for the Final Transport Rule now known as CSAPR; June 2011). *https://www.epa.gov/csapr/air-quality-modeling-final-rule-technical-support-document.*

[6] March 2018 Memo and Supplemental Information Regarding Interstate Transport SIPs for the 2015 Ozone NAAQS (March 2018). *https://www.epa.gov/airmarkets/march-2018-memo-and-supplemental-information-regarding-interstate-transport-sips-2015.*

[7] *See* 81 FR 74530-531.

## Results

The data in the tables below indicate that, for the 2015 ozone NAAQS, the amount of upwind collective contribution captured using a 1 ppb threshold is generally comparable to the amount captured using a threshold equivalent to 1 percent of the NAAQS. In particular, the data in Table 1 indicate that using a 1 percent threshold captures 77 percent of the total upwind contribution when summed across all receptors. Overall, using a 1 ppb threshold captures 70 percent, which is a similar and only slightly lower amount of contribution. By contrast, using a 2 ppb threshold captures 55 percent, much less of the total contribution summed across all receptors. The data in Table 2 indicate that the percent of upwind contribution captured by a 1 percent and 1 ppb threshold at individual receptors are also of a similar magnitude at most sites. However, a 2 ppb threshold captures a notably lower portion of the total upwind contribution at most receptors. Finally, the data in Table 3 indicate that, on average across all receptors, a 1 ppb threshold captures 86 percent of the net contribution captured using a 1 percent threshold, whereas, a 2 ppb threshold captures only half of the net contribution using 1 percent.

Because the amount of upwind collective contribution captured with the 1 percent and 1 ppb thresholds is generally comparable, overall, we believe it may be reasonable and appropriate for states to use a 1 ppb contribution threshold, as an alternative to a 1 percent threshold, at Step 2 of the 4-step framework in developing their SIP revisions addressing the good neighbor provision for the 2015 ozone NAAQS. Although the 1 ppb threshold captures somewhat less upwind contribution across receptors than the 1 percent threshold, the 1 ppb threshold still generally captures a substantial amount of transported contribution from upwind states to downwind receptors. Thus, the use of a 1 ppb threshold to identify linked upwind states still provides the potential, at Step 3, for meaningful emission reductions in linked upwind states in order to aid downwind states with attainment and maintenance of the 2015 ozone NAAQS. However, the amount of upwind contribution captured using a 2 ppb threshold is notably less at most receptors than the amount captured with either a 1 ppb or 1 percent threshold, and therefore emission reductions from states linked at that higher threshold may be insufficient to address collective upwind state contribution to downwind air quality problems.

Please share this information with the air agencies in your Region.

## For Further Information

If you have any questions concerning this memorandum, please contact Norm Possiel at (919) 541-5692, *possiel.norm@epa.gov* for modeling information or Beth Palma at (919) 541-5432, *palma.elizabeth@epa.gov* for any other information.

Table 1. Total upwind contribution and the sum of upwind contribution at each receptor captured using each alternative threshold (units are ppb).

| Site | State | County | 2023 Average Design Value | Total Upwind State Contribution | Sum of Upwind Contribution Captured with 0.70 ppb Threshold | Sum of Upwind Contribution Captured with 1 ppb Threshold | Sum of Upwind Contribution Captured with 2 ppb Threshold |
|---|---|---|---|---|---|---|---|
| 40130019 | AZ | Maricopa | 69.3 | 2.55 | 1.87 | 1.87 | 0.00 |
| 40131004 | AZ | Maricopa | 69.8 | 2.58 | 2.03 | 2.03 | 2.03 |
| 80050002 | CO | Arapahoe | 69.3 | 5.98 | 3.47 | 3.47 | 0.00 |
| 80350004 | CO | Douglas | 71.1 | 5.94 | 3.35 | 3.35 | 0.00 |
| 80590006 | CO | Jefferson | 71.3 | 7.06 | 4.68 | 2.34 | 0.00 |
| 80590011 | CO | Jefferson | 70.9 | 6.98 | 4.51 | 3.57 | 0.00 |
| 80690011 | CO | Larimer | 71.2 | 6.33 | 3.48 | 2.60 | 0.00 |
| 81230009 | CO | Weld | 70.2 | 5.63 | 2.77 | 1.05 | 0.00 |
| 90010017 | CT | Fairfield | 68.9 | 37.44 | 32.15 | 32.15 | 28.66 |
| 90013007 | CT | Fairfield | 71.0 | 41.29 | 36.91 | 33.63 | 27.38 |
| 90019003 | CT | Fairfield | 73.0 | 44.24 | 38.55 | 36.93 | 32.28 |
| 90099002 | CT | New Haven | 69.9 | 35.25 | 29.49 | 28.76 | 24.96 |
| 240251001 | MD | Harford | 70.9 | 25.88 | 20.16 | 17.79 | 14.92 |
| 260050003 | MI | Allegan | 69.0 | 42.90 | 38.87 | 36.63 | 31.73 |
| 261630019 | MI | Wayne | 69.0 | 17.63 | 11.81 | 10.89 | 8.69 |
| 360810124 | NY | Queens | 70.2 | 30.68 | 23.73 | 23.00 | 15.73 |
| 361030002 | NY | Suffolk | 74.0 | 28.82 | 22.31 | 18.74 | 15.74 |
| 480391004 | TX | Brazoria | 74.0 | 13.36 | 7.48 | 4.80 | 3.80 |
| 481210034 | TX | Denton | 69.7 | 8.64 | 3.15 | 3.15 | 0.00 |
| 482010024 | TX | Harris | 70.4 | 8.19 | 3.06 | 3.06 | 3.06 |
| 482011034 | TX | Harris | 70.8 | 9.86 | 3.38 | 3.38 | 3.38 |
| 482011039 | TX | Harris | 71.8 | 13.01 | 8.26 | 4.72 | 4.72 |
| 484392003 | TX | Tarrant | 72.5 | 10.06 | 4.20 | 3.42 | 0.00 |



NMED Exhibit 9d

| Site | State | County | 2023 Average Design Value | Total Upwind State Contribution | Sum of Upwind Contribution Captured with 0.70 ppb Threshold | Sum of Upwind Contribution Captured with 1 ppb Threshold | Sum of Upwind Contribution Captured with 2 ppb Threshold |
|---|---|---|---|---|---|---|---|
| 550790085 | WI | Milwaukee | 71.2 | 32.58 | 28.45 | 23.61 | 22.39 |
| 551170006 | WI | Sheboygan | 72.8 | 36.53 | 31.62 | 29.02 | 24.90 |
| | | | | | | | |
| Percent of Overall Upwind Contribution Captured => | | | | | 77% | 70% | 55% |

Table 2. Percent of the upwind contribution captured by each alternative threshold at each receptor.

| Site | State | County | Percent of Upwind Contribution Captured using a 0.70 ppb Threshold | Percent of Upwind Contribution Captured using a 1 ppb Threshold | Percent of Upwind Contribution Captured using a 2 ppb Threshold |
|---|---|---|---|---|---|
| 40130019 | AZ | Maricopa | 73.3% | 73.3% | 0.0% |
| 40131004 | AZ | Maricopa | 78.7% | 78.7% | 78.7% |
| 80050002 | CO | Arapahoe | 58.0% | 58.0% | 0.0% |
| 80350004 | CO | Douglas | 56.4% | 56.4% | 0.0% |
| 80590006 | CO | Jefferson | 66.3% | 33.1% | 0.0% |
| 80590011 | CO | Jefferson | 64.6% | 51.1% | 0.0% |
| 80690011 | CO | Larimer | 55.0% | 41.1% | 0.0% |
| 81230009 | CO | Weld | 49.2% | 18.7% | 0.0% |
| 90010017 | CT | Fairfield | 85.9% | 85.9% | 76.5% |
| 90013007 | CT | Fairfield | 89.4% | 81.4% | 66.3% |
| 90019003 | CT | Fairfield | 87.1% | 83.5% | 73.0% |
| 90099002 | CT | New Haven | 83.7% | 81.6% | 70.8% |
| 240251001 | MD | Harford | 77.9% | 68.7% | 57.7% |
| 260050003 | MI | Allegan | 90.6% | 85.4% | 74.0% |

| Site | State | County | Percent of Upwind Contribution Captured using a 0.70 ppb Threshold | Percent of Upwind Contribution Captured using a 1 ppb Threshold | Percent of Upwind Contribution Captured using a 2 ppb Threshold |
|---|---|---|---|---|---|
| 261630019 | MI | Wayne | 67.0% | 61.8% | 49.3% |
| 360810124 | NY | Queens | 77.3% | 75.0% | 51.3% |
| 361030002 | NY | Suffolk | 77.4% | 65.0% | 54.6% |
| 480391004 | TX | Brazoria | 56.0% | 35.9% | 28.4% |
| 481210034 | TX | Denton | 36.5% | 36.5% | 0.0% |
| 482010024 | TX | Harris | 37.4% | 37.4% | 37.4% |
| 482011034 | TX | Harris | 34.3% | 34.3% | 34.3% |
| 482011039 | TX | Harris | 63.5% | 36.3% | 36.3% |
| 484392003 | TX | Tarrant | 41.7% | 34.0% | 0.0% |
| 550790085 | WI | Milwaukee | 87.3% | 72.5% | 68.7% |
| 551170006 | WI | Sheboygan | 86.6% | 79.4% | 68.2% |

Table 3. Percent of the contribution captured with a 0.70 ppb threshold that is captured using 1 ppb and 2 ppb thresholds.

| Site | State | County | Contribution Captured with 1 ppb Threshold vs a 0.70 ppb Threshold | Contribution Captured with 2 ppb Threshold vs a 0.70 ppb Threshold |
|---|---|---|---|---|
| 40130019 | AZ | Maricopa | 100.0% | 0.0% |
| 40131004 | AZ | Maricopa | 100.0% | 100.0% |
| 80050002 | CO | Arapahoe | 100.0% | 0.0% |
| 80350004 | CO | Douglas | 100.0% | 0.0% |
| 80590006 | CO | Jefferson | 50.0% | 0.0% |
| 80590011 | CO | Jefferson | 79.2% | 0.0% |
| 80690011 | CO | Larimer | 74.7% | 0.0% |
| 81230009 | CO | Weld | 37.9% | 0.0% |
| 90010017 | CT | Fairfield | 100.0% | 89.1% |

| Site | State | County | Contribution Captured with 1 ppb Threshold vs a 0.70 ppb Threshold | Contribution Captured with 2 ppb Threshold vs a 0.70 ppb Threshold |
|---|---|---|---|---|
| 90013007 | CT | Fairfield | 91.1% | 74.2% |
| 90019003 | CT | Fairfield | 95.8% | 83.7% |
| 90099002 | CT | New Haven | 97.5% | 84.6% |
| 240251001 | MD | Harford | 88.2% | 74.0% |
| 260050003 | MI | Allegan | 94.2% | 81.6% |
| 261630019 | MI | Wayne | 92.2% | 73.6% |
| 360810124 | NY | Queens | 96.9% | 66.3% |
| 361030002 | NY | Suffolk | 84.0% | 70.6% |
| 480391004 | TX | Brazoria | 64.2% | 50.8% |
| 481210034 | TX | Denton | 100.0% | 0.0% |
| 482010024 | TX | Harris | 100.0% | 100.0% |
| 482011034 | TX | Harris | 100.0% | 100.0% |
| 482011039 | TX | Harris | 57.1% | 57.1% |
| 484392003 | TX | Tarrant | 81.4% | 0.0% |
| 550790085 | WI | Milwaukee | 83.0% | 78.7% |
| 551170006 | WI | Sheboygan | 91.8% | 78.7% |
| | | | | |
| Average Percent Captured => | | | 86% | 51% |

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
RESEARCH TRIANGLE PARK, NC 27711

OFFICE OF
AIR QUALITY PLANNING
AND STANDARDS

OCT 19 2018

**MEMORANDUM**

**SUBJECT:** Considerations for Identifying Maintenance Receptors for Use in Clean Air Act Section 110(a)(2)(D)(i)(I) Interstate Transport State Implementation Plan Submissions for the 2015 Ozone National Ambient Air Quality Standards

**FROM:** Peter Tsirigotis
Director

**TO:** Regional Air Division Directors, Regions 1–10

The purpose of this memorandum is to present information that states may consider as they evaluate the status of monitoring sites that the Environmental Protection Agency (EPA) identified as potential maintenance receptors with respect to the 2015 ozone National Ambient Air Quality Standards (NAAQS) based on EPA's 2023 modeling.[1] States may use this information when developing state implementation plans (SIPs) for the 2015 ozone NAAQS addressing the good neighbor provision in Clean Air Act (CAA) section 110(a)(2)(D)(i)(I). In brief, this document discusses (1) using alternative technical methods for projecting whether future air quality warrants identifying monitors as maintenance receptors and (2) considering current monitoring data when identifying monitoring sites that, although projected to be in attainment, as described below, should be identified as maintenance receptors because of the risk that they could exceed the NAAQS due to year-to-year (*i.e.*, inter-annual) variability in meteorological conditions.

This document does not substitute for provisions or regulations of the CAA, nor is it a regulation itself. Rather, it provides recommendations for states using the included analytical information in developing SIP submissions, and for EPA Regional offices in acting on them. Thus, it does not impose binding, enforceable requirements on any party. State air agencies retain the discretion to develop good neighbor SIP revisions that differ from this guidance.

Following the recommendations in this guidance does not ensure that EPA will approve a SIP revision in all instances where the recommendations are followed, as the guidance may not apply to the facts and circumstances underlying a particular SIP. Final decisions by EPA to approve

[1] Information on the Interstate Transport State Implementation Plan Submissions for the 2015 Ozone National Ambient Air Quality Standards under Clean Air Act Section 110(a)(2)(D)(i)(I) (March 2018). *https://www.epa.gov/airmarkets/2015-ozone-naaqs-mem.*

a particular SIP revision will only be made based on the requirements of the statute following an air agency's final submission of the SIP revision to EPA and after appropriate notice and opportunity for public review and comment. Interested parties may raise comments about the appropriateness of the application of this guidance to a particular SIP revision. EPA and air agencies should consider whether the recommendations in this guidance are appropriate for each situation.

**Introduction**

CAA section 110(a)(2)(D)(i)(I), otherwise known as the good neighbor provision, requires states to prohibit emissions "which will contribute significantly to nonattainment in, or interfere with maintenance by, any other state with respect to any" NAAQS. EPA has historically used a 4-step framework to determine upwind state obligations (if any) under the good neighbor provision for regional pollutants like ozone: (1) identify downwind areas, referred to as "receptors," expected to have problems attaining or maintaining the NAAQS; (2) identify upwind states that contribute to those downwind air quality problems and warrant further review and analysis; (3) identify the emissions reductions (if any) necessary to eliminate an upwind state's significant contribution to nonattainment and/or interference with maintenance of the NAAQS in the downwind areas, considering cost and air quality factors; and (4) adopt permanent and enforceable measures needed to achieve those emissions reductions. EPA notes that, in developing their SIP revisions for the 2015 ozone NAAQS, states have flexibility to follow this framework or develop alternative frameworks to evaluate interstate transport obligations, so long as a state's chosen approach has adequate technical justification and is consistent with the requirements of the CAA.

At Step 1, EPA has historically used base year and future year air quality modeling coupled with base period measured ozone design values to project design values to a future analytic year.[2] In a memo issued in March 2018, EPA released updated modeling, which uses 2011 as the base year and 2023 as the future analytic year, to evaluate interstate transport for the 2015 ozone NAAQS.[3] As part of EPA's 2023 modeling analysis, EPA projected the average and maximum base period 2009 – 2013 design values to 2023.[4,5] EPA evaluated the projected 2023 design values in combination with measured 2016 design values using the same methodology used in the Cross-State Air Pollution Rule Update (CSAPR Update)[6] to identify receptors with anticipated potential nonattainment and maintenance issues with respect to the 2015 ozone NAAQS in 2023. Under the CSAPR Update methodology, those sites that are violating the NAAQS based on 2016 design values (*i.e.*, currently not attaining) and that also have projected 2023 *average* design values that exceed the NAAQS (*i.e.*, 2023 average design values of 71 parts per billion (ppb) or greater) are

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[2] Air Quality Modeling Technical Support Document for the Final Cross State Air Pollution Rule Update (August 2016). *https://www.epa.gov/airmarkets/air-quality-modeling-technical-support-document-final-cross-state-air-pollution-rule*.

[3] Information on the Interstate Transport State Implementation Plan Submissions for the 2015 Ozone National Ambient Air Quality Standards under Clean Air Act Section 110(a)(2)(D)(i)(I) (March 2018). *https://www.epa.gov/airmarkets/march-2018-memo-and-supplemental-information-regarding-interstate-transport-sips-2015*.

[4] The base period includes the three design values that contain 2011 monitoring data (*i.e.*, 2009-2011, 2010-2012, and 2011-2013).

[5] The base period maximum design value is the highest of the three design values in the period 2009-2013.

[6] *See* 81 FR 74504 (October 26, 2016).

identified as potential nonattainment receptors in 2023.[7] Under the CSAPR Update methodology, those sites with a 2023 *maximum* 3-year design value that exceeds the NAAQS are identified as potential maintenance receptors. This methodology considers the effects of inter-annual variability in ozone-conducive meteorology to identify sites that may have difficulty maintaining the ozone NAAQS. A projected maximum design value that exceeds the NAAQS indicates that when meteorology is conducive to ozone formation, the receptor struggles with maintenance of the standard. Under the CSAPR Update methodology, maintenance-only receptors therefore include both (1) those sites with projected average and maximum design values above the NAAQS that are currently measuring clean data and (2) those sites with projected average design values below the level of the NAAQS but with projected maximum design values of 71 ppb or greater.[8]

**Considerations for Identifying Maintenance Receptors**

The D.C. Circuit's decision in *North Carolina v. EPA* requires that EPA and the states identify separate nonattainment and maintenance receptors to give independent significance to the "contribute significantly" and "interfere with maintenance" clauses of the good neighbor provision when identifying downwind air quality problems that must be addressed.[9] In particular, the court held that the good neighbor provision requires states to address emissions that interfere with maintenance in downwind areas struggling to meet the NAAQS despite air quality modeling projecting attainment.[10] While the court did not specify a particular methodology for identifying downwind areas that would struggle to maintain the NAAQS, the court cited the state petitioner's demonstration regarding historic variability in ozone concentrations in areas otherwise projected to attain the NAAQS in support of its holding.[11]

In rules promulgated after *North Carolina*, EPA has relied on projections of base period maximum design values to identify those sites that are at risk of being nonattainment in the future due to inter-annual variability in ozone-conducive meteorology, as indicated above. EPA acknowledges that there may be other valid methodologies for identifying such areas. However, consistent with the holding in *North Carolina*, EPA believes that any alternative methods used to identify maintenance receptors must be different than those used to identify nonattainment receptors and should demonstrate that the alternative method considers variability in meteorological conditions that are conducive for ozone formation in the area containing the monitoring site.

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[7] In determining compliance with the NAAQS, EPA truncates ozone design values to integer values. For example, EPA truncates a design value of 70.9 ppb to 70 ppb, which is attainment. Similarly, EPA considers design values at or above 71.0 ppb to be violations of the 2015 ozone NAAQS.

[8] The nonattainment receptors are also identified as maintenance receptors because the maximum design values for each of these sites is always greater than or equal to the average design value.

[9] 531 F.3d 896, 909-911 (2008).

[10] *Id.*

[11] *Id.* at 909.

**Flexibilities Related to Identifying Maintenance Receptors**

In response to comments received through stakeholder outreach, EPA has identified two potential flexibilities that states may use to identify maintenance receptors with an appropriate technical demonstration. First, EPA believes that states may, in some cases, eliminate a site as a maintenance receptor if the site is currently measuring clean data. Second, EPA believes that a state may, in some cases, use a design value from the base period that is not the maximum design value.[12] For either of these alternative methods to satisfy the D.C. Circuit's instruction to consider areas struggling to meet the NAAQS, EPA would expect states to include with their SIP demonstration technical analyses showing that:

(1) meteorological conditions in the area of the monitoring site were conducive to ozone formation during the period of clean data or during the alternative base period design value used for projections;
(2) ozone concentrations have been trending downward at the site since 2011 (and ozone precursor emissions of nitrogen oxide (NOx) and volatile organic compounds (VOC) have also decreased); and
(3) emissions are expected to continue to decline in the upwind and downwind states out to the attainment date of the receptor.

The intent of these analyses is to demonstrate that monitoring sites that would otherwise be identified as maintenance receptors under the CSAPR Update approach, as previously described, are not likely to violate the NAAQS in the future analytic year. EPA expects that, with such analyses, the state could justify exclusion of a monitoring site as a maintenance receptor, notwithstanding modeling projections showing a maximum design value exceeding the 2015 ozone NAAQS.

To assist states with the recommended analyses, EPA is providing the following information related to analyzing meteorological conduciveness and ozone and emissions trends:

(1) information on meteorological conduciveness for ozone formation based on regional and state-level historical and current climatological data for summertime monthly and seasonal temperature (*see* Attachment A);
(2) a data file containing ozone design values for individual monitoring sites nationwide for the years 2008 through 2017 and for 2023, based on EPA's modeling. This information is available on EPA's website at: *https://www.epa.gov/airmarkets/march-2018-memo-and-supplemental-information-regarding-interstate-transport-sips-2015-0*; and
(3) a data file containing state-level annual NOx and VOC emissions from anthropogenic sources with a breakout by major source category, for individual years from 2011 through 2017 and for 2023, based on EPA's projections. This information is available on EPA's website at:

[12] Stakeholder comments on potential 2015 NAAQS transport flexibilities can be found at *https://www.epa.gov/airmarkets/march-2018-memo-and-supplemental-information-regarding-interstate-transport-sips-2015*.

*https://www.epa.gov/airmarkets/march-2018-memo-and-supplemental-information-regarding-interstate-transport-sips-2015-0*.

States developing the technical analyses necessary to support use of the flexibilities described in this memo are encouraged to supplement EPA-provided information with additional data (as appropriate) to support a showing that a specific monitoring site is not at risk of exceeding the NAAQS in the future. For example, states may show that such a site should not be identified as a maintenance receptor by providing (1) a more refined analysis of meteorological conduciveness that considers additional relevant or more locally tailored meteorological parameters, (2) a more temporally or spatially refined emissions trends analysis, and/or (3) an analysis of historical ozone trends that considers, in addition to the design value, trends in other ozone metrics such as annual $4^{th}$ high 8-hour daily maximum ozone concentrations and the number of days with measured exceedances of the 2015 NAAQS.

Please share this information with the air agencies in your Region.

**For Further Information**

If you have any questions concerning this memorandum, please contact Norm Possiel at (919) 541-5692, *possiel.norm@epa.gov* for modeling information or Chris Werner at (919) 541-5133, *werner.christopher@epa.gov* for any other information.

Attachment

# Attachment A

# Information on Meteorological Conduciveness for Ozone Formation

Meteorological conditions including temperature, humidity, winds, solar radiation, and vertical mixing affect the formation and transport of ambient ozone concentrations. Ozone is more readily formed on warm, sunny days when the air is stagnant and/or when the winds are favorable for transport from upwind source areas. Conversely, ozone production is more limited on days that are cloudy, cool, rainy, and windy (*http://www.epa.gov/airtrends/weather.html*). Statistical modeling analyses have shown that temperature and certain other meteorological variables are highly correlated with the magnitude of ozone concentrations (Camalier, et al., 2007).[1] The overall extent to which meteorological conditions vary from year-to-year (*i.e.*, inter-annual variability) depends on the nature of large scale meteorological drivers such as the strength and position of the jet stream. Inter-annual cycles in the jet stream contribute to inter-annual variability in the degree to which summertime meteorological conditions are favorable for ozone formation within a particular region. Meteorological conditions that frequently correspond with observed 8-hour daily maximum concentrations greater than the National Ambient Air Quality Standards (NAAQS) are referred to as being conducive to ozone formation.

This attachment contains information to help evaluate whether particular summers had ozone-conducive or unconducive meteorology within the 10-year period 2008 through 2017. Information is provided on a state-by-state basis and for individual regions (*see* Figure 1).

- Table A-1 contains tabular summaries of the difference (*i.e.*, anomaly[2]) of monthly average temperature compared to the long-term average.[3]
- Figure A-2 contains maps of the 3-month (June, July, August) statewide anomalies and rank[4] for average temperature compared to the long-term average.
- Figure A-3 contains maps showing spatial fields of daily maximum temperature anomalies (percentiles) for the period June through August for the years 2011 through 2017 (maps are unavailable for years prior to 2011).
- Figure A-4 contains graphical summaries of the total number of cooling degree days for the 3-month period June through August in each region.

The above tabular and graphic information was obtained from the NOAA National Centers for Environmental Information (NCEI) at *https://www.ncdc.noaa.gov/temp-and-precip/us-maps/* and *https://www.ncdc.noaa.gov/cag/.*

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[1] Additional references related to ozone formation and meteorology are provided on page A-3.

[2] "The term temperature anomaly means a departure from a reference value or long-term average. A positive anomaly indicates that the observed temperature was warmer than the reference value, while a negative anomaly indicates that the observed temperature was cooler than the reference value." *https://www.ncdc.noaa.gov/monitoring-references/faq/anomalies.php*.

[3] Note that because of the relatively large inter-annual variability in certain meteorological conditions such as temperature and precipitation, long-term "average" conditions, usually referred to as "normal," are often the mathematical mean of extremes and thus, "average" or "normal" values of temperature or precipitation should not necessarily be considered as representing "typical" conditions.

[4] "In order to place each month and season into historical context, the National Centers for Environmental Information assigns ranks for each geographic area (division, state, region, etc.) based on how the temperature or precipitation value compares with other values throughout the entire record when sorted from lowest to highest value. In other words, the numeric rank value within the area represents the position or location of the sorted value throughout the historical record (1895-present)." *https://www.ncdc.noaa.gov/monitoring-references/dyk/ranking-definition*.

In general, below average temperatures are an indication that meteorological conditions are unconducive for ozone formation, whereas above average temperatures are an indication that meteorology is conducive to ozone formation. Within a particular summer season, the degree that meteorology is conducive for ozone formation can vary from region to region and fluctuate with time within a particular region. For example, the temperature-related information presented below suggests that summer meteorology was generally conducive for ozone formation in 2010, 2011, 2012, and 2016 in most regions. In contrast, the summer of 2009 was generally unconducive for ozone formation, overall, in most regions. In addition, the summers of 2013 and 2014 were not particularly conducive for ozone formation in the Upper Midwest, Ohio Valley, South, Southeast.

Additional information on the relationships between ozone and meteorological conditions can be found in the following publications:

Blanchard et al., 2010 - *NMOC, ozone, and organic aerosol in the southeastern United States, 1999-2007: 2. Ozone trends and sensitivity to NMOC emissions in Atlanta, GA.*
Reinforces the relationship between temperature, relative humidity and winds to ozone formation.
*https://www.sciencedirect.com/science/article/pii/S1352231010005996?via%3Dihub*

Blanchard et al., 2014 - *Ozone in the southeastern United States: An observation-based model using measurements from the SEARCH network.*
Update to the 2007 paper by Camalier with data from the SEARCH network from 2002-2011.
*https://www.sciencedirect.com/science/article/pii/S1352231014001022?via%3Dihub*

Bloomer et al., 2009 – *Observed relationships of ozone air pollution with temperature and emissions.*
Statistical analysis of 21 years of ozone and temperature data (1987-2008). From a climate scenario perspective, authors examine the climate penalty or how ozone levels change as temperature changes. Reinforces the standing that as temperature increases, ozone concentrations increase, but indicates that due to decreasing emissions, the rate is slower in future scenarios.
*https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2009GL037308*

Kavassalis & Murphy, 2017 - *Understanding ozone-meteorology correlations: A role for dry deposition.*
Authors observe the strong correlation between temperature and relative humidity, but work to understand other reasoning why models under predict the strength of the correlation between relative humidity and ozone. Includes a statistical analysis of 28 years of data and examines vapor pressure deficit and dry deposition as factors. Reinforces meteorological conditions that lead to high ozone days.
*https://agupubs.onlinelibrary.wiley.com/doi/full/10.1002/2016GL071791*

Reddy & Pfister, 2016 - *Meteorological Factors contributing to the interannaul variability of midsummer surface ozone in Colorado, Utah, and other western US States.*

Authors found strong correlation between 500-mb and 7008-mb patterns, surface temperature, and zonal winds with the resulting high 8-hour daily maximum ozone values.
*https://agupubs.onlinelibrary.wiley.com/doi/full/10.1002/2015JD023840*

Tawfik and Steiner, 2013 - *A proposed physical mechanism for ozone-meteorology correlations using land-atmosphere coupling regimes.*
Discusses the north-south gradient of temperature and relative humidity correlations with ozone formation. Examines 17 years of ozone, NOx, and isoprene measurements.
*https://linkinghub.elsevier.com/retrieve/pii/S1352231013001672*

White et al., 2007 - *Comparing the impact of meteorological variability on surface ozone during the NEAQS (2002) and ICARTT (2004) field campaigns.*
Authors found that while deep boundary layers are noted during periods of elevated ozone, this is likely due to being coincident with other meteorological factors (high temperatures, high pressure systems, low winds).
*https://agupubs.onlinelibrary.wiley.com/doi/10.1029/2006JD007590*

Zhang et al., 2017 – *Quantifying the relationship between air pollution events and extreme weather events.*
Authors examined ozone from 1980-2009 and built a statistical model to examine the impacts of extreme meteorological events on extreme air quality conditions. Found ozone extremes have decreased over the last 30 years, more rapidly recently, but remain highly correlated to extreme temperature events. Highest correlation was found in the eastern United States (U.S.).
*https://www.sciencedirect.com/science/article/pii/S0169809516306093?via%3Dihub*

Figure 1. U.S. climate regions.
*http://www.ncdc.noaa.gov/monitoring-references/maps/us-climate-regions.php*

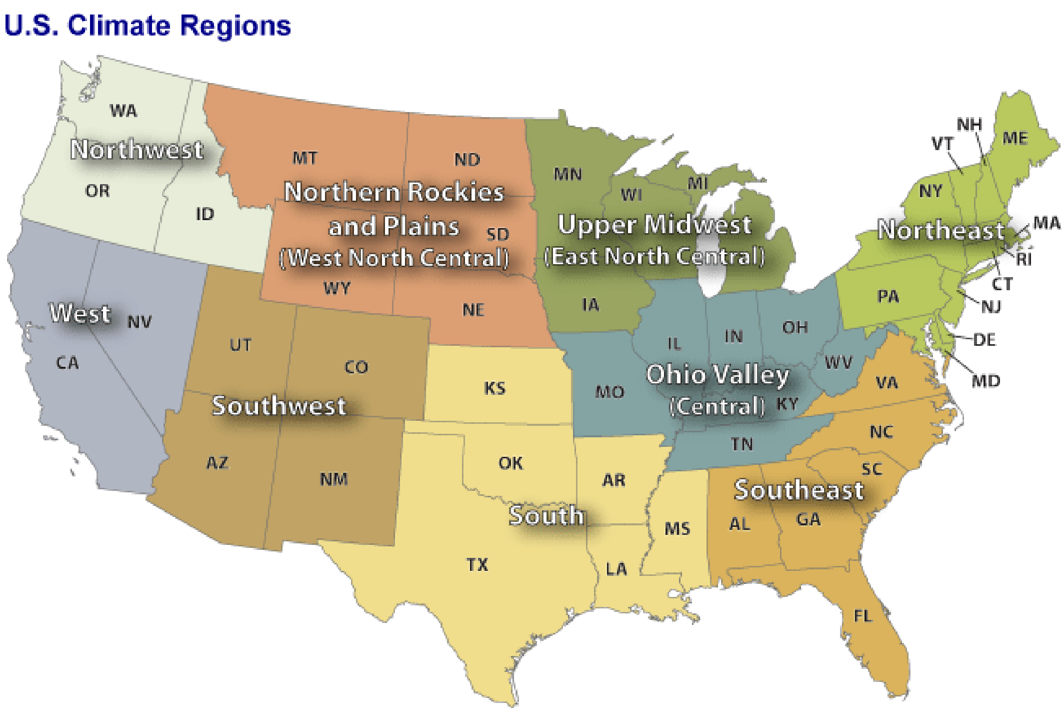

Table A-1. Temperature anomalies by month for May through September for each climate region for the years 2008 through 2017.[1]

| 2008 | May | Jun | Jul | Aug | Sep |
|---|---|---|---|---|---|
| Northeast | C | W | W | C | N |
| Southeast | C | WW | N | C | N |
| Ohio Valley | C | W | C | C | N |
| Upper Midwest | C | N | N | N | W |
| South | N | W | N | C | CC |
| Northern Rockies | C | C | N | N | N |
| Southwest | N | W | W | W | N |
| Northwest | N | N | W | W | N |
| West | N | W | W | WW | W |

[1]Unshaded boxes with the "N" marker represent near-normal temperatures that fall within the interquartile range. Blue colors indicate cooler than normal conditions, with the number of "C"s indicating the degree of the anomaly. CCC = coolest on record, CC = coolest 10th percentile, C = coolest 25th percentile. Red colors indicate warmer than normal conditions, with the number of "W"s indicating the degree of the anomaly. WWW = warmest on record, WW = warmest 10th percentile, W = warmest 25th percentile. N/A = data not available. More on the definition of temperature ranks can be found at: *https://www.ncdc.noaa.gov/monitoring-content/monitoring-references/dyk/images/ranking-definition-legend.png.*

| 2009 | May | Jun | Jul | Aug | Sep |
|---|---|---|---|---|---|
| Northeast | N | C | CC | W | C |
| Southeast | N | W | CC | N | N |
| Ohio Valley | N | W | CC | C | N |
| Upper Midwest | N | C | CC | C | W |
| South | N | W | N | N | C |
| Northern Rockies | N | C | C | C | WW |
| Southwest | WW | C | W | W | W |
| Northwest | W | C | WW | W | WW |
| West | WW | C | W | N | WWW |



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| 2010 | May | Jun | Jul | Aug | Sep |
|---|---|---|---|---|---|
| Northeast | WW | W | WW | W | W |
| Southeast | WW | WW | WW | WW | W |
| Ohio Valley | W | WW | W | WW | N |
| Upper Midwest | W | N | W | WW | C |
| South | W | WW | N | WW | W |
| Northern Rockies | C | N | N | W | N |
| Southwest | C | W | W | W | WWW |
| Northwest | CC | C | N | N | W |
| West | CC | W | W | N | W |

| 2011 | May | Jun | Jul | Aug | Sep |
|---|---|---|---|---|---|
| Northeast | W | W | WW | N | WW |
| Southeast | N | WW | WW | WW | N |
| Ohio Valley | N | W | WW | W | C |
| Upper Midwest | N | N | WW | W | N |
| South | N | WW | WWW | WWW | N |
| Northern Rockies | C | N | W | W | W |
| Southwest | C | W | WW | WWW | W |
| Northwest | CC | C | C | W | WW |
| West | C | C | N | W | WW |

| 2012 | May | Jun | Jul | Aug | Sep |
|---|---|---|---|---|---|
| Northeast | WW | N | WW | W | N |
| Southeast | WW | C | WW | N | N |
| Ohio Valley | WW | N | WW | N | C |
| Upper Midwest | W | W | WW | N | N |
| South | WW | W | WW | N | N |
| Northern Rockies | W | W | WW | W | W |
| Southwest | WW | WW | W | WW | W |
| Northwest | N | C | W | WW | W |
| West | W | W | N | WWW | WW |

| 2013 | May | Jun | Jul | Aug | Sep |
|---|---|---|---|---|---|
| Northeast | W | W | WW | N | N |
| Southeast | C | W | C | C | N |
| Ohio Valley | N | N | C | C | N |
| Upper Midwest | N | N | N | N | W |
| South | C | W | C | N | W |
| Northern Rockies | N | N | N | W | WW |
| Southwest | W | WW | W | W | W |
| Northwest | W | W | WW | WW | WW |
| West | W | WW | WW | N | W |

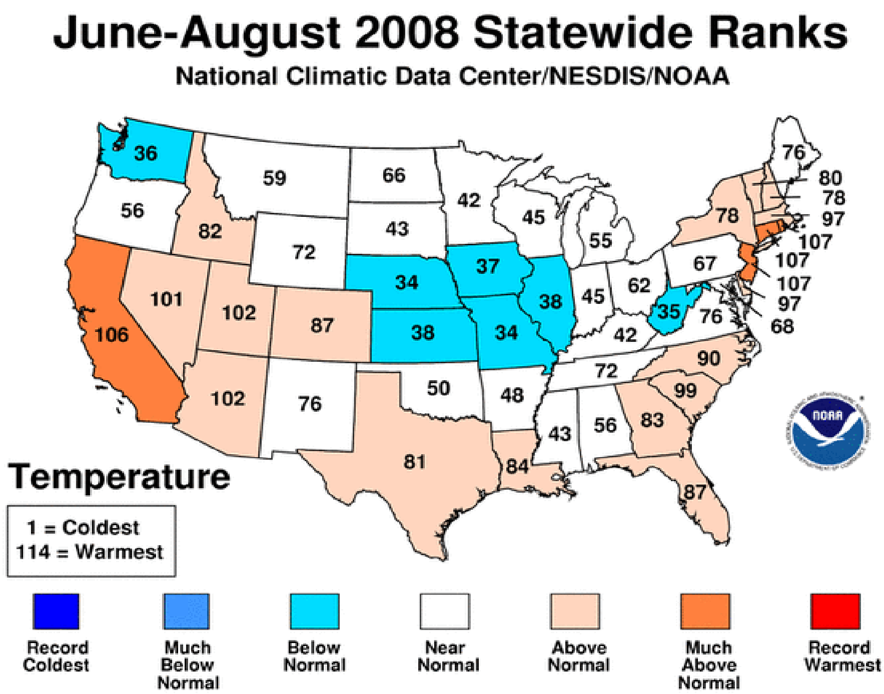
| 2014 | May | Jun | Jul | Aug | Sep |
|---|---|---|---|---|---|
| Northeast | W | W | N | N | W |
| Southeast | W | W | C | N | W |
| Ohio Valley | N | W | CC | N | N |
| Upper Midwest | N | W | CC | N | N |
| South | N | N | C | N | N |
| Northern Rockies | N | C | N | N | N |
| Southwest | N | W | W | C | WW |
| Northwest | W | N | WW | W | W |
| West | W | W | WW | N | WW |

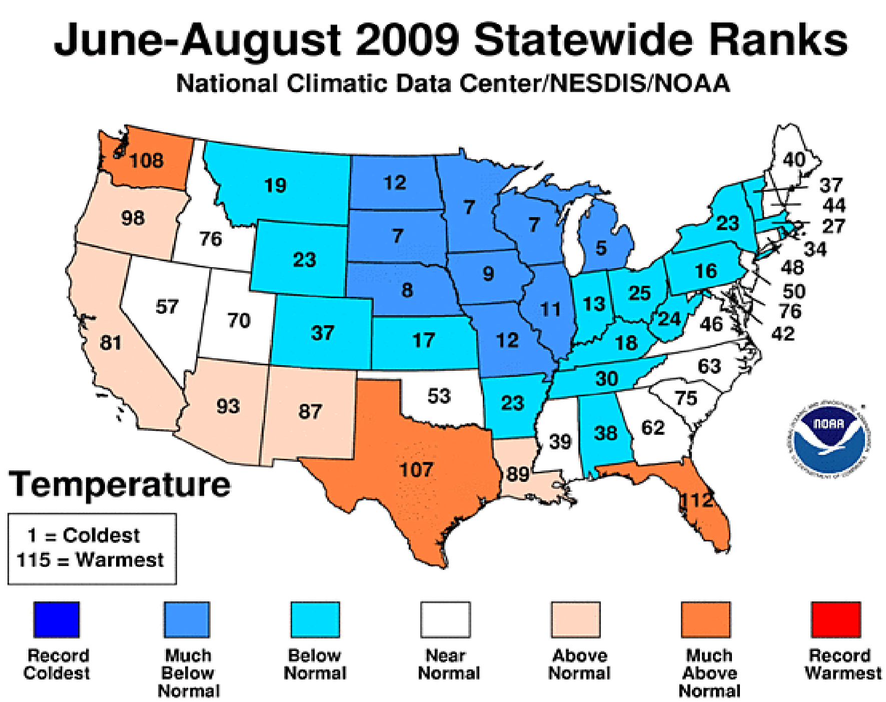
| 2015 | May | Jun | Jul | Aug | Sep |
|---|---|---|---|---|---|
| Northeast | WWW | N | N | W | WW |
| Southeast | W | WW | W | N | N |
| Ohio Valley | W | W | N | C | W |
| Upper Midwest | N | N | N | N | WWW |
| South | C | N | W | N | WW |
| Northern Rockies | C | WW | N | N | WW |
| Southwest | C | WW | C | WW | WWW |
| Northwest | W | WWW | W | W | N |
| West | N | WWW | C | WW | WW |

| 2016 | May | Jun | Jul | Aug | Sep |
|---|---|---|---|---|---|
| Northeast | N | W | W | WWW | WW |
| Southeast | N | W | WW | WW | WW |
| Ohio Valley | N | W | W | W | WW |
| Upper Midwest | N | W | N | W | WW |
| South | C | W | WW | N | W |
| Northern Rockies | N | WW | N | N | W |
| Southwest | C | WWW | WW | N | N |
| Northwest | W | WW | C | W | N |
| West | N | WW | W | W | N |

| 2017 | May | Jun | Jul | Aug | Sep |
|---|---|---|---|---|---|
| Northeast | N | W | N | N | WW |
| Southeast | N | N | W | N | N |
| Ohio Valley | N | N | W | CC | N |
| Upper Midwest | N | W | N | C | WW |
| South | C | N | W | C | N |
| Northern Rockies | N | W | WW | N | W |
| Southwest | N | WW | WW | W | W |
| Northwest | W | W | WW | WWW | W |
| West | W | WW | WW | WW | N |

Figure A-2. Statewide average temperature ranks for the period June through August for the years 2008 through 2017. Note that the NCEI changed the display format of temperature rank maps beginning in 2014.



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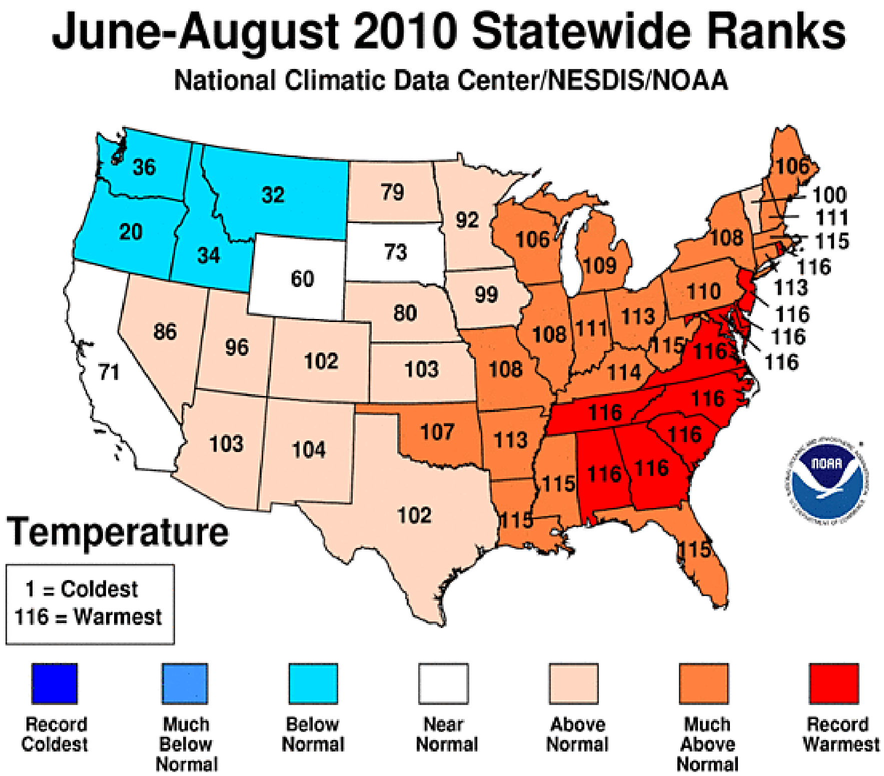
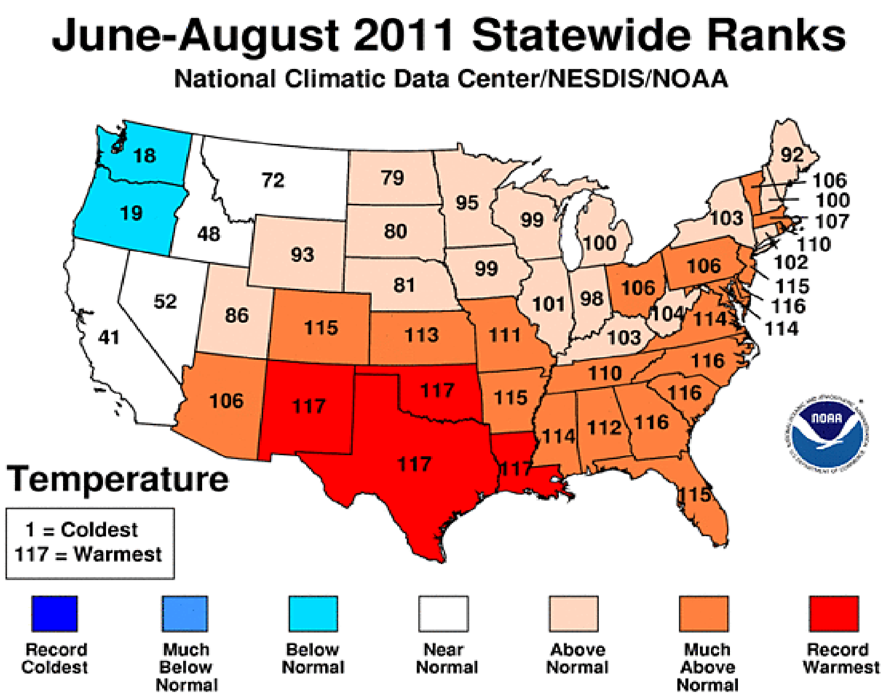
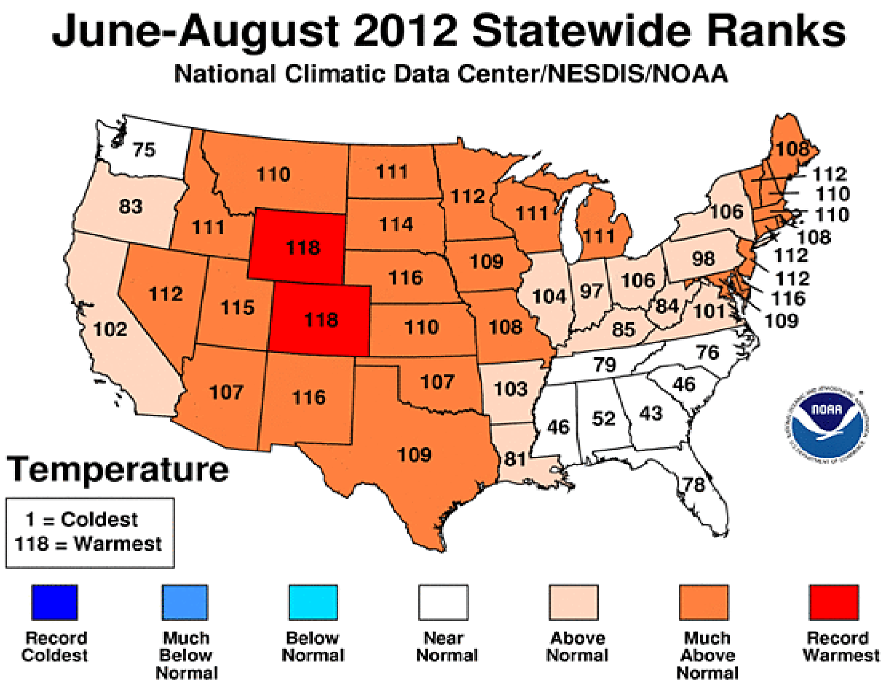
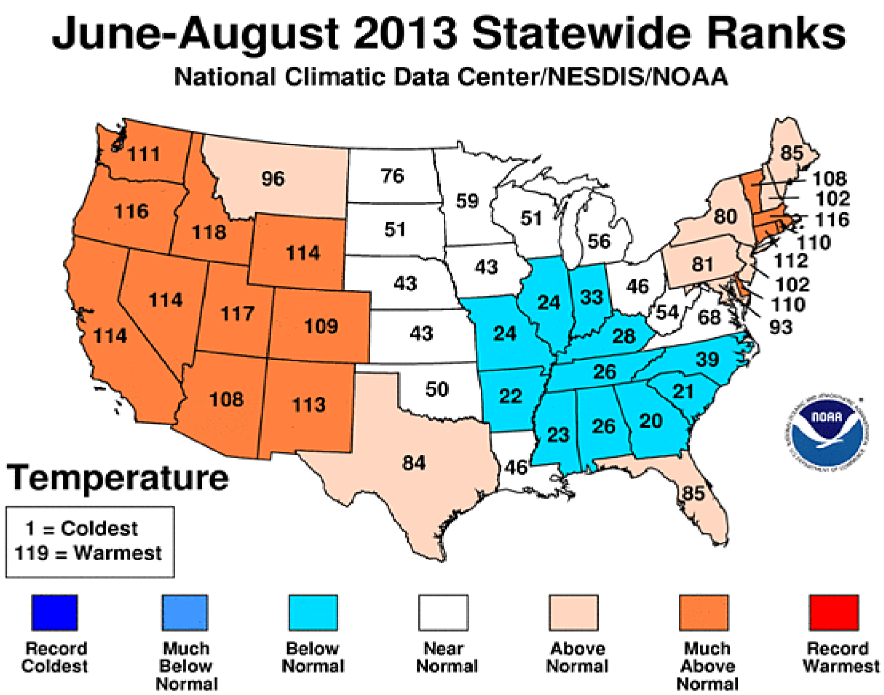

June-August 2010 Statewide Ranks
National Climatic Data Center/NESDIS/NOAA
36
32
79
92
106
109
108
106
100
111
115
116
113
116
116
116
20
34
60
73
80
99
108
111
113
110
115
116
71
86
96
102
103
108
114
116
116
116
107
113
115
116
116
103
104
102
115
115
Temperature
1 = Coldest
116 = Warmest
Record Coldest
Much Below Normal
Below Normal
Near Normal
Above Normal
Much Above Normal
Record Warmest

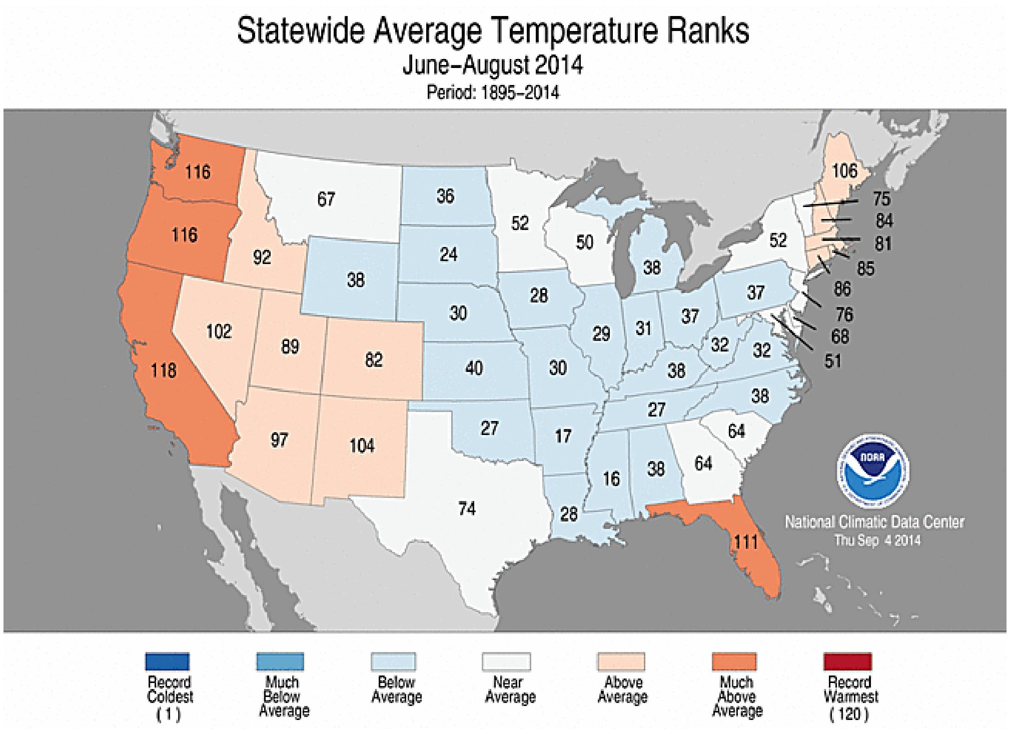

June-August 2011 Statewide Ranks
National Climatic Data Center/NESDIS/NOAA
18
72
79
95
99
100
92
106
100
107
110
102
115
116
114
19
48
93
80
99
103
106
52
81
101
98
106
104
114
41
86
115
113
111
103
116
110
116
106
117
117
115
114
112
116
117
117
115
Temperature
1 = Coldest
117 = Warmest
Record Coldest
Much Below Normal
Below Normal
Near Normal
Above Normal
Much Above Normal
Record Warmest

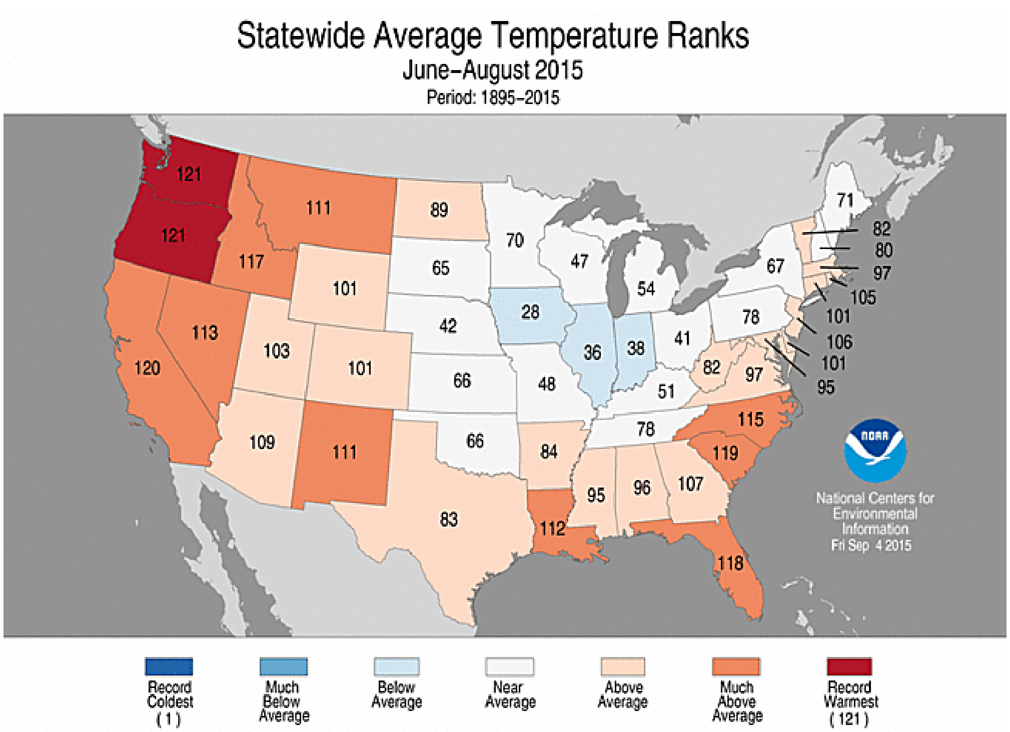


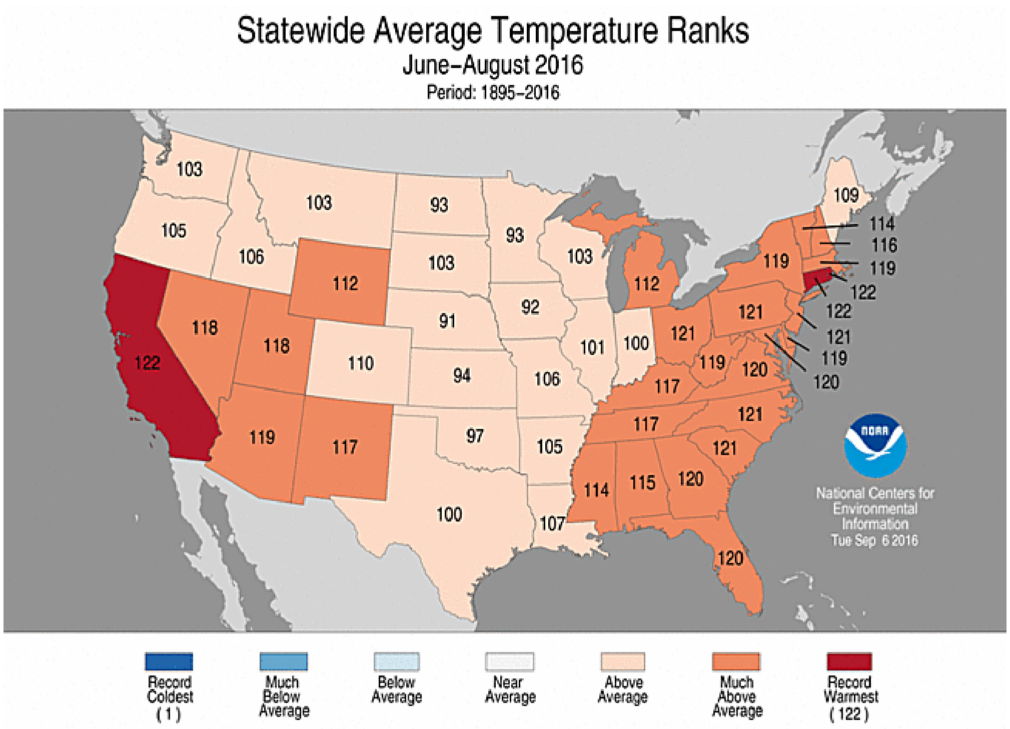
June-August 2012 Statewide Ranks
National Climatic Data Center/NESDIS/NOAA
75
83
110
111
108
112
110
110
106
112
111
111
118
114
111
108
109
98
112
112
116
116
115
118
104
97
106
84
101
109
102
112
110
108
85
79
76
107
107
116
103
46
46
52
43
109
81
78
Temperature
1 = Coldest
118 = Warmest
Record Coldest
Much Below Normal
Below Normal
Near Normal
Above Normal
Much Above Normal
Record Warmest

June-August 2013 Statewide Ranks
National Climatic Data Center/NESDIS/NOAA
111
96
76
85
108
102
116
59
51
80
116
118
51
56
110
114
43
43
46
81
112
102
110
93
114
24
33
54
68
117
109
43
24
28
114
26
39
50
22
21
108
113
23
26
20
84
46
85
Temperature
1 = Coldest
119 = Warmest
Record Coldest
Much Below Normal
Below Normal
Near Normal
Above Normal
Much Above Normal
Record Warmest


Statewide Average Temperature Ranks
June–August 2014
Period: 1895–2014
National Climatic Data Center
Thu Sep 4 2014
Record Coldest (1)
Much Below Average
Below Average
Near Average
Above Average
Much Above Average
Record Warmest (120)


Statewide Average Temperature Ranks
June–August 2015
Period: 1895–2015
National Centers for Environmental Information
Fri Sep 4 2015
Record Coldest (1)
Much Below Average
Below Average
Near Average
Above Average
Much Above Average
Record Warmest (121)


Statewide Average Temperature Ranks
June–August 2016
Period: 1895–2016
103
105
103
93
93
103
106
112
119
112
109
114
116
119
122
122
121
119
120
118
122
118
110
91
92
101
100
121
121
119
120
117
94
106
117
121
97
105
121
119
117
114
115
120
100
107
120
National Centers for
Environmental
Information
Tue Sep 6 2016
Record Coldest (1)
Much Below Average
Below Average
Near Average
Above Average
Much Above Average
Record Warmest (122)

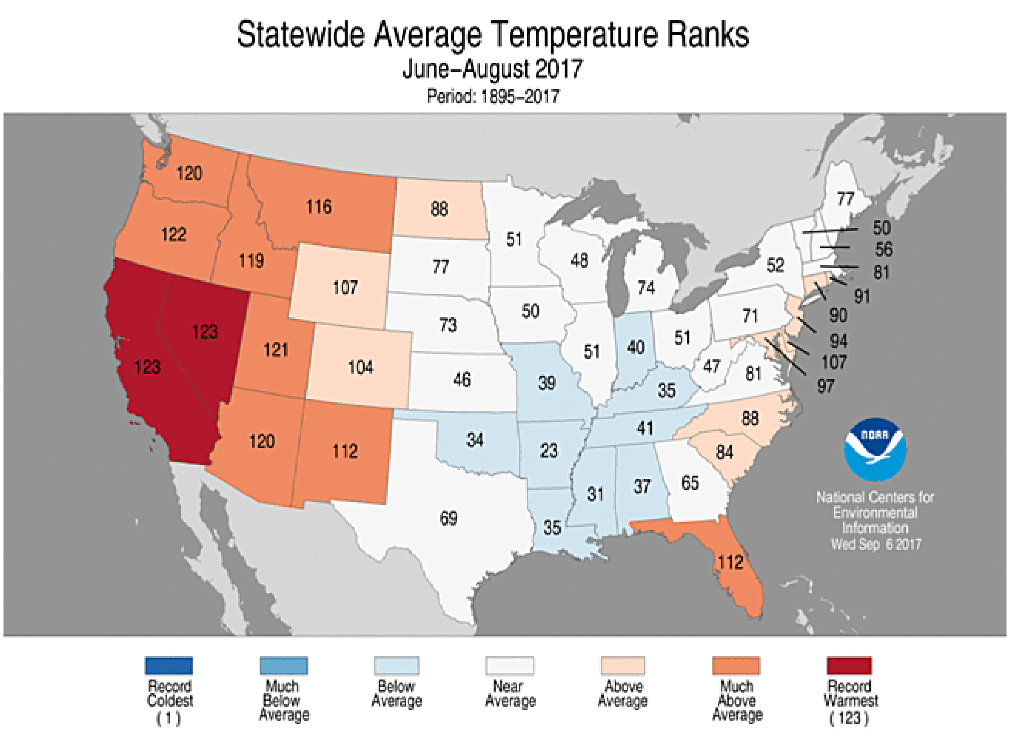
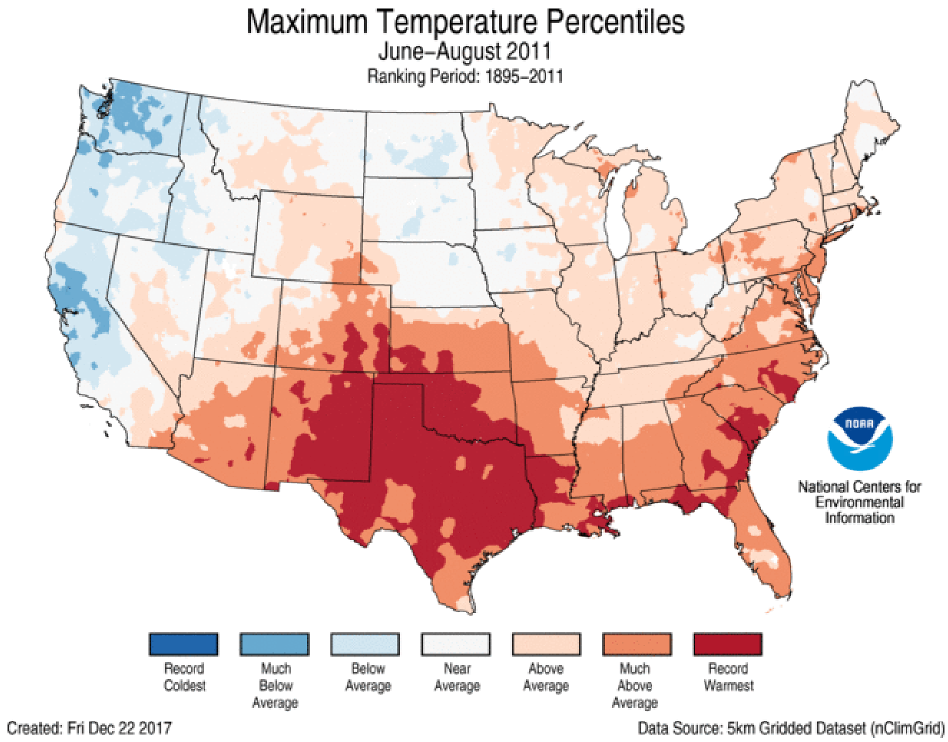
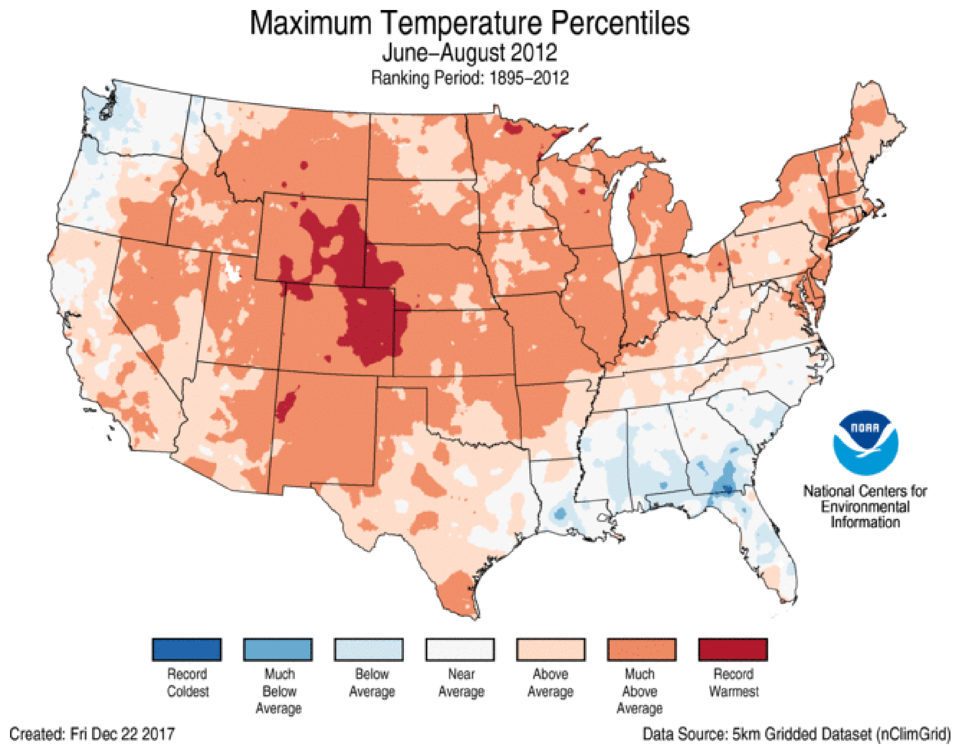
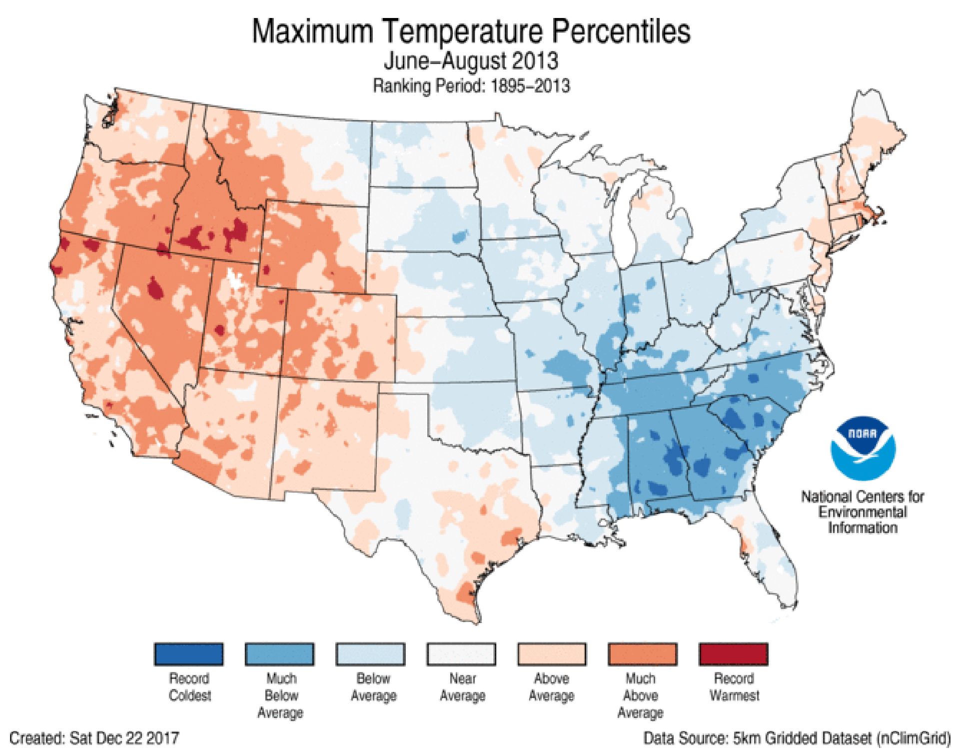
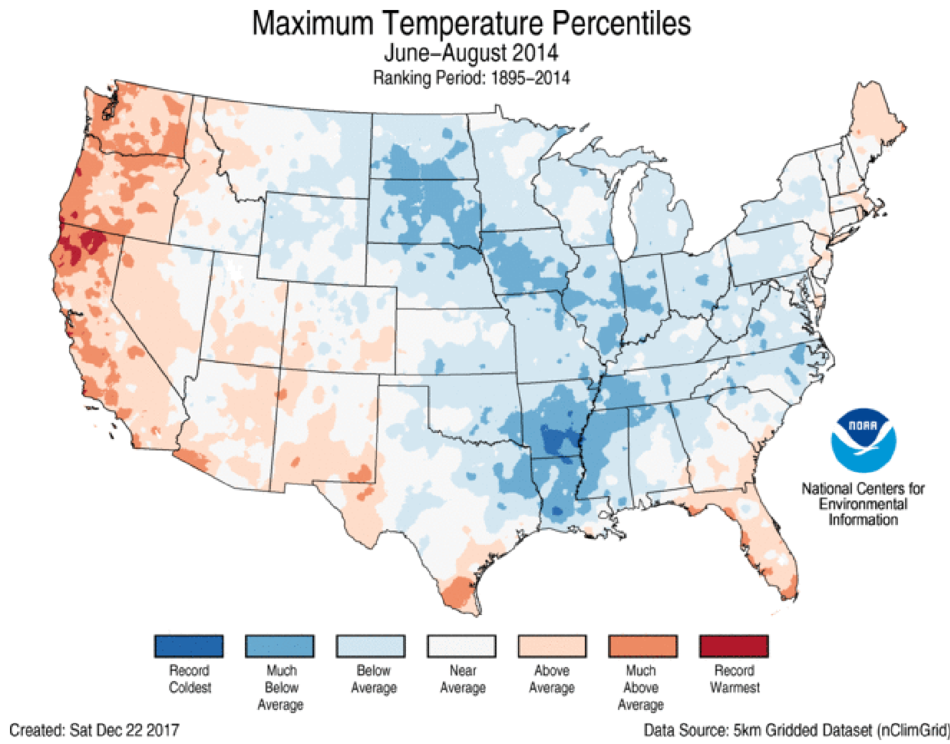

Statewide Average Temperature Ranks
June–August 2017
Period: 1895–2017
120
122
116
88
51
48
119
107
77
74
52
77
50
56
81
91
90
94
107
97
123
123
121
104
73
50
51
40
51
71
47
81
46
39
35
120
112
34
23
41
88
84
31
37
65
69
35
112
National Centers for
Environmental
Information
Wed Sep 6 2017
Record Coldest (1)
Much Below Average
Below Average
Near Average
Above Average
Much Above Average
Record Warmest (123)

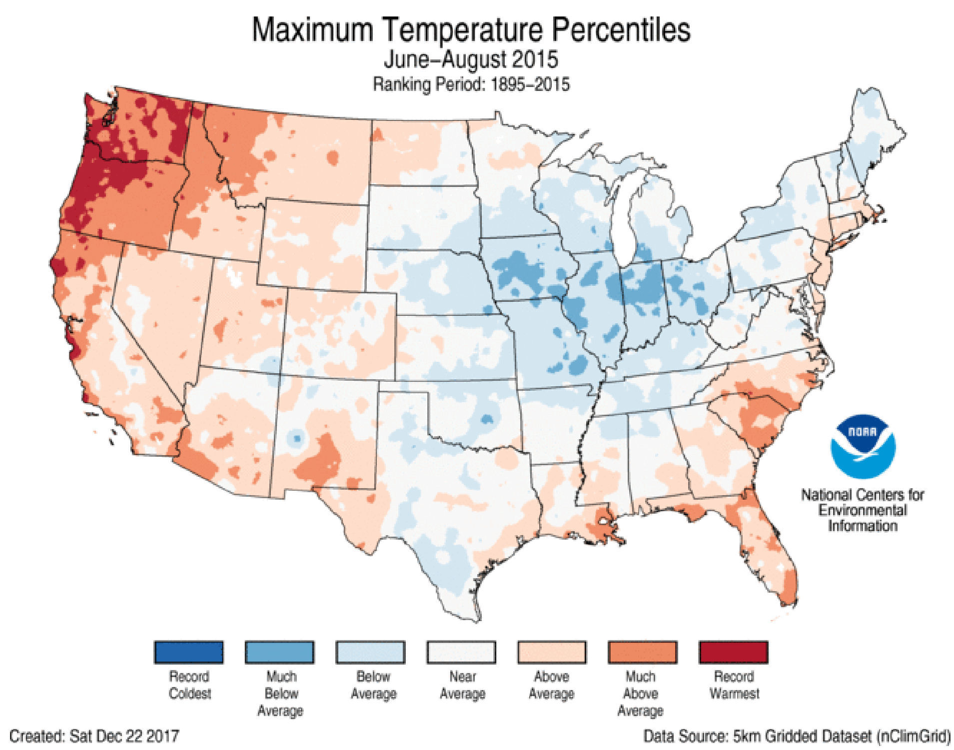
Figure A-3. Spatial fields of daily maximum temperature anomalies (percentiles) for the period June through August for the years 2011 through 2017. Note that the NCDC began creating these maps in 2011.

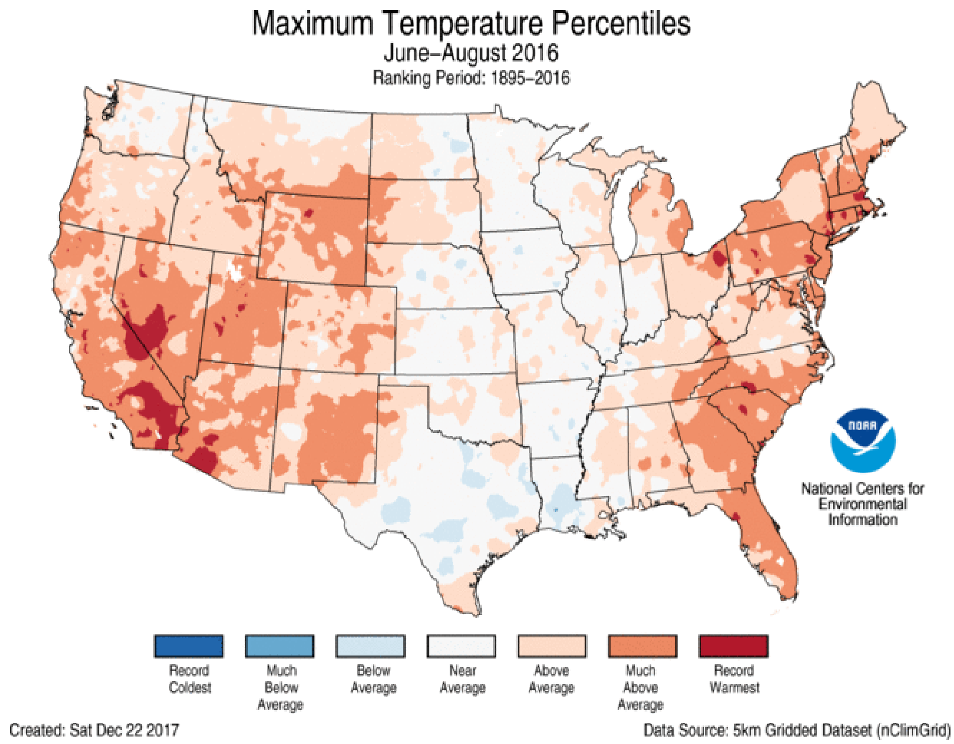



Maximum Temperature Percentiles
June–August 2012
Ranking Period: 1895–2012
National Centers for Environmental Information
Record Coldest
Much Below Average
Below Average
Near Average
Above Average
Much Above Average
Record Warmest
Created: Fri Dec 22 2017
Data Source: 5km Gridded Dataset (nClimGrid)

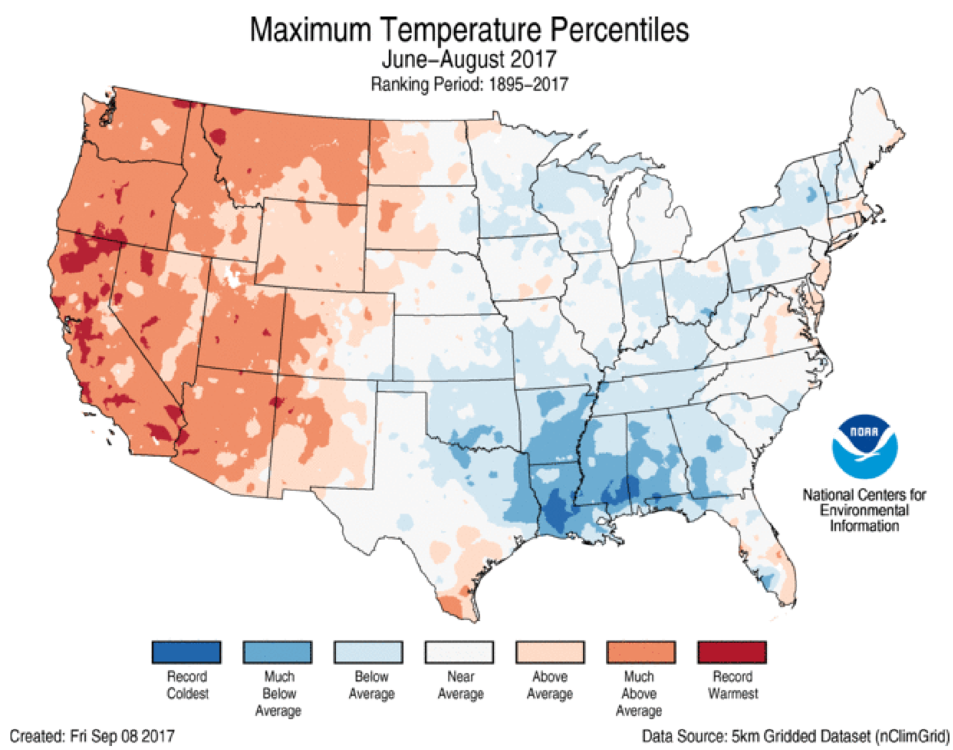

Maximum Temperature Percentiles
June–August 2013
Ranking Period: 1895–2013
National Centers for Environmental Information
Record Coldest
Much Below Average
Below Average
Near Average
Above Average
Much Above Average
Record Warmest
Created: Sat Dec 22 2017
Data Source: 5km Gridded Dataset (nClimGrid)


Maximum Temperature Percentiles
June–August 2014
Ranking Period: 1895–2014
National Centers for Environmental Information
Record Coldest
Much Below Average
Below Average
Near Average
Above Average
Much Above Average
Record Warmest
Created: Sat Dec 22 2017
Data Source: 5km Gridded Dataset (nClimGrid)


Maximum Temperature Percentiles
June–August 2015
Ranking Period: 1895–2015
National Centers for Environmental Information
Record Coldest
Much Below Average
Below Average
Near Average
Above Average
Much Above Average
Record Warmest
Created: Sat Dec 22 2017
Data Source: 5km Gridded Dataset (nClimGrid)

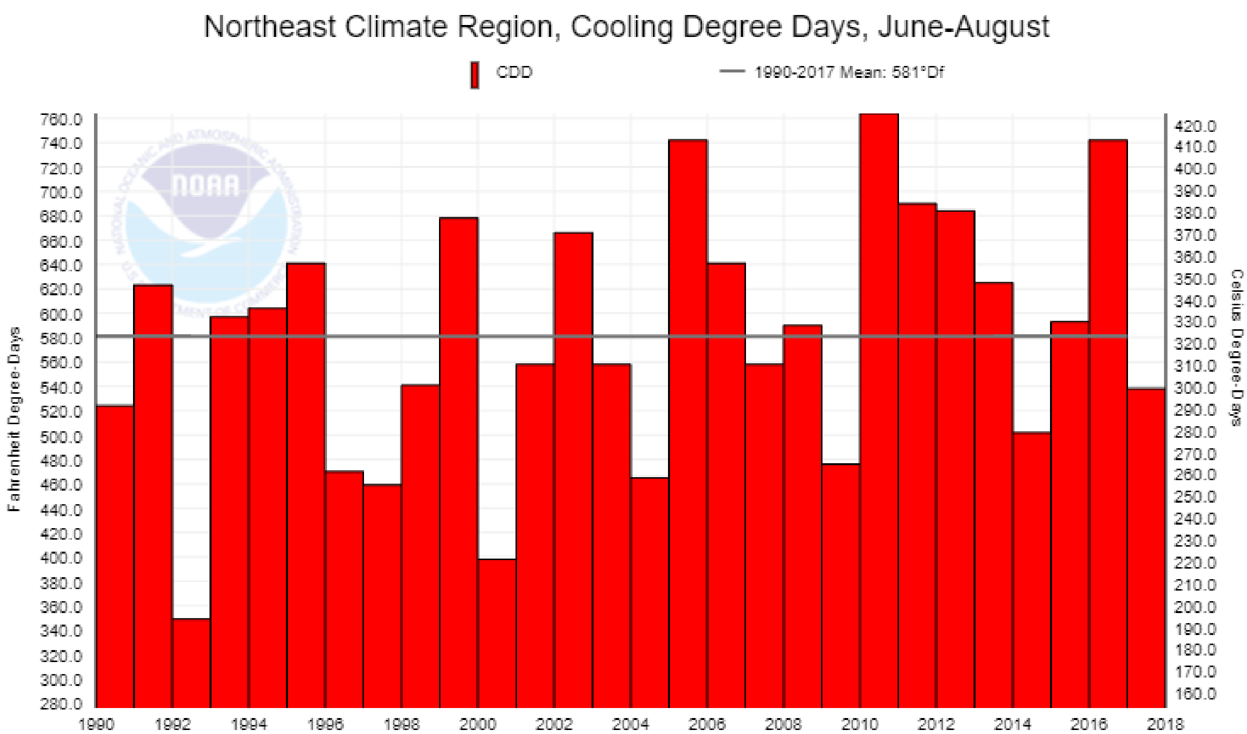


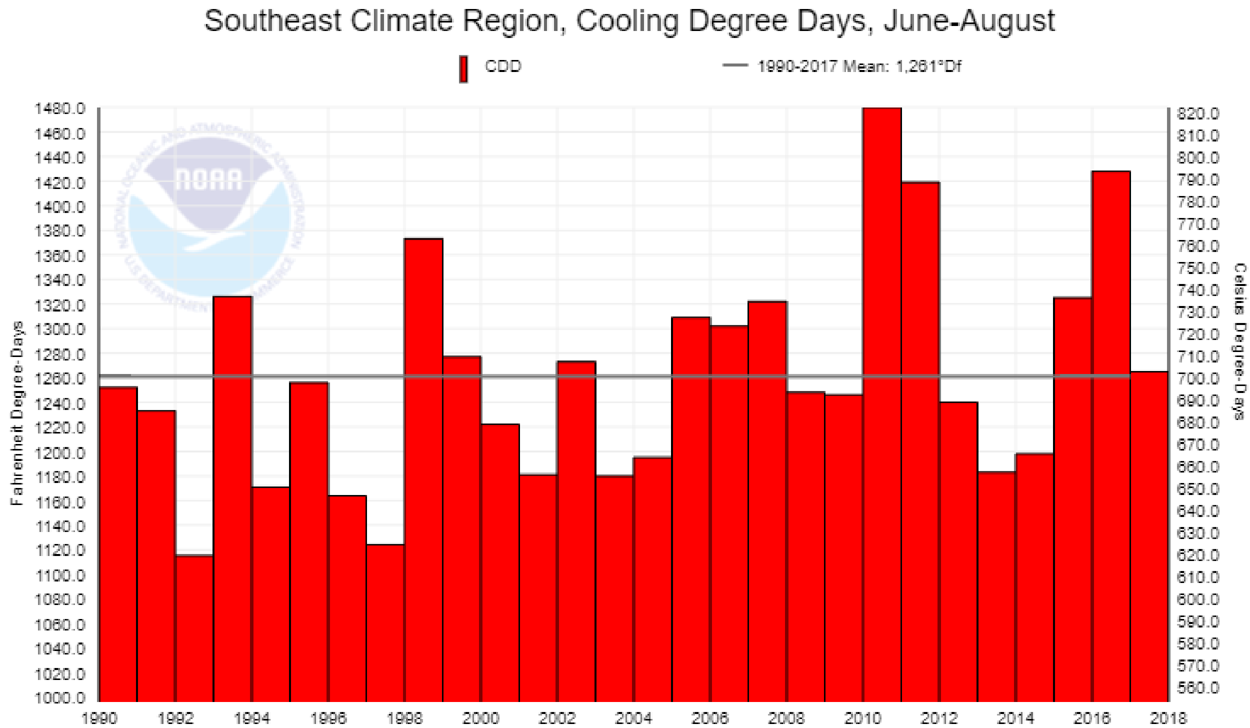
Maximum Temperature Percentiles
June–August 2016
Ranking Period: 1895–2016
National Centers for Environmental Information
Record Coldest
Much Below Average
Below Average
Near Average
Above Average
Much Above Average
Record Warmest
Created: Sat Dec 22 2017
Data Source: 5km Gridded Dataset (nClimGrid)

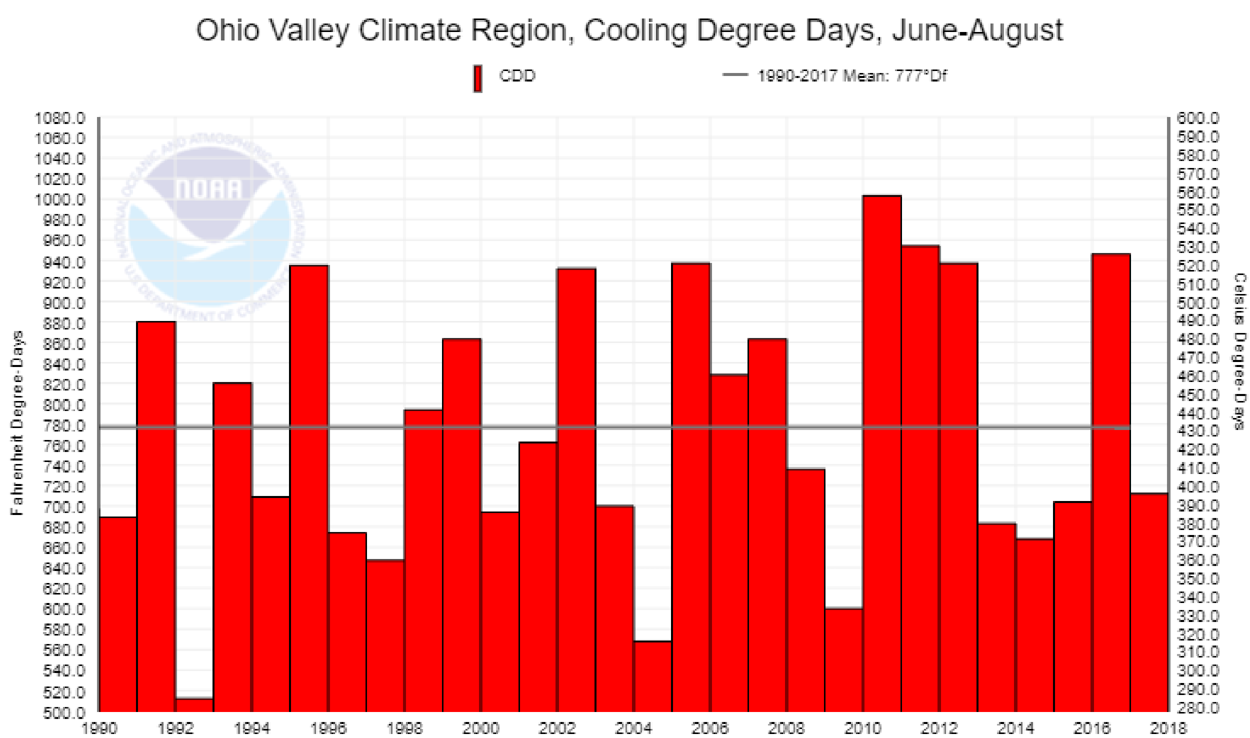
Maximum Temperature Percentiles
June–August 2017
Ranking Period: 1895–2017
National Centers for Environmental Information
Record Coldest
Much Below Average
Below Average
Near Average
Above Average
Much Above Average
Record Warmest
Created: Fri Sep 08 2017
Data Source: 5km Gridded Dataset (nClimGrid)

Figure A-4. Cooling degree days for June through August for each climate region. Note that (1) data are provided back to 1990 and (2) the range of the y-axis differs in some cases by climate region.

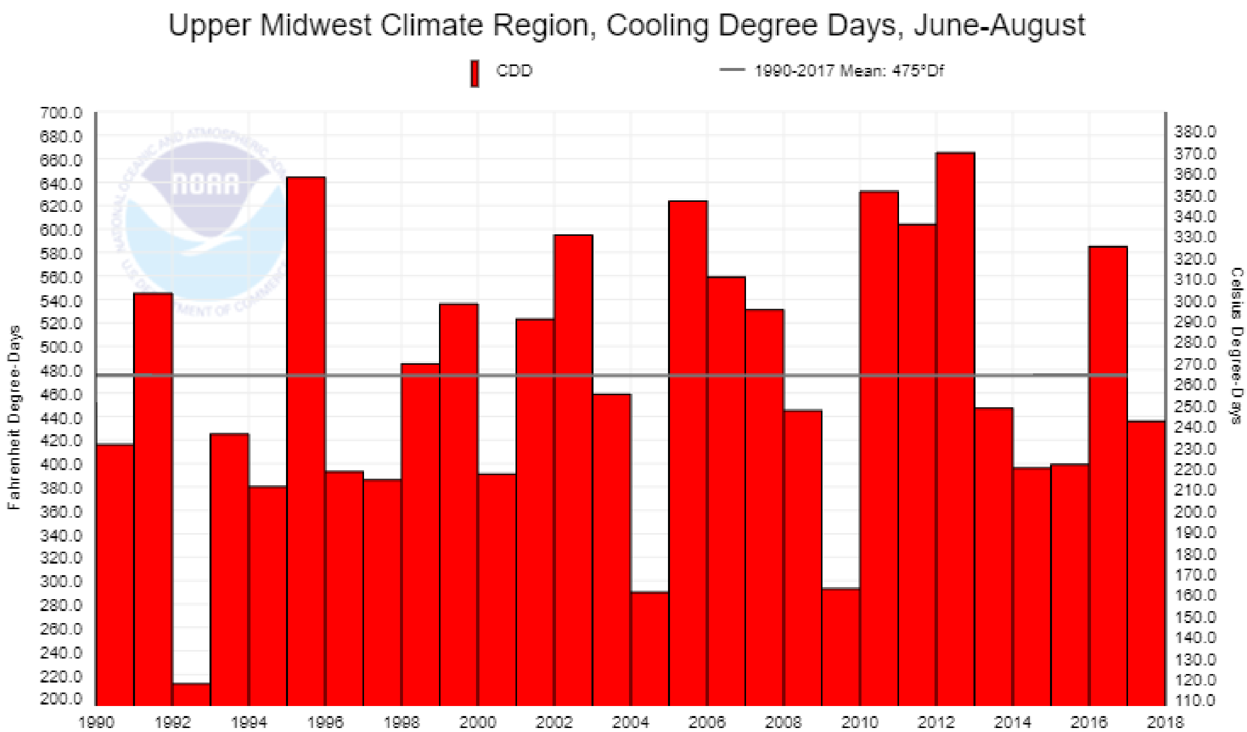


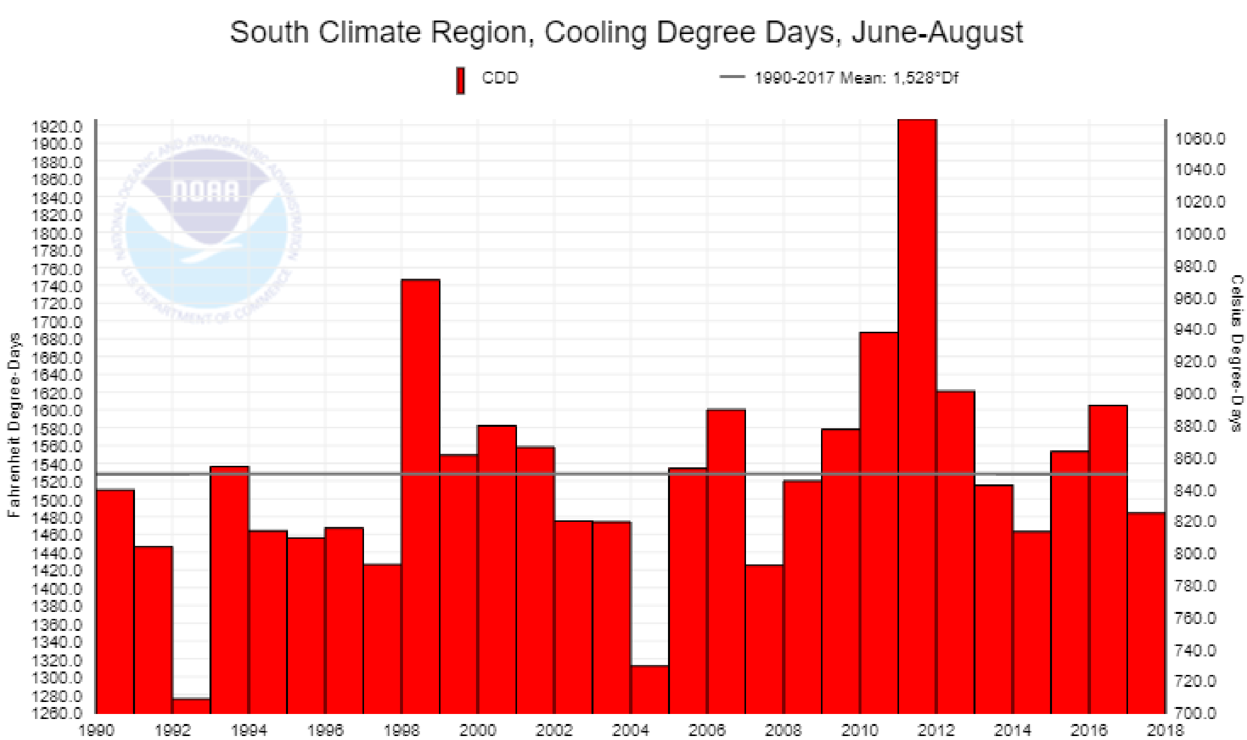


Southeast Climate Region, Cooling Degree Days, June-August
CDD
1990-2017 Mean: 1,261°Df
Fahrenheit Degree-Days
Celsius Degree-Days

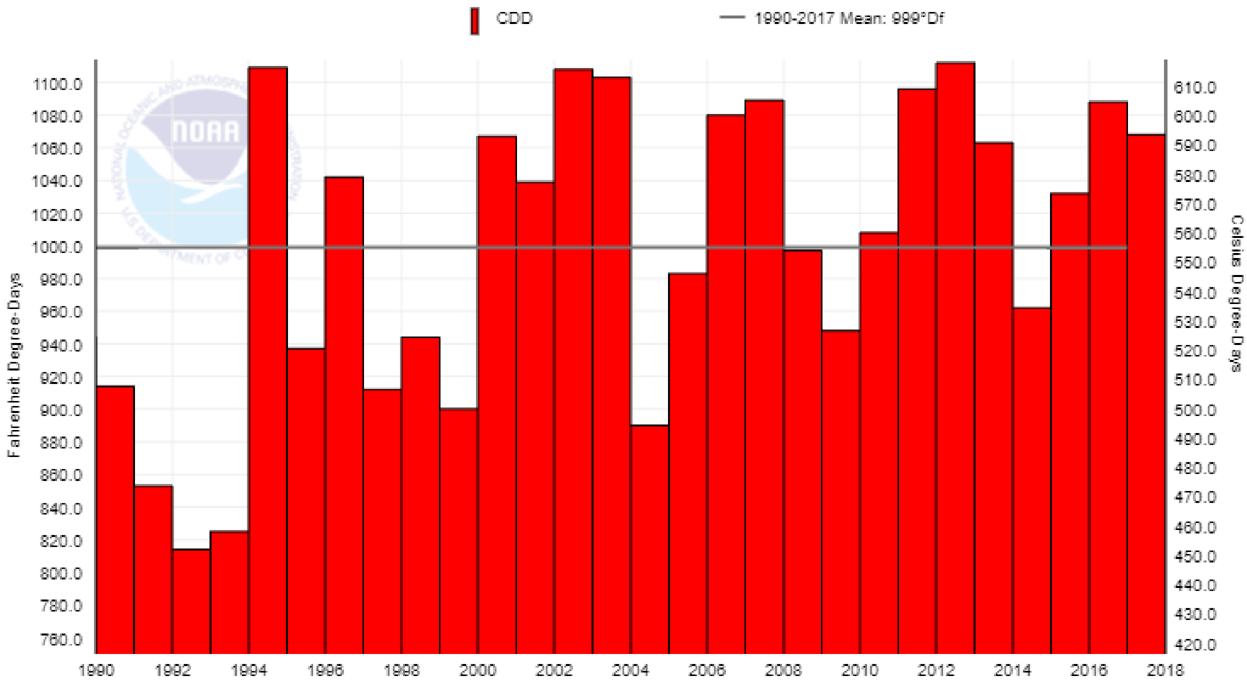



Ohio Valley Climate Region, Cooling Degree Days, June-August
CDD
1990-2017 Mean: 777°Df
Fahrenheit Degree-Days
Celsius Degree-Days

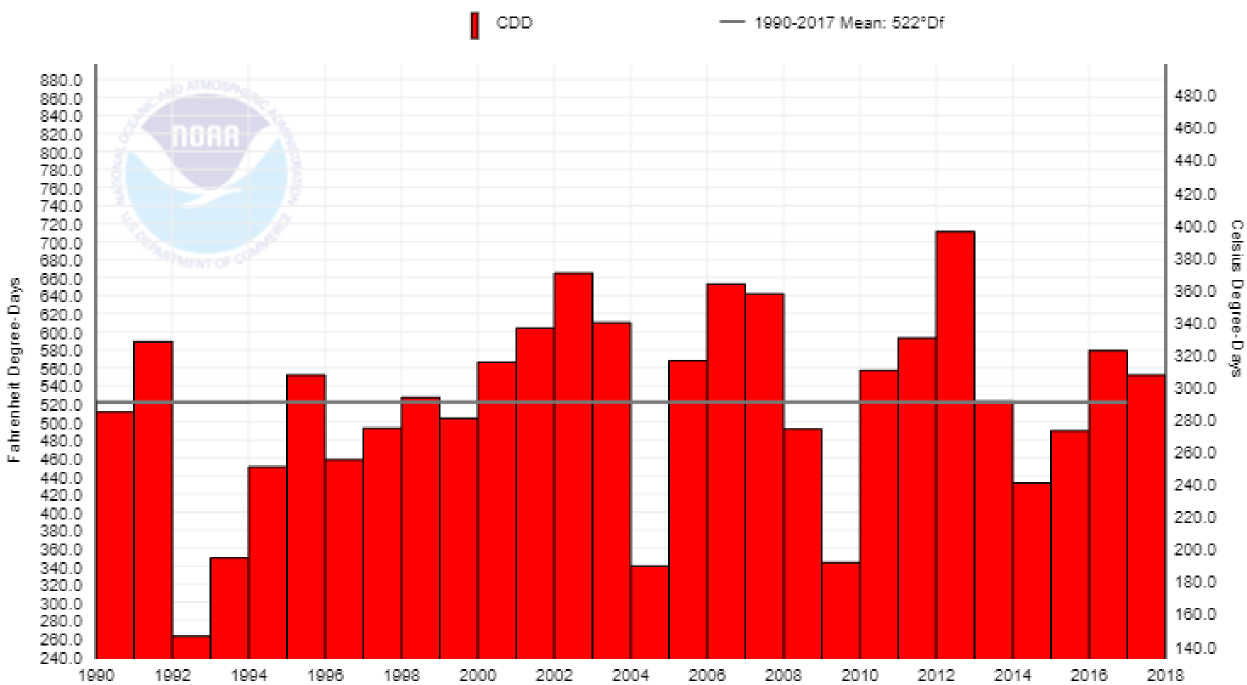

Upper Midwest Climate Region, Cooling Degree Days, June-August
CDD
1990-2017 Mean: 475°Df
Fahrenheit Degree-Days
Celsius Degree-Days
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018

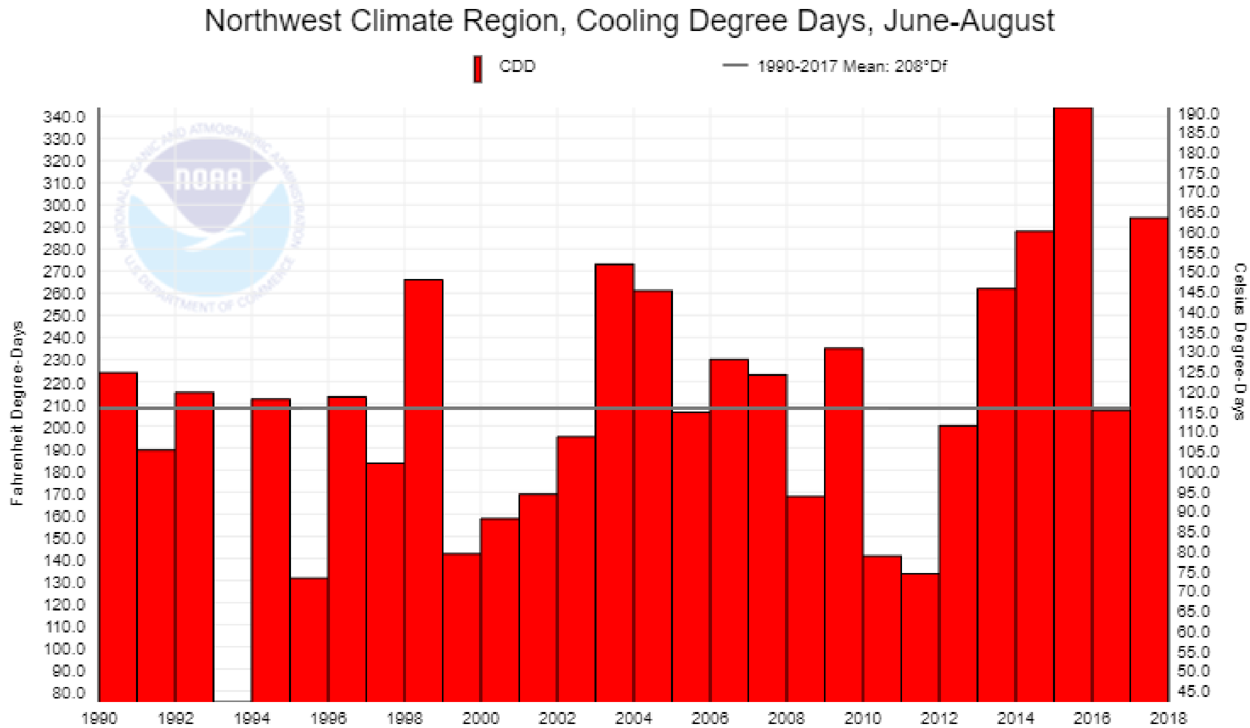

South Climate Region, Cooling Degree Days, June-August
CDD
1990-2017 Mean: 1,528°Df
Fahrenheit Degree-Days
Celsius Degree-Days
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018

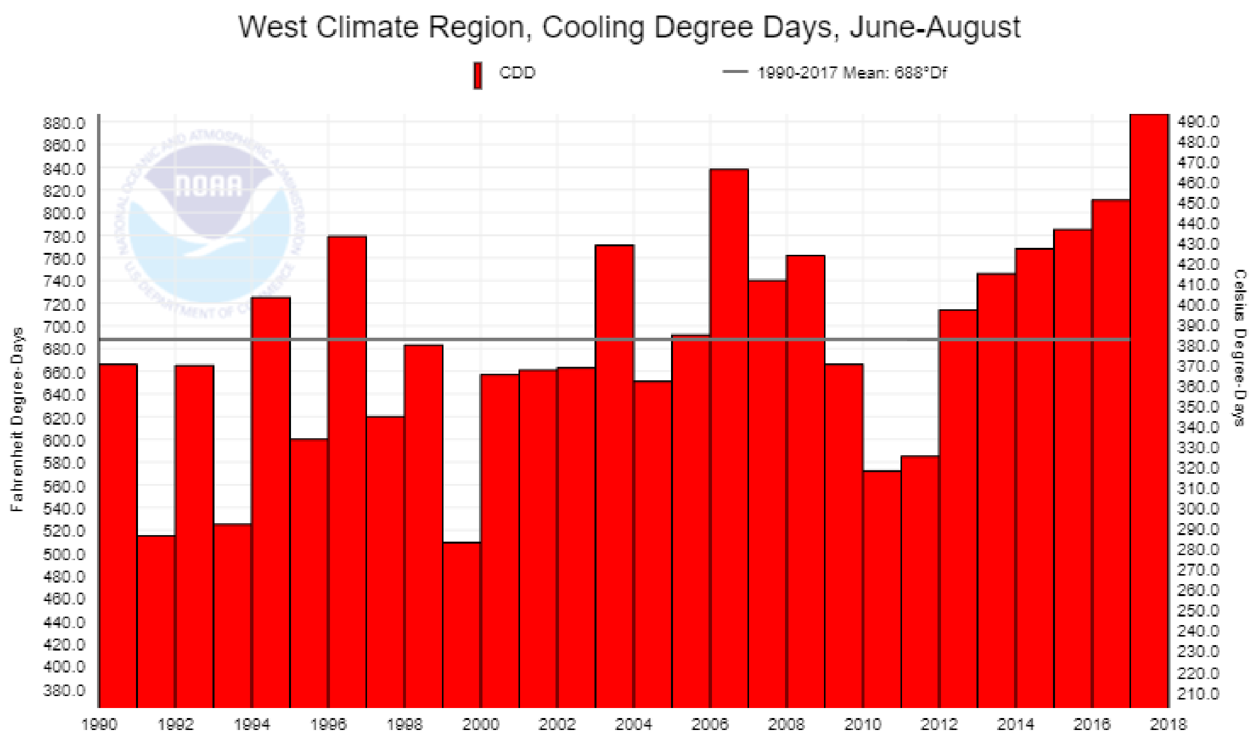
## Southwest Climate Region, Cooling Degree Days, June-August




## Northern Rockies and Plains Climate Region, Cooling Degree Days, June-August








NMED Exhibit 9e

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
RESEARCH TRIANGLE PARK, NC 27711

SEP 13 2013

OFFICE OF
AIR QUALITY PLANNING
AND STANDARDS

**MEMORANDUM**

**SUBJECT:** Guidance on Infrastructure State Implementation Plan (SIP) Elements under Clean Air Act Sections 110(a)(1) and 110(a)(2)

**FROM:** Stephen D. Page, Director
Office of Air Quality Planning and Standards

**TO:** Regional Air Directors, Regions 1 – 10

The purpose of this memorandum is to distribute non-binding guidance from the U.S. Environmental Protection Agency on the requirements of certain provisions of the Clean Air Act (CAA) titled, "Guidance on Infrastructure State Implementation Plan (SIP) Elements under Clean Air Act Sections 110(a)(1) and 110(a)(2)."

Sections 110(a)(1) and 110(a)(2) of the CAA direct each state to develop and submit to the EPA a plan that provides for the implementation, maintenance, and enforcement of the national ambient air quality standards (NAAQS).[1] Moreover, section 110(a)(1) requires that each state make a new SIP submission within 3 years after promulgation of a new or revised primary or secondary NAAQS, for approval into the existing SIP to assure that the SIP meets the applicable requirements for such new or revised NAAQS. This type of SIP submission is commonly referred to as an "infrastructure SIP."

The attached guidance, developed with the benefit of extensive written comments from state and local air agencies on a draft version, provides advice on the development of infrastructure SIPs for the 2008 ozone NAAQS, the 2010 nitrogen dioxide NAAQS, the 2010 sulfur dioxide NAAQS, and the 2012 fine particulate matter ($PM_{2.5}$) NAAQS, as well as infrastructure SIPs for new or revised NAAQS promulgated in the future. This guidance does not address CAA section 110(a)(2)(D)(i)(I), which concerns interstate pollution transport affecting attainment and maintenance of the NAAQS. The EPA expects to issue guidance in the future with respect to section 110(a)(2)(D)(i)(I).

Section 110(a)(1) directs each state to make an infrastructure SIP submission to the EPA within 3 years of promulgation of a new or revised NAAQS,[2] after reasonable notice and public hearing.[3] Section

[1] These CAA sections and this guidance may also apply, as appropriate under the Tribal Authority Rule in 40 CFR Part 49, to an Indian tribe that receives a determination of eligibility for treatment as a state for purposes of administering a tribal air quality management program under section 110(a) of the CAA. This memorandum and the guidance uses the term "air agency" to refer to a state or tribe that develops and submits an infrastructure SIP, except when quoting or paraphrasing a CAA section or EPA regulation that uses the term "state."

[2] The Administrator may specify a shorter period.



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110(a)(2) specifies the substantive elements that infrastructure SIP submissions need to address, as appropriate, for EPA approval. Many of the elements listed in section 110(a)(2) relate to the general information and authorities that constitute the basic structural requirements for a SIP needed for an air agency's overall air quality management program to be effective – elements that have been required to be in place since the initial SIPs were submitted in response to the CAA of 1970. Other elements listed in section 110(a)(2) relate to SIP requirements that have been added in successive amendments to the CAA since 1970. Although the 110(a)(2) requirements do not explicitly distinguish among the different criteria pollutants or different NAAQS, the structural SIP provisions needed to meet these requirements may depend on the particular new or revised NAAQS whose promulgation has triggered the requirement for a new infrastructure SIP submission. For example, a new or revised NAAQS may be accompanied by new ambient monitoring requirements tailored to that NAAQS or new prevention of significant deterioration program requirements. Overall, the requirement for a new infrastructure SIP submission provides an opportunity for the air agency, the public and the EPA to review the basics of the air quality management program in light of each new or revised NAAQS.

We acknowledge that air agencies continue to express concerns about the EPA's issuance of timely guidance to assist their efforts to implement a new or revised NAAQS. Our goal in providing the attached guidance document is to provide air agencies with recommendations in order to develop infrastructure SIPs that will meet the CAA requirements for recently promulgated NAAQS. The EPA will work to assist air agencies in the development and completion of these infrastructure SIPs so they may be submitted as soon as possible.

The attached guidance is also intended to provide comprehensive recommendations for infrastructure SIPs for new or revised NAAQS promulgated in the future. Our expectation is that this guidance will help to address the timeliness concerns expressed by air agencies and serve as guidance to address infrastructure SIP requirements for future NAAQS. As a result, the EPA intends that air agencies may continue to rely on this guidance for preparing infrastructure SIP submissions necessary for future NAAQS revisions, until such time as this guidance is supplemented or replaced by future guidance. Moreover, as air agencies and the EPA develop and act upon infrastructure SIP submissions through notice-and-comment rulemaking, the EPA anticipates that additional clarity will be provided about the best means to meet the statutory requirements.

Although this guidance provides recommendations for the development and review of infrastructure SIPs for multiple NAAQS, we are not recommending whether an air agency should or should not make a single infrastructure SIP submission to address requirements for more than one NAAQS simultaneously. Air agencies should consult with the appropriate EPA Regional Office for advice regarding combining infrastructure SIP submissions for multiple NAAQS.

Please share this guidance with the air agencies in your Region.

**For Further Information**

If you have any questions concerning this guidance, please contact H. Lynn Dail, at (919) 541-2363, *dail.lynn@epa.gov*, or Lisa Sutton, at (919) 541-3450, *sutton.lisa@epa.gov*.

Attachment

[3] The EPA's rules provide that a public hearing must be offered by the air agency, but is only required if a request is made.

# Guidance on Infrastructure State Implementation Plan (SIP) Elements under Clean Air Act Sections 110(a)(1) and 110(a)(2)

September 2013

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**List of Selected Acronyms and Abbreviations**

| | |
|---|---|
| AERMOD | American Meteorological Society/EPA Regulatory Model |
| AMTIC | Ambient Monitoring Technology Information Center |
| AQI | Air Quality Index |
| CAA | Clean Air Act |
| CMAQ | Community Multi-scale Air Quality [Model] |
| CAMx | Comprehensive Air Quality Model with Extensions |
| CFR | Code of Federal Regulations |
| CSAPR | Cross-State Air Pollution Rule |
| EPA | Environmental Protection Agency |
| EGU | Electric generating unit |
| FIP | Federal implementation plan |
| FR | Federal Register |
| GHG | Greenhouse gases |
| IBR | Incorporation by reference |
| NAAQS | National Ambient Air Quality Standards |
| $NO_2$ | Nitrogen dioxide |
| NOAA | National Oceanic and Atmospheric Administration |
| NPS | National Park Service |
| NSR | New Source Review |
| OAQPS | Office of Air Quality Planning and Standards |
| Pb | Lead |
| $PM_{2.5}$ | Fine particulate matter |
| ppm | Parts per million |
| PSD | Prevention of significant deterioration |
| RAVI | Reasonably Attributable Visibility Impairment |
| SHL | Significant harm level |
| SIP | State implementation plan (also, if indicated by the context, a tribal implementation plan) |
| $SO_2$ | Sulfur dioxide |
| SSM | Startup, shutdown, and malfunction |
| TAR | Tribal Authority Rule |
| TIP | Tribal Implementation Plan |
| UBR | Unavoidable breakdown rule |
| $\mu g/m^3$ | Micrograms per cubic meter |

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# Guidance on Infrastructure State Implementation Plan (SIP) Elements under Clean Air Act Sections 110(a)(1) and 110(a)(2)

## I. Introduction

Under Clean Air Act (CAA) sections 110(a)(1) and 110(a)(2), each state[1] is required to submit a state implementation plan (SIP)[2] that provides for the implementation, maintenance, and enforcement of each primary or secondary national ambient air quality standard (NAAQS). Moreover, section 110(a)(1) and section 110(a)(2) require each state to make this new SIP submission within 3 years after promulgation of a new or revised NAAQS.[3] This type of SIP submission is commonly referred to as an "infrastructure SIP."

Section 110(a)(1) generally directs each state to submit an infrastructure SIP to the U.S. Environmental Protection Agency after reasonable notice and public hearing.[4] Section 110(a)(2) specifies the substantive elements these submissions need to address, as applicable, for the EPA's approval. The subsections of section 110(a)(2) list a variety of requirements, some of which address authority, some of which address substantive requirements, and some of which consist of a combination of authority and substantive requirements. The conceptual purpose of an

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[1] These CAA sections and this guidance may also apply, as appropriate under the Tribal Authority Rule (TAR) in 40 CFR part 49, to an Indian tribe that receives a determination of eligibility for treatment as a state for purposes of administering a tribal air quality management program under section 110(a) of the CAA. Tribes should look to the TAR and engage their respective EPA Regional Offices in discussing how this guidance may impact the development and approvability of their tribal implementation plans (TIPs). We encourage states to provide outreach and engage in discussions with tribes about their SIPs as they are being developed.

[2] In the CAA and in this guidance, "plan," "SIP," and "TIP" may, depending on context, refer either to (i) all or part of the existing state (or tribal) implementation plan (*i.e.*, the collection of all submissions previously approved by the EPA as meeting CAA requirements) or (ii) a submission that adds to or modifies the existing plan as directed by section 110(a)(l).

[3] The Administrator may specify a shorter period.

[4] The EPA rules provide that a public hearing must be offered by the air agency but is only required if a request is made.

infrastructure SIP submission is to assure that the air agency's[5] SIP contains the necessary structural requirements for the new or revised NAAQS, whether by establishing that the SIP already contains the necessary provisions, by making a substantive SIP revision to update the SIP, or both. Overall, the infrastructure SIP submission process provides an opportunity for the responsible air agency, the public, and the EPA to review the basic structural requirements of the air agency's air quality management program in light of each new or revised NAAQS.

This non-binding guidance[6] provides recommendations for air agencies' development and the EPA's review of infrastructure SIPs for the 2008 ozone primary and secondary NAAQS,[7] the 2010 primary nitrogen dioxide ($NO_2$) NAAQS,[8] the 2010 primary sulfur dioxide ($SO_2$) NAAQS,[9] and the 2012 primary fine particulate matter ($PM_{2.5}$) NAAQS,[10] as well as

[5] This guidance uses the term "air agency" to generally refer to a state, territory, or tribe that develops and submits an infrastructure SIP or TIP, except when quoting or paraphrasing a CAA section or a EPA regulation that uses the term "state."

[6] None of the recommendations contained in this guidance are binding or enforceable against any person, and no part of the guidance or the guidance as a whole constitutes final agency action that could injure any person or represent the consummation of agency decision making. Only final actions taken to approve or disapprove SIP submissions that implement any of the recommendations in this guidance would be final actions for purposes of CAA section 307(b). Therefore, this guidance is not judicially reviewable. This document is not a rule or regulation, and the guidance it contains may not apply to a particular situation based upon the individual facts and circumstances. This guidance does not change or substitute for any law, regulation, or other legally binding requirement and is not legally enforceable. The use of non-mandatory language such as "guidance," "recommend," "may," "should," and "can" is intended to describe the EPA's policies and recommendations. Mandatory terminology such as "must" and "required" is intended to describe controlling legal requirements under the terms of the CAA and the EPA regulations. Neither such language nor anything else in this document is intended to or does establish legally binding requirements in and of itself.

[7] The EPA revised the levels of the primary and secondary 8-hour ozone standards to 0.075 parts per million (ppm). 40 CFR 50.15. 73 FR 16436 (March 27, 2008).

[8] The EPA revised the primary $NO_2$ standard by adding a 1-hour level of 100 parts per billion (ppb), while retaining the previous annual primary and secondary standards. 40 CFR 50.11(b) and (f). 75 FR 6474 (February 9, 2010). The EPA has also recently reviewed the air quality criteria and the secondary NAAQS for nitrogen oxides and sulfur oxides and retained the current $NO_2$ and $SO_2$ secondary standards, 77 FR 20218 (April 3, 2012).

[9] On June 2, 2010, the EPA established a new 1-hour $SO_2$ standard at a level of 75 ppb. 40 CFR 50.17. This rule also provided for the automatic future revocation of the previous annual and 24-hour $SO_2$ NAAQS for most areas following 1 year after designation under the new NAAQS. 40 CFR 50.4(e). The previous 3-hour secondary standard remains in place indefinitely. 40 CFR 50.5. 75 FR 35520 (June 22, 2010). The EPA has also recently reviewed the air quality criteria and the secondary NAAQS for nitrogen oxides and sulfur oxides and retained the current $NO_2$ and $SO_2$ secondary standards, 77 FR 20218 (April 3, 2012).

[10] The EPA revised the annual $PM_{2.5}$ standard by lowering the level to 12.0 micrograms per cubic meter ($\mu g/m^3$). 78 FR 3086 (January 15, 2013).

infrastructure SIPs for new or revised NAAQS promulgated in the future. As a result, air agencies may continue to rely on this guidance for developing infrastructure SIPs for future new or revised NAAQS until this guidance is supplemented or replaced by future guidance. This guidance does not address section 110(a)(2)(D)(i)(I), which concerns interstate pollution transport affecting attainment and maintenance of the NAAQS. The EPA expects to issue guidance in the future with respect to this section of the CAA.

Section II of this document provides general guidance for the development of infrastructure SIPs, and section III presents guidance on the individual elements (and sub-elements) that constitute an infrastructure SIP.

## II. General Guidance on Infrastructure SIPs

**<u>Which elements of CAA 110(a)(2) affect infrastructure SIPs?</u>**

Infrastructure SIP elements are addressed in portions of section 110(a)(2) of the CAA. Under this section, states are required to develop and maintain an air quality management program that meets various basic structural requirements, including, but not limited to: enforceable emission limitations; an ambient monitoring program; an enforcement program; air quality modeling capabilities; and adequate personnel, resources, and legal authority.

Although, as stated in section I of this document, infrastructure SIPs are required to be submitted within 3 years after the promulgation of a new or revised NAAQS, the EPA interprets section 110(a)(2) to exclude two elements that could not be governed by the 3-year submission deadline of section 110(a)(1). Both these elements pertain to part D, in title I of the CAA, which addresses SIP requirements and submission deadlines for designated nonattainment areas for a NAAQS. Therefore, the following elements are considered by the EPA to be outside the scope of infrastructure SIP actions: (1) section 110(a)(2)(C) to the extent that it refers to permit programs (known as “nonattainment new source review”) under part D; and (2) section 110(a)(2)(I) in its entirety, which addresses SIP revisions for nonattainment areas. Both these elements pertain to SIP revisions that collectively are referred to as a nonattainment SIP or an attainment plan, which would be due by the dates statutorily prescribed under subparts 2 through 5 under part D, extending as far as 10 years following area designations for some elements. Because the CAA directs states to submit these plan elements on a separate schedule, the EPA does not believe it is necessary for states to include these elements in the infrastructure SIP submission due 3 years after adoption or revision of a NAAQS. While an infrastructure SIP submission is not expected to meet the requirements for a nonattainment SIP, the scope of an infrastructure SIP does not exclude geographical areas that have been designated nonattainment for the new or revised NAAQS or an earlier NAAQS for the same pollutant. Sections 110(a)(1) and 110(a)(2) reflect the congressional intent that each air agency have an air quality program, covering all geographical areas of the state, that includes the specified air agency authorities, requirements, and activities.

The infrastructure SIP submission requirement does not move up the date for any required submission of a part D plan for areas designated nonattainment for the new NAAQS. However, in order to cover all parts of the state or area of Indian country, an infrastructure SIP submission may reference pre-existing SIP emission limits or other rules contained in part D plans for the predecessor to the relevant new or revised NAAQS. It may also include recently adopted emission limits that are intended to be part of the not-yet-submitted part D plan for the new or revised NAAQS. To avoid confusion about the legal effect of the EPA's action on an infrastructure SIP submission, we intend to make clear in each final action that EPA approval of the infrastructure SIP submission is solely with regard to whether the submission meets particular infrastructure SIP required elements (as opposed to nonattainment SIP elements). This means that the EPA may approve a submission as meeting the air agency's obligation under section 110(a)(1) and 110(a)(2) stemming from the particular new or revised NAAQS, without necessarily determining whether the submission meets the applicable requirements for nonattainment SIPs under part D of title I of the CAA for the same or any other NAAQS. An approval on this basis will make the referenced or newly submitted SIP emission limits or other rules federally enforceable, and will make clear that there has been no disapproval of an applicable required SIP submission and thus that there is no federal implementation plan (FIP) obligation stemming from CAA section 110(a)(1) or (2).[11]

**<u>Developing and Submitting an Infrastructure SIP Submission</u>**

Upon the promulgation of a new or revised NAAQS, the infrastructure SIP process should begin with the air agency's review of the adequacy of its existing SIP provisions for

[11]In general, a finding by the EPA that an air agency has failed to submit a complete SIP or an action by the EPA to disapprove a SIP or SIP element initiates a FIP obligation, if the submission is required by the CAA. Mandatory sanctions would not apply under CAA section 179 because the failure to submit a SIP is neither with respect to a submission that is required under CAA title I part D nor in response to a SIP call under CAA section 110(k)(5). Some of the sections of this guidance document address FIP implications on individual elements more specifically.

purpose of meeting the infrastructure SIP requirements for the new or revised NAAQS. In order to develop an infrastructure SIP submission, an air agency may cite existing EPA-approved provisions and/or adopt new or revised statutory authorities and regulations, as necessary, in order to address each element of the infrastructure SIP. Further, with respect to a given NAAQS, an air agency may elect to make multiple submissions; each addressing some but not all elements or sub-elements of section 110(a)(2) so long as those submissions meet all of the infrastructure requirements in the aggregate. An air agency may also elect to make one submission to address infrastructure SIP requirements for multiple NAAQS, if it represents the submission as such during its adoption process and in its transmittal to the EPA. Of course, such a submission to address multiple NAAQS should establish how the air agency believes that the SIP meets each of the requirements of section 110(a)(2), as applicable, for each of the relevant NAAQS.

It is important that the SIP submission demonstrate the authority of the responsible air agency (or agencies, if responsibility for implementation is shared, *e.g.*, between state and local agencies) to implement the new or revised NAAQS that has triggered the need for the infrastructure SIP submission. This can be an issue for approval if an older underlying legal authority enumerates specific ambient standards by pollutant, indicator, averaging period, level, and/or date of promulgation but does not include the new or revised NAAQS in its list. Air agencies are encouraged to discuss any situations of this type with their respective EPA Regional Offices.

We encourage each air agency to consult with the appropriate EPA Regional Office, to consider the completeness of the submission, and to consider how the submission satisfies the applicable EPA regulations governing approval of infrastructure SIP submissions in 40 CFR part 51 ("Requirements for Preparation, Adoption, and Submittal of Implementation Plans"). The regulations are referenced in this document, some with overlapping provisions across subparts, and include the following:

- Subpart A – Air Emissions Reporting Requirements
- Subpart F – Procedural Requirements
- Subpart G – Control Strategy
- Subpart H – Prevention of Air Pollution Emergency Episodes

- Subpart I – Review of New Sources and Modifications
- Subpart J – Ambient Air Quality Surveillance
- Subpart K – Source Surveillance
- Subpart L – Legal Authority
- Subpart M – Intergovernmental Consultation
- Subpart O – Miscellaneous Plan Content Requirements
- Subpart P – Protection of Visibility
- Subpart Q – Reports

Once the air agency has made one or more infrastructure SIP submissions, the EPA will evaluate the submission(s) for completeness. The EPA's criteria for determining completeness of a SIP submission are codified at 40 CFR part 51 appendix V and are discussed in a later subsection of this guidance. An air agency's familiarity with the EPA's regulatory completeness criteria will benefit the air agency during the process of developing an approvable submission.

The EPA's review can be expedited if a SIP submission includes a detailed explanation of how the existing EPA-approved SIP in combination with any newly submitted provisions meets each of the applicable requirements of section 110(a)(2). The EPA expects the submissions to include a description of the correlation between each infrastructure element and an equivalent set of statutory, regulatory, and/or non-regulatory provisions, as appropriate, that are part of or (for some elements) are referred to by the existing SIP or the new submission. (Refer to section III for more detail on submission requirements for each individual element.) When an air agency's infrastructure SIP submission more clearly identifies the CAA element(s) being met by the SIP and how they are met, the EPA can more easily determine whether the submission is complete and approvable with respect to that element.

**<u>Certifications</u>**

Where an air agency determines that the provisions in or referred to by its existing EPA-approved SIP are adequate with respect to a given infrastructure SIP element (or subelement) even in light of the promulgation of a new or revised NAAQS, the air agency may make a SIP submission in the form of a certification. This type of infrastructure SIP submission may, *e.g.*, take the form of a letter to the EPA from the Governor or her/his designee containing a "certification" (or declaration) that the already-approved SIP contains or references provisions that satisfy all or some of the requirements of section 110(a)(2), as applicable, for purposes of implementing the new or revised NAAQS. In such a case, the submission would not need to include a paper copy of the relevant pre-existing provisions (*e.g.*, rules or statutes).[12] Rather, the certification submission should provide citations to the state, local, or tribal statutes, regulations, or non-regulatory measures, as appropriate, in or referenced by the already EPA-approved SIP that meet particular infrastructure SIP element requirements and should include an explanation as to how those existing provisions meet the relevant requirements. The air agency should consult with its EPA Regional Office on the wording of this type of infrastructure SIP submission prior to making its submission. As for any other SIP submission, an air agency (unless the EPA has approved a request for parallel processing) would need to provide reasonable notice and

[12] In contrast, where an air agency's infrastructure SIP submission seeks the EPA's approval of or references a new provision (*e.g.*, a rule or statute) that has not already been approved, or submitted for approval, into the SIP, a complete SIP submission should include at least one hard copy and an exact duplicate electronic version of the adopted provisions (unless otherwise agreed to by the air agency and the Regional Office). Memorandum dated April 6, 2011, from Janet McCabe, titled "Regional Consistency for the Administrative Requirements of State Implementation Plans and the Use of Letter Notices." The EPA is investigating means to provide for states a method to transmit SIP submissions electronically with no requirement for paper copy submissions.

opportunity for comment prior to submitting a certification SIP submission to the EPA.[13] This "reasonable notice and public hearing" requirement for approvable infrastructure SIP submissions appears at sections 110(a)(1) and the introductory text of section 110(a)(2), and it has much the same wording as the more generally applicable procedural requirement at section 110(l) of the CAA ("Plan Revisions"). *See* CAA sections 110(a)(1) and (2) and 110(l). Compliance with this procedural requirement is verified through an additional certification by the air agency that a public hearing (if one was requested) was held in accordance with the EPA's regulatory procedural requirements for public hearings.[14] *See* 40 CFR 51.102 and 40 CFR part 51, appendix V, paragraph 2.1(g).

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[13] The EPA regulations at 40 CFR part 51 appendix V provide that a public hearing must always be offered and that a hearing must be held if requested. The EPA has received comment that when all of the elements in an existing infrastructure SIP were previously subject to a public comment process, including the opportunity for public hearing(s), when they were first submitted for the EPA's approval and incorporation into the SIP, no public comment requirements should apply to a "certification" infrastructure submission. The EPA believes this suggested interpretation is inconsistent with the plain text of section 110(a)(1) of the CAA. Section 110(a)(1) first provides that "[e]ach State shall, *after reasonable notice and public hearings*, adopt and submit to the Administrator, within 3 years (or such shorter period as the Administrator may prescribe) after the promulgation of a [primary NAAQS] (or any revision thereof) … a plan [*i.e.*, infrastructure SIP] which provides for implementation, maintenance, and enforcement of such primary standard." The clause "after reasonable notice and public hearings" is most naturally read as imposing that procedure on the immediately following phrase, "adopt and submit," the direct object of which is the infrastructure SIP itself. The suggested interpretation would instead apply the phrase "after reasonable notice and public hearings" to SIP revisions submitted before the promulgation of the new or revised primary NAAQS, despite the complete absence of a reference to those earlier SIP revisions in section 110(a)(1). Any possible residual ambiguity is removed by the last sentence of section 110(a)(1), which requires an infrastructure SIP for a secondary NAAQS to be considered (unless a separate public hearing is provided) "at the hearing required by the first sentence of this paragraph." The only possible interpretation of this sentence is that there must be an opportunity for public hearing for the infrastructure SIPs for both the primary and secondary NAAQS. This is a reasonable interpretation because it informs the public that the SIP is being revised and allows for comment as to whether the air agency's earlier approved regulations also satisfy the relevant obligation stemming from the promulgation of the new or revised NAAQS. Furthermore, the next footnote explains that the EPA has recently clarified procedures for providing notice and opportunity for comment that reduce the burden on air agencies while still assuring adequate notice to the public.

[14] Additional guidance regarding how an air agency may submit a SIP or a SIP revision can be found in a memorandum dated April 6, 2011, from Janet McCabe, Deputy Assistant Administrator, Office of Air and Radiation, to Regional Administrators, titled "Regional Consistency for the Administrative Requirements of State Implementation Plans and the Use of 'Letter Notices'." Refer also to a memorandum dated Nov. 22, 2011, jointly from Janet McCabe, Deputy Assistant Administrator, Office of Air and Radiation, and Becky Weber, Director, Air and Waste Management Division, Region 7, to Air Division Directors, Regions 1-10, titled "Guidelines for Preparing Letters Submitting State Implementation Plans (SIPs) to EPA and for Preparing Public Notices for SIPs." These guidance memos identify certain streamlining approaches that are available to an air agency, depending on the situation.

As with any SIP submission, the EPA's review can be expedited if a SIP certification submission includes a detailed explanation of how the existing SIP meets each of the applicable requirements of section 110(a)(2). This should include a description of the correlation between each infrastructure element and an equivalent set of statutory, regulatory, and/or non-regulatory provisions, as appropriate, that are part of or are referenced by the existing SIP. When an air agency's infrastructure certification submission more clearly identifies the CAA element(s) being met by the SIP and how they are met, the EPA can more easily determine whether the submission is complete and approvable with respect to that element.

## Determining Completeness of an Infrastructure SIP Submission

Section 110(k)(2) directs the EPA to take final action on a SIP submission within 1 year after the submission is determined to be complete under section 110(k)(l). If the EPA makes an affirmative finding that a SIP submission is complete, the date of the finding establishes the "completeness date" for the submission. If, however, the EPA makes no affirmative completeness finding, then the submission is deemed complete by operation of law on the date 6 months after the submission date. A finding that an infrastructure SIP submission is complete does not necessarily mean that the submission is approvable; the completeness review only addresses whether the air agency has provided information sufficient to commence formal EPA review for approvability. Refer to 40 CFR part 51 appendix V ("Criteria for Determining the Completeness of Plan Submissions").

Historically, when reviewing infrastructure SIP submissions, the EPA has operated on the basis that the elements and sub-elements of section 110(a)(2) for a given NAAQS are, for the most part, severable.[15] The EPA may elect to make a finding of failure to submit in whole or in part, based upon whether a state has made a complete infrastructure SIP submission for the relevant elements of section 110(a)(2). For a state that has not made any infrastructure SIP

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[15] See, *e.g.*, 76 FR 81371 (December 28, 2011), "Approval and Promulgation of Implementation Plans; Texas; Infrastructure and Interstate Transport Requirements for the 1997 Ozone and the 1997 and 2006 $PM_{2.5}$ NAAQS, Final Rule," where the EPA approved severable portions of infrastructure SIP revisions submitted by Texas.

submission, the EPA generally will make a finding with respect to all of the relevant elements.[16] For a state that has made a SIP submission but whose submission is incomplete for some of the relevant elements, the EPA generally will issue a finding of failure to submit only with respect to those elements. This separation makes clear what mandatory EPA duty subsequently exists with respect to each element or subelement. If the EPA has made separate findings as to the completeness of submissions for two or more elements (and sub-elements), the 12-month statutory deadline for EPA action to approve or disapprove the elements for which the air agency has made a complete submission and the 24-month statutory deadline for EPA action to promulgate FIPs for incomplete elements would apply separately. The EPA intends to continue its practice of acting on infrastructure SIP elements together or separately, as appropriate.

Any SIP submission is deemed by operation of law to be complete six months after submission, unless the EPA has before that date made an affirmative finding that the submission is complete or incomplete. Any inconsistency between the scope of the submission as described in the pre-submission public notice of the SIP submission and the actual submission, or between the description of the scope of the submission in the transmittal letter to the EPA and the actual substantive coverage of the submission can create ambiguity as to which infrastructure SIP elements in fact have been submitted and thus are capable of becoming complete by operation of law (and triggering a deadline for the EPA's action) and which have in fact not yet been submitted.[17] To provide clarity for all parties, air agencies should be very clear and accurate in the wording of their public notices and transmittal letters. It is also advisable for the air agency to discuss this wording with its EPA Regional Office before submission. On its part, an EPA Regional Office, in receipt of a submission with any inconsistencies of the type described, should consider steps it can take or ask the air agency to take prior to the six-month point in order to avoid the creation of ambiguity or an incorrect result as to which SIP elements have actually

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[16] Under the TAR, a tribe is not subject to deadlines for certain planning requirements (including submission of infrastructure SIPs). *See* 63 FR 7254 (Feb. 12, 1998) for more information.

[17] The EPA's experience is that the existence of a FIP for PSD or regional haze may increase the risk of such inconsistencies occurring inadvertently. FIP-related aspects are discussed in more detail in the next section of this guidance.

been submitted and are complete and consequently subject to a statutory deadline for the EPA action.

Section 2.3 of 40 CFR part 51 appendix V waives certain completeness requirements if the EPA has granted an air agency request for parallel processing of the submission. Under the parallel processing approach, the EPA proposes to approve a draft SIP submission so that final approval can be given more quickly after the final adoption of any new measures as state, local, or tribal law and conclusion of the public comment process normally required for any SIP submission. The EPA intends to grant requests for parallel processing of infrastructure SIP submissions if (1) the only missing elements of completeness are final state adoption of rules or other provisions and/or conclusion of the public comment process for the SIP submission, including evidence thereof as specified in section 2.3 of appendix V, and (2) the schedule provided by the air agency for the conclusion of the adoption process and/or the public comment process for the SIP submission is reasonably expeditious.[18] In such a case, the EPA generally would also either make a finding of completeness for the submission or allow it to become complete by operation of law. If both these conditions are not met, the EPA will not grant the parallel processing request. However, the EPA generally will not make a finding of failure to submit a complete SIP but may be required to do so if under a court order.

**Effect of a Federal Implementation Plan on an Infrastructure SIP**

The CAA directs states to submit SIPs to the EPA for approval. In some cases, and for various reasons, the EPA may have previously determined that an air agency had not satisfied a SIP requirement, and so accordingly promulgated a FIP to address the gap in the SIP. The infrastructure SIP process can be affected when an air agency is currently subject to a FIP that is related to an infrastructure SIP element. Therefore, this section describes the potential impact of pre-existing FIPs on the infrastructure SIP process. This explanation is relevant not only for air

[18] With regard to the 1992 EPA Memorandum from John Calcagni, Air Quality Management Division, OAQPS, to EPA Air Division Directors, Regions I through X, “State Implementation Plan (SIP) Actions Submitted in Response to Clean Air Act (Act) Deadlines,” October 29, 1992, note that the EPA no longer considers the section titled “Requests for Parallel Process to Meet Act Deadlines” to be its guidance for infrastructure SIPs that are submitted with requests for parallel processing.

agencies that currently have a FIP in effect but also for air agencies that may be subject to a FIP in the future.

The EPA's obligation to promulgate a FIP is set out in section 110(c) of the CAA. A FIP may be triggered if the EPA takes any of the following actions: (1) the EPA finds that a state has failed to make a required SIP submission; (2) the EPA finds that a required submission was incomplete; or (3) the EPA disapproves a required SIP submission in whole or in part. If the EPA takes one of these actions, section 110(c) obligates the EPA to promulgate a FIP within 2 years of the action, a deadline that is commonly referred to as a "FIP clock." In order to remove the EPA's FIP obligation, the state must make a SIP submission that meets the applicable CAA requirements and is approved by the EPA prior to the EPA's promulgation of a FIP. Whenever the EPA promulgates a FIP for a state air agency, the FIP rulemaking will identify the specific CAA provisions that required the promulgation of the FIP, and the FIP will be codified in the appropriate section of 40 CFR part 52.

Under the TAR, a tribe is not subject to deadlines for planning requirements (including submission of infrastructure SIPs).[19] In general, the concept of failure to submit a complete implementation plan does not apply in tribal situations, and there is no FIP clock started if a tribe has not submitted an infrastructure TIP. Under the TAR, in the absence of an approved tribal implementation plan the EPA will promulgate a FIP for one or more infrastructure SIP elements when and if it is necessary and appropriate to do so. For example, the EPA has promulgated new source review FIPs to govern permitting of sources in Indian country.

If the EPA has promulgated a FIP, then this means that the EPA has previously determined that the air agency's SIP did not meet some CAA requirement as of the date of promulgation of that FIP. While the intent and effect of the FIP is to achieve the same air quality protection as the SIP should have achieved, it is the EPA's interpretation of sections 110(a)(1) and 110(a)(2) that the EPA cannot give "credit" for the FIP when determining whether an air agency has met any later obligations under these sections.

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[19] *See* 63 FR 7254 (February 12, 1998) for more information on the TAR.

As an example of a FIP that affects the infrastructure SIP submission process, we note that, for various reasons, several states do not have EPA-approved major source preconstruction permit programs in their SIPs for prevention of significant deterioration (PSD) as required by part C of title I of the CAA. The EPA has promulgated a set of PSD rules which establish authority for the EPA (or an air agency to which the EPA has delegated authority to administer the federal PSD program)[20] to issue preconstruction permits to major stationary sources in any area not covered by a PSD program in a SIP.[21] The EPA has also promulgated FIPs for each area without a SIP-approved PSD program, indicating that this set of federal PSD rules applies in that area.[22] Such a PSD FIP may be relevant to infrastructure Element C, Element J, Element D(i)(II), and the portion of Element D(ii) related to notification to other states. As another example, the EPA has promulgated full or partial FIPs to address reasonably attributable visibility impairment (RAVI) and regional haze for some air agencies.[23] A RAVI FIP or a regional haze FIP may be relevant to Element D(i)(II). These linkages are further discussed in the section pertaining to each of these elements.

The infrastructure SIP process will vary to some extent depending on whether or not the air agency's SIP submission purports to, and actually does, satisfy infrastructure SIP requirements that are currently being met by means of a FIP, as explained in the following paragraphs.

Consider an air agency that is currently subject to a FIP that is relevant to certain infrastructure SIP elements makes a submission and states in a general way in the transmittal letter that the submission satisfies all elements of CAA section 110(a)(2), or if it specifically states that the submission satisfies the elements to which the FIP is relevant, the EPA would

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[20] The EPA is planning on extending the opportunity for delegation of new source review permitting to qualified tribes.

[21] *See* 40 CFR 52.21; Prevention of Significant Deterioration of Air Quality.

[22] *See, e.g.*, 40 CFR 52.738 for the PSD program applicable to sources in Illinois.

[23] Some of these regional haze FIPs relied on the Cross-State Air Pollution Rule (CSAPR), which was subsequently vacated by the U.S. Court Appeals for the D.C. Circuit. *EME Homer City Generation, L.L.P. v. EPA,* 696 F.3d 7 (D.C. Cir. 2012). The Supreme Court has accepted the EPA's petition for it to review the D.C. Circuit's decision. Air agencies should consult with their EPA Regional Offices regarding the current status of this litigation and the implications if any for infrastructure SIP submissions.

evaluate whether the submission, in fact, contains existing or new substantive provisions to address the section 110(a)(2) requirement presently covered by the FIP. If the submission does not substantively address the elements or sub-elements presently covered by the FIP, then the EPA Regional Office should encourage the air agency to clarify its intentions as to which elements have been submitted. The air agency might then clarify that it has made no submission for certain elements, in which case the EPA would not make a finding of complete submission for those elements and those elements could not become complete by operation of law. (The EPA may make a finding of failure to submit for those elements.) In the absence of such a clarification, the EPA Regional Office should determine that the air agency has failed to make a complete submission for those elements. Such a finding generally would create an obligation for the EPA to adopt a FIP within 24 months. However, based on the PSD FIP example and to the extent that the SIP deficiency is addressed by continuing to implement the existing PSD FIP, the EPA would have no additional FIP obligation under section 110(c) and the air agency would not have to take any further action for the current FIP-based permitting process to continue operating. Mandatory sanctions would not apply under CAA section 179 because such a finding of failure to submit a complete SIP was made neither with respect to a submission that is required under CAA title I part D nor in response to a SIP call under CAA section 110(k)(5).

To provide further clarity, consider how the following three scenarios may prompt differing EPA actions.

First scenario. Under this scenario, the transmittal letter for the infrastructure SIP submission makes clear that the submission is not intended to satisfy certain elements that can be addressed by continuing to apply the FIP. In this situation, the EPA would make a completeness finding that extends only to the SIP elements actually submitted by the air agency, and a finding that other relevant applicable elements were not submitted.[24] The EPA would be required to take action only on the elements that were submitted, within 12 months after those elements have been determined to be complete. The overall infrastructure SIP would not be approvable with

[24] If, instead, the submission that clearly addressed only some required elements has become complete at the 6-month point by operation of law, the EPA would still consider the air agency to not have made a complete submission for the missing elements.

respect to the elements that were not submitted, and thus the EPA could only partially approve the overall infrastructure SIP.[25]

Second scenario. Under the second scenario, suppose the air agency makes a SIP submission that references the existence of a PSD FIP and asserts that the existence of the FIP is a sufficient basis for EPA approval of the submission with respect to these elements. The EPA would not consider the existence of the PSD FIP, even if referenced in the submission, as meeting completeness or approvability criteria for these elements. This is because a FIP is not a state plan and thus cannot serve to satisfy the state's obligation to submit a SIP. The EPA's action on the SIP submission would indicate that the air agency has not met the underlying statutory obligations in section 110(a)(2) with respect to Elements C and J. However, when the SIP deficiency is being addressed by the existing PSD FIP, the EPA would have no additional FIP obligation under section 110(c) and the state would not have to take any further action for the current FIP-based permitting process to continue operating. In this example, the EPA may be able to approve a state-developed SIP later, if the air agency develops and submits a SIP meeting all statutory and regulatory requirements relevant to Elements C and J.

Third scenario. Under this scenario, the transmittal letter for the infrastructure SIP submission explicitly or implicitly indicates that the submission is intended to satisfy all required elements (including the elements that may be addressed by continuing to apply the existing PSD FIP), and the 6-month point has passed without any clarification by the air agency or any finding by the EPA Regional Office regarding completeness. In this situation, the EPA will generally treat the submission as having been intended to address all the required elements and to be complete for all elements. The 12-month clock for EPA action on the submission would apply to all elements and the EPA would proceed to disapprove the submission for the same elements with respect to the subject NAAQS that were previously addressed in the context of earlier NAAQS by the FIP. However, similar to the first scenario in which the SIP deficiency has

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[25] *Note*: Because an infrastructure SIP is not a required plan submission under part D of title I of the CAA, disapproval of (or a finding of failure to submit) an infrastructure SIP or element thereof does not trigger mandatory sanctions under CAA section 179, unless the submission was required in response to a SIP call under section 110(k)(5) of the CAA.

already been addressed, to the extent that the existing FIP addresses the deficiency, the EPA would have no additional FIP obligation under section 110(c) and the state would not have to take any further action for the current FIP-based permitting process to continue operations. As in the first scenario, the EPA may be able to approve a state-developed SIP later, if the air agency develops and submits a SIP meeting all statutory and regulatory requirements relevant to Elements C and J.

For some state air agencies and some sources in Indian country, there are RAVI or regional haze FIPs in place that may be relevant to the subelement of Element D(i)(II) related to interference with measures by another state to protect visibility. This subelement is sometimes referred to as the "visibility transport" prong or simply, as "prong 4." While fully approved RAVI and regional haze SIPs can be relied upon in satisfying this subelement, as explained later in this document, it may be possible in some cases for the element to be satisfied even if there is a FIP in place. Air agencies in this situation should read the section on Element D(i)(II) and consult with their respective EPA Regional Offices on this aspect of their infrastructure SIP submission.

If a new submission in fact does address the substance of the element or subelement covered by a FIP, the EPA would review the submission and may approve the infrastructure SIP. The EPA may also withdraw the FIP that had been addressing that element or subelement for previous NAAQS, if all relevant CAA requirements are met by the SIP.

## III. Guidance on Individual Infrastructure SIP Elements

The EPA interprets section 110(a)(1) and section 110(a)(2) to require infrastructure SIP submissions to meet the elements of section 110(a)(2), as applicable. As described in section II, the EPA interprets the portion of section 110(a)(2)(C) that pertains to a permitting program that applies to nonattainment NSR within nonattainment areas, and the requirements of section 110(a)(2)(I) that pertain to the specific requirements for attainment plans for designated nonattainment areas, to be outside the scope of the infrastructure SIP requirements because of the separate statutory schedules for area designations and submission of attainment plans provided elsewhere in the CAA. With respect to the remaining elements of section 110(a)(2), subsections (A) through (M), the CAA imposes an obligation on states to address those elements, as appropriate, within the 3-year infrastructure SIP submission deadline. This section provides recommendations to air agencies about how to make infrastructure SIP submissions to meet these remaining relevant elements, as applicable.

### Element A – Section 110(a)(2)(A): Emission Limits and Other Control Measures

> *Each such plan shall –*
>
> *(A) include enforceable emission limitations and other control measures, means, or techniques (including economic incentives such as fees, marketable permits, and auctions of emissions rights), as well as schedules and timetables for compliance, as may be necessary or appropriate to meet the applicable requirements of this Chapter.*

To satisfy Element A, an air agency's submission should identify existing EPA-approved SIP provisions or new SIP provisions that the air agency has adopted and submitted for EPA approval that limit emissions of pollutants relevant to the subject NAAQS, including precursors of the relevant NAAQS pollutant where applicable. Emissions limitations and other control measures needed to attain the NAAQS in areas designated nonattainment for that NAAQS will be due on a different schedule from the section 110 infrastructure elements and will be reviewed and acted upon with regard to approvability for the specific purposes of such an attainment plan under CAA title I part D through a separate process at a later time. *See* "Which elements of CAA

110(a)(2) affect infrastructure SIPs?" in section II of this guidance for additional discussion of this distinction.

There are two issues that relate to Element A for which we are providing general guidance. These are whether air agencies would need to correct the following in order for the EPA to approve their infrastructure SIP submissions: (1) previously approved emissions limitations that may treat startup, shutdown, and malfunction (SSM) events inconsistently with the CAA as interpreted by our longstanding guidance on excess emissions (the EPA's SSM Policy) and more recently by multiple courts; and (2) previously approved SIP provisions for "director's variance" or "director's discretion" that purport to allow revisions to or exemptions from SIP emission limitations with limited public process or without requiring further approval by the EPA.[26] The guidance provided here is consistent with the EPA interpretations articulated in provisions in several recent EPA final actions on SIPs.[27, 28]

In recent infrastructure SIP actions, the EPA has drawn an important distinction with respect to SSM issues and director's discretion issues in this particular context. The EPA does not interpret section 110(a)(2) to require air agencies and the EPA to address potentially deficient

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[26] For further description of EPA's SSM Policy, *see*, *e.g.*, a memorandum dated September 20, 1999, titled, "State Implementation Plans: Policy Regarding Excess Emissions During Malfunctions, Startup, and Shutdown," from Steven A. Herman, Assistant Administrator for Enforcement and Compliance Assurance, and Robert Perciasepe, Assistant Administrator for Air and Radiation. Also, the EPA issued a proposed action on February 12, 2013, titled "State Implementation Plans: Response to Petition for Rulemaking; Findings of Substantial Inadequacy; and SIP Calls to Amend Provisions Applying to Excess Emissions During Periods of Startup, Shutdown and Malfunction." This rulemaking responds to a petition for rulemaking filed by the Sierra Club that concerns SSM provisions in 39 states' SIPs. It clarifies and restates the EPA's SSM SIP policy.

[27] *See*, *e.g.*, a SIP call issued to Utah (72 FR 21639, Apr. 18, 2010) concerning treatment of malfunction events under Utah's "unavoidable breakdown rule" (UBR). The EPA determined that Utah's SIP was substantially inadequate because its UBR allowed operators of CAA-regulated facilities to avoid enforcement actions when they suffer an unexpected and unavoidable equipment malfunction. In this SIP call, the EPA called on Utah to promulgate a new UBR that conforms to the EPA's interpretation of the CAA. Litigants maintained that the SIP call was arbitrary and capricious and asked the Tenth Circuit Court to vacate it. The Court denied the petition for review of the Utah SIP call. *U.S. Magnesium, LLC v. EPA,* U.S. Court of Appeals, No. 09-1269, January 14, 2011.

[28] As another example that presents the EPA's position on infrastructure SIPs with respect to this issue, *see* the preamble language in the final rule published in the *Federal Register* on July 13, 2011 (76 FR 41075), "Approval and Promulgation of Air Quality Implementation Plans; Illinois; Indiana; Michigan; Minnesota; Ohio; Wisconsin; Infrastructure SIP Requirements for the 1997 8-Hour Ozone and $PM_{2.5}$ National Ambient Air Quality Standards." In section II of the preamble, the EPA described at length the position summarized in this guidance regarding existing provisions related to excess emissions during periods of SSM and existing provisions related to "director's variance" or "director's discretion."

pre-existing SIP provisions of these types in the context of acting on an infrastructure SIP submission. The EPA considers this a reasonable interpretation of the CAA in such a context. The EPA notes that it has alternative tools in the CAA to address existing SIP deficiencies of this type, in appropriate circumstances.

However, any "new" provisions in the infrastructure SIP submission that are relevant to SSM (*e.g.*, any newly created enforcement discretion provisions, affirmative defense provisions, or special emissions limitations that apply during SSM periods but that have not already been approved by the EPA) should be consistent with the EPA's policy on what types of SSM provisions are permissible in SIPs under the CAA. For instance, new provisions as part of an approvable SIP submission cannot allow an air director the discretion to determine whether an instance of excess emissions is a violation of an emission limitation, because such a determination could bar the EPA and citizens from enforcing applicable requirements. Similarly, new provisions in a SIP for the exercise of enforcement discretion with regard to SSM events may only apply to state or tribal government personnel so that they do not limit enforcement by the EPA or citizens. Excess emissions, including those occurring during SSM periods, might prevent attainment and maintenance of the NAAQS and compliance with other applicable CAA requirements. The EPA views all periods of excess emissions as violations of the applicable emission limitation. Therefore, if an infrastructure SIP contains provisions that have not already been approved by the EPA, and that impermissibly exempt from enforcement excess emissions that may occur at a facility during SSM periods or that otherwise are inconsistent with the EPA's interpretation of the CAA as outlined in its SSM Policy, the EPA will not propose to fully approve the submission as meeting section 110(a)(1) and (2) requirements.

With regard to "director's discretion" to revise emission limits, any "new" provisions in the infrastructure SIP submission (*i.e.*, provisions that have not already been approved by the EPA) should be consistent with the EPA's interpretation of the CAA as expressed in its policy regarding director's discretion.[29]

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[29] *See* 77 FR 34309 and 34311 (June 11, 2012). "Approval and Promulgation of Implementation Plans; Tennessee; 110(a)(1) and (2) Infrastructure Requirements for the 1997 Annual and 2006 24-Hour Fine Particulate National Ambient Air Quality Standards, Proposed Rule."

The EPA will continue to consider for approval, as it has in recent final SIP actions,[30] SIPs that provide for a limited affirmative defense to civil penalties for excess emissions occurring during properly demonstrated and documented malfunction periods.

In summary, the EPA in recent final actions on infrastructure SIP submissions has maintained that the CAA does not require that new infrastructure SIP submissions address *existing* potentially inadequate provisions concerning SSM or director's discretion in order to be approved as meeting the CAA section 110(a)(1) and (2) requirements triggered by the new or revised NAAQS. The EPA's stated position has been that it can approve an infrastructure SIP submission, even if the infrastructure SIP may incorporate by reference previously approved SIP provisions that are or may not be consistent with the EPA's SSM Policy and its policy on director's discretion to revise emission limits. The EPA articulated this position in a number of infrastructure SIP actions taken in 2011, noting in the preambles for those actions that existing provisions for SSM and director's discretion may be dealt with separately, outside the context of acting on an air agency's new infrastructure SIP submission.[31] However, if an air agency submits an infrastructure SIP submission that would create a *new* SIP provision related to SSM that is inconsistent with the EPA's interpretation of the requirements of the CAA, the EPA may disapprove it. We intend to continue this practice and affirm it as part of this guidance.

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[30] *See* 75 FR 68989 at 68992 (November 10, 2010), "Approval and Promulgation of Implementation Plans; Texas: Excess Emissions During Startup, Shutdown, Maintenance, and Malfunction Activities." In *Luminant Generation Co. v. EPA*, No. 10-60934, 2012 WL 4841615 (5th Cir. 2012), the Court upheld the EPA's approval of an affirmative defense for malfunctions and disapproval of an affirmative defense provision in a SIP submission that pertained to "planned activities," which included startup, shutdown, and maintenance. The EPA disapproved this provision, in part because it provided an affirmative defense for maintenance. The Court rejected challenges to the EPA's disapproval of this provision, holding that under *Chevron* step 2, the EPA's interpretation of the CAA was reasonable. *See* also the *Federal Register* notice signed on February 12, 2013, restating the EPA's policy on affirmative defense provisions and proposing 36 SIP calls to correct affirmative defense and other SSM-related SIP provisions.

[31] As one example of preamble language that presents the EPA's position on infrastructure SIPs with respect to this issue, *see* the final rule published in the *Federal Register* on July 13, 2011 (76 FR 41075), "Approval and Promulgation of Air Quality Implementation Plans; Illinois; Indiana; Michigan; Minnesota; Ohio; Wisconsin; Infrastructure SIP Requirements for the 1997 8-Hour Ozone and $PM_{2.5}$ National Ambient Air Quality Standards." In section II of the preamble, the EPA described at length the position summarized here regarding existing provisions related to excess emissions during periods of SSM and existing provisions related to "director's variance" or "director's discretion."

**Element B – Section 110(a)(2)(B): Ambient Air Quality Monitoring/Data System**

*Each such plan shall –*

*(B) provide for establishment and operation of appropriate devices, methods, systems, and procedures necessary to –*

*(i) monitor, compile, and analyze data on ambient air quality, and*

*(ii) upon request, make such data available to the Administrator.*

To meet Element B requirements, the best practice for an air agency submitting an infrastructure SIP would be to submit, for inclusion into the SIP (if not already part of the SIP), the statutory or regulatory provisions that provide the air agency or official with the authority and responsibility to perform the actions listed in the bullets below along with a narrative explanation of how the provisions meet the requirements of this element.[32]

- Monitor air quality for the relevant NAAQS pollutant(s) at appropriate locations in accordance with the EPA's ambient air quality monitoring network requirements. *See* the EPA's Ambient Monitoring Technology Information Center (AMTIC) website, 40 CFR part 53 ("Ambient Air Monitoring Reference and Equivalent Methods"), and 40 CFR part 58 ("Ambient Air Quality Surveillance"). *See* also 40 CFR 51.190 (referencing 40 CFR part 58).[33]

- Submit data to the EPA's Air Quality System (AQS) in a timely manner in accordance with 40 CFR part 58. Under 40 CFR part 58, subpart B ("Monitoring Network"), for example, *see* 40 CFR 58.16 ("Data submittal and archiving requirements").

- Provide to the EPA Regional Office information regarding air quality monitoring activities, including a description of how the air agency has complied with monitoring requirements, and an explanation of any proposed changes to the network.

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[32] The EPA recognizes that some air agencies may have general authorizing provisions that do not specifically enumerate specific activities but do implicitly authorize the air agency to perform such activities, in which case inclusion of those provisions would meet the intent of this best practice.

[33] Note that despite the recent reorganization of 40 CFR part 58 without a corresponding conforming update of the cross-reference to part 58 in 40 CFR 51.190, all requirements under part 58 must still be met.

Submission of annual monitoring network plans consistent with the EPA's ambient air monitoring regulations is one way of providing this information. Under 40 CFR part 58, subpart B, *see*, *e.g.*, 40 CFR 58.10 ("Annual monitoring network plan and periodic network assessment").

- Obtain the EPA's approval of any planned changes to monitoring sites or to the network plan, consistent with applicable requirements in 40 CFR 58.14 ("System Modification").

If an air agency chooses not to include the relevant statute or regulation in its SIP, then the air agency should provide a reference or citation to the authority provisions along with a narrative explanation of how the provisions meet the requirements of this element, as well as a copy of the relevant authority to accompany the SIP as required by 40 CFR 51.231.

For any new or revised NAAQS, the infrastructure SIP submission should provide assurance that the state will meet changes in monitoring requirements related to the new or revised NAAQS.

**Element C – Section 110(a)(2)(C): Programs for Enforcement of Control Measures and for Construction or Modification of Stationary Sources.**

*Each such plan shall –*

*(C) include a program to provide for the enforcement of the measures described in subparagraph (A), and regulation of the modification and construction of any stationary source within the areas covered by the plan as necessary to assure that national ambient air quality standards are achieved, including a permit program as required in parts C and D of this Subchapter.*

This element consists of three sub-elements; enforcement, state-wide regulation of new and modified minor sources and minor modifications of major sources; and preconstruction permitting of major sources and major modifications in areas designated attainment or unclassifiable for the subject NAAQS as required by CAA title I part C (*i.e.*, the major source

PSD program).[34,35] While this section outlines the general requirements for approvability of an infrastructure SIP with respect to Element C, air agencies previously subject to FIPs with respect to this element for major source PSD in the context of earlier NAAQS have the option, as discussed in more detail below and in Section II: “Which elements of CAA 110(a)(2) affect infrastructure SIPs?”, to remain subject to those FIPs as the remedy for infrastructure SIP deficiencies for a new or revised NAAQS.

Enforcement: To satisfy this subelement, an infrastructure SIP submission should identify the statutes, regulations, or other provisions in the existing SIP (or new provisions that are submitted as part of the infrastructure SIP to be incorporated into the SIP) that provide for enforcement of those emission limits and control measures that the air agency has identified in its submission for purposes of satisfying Element A (Emissions limits and other control measures).

Regulation of minor sources and minor modifications: To satisfy the subelement for pre-construction regulation of the modification and construction of minor stationary sources and the minor modification of major stationary sources, an infrastructure SIP submission should identify the existing EPA-approved SIP provisions and/or include new provisions that govern the minor source pre-construction program that regulates emissions of the relevant NAAQS pollutant(s). The EPA rules addressing SIP requirements for pre-construction regulatory programs that apply to minor sources and minor modifications are at 40 CFR sections 51.160 through 51.164.

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[34] The terms "major" and "minor" categorize a stationary source or a modification of a stationary source, for NSR applicability purposes, in terms of an annual emissions rate (tons per year) or change in annual emission rate for a pollutant. The pre-construction minor NSR program generally applies to minor stationary sources and minor modification projects at major stationary sources. A major “stationary source” is defined in the applicable PSD or nonattainment NSR regulations. Some air agencies exempt small minor sources and modifications from pre-construction regulatory requirements.

[35] As explained in section II of this document, the EPA considers evaluation of permit provisions that implement CAA title I part D (the major source nonattainment NSR program) to generally be outside the scope of infrastructure SIP actions. Hence, to address the sub-element regarding major source permitting, only the major source permitting program applicable in areas designated attainment or unclassifiable is an issue. In contrast, because part D does not impose any special requirements for permitting of minor sources in nonattainment areas, the infrastructure SIP due 3 years after a new or revised NAAQS should address Element C with regard to minor sources in unclassifiable, attainment, and nonattainment areas, without regard to designation.

Preconstruction PSD permitting of major sources:[36] To satisfy the subelement regarding the PSD program required by CAA title I part C, an infrastructure SIP submission should demonstrate that one or more air agencies has the authority to implement a comprehensive PSD permit program under CAA title I part C, for all PSD-subject sources located in areas that are designated attainment or unclassifiable for one or more NAAQS. The infrastructure SIP submission should also identify the existing SIP provisions that govern the major source PSD program. As explained in more detail below, to be approvable the infrastructure SIP submission should also address any new or revised PSD permitting program requirements for which the deadline for SIP submissions has passed as of the date of EPA's proposed action on the infrastructure submission.

The SIP permitting provisions that implement CAA title I part C (the PSD program) govern preconstruction review and permitting of any new or modified major stationary sources of air pollutants regulated under the CAA (as well as any precursors to the formation of those pollutants when identified for regulation by the Administrator) in areas designated as attainment or unclassifiable. The EPA rules providing the minimum requirements for approvable PSD programs can be found generally at 40 CFR 51.166 (general provisions for PSD programs approved in SIPs) and 40 CFR 51.307 (specific provisions pertaining to new source review for potential impacts on air quality related values in Class I areas).

The EPA interprets Element C to mean that each infrastructure SIP submission for a particular NAAQS would need to demonstrate that the air agency has a complete PSD permitting program in place covering the requirements for all regulated NSR pollutants, including greenhouse gases (GHG), in order to demonstrate that the SIP meets Element C.[37]

Element C requires that each infrastructure SIP contain a permitting program "as required by part C." CAA title I part C is applicable to all pollutants subject to regulation under the CAA. *See, e.g.*, CAA section 165(a)(4). There is no specific language in the last clause of Element C

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[36] The discussion here of the PSD portion of Element C also applies in full to the PSD portion of Element J.

[37] *See, e.g.*, 77 FR 64737 (October 23, 2012), "Partial Approval and Partial Disapproval of Air Quality State Implementation Plans; Nevada; Infrastructure Requirements for Ozone and Fine Particulate Matter."

that restricts its application to only those provisions of CAA title I part C that pertain to the particular new or revised NAAQS addressed by the particular infrastructure SIP action. Because the scope of CAA title I part C is comprehensive (covering all pollutants subject to regulation under the CAA, including GHG), the EPA likewise reads the unrestricted reference to CAA title I part C in Element C to mean that this provision has the same scope as CAA title I part C itself. Thus, an infrastructure SIP submission for any one of the recently revised NAAQS must be "comprehensive" in that it would need to meet all CAA title I part C requirements for other regulated NSR pollutants as well.

The broad scope of Element C with respect to major source PSD permitting raises the question of how the EPA will proceed when the timing of requirements for multiple, related SIP submissions (*e.g.*, for mandatory PSD SIP revisions) impacts the ability of the air agency and the EPA to address certain substantive issues in the infrastructure SIP submission in a reasonable fashion. It is appropriate for the EPA to take into consideration the timing of related requirements for SIP submissions in determining what an air agency can reasonably be expected to have addressed in an infrastructure SIP submission for a NAAQS at the time when the EPA acts on such submission. The EPA does not consider it reasonable to interpret Element C to require the EPA to propose to disapprove an air agency's infrastructure SIP submission because the air agency had not submitted a PSD permitting program revision that was not yet due as of the date of EPA's proposed action. Because it would be unreasonable to propose such a disapproval, the EPA likewise does not consider it reasonable to take final disapproval action under such circumstances. In other words, the EPA interprets these CAA sections to allow the EPA to approve an infrastructure SIP submission for the major source PSD permitting subelement of Element C (and Element J) provided that the EPA has already approved or is simultaneously approving the air agency's SIP submission(s)[38] with respect to all structural PSD permitting program revision requirements that were due under the EPA regulations or the CAA on or before the date of the EPA's proposed action on the infrastructure SIP submission. To adopt a different approach, by which the EPA could not act on an infrastructure SIP or at least

[38] These submissions may be submitted separately or together with the infrastructure SIP submission on which the EPA is proposing action.

could not approve an infrastructure SIP whenever there was any impending revision to the PSD permitting program regulations required by another collateral rulemaking action, would result in regulatory gridlock and make it impracticable or impossible for the EPA to act on infrastructure SIPs if the EPA had recently revised its PSD permitting regulations but the submission required by such revisions was not yet due. The EPA believes that such an outcome would be an unreasonable reading of the statutory process for the infrastructure SIPs contemplated in sections 110(a)(1) and (2).

Consequently, the EPA generally plans to proceed as follows. The EPA may propose to approve an infrastructure SIP submission with respect to the major source PSD permitting subelement of Element C if the air agency has submitted, in a timely manner, all structural PSD permitting program provisions for which the SIP submission deadline has passed as of the date of the proposed approval.[39] Subject to consideration of public comments on the proposed action, the EPA believes it may proceed to fully approve an infrastructure submission with respect to Element C if all such structural PSD permitting program submissions have been or are being simultaneously fully approved into the SIP. The EPA does not intend to treat any structural PSD permitting program requirement for which the SIP submission deadline falls *after* the date of the EPA's proposed action on the infrastructure SIP as a required criterion for approval of the infrastructure SIP. The PSD permitting program revisions treated in this manner may include not only those related to the new or revised NAAQS whose promulgation has triggered the need for a new infrastructure SIP submission but also those related to any other regulated NSR pollutants as required by CAA title I part C and 40 CFR part 51.166.[40]

If an air agency lacks a PSD permitting program in its existing EPA-approved SIP addressing all regulated NSR pollutants, and it is already subject to a FIP, then major stationary

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[39] Structural PSD program provisions include provisions necessary for the PSD program to address all regulated sources and NSR pollutants, including GHG. Structural PSD program provisions do not include provisions which under 40 CFR 51.166 are at the option of the air agency, such as the option for air agencies to provide grandfathering of complete permit applications with respect to the 2012 $PM_{2.5}$ NAAQS.

[40] *See, e.g.*, "Approval and Promulgation of Implementation Plans; Mississippi: New Source Review – Prevention of Significant Deterioration; Fine Particulate Matter ($PM_{2.5}$) National Ambient Air Quality Standards," 77 FR 59095 (September 26, 2012), a recent infrastructure SIP approval action that addressed a state's PSD SIP status with respect to the 2008 $PM_{2.5}$ NSR Rule.

sources within its jurisdiction are subject to the federal PSD permitting requirements in 40 CFR 52.21. Some air agencies are subject to a FIP for PSD permitting of all regulated NSR pollutants, and fewer air agencies are subject to a FIP for PSD permitting that is limited to particular pollutants (such as GHG). For sources subject to a pre-existing FIP for PSD permitting, either the EPA Regional Office issues PSD permits or, in instances where federal authority is delegated by the EPA Regional Office to it, the state or local air agency issues the PSD permits under the FIP (and tribes might be delegated in the same manner in the future). The EPA recognizes that some states have indicated a preference to operate under an EPA-administered PSD permitting program. Many air agencies have for some time been delegated the authority to implement a PSD FIP program. Other states have implemented their SIP-approved PSD permitting program. When an area is already subject to a FIP for PSD permitting (whether or not a state, local, or tribal air agency has been delegated federal authority to implement the PSD FIP), the air agency may choose to continue to rely on the PSD FIP to have permits issued pursuant to the FIP. If so, the EPA could not fully approve the infrastructure SIP submission with respect to Element C; however, the EPA anticipates that there would be no adverse consequences to the air agency or to sources from this lack of full approval of the infrastructure SIP. Mandatory sanctions would not apply under CAA section 179 because the failure to submit a PSD SIP is neither with respect to a submission that is required under CAA title I part D, nor in response to a SIP call under CAA section 110(k)(5). This relationship between a pre-existing FIP and the EPA's action on an infrastructure SIP element is also explained in section II of this document.

The EPA has maintained that the CAA allows the EPA to approve infrastructure SIP submissions that do not implement the NSR Reform Rules promulgated mainly in 2002.[41] We articulated this position in a number of infrastructure SIP final actions taken in 2011, noting in the preambles for those actions that existing SIP provisions for PSD programs that have not

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[41] The NSR rules have undergone a series of improvements over many years. Significant reforms were promulgated in a rulemaking commonly referred to as the "2002 NSR Reform Rules," which were published in the *Federal Register* at 67 FR 80186 (December 31, 2002).

addressed the NSR Reform Rules may be dealt with separately, outside the context of acting on a state's infrastructure SIP.[42]

Air agencies may wish to reduce the need to amend their major source PSD rules after each new or revised NAAQS by writing them so that their coverage of pollutants and NAAQS automatically updates with the promulgation of a new or revised NAAQS, and/or so that the specific PSD program requirements automatically update to stay matched with the federal PSD program requirements in 40 CFR 52.21. Depending on state or tribal law provisions, it may be possible to do one or both of these through the use of "rolling" incorporation by reference (IBR). An advantage of the rolling IBR approach is that it enables air agencies to quickly implement requirements of the CAA that may be immediately applicable to regulated sources upon the effective date of the new or revised NAAQS and before the deadline for air agencies to make infrastructure SIP submissions to the EPA. For example, one of the PSD program requirements is the requirement under section 165(a)(3) of the CAA that a permit applicant show it will not cause or contribute to a violation of any NAAQS. This requirement generally[43] applies to any NAAQS in effect on the date a PSD permit decision is issued and is not deferred until an infrastructure SIP submission is due. Where permissible under state or tribal law, a rolling IBR approach is advisable to enable air agencies to implement this type of CAA requirement immediately upon the effective date of a NAAQS, thus ensuring that there is a mechanism in place for regulated sources in the state or an area of Indian country to meet CAA requirements resulting from a new or revised NAAQS as soon as it becomes applicable.

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[42] As one example of the preamble language that presents the EPA's position on infrastructure SIPs with respect to the issue of NSR Reform, *see* the final rule published in the *Federal Register* on July 13, 2011, "Approval and Promulgation of Air Quality Implementation Plans; Illinois; Indiana; Michigan; Minnesota; Ohio; Wisconsin; Infrastructure SIP Requirements for the 1997 8-Hour Ozone and $PM_{2.5}$ National Ambient Air Quality Standards." 76 FR 41075. In section II of the preamble, the EPA applied the described position to existing provisions for PSD programs in light of the "NSR Reform Rules" that we promulgated mainly in 2002; *see* 67 FR 80186 (Dec. 31, 2002).

[43] In some circumstances, the EPA has authorized "grandfathering" of pending PSD permit applications. *See* 78 FR 3086, January 15, 2012.

**<u>Elements D(i)(I) and (II) – Section 110(a)(2)(D)(i): Interstate Pollution Transport</u>**

*Each such plan shall –*

*(D) contain adequate provisions –*

*(i) prohibiting, consistent with the provisions of this subchapter, any source or other type of emissions activity within the State from emitting any air pollutant in amounts which will –*

*(I) contribute significantly to nonattainment in, or interfere with maintenance by, any other State with respect to any such national primary or secondary ambient air quality standard, or*

*(II) interfere with measures required to be included in the applicable implementation plan for any other State under part C of this subchapter to prevent significant deterioration of air quality or to protect visibility.*

Section 110(a)(2)(D)(i) contains two subsections: (D)(i)(I) and (D)(i)(II). Section 110(a)(2)(D)(i)(I) addresses any emissions activity in one state that contributes significantly to nonattainment, or interferes with maintenance, of the NAAQS in another state. The EPA sometimes refers to these requirements as prong 1 (significant contribution to nonattainment) and prong 2 (interference with maintenance). Neither prong 1 nor prong 2 is addressed in this guidance. This guidance does not modify any prior statements by the EPA with respect to prongs 1 and 2 and does not address, discuss, or in any way alter any requirements set forth in either prong.

Element D(i)(II) requires SIPs to include provisions prohibiting any source or other type of emissions activity in one state from interfering with measures required of any other state to prevent significant deterioration of air quality or from interfering with measures required of any other state to protect visibility (referring to visibility in Class I areas). The EPA sometimes refers to these requirements under subsection 110(a)(2)(D)(i)(II) as prong 3 (interference with PSD) and prong 4 (interference with visibility protection). The EPA interprets section 110(a)(2) to require air agencies to address prong 3 and prong 4 as part of each infrastructure SIP submission.

<u>Prong 3</u>: Under section 110(a)(2)(D)(i)(II), SIPs would need to have provisions prohibiting emissions that would interfere with measures required to be in any other air agency's

SIP under part C of the CAA to prevent significant deterioration of air quality. Because part C requires an air agency's PSD permitting program to address all pollutants subject to regulation under the CAA, the EPA interprets prong 3 to mean that the infrastructure SIP submission should have provisions to prevent emissions of any regulated pollutant from interfering with any other air agency's comprehensive PSD permitting program, in addition to the new or revised NAAQS that is the subject of the infrastructure submission. Moreover, the infrastructure SIP should address the potential for such interference by sources throughout the jurisdiction of the air agency.

One way to meet prong 3 (”interference with PSD”), specifically with respect to those in-state sources and pollutants that are subject to PSD permitting, is through an air agency's confirmation in its infrastructure SIP submission that new major sources and major modifications are subject to a comprehensive EPA-approved PSD permitting program in the SIP that applies to all regulated NSR pollutants and that satisfies the requirements of the EPA's PSD implementation rule(s), as discussed above for purposes of Element C. This is because in order to be approved by the EPA, a major source PSD permitting program would need to fully consider source impacts on air quality in other states.

In-state sources not subject to PSD for any one or more of the pollutants subject to regulation under the CAA because they are in a nonattainment area for a NAAQS related to those particular pollutants may also have the potential to interfere with PSD in an attainment or unclassifiable area of another state. The EPA cannot ignore this potential when reviewing an infrastructure SIP for this prong. The EPA will consider and may rely on an air agency's EPA-approved nonattainment NSR provisions in determining whether a SIP satisfies prong 3 with respect to sources located in areas subject to nonattainment NSR for any one or more pollutants and thus not subject to PSD permitting for those NAAQS pollutants.[44] SIP revisions to address nonattainment NSR requirements for any new or revised NAAQS are, however, due on a separate timeframe under section 172(b) of the CAA and are not subject to the timeframe for submission of infrastructure SIPs under section 110(a)(1). Therefore, a fully approved nonattainment NSR program with respect to any previous NAAQS may generally be considered by the EPA as adequate for purposes of meeting the requirement of prong 3 with respect to sources and pollutants subject to such program. Also, if an air agency makes a submission indicating that it issues permits pursuant to 40 CFR part 51 appendix S in a nonattainment area because a nonattainment NSR program for a particular NAAQS pollutant has not yet been approved by the EPA for that area, that permitting program may generally be considered by the EPA as adequate for purposes of meeting the requirements of prong 3 with respect to sources and pollutants subject to such program. Such reliance for infrastructure purposes would not constitute approval under CAA title I part D, and the EPA will explain this in the preambles to any proposed or final actions that rely on this rationale to support the conclusion that prong 3 is satisfied.

For an air agency without an EPA-approved major source PSD program and/or, where required, an EPA-approved nonattainment NSR program, it may still be possible for the EPA to also find, given the facts of the situation, that other SIP provisions and/or physical condition are adequate to prohibit interference with other air agencies' measures to prevent significant deterioration of air quality.

Prong 4: Under section 110(a)(2)(D)(i)(II), an infrastructure SIP submission cannot be approved with respect to prong 4 (visibility transport) until the EPA has issued final approval of SIP provisions that the EPA has found to adequately address any contribution of that state's

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[44] Refer, *e.g.*, to a memorandum issued by William T. Harnett, Director, OAQPS/AQPD, "Guidance for State Implementation Plan (SIP) Submissions to Meet Current Outstanding Obligations Under Section 110(a)(2)(D)(i) for the 8-Hour Ozone and $PM_{2.5}$ National Ambient Air Quality Standards," dated August 15, 2006. According to that 2006 Harnett memo, in section 5, "[t]he implementation of a PSD and NNSR permitting program in each state serves to prevent significant deterioration in neighboring states and thus largely satisfies the requirements of section 110(a)(2)(D)(i)(II) of the CAA." Nevertheless, nonattainment-related provisions, although identified in section 110(a)(2) of the CAA, are considered by the EPA to be outside the scope of infrastructure SIP actions, as discussed in section II of this guidance.

sources to impacts on visibility program requirements in other states. The EPA interprets this prong to be pollutant-specific, such that the infrastructure SIP submission need only address the potential for interference with protection of visibility caused by the pollutant (including precursors) to which the new or revised NAAQS applies. Carbon monoxide does not affect visibility, so an infrastructure SIP for any future new or revised NAAQS for carbon monoxide need only state this fact in order to meet prong 4. Significant impacts from lead (Pb) emissions from stationary sources are expected to be limited to short distances from the source and most, if not all, Pb stationary sources are located at distances from Class I areas such that visibility impacts would be negligible. Although Pb can be a component of coarse and fine particles, Pb generally comprises a small fraction of coarse and fine particles. Furthermore, when evaluating the extent to which Pb could impact visibility, Pb-related visibility impacts were found to be insignificant (*e.g.*, less than 0.10 percent).[45] Although we anticipate that Pb emissions will contribute only negligibly to visibility impairment in Class I areas, the air agency's submission of an infrastructure SIP for a new or revised Pb NAAQS should include an explanation in support of the air agency's conclusion (and, if appropriate, should include control measures in its submission to limit impacts in other states).

One way in which prong 4 may be satisfied for any relevant NAAQS is through an air agency's confirmation in its infrastructure SIP submission that it has an approved regional haze SIP that fully meets the requirements of 40 CFR 51.308 or 51.309. 40 CFR 51.308 and 51.309 specifically require that a state participating in a regional planning process include all measures needed to achieve its apportionment of emission reduction obligations agreed upon through that process. *See*, for example, 40 CFR 51.308(d)(3)(ii). A fully approved regional haze SIP will ensure that emissions from sources under an air agency's jurisdiction are not interfering with measures required to be included in other air agencies' plans to protect visibility. However, if the air agency has submitted a 5-year progress report SIP that indicates that the regional haze SIP is deficient with respect to ensuring reasonable progress toward natural visibility conditions in a

[45] Memorandum from Mark Schmidt, OAQPS, "Ambient Pb's Contribution to Class I Area Visibility Impairment," June 17, 2011.

Class I area in another state, the infrastructure SIP submission would need to explain how nevertheless the overall SIP satisfies prong 4.

After the next round of regional haze SIPs become due in 2018, the EPA may find it appropriate to supplement the guidance provided here regarding the relationship between regional haze SIPs and prong 4.

A number of air agencies do not have fully approved regional haze SIPs in place and instead have FIPs in place, which cannot be relied upon to satisfy prong 4.[46] The presence of a regional haze FIP does not necessarily require disapproval of the infrastructure SIP for prong 4. A state air agency may elect to satisfy prong 4 by providing, as an alternative to relying on its regional haze SIP alone, a demonstration in its infrastructure SIP submission that emissions within its jurisdiction do not interfere with other air agencies' plans to protect visibility. Such an infrastructure SIP submission would need to include measures to limit visibility-impairing pollutants and ensure that the reductions conform with any mutually agreed regional haze reasonable progress goals for mandatory Class I areas in other states.[47]

If the EPA determines the SIP to be incomplete or partially disapproves an infrastructure SIP submission for prong 4, a FIP obligation will be created. If a FIP or FIPs are already in effect that correct all regional haze SIP deficiencies, there will be no additional practical consequences from the partial disapproval for the affected air agency, the sources within its jurisdiction, or the

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[46] Some approved regional haze SIPs have relied on the fact that electric generating units (EGUs) in the state must comply with a FIP previously promulgated by the EPA as part of the CSAPR to satisfy best achievable retrofit technology requirements for EGUs. In this limited way, if a regional haze SIP of this type has itself been approved by the EPA, it is possible for FIP provisions to be taken into account by the EPA in determining whether an infrastructure SIP may be approved for prong 4.

[47] As examples of the possibility that an infrastructure SIP submission can satisfy prong 4 even though the regional haze SIP has not been fully approved, *see*: (i) "Approval and Promulgation of State Implementation Plans; State of Colorado; Interstate Transport of Pollution Revisions for the 1997 8-Hour Ozone and 1997 PM2.5 NAAQS: 'Interference With Visibility' Requirement – Final Rule", 76 FR 22036 (April 20, 2011); and (ii) "Approval and Promulgation of Implementation Plans; Kentucky; 110(a)(1) and (2) Infrastructure Requirements for the 2008 8-Hour Ozone National Ambient Air Quality Standards – Final Rule," 78 FR 14681 (March 7, 2013). In the first action, the EPA approved the infrastructure SIP submission with respect to prong 4 without having approved a regional haze SIP, based on the state's demonstration that it does not interfere with other states' measures to protect visibility through their regional haze SIPs. In the second proposed action, the EPA approved Kentucky's submission with respect to prong 4 based on the partial approval of its regional haze SIP and its CSAPR SIP.

EPA. The EPA will not be required to take further action with respect to prong 4 because the FIP already in place would satisfy the requirements with respect to prong 4. In addition, unless the infrastructure SIP submission is required in response to a SIP call under CAA section 110(k)(5), mandatory sanctions under CAA section 179 would not apply because the deficiencies are not with respect to a submission that is required under CAA title I part D. Nevertheless, the EPA continues to encourage all air agencies that may be subject to full or partial FIPs for regional haze requirements to consider adopting additional SIP provisions that would allow the EPA to fully approve the regional haze SIP and thus to withdraw the FIP and approve the infrastructure SIP with respect to prong 4.

**Element D(ii) – Section 110(a)(2)(D)(ii): Interstate Pollution Abatement and International Air Pollution**

*Each such plan shall –*

*(D) contain adequate provisions –*

*(ii) insuring compliance with the applicable requirements of sections 126 and 115 (relating to interstate and international pollution abatement).*

Element D(ii) is satisfied when an infrastructure SIP ensures compliance with the applicable requirements of CAA sections 126(a), 126(b) and (c), and 115.

Interstate Pollution Abatement:

*Sec. 126. (a) Each applicable implementation plan shall –*

*(1) require each major proposed new (or modified) source –*

*(A) subject to part C (relating to significant deterioration of air quality) or*

*(B) which may significantly contribute to levels of air pollution in excess of the national ambient air quality standards in any air quality control region outside the State in which such source intends to locate (or make such modification), to provide written notice to all nearby States the air pollution levels of which may be affected by such source at least sixty days prior to the date on which commencement of construction is to be permitted by the State providing notice, and*

*(2) identify all major existing stationary sources which may have the impact described in paragraph (1) with respect to new or modified sources and provide notice to all nearby States of the identity of such sources not later than three months after the date of enactment of the Clean Air Act Amendments of 1977.*

Under section 126(a)(1) of the CAA, each SIP would need to contain provisions requiring each new or modified major source required by CAA title I part C to be subject to PSD to notify neighboring air agencies of potential impacts from the source. Consistent with EPA's interpretation of part C with respect to the requirements of Element C, the notification requirements apply to potential impacts from all PSD-regulated pollutants, not only the new or revised NAAQS for which the infrastructure SIP submission is being made. Section 126(a)(1) also requires that each SIP contain provisions requiring each new or modified major source to provide similar notification if it may significantly contribute to levels of pollution in excess of a NAAQS in any air quality control region outside of the state in which the source is located.

Air agencies with PSD programs that have been approved into their SIPs should already have a regulatory provision in place, consistent with 40 CFR 51.166(q)(2)(iv), which requires the permitting authority to notify air agencies whose lands may be affected by emissions from that source. Inasmuch as the information that the permitting authority provides to other air agencies is submitted by the source to the permitting authority, the EPA considers the notification by the permitting authority to satisfy the requirement of CAA section 126(a)(1)(A) that a new or modified major source subject to part C notify neighboring air agencies of its potential downwind impact.

A state that is subject to a FIP for its PSD program may not have an infrastructure SIP that satisfies Element D(ii) with respect to section 126(a)(1) of the CAA, depending on the scope of the gap in the SIP that led to the PSD FIP. Where some or all pollutants in a state are subject to a PSD FIP, the EPA may find the infrastructure SIP submission to be incomplete with respect to Element D(ii) and could not fully approve the infrastructure SIP submission with respect to Element D(ii) if the approved SIP has no other provision meeting the notification requirements of section 126(a)(1). Nonetheless, as noted above, the EPA anticipates that there would be no adverse consequences to the air agency or to sources within its jurisdiction from this lack of full approval. The EPA would not likely be required to take further action with respect to notification under this element, because the federal PSD rules should fully address the notification issue through the requirements of 40 CFR 52.21(q) and 40 CFR 124.10(c)(vii) and thus satisfy the FIP requirement triggered by the disapproval of the infrastructure SIP.[48] In addition, unless the infrastructure SIP submission is required in response to a SIP call under CAA section 110(k)(5), mandatory sanctions under CAA section 179 would not apply because the deficiencies are not with respect to a submission that is required under CAA title I part D.

The EPA notes that the requirement stated in CAA section 126(a)(2) was a one-time obligation on states that does not apply to the EPA's review of infrastructure SIP submissions.

<u>Interstate Pollution Abatement:</u>

> *Section 126...*
>
> *(b) Any State or political subdivision may petition the Administrator for a finding that any major source or group of stationary sources emits or would emit any air pollutant in violation of the prohibition of section 110(A)(2)(D)(ii) or this section. Within 60 days after receipt of any petition under this subsection and after public hearing, the Administrator shall make such a finding or deny the petition.*
>
> *(c) Notwithstanding any permit which may have been granted by the State in which the source is located (or intends to locate), it shall be a violation of [this section and] the applicable implementation plan in such State –*
>
> *(1) for any major proposed new (or modified) source with respect to which a finding has been made under subsection (b) to be constructed or to operate in violation of [this section and] the prohibition of section 110(a)(2)(D)(ii) or this section, or*
>
> *(2) for any major existing source to operate more than three months after such finding has been made with respect to it.*
>
> *The Administrator may permit the continued operation of a source referred to in paragraph (2) beyond the expiration of such three-month period if such source complies with such emission limitations and compliance schedules (containing increments of progress) as may be provided by the Administrator to bring about compliance with the requirements contained in section 110(a)(2)(D)(ii) as expeditiously as practicable, but in no case later than three years after the date of such finding. Nothing in the preceding sentence shall be construed to preclude any such source from being eligible for an enforcement order under section 113(d) after the expiration of such period during which the Administrator has permitted continuous operation.*

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[48] 40 CFR part 124, including 124.10(c)(vii), provides for EPA notification to states whose lands may be affected by emissions from the source and applies to all federal PSD permits issued in accordance with 40 CFR 52.21.

Please note that the EPA has concluded that the cross-reference in CAA section 126(b) to CAA section 110(a)(2)(D)(ii) is a scrivener's error and that Congress intended to refer to section 110(a)(2)(D)(i). *See Appalachian Power Co. v. EPA, 249 F.3d -1032, 1040-44 (D.C. Cir. 2001).* Section 110(a)(2)(D)(i), in short, prohibits any source or emissions activity in a state from emitting any amount of air pollutant which will contribute significantly to nonattainment or interfere with maintenance of the NAAQS in another state. (42 U.S.C. § 7410.)

The required content of an infrastructure SIP with respect to Element D(ii) is affected by sections 126(b) and 126(c) of the CAA only if: (1) the Administrator has, in response to a petition, made a finding under section 126(b) of the CAA that emissions from a source or sources within the air agency's jurisdiction emit prohibited amounts of air pollution relevant to the new or revised NAAQS for which the infrastructure SIP submission is being made; and (2) under section 126(c) of the CAA, the Administrator has required the source or sources to cease construction, cease or reduce operations, or comply with emissions limitations and compliance schedule requirements for continued operation. Where appropriate, the EPA recommends that an infrastructure SIP submission concerning section 126(c) include a statement to the following effect: "No source or sources within the state [or tribal area] are the subject of an active finding under section 126 of the CAA with respect to the particular NAAQS at issue." Otherwise, where a source or sources within the air agency's jurisdiction are subject to such a finding and there are substantive SIP requirements imposed by the Administrator under section 126(c) of the CAA, then we encourage the air agency to consult with its EPA Regional Office.

<u>International Air Pollution</u>:

> *Sec. 115. (a) Whenever the Administrator, upon receipt of reports, surveys or studies from any duly constituted international agency has reason to believe that any air pollutant or pollutants emitted in the United States cause or contribute to air pollution which may reasonably be anticipated to endanger public health or welfare in a foreign country or whenever the Secretary of State requests him to do so with respect to such pollution which the Secretary of State alleges is of such a nature, the Administrator shall give formal notification thereof to the Governor of the State in which such emissions originate.*
>
> *(b) The notice of the Administrator shall be deemed to be a finding under section 110(a)(2)(H)(ii) which requires a plan revision with respect to so much of the applicable implementation plan as is inadequate to prevent or eliminate the endangerment referred to in subsection (a). Any foreign country so affected by*

> *such emission of pollutant or pollutants shall be invited to appear at any public hearing associated with any revision of the appropriate portion of the applicable implementation plan.*

Section 115 of the CAA authorizes the Administrator to require a state to revise its SIP under certain conditions to alleviate international transport into another country. Because of the appearance of the phrase “applicable requirements of section[]…115” in Element D(ii), the EPA interprets this requirement to be NAAQS-specific. That is, when acting on an infrastructure SIP submission for a new or revised NAAQS, the EPA will look to whether the Administrator has made a finding with respect to emissions of the particular NAAQS pollutant and its precursors, if applicable. Where appropriate, the EPA recommends that infrastructure SIP submission requirements concerning section 115 include a statement to the following effect: "There are no final findings under section 115 of the CAA against this state [or tribal area] with respect to the particular NAAQS at issue." If there are one or more final findings under section 115 of the CAA, then we encourage the air agency to consult with its EPA Regional Office.

**Element E – Section 110(a)(2)(E): Adequate Resources and Authority, Conflict of Interest, and Oversight of Local Governments and Regional Agencies**

*Each such plan shall –*

> *(E) provide (i) necessary assurances that the State (or, except where the Administrator deems inappropriate, the general purpose local government or governments, or a regional agency designated by the State or general purpose local governments for such purpose) will have adequate personnel, funding, and authority under State (and, as appropriate, local) law to carry out such implementation plan (and is not prohibited by any provision of Federal or State law from carrying out such implementation plan or portion thereof),*
> *(ii) requirements that the State comply with the requirements respecting State boards under section 128, and (iii) necessary assurances that, where the State has relied on a local or regional government, agency, or instrumentality for the implementation of any plan provision, the State has responsibility for ensuring adequate implementation of such plan provision.*

<u>Subelement (i):</u> The SIP should provide necessary assurances[49] that the air agency has adequate personnel and funding to implement the relevant NAAQS. In accordance with the EPA's regulations at 40 CFR part 51, subpart M ("Intergovernmental Consultation"), the infrastructure SIP submission should identify the organizations that will participate in developing, implementing, and enforcing the EPA-approved SIP provisions related to the new or revised NAAQS and thus require resources for doing so. The infrastructure SIP submission should identify the responsibilities of such organizations and include related agreements among the organizations. For compliance with section 110(a)(2)(E), *see* 40 CFR 51.240 ("General plan requirements"). Also, in accordance with the EPA's regulations at 40 CFR part 51, subpart O ("Miscellaneous Plan Content Requirements"), the infrastructure SIP submission should describe the resources that are available to these organizations for carrying out the SIP. Resources to be described should include: (1) those available to these organizations as of the date of infrastructure SIP submission; (2) those considered necessary during the 5 years following infrastructure SIP submission; and (3) projections regarding acquisition of the described resources. For compliance with section 110(a)(2)(E) with respect to resources, *see* 40 CFR 51.280 ("Resources").

Further, the infrastructure SIP submission should assure that the responsible state, local, and/or regional agencies, or a tribal authority, have adequate authority under statutes, rules, and regulations to carry out SIP obligations with respect to the relevant NAAQS. *See* the EPA's regulations at 40 CFR part 51, subpart L ("Legal Authority") and subpart O. In accordance with the EPA's regulations at subpart L, the infrastructure SIP submission should show that the responsible organizations have the legal authority to carry out the provisions identified in the SIP submission.

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[49] As with any SIP submission, the EPA's review can be expedited if a SIP submission for this element includes a detailed explanation of how the existing SIP (supplemented by any new provisions included in the submission) meets each of the applicable requirements of section 110(a)(2)(E)(i). This should include a description of the correlation between the requirements of this element and an equivalent set of statutory, regulatory, and/or non-regulatory provisions, as appropriate. When an air agency's infrastructure submission more clearly identifies each CAA element being met by the SIP submission and explains how it is met, the EPA can more easily determine whether the submission is complete and approvable with respect to that element.

In accordance with 40 CFR 51.231, the infrastructure SIP submission should identify the provisions of law or regulations that the air agency determines provide the necessary authority, and the air agency should submit copies of those laws or regulations with the infrastructure SIP submission. If an official, legal copy of a particular law or regulation has already been provided to the EPA in an earlier SIP submission, that copy only needs to be referenced with sufficient specificity to avoid ambiguity, rather than a new copy submitted.[50] For compliance with section 110(a)(2)(E) with respect to legal authority, *see* 40 CFR 51.230 and 40 CFR 51.231.

Having reviewed and approved air agency SIP submissions with respect with this element, the EPA expects that it would be unusual for air agencies to need to make SIP revisions regarding personnel, funding, or legal authority in order to satisfy this subelement. However, for any new or revised NAAQS, the air agency should explain in the infrastructure SIP submission how resources and personnel and legal authority are adequate and provide any additional assurances needed to meet changes in resource requirements by the new or revised NAAQS.

Subelement (ii):

State Boards:

The infrastructure SIP submission (possibly in combination with earlier submissions already approved by the EPA) would need to include the statutory or regulatory provisions that impose the requirements mandated by CAA section 128 pertaining to certain boards, bodies, and personnel involved in approving permits or enforcement orders. Because CAA section 110(a)(2)(e)(ii) directs states to "provide requirements that the state comply with the

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[50] Refer to a memorandum dated November 22, 2011, jointly from Janet McCabe, Deputy Assistant Administrator, Office of Air and Radiation, and Becky Weber, Director, Air and Waste Management Division, Region 7, to Air Division Directors, Regions 1-10, titled "Guidelines for Preparing Letters Submitting State Implementation Plans (SIPs) to EPA and for Preparing Public Notices for SIPs."

requirements respecting state boards under section 128,”[51] the provisions that implement CAA section 128 would need to be contained within the SIP. That is, the EPA would not approve an infrastructure SIP submission that only provides a narrative description of existing air agency laws, rules, and regulations that are not approved into the SIP to address CAA section 128 requirements. If an existing rule regarding conflict of interest and disclosure requirements has been adopted under the authority of a state or tribal law, the rule would need to be included in the SIP submission, but the authorizing law would not. If the state or tribal law is self-executing and there is no rule that could be included in the SIP, then the law would need to be incorporated into the SIP. Inclusion of an existing law in the SIP does not prevent the state legislature or tribal council from amending that law at a later date as a matter of state law, although eventually the EPA-approved SIP will need to be updated with any such amendment in order to revise the federally enforceable SIP.

All air agencies are subject to the provisions of CAA section 128. However, if there is no board or body authorized to approve permits or enforcement orders under the CAA, then a negative declaration to that effect may serve to satisfy the "board or body" requirements under paragraph (a)(1) of CAA section 128. It is the EPA’s stated interpretation that a multi-member board or body that has authority under state or tribal law to hear appeals of CAA permits or

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[51] *Sec. 128. (a) Not later than the date one year after the date of the enactment of this section, each applicable implementation plan shall contain requirements that –*

*(1) any board or body which approves permits or enforcement orders under this Act shall have at least a majority of members who represent the public interest and do not derive any significant portion of their income from persons subject to permits or enforcement orders under this Act, and*

*(2) any potential conflicts of interest by members of such board or body or the head of an executive agency with similar powers be adequately disclosed.*

*A State may adopt any requirements respecting conflicts of interest for such boards or bodies or heads of executive agencies, or any other entities which are more stringent than the requirements of (paragraphs (1) and (2), and the Administrator shall approve any such more stringent requirements submitted as part of an implementation plan.*

enforcement orders is considered to have authority to “approve” those permits or enforcement orders. Accordingly, the requirements of section 128(a)(1) related to public interest and limitations on sources of income are applicable to such a board or body and would need to be met through provisions incorporated into the SIP.[52,53]

The provisions of section 128(a)(2), which concern disclosure of potential conflicts of interest, would need to be substantively met by provisions incorporated into the SIP, regardless of whether it is a board, some other body, or the head of an executive agency that has responsibility for approving permits or enforcement orders in that state or an area of Indian country. It is the EPA’s stated interpretation that a multi-member board or body that has authority under state or tribal law to hear appeals of CAA permits or enforcement orders is considered to have authority to “approve” those permits or enforcement orders. Accordingly, the requirement of section 128(a)(2) related to disclosure is applicable to such a board or body and would need to be met through provisions incorporated into the SIP.

In 1978, the EPA issued a guidance memorandum recommending ways air agencies could meet the requirements of section 128, including suggested interpretations of certain terms in section 128.[54] EPA has not issued further guidance or regulations of general applicability on the subject since that time. However, as part of its actions on several infrastructure SIP submissions, the EPA has more recently proposed certain interpretations of section 128 as applied to these specific submissions, invited comment on these interpretations, and finalized its actions. Within those actions, EPA has thus provided additional interpretation of the terms of section 128 given specific facts and circumstances, consistent with the statutory requirements.

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[52] The EPA expressed this interpretation in a proposed action on the infrastructure SIP for Arizona. June 27, 2012. “Partial Approval and Disapproval of Air Quality Implementation Plans; Arizona: Infrastructure Requirement for Ozone and Fine Particulate Matter.” 77 FR 38239. This action was finalized on November 5, 2012, 77 FR 66398.

[53] “Approval and Promulgation of State Implementation Plans; Hawaii Infrastructure Requirements for the 1997 8-Hour Ozone and the 1997 and 2006 Fine Particulate Matter National Ambient Air Quality Standards.” 77 FR 47530 (August 9, 2012). The EPA’s action on the infrastructure SIP for Arizona referenced the proposal for this action on the infrastructure SIP for Hawaii.

[54] *See* Memorandum from David O. Bickart to Regional Air Directors, "Guidance to States for Meeting Conflict of Interest Requirements of Section 128," Suggested Definitions, March 2, 1978.

*See, e.g.,* EPA's proposed (77 FR 44555, July 30, 2012) and final (77 FR 66398, November 5, 2012) actions on an infrastructure SIP submission from Arizona. Unlike the recommendations of the 1978 guidance memorandum, in this action the EPA interpreted the term "state board" to exclude an individual official. As in the 1978 guidance memorandum, in this action the EPA interpreted the requirement regarding representation of the public interest and limitations on income to apply to a board that does not issue permits and compliance orders but does hear appeals of permits and compliance orders. The EPA notes that air agencies in different jurisdictions may have very different organizational structures and very different allocations of authorities and responsibilities with respect to permits and enforcement orders. Thus, the EPA recommends that air agencies consult with their respective EPA Regional Offices about the most appropriate method for assuring that the requirements of section 110(a)(2)(E)(ii) and section 128 are met in that jurisdiction under the relevant facts and circumstances.

Subelement (iii): The infrastructure SIP submission should provide necessary assurances[55] that the state retains responsibility for ensuring adequate implementation of SIP obligations with respect to relevant NAAQS. A state may authorize a local or regional agency to carry out the SIP or a portion of the SIP within that agency's jurisdiction, if the SIP demonstrates that the local agency has the necessary legal authority. However, in these cases the infrastructure SIP submission needs to also provide assurances that the state air agency retains responsibility for ensuring adequate implementation of the SIP. Under subpart L, *see* 40 CFR 51.232 ("Assignment of legal authority to local agencies").

[55] As with any SIP submission, the EPA's review can be expedited if a SIP submission for this element includes a detailed explanation of how the existing SIP meets each of the applicable requirements of section 110(a)(2)(E)(i). This should include a description of the correlation between the requirements of this element and an equivalent set of statutory, regulatory, and/or non-regulatory provisions, as appropriate, that are part of the existing SIP. When an air agency's infrastructure submission more clearly identifies each CAA element being met by the SIP submission and explains how the element is met, the EPA can more easily determine whether the submission is complete and approvable with respect to that element.

**<u>Element F – Section 110(a)(2)(F): Stationary Source Monitoring and Reporting</u>**

> *Each such plan shall –*
>
> *(F) require, as may be prescribed by the Administrator –*
>
> *(i) the installation, maintenance, and replacement of equipment, and the implementation of other necessary steps, by owners or operators of stationary sources to monitor emissions from such sources,*
>
> *(ii) periodic reports on the nature and amounts of emissions and emissions-related data from such sources, and*
>
> *(iii) correlation of such reports by the State agency with any emission limitations or standards established pursuant to this Chapter, which reports shall be available at reasonable times for public inspection.*

<u>Subelement (i):</u> The EPA's rules regarding how SIPs would need to address requirements for source monitoring are contained in 40 CFR 51.212 ("Testing, inspection, enforcement, and compliance"). This EPA regulation requires SIPs to provide for a program of periodic testing and inspection of stationary sources, to provide for the identification of allowable test methods, and to exclude any provision that would prevent the use of any credible evidence of noncompliance. The infrastructure SIP submission should describe the air agency's program for source testing, reference the statutory authority for the air agency's program, and certify the absence of any provision preventing the use of any credible evidence.

<u>Subelement (ii):</u> To address periodic reporting requirements, the infrastructure SIP submission should include air agency requirements providing for periodic reporting of emissions and emissions-related data by sources to the air agency, as required by the following emissions reporting requirements: 40 CFR 51.211 ("Emissions reports and recordkeeping"); 40 CFR sections 51.321 through 51.323 ("Source Emissions and State Action Reporting"); and the EPA's Air Emissions Reporting Rule, 40 CFR part 51, subpart A ("Air Emissions Reporting Requirements").[56] We note that the section 51.321 requirement that emissions reports from states be made through the appropriate EPA Regional Office has been superseded in practice, as these data are now to be reported electronically through a centralized data portal pursuant to 40 CFR

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[56] 40 CFR sections 51.321 through 51.323 nominally address emission reporting but merely cross-reference to subpart A.

51.45(b), which refers to the website *http://www.epa.gov/ttn/chief* for the latest information on data reporting procedures. However, states should consult with the appropriate EPA Regional Office as they prepare and submit these data. All states have existing periodic source reporting of emissions and emission inventory reporting practices. Thus for any new or revised NAAQS, the infrastructure SIP may be able to certify existing authority and commitments and provide any additional assurance needed to meet changes in reporting and inventory requirements associated with the new or revised NAAQS.

Subelement (iii): The infrastructure SIP submission should reference and describe existing air agency requirements that have been approved into the SIP by the EPA, or include air agency requirements being newly submitted, that provide for the following: (1) correlation[57] by the air agency of emissions reports by sources with applicable emission limitations or standards; and (2) the public availability of emission reports by sources. Under 40 CFR part 51 subpart G, 40 CFR 51.116 ("Data availability"), contains the requirements for correlating data. Correlation with applicable emissions limitations or standards is relevant only for those reports of source emissions that reflect the test method(s) and averaging period(s) specified in applicable emission limitations or standards. Thus, source reports of annual, ozone season, or summer day emissions used by the air agency to create the annual and triennial emission inventory submission to the EPA under 40 CFR part 51 subpart A in general would not need to be correlated with specific emission limitations or standards, as many sources do not have applicable emission limitations defined for those averaging periods. However, if the sources have applicable emissions limitations that are defined for these averaging periods, then they would need to be correlated.

[57] As defined in 40 CFR 51.116(c), the term "correlated" means "presented in such a manner as to show the relationship between measured or estimated amounts of emissions and the amounts of such emissions allowable under the applicable emission limitations or other measures."

**Element G – Section 110(a)(2)(G): Emergency Powers**

*Each such plan shall –*

*(G) provide for authority comparable to that in section 303 and adequate contingency plans to implement such authority.*

Section 303 of the CAA provides authority to the EPA Administrator to seek a court order to restrain any source from causing or contributing to emissions that present an "imminent and substantial endangerment to public health or welfare, or the environment." The EPA has interpreted section 110(a)(2)(G) as imposing two basic requirements for purposes of an infrastructure SIP submission.

To meet Element G requirements, the best practice for an air agency submitting an infrastructure SIP would be to submit, for inclusion into the SIP (if not already part of the SIP), the statutory or regulatory provisions that provide the air agency or official with authority comparable to that of the EPA Administrator under section 303 (*see, e.g.*, 40 CFR 51.230(c)), along with a narrative explanation of how they meet the requirements of this element.[58] If an air agency chooses not to include the relevant statute or regulation in its SIP, then the air agency should provide a reference or citation to the authority provisions, along with a narrative explanation of how the provisions meet the requirements of this element, as well as a copy of the relevant authority to accompany the SIP as required by 40 CFR 51.231.

The air agency is also required to submit, for approval into the SIP (if not already part of the SIP), an adequate contingency plan to implement the air agency's emergency episode authority. This can be met by submitting a plan that meets the applicable requirements of 40 CFR part 51, subpart H (40 CFR 51.150 through 51.153) ("Prevention of Air Pollution Emergency Episodes") for the relevant NAAQS if the NAAQS is covered by those regulations.

The EPA's subpart H regulations provide specific ambient levels for contingency plan purposes for most NAAQS. In the case of the 2006 $PM_{2.5}$ NAAQS, for which the EPA has not

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[58] The EPA recognizes that some air agencies may have general authorizing provisions that do not specifically enumerate specific activities but do implicitly authorize the air agency to perform such activities, in which case inclusion of those provisions would meet the intent of this best practice.

yet promulgated regulations that provide the ambient levels to classify different priority levels, the EPA has recommended these levels through guidance.[59]

Subpart H includes criteria for classification of areas into priority regions, based on ambient air concentrations of the particular pollutant being addressed. The currently applicable priority classifications for regions for each state can be found in 40 CFR part 52 subparts B through DDD (*see* sections titled "Classification of Regions"). As noted above, the air agency's infrastructure SIP submission would need to include the contingency plan, if one is required and has not yet been approved by the EPA. If an area is classified as a Priority I, IA, or II region for a specified pollutant, then the infrastructure SIP should contain an emergency contingency plan meeting the specific requirements of 40 CFR 51.151 and 51.152, as appropriate, with respect to that pollutant. For such areas, the infrastructure submission should demonstrate that the air agency's existing EPA-approved SIP already contains an adequate contingency plan, if that is the case; otherwise, the submission should include the substantive SIP revisions necessary to meet the emergency contingency plan requirements with respect to that pollutant.

Specifically, if an area is classified as a Priority I region for a specified pollutant, the area's contingency plan (with respect to that pollutant) would need to include provisions that trigger actions to prevent air quality concentrations from reaching a "significant harm level" (SHL), which represents an imminent and substantial endangerment to public health. *See* 40 CFR 51.151 and the more detailed explanation below. Each implementation plan for a Priority I, IA, or II region would need to include a contingency plan that provides for taking certain specified actions. Specifically, 40 CFR sections 51.152(b) and (c) state that:

> *(b) Each contingency plan for a Priority I region must provide for the following:*
>
> *(1) Prompt acquisition of forecasts of atmospheric stagnation conditions and of updates of such forecasts as frequently as they are issued by the National Weather Service.*
>
> *(2) Inspection of sources to ascertain compliance with applicable emission control action requirements.*

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[59] *See* a memorandum from William T. Harnett, Director, Air Quality Policy Division, OAQPS, to Regional Air Division Directors, Regions I through X, "Guidance on SIP Elements Required Under Sections 110(a)(1) and (2) for the 2006 Fine Particle ($PM_{2.5}$) National Ambient Air Quality Standards (NAAQS)." (September 25, 2009).

*(3) Communications procedures for transmitting status reports and orders as to emission control actions to be taken during an episode stage, including procedures for contact with public officials, major emission sources, public health, safety, and emergency agencies and news media.*

*(c) Each plan for a Priority IA and II region must include a contingency plan that meets, as a minimum, the requirements of paragraphs (b)(1) and (b)(2) of this section. Areas classified as Priority III do not need to develop episode plans.*

To satisfy a Priority I, IA, or II region's contingency plan requirements under 40 CFR 51.152(b)(1) regarding forecasts of atmospheric stagnation conditions, an infrastructure SIP submission may cite existing ambient monitoring and forecasting networks (such as *AIRNow*).[60]

Areas that maintain air quality at ambient levels lower that the concentrations listed in sections 51.150(b), (c), and (d), with respect to the pollutants listed, are classified as Priority III regions. These areas are subject to the requirements of CAA Element G. However, according to 40 CFR 51.152(c), areas classified as Priority III regions are not required to develop emergency episode plans, which the EPA has interpreted to mean the contingency plans otherwise required under Element G.

In a final rulemaking signed on December 14, 2012, to revise the $PM_{2.5}$ NAAQS, the EPA retained the pre-existing level of 500 $\mu g/m^3$, 24-hour average, for the Air Quality Index (AQI) value of 500 and did not establish an SHL for $PM_{2.5}$.[61] In addition, there is currently no established SHL for Pb. For those pollutants for which there is an SHL, the SHL is an important part of air pollution Emergency Episode Plans. Even in the absence of an SHL, the EPA believes that the central components of a contingency plan would be to reduce emissions from the source(s) at issue (if necessary by curtailing operations of Pb or $PM_{2.5}$ sources) and public communication as needed. In addition, if an air agency believes, based on its inventory of Pb or

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[60] The EPA, in partnership with National Oceanic and Atmospheric Administration (NOAA), National Park Service (NPS), and tribal, state, and local agencies, developed the *AIRNow* website (*see* http://www.airnow.gov) to provide easy public access to national air quality information. The website offers daily AQI forecasts as well as real-time AQI conditions for over 300 cities across the U.S. and provides links to more detailed state and local air quality websites.

[61] *See* 78 FR 3086 (January 15, 2013), "National Ambient Air Quality Standards for Particulate Matter." The published version is posted at http://www.gpo.gov/fdsys/pkg/FR-2013-01-15/pdf/2012-30946.pdf.

$PM_{2.5}$ sources and historic ambient monitoring data, that it does not need a more specific contingency plan beyond having authority to restrain any source from causing or contributing to an imminent and substantial endangerment, then the air agency could provide such a detailed rationale as part of its SIP submission. Additionally, because smoke from fires has the potential to be the cause of extremely high levels of $PM_{2.5}$, the EPA recommends that air quality-triggered responses incorporated into an Emergency Episode Plan for $PM_{2.5}$ be developed through a collaborative process working with state and tribal air quality, forestry, and agricultural agencies, federal land management agencies, private land managers, and the public.

An episode in which concentrations of $NO_2$ or $SO_2$ approach the SHL is likely to be due to a single facility's equipment malfunction. Accordingly, as part of a SIP to satisfy a Priority I region's contingency plan requirements, an infrastructure SIP submission for an $NO_2$ NAAQS or an $SO_2$ NAAQS may specify the facility-specific or equipment-specific measures to be taken in the event of an air pollution emergency.

In accordance with 40 CFR 51.152(d)(1) and (2), the Administrator may either: (i) exempt portions of a Priority I, IA, or II region that have been designated as attainment or unclassifiable under section 107 of the CAA from the requirements of 40 CFR 51.152 to develop an emergency episode contingency plans, or (ii) limit the requirements pertaining to emission control actions in Priority I regions to certain areas or to certain major sources. Air agencies interested in such an exemption or limitation in appropriate circumstances should contact their respective EPA Regional Offices.

Appendix L to 40 CFR part 51 provides example regulations that air agencies could use to develop contingency plans and inform decisions concerning air pollution emergency episodes. The example regulations provided in appendix L reflect generally recognized ways of preventing air pollution from reaching levels that would cause imminent and substantial endangerment to the health of persons located within affected areas. States with Priority I, IA, or II areas are directed by subpart H to have emergency episode contingency plans that contain alert levels for $SO_2$, $PM_{10}$, carbon monoxide, $NO_2$, and ozone, but air agencies are not required to adopt the appendix L example regulations.

**Element H – Section 110(a)(2)(H): SIP Revisions**

*Each such plan shall –*

*(H) provide for revision of such plan –*

*(i) from time to time as may be necessary to take account of revisions of such national primary or secondary ambient air quality standard or the availability of improved or more expeditious methods of attaining such standard, and*

*(ii) except as provided in paragraph (3)(C), whenever the Administrator finds on the basis of information available to the Administrator that the plan is substantially inadequate to attain the national ambient air quality standard which it implements or to otherwise comply with any additional requirements established under this chapter.*

To demonstrate that the requirements under Element H are met, the best practice for an air agency submitting an infrastructure SIP would be to submit, for inclusion into the SIP (if not already part of the SIP), the statutory or regulatory provisions that provide the air agency or official with the authority to perform the following actions along with a narrative explanation of how they meet the requirements of this element: (1) revise its section 110 plan from time to time as may be necessary to take into account revisions of such primary or secondary NAAQS or the availability of improved or more expeditious methods of attaining such standards; and (2) revise the plan in the event the Administrator finds the plan to be substantially inadequate to attain the NAAQS or otherwise meet all applicable CAA requirements.[62]

If an air agency chooses not to include the relevant statute or regulation in its SIP, then the air agency should provide a reference or citation to the authority provisions, along with a narrative explanation of how the provisions meet the requirements of this element, as well as a copy of the relevant authority to accompany the SIP as required by 40 CFR 51.231. More information may be found under 40 CFR part 51, subpart F ("Procedural Requirements"), specifically, 40 CFR 51.104 ("Revisions").

[62] The EPA recognize that some air agencies may have general authorizing provisions that do not specifically enumerate specific activities but do implicitly authorize the air agency to perform such activities, in which case inclusion of those provisions would meet the intent of this best practice.

**Element I – Section 110(a)(2)(I): Plan Revisions for Nonattainment Areas**

> *Each such plan shall –*
>
> *(I) in the case of a plan or plan revision for an area designated as a nonattainment area, meet the applicable requirements of part D of this subchapter (relating to nonattainment areas).*

As noted earlier in this document, the EPA does not expect infrastructure SIP submissions to address subsection 110(a)(2)(I). The specific SIP submissions for designated nonattainment areas, as required under CAA title I part D, are subject to a different submission schedule[63] than those for section 110 infrastructure elements and will be reviewed and acted upon through a separate process. Air agencies do not need to address Element I in an infrastructure SIP submission. For clarity's sake, to better inform the public comment process on the SIP submission, the air agency may wish to clearly state that Element I is not being addressed and reiterate in the infrastructure SIP submission that, according to the EPA's interpretation of the CAA this element does not need to be addressed in the context of an infrastructure SIP submission.

**Element J – Section 110(a)(2)(J): Consultation with Government Officials, Public Notification, and PSD and Visibility Protection**

> *Each such plan shall –*
>
> *(J) meet the applicable requirements of section 121 (relating to consultation), section 127 (relating to public notification), and part C (relating to prevention of significant deterioration of air quality and visibility protection)....*

This element contains four separable sub-elements: consultation with identified officials on certain air agency actions; public notification; prevention of significant deterioration; and visibility protection.

Consultation with identified officials on certain actions:

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[63] These elements are typically referred to as nonattainment SIP or attainment plan elements and are due by the dates prescribed under subparts 2 through 5 of part D, extending as far as 10 years following designation for some elements.

*Sec. 121. In carrying out the requirements of this Act requiring applicable implementation plans to contain –*

*(1) any transportation controls, air quality maintenance plan requirements or preconstruction review of direct sources of air pollution, or*

*(2) any measure referred to –*

*(A) in part D (pertaining to nonattainment requirements), or*

*(B) in part C (pertaining to prevention of significant deterioration),*

*and in carrying out the requirements of section 113(d) (relating to certain enforcement orders), the State shall provide a satisfactory process of consultation with general purpose local governments, designated organizations of elected officials of local governments and any Federal land manager having authority over Federal land to which the State plan applies, effective with respect to any such requirement which is adopted more than one year after the date of enactment of the Clean Air Act Amendments of 1977 as part of such plan. Such process shall be in accordance with regulations promulgated by the Administrator to assure adequate consultation. The Administrator shall update as necessary the original regulations required and promulgated under this section (as in effect immediately before the date of the enactment of the Clean Air Act Amendments of 1990) to ensure adequate consultation. Only a general purpose unit of local government, regional agency, or council of governments adversely affected by action of the Administrator approving any portion of a plan referred to in this subsection may petition for judicial review of such action on the basis of a violation of the requirements of this section.*

The infrastructure SIP submission would need to show that there is an established process for consultation with general-purpose local governments, designated organizations of elected officials of local governments, and any federal land manager having authority over federal land to which the plan applies, consistent with CAA section 121, which lists the specific types of actions for which such consultation is required. If the relevant statute is self-executing such that there is no associated regulation or other documents such as a memorandum of understanding, then the statute would need to be included in the SIP. If a regulation or other document meeting the CAA requirements exists, then the regulation or other document would need to be included in the SIP submission, and the authorizing statute should be referenced but the statute is not required to be part of the EPA-approved SIP. Under the requirements of 40 CFR 51.240, the SIP would need to identify organizations "that will participate in developing, implementing, and enforcing the plan and the responsibilities of such organizations." The plan should also include any related agreements or memoranda of understanding among the organizations. *See* subpart M ("Intergovernmental Consultation").

Public Notification:

> *Section 127. (a) Each State plan shall contain measures which will be effective to notify the public during any calendar [year] on a regular basis of instances or areas in which any national primary ambient air quality standard is exceeded or was exceeded during any portion of the preceding calendar year to advise the public of the health hazards associated with such pollution, and to enhance public awareness of the measures which can be taken to prevent such standards from being exceeded and the ways in which the public can participate in regulatory and other efforts to improve air quality. Such measures may include the posting of warning signs on interstate highway access points to metropolitan areas or television, radio, or press notices or information.*
>
> *(b) The Administrator is authorized to make grants to States to assist in carrying out the requirements of subsection (a).*

The infrastructure SIP submission would need to show that the air agency does the following: regularly notifies the public of instances or areas in which the new or revised primary NAAQS was exceeded; advises the public of the health hazards associated with such exceedances; and enhances public awareness of measures that can prevent such exceedances and of ways in which the public can participate in regulatory and other efforts to improve air quality. 40 CFR 51.285 ("Public notification"), repeats the language of CAA section 127.

Prevention of significant deterioration: The approvability of an air agency's PSD program is essential to the approvability of an infrastructure SIP submission with respect to CAA section 110(a)(2)(J). The requirements for Element J in relation to a comprehensive PSD permitting program are the same as described earlier in this document with respect to Element C. Generally, every PSD-related requirement of Element C applies, including the requirement that the PSD permitting program address all regulated pollutants. Please refer to that section.

Visibility protection: Under 40 CFR part 51 subpart P, implementing the visibility requirements of CAA title I, part C, states are subject to requirements for RAVI, new source review for possible impacts on air quality related values in Class I areas, and regional haze planning. Specific requirements stemming from these CAA sections are codified at 40 CFR part 51 subpart P. However, when the EPA establishes or revises a NAAQS, these requirements under part C do not change. The EPA believes that there are no new visibility protection requirements under part C as a result of a revised NAAQS. Therefore, there are no newly applicable visibility protection obligations pursuant to Element J after the promulgation of a new or revised NAAQS. Air agencies do not need to address the visibility subelement of Element J in an infrastructure SIP submission. For clarity's sake, to better inform the public comment process on the SIP submission, the air agency may wish to clearly state that the visibility subelement of Element J is not being addressed, and reiterate in the submission that according to EPA's interpretation of the CAA this element does not need to be addressed.

**Element K – Section 110(a)(2)(K): Air Quality Modeling and Submission of Modeling Data**

> *Each such plan shall –*
>
> *(K) provide for –*
>
> *(i) the performance of such air quality modeling as the Administrator may prescribe for the purpose of predicting the effect on ambient air quality of any emissions of any air pollutant for which the Administrator has established a national ambient air quality standard, and*
>
> *(ii) the submission, upon request, of data related to such air quality modeling to the Administrator.*

To meet Element K, the best practice would be for an air agency to submit, for inclusion into the SIP (if not already part of the SIP), the statutory or regulatory provisions that provide the air agency or official with the authority to perform the following actions along with a narrative explanation of how the provisions meet the requirements of this element[64]: (1) conduct air quality modeling to predict the effect on ambient air quality of any emissions of any air pollutant for which a NAAQS has been promulgated, and (2) provide such modeling data to the EPA Administrator upon request.

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[64] The EPA recognizes that some air agencies may have general authorizing provisions that do not specifically enumerate specific activities but do implicitly authorize the air agency to perform such activities, in which case inclusion of those provisions would meet the intent of this best practice.

If an air agency chooses not to include the relevant statute or regulations in its SIP, then the air agency should provide a reference or citation to the authority provisions, along with a narrative explanation of how they meet the requirements of this element, as well as a copy of the relevant authority to accompany the SIP as required by 40 CFR 51.231.

**Element L – Section 110(a)(2)(L): Permitting Fees**

*Each such plan shall –*

*(L) require the owner or operator of each major stationary source to pay to the permitting authority, as a condition of any permit required under this chapter, a fee sufficient to cover –*

*(i) the reasonable costs of reviewing and acting upon any application for such a permit, and*

*(ii) if the owner or operator receives a permit for such source, the reasonable costs of implementing and enforcing the terms and conditions of any such permit (not including any court costs or other costs associated with any enforcement action),*

*until such fee requirement is superseded with respect to such sources by the Administrator's approval of a fee program under subchapter V of this chapter.*

Currently, every state has an EPA-approved fee program under CAA title V. However, this fee program is not required to be part of the EPA-approved SIP. The infrastructure SIP should provide citations to the regulations providing for collection of permitting fees under the state's EPA-approved Title V permit program. These citations to the EPA-approved title V regulations will not cause the title V program to be treated as part of the EPA-approved SIP, and the EPA will not re-review the title V program itself in the context of reviewing infrastructure SIP submissions. *See* 40 CFR 70.9 ("Fee determination and certification") and 40 CFR part 70, appendix A ("Approval Status of State and Local Operating Permits Programs"). If the state title V program fees cover all CAA permitting, implementation, and enforcement for new and modified major sources as well as existing major sources, this reference to the title V program will satisfy this element. If a state's approved title V permit program fees do not cover the reasonable costs of reviewing and acting upon applications for PSD and NNSR permits for major sources[65] (along with the reasonable costs of implementing and enforcing the terms and conditions of PSD and NNSR permits), then the air agency should contact its Regional Office regarding what needs to be in the submission to fulfill this Element.

**Element M – Section 110(a)(2)(M): Consultation and Participation by Affected Local Entities**

> *Each such plan shall –*
> *(M) provide for consultation and participation by local political subdivisions affected by the plan.*

To satisfy Element M, the SIP should provide for consultation with affected local political subdivisions. As part of an infrastructure SIP submission, an air agency may simply identify its policies or procedures that allow and promote such consultation. For example, the infrastructure SIP submission may cite a policy wherein the air agency, before adopting or amending a plan, policy, or program, will consult with the regional planning coalition composed of local political subdivisions potentially affected by the action and explain how such information is used in the development of a SIP submission to the EPA for approval into the SIP. The normal public hearing process prior to adoption and submission of a SIP revision may also be cited as a component of the provisions for consultation, since leaders of political subdivisions have the opportunity to participate in that public process.

**For Further Information**

If you have any questions concerning this guidance, please contact Mr. H. Lynn Dail, by telephone at (919) 541-2363, or by email at *dail.lynn@epa.gov*, or Ms. Lisa Sutton, by telephone at (919) 541-3450 or by email at *sutton.lisa@epa.gov*.

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[65] Substantive NNSR provisions will not be reviewed as part of the EPA's action on the infrastructure SIP submission. *See* discussion in Section II, "Which elements of CAA 110(a)(2) affect infrastructure SIPs?"

# Air Quality Modeling Technical Support Document for the Final Cross State Air Pollution Rule Update

Office of Air Quality Planning and Standards
United States Environmental Protection Agency
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## 1. Introduction

In this technical support document (TSD) we describe the air quality modeling performed to support the final Cross State Air Pollution Rule for the 2008 ozone National Ambient Air Quality Standards (NAAQS)[1]. In this document, air quality modeling is used to project ozone concentrations at individual monitoring sites to 2017[2] and to estimate state-by-state contributions to those 2017 concentrations. The projected 2017 ozone concentrations are used to identify ozone monitoring sites that are projected to be nonattainment or have maintenance problems for the 2008 ozone NAAQS in 2017. Ozone contribution information is then used to quantify projected interstate contributions from emissions in each upwind state to ozone concentrations at projected 2017 nonattainment and maintenance sites in other states (i.e., in downwind states).[3]

The remaining sections of this TSD are as follows. Section 2 describes the air quality modeling platform and the evaluation of model predictions using measured concentrations. Section 3 defines the procedures for projecting ozone design value concentrations to 2017 and the approach for identifying monitoring sites with projected nonattainment and/or maintenance problems. Section 4 describes (1) the source contribution (i.e., apportionment) modeling and (2) the procedures for quantifying contributions to individual monitoring sites including nonattainment and/or maintenance sites. Section 5 includes an analysis of the contributions captured at alternative thresholds. For questions about the information in this TSD please contact Norm Possiel at possiel.norm@epa.gov or (919) 541-5692. An electronic copy of the 2009 – 2013 base period and projected 2017 ozone design values and 2017 ozone contributions based on the final rule modeling can be obtained from docket for this rule. Electronic copies of the ozone design values and contributions can also be obtained at www.epa.gov/airtransport.

[1] The EPA revised the levels of the primary and secondary 8-hour ozone standards to 0.075 parts per million (ppm). 40 CFR 50.15. 73 FR 16436 (March 27, 2008).

[2] 2017 was selected as the future year analytic base case because 2017 corresponds to the attainment date for ozone nonattainment areas classified as Moderate.

[3] The 2011-based modeling platform used for the final rule air quality modeling reflects revisions based on comments on the proposal modeling.

## 2. Air Quality Modeling Platform

EPA has developed a 2011-based air quality modeling platform which includes emissions, meteorology and other inputs for 2011. The 2011 base year emissions were projected to a future year base case scenario, 2017. The 2011 modeling platform and projected 2017 emissions were used to drive the 2011 base year and 2017 base case air quality model simulations.[4] The base year 2011 platform was chosen in part because it represents the most recent, complete set of base year emissions information currently available for national-scale air quality modeling. In addition, as described below, the meteorological conditions during the summer of 2011 were generally conducive for ozone formation across much of the U.S., particularly the eastern U.S.

### *2.1 Air Quality Model Configuration*

The photochemical model simulations performed for this ozone transport assessment used the Comprehensive Air Quality Model with Extensions (CAMx version 6.20) (Ramboll Environ, 2015)[5]. CAMx is a three-dimensional grid-based Eulerian air quality model designed to simulate the formation and fate of oxidant precursors, primary and secondary particulate matter concentrations, and deposition over regional and urban spatial scales (e.g., the contiguous U.S.). Consideration of the different processes (e.g., transport and deposition) that affect primary (directly emitted) and secondary (formed by atmospheric processes) pollutants at the regional scale in different locations is fundamental to understanding and assessing the effects of emissions on air quality concentrations. CAMx was applied with the carbon-bond 6 revision 2 (CB6r2) gas-phase chemistry mechanism[6] (Ruiz and Yarwood, 2013) and the Zhang dry deposition scheme (Zhang, et al., 2003).

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[4] EPA also used the 2011-based air quality modeling platform to perform a 2017 "illustrative" control case air quality model simulation to inform (1) the analysis to quantify upwind state emissions that significantly contribute to nonattainment or interfere with maintenance of the NAAQS in downwind states and (2) the analysis of the costs and benefits of this proposed rule. The 2017 illustrative control case emissions and air quality modeling results are described in the Ozone Transport Policy Analysis Final Rule TSD and in the Regulatory Impact Assessment for the final rule.

[5] For the proposal modeling EPA had used CAMx v6.11. For the final rule air quality modeling EPA used CAMx version 6.20 which was the latest public release version of CAMx available at the time the air quality modeling was performed for the final rule. In response to comments on the proposal, EPA used the default value for the "HMAX" time step parameter, as specified by the CAMx model developer Ramboll Environ, in the final rule air quality modeling.

[6] The "chemparam.2_CF" chemical parameter file was used in the CAMx model simulations.

Figure 2-1 shows the geographic extent of the modeling domain that was used for air quality modeling in this analysis. The domain covers the 48 contiguous states along with the southern portions of Canada and the northern portions of Mexico. This modeling domain contains 25 vertical layers with a top at about 17,550 meters, or 50 millibars (mb), and horizontal grid resolution of 12 km x 12 km. The model simulations produce hourly air quality concentrations for each 12 km grid cell across the modeling domain.

CAMx requires a variety of input files that contain information pertaining to the modeling domain and simulation period. These include gridded, hourly emissions estimates and meteorological data, and initial and boundary concentrations. Separate emissions inventories were prepared for the 2011 base year and the 2017 base case. All other inputs (i.e. meteorological fields, initial concentrations, and boundary concentrations) were specified for the 2011 base year model application and remained unchanged for the future-year model simulations[7].

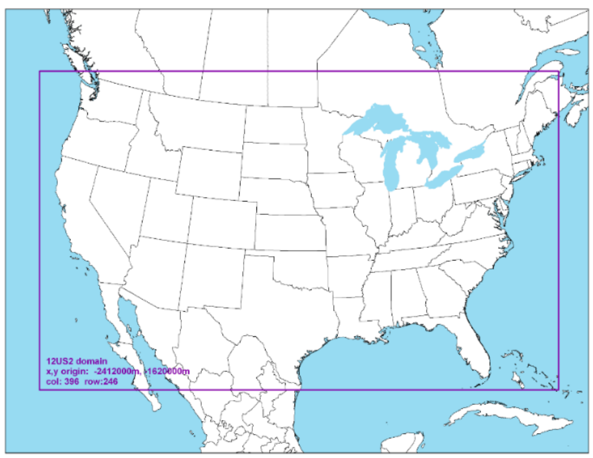


Figure 2-1. Map of the CAMx modeling domain used for transport modeling.

[7] The CAMx annual simulations for 2011 and 2017 were each performed using two time segments (January 1 through April 30, 2011 with a 10-day ramp-up period at the end of December 2010 and May 1 through December 31, 2011 with a 10-day ramp-up period at the end of April 2011). The CAMx 2017 contribution modeling was performed for the period May 1 through September 30, 2011 with a 10-day ramp-up period at the end of April 2011.

*2.2 Characterization of 2011 Summer Meteorology*

Meteorological conditions including temperature, humidity, winds, solar radiation, and vertical mixing affect the formation and transport of ambient ozone concentrations. Ozone is more readily formed on warm, sunny days when the air is stagnant. Conversely, ozone production is more limited on days that are cloudy, cool, rainy, and windy (http://www.epa.gov/airtrends/weather.html). Statistical modeling analyses have shown that temperature and certain other meteorological variables are highly correlated with the magnitude of ozone concentrations (Camalier, et al., 2007).

In selecting a year for air quality modeling it is important to simulate a variety of meteorological conditions that are generally associated with elevated air quality (U.S. EPA, 2014a). Specifically for ozone, modeled time periods should reflect meteorological conditions that frequently correspond with observed 8-hour daily maximum concentrations greater than the NAAQS at monitoring sites in nonattainment areas (U.S. EPA, 2014a). However, because of inter-annual variability in weather patterns it may not always be possible to identify a single year that will be representative of "typical" meteorological conditions favorable for ozone formation within each region of the U.S.

As part of the development of the 2011 modeling platform we examined the "ozone season" (i.e., May through September) temperature and precipitation regimes across the U.S. in 2011 compared to long-term, climatological normal (i.e., average  e) conditions[8]. Table A-1 in Appendix A describes the observed 2011 surface temperature anomalies (i.e., departure from normal) for each of the nine National Oceanic and Atmospheric Administration (NOAA) climate regions shown in Figure 2-2. The aggregate temperature and precipitation anomalies by state for the core summer months, June through August, of 2011 are shown in Figures A-1 and A-2, respectively. Overall, temperatures were warmer than normal during the summer of 2011 in nearly all regions, except for the West and Northwest. Record warmth occurred in portions of the South and Southwest regions. The summer months experienced below average precipitation for much of the southern and southeastern U.S., whereas wetter conditions than average were

[8] Note that because of the relatively large inter-annual variability in certain meteorological conditions such as temperature and precipitation, "average" conditions, usually referred to as "normal" are often the mathematical mean of extremes and thus, "average" or "normal" values of temperature or precipitation should not necessarily be considered as being "typical".

experienced in California and in several northern tier states. Extensive drought conditions occurred in portions of the southern Great Plains states. The warmer and dryer conditions were associated with a strong upper air ridge over the central U.S during the summer of 2011.

In addition to the above characterization of the ozone season meteorology in 2011, we also compared the temperature and precipitation regimes in 2011 to those in other individual years from 2005 through 2016[9] for the eastern U.S. (see Appendix A for climate region temperature anomaly tables and state temperature and precipitation anomaly maps for each year in from 2005 through 2016). While warmer than the long-term average, 2011 summer temperatures in the eastern U.S. were comparable to those in several other recent years. The tables and maps in Appendix A indicate that 2005, 2006, 2007, 2010, 2012, and 2016 also featured above normal or much above normal temperatures across broad areas of the East. Thus, on a regional basis, temperatures in the summer of 2011 and therefore the temperature-related meteorological conduciveness for ozone formation, was not "unusual" compared to other summers over the most recent 12-year time period. Also of note is that temperatures during the summer months in 2008, 2009, 2013, 2014, and to a more limited extent 2015, were cooler than normal across broad portions of the eastern U.S. indicating that these years were generally unfavorable for ozone formation in the East. This was most notable during July 2014 when most states in the East recorded below average summer temperatures. Examining the precipitation anomaly maps in Figure A-2 indicates that while 2011 may have featured record or near record drought in the South and portions of the Southeast, other recent years featured near record drought in other regions (i.e., the Southeast in 2007 and the Upper Midwest in 2012).

The inter-annual variability in summer temperatures can also be analyzed by examining temporal patterns in "cooling degree days". This metric is calculated as the sum of the difference between the daily mean temperature and a reference temperature of 65 degrees, which is used as an indicator of indoor comfort. Cooling degree days provide a measure of how much (in degrees), and for how long (in days), the outside air temperature was *above* a certain level. That is, cooling degree days is an estimate of the energy needed to cool a residence to a comfortable temperature. Higher values indicate warm weather and result in higher energy demand for cooling. Figure A-3 contains charts showing the temporal pattern in cooling degree

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[9] The data for the ozone season in 2016 is limited to May through July since July is the most recent month for which data are available for consideration in this rulemaking.

days from 1990 through 2015 for each of the climate regions in the East (i.e., the Northeast, Ohio Valley, Upper Midwest, and Southeast, and South regions). These charts indicate that there is considerable inter-annual variability in the magnitude in cooling degree days. Although the summer 2011 was above average in each climate region in the East, 2011 was not "extreme" compared to a number of the other years during this long-term record. Specific examples that illustrate this finding include:

- Upper Midwest: 2010 and 2012 had a greater number of cooling degree days than 2011
- Northeast: 2005 and 2010 had a greater number of cooling degree days than 2011
- Ohio Valley and Southeast: 2010 had a greater number of cooling degree days than 2011

However, in the South region the magnitude of cooling degree days was greater in 2011 than other years. In contrast, the more recent summers of 2013, 2014, and 2015 had much fewer cooling degree days in most of the eastern climate regions compared to 2011. In addition, the Southeast region had a below average number of cooling degree days in the summer of 2012.

Thus, the results of the analysis of summer average temperatures (above) and the analysis of summer cooling degree days (which is based on temperature) demonstrate that, on balance, the summer of 2011 was an appropriate year to choose for the air quality modeling for this rule in view of the following considerations: (1) based on temperature indicators, 2011 was generally conducive to ozone formation in all of the climate regions in the East, (2) 2011 was not the warmest summer since 2005, except in one of the eastern climate regions, and (3) other years since 2005 have been either warmer than 2011 in multiple eastern climate regions (i.e., 2010) or cooler than 2011, and thus potentially unconducive for ozone formation in one or more of the eastern climate regions (i.e., 2009, 2012, 2013, 2014, and 2015).

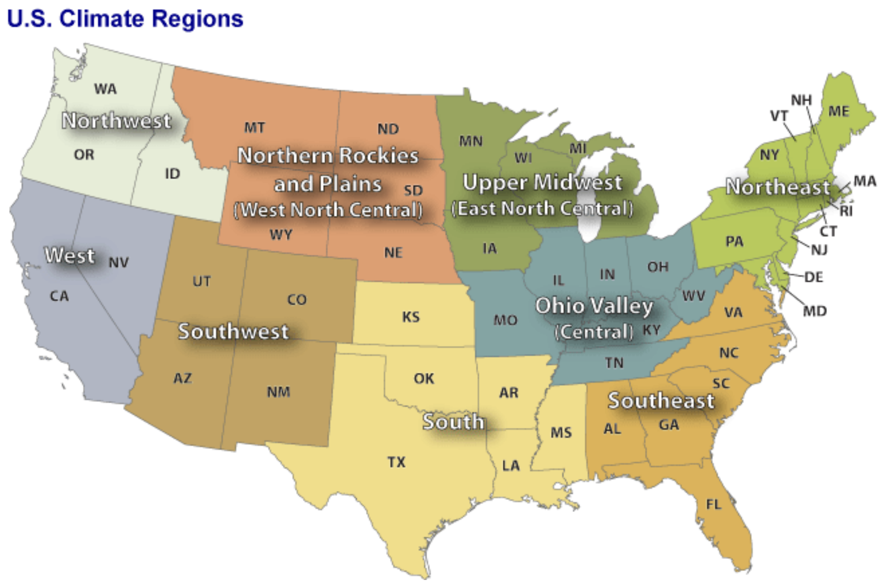


Figure 2-1. U.S. climate regions.
(http://www.ncdc.noaa.gov/monitoring-references/maps/us-climate-regions.php)

*2.3 Meteorological Data for 2011*

The meteorological data for air quality modeling of 2011 were derived from running Version 3.4 of the Weather Research Forecasting Model (WRF) (Skamarock, et al., 2008). The meteorological outputs from WRF include hourly-varying horizontal wind components (i.e., speed and direction), temperature, moisture, vertical diffusion rates, and rainfall rates for each grid cell in each vertical layer. Selected physics options used in the WRF simulation include Pleim-Xiu land surface model (Xiu and Pleim, 2001; Pleim and Xiu, 2003), Asymmetric Convective Model version 2 planetary boundary layer scheme (Pleim 2007a,b), Kain-Fritsch cumulus parameterization (Kain, 2004) utilizing the moisture-advection trigger (Ma and Tan, 2009), Morrison double moment microphysics (Morrison, et al., 2005; Morrison and Gettelman, 2008), and RRTMG longwave and shortwave radiation schemes (Iacono, et.al., 2008).

The WRF model simulation was initialized using the 12km North American Model (12NAM) analysis product provided by the National Climatic Data Center (NCDC). Where 12NAM data were unavailable, the 40km Eta Data Assimilation System (EDAS) analysis (ds609.2) from the National Center for Atmospheric Research (NCAR) was used. Analysis nudging for temperature, wind, and moisture was applied above the boundary layer only. The model simulations were conducted in 5.5 day blocks with soil moisture and temperature carried from one block to the next via the “ipxwrf” program (Gilliam and Pleim, 2010). Landuse and land cover data were based on the 2006 National Land Cover Database (NLCD2006) data.[10] Sea surface temperatures at 1 km resolution were obtained from the Group for High Resolution Sea Surface Temperatures (GHRSST) (Stammer, et al., 2003). As shown in Table 2-2, the WRF simulations were performed with 35 vertical layers up to 50 mb, with the thinnest layers being nearest the surface to better resolve the planetary boundary layer (PBL). The WRF 35-layer structure was collapsed to 25 layers for the CAMx air quality model simulations, as shown in Table 2-2.

Table 2-2. WRF and CAMx layers and their approximate height above ground level.

| CAMx Layers | WRF Layers | Sigma P | Pressure (mb) | Approximate Height (m AGL) |
|---|---|---|---|---|
| 25 | 35 | 0.00 | 50.00 | 17,556 |
| | 34 | 0.05 | 97.50 | 14,780 |
| 24 | 33 | 0.10 | 145.00 | 12,822 |
| | 32 | 0.15 | 192.50 | 11,282 |
| 23 | 31 | 0.20 | 240.00 | 10,002 |
| | 30 | 0.25 | 287.50 | 8,901 |
| 22 | 29 | 0.30 | 335.00 | 7,932 |
| | 28 | 0.35 | 382.50 | 7,064 |
| 21 | 27 | 0.40 | 430.00 | 6,275 |
| | 26 | 0.45 | 477.50 | 5,553 |
| 20 | 25 | 0.50 | 525.00 | 4,885 |
| | 24 | 0.55 | 572.50 | 4,264 |
| 19 | 23 | 0.60 | 620.00 | 3,683 |
| 18 | 22 | 0.65 | 667.50 | 3,136 |
| 17 | 21 | 0.70 | 715.00 | 2,619 |
| 16 | 20 | 0.74 | 753.00 | 2,226 |
| 15 | 19 | 0.77 | 781.50 | 1,941 |
| 14 | 18 | 0.80 | 810.00 | 1,665 |
| 13 | 17 | 0.82 | 829.00 | 1,485 |
| 12 | 16 | 0.84 | 848.00 | 1,308 |
| 11 | 15 | 0.86 | 867.00 | 1,134 |
| 10 | 14 | 0.88 | 886.00 | 964 |
| 9 | 13 | 0.90 | 905.00 | 797 |

[10] The 2006 NLCD data are available at http://www.mrlc.gov/nlcd06_data.php

| CAMx Layers | WRF Layers | Sigma P | Pressure (mb) | Approximate Height (m AGL) |
|---|---|---|---|---|
| | 12 | 0.91 | 914.50 | 714 |
| 8 | 11 | 0.92 | 924.00 | 632 |
| | 10 | 0.93 | 933.50 | 551 |
| 7 | 9 | 0.94 | 943.00 | 470 |
| | 8 | 0.95 | 952.50 | 390 |
| 6 | 7 | 0.96 | 962.00 | 311 |
| 5 | 6 | 0.97 | 971.50 | 232 |
| 4 | 5 | 0.98 | 981.00 | 154 |
| | 4 | 0.99 | 985.75 | 115 |
| 3 | 3 | 0.99 | 990.50 | 77 |
| 2 | 2 | 1.00 | 995.25 | 38 |
| 1 | 1 | 1.00 | 997.63 | 19 |

Details of the annual 2011 meteorological model simulation and evaluation are provided in a separate technical support document (US EPA, 2014b) which can be obtained at http://www.epa.gov/ttn/scram/reports/MET_TSD_2011_final_11-26-14.pdf

The meteorological data generated by the WRF simulations were processed using wrfcamx v4.3 (Ramboll Environ, 2014)[11] meteorological data processing program to create model-ready meteorological inputs to CAMx. In running wrfcamx, vertical eddy diffusivities (Kv) were calculated using the Yonsei University (YSU) (Hong and Dudhia, 2006) mixing scheme. We used a minimum Kv of 0.1 $m^2$/sec except for urban grid cells where the minimum Kv was reset to 1.0 $m^2$/sec within the lowest 200 m of the surface in order to enhance mixing associated with the nighttime “urban heat island” effect. In addition, we invoked the subgrid convection and subgrid stratoform cloud options in our wrfcamx run for 2011.

[11] For the proposal modeling EPA used wrfcamx version 4.0. For the final rule air quality modeling EPA used wrfcamx version 4.3 since this was the latest public release version of wrfcamx at the time the meteorological data were processed for the final rule air quality modeling.

*2.4 Initial and Boundary Concentrations*

The lateral boundary and initial species concentrations are provided by a three-dimensional global atmospheric chemistry model, GEOS-Chem (Yantosca, 2004) standard version 8-03-02 with 8-02-01 chemistry. The global GEOS-Chem model simulates atmospheric chemical and physical processes driven by assimilated meteorological observations from the NASA's Goddard Earth Observing System (GEOS-5; additional information available at: http://gmao.gsfc.nasa.gov/GEOS/ and http://wiki.seas.harvard.edu/geos-chem/index.php/GEOS-5). This model was run for 2011 with a grid resolution of 2.0 degrees x 2.5 degrees (latitude-longitude). The predictions were used to provide one-way dynamic boundary concentrations at one-hour intervals and an initial concentration field for the CAMx simulations. The 2011 boundary concentrations from GEOS-Chem were used for the 2011 and 2017 model simulations. The procedures for translating GEOS-Chem predictions to initial and boundary concentrations are described elsewhere (Henderson, 2014). More information about the GEOS-Chem model and other applications using this tool is available at: http://www-as.harvard.edu/chemistry/trop/geos.

*2.5 Emissions Inventories*

CAMx requires detailed emissions inventories containing temporally allocated (i.e., hourly) emissions for each grid-cell in the modeling domain for a large number of chemical species that act as primary pollutants and precursors to secondary pollutants. Annual emission inventories for 2011 and 2017 were preprocessed into CAMx-ready inputs using the Sparse Matrix Operator Kernel Emissions (SMOKE) modeling system (Houyoux et al., 2000).[12] Information on the emissions inventories used as input to the CAMx model simulations can be found in the following emissions inventory technical support documents: Emissions Inventories for the Version 6.3, 2011 Emissions Modeling Platform (U.S. EPA, 2016) and 2011 National Emissions Inventory, version 2 (U.S. EPA, 2015).[13]

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[12] The SMOKE output emissions case name for the 2011 base year is "2011ek_cb6v2_v6_11g" and the emissions case name for the 2017 base case is "2017ek_cb6v2_v6_11g".

[13] Numerous revisions were made to the 2011 and 2017 emissions inventories for the final rule air quality modeling based on comments on the emissions data use for the proposal (see U.S. EPA, 2016).

*2.6 Air Quality Model Evaluation*

An operational model performance evaluation for ozone was conducted to examine the ability of the CAMx v6.20 modeling system to simulate 2011 measured concentrations. This evaluation focused on graphical analyses and statistical metrics of model predictions versus observations. Details on the evaluation methodology, the calculation of performance statistics, and results are provided in Appendix B. Overall, the ozone model performance statistics for the CAMx v6.20 2011 simulation are within or close to the ranges found in other recent peer-reviewed applications (e.g., Simon et al, 2012). As described in Appendix B, the predictions from the 2011 modeling platform correspond closely to observed concentrations in terms of the magnitude, temporal fluctuations, and geographic differences for 8-hour daily maximum ozone. Thus, the model performance results demonstrate the scientific credibility of our 2011 modeling platform. These results provide confidence in the ability of the modeling platform to provide a reasonable projection of expected future year ozone concentrations and contributions.

## 3. Identification of Future Nonattainment and Maintenance Receptors

*3.1 Definition of Nonattainment and Maintenance Receptors*

The approach in the final rule for identifying the 2017 nonattainment and maintenance receptors is described in the preamble. In brief, we are finalizing an approach for identifying nonattainment receptors in this rulemaking as those sites that are violating the NAAQS based on current measured air quality (i.e., 2013-2015 design values) and that also have projected 2017 average design values that exceed the NAAQS (i.e., 2017 average design values of 76 ppb or greater).[14] We followed the approach in the CSAPR to identify sites that would have difficulty maintaining the 2008 ozone NAAQS in a scenario that takes into account historic variability in air quality at the monitoring site. In the CSAPR approach, monitoring sites with a 2017 maximum design value that exceeds the NAAQS, even if the 2017 average design value is below the NAAQS, are projected to have a maintenance problem in 2017. Monitoring sites with a 2017 average design value below the NAAQS, but with a maximum design value that exceeds the NAAQS, are considered maintenance-only sites. In addition, those sites that have projected 2017

[14] In determining compliance with the NAAQS, ozone design values are truncated to integer values. For example, a design value of 75.9 ppb is truncated to 75 ppb which is attainment. In this manner, design values at or above 76.0 ppb are considered to be violations of the NAAQS.

average design values that exceed the NAAQS, but are currently measuring clean data based on 2013-2015 design values are also defined as maintenance-only receptors. Maintenance-only receptors therefore include both (1) those sites with projected average design values above the NAAQS that are currently measuring clean data and (2) those sites with projected average design values below the level of the NAAQS, but with projected maximum design values of 76 ppb or greater. In addition to the maintenance-only receptors, the 2017 ozone nonattainment receptors are also maintenance receptors because the maximum design values for each of these sites is always greater than or equal to the average design value. The procedures for calculating projected 2017 average and maximum design values are described below. The monitoring sites that we project to be nonattainment and maintenance receptors for the ozone NAAQS in the 2017 base case are used for assessing the contribution of emissions in upwind states to downwind nonattainment and maintenance of the 2008 ozone NAAQS as part of this final rule.

*3.2 Approach for Projecting 2017 Ozone Design Values*

The ozone predictions from the 2011 and 2017 CAMx model simulations were used to project ambient (i.e., measured) ozone design values (DVs) to 2017 following the approach described in EPA's current guidance for attainment demonstration modeling (US EPA, 2014a),[15] as summarized here. The modeling guidance recommends using 5-year weighted average ambient design values[16] centered on the base modeling year as the starting point for projecting average design values to the future. Because 2011 is the base emissions year, we used the average ambient 8-hour ozone design values for the period 2009 through 2013 (i.e., the average of design values for 2009-2011, 2010-2012 and 2011-2013) to calculate the 5-year weighted average design values. The 5-year weighted average ambient design value at each site was projected to 2017 using the Model Attainment Test Software program (Abt Associates, 2014**)**. This program calculates the 5-year weighted average design value based on observed data and projects future year values using the relative response predicted by the model. Equation (3-1) describes the recommended model attainment test in its simplest form, as applied for monitoring site *i*:

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[15] EPA's ozone attainment demonstration modeling guidance is referred to as "the modeling guidance" in the remainder of this document.

[16] The air quality design value for a site is the 3-year average of the annual fourth-highest daily maximum 8-hour average ozone concentration.

$$(\mathrm{DVF})_{\mathrm{i}} = (RRF)_i * (DVB)_i \qquad \text{Equation 3-1}$$

$\mathrm{DVF_i}$ is the estimated design value for the future year at monitoring site $i$; $\mathrm{RRF_i}$ is the relative response factor for monitoring site $i$; and $\mathrm{DVB_i}$ is the base period design value monitored at site $i$. The relative response factor for each monitoring site $(RRF)_i$ is the fractional change in 8-hour daily maximum ozone between the base and future year. The RRF is based on the average ozone on model-predicted "high" ozone days in grid cells in the vicinity of the monitoring site. The modeling guidance recommends calculating RRFs based on the highest 10 modeled ozone days in the base year simulation at each monitoring site. Specifically, the RRF was calculated based on the 10 highest days in the 2011 base year modeling in the vicinity of each monitor location.

As recommended by the modeling guidance, we considered model response in grid cells immediately surrounding the monitoring site along with the grid cell in which the monitor is located. The RRF was based on a 3 x 3 array of 12 km grid cells centered on the location of the grid cell containing the monitor. On each high ozone day, the grid cell with the highest base year ozone value in the 3 x 3 array surrounding the location of the monitoring site was used for both the base and future components of the RRF calculation (paired in space). In cases for which the base year model simulation did not have 10 days with ozone values greater than or equal to 60 ppb at a site, we used all days with ozone >= 60 ppb, as long as there were at least 5 days that meet that criteria. At monitor locations with less than 5 days with modeled 2011 base year ozone >= 60 ppb, no RRF or DVF was calculated for the site and the monitor in question was not included in this analysis.

The approach for calculating 2017 maximum design values is similar to the approach for calculating 2017 average design values. To calculate the 2017 maximum design value we start with the highest (i.e., maximum) ambient design value from the 2011-centered 5-year period (i.e., the maximum of design values from 2009-2011, 2010-2012, and 2011-2013). The base period maximum design value at each site was projected to 2017 using the site-specific RRFs, as determined using the procedures for calculating RRFs described above.

Table 3-1 contains the 2009-2013 base period average and maximum 8-hour ozone design values, the 2017 base case average and maximum design values, and the 2013-2015 design values for the 6 sites in the eastern U.S. projected to be 2017 nonattainment receptors. Table 3-2 contains this same information for the 13 maintenance-only sites in the eastern U.S.

The 2009-2013 base period and 2017 base case average and maximum design values for individual monitoring sites in the U.S. are provided in the docket.[17]

Table 3-1. Average and maximum 2009-2013 and 2017 base case 8-hour ozone design values and 2013-2015 design values (ppb) at projected nonattainment sites in the eastern U.S. (nonattainment receptors).

| Monitor ID | State | County | Average Design Value 2009-2013 | Maximum Design Value 2009-2013 | Average Design Value 2017 | Maximum Design Value 2017 | 2013-2015 Design Value |
|---|---|---|---|---|---|---|---|
| 090019003 | Connecticut | Fairfield | 83.7 | 87 | 76.5 | 79.5 | 84 |
| 090099002 | Connecticut | New Haven | 85.7 | 89 | 76.2 | 79.2 | 78 |
| 480391004 | Texas | Brazoria | 88.0 | 89 | 79.9 | 80.8 | 80 |
| 484392003 | Texas | Tarrant | 87.3 | 90 | 77.3 | 79.7 | 76 |
| 484393009 | Texas | Tarrant | 86.0 | 86 | 76.4 | 76.4 | 78 |
| 551170006 | Wisconsin | Sheboygan | 84.3 | 87 | 76.2 | 78.7 | 77 |

[17] There are 7 sites in 3 counties in the West that were excluded from this listing because the ambient design values at these sites were dominated by wintertime ozone episodes and not summer season conditions that are the focus of this transport assessment. High winter ozone concentrations that have been observed in certain parts of the Western U.S. are believed to result from the combination of strong wintertime inversions, large NOx and VOC emissions from nearby oil and gas operations, increased UV intensity due to reflection off of snow surfaces and potentially still uncharacterized sources of free radicals. The 7 sites excluded from this analysis are in Rio Blanco County, CO (site ID 081030006), Fremont County, WY (site ID 560130099), and Sublette County, WY (site IDs 560350097, 560350099, 560350100, 560350101, and 560351002). Information on the analysis to identify these sites as influenced by wintertime ozone episodes can be found in Appendix 3A of the Regulatory Impact Analysis of the Proposed Revisions to the National Ambient Air Quality Standards for Ground-Level Ozone (EPA, 2014d) (http://www.epa.gov/ttn/ecas/ria.html)

Table 3-2. Average and maximum 2009-2013 and 2017 base case 8-hour ozone design values and 2013-2015 design values (ppb) at projected maintenance-only sites in the eastern U.S. (maintenance-only receptors).

| Monitor ID | State | County | Average Design Value 2009-2013 | Maximum Design Value 2009-2013 | Average Design Value 2017 | Maximum Design Value 2017 | 2013-2015 Design Value |
|---|---|---|---|---|---|---|---|
| 090010017 | Connecticut | Fairfield | 80.3 | 83 | 74.1 | 76.6 | 81 |
| 090013007 | Connecticut | Fairfield | 84.3 | 89 | 75.5 | 79.7 | 83 |
| 211110067 | Kentucky | Jefferson | 85.0 | 85 | 76.9 | 76.9 | N/A* |
| 240251001 | Maryland | Harford | 90.0 | 93 | 78.8 | 81.4 | 71 |
| 260050003 | Michigan | Allegan | 82.7 | 86 | 74.7 | 77.7 | 75 |
| 360850067 | New York | Richmond | 81.3 | 83 | 75.8 | 77.4 | 74 |
| 361030002 | New York | Suffolk | 83.3 | 85 | 76.8 | 78.4 | 72 |
| 390610006 | Ohio | Hamilton | 82.0 | 85 | 74.6 | 77.4 | 70 |
| 421010024 | Pennsylvania | Philadelphia | 83.3 | 87 | 73.6 | 76.9 | 73 |
| 481210034 | Texas | Denton | 84.3 | 87 | 75.0 | 77.4 | 83 |
| 482010024 | Texas | Harris | 80.3 | 83 | 75.4 | 77.9 | 79 |
| 482011034 | Texas | Harris | 81.0 | 82 | 75.7 | 76.6 | 74 |
| 482011039 | Texas | Harris | 82.0 | 84 | 76.9 | 78.8 | 69 |

*The 2013-2015 design value at this site is not valid due to incomplete data for 2013. There are valid 4th high measured concentrations for 2014 and 2015 and therefore the site may have valid design value data when the 2014-2016 data are complete. The 2014 4th high value at this site was 70 ppb and the 2015 4th high value at this site was 76 ppb. In addition, there is one other monitoring site in Jefferson County, KY which has a valid 2013-2015 design value of 66 ppb. There is one other site in the Louisville CBSA which has a slightly higher 2013-2015 design value of 68 ppb (site 211850004 in Oldham County, KY). Since there are no valid design value data that indicate that the Jefferson County receptor or any other monitoring site in Jefferson County or the Louisville metropolitan area is currently exceeding the 2008 NAAQS, for the purposes of this final rule, the Jefferson County, KY receptor will be considered a maintenance receptor.

## 4. Ozone Contribution Modeling

### *4.1 Methodology*

The EPA performed nationwide,[18] state-level ozone source apportionment modeling using the CAMx OSAT/APCA technique[19] (Ramboll Environ, 2015) to quantify the contribution of 2017 base case $NO_X$ and VOC emissions from all sources in each state to projected 2017 ozone concentrations at ozone monitoring sites. In the source apportionment model run, we tracked the ozone formed from each of the following contribution categories (i.e., "tags"):

- States – anthropogenic $NO_X$ and VOC emissions from each state tracked individually (emissions from all anthropogenic sectors in a given state were combined);

[18] As shown in Figure 2-1, the EPA's nationwide modeling includes the 48 contiguous states and the District of Columbia.

[19] As part of this technique, ozone formed from reactions between biogenic VOC and NOx with anthropogenic NOx and VOC are assigned to the anthropogenic emissions.

- Biogenics – biogenic $NO_X$ and VOC emissions domain-wide (i.e., not by state)[20];
- Boundary Concentrations – concentrations transported into the modeling domain;
- Tribes – the emissions from those tribal lands for which we have point source inventory data in the 2011 NEI (we did not model the contributions from individual tribes);
- Canada and Mexico – anthropogenic emissions from sources in the portions of Canada and Mexico included in the modeling domain (contributions from Canada and Mexico were not modeled separately);
- Fires – combined emissions from wild and prescribed fires domain-wide (i.e., not by state); and
- Offshore – combined emissions from offshore marine vessels and offshore drilling platforms (i.e., not by state).

The contribution modeling provided contributions to ozone from anthropogenic $NO_X$ and VOC emissions in each state, individually. The contributions to ozone from chemical reactions between biogenic $NO_X$ and VOC emissions were modeled and assigned to the "biogenic" category. The contributions from wild fire and prescribed fire $NO_X$ and VOC emissions were modeled and assigned to the "fires" category. The contributions from the "biogenic", "offshore", and "fires" categories are not assigned to individual states nor are they included in the state contributions.

CAMx OSAT/APCA model run was performed for the period May 1 through September 30 using the projected 2017 base case emissions and 2011 meteorology for this time period. The hourly contributions[21] from each tag were processed to calculate an 8-hour average contribution metric. The process for calculating the contribution metric uses the contribution modeling outputs in a "relative sense" to apportion the projected 2017 average design value at each monitoring location into contributions from each individual tag. This process is similar in concept to the approach described above for using model predictions to calculate 2017 ozone design values. The approach used to calculate the contribution metric is described by the following steps:

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[20] Biogenic emissions and emissions from wild fires and prescribed fires were held constant between 2011 and 2017 since (1) these emissions are tied to the 2011 meteorological conditions and (2) the focus of this rule is on the contribution from anthropogenic emissions to projected ozone nonattainment and maintenance.

[21] Contributions from anthropogenic emissions under "$NO_X$-limited" and "VOC-limited" chemical regimes were combined to obtain the net contribution from $NO_X$ and VOC anthropogenic emissions in each state.

**Step 1.** Modeled hourly ozone concentrations are used to calculate the 8-hour daily maximum ozone (MDA8) concentration in each grid cell on each day.

**Step 2.** The gridded hourly ozone contributions from each tag are subtracted from the corresponding gridded hourly total ozone concentrations to create a "pseudo" hourly ozone value for each tag for each hour in each grid cell.

**Step 3.** The hourly "pseudo" concentrations from Step 2 are used to calculate 8-hour average "pseudo" concentrations for each tag for the time period that corresponds to the MDA8 concentration from Step 1. Step 3 results in spatial fields of 8-hour average "pseudo" concentrations for each grid cell for each tag on each day.

**Step 4.** The 8-hour average "pseudo" concentrations for each tag and the MDA8 concentrations are extracted for those grid cells containing ozone monitoring sites. We used the data for all days with 2017 MDA8 concentrations >=76 ppb (i.e., projected 2017 exceedance days) in the downstream calculations. If there were fewer than five 2017 exceedance days at a particular monitoring site then the data from the top five 2017 MDA8 concentration days are extracted and used in the calculations.[22]

**Step 5.** For each monitoring site and each tag, the 8-hour "pseudo" concentrations are then averaged across the days selected in Step 4 to create a multi-day average "pseudo" concentration for tag at each site. Similarly, the MDA8 concentrations were average across the days selected in Step 4.

**Step 6.** The multi-day average "pseudo" concentration and the corresponding multi-day average MDA8 concentration are used to create a Relative Contribution Factor (RCF) for each tag at each monitoring site. The RCF is the difference between the MDA8 concentration and the corresponding "pseudo" concentration, normalized by the MDA8 concentration.

**Step 7.** The RCF for each tag is multiplied by the 2017 average ozone design value to create the ozone contribution metrics for each tag at each site. Note that the sum of the contributions from each tag equals the 2017 average design value for that site.

**Step 8.** The contributions calculated from Step 7 are truncated to two digits to the right of the decimal (e.g., a calculated contribution of 0.78963… is truncated to 0.78 ppb). As a result of truncation the reported contributions may not always sum to the 2017 average design value.

[22] If there were fewer than 5 days with a modeled 2017 MDA8 concentration ≥ 60 ppb for the location of a particular monitoring site, then contributions were not calculated at that monitor.

Table 4-1 provides an example of the calculation of contributions from two states (state A and state B) to a particular nonattainment site starting with Step 4, above. The table includes the daily “pseudo” concentrations for state A and state B and corresponding MDA8 ozone concentrations on those days with 2017 model-predicted exceedances at this site. The MDA8 ozone concentrations on these days are ranked-ordered in the table. The 2017 average design value for this example is 77.5 ppb. Using the data in Table 4-1, the RCF for state A and state B are calculated as:

(90.372 – 81.857) / 90.372 = 0.09422 for state A, and

(90.372 – 90.163) / 90.372 = 0.00231 for state B

The contributions from state A and state B to the 2017 average design value at this site are calculated as:

77.5 x 0.09422 = 7.3020 which is truncated to 7.30 ppb for state A, and

77.5 x 0.00231 = 0.1790 which is truncated to 0.17 ppb for state B

Table 4-1. Example calculation of ozone contributions (units are ppb).

| Month | Day | Predicted MDA8 O3 on 2017 Modeled Exceedance Days | "Pseudo" 8-Hr O3 for State A | "Pseudo" 8-Hr O3 for State B |
|---|---|---|---|---|
| 7 | 11 | 110.832 | 98.741 | 110.817 |
| 7 | 6 | 102.098 | 89.017 | 102.081 |
| 7 | 21 | 100.739 | 87.983 | 100.560 |
| 6 | 9 | 94.793 | 87.976 | 93.179 |
| 6 | 8 | 92.255 | 84.707 | 92.207 |
| 7 | 18 | 84.768 | 72.196 | 84.635 |
| 8 | 1 | 81.719 | 81.065 | 81.718 |
| 7 | 17 | 81.453 | 73.034 | 81.443 |
| 7 | 22 | 78.377 | 74.500 | 78.303 |
| 6 | 16 | 76.695 | 69.357 | 76.695 |
| Multi-Day Average => | | 90.372 | 81.857 | 90.163 |
| 2017 Average Design Value is 77.5 ppb | | Relative Contribution Factors => | 0.09422 | 0.00231 |
| | | Contributions => | 7.3020 | 0.1790 |
| | | Truncated Contributions => | 7.30 | 0.17 |

The average contribution metric calculated in this manner is intended to provide a reasonable representation of the contribution from individual states to the projected 2017 design value, based on modeled transport patterns and other meteorological conditions generally associated with modeled high ozone concentrations in the vicinity of the monitoring site. This average contribution metric is beneficial since the magnitude of the contributions is directly related to the magnitude of the design value at each site.

### *4.2 Contribution Modeling Results*

The contributions from each tag to individual nonattainment and maintenance-only sites in the East are provided in Appendix C. The largest contributions from each state to 2017 downwind nonattainment sites and to downwind maintenance-only sites are provided in Table 4-2. The 2017 contributions from each tag to individual monitoring sites across the U.S. are provided in the docket.

Table 4-2. Largest Contribution to Downwind 8-Hour Ozone Nonattainment and Maintenance Receptors for Each State in the Eastern U.S. (units are ppb).

| Upwind State | Largest Downwind Contribution to Nonattainment Receptors | Largest Downwind Contribution to Maintenance Receptors |
|---|---|---|
| AL | 0.99 | 0.73 |
| AR | 1.00 | 2.07 |
| CT | 0.00 | 0.46 |
| DE | 0.38 | 1.32 |
| DC | 0.07 | 0.86 |
| FL | 0.71 | 0.75 |
| GA | 0.60 | 0.62 |
| IL | 17.90 | 23.61 |
| IN | 6.49 | 12.32 |
| IA | 0.58 | 0.81 |
| KS | 1.13 | 1.22 |
| KY | 0.68 | 10.88 |
| LA | 3.01 | 3.20 |
| ME | 0.00 | 0.01 |
| MD | 2.12 | 5.22 |
| MA | 0.12 | 0.06 |
| MI | 2.62 | 1.27 |
| MN | 0.40 | 0.36 |

| Upwind State | Largest Downwind Contribution to Nonattainment Receptors | Largest Downwind Contribution to Maintenance Receptors |
|---|---|---|
| MS | 0.81 | 0.79 |
| MO | 1.67 | 3.78 |
| NE | 0.35 | 0.27 |
| NH | 0.02 | 0.02 |
| NJ | 9.52 | 11.90 |
| NY | 18.50 | 18.81 |
| NC | 0.51 | 0.50 |
| ND | 0.06 | 0.22 |
| OH | 1.83 | 3.78 |
| OK | 2.24 | 1.62 |
| PA | 9.28 | 14.61 |
| RI | 0.03 | 0.01 |
| SC | 0.15 | 0.30 |
| SD | 0.08 | 0.12 |
| TN | 0.50 | 1.82 |
| TX | 2.18 | 2.64 |
| VT | 0.01 | 0.01 |
| VA | 1.92 | 5.21 |
| WV | 1.04 | 3.31 |
| WI | 0.33 | 2.52 |

As discussed in the preamble, the EPA is establishing an air quality screening threshold calculated as one percent of the NAAQS. For this rule, the 8-hour ozone threshold is 0.75 ppb. This threshold is used to identify upwind states that contribute to downwind ozone concentrations in amounts sufficient to "link" them to these to downwind nonattainment and maintenance receptors.

States in the East whose contributions to a specific receptor meet or exceed the screening threshold are considered linked to that receptor; those states' ozone contributions and emissions (and available emission reductions) are analyzed further, as described in the preamble, to determine whether and what emissions reductions might be required from each state. States in the East whose contribution to a specific receptor is below the screening threshold are not linked to that receptor and the EPA determines that such states do not significantly contribute to nonattainment or interfere with maintenance of the NAAQS at that downwind receptor.

Based on the maximum downwind contributions identified in Table 4-2, the following states contribute at or above the 0.75 ppb threshold to downwind nonattainment receptors: Alabama, Arkansas, Illinois, Indiana, Kansas, Louisiana, Maryland, Michigan, Mississippi, Missouri, New Jersey, New York, Ohio, Oklahoma, Pennsylvania, Texas, Virginia, and West Virginia. Based on the maximum downwind contributions in Table 4-2, the following states contribute at or above the 0.75 ppb threshold to downwind maintenance-only receptors: Arkansas, Delaware, District of Columbia, Florida, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maryland, Michigan, Mississippi, Missouri, New Jersey, New York, Ohio, Oklahoma, Pennsylvania, Tennessee, Texas, Virginia, West Virginia, and Wisconsin. The following states contribute below the threshold to all identified receptors: Connecticut, Georgia, Maine, Massachusetts, Minnesota, Nebraska, New Hampshire, North Carolina, North Dakota, Rhode Island, South Carolina, South Dakota, and Vermont.

*4.4 Considerations for Florida*

In the EPA's 2017 modeling for the final rule, Florida is modeled to have an average contribution at the 0.75 ppb threshold to the 2017 design values at two receptors in Houston (i.e., Harris County sites 482010024 and 482011034). However, a newer version of the CAMx chemical mechanism contains updated chemical reactions (halogen chemistry) which may have an impact on the estimated ozone contributions from Florida emissions to Houston receptors. In the final rule modeling, the EPA was not able to explicitly account for the updated chemistry because this chemistry had not yet been included by the model developer in the source apportionment tool in CAMx at the time the modeling was performed for this final rule. However, because Florida's maximum contribution to receptors in Houston is exactly at the 0.75 ppb threshold, the agency believes that if it had performed the final rule modeling with the updated halogen chemistry, Florida's contribution would likely be below this threshold. Therefore, the EPA is not including Florida in the final rule because it finds that Florida's contribution to downwind nonattainment and maintenance receptors is insignificant when this updated halogen chemistry is considered. More details and analysis of the impact of the CAMx halogen chemistry updates on the contributions from Florida and other Gulf Coast states can be found in Appendix D.

*4.4 Upwind/Downwind Linkages*

The linkages between upwind states and downwind nonattainment receptors and maintenance-only receptors in the eastern U.S. are provided by receptor site in Table 4-3 and by upwind state in Table 4-4 and Table 4-5.

Table 4-3. Upwind states that are "linked" to each downwind nonattainment and maintenance-only receptor in the eastern U.S.

| Site | State | County | Linked Upwind States | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 90010017 | CT | Fairfield | MD | NJ | NY | OH | PA | VA | WV | | | | |
| 90013007 | CT | Fairfield | IN | MD | MI | NJ | NY | OH | PA | VA | WV | | |
| 90019003 | CT | Fairfield | IN | MD | MI | NJ | NY | OH | PA | VA | WV | | |
| 90099002 | CT | New Haven | MD | NJ | NY | OH | PA | VA | | | | | |
| 211110067 | KY | Jefferson | IL | IN | MI | OH | | | | | | | |
| 240251001 | MD | Harford | DC | IL | IN | KY | MI | OH | PA | TX | VA | WV | |
| 260050003 | MI | Allegan | AR | IL | IN | IA | KS | MO | OK | TX | WI | | |
| 360850067 | NY | Richmond | IN | KY | MD | NJ | OH | PA | VA | WV | | | |
| 361030002 | NY | Suffolk | IL | IN | MD | MI | NJ | OH | PA | VA | WV | | |
| 390610006 | OH | Hamilton | IL | IN | KY | MI | MO | TN | TX | WV | | | |
| 421010024 | PA | Philadelphia | DE | IL | IN | KY | MD | NJ | OH | TN | TX | VA | WV |
| 480391004 | TX | Brazoria | AR | IL | LA | MS | MO | | | | | | |
| 481210034 | TX | Denton | LA | OK | | | | | | | | | |
| 482010024 | TX | Harris | LA | | | | | | | | | | |
| 482011034 | TX | Harris | LA | MO | OK | | | | | | | | |
| 482011039 | TX | Harris | AR | IL | LA | MS | MO | OK | | | | | |
| 484392003 | TX | Tarrant | AL | KS | LA | OK | | | | | | | |
| 484393009 | TX | Tarrant | AL | LA | OK | | | | | | | | |
| 551170006 | WI | Sheboygan | IL | IN | KS | LA | MI | MO | OK | TX | | | |

Table 4-4. Linkages between each upwind state and downwind nonattainment receptors in the eastern U.S.

| Upwind State | Downwind Nonattainment Receptors | | |
|---|---|---|---|
| AL | Tarrant Co, TX (484392003) | Tarrant Co, TX (484393009) | |
| AR | Brazoria Co, TX (480391004) | | |
| IL | Brazoria Co, TX (480391004) | Sheboygan Co, WI (551170006) | |

| Upwind State | Downwind Nonattainment Receptors | | |
|---|---|---|---|
| IN | Fairfield Co, CT (090019003) | Sheboygan Co, WI (551170006) | |
| KS | Tarrant Co, TX (484392003) | Sheboygan Co, WI (551170006) | |
| LA | Brazoria Co, TX (480391004) | Tarrant Co, TX (484392003) | Tarrant Co, TX (484393009) |
| | Sheboygan Co, WI (551170006) | | |
| MD | Fairfield Co, CT (090019003) | New Haven Co, CT (090099002) | |
| MI | Fairfield Co, CT (090019003) | Sheboygan Co, WI (551170006) | |
| MS | Brazoria Co, TX (480391004) | | |
| MO | Brazoria Co, TX (480391004) | Sheboygan Co, WI (551170006) | |
| NJ | Fairfield Co, CT (090019003) | New Haven Co, CT (090099002) | |
| NY | Fairfield Co, CT (090019003) | New Haven Co, CT (090099002) | |
| OH | Fairfield Co, CT (090019003) | New Haven Co, CT (090099002) | |
| OK | Tarrant Co, TX (484392003) | Tarrant Co, TX (484393009) | Sheboygan Co, WI (551170006) |
| PA | Fairfield Co, CT (090019003) | New Haven Co, CT (090099002) | |
| TX | Sheboygan Co, WI (551170006) | | |
| VA | Fairfield Co, CT (090019003) | New Haven Co, CT (090099002) | |
| WV | Fairfield Co, CT (090019003) | | |

Table 4-5. Linkages between each upwind states and downwind maintenance-only receptors in the eastern U.S.

| Upwind State | Downwind Maintenance Receptors | | |
|---|---|---|---|
| AR | Allegan Co, MI (260050003) | Harris Co, TX (482011039) | |
| DE | Philadelphia Co, PA (421010024) | | |
| DC | Harford Co, MD (240251001) | | |
| IL | Jefferson Co, KY (211110067) | Harford Co, MD (240251001) | Allegan Co, MI (260050003) |
| | Suffolk Co, NY (361030002) | Hamilton Co, OH (390610006) | Philadelphia Co, PA (421010024) |
| | Harris Co, TX (482011039) | | |
| IN | Fairfield Co, CT (090013007) | Jefferson Co, KY (211110067) | Harford Co, MD (240251001) |
| | Allegan Co, MI (260050003) | Richmond Co, NY (360850067) | Suffolk Co, NY (361030002) |
| | Hamilton Co, OH (390610006) | Philadelphia Co, PA (421010024) | |
| IA | Allegan Co, MI (260050003) | | |
| KS | Allegan Co, MI (260050003) | | |
| KY | Harford Co, MD (240251001) | Richmond Co, NY (360850067) | Hamilton Co, OH (390610006) |
| | Philadelphia Co, PA (421010024) | | |
| LA | Denton Co, TX (481210034) | Harris Co, TX (482010024) | Harris Co, TX (482011034) |
| | Harris Co, TX (482011039) | | |
| MD | Fairfield Co, CT (090010017) | Fairfield Co, CT (090013007) | Richmond Co, NY (360850067) |
| | Suffolk Co, NY (361030002) | Philadelphia Co, PA (421010024) | |
| MI | Fairfield Co, CT (090013007) | Jefferson Co, KY (211110067) | Harford Co, MD (240251001) |

| Upwind State | Downwind Maintenance Receptors | | |
|---|---|---|---|
| | Suffolk Co, NY (361030002) | Hamilton Co, OH (390610006) | |
| MS | Harris Co, TX (482011039) | | |
| MO | Allegan Co, MI (260050003) | Hamilton Co, OH (390610006) | Harris Co, TX (482011034) |
| | Harris Co, TX (482011039) | | |
| NJ | Fairfield Co, CT (090010017) | Fairfield Co, CT (090013007) | Richmond Co, NY (360850067) |
| | Suffolk Co, NY (361030002) | Philadelphia Co, PA (421010024) | |
| NY | Fairfield Co, CT (090010017) | Fairfield Co, CT (090013007) | |
| OH | Fairfield Co, CT (090010017) | Fairfield Co, CT (090013007) | Jefferson Co, KY (211110067) |
| | Harford Co, MD (240251001) | Richmond Co, NY (360850067) | Suffolk Co, NY (361030002) |
| | Philadelphia Co, PA (421010024) | | |
| OK | Allegan Co, MI (260050003) | Denton Co, TX (481210034) | Harris Co, TX (482011034) |
| | Harris Co, TX (482011039) | | |
| PA | Fairfield Co, CT (090010017) | Fairfield Co, CT (090013007) | Harford Co, MD (240251001) |
| | Richmond Co, NY (360850067) | Suffolk Co, NY (361030002) | |
| TN | Hamilton Co, OH (390610006) | Philadelphia Co, PA (421010024) | |
| TX | Harford Co, MD (240251001) | Allegan Co, MI (260050003) | Hamilton Co, OH (390610006) |
| | Philadelphia Co, PA (421010024) | | |
| VA | Fairfield Co, CT (090010017) | Fairfield Co, CT (090013007) | Harford Co, MD (240251001) |
| | Richmond Co, NY (360850067) | Suffolk Co, NY (361030002) | Philadelphia Co, PA (421010024) |
| WV | Fairfield Co, CT (090010017) | Fairfield Co, CT (090013007) | Harford Co, MD (240251001) |

| Upwind State | Downwind Maintenance Receptors | | |
|---|---|---|---|
| | Richmond Co, NY (360850067) | Suffolk Co, NY (361030002) | Hamilton Co, OH (390610006) |
| | Philadelphia Co, PA (421010024) | | |
| WI | Allegan Co, MI (260050003) | | |

*4.5 Corroboration of Upwind/Downwind Linkages*

As a corollary analysis to the source apportionment air quality modeling used in this rule to establish upwind state-to-downwind nonattainment “linkages”, EPA used a technique involving independent meteorological inputs to examine the general plausibility of these linkages. Using the HYSPLIT (HYbrid Single-Particle Lagrangian Integrated Trajectory) model along with observation-based meteorological wind fields, EPA created air flow back trajectories for each of the 19 nonattainment or maintenance-only receptors on days with a measured exceedance in 2011 and in several other recent high ozone years (i.e., 2005, 2007, 2010, and 2012) at each of these sites. One focus of this analysis was on trajectories for exceedance days occurring in 2011, since this was the year of meteorology that was used for air quality modeling to support this rule. The results of this analysis indicate that for each receptor, back trajectories on certain exceedance days in 2011 passed over a portion of each upwind state linked to that receptor. This finding generally corroborates the linkages modeled for the final CSAPR Update.

A second focus of this analysis was to examine year-to-year differences in transport patterns over the multi-year time period. For this purpose we examined trajectories for exceedance days occurring in 2005, 2007, 2010, and 2012 which are other recent years with high ozone concentrations in the eastern U.S. Looking at these years collectively, EPA finds that for each receptor, the back trajectories crossed over a portion of each upwind state linked to the receptor upstream of days with measured exceedances at the receptor site. This finding suggests that the linkages established for this rule using the source-apportionment modeling with 2011 meteorology are robust with respect to the use of different meteorological years. Thus, the results of the trajectory analysis corroborate and add confidence to the upwind/downwind linkages in the final CSAPR Update. In addition, comparing the back trajectories on exceedance day in 2011 to those in the other four years analyzed indicates that high ozone day transport patterns that occurred in 2011 are generally representative of the most prevalent transport patterns on exceedance days during these other high ozone years. Details of the back trajectory analysis are provided in Appendix E.

## 5. Analysis of Contributions Captured by Various Thresholds

In this section we present a summary of the amount of upwind contribution to each receptor in the eastern U.S. based on the 1 percent of the NAAQS threshold in comparison to the amount of contribution based on two other thresholds: 0.5 percent of the NAAQS and 5 percent of the NAAQS. This analysis is similar to the analysis of alternative thresholds performed for the original CSAPR rulemaking. The concentration associated with each of these thresholds, as used in this analysis, is given in Table 5-1.

Table 5-1. Concentrations associated with thresholds of 0.5 percent, 1 percent, and 5 percent.

| 0.5 Percent Threshold | 1 Percent Threshold | 5 Percent Threshold |
|---|---|---|
| 0.375 ppb | 0.75 ppb | 3.75 ppb |

For the analysis of thresholds we used the 2017 modeled contributions described above in section 4 to calculate several "metrics" (i.e., measures of contribution) for each receptor as listed in Table 5-2. In this table "x" refers to one of the thresholds included in this analysis, namely, 0.5 percent, 1 percent, and 5 percent.

Table 5-2. Contribution metrics used for the analysis of thresholds.

| Threshold Analysis Metrics |
|---|
| In-State Contribution |
| Total Contribution from All Upwind States |
| Upwind Contribution as a Percent of Receptor 2017 Design Value |
| Upwind Contribution as a Percent of Total U.S. Anthropogenic Ozone at the Receptor |
| Number of Upwind States that Contribute at or Above "x" Percent Threshold |
| Total Contribution from Upwind States using a "x" Percent Threshold |
| Percent of Total Upwind Contribution Captured with "x" Percent Threshold |

The method for calculating each of the metrics in Table 5-2 is as follows:

*1. In-State Contribution*

- Amount of contribution from emissions from the state in which the receptor is located.

*2. Total Contribution from All Upwind States*

- Sum of contributions from all upwind states, without consideration of any contribution threshold[23].

*3. Upwind Contribution as a Percent of Receptor 2017 Design Value*

- Ratio of total contribution from all upwind states (metric 2) divided by the design value (As noted above in section 4, the sum of all upwind state contributions, the in-state contribution, and the total contribution from background sources is equivalent to the 2017 average design value.)

*4. Upwind Contribution as a Percent of Total U.S. Anthropogenic Ozone at the Receptor*

- Ratio of total contribution from all upwind states (metric 2) divided by the sum of the in-state contribution (metric 1) and the total upwind state contributions (metric 2), expressed as a percent.

*5. Number of Upwind States that Contribute At or Above "x" Percent Threshold*

- Count of the number of upwind states that contribute amounts at or above the given threshold.

*6. Total Contribution from Upwind States using a "x" Percent Threshold*

- Sum of contributions from all upwind states the individually contribute at or above the given threshold.

*7. Percent of Upwind Contribution Captured with "x" Percent Threshold*

- Total contribution using an "x" percent threshold (metric 5) divided by the total contribution from all upwind states (metric 2), expressed as a percent.

Tables containing the data for each of the metrics for each nonattainment and maintenance receptor identified by this rulemaking at each of the analyzed thresholds are provided in Appendix F.

[23] Note that metrics 1 and 2 do not include contributions from fires, biogenics, offshore sources, or boundary conditions. Therefore, metrics 1 and 2 do not sum to the total average 2017 design value.

The data for metric 2 and metric 4 in Table F-1 indicate that the total amount of transport from all upwind states comprises a very large portion of the 8-hour ozone concentrations at the nonattainment and maintenance receptor sites in the eastern U.S. For example, the modeling results indicate that approximately 90 percent of the U.S. anthropogenic ozone concentration at some of the receptors in the New York City area and at the receptor in Allegan Co., MI is due to transport from upwind states. For the receptor in Sheboygan Co., WI, more than 75 percent of the U.S. anthropogenic ozone concentration is due to transport from upwind states. For receptors in Harford Co., MD, Hamilton Co., OH, Jefferson Co., KY, and Philadelphia Co., PA the portion of ozone that is due to upwind transport is in the range of 50 to 65 percent of anthropogenic ozone concentrations. In Dallas and Houston, transport is 20 to 30 percent of the total anthropogenic ozone at most receptors in these two areas. Thus, the total collective contribution from upwind state's sources represent a significant portion of the ozone concentrations at downwind nonattainment and maintenance receptor locations in the eastern U.S.

The data for metric 6 and metric 7 in Tables F-3 and F-4, respectively, further indicate that 0.5 percent and 5 percent are reasonable lower and upper alternatives for evaluating the 1 percent threshold for several reasons: (1) a 0.5 percent threshold would capture nearly all of the total amount of transport from upwind states at 12 of the 19 receptors (e.g., over 90 percent at seven receptors and between 85 and 90 percent at an additional five receptors), whereas (2) a 5 percent threshold would not capture any upwind transport at the seven receptors in Texas.

The data in Appendix F confirm that a 1 percent threshold is appropriate to identify those upwind states subject to further analysis for this final rule in that this threshold captures a significantly greater percentage of the total amount of upwind transport at most of the receptors compared to a 5 percent threshold (see metric 7 in Table F-4) while also capturing nearly all of the upwind transport that would be captured with a 0.5 percent threshold at most of receptors (see Table F-5). Specifically, the data for metric 7 in Table F-4 show that the 1 percent threshold captures between 34 percent and 64 percent of total upwind transport at the receptors in Texas that would be completely ignored with the higher 5 percent threshold. Because the percent of total upwind transport captured at a particular threshold declines as the threshold increases, thresholds between 1 and 5 percent (e.g., 2 and 3 percent) would also be expected to capture less of the total upwind transport at each receptor, particularly at the Texas receptors. In addition, the data in Table F-5 shows that the 1 percent threshold captures over 90 percent of the total upwind transport that would be captured by a lower 0.5 percent threshold at nine receptors and between 85 and 90 percent of total transport that would captured by a 0.5 percent threshold at an additional five receptors. Although a lower 0.5 percent threshold would provide relatively modest increases in the overall percentage of ozone transport captured, the data for metric 5 in Table F-2 show that the lower threshold would result in significantly more linkages and would potentially add more states than the 1 percent threshold. The EPA does not believe that the additional upwind transport captured at this lower threshold is sufficient to merit linking additional upwind states because the air quality benefits would be limited. Thus, a 1 percent threshold provides an appropriate balance between alternative higher and lower thresholds.

In view of results of this analysis it is unlikely that examining other alternative thresholds beyond or between 0.5 percent and 5 percent would lead to a different conclusion that 1 percent is the appropriate threshold for this final rule. Further interpretation of the contribution summaries presented in Tables F-1 through F-5 with respect to decisions on the selection of thresholds for the final rule can be found in section IV.B.3 of the final rule preamble.

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# Appendix A

# Analysis of Meteorology in 2011

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This appendix contains (1) tabular summaries of average temperature anomalies based on observed data for May through September by climate region for the 2005 through July 2016, (2) maps of the June through August statewide temperature and precipitation ranks and anomalies for the 2005 through July 2016, and (3) graphical summaries of the total number of cooling degree days for June, July, and August in each climate region of the eastern U.S. (i.e., Northeast, Ohio Valley, Upper Midwest, Southeast, and South) for the period 1990 through 2015.

Table A-1. Temperature anomalies by month for May through September for each climate region for the years 2005 through 2016.

| 2005 | May | Jun | Jul | Aug | Sep |
|---|---|---|---|---|---|
| Northeast | CC | WW | W | WW | WW |
| Southeast | CC | N | W | WW | W |
| Ohio Valley | C | W | W | W | W |
| Upper Midwest | C | WW | W | N | WW |
| South | C | W | N | N | WW |
| Northern Rockies | C | N | W | N | W |
| Southwest | W | N | W | N | W |
| Northwest | W | C | WW | W | N |
| West | W | C | WW | W | N |

Unshaded boxes with the "N" marker represent near-normal temperatures that fall within the interquartile range. Blue colors indicate cooler than normal conditions, with the number of "C"s indicating the degree of the anomaly. CCC = coolest on record, CC = coolest 10th percentile, C = coolest 25th percentile. Red colors indicate warmer than normal conditions, with the number of "W"s indicating the degree of the anomaly. WWW = warmest on record, WW = warmest 10th percentile, W = warmest 25th percentile. N/A = data not available.

| 2006 | May | Jun | Jul | Aug | Sep |
|---|---|---|---|---|---|
| Northeast | N | W | WW | N | N |
| Southeast | N | N | W | WW | N |
| Ohio Valley | C | N | W | W | C |
| Upper Midwest | W | N | WW | W | C |
| South | W | W | W | N | C |
| Northern Rockies | W | W | WW | W | N |
| Southwest | WW | W | WW | N | CC |
| Northwest | W | WW | WW | N | N |
| West | W | WW | WWW | N | N |

| 2007 | May | Jun | Jul | Aug | Sep |
|---|---|---|---|---|---|
| Northeast | W | W | C | W | W |
| Southeast | N | N | C | WWW | W |
| Ohio Valley | W | W | C | WW | W |
| Upper Midwest | W | W | N | W | W |
| South | N | C | CC | W | W |
| Northern Rockies | W | W | WW | W | W |
| Southwest | W | W | WW | WWW | W |
| Northwest | W | W | WWW | N | N |
| West | W | W | WW | WW | N |

| 2008 | May | Jun | Jul | Aug | Sep |
|---|---|---|---|---|---|
| Northeast | C | W | W | C | N |
| Southeast | C | WW | N | C | N |
| Ohio Valley | C | W | C | C | N |
| Upper Midwest | C | N | N | N | W |
| South | N | W | N | C | CC |
| Northern Rockies | C | C | N | N | N |
| Southwest | N | W | W | W | N |
| Northwest | N | N | W | W | N |
| West | N | W | W | WW | W |

| 2009 | May | Jun | Jul | Aug | Sep |
|---|---|---|---|---|---|
| Northeast | N | C | CC | W | C |
| Southeast | N | W | CC | N | N |
| Ohio Valley | N | W | CC | C | N |
| Upper Midwest | N | C | CC | C | W |
| South | N | W | N | N | C |
| Northern Rockies | N | C | C | C | WW |
| Southwest | WW | C | W | W | W |
| Northwest | W | C | WW | W | WW |
| West | WW | C | W | N | WWW |

| 2010 | May | Jun | Jul | Aug | Sep |
|---|---|---|---|---|---|
| Northeast | WW | W | WW | W | W |
| Southeast | WW | WW | WW | WW | W |
| Ohio Valley | W | WW | W | WW | N |
| Upper Midwest | W | N | W | WW | C |
| South | W | WW | N | WW | W |
| Northern Rockies | C | N | N | W | N |
| Southwest | C | W | W | W | WWW |
| Northwest | CC | C | N | N | W |
| West | CC | W | W | N | W |

| 2011 | May | Jun | Jul | Aug | Sep |
|---|---|---|---|---|---|
| Northeast | W | W | WW | N | WW |
| Southeast | N | WW | WW | WW | N |
| Ohio Valley | N | W | WW | W | C |
| Upper Midwest | N | N | WW | W | N |
| South | N | WW | WWW | WWW | N |
| Northern Rockies | C | N | W | W | W |
| Southwest | C | W | WW | WWW | W |
| Northwest | CC | C | C | W | WW |
| West | C | C | N | W | WW |

| 2012 | May | Jun | Jul | Aug | Sep |
|---|---|---|---|---|---|
| Northeast | WW | N | WW | W | N |
| Southeast | WW | C | WW | N | N |
| Ohio Valley | WW | N | WW | N | C |
| Upper Midwest | W | W | WW | N | N |
| South | WW | W | WW | N | N |
| Northern Rockies | W | W | WW | W | W |
| Southwest | WW | WW | W | WW | W |
| Northwest | N | C | W | WW | W |
| West | W | W | N | WWW | WW |

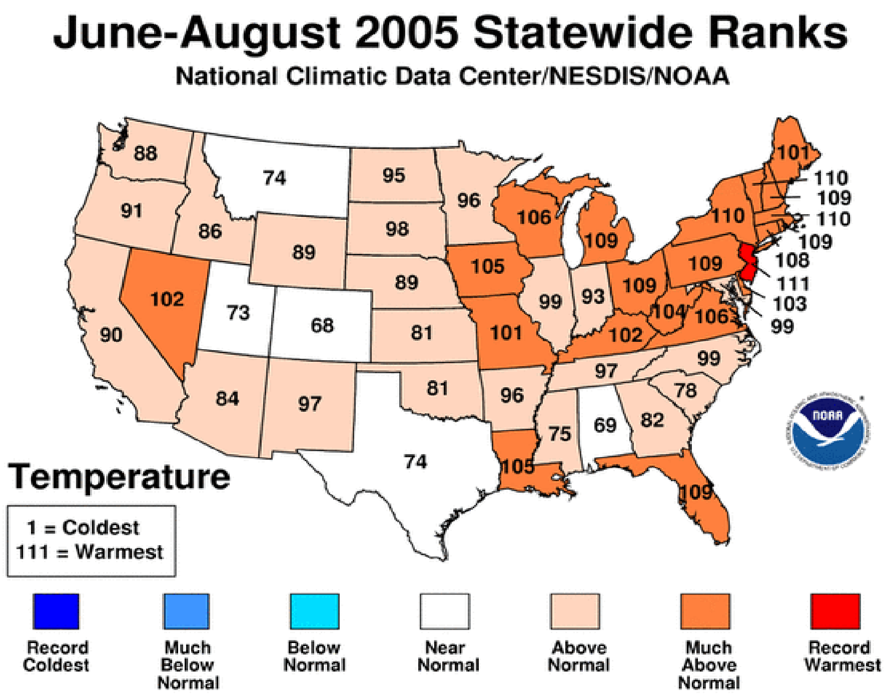
| 2013 | May | Jun | Jul | Aug | Sep |
|---|---|---|---|---|---|
| Northeast | W | W | WW | N | N |
| Southeast | C | W | C | C | N |
| Ohio Valley | N | N | C | C | N |
| Upper Midwest | N | N | N | N | W |
| South | C | W | C | N | W |
| Northern Rockies | N | N | N | W | WW |
| Southwest | W | WW | W | W | W |
| Northwest | W | W | WW | WW | WW |
| West | W | WW | WW | N | W |

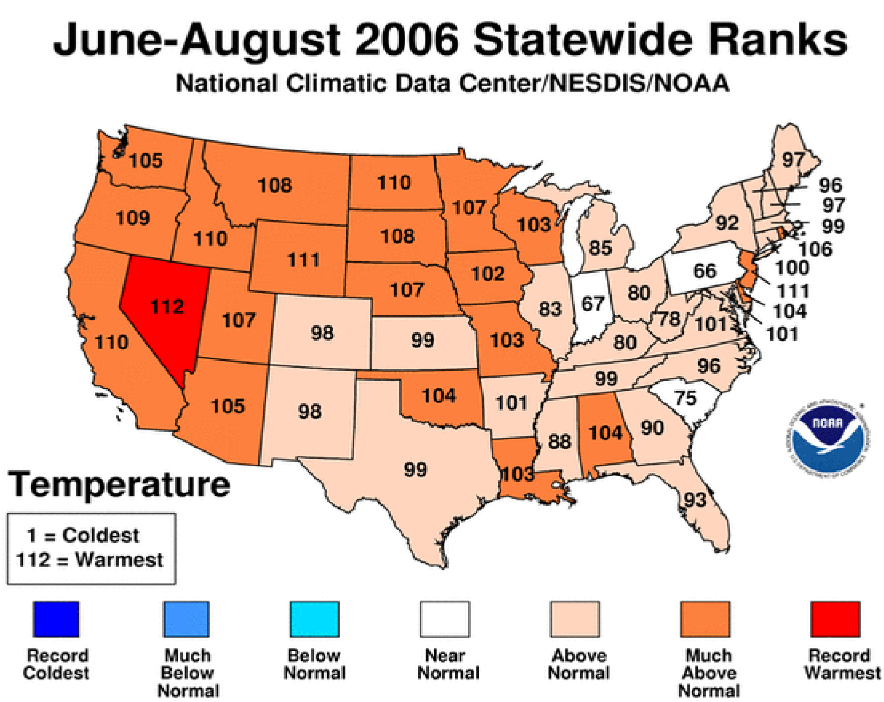
| 2014 | May | Jun | Jul | Aug | Sep |
|---|---|---|---|---|---|
| Northeast | W | W | N | N | W |
| Southeast | W | W | C | N | W |
| Ohio Valley | N | W | CC | N | N |
| Upper Midwest | N | W | CC | N | N |
| South | N | N | C | N | N |
| Northern Rockies | N | C | N | N | N |
| Southwest | N | W | W | C | WW |
| Northwest | W | N | WW | W | W |
| West | W | W | WW | N | WW |

| 2015 | May | Jun | Jul | Aug | Sep |
|---|---|---|---|---|---|
| **Northeast** | WWW | N | N | W | WW |
| **Southeast** | W | WW | W | N | N |
| **Ohio Valley** | W | W | N | C | W |
| **Upper Midwest** | N | N | N | N | WWW |
| **South** | C | N | W | N | WW |
| **Northern Rockies** | C | WW | N | N | WW |
| **Southwest** | C | WW | C | WW | WWW |
| **Northwest** | W | WWW | W | W | N |
| **West** | N | WWW | C | WW | WW |

| 2016 | May | Jun | Jul | Aug | Sep |
|---|---|---|---|---|---|
| **Northeast** | N | W | W | N/A | N/A |
| **Southeast** | N | W | WW | N/A | N/A |
| **Ohio Valley** | N | W | W | N/A | N/A |
| **Upper Midwest** | N | W | N | N/A | N/A |
| **South** | C | W | WW | N/A | N/A |
| **Northern Rockies** | N | WW | N | N/A | N/A |
| **Southwest** | C | WWW | WW | N/A | N/A |
| **Northwest** | W | WW | C | N/A | N/A |
| **West** | N | WW | W | N/A | N/A |

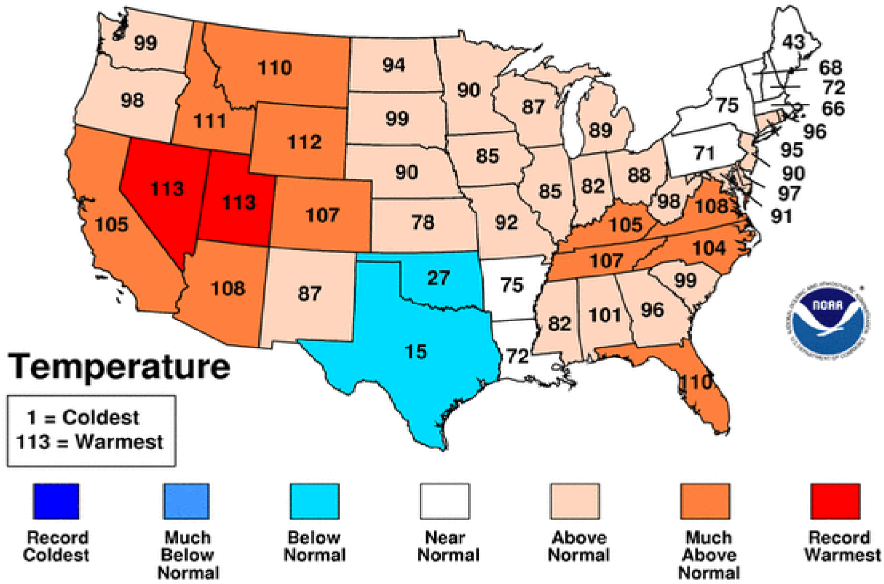
Figure A-1. Statewide average temperature ranks for the period June through August for the years 2005 through 2016 (data for 2016 are only available for June and July).



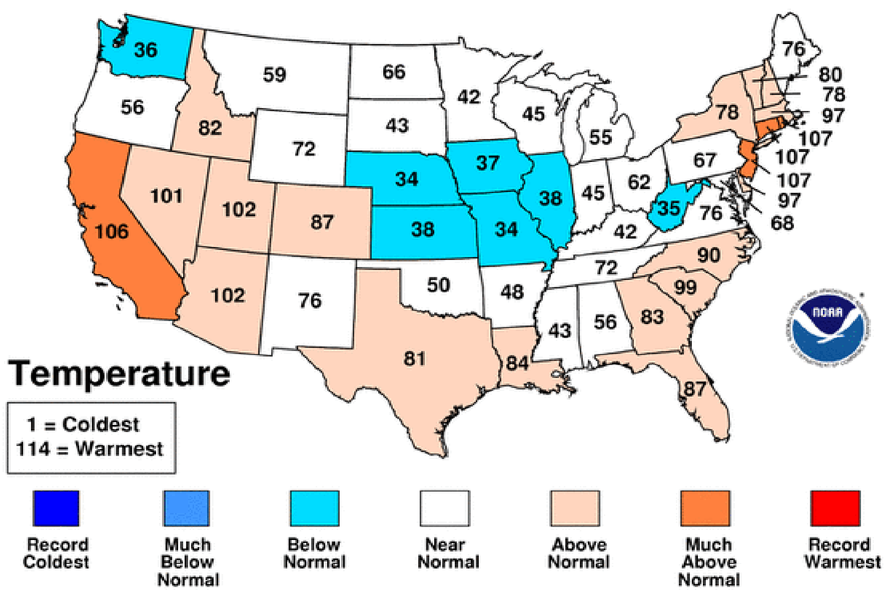
## June-August 2007 Statewide Ranks

National Climatic Data Center/NESDIS/NOAA



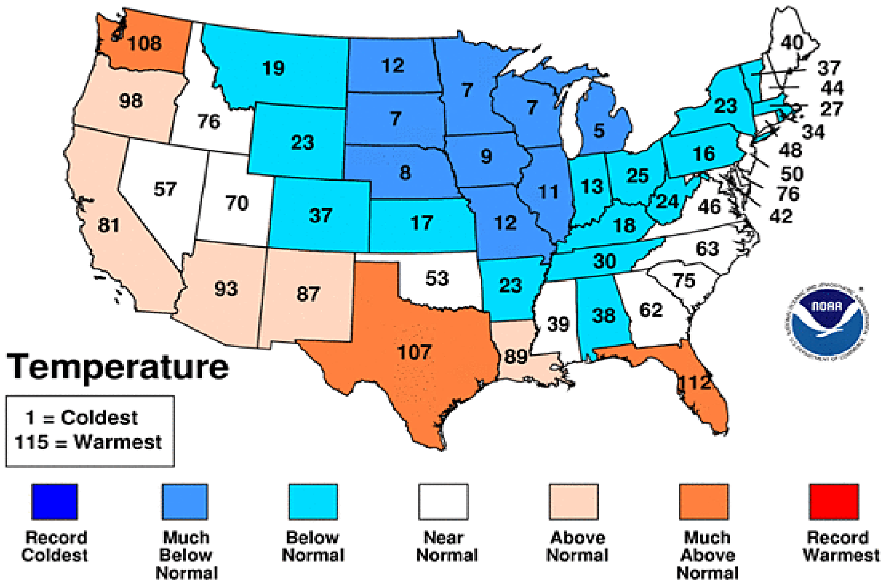

## June-August 2008 Statewide Ranks

National Climatic Data Center/NESDIS/NOAA



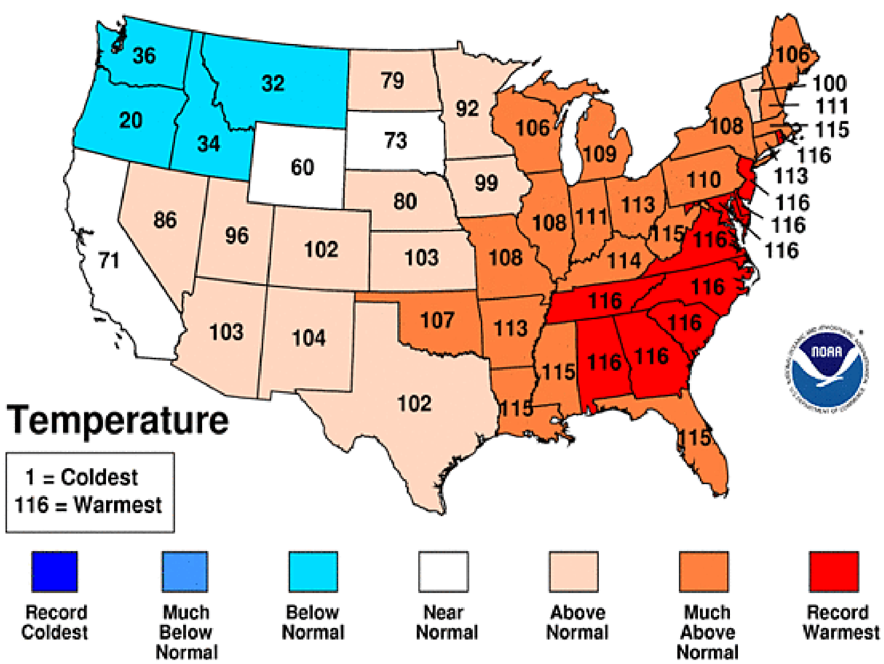
# June-August 2009 Statewide Ranks

National Climatic Data Center/NESDIS/NOAA




# June-August 2010 Statewide Ranks

National Climatic Data Center/NESDIS/NOAA



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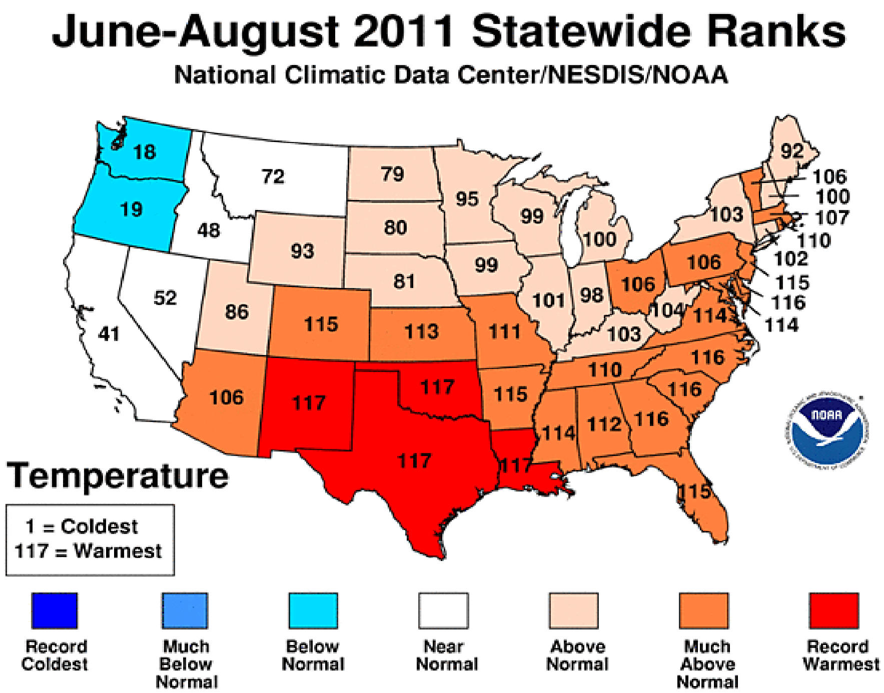


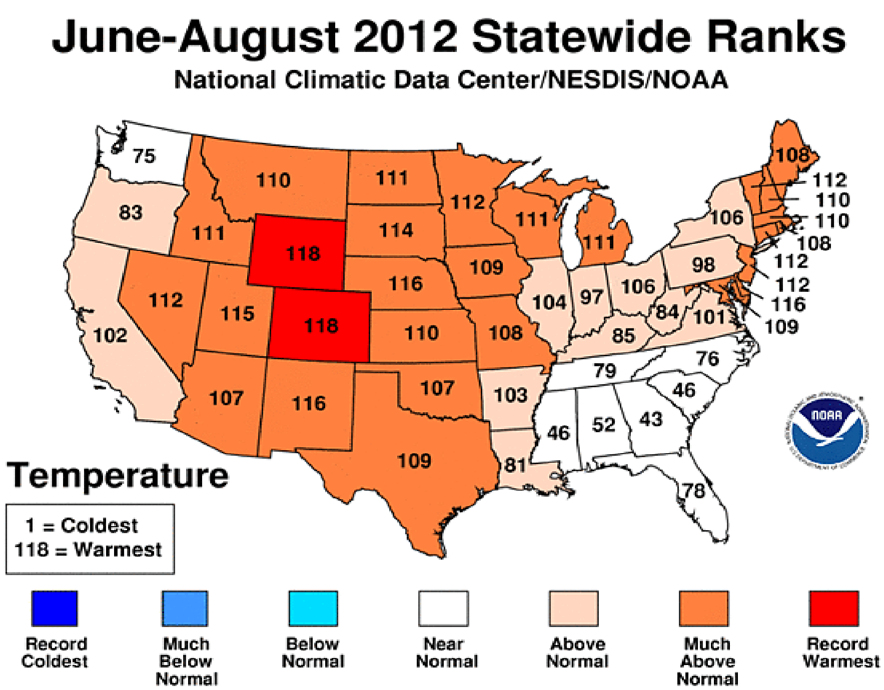




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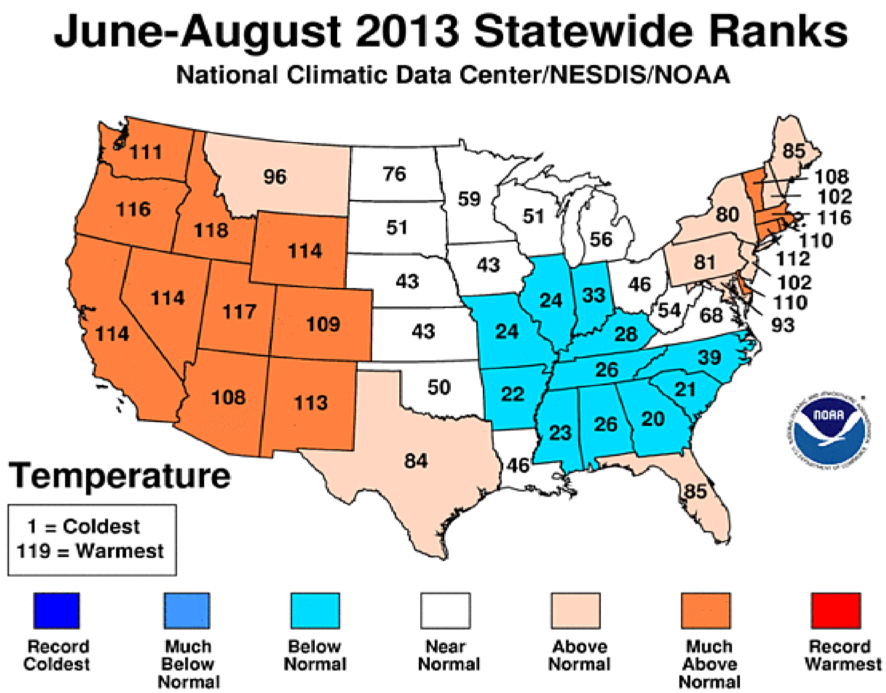
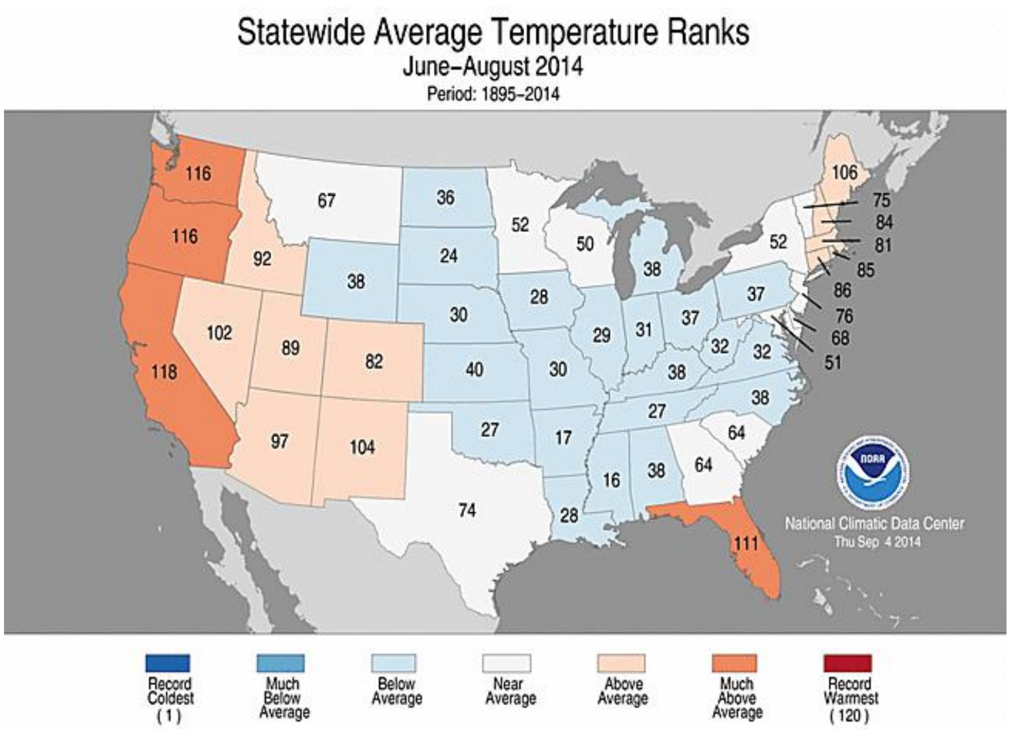
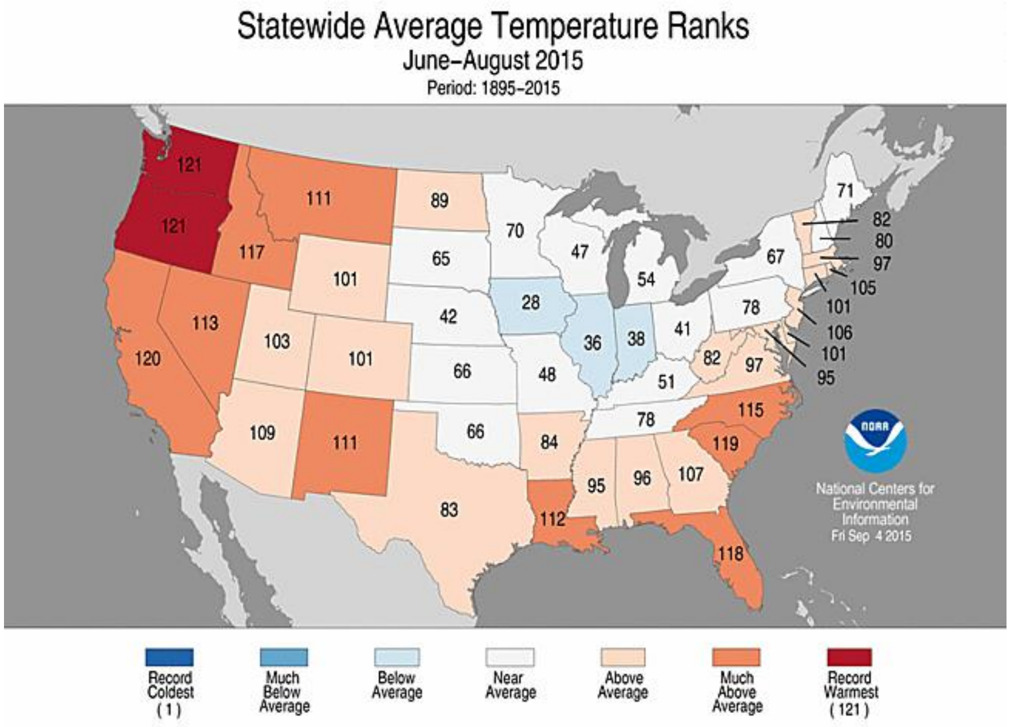
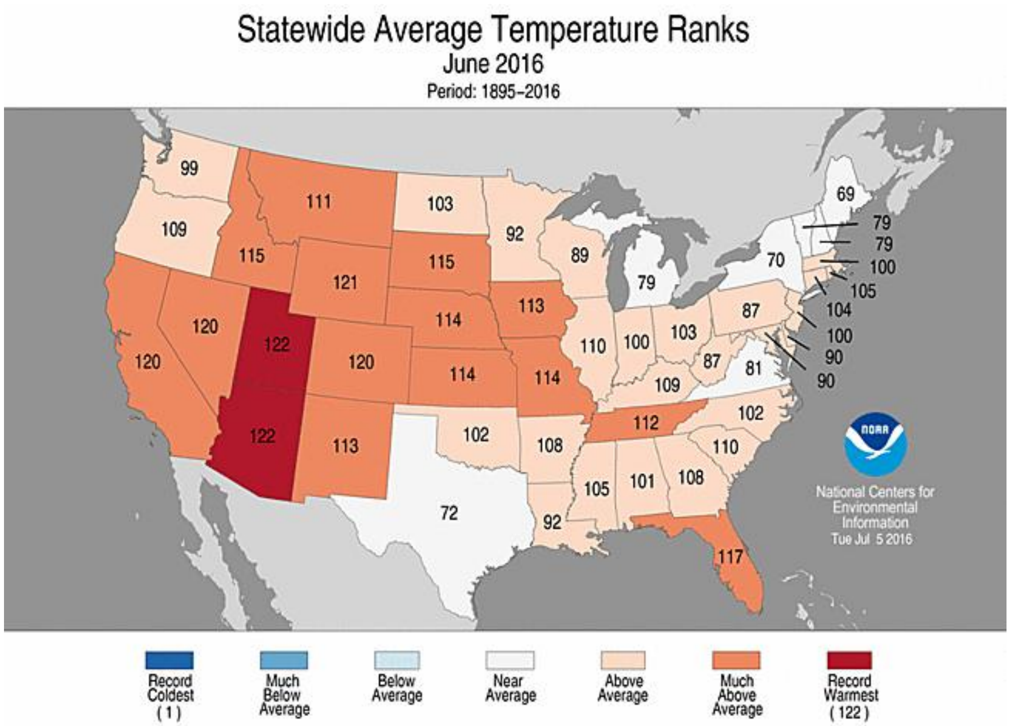

June-August 2013 Statewide Ranks
National Climatic Data Center/NESDIS/NOAA
111
96
76
59
51
56
85
108
102
116
110
112
102
110
93
80
81
116
118
114
51
43
43
46
24
33
54
68
28
114
117
109
43
24
39
114
26
21
108
113
50
22
20
23
26
84
46
85
Temperature
1 = Coldest
119 = Warmest
Record Coldest
Much Below Normal
Below Normal
Near Normal
Above Normal
Much Above Normal
Record Warmest


Statewide Average Temperature Ranks
June–August 2014
Period: 1895–2014
116
67
36
52
50
106
75
84
81
85
116
92
24
38
52
38
86
76
68
51
38
28
37
30
37
29
31
102
89
82
32
32
40
30
38
118
38
27
27
64
97
104
17
16
38
64
74
28
111
National Climatic Data Center
Thu Sep 4 2014
Record Coldest (1)
Much Below Average
Below Average
Near Average
Above Average
Much Above Average
Record Warmest (120)



Statewide Average Temperature Ranks
June–August 2015
Period: 1895–2015
121
121
111
89
70
47
71
82
80
97
105
117
101
65
54
67
101
113
42
28
78
106
103
101
36
38
41
101
120
66
48
51
82
97
95
115
109
111
66
84
78
119
95
96
107
83
112
118
National Centers for Environmental Information
Fri Sep 4 2015
Record Coldest (1)
Much Below Average
Below Average
Near Average
Above Average
Much Above Average
Record Warmest (121)

Statewide Average Temperature Ranks
June 2016
Period: 1895–2016
99
111
103
69
109
92
79
115
89
79
121
115
70
100
79
105
120
113
104
122
114
87
100
120
110
100
103
90
120
114
114
87
81
90
109
102
112
122
113
102
108
110
105
101
108
72
92
117
National Centers for Environmental Information
Tue Jul 5 2016
Record Coldest (1)
Much Below Average
Below Average
Near Average
Above Average
Much Above Average
Record Warmest (122)

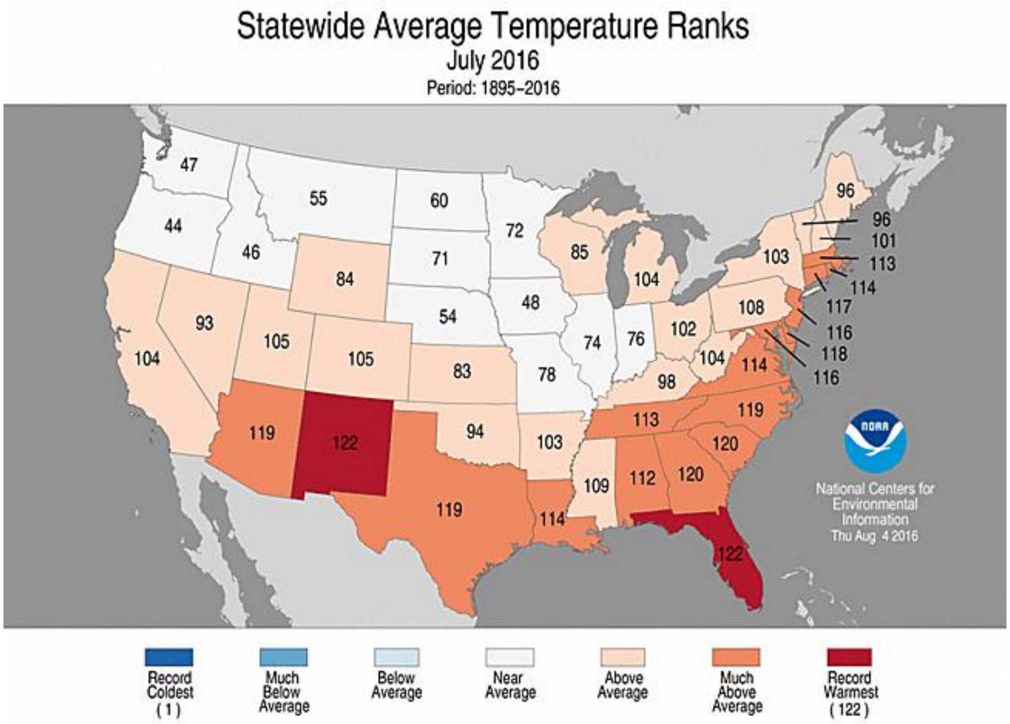





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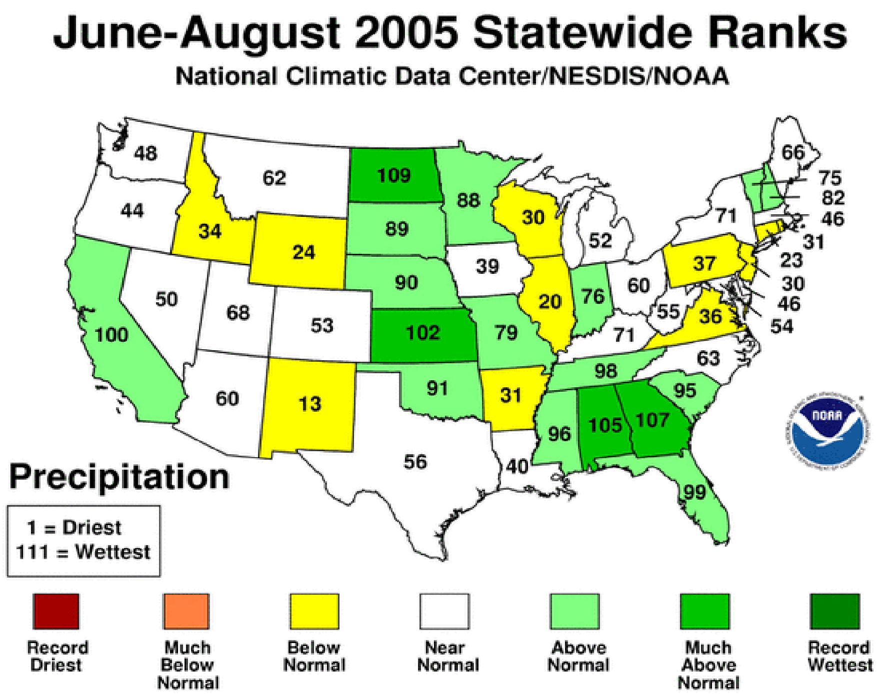
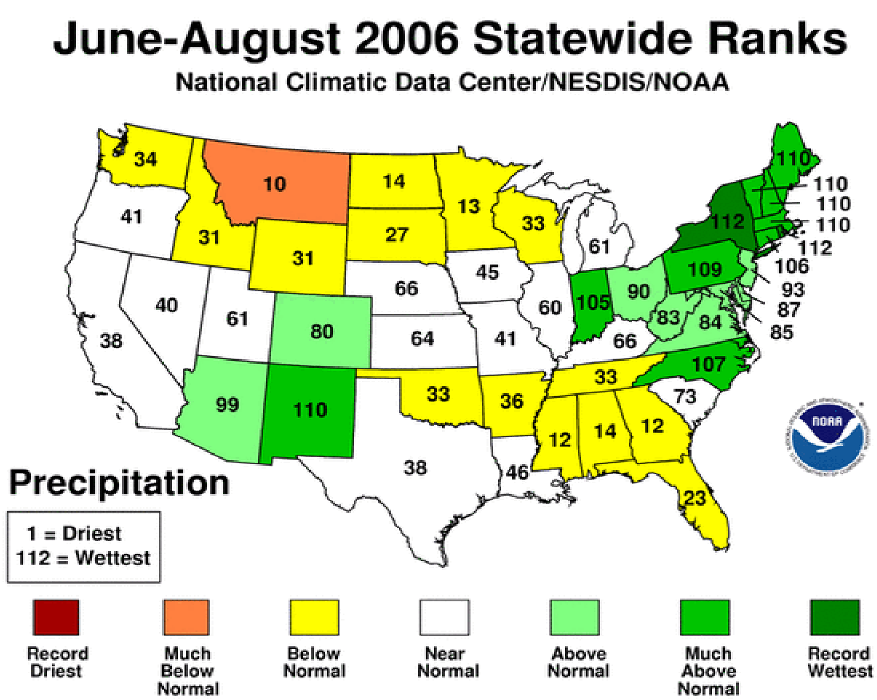
Figure A-2. Statewide average precipitation ranks for the period June through August for the years 2005 through 2016 (data for 2016 are only available for June and July).



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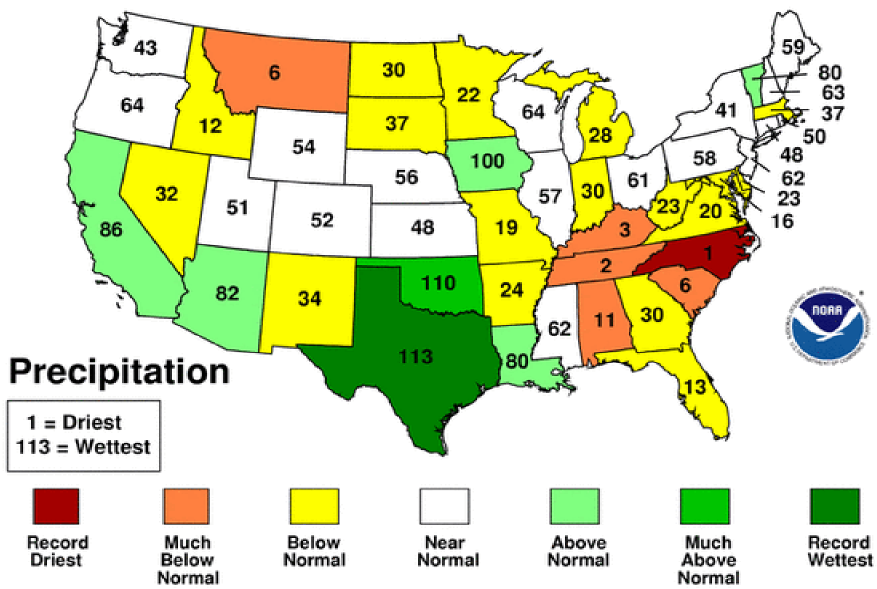
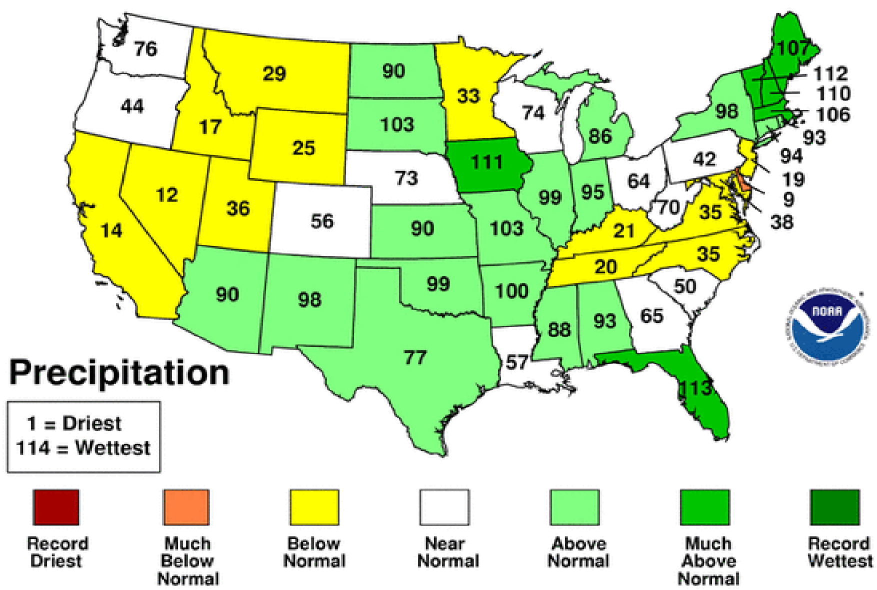
## June-August 2007 Statewide Ranks

National Climatic Data Center/NESDIS/NOAA




## June-August 2008 Statewide Ranks

National Climatic Data Center/NESDIS/NOAA

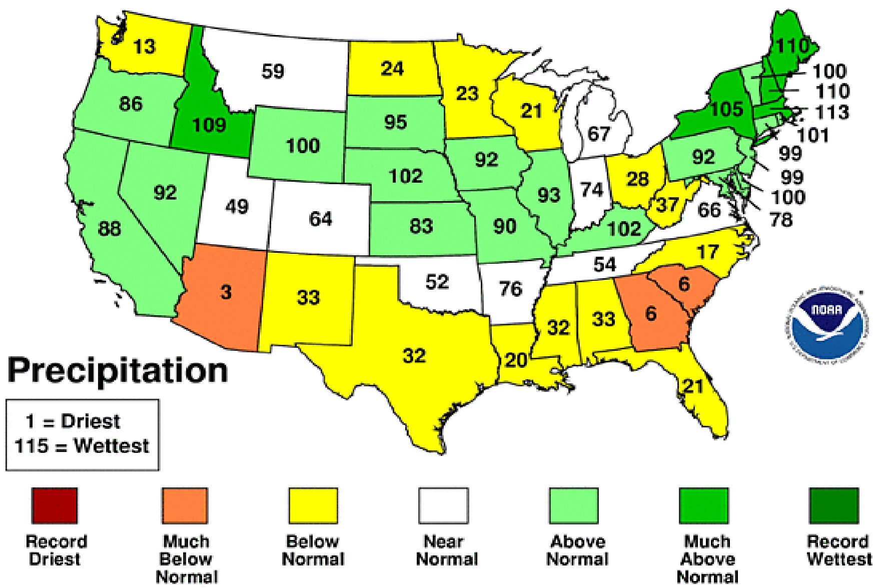





NMED Exhibit 9g

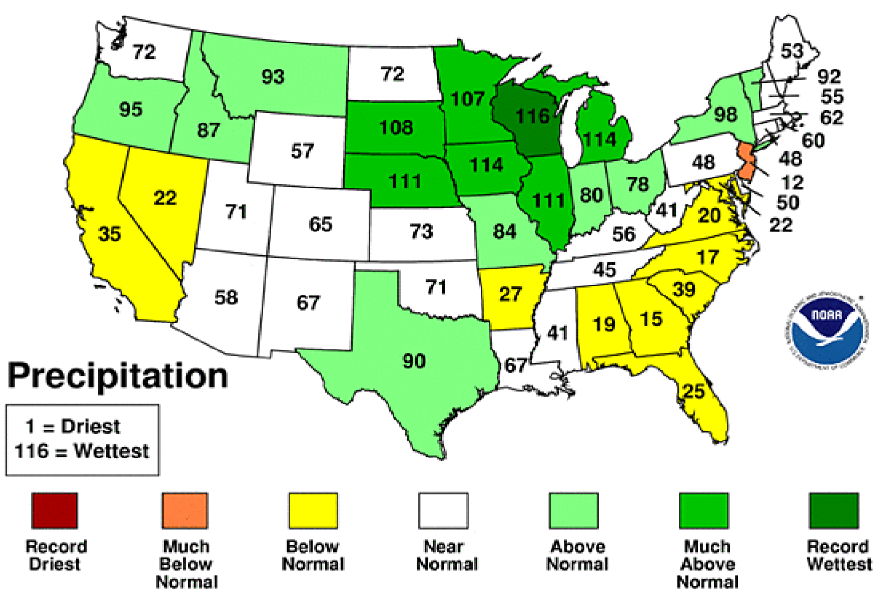
# June-August 2009 Statewide Ranks

National Climatic Data Center/NESDIS/NOAA




# June-August 2010 Statewide Ranks

National Climatic Data Center/NESDIS/NOAA

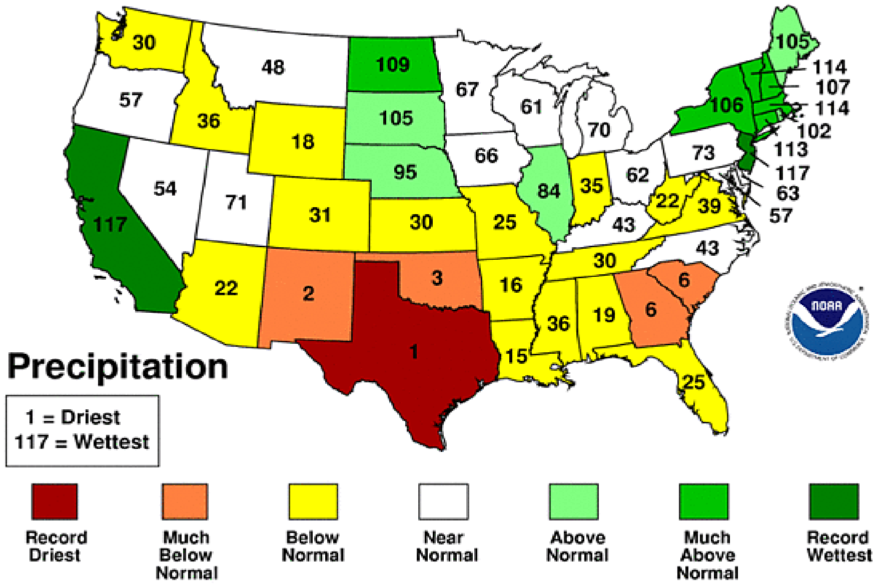





NMED Exhibit 9g

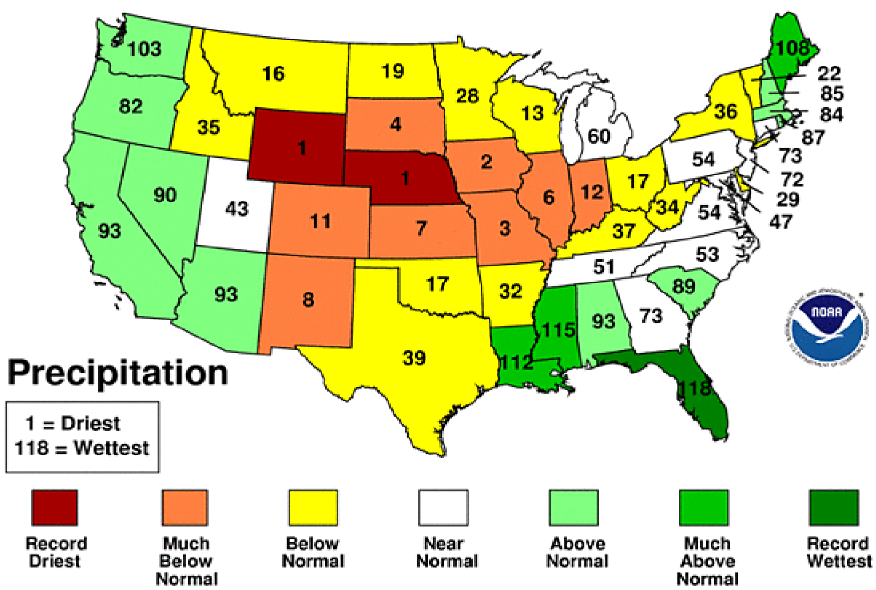
## June-August 2011 Statewide Ranks

National Climatic Data Center/NESDIS/NOAA




## June-August 2012 Statewide Ranks

National Climatic Data Center/NESDIS/NOAA



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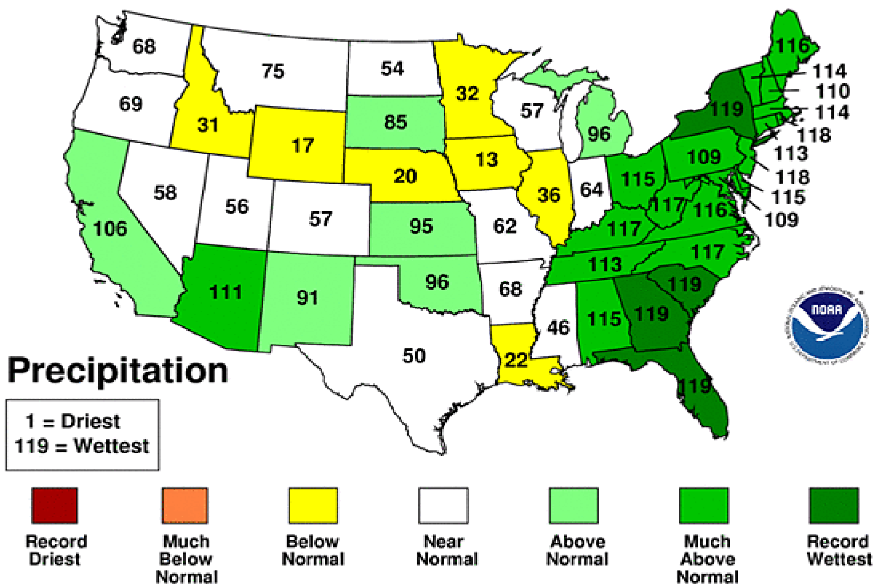
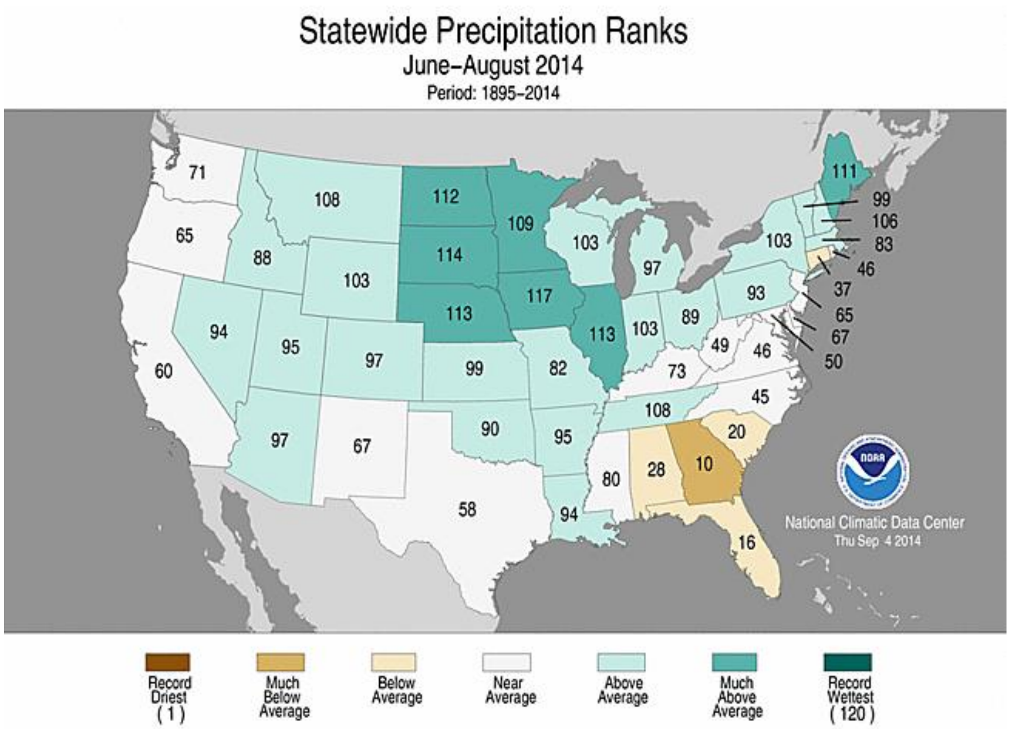
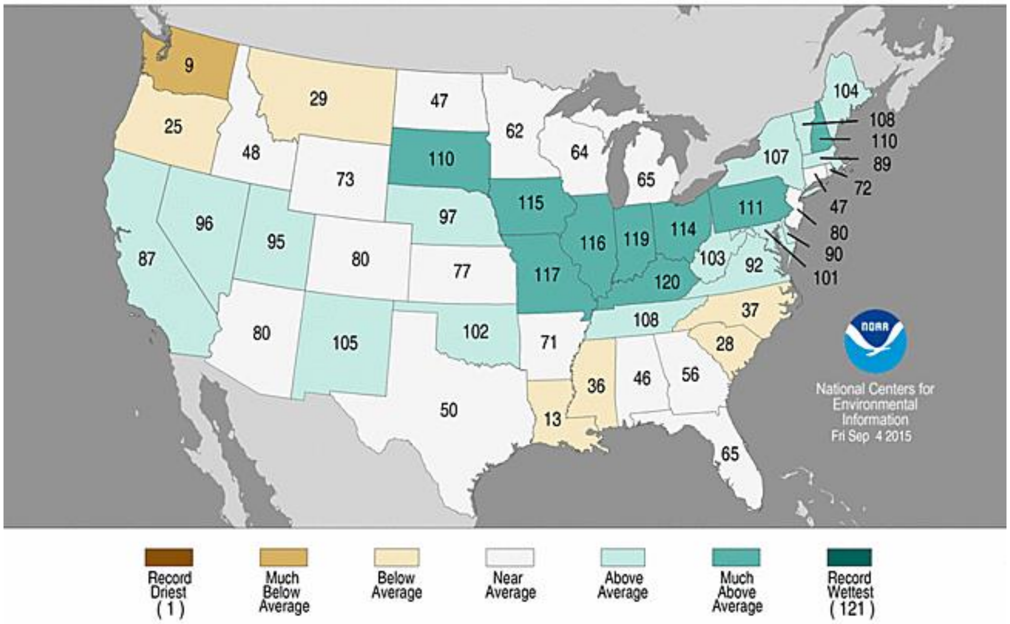
# June-August 2013 Statewide Ranks

National Climatic Data Center/NESDIS/NOAA

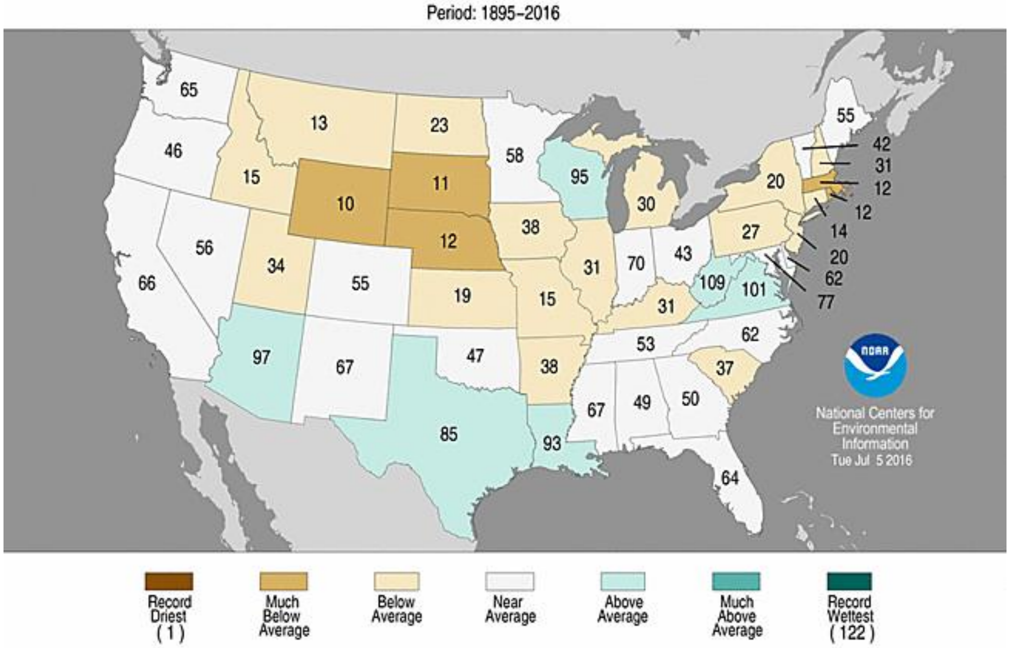


## Statewide Precipitation Ranks
June–August 2015
Period: 1895–2015




## Statewide Precipitation Ranks
June 2016
Period: 1895–2016



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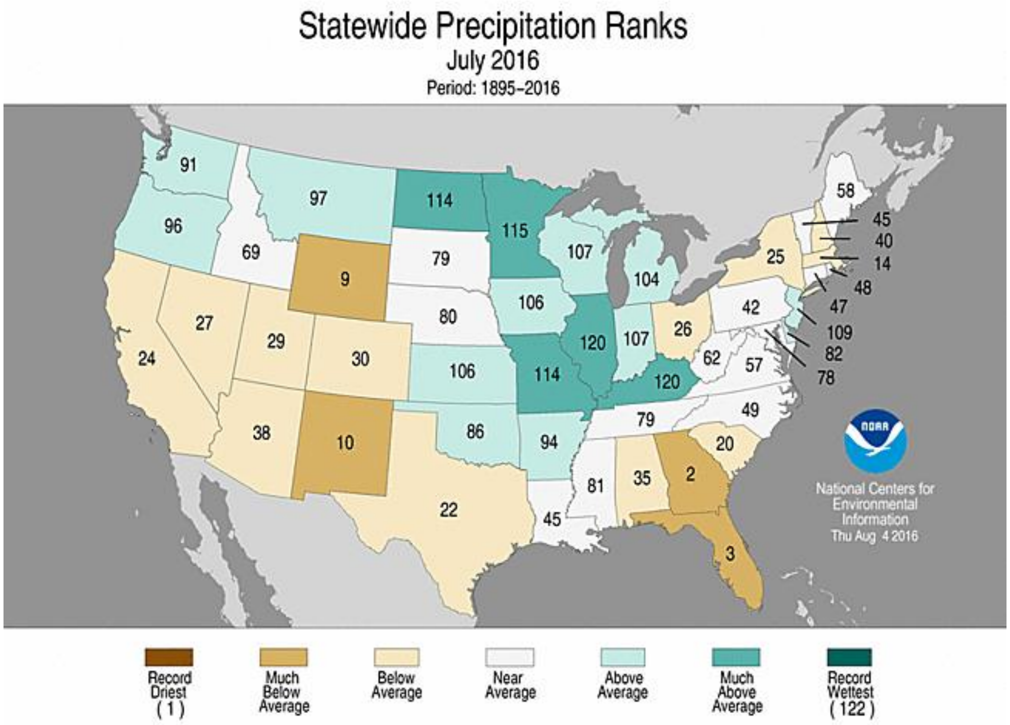




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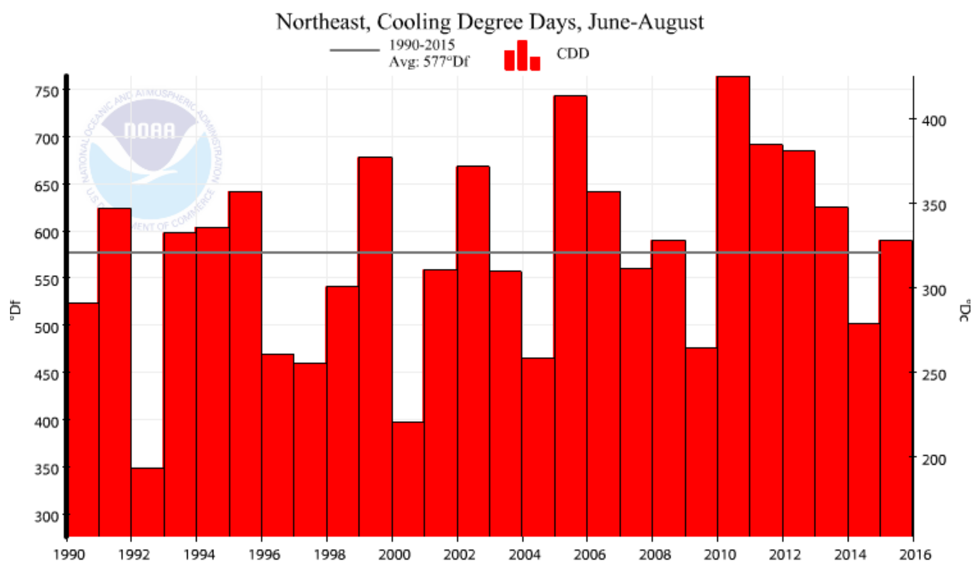
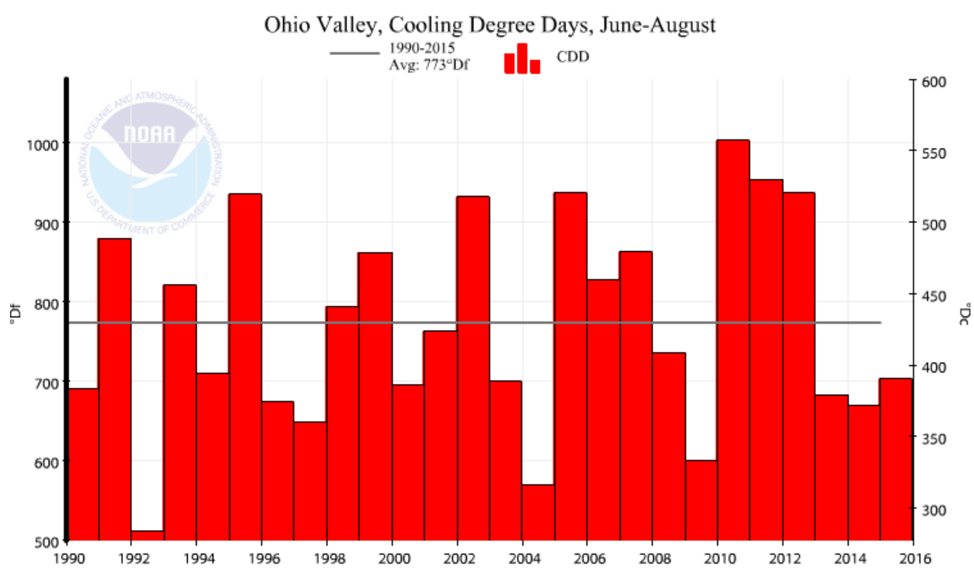
Figure A-3. Cooling degree days for June through August from 1990 through 2015 for each climate region in the eastern U.S. (i.e., the Northeast, Ohio Valley, Upper Midwest, Southeast, and South climate regions). Note that the range of the y-axis differs by climate region.



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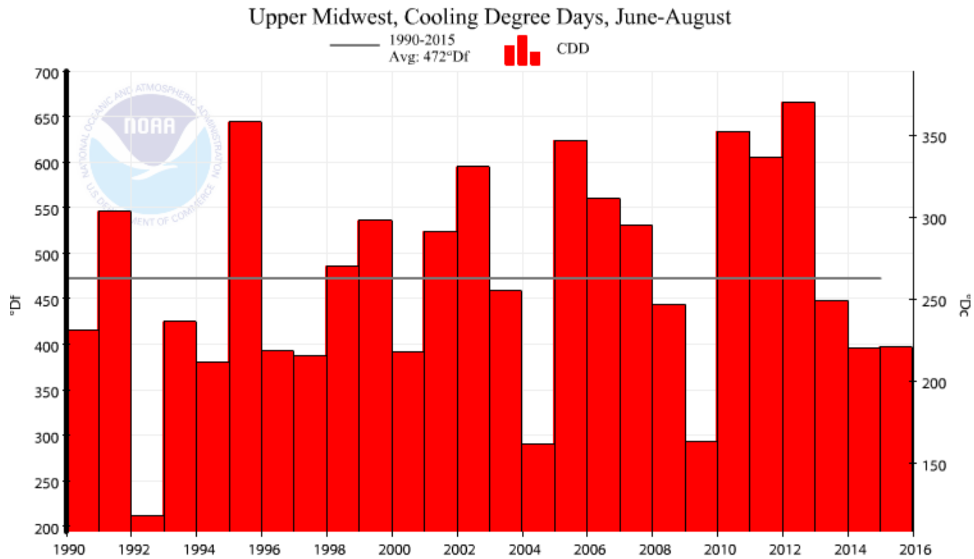
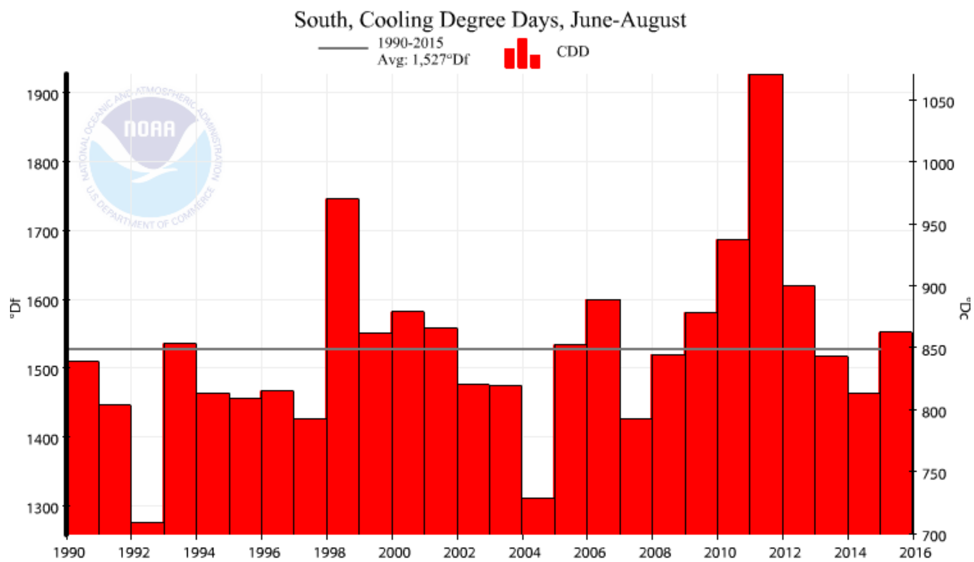

Upper Midwest, Cooling Degree Days, June-August
1990-2015
Avg: 472°Df
CDD
°Df
°Dc
700
650
600
550
500
450
400
350
300
250
200
350
300
250
200
150
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016


South, Cooling Degree Days, June-August
1990-2015
Avg: 1,527°Df
CDD
°Df
°Dc
1900
1800
1700
1600
1500
1400
1300
1050
1000
950
900
850
800
750
700
1990
1992
1994
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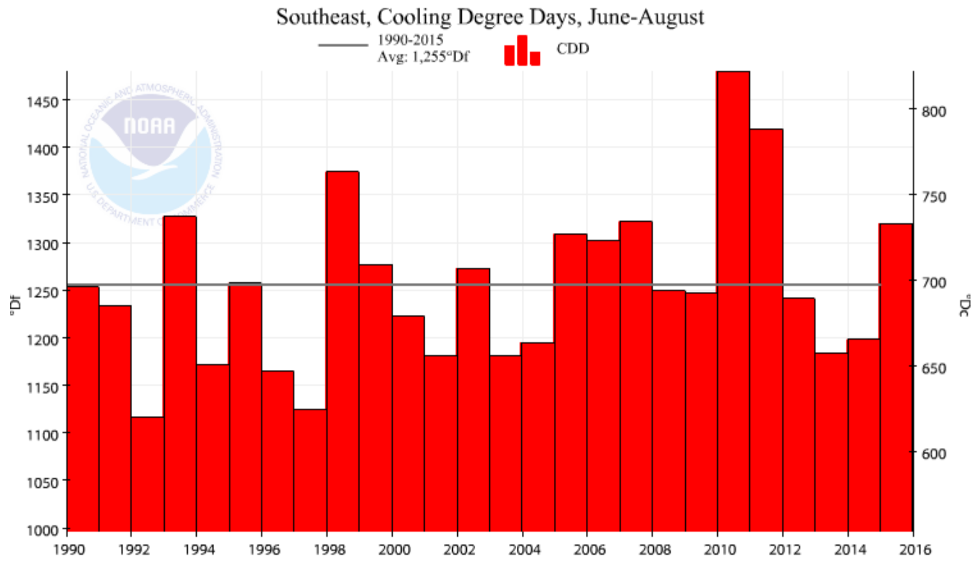
2008
2010
2012
2014
2016



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# Appendix B

# 2011 Model Performance Evaluation

An operational model evaluation was conducted for the 2011 base year CAMx v6.20 model simulation performed for the 12 km U.S. modeling domain. The purpose of this evaluation is to examine the ability of the 2011 air quality modeling platform to represent the magnitude and spatial and temporal variability of measured (i.e., observed) ozone concentrations within the modeling domain. The evaluation presented here is based on model simulations using the v6.3 version of the 2011 emissions platform (i.e., case name 2011ek_cb6v2_v6_11g). The model evaluation for ozone focuses on comparisons of model predicted 8-hour daily maximum concentrations to the corresponding observed data at monitoring sites in the EPA Air Quality System (AQS) and the Clean Air Status and Trends Network (CASTNet). The locations of the ozone monitoring sites in these two networks are shown in Figures A-1a and A-1b.

Included in the evaluation are statistical measures of model performance based upon model-predicted versus observed concentrations that were paired in space and time. Model performance statistics were calculated for several spatial scales and temporal periods. Statistics were calculated for individual monitoring sites, and in aggregate for monitoring sites within each state and within each of nine climate regions of the 12 km U.S. modeling domain. The regions include the Northeast, Ohio Valley, Upper Midwest, Southeast, South, Southwest, Northern Rockies, Northwest and West[1,2], which are defined based upon the states contained within the National Oceanic and Atmospheric Administration (NOAA) climate regions (Figure A-2)[3] as defined in Karl and Koss (1984).

[1] The nine climate regions are defined by States where: Northeast includes CT, DE, ME, MA, MD, NH, NJ, NY, PA, RI, and VT; Ohio Valley includes IL, IN, KY, MO, OH, TN, and WV; Upper Midwest includes IA, MI, MN, and WI; Southeast includes AL, FL, GA, NC, SC, and VA; South includes AR, KS, LA, MS, OK, and TX; Southwest includes AZ, CO, NM, and UT; Northern Rockies includes MT, NE, ND, SD, WY; Northwest includes ID, OR, and WA; and West includes CA and NV.

[2] Note most monitoring sites in the West region are located in California (see Figures 2A-2a and 2A-2b), therefore statistics for the West will be mostly representative of California ozone air quality.

[3] NOAA, National Centers for Environmental Information scientists have identified nine climatically consistent regions within the contiguous U.S., http://www.ncdc.noaa.gov/monitoring-references/maps/us-climate-regions.php.

For maximum daily average 8-hour (MDA8) ozone, model performance statistics were created for the period May through September.[4] The aggregate statistics by state and by climate region are presented and in this appendix. Model performance statistics by monitoring site for MDA8 ozone based on days with observed values $\geq$ 60 ppb can be found in the docket in the file named "Final CSAPR Update 2011 Ozone Model Performance Statistics by Site". Performance statistics by site calculated for days with observed values $\geq$ 75 ppb can be found in the docket in the file "Supplemental 2011 O3 Model Performance Statistics_Final CSAPR Update".

In addition to the above performance statistics, we prepared several graphical presentations of model performance for MDA8 ozone. These graphical presentations include:

(1) density scatter plots of observed AQS data and predicted MDA8 ozone concentrations for May through September;

(2) regional maps that show the mean bias and error as well as normalized mean bias and error calculated for MDA8 ≥ 60 ppb for May through September at individual AQS and CASTNet monitoring sites;

(3) bar and whisker plots that show the distribution of the predicted and observed MDA8 ozone concentrations by month (May through September) and by region and by network; and

(4) time series plots (May through September) of observed and predicted MDA8 ozone concentrations for the 19 projected 2017 nonattainment and maintenance-only sites.

The Atmospheric Model Evaluation Tool (AMET) was used to calculate the model performance statistics used in this document (Gilliam et al., 2005). For this evaluation of the ozone predictions in the 2011 CAMx modeling platform, we have selected the mean bias, mean error, normalized mean bias, and normalized mean error to characterize model performance, statistics which are consistent with the recommendations in Simon et al. (2012) and the draft photochemical modeling guidance (U.S. EPA, 2014c). As noted above, we calculated the performance statistics by climate region for the period May through September.

Mean bias (MB) is the average of the difference (predicted – observed) divided by the total number of replicates ($n$). Mean bias is given in units of ppb and is defined as:

[4] In calculating the ozone season statistics we limited the data to those observed and predicted pairs with observations that are greater than or equal 60 ppb in order to focus on concentrations at the upper portion of the distribution of values.

MB = $\frac{1}{n}\sum_1^n(P - O)$ , where P = predicted and O = observed concentrations.

Mean error (ME) calculates the absolute value of the difference (predicted - observed) divided by the total number of replicates (*n*). Mean error is given in units of ppb and is defined as:

ME = $\frac{1}{n}\sum_1^n |P - O|$

Normalized mean bias (NMB) is the average the difference (predicted - observed) over the sum of observed values. NMB is a useful model performance indicator because it avoids over inflating the observed range of values, especially at low concentrations. Normalized mean bias is given in percentage units and is defined as:

NMB = $\frac{\sum_1^n(P-O)}{\sum_1^n(O)} * 100$

Normalized mean error (NME) is the absolute value of the difference (predicted - observed) over the sum of observed values. Normalized mean error is given in percentage units and is defined as:

NME = $\frac{\sum_1^n|P-O|}{\sum_1^n(O)} * 100$

As described in more detail below, the model performance statistics indicate that the 8-hour daily maximum ozone concentrations predicted by the 2011 CAMx modeling platform closely reflect the corresponding 8-hour observed ozone concentrations in space and time in each region of the 12 km U.S. modeling domain. The acceptability of model performance was judged by considering the 2011 CAMx performance results in light of the range of performance found in recent regional ozone model applications (NRC, 2002; Phillips et al., 2007; Simon et al., 2012; U.S. EPA, 2005; U.S. EPA, 2009; U.S. EPA, 2011). These other modeling studies represent a wide range of modeling analyses that cover various models, model configurations, domains, years and/or episodes, chemical mechanisms, and aerosol modules. Overall, the ozone model performance results for the 2011 CAMx simulations are within the range found in other recent peer-reviewed and regulatory applications. The model performance results, as described in this document, demonstrate that the predictions from the 2011 modeling platform correspond closely to observed concentrations in terms of the magnitude, temporal fluctuations, and geographic differences for 8-hour daily maximum ozone.

The density scatter plots of MDA8 ozone are provided Figure A-3. The 8-hour ozone model performance bias and error statistics by network for the ozone season (May-September average) for each region and each state are provided in Tables A-1 and A-2, respectively. The statistics shown were calculated using data pairs on days with observed 8-hour ozone of ≥ 60 ppb. The distributions of observed and predicted 8-hour ozone by month in the period May through September for each region are shown in Figures A-4 through A-12. Spatial plots of the mean bias and error as well as the normalized mean bias and error for individual monitors are shown in Figures A-13 through A-16. Time series plots of observed and predicted MDA 8-hour ozone during the period May through September at the 19 nonattainment and maintenance sites (see Table A-3) are provided in Figure A-17, (a) through (s).

The density scatter plots in Figure A-3 provide a qualitative comparison of model-predicted and observed MDA8 ozone concentrations. In these plots the intensity of the colors indicates the density of individual observed/predicted paired values. The greatest number of individual paired values is denoted by the core area in white. The plots indicate that the predictions correspond to the observations in that a large number of observed/predicted paired values lie along or close to the 1:1 line shown on each plot. Overall, the model tends to over-predict the observed values to some extent, particularly at low and mid-range concentrations generally < 60 ppb in each of the regions. This feature is most evident in the South and Southeast regions. In the West region, high concentrations are under-predicted and low and mid-range concentrations are over-predicted. Observed and predicted values are in close agreement in the Southwest and Northwest regions.

As indicated by the statistics in Table A-1, bias and error for 8-hour daily maximum ozone are relatively low in each region. Generally, mean bias for 8-hour ozone ≥ 60 ppb during the period May through September is within ± 5 ppb[5] at AQS sites in the eastern climate regions (i.e., Northeast, Ohio Valley, Upper Midwest, Southeast, and South) and at rural CASTNet sites

[5] Note that "within ± 5 ppb" includes values that are greater than or equal to -5 ppb and less than or equal to 5 ppb.

in the Northeast, Ohio Valley, Upper Midwest, and Southeast. The mean error is less than 10 ppb in all regions, except the West. Normalized mean bias is within ± 5 percent for AQS sites in all regions of the East, except for the South where the normalized mean bias of -6.6 percent is also relatively small. The mean bias and normalized mean bias statistics indicate a tendency for the model to under predicted MDA8 ozone concentrations in the western regions for AQS and CASTNet sites. The normalized mean error is less than 15 percent for both networks in all regions, except for the CASTNet sites in the West. Looking at model performance for individual states (Table A-2) indicates that mean bias is within ± 5 ppb for a majority of the states and within ± 10 ppb for all but two states. The mean error is less than 10 ppb for nearly all states and greater than 15 ppb for only one state. The normalized mean bias is within ± 10 percent for all states in the East, except for North Dakota and South Dakota. The normalized mean error is within ± 15 percent for nearly all states nationwide.

The monthly distributions of 8-hour daily maximum model predicted ozone generally corresponds well with that of the observed concentrations, as indicated by the graphics in Figures A-4 through A-12. The distribution of predicted concentrations tends to be close to that of the observed data at the 25$^{th}$ percentile, median and 75th percentile values for each region, although there is a small persistent overestimation bias in the Northeast, Southeast, and Ohio Valley regions, and a tendency for under-prediction in the western regions (i.e., Southwest, Northern Rockies, Northwest,[6] and West), particularly at CASTNet sites in the West region.

Figures A-13 through A-16 show the spatial variability in bias and error at monitor locations. Mean bias, as seen from Figure A-13, is within ± 5 ppb at many sites across the East with over-prediction of 5 to 10 ppb or more at some of the sites from the Southeast into the Northeast. Elsewhere in the U.S., mean bias is generally in the range of -5 to -10 ppb. The most notable exception is in portions of California where the mean bias is in the range of -10 to -15 ppb at a number of interior sites. Figure A-14 indicates that the normalized mean bias for days with observed 8-hour daily maximum ozone greater than or equal to 60 ppb is within ± 10 percent at the vast majority of monitoring sites across the modeling domain. There are regional differences in model performance, where the model tends to over-predict at some sites from the

[6] Note that the over-prediction at CASTNet sites in the Northwest seen in Figure A-11 may not be representative of performance in rural areas of this region because there are so few observed and predicted data values in this region.

Southeast into the Northeast and generally under predict in the Southwest, Northern Rockies, Northwest and West. Model performance in the Ohio Valley and Upper Midwest states shows that most sites are within ± 10 percent with only a few sites outside of this range.

Model error, as seen from Figure A-15, is 10 ppb or less at most of the sites across the modeling domain. Figure A-16 indicates that the normalized mean error for days with observed 8-hour daily maximum ozone greater than or equal to 60 ppb is within 15 percent at the vast majority of monitoring sites across the modeling domain. Somewhat greater error (i.e., greater than 15 percent) is evident at sites in several areas most notably within portions of the Northeast and in portions of Florida, and the western most part of the modeling domain.

In addition to the above analysis of overall model performance, we also examine how well the modeling platform replicates day to day fluctuations in observed 8-hour daily maximum concentrations using data for the 19 nonattainment and maintenance-only sites. For this site-specific analysis we present the time series of observed and predicted 8-hour daily maximum concentrations by site over the period May through September. The results, as shown in Figures A-17 (a) through (s), indicate that the modeling platform generally replicates the day-to-day variability in ozone during this time period at these sites. That is, days with high modeled concentrations are generally also days with high measured concentrations and, conversely, days with low modeled concentrations are also days with low measured concentrations in most cases. For example, model predictions at several sites not only accurately capture the day-to-day variability in the observations, but also appear to have relatively low bias on individual days: Jefferson County, KY; Hamilton County, OH; Philadelphia County, PA; Richmond County, NY; and Suffolk County, NY. The sites in Fairfield County, CT, New Haven County, CT, Harford County, MD, and Allegan County, MI each track closely with the observations, but there is a tendency to over predict on several days. Other sites generally track well and capture day-to-day variability but underestimate ozone on some of the days with measured high ozone concentrations: Brazoria County, TX; Denton County, TX; Harris County, TX; Tarrant County, TX; and Sheboygan County, WI. Note that at the site in Brazoria County, TX and at that Harris County, TX site 482011039, there is an extended period from mid-July to mid-August with very low observed ozone concentrations, mostly in the range of 30 to 40 ppb. The model also predicted generally low ozone concentrations at these sites during this period, but the modeled values were in the range of 40 to 60 ppb which is not quite as low as the observed values. Looking across all 19 sites indicates that the modeling platform is able to capture the both the site-to-site differences in the short-term variability and the general magnitude of the observed ozone concentrations.

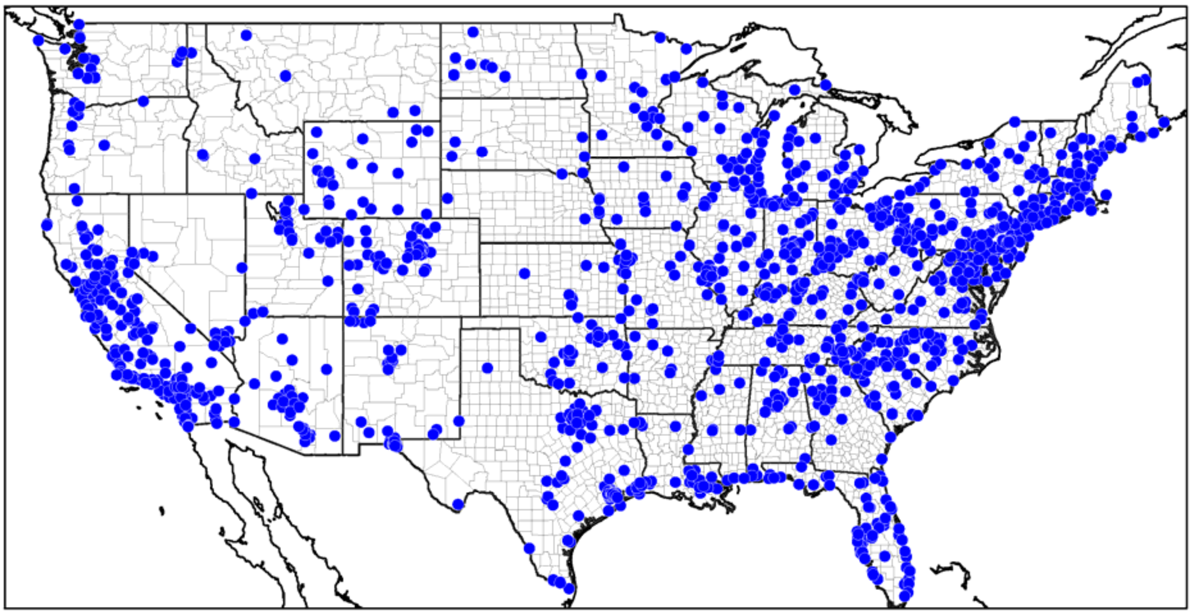


Figure A-1a. AQS ozone monitoring sites.

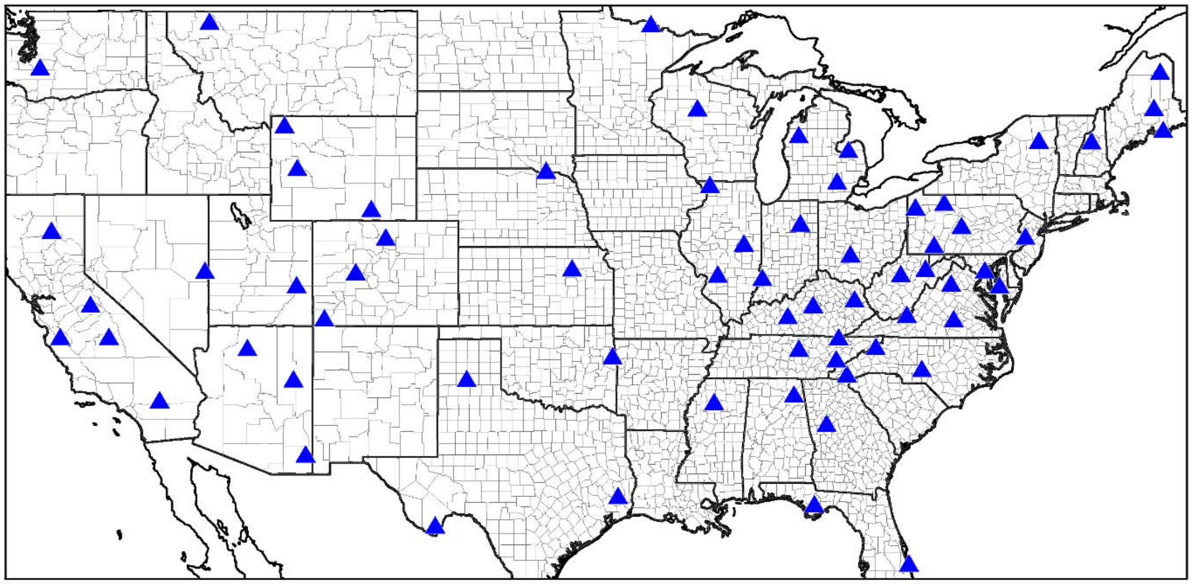


Figure A-1b. CASTNet ozone monitoring sites.

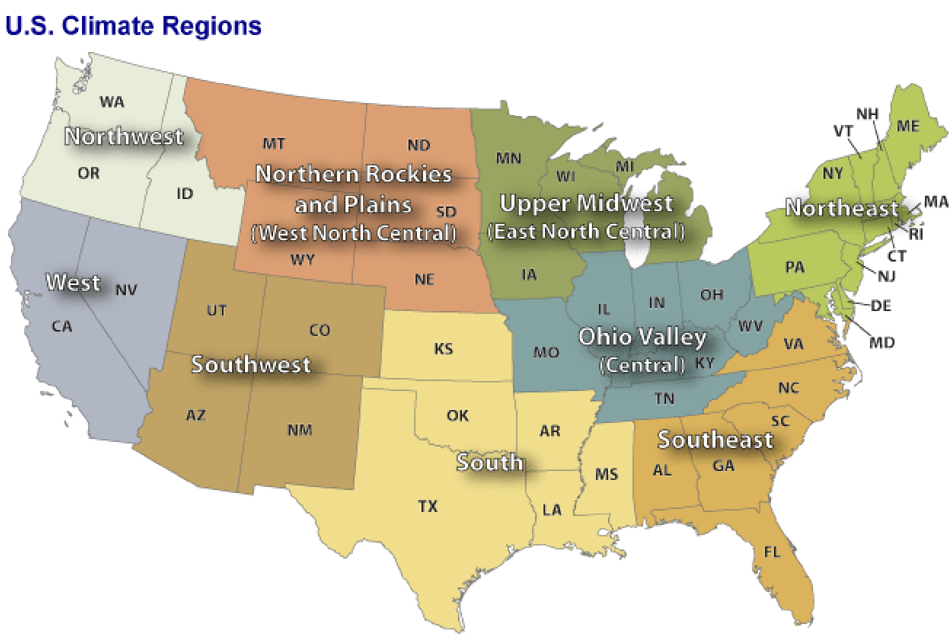


Figure A-2. NOAA climate regions (source: http://www.ncdc.noaa.gov/monitoring-references/maps/us-climate-regions.php#references)

Table A-1. Performance statistics for MDA8 ozone ≥ 60 ppb for May through September by climate region, for AQS and CASTNet networks.

| Network | Climate Region | No. of Obs | MB (ppb) | ME (ppb) | NMB (%) | NME (%) |
|---|---|---|---|---|---|---|
| AQS | Northeast | 4,085 | 2.2 | 7.6 | 3.2 | 11.1 |
| | Ohio Valley | 6,325 | 0.1 | 7.6 | 0.1 | 11.2 |
| | Upper Midwest | 1,162 | -3.1 | 7.5 | -4.6 | 11.0 |
| | Southeast | 4,840 | 3.3 | 7.1 | 4.9 | 10.7 |
| | South | 5,694 | -4.5 | 8.4 | -6.6 | 12.1 |
| | Southwest | 6,033 | -6.2 | 8.4 | -9.5 | 12.7 |
| | Northern Rockies | 380 | -6.6 | 7.8 | -10.5 | 12.4 |
| | Northwest | 79 | -5.8 | 8.8 | -9.1 | 13.8 |
| | West | 8,655 | -8.6 | 10.3 | -12.2 | 14.6 |
| | | | | | | |
| CASTNet | Northeast | 264 | 2.3 | 6.1 | 3.4 | 9.0 |
| | Ohio Valley | 433 | -2.3 | 6.3 | -3.4 | 9.4 |
| | Upper Midwest | 38 | -4.1 | 5.9 | -6.0 | 8.8 |
| | Southeast | 201 | 1.2 | 5.4 | 1.8 | 8.3 |
| | South | 215 | -7.9 | 8.6 | -11.9 | 12.9 |
| | Southwest | 382 | -8.4 | 9.2 | -12.8 | 14.0 |
| | Northern Rockies | 110 | -8.4 | 8.7 | -13.3 | 13.7 |
| | Northwest | - | - | - | - | - |
| | West | 425 | -13.6 | 13.8 | -18.6 | 19.0 |

Table A-2. Performance statistics for MDA8 ozone ≥ 60 ppb for May through September by state based on data at AQS network sites.

| State | No. of Obs | MB (ppb) | ME (ppb) | NMB (%) | NME (%) |
|---|---|---|---|---|---|
| AL | 739 | 4.0 | 7.2 | 5.9 | 10.9 |
| AZ | 2334 | -6.2 | 9.2 | -9.4 | 13.8 |
| AR | 252 | -3.4 | 8.5 | -5.1 | 12.6 |
| CA | 7533 | -8.9 | 10.6 | -12.4 | 14.9 |
| CO | 2067 | -6.1 | 8.0 | -9.3 | 12.0 |
| CT | 245 | 3.0 | 10.1 | 4.2 | 14.3 |
| DE | 232 | 2.3 | 6.9 | 3.4 | 10.0 |
| DC | 87 | 2.5 | 11.7 | 3.6 | 16.8 |
| FL | 581 | 3.1 | 7.7 | 4.7 | 11.7 |
| GA | 829 | 3.8 | 7.7 | 5.7 | 11.4 |
| ID | 51 | -10.0 | 10.4 | -15.8 | 16.3 |

| State | No. of Obs | MB (ppb) | ME (ppb) | NMB (%) | NME (%) |
|---|---|---|---|---|---|
| IL | 782 | -2.6 | 8.5 | -3.8 | 12.7 |
| IN | 1142 | 0.0 | 6.8 | 0.0 | 10.1 |
| IA | 126 | -3.1 | 6.7 | -4.9 | 10.5 |
| KS | 352 | -4.8 | 7.6 | -7.1 | 11.4 |
| KY | 845 | 1.2 | 7.7 | 1.8 | 11.5 |
| LA | 711 | 1.8 | 7.7 | 2.7 | 11.3 |
| ME | 101 | -1.4 | 6.5 | -2.1 | 9.8 |
| MD | 766 | 3.4 | 8.2 | 4.8 | 11.8 |
| MA | 197 | 3.4 | 7.9 | 5.0 | 11.7 |
| MI | 638 | -3.4 | 7.8 | -5.0 | 11.4 |
| MN | 35 | 0.6 | 7.0 | 0.8 | 10.5 |
| MS | 260 | 2.3 | 8.5 | 3.4 | 12.9 |
| MO | 719 | -1.2 | 7.7 | -1.8 | 11.3 |
| MT* | - | - | - | - | - |
| NE | 41 | -2.4 | 5.6 | -3.9 | 8.8 |
| NV | 1122 | -6.9 | 8.1 | -10.4 | 12.2 |
| NH | 98 | -4.8 | 8.3 | -7.4 | 12.8 |
| NJ | 439 | 2.2 | 7.5 | 3.1 | 10.7 |
| NM | 961 | -6.5 | 8.0 | -9.9 | 12.3 |
| NY | 504 | 0.2 | 7.3 | 0.3 | 10.7 |
| NC | 1496 | 3.2 | 6.4 | 4.8 | 9.7 |
| ND | 10 | -15.3 | 15.3 | -24.5 | 24.5 |
| OH | 1624 | 0.3 | 7.8 | 0.4 | 11.5 |
| OK | 1475 | -6.2 | 8.2 | -9.0 | 11.9 |
| OR | 21 | 1.8 | 5.9 | 2.8 | 9.0 |
| PA | 1336 | 2.8 | 6.7 | 4.1 | 10.0 |
| RI | 75 | 1.8 | 8.1 | 2.7 | 12.0 |
| SC | 545 | 2.7 | 6.4 | 4.0 | 9.7 |
| SD | 21 | -11.8 | 12.0 | -18.7 | 19.0 |
| TN | 993 | 1.4 | 7.3 | 2.2 | 10.9 |
| TX | 2644 | -6.0 | 8.7 | -8.6 | 12.5 |
| UT | 671 | -6.2 | 7.5 | -9.7 | 11.7 |
| VT | 5 | -5.7 | 8.3 | -8.5 | 12.4 |
| VA | 650 | 2.8 | 7.7 | 4.1 | 11.5 |
| WA | 7 | 1.8 | 6.7 | 2.8 | 10.6 |
| WV | 220 | 2.9 | 6.4 | 4.4 | 9.8 |
| WI | 363 | -3.0 | 7.2 | -4.3 | 10.5 |
| WY | 308 | -6.5 | 7.6 | -10.3 | 12.0 |

*No statistics were calculated for Montana because there were no days with observed MDA8 ozone $\geq$ 60 ppb in the ambient data set used for these calculations.

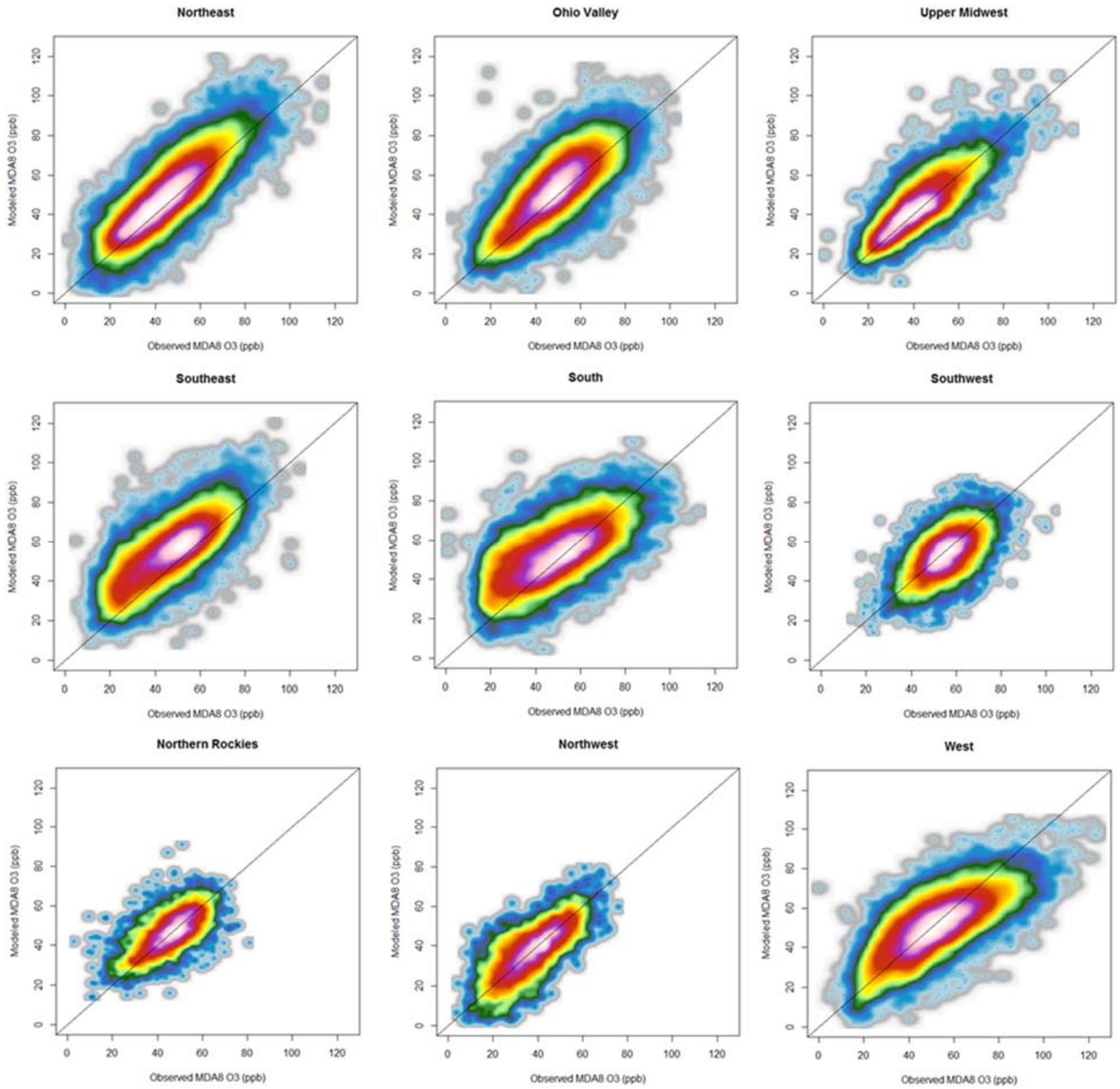


Figure A-3. Density scatter plots of observed vs predicted MDA8 ozone for the Northeast, Ohio River Valley, Upper Midwest, Southeast, South, Southwest, Northern Rockies, Northwest, and West regions.

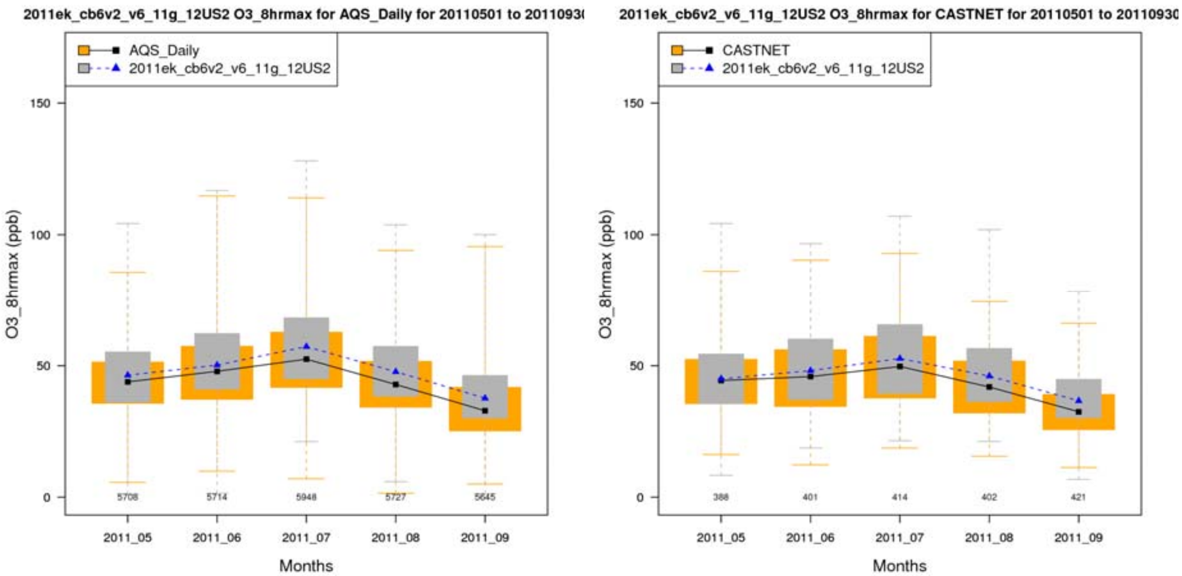


Figure A-4. Distribution of observed and predicted MDA8 ozone by month for the period May through September for the Northeast region, AQS Network (left) and CASTNet (right). [symbol = median; top/bottom of box = 75th/25th percentiles; top/bottom line = max/min values]

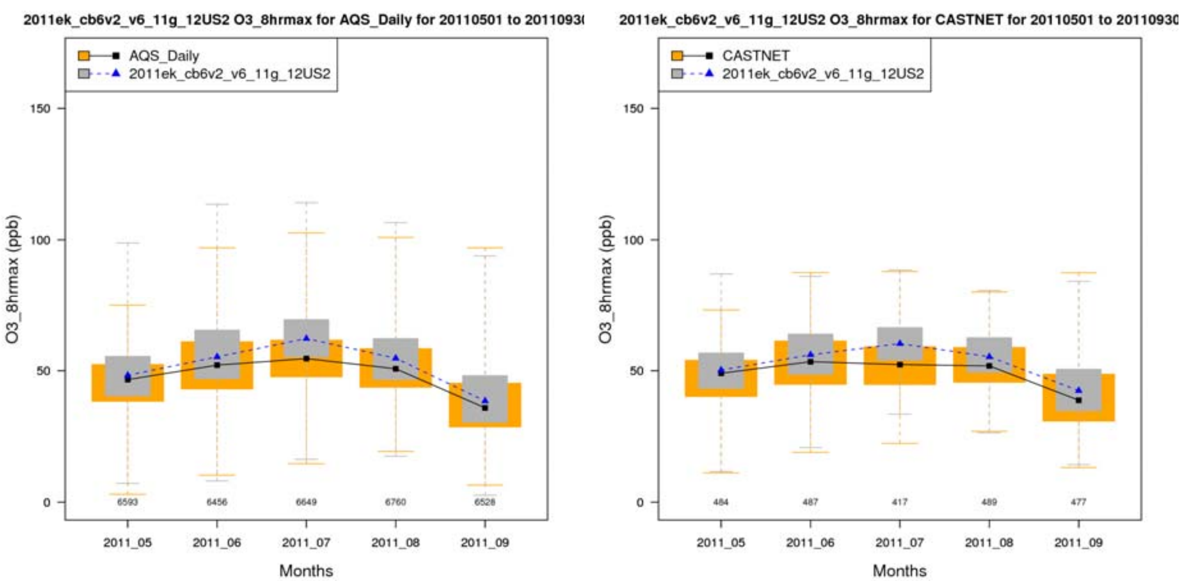


Figure A-5. Distribution of observed and predicted MDA8 ozone by month for the period May through September for the Ohio Valley region, AQS Network (left) and CASTNet (right).

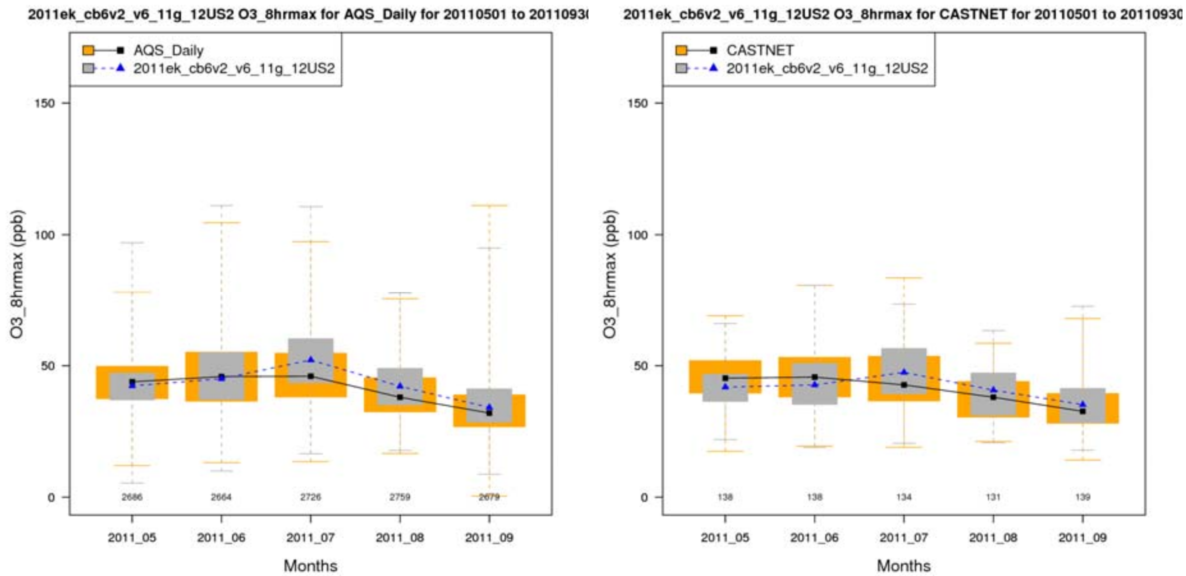


Figure A-6. Distribution of observed and predicted MDA8 ozone by month for the period May through September for the Upper Midwest region, AQS Network (left) and CASTNet (right).

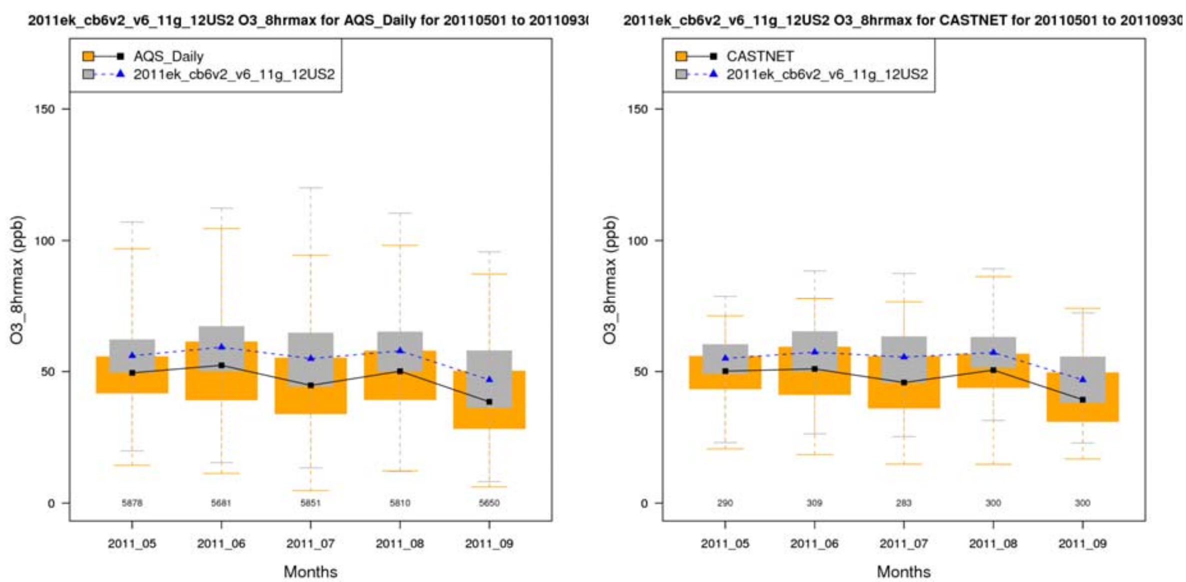


Figure A-7. Distribution of observed and predicted MDA8 ozone by month for the period May through September for the Southeast region, AQS Network (left) and CASTNet (right).

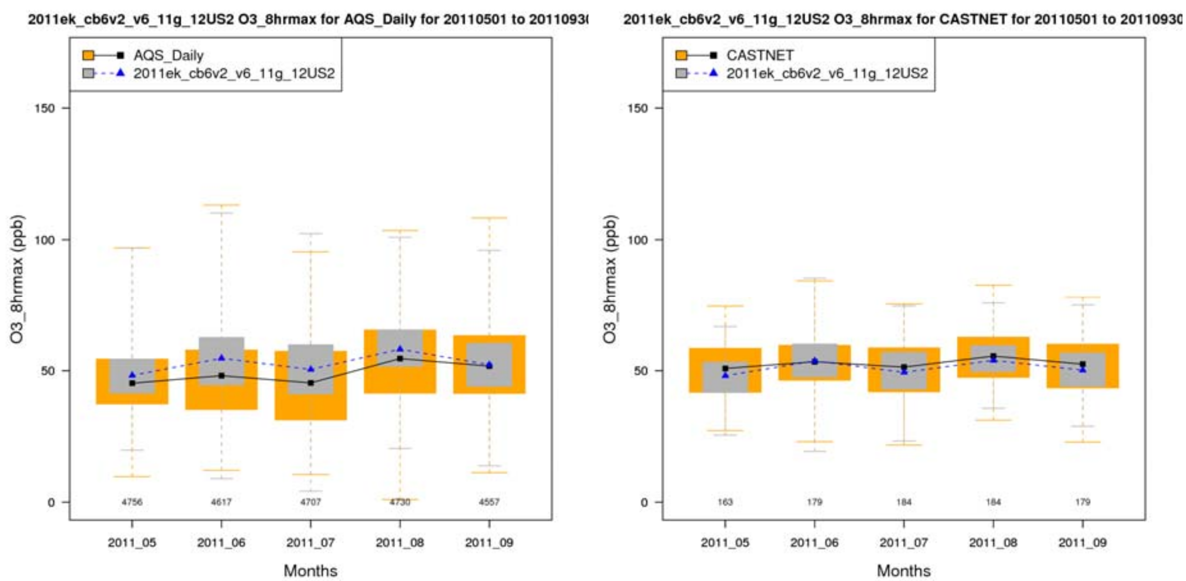


Figure A-8. Distribution of observed and predicted MDA8 ozone by month for the period May through September for the South region, AQS Network (left) and CASTNet (right).

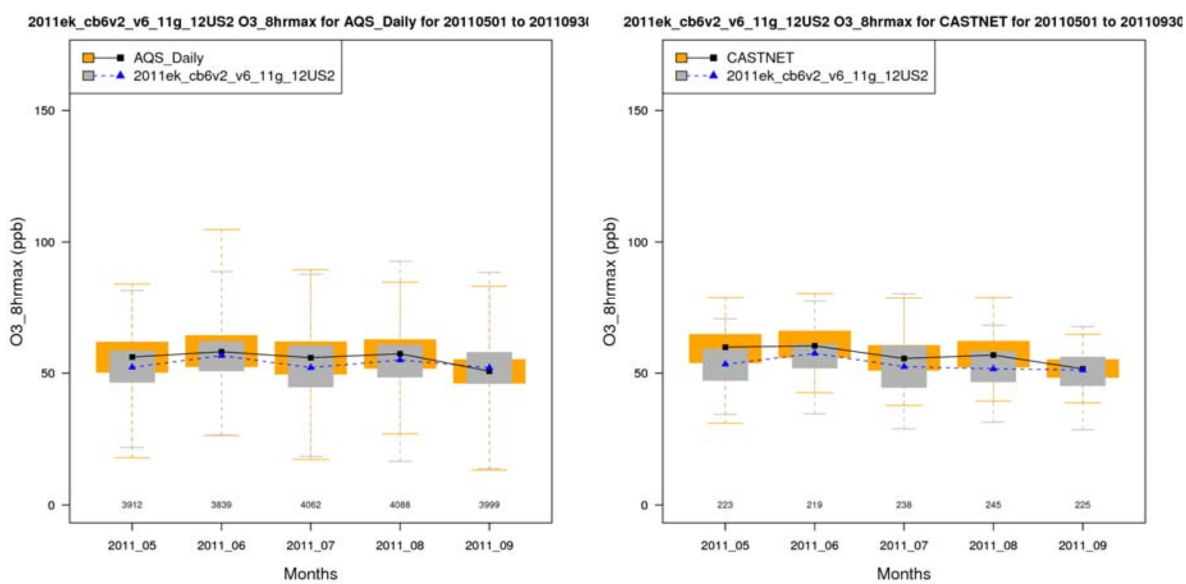


Figure A-9. Distribution of observed and predicted MDA8 ozone by month for the period May through September for the Southwest region, AQS Network (left) and CASTNet (right).

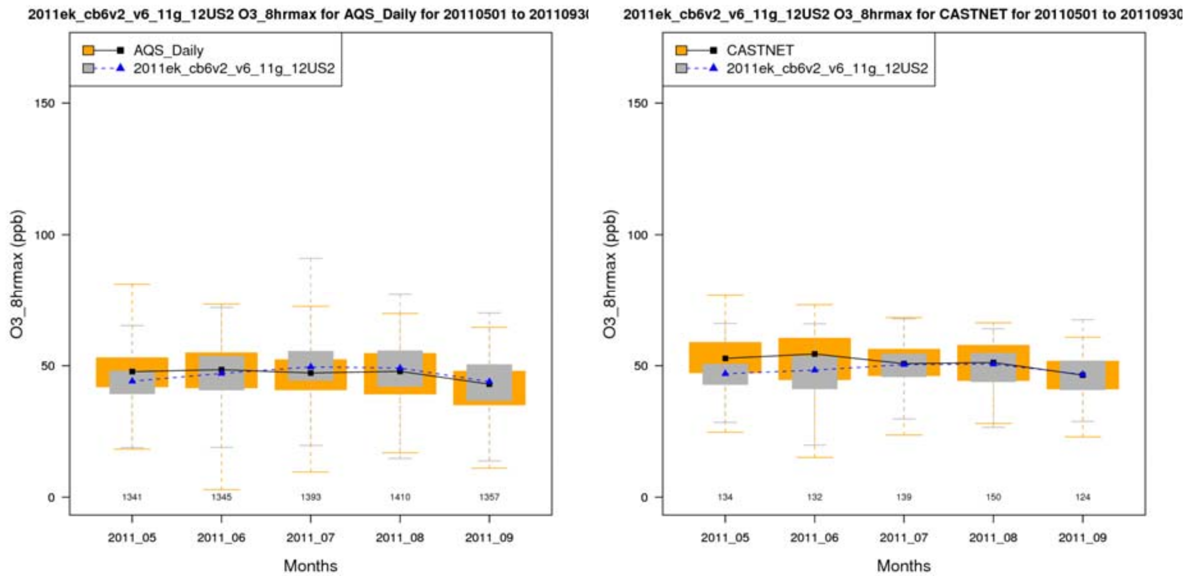


Figure A-10. Distribution of observed and predicted MDA8 ozone by month for the period May through September for the Northern Rockies region, AQS Network (left) and CASTNet (right).

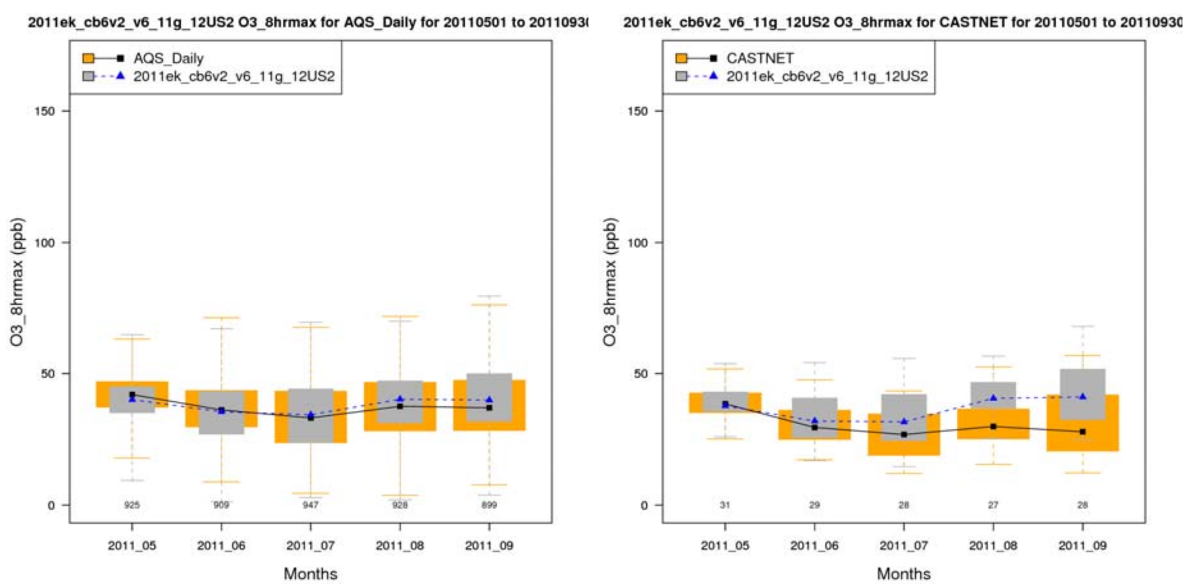


Figure A-11. Distribution of observed and predicted MDA8 ozone by month for the period May through September for the Northwest region, AQS Network (left) and CASTNet (right).



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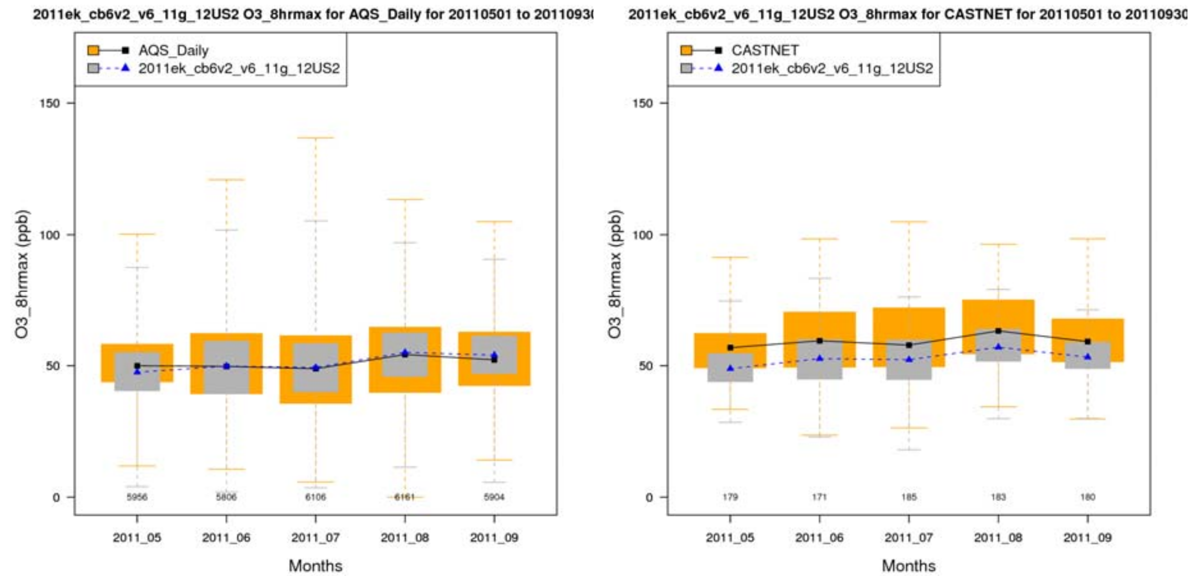


Figure A-12. Distribution of observed and predicted MDA8 ozone by month for the period May through September for the West region, AQS Network (left) and CASTNet (right).

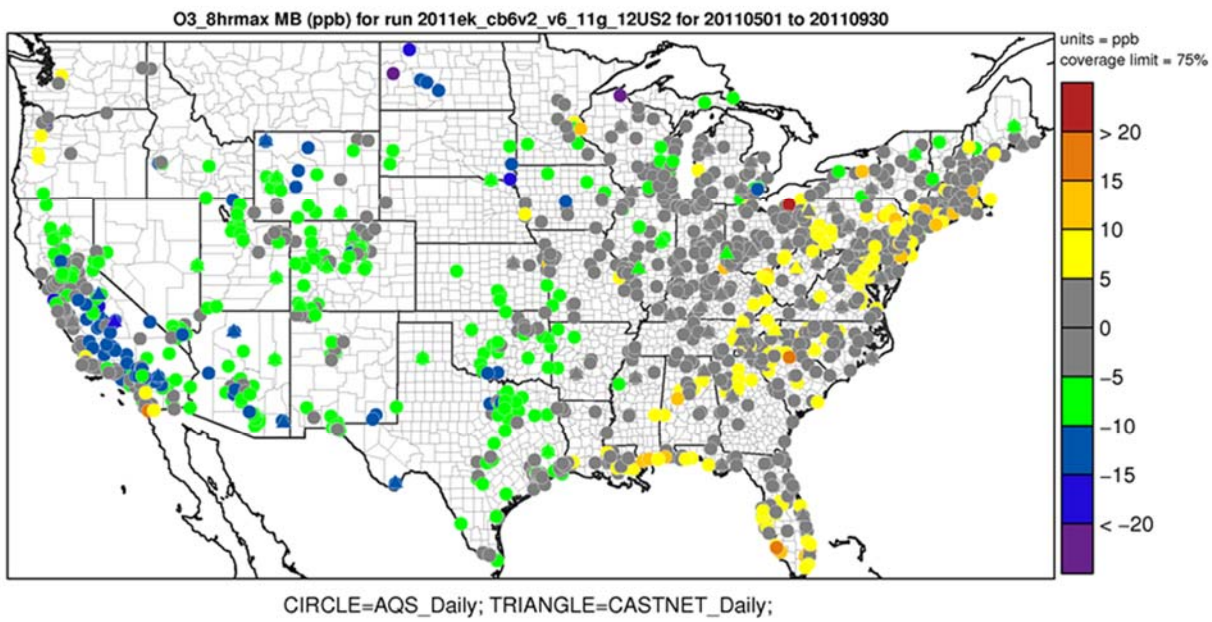


Figure A-13. Mean Bias (ppb) of MDA8 ozone ≥ 60 ppb over the period May-September 2011 at AQS and CASTNet monitoring sites.

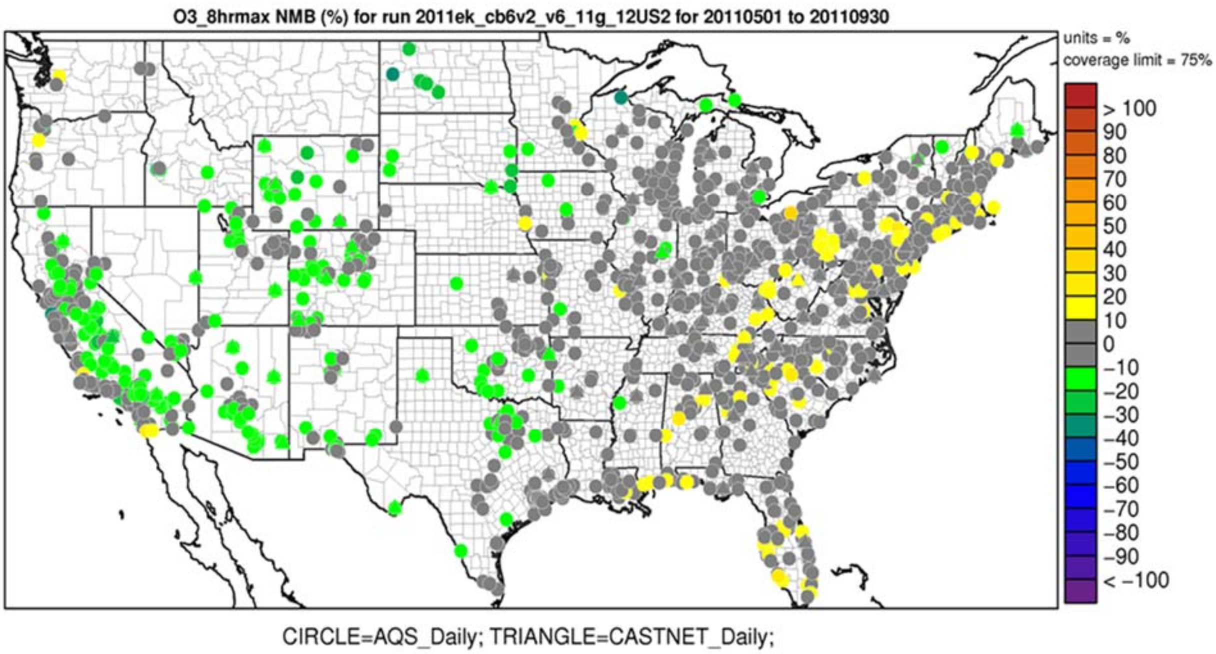


Figure A-14. Normalized Mean Bias (%) of MDA8 ozone ≥ 60 ppb over the period May-September 2011 at AQS and CASTNet monitoring sites.

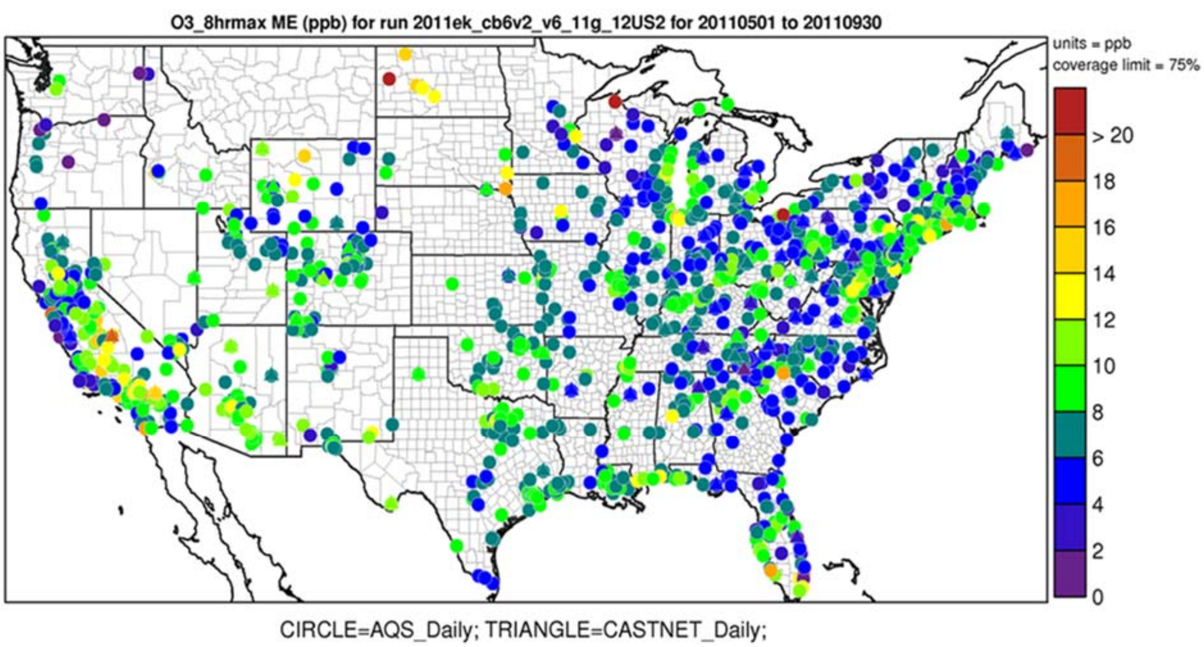


Figure A-15. Mean Error (ppb) of MDA8 ozone ≥ 60 ppb over the period May-September 2011 at AQS and CASTNet monitoring sites.

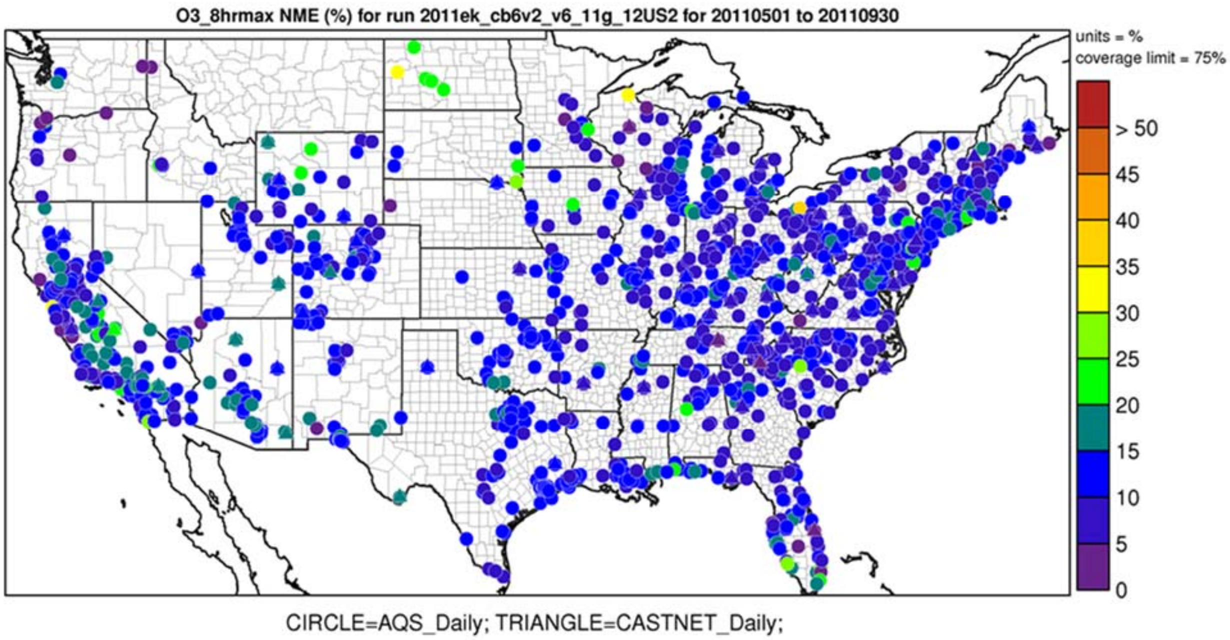


Figure A-16. Normalized Mean Error (%) of MDA8 ozone ≥ 60 ppb over the period May-September 2011 at AQS and CASTNet monitoring sites.

Table A-3. Monitoring sites used for the ozone time series analysis.

| Site | County | State |
|---|---|---|
| 90010017 | Fairfield | CT |
| 90013007 | Fairfield | CT |
| 90019003 | Fairfield | CT |
| 90099002 | New Haven | CT |
| 211110067 | Jefferson | KY |
| 240251001 | Harford | MD |
| 260050003 | Allegan | MI |
| 360850067 | Richmond | NY |
| 361030002 | Suffolk | NY |
| 390610006 | Hamilton | OH |

| Site | County | State |
|---|---|---|
| 421010024 | Philadelphia | PA |
| 480391004 | Brazoria | TX |
| 481210034 | Denton | TX |
| 482010024 | Harris | TX |
| 482011034 | Harris | TX |
| 482011039 | Harris | TX |
| 484392003 | Tarrant | TX |
| 484393009 | Tarrant | TX |
| 551170006 | Sheboygan | WI |

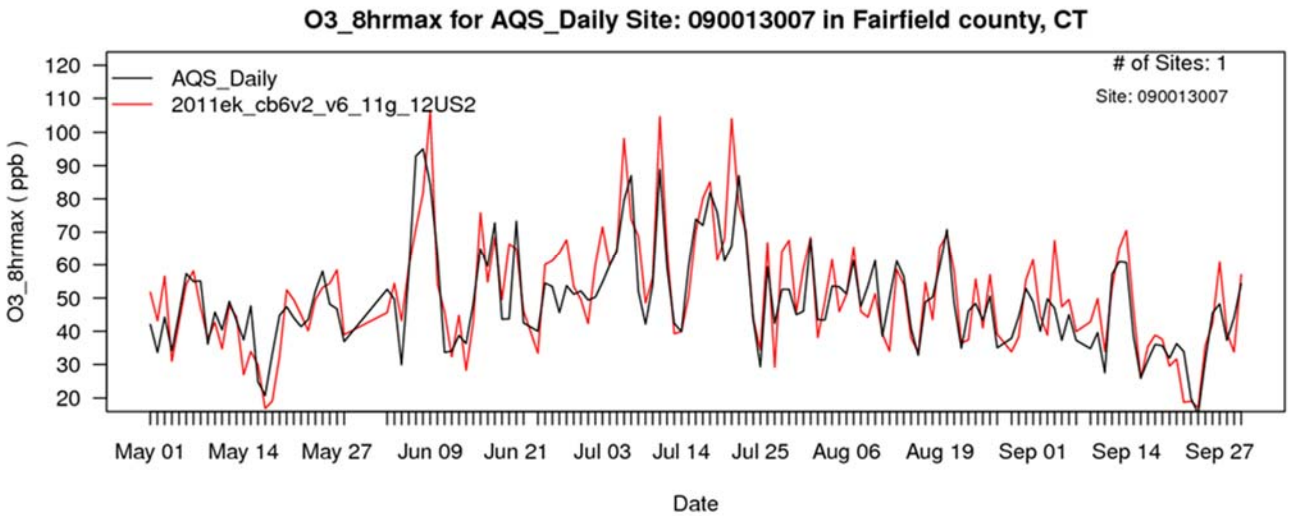


Figure A-17a. Time series of observed (black) and predicted (red) MDA8 ozone for May through September 2011 at site 090013007 in Fairfield Co., Connecticut.

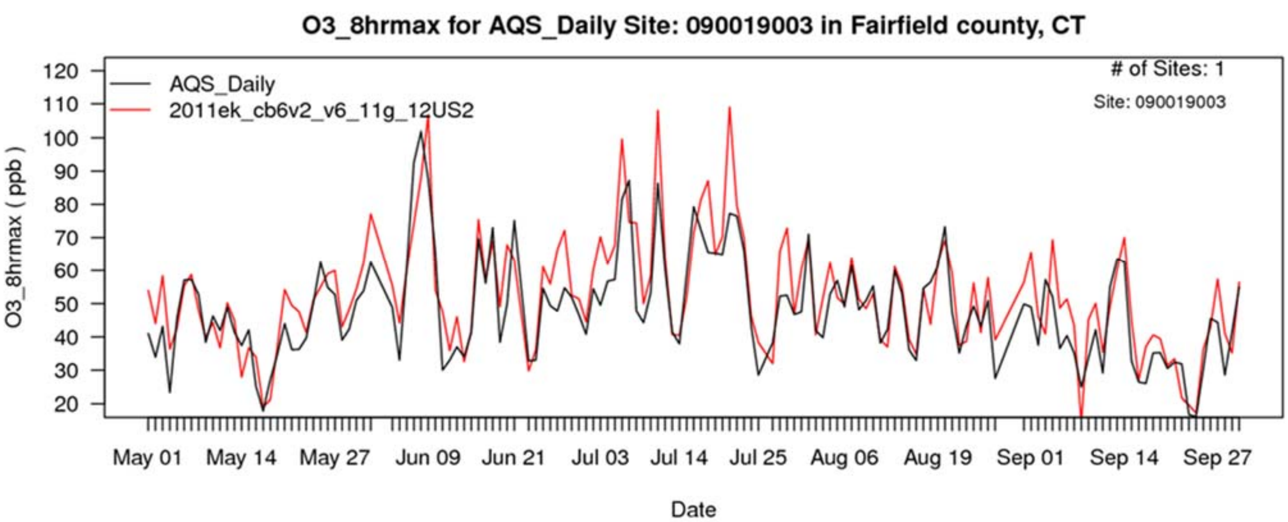


Figure A-17b. Time series of observed (black) and predicted (red) MDA8 ozone for May through September 2011 at site 090019003 in Fairfield Co., Connecticut.

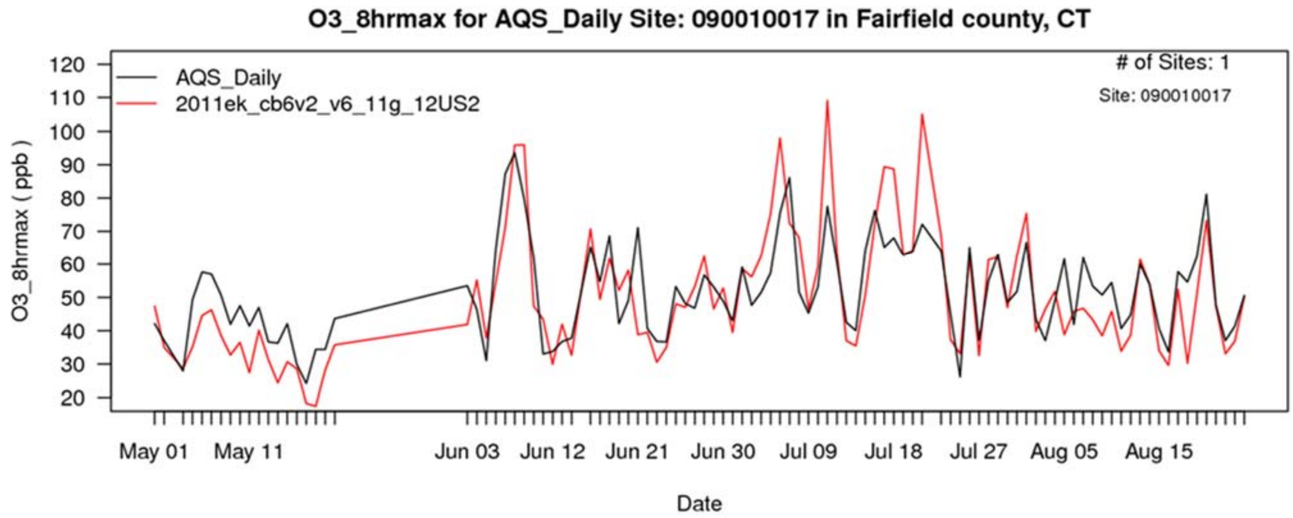


Figure A-17c. Time series of observed (black) and predicted (red) MDA8 ozone for May through September 2011 at site 090010017 in Fairfield Co., Connecticut.

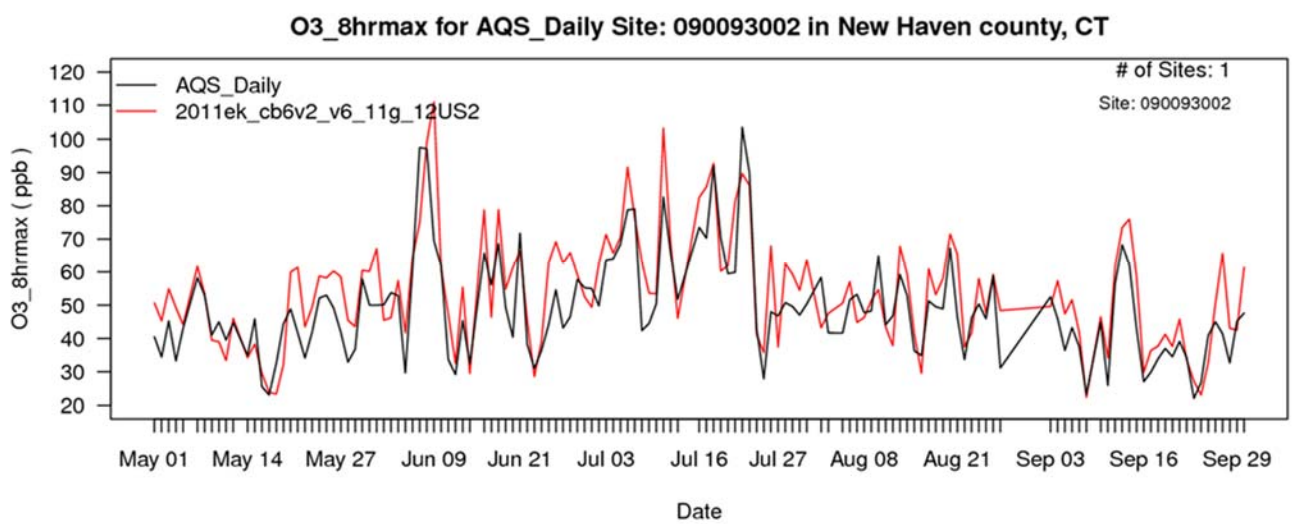


Figure A-17d. Time series of observed (black) and predicted (red) MDA8 ozone for May through September 2011 at site 090093002 in New Haven Co., Connecticut.

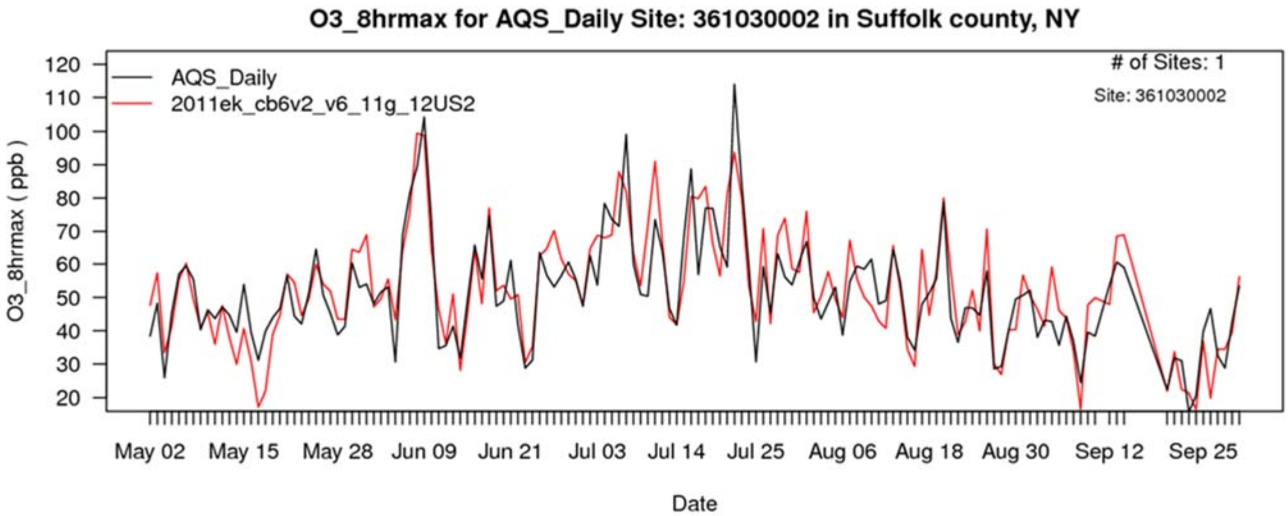


Figure A-17e. Time series of observed (black) and predicted (red) MDA8 ozone for May through September 2011 at site 361030002 in Suffolk Co., New York.

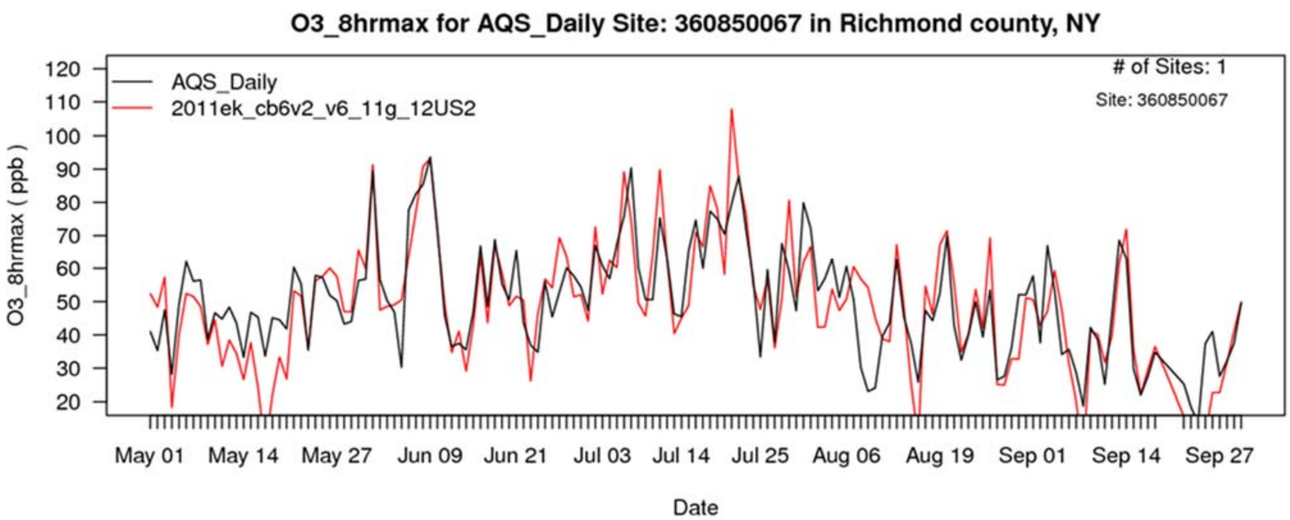


Figure A-17f. Time series of observed (black) and predicted (red) MDA8 ozone for May through September 2011 at site 360850067 in Richmond Co., New York.

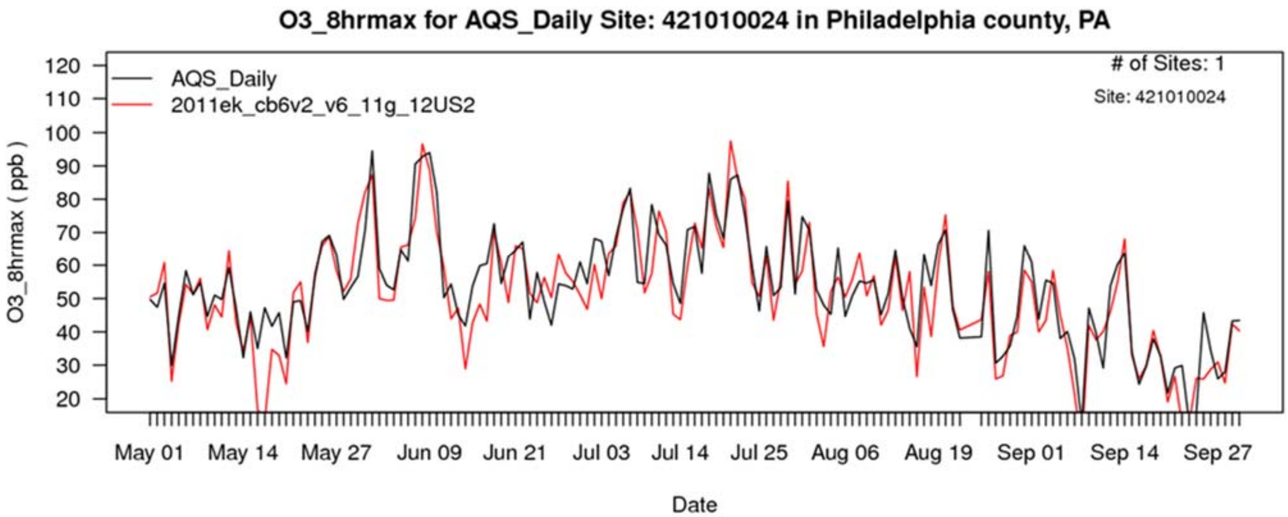


Figure A-17g. Time series of observed (black) and predicted (red) MDA8 ozone for May through September 2011 at site 421010024 in Philadelphia Co., Pennsylvania.

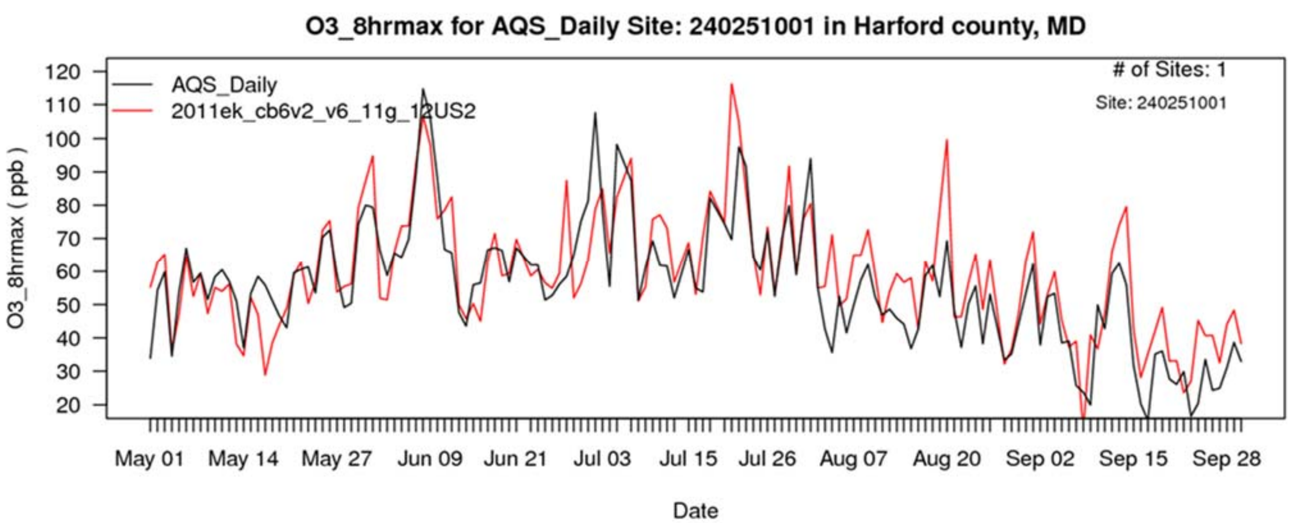


Figure A-17h. Time series of observed (black) and predicted (red) MDA8 ozone for May through September 2011 at site 240251001 in Harford Co., Maryland.

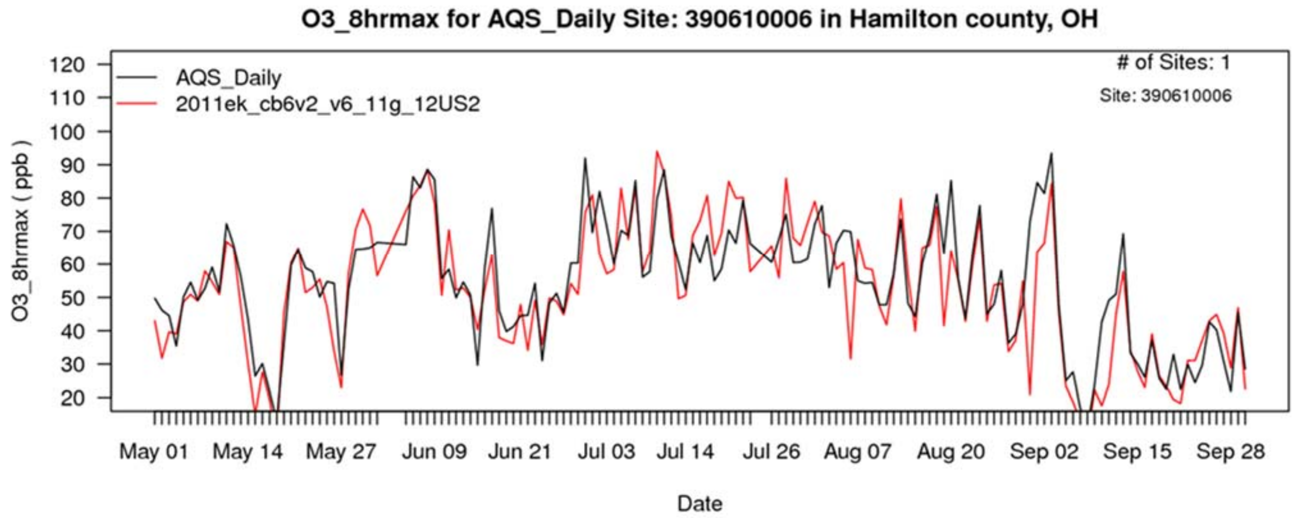


Figure A-17i. Time series of observed (black) and predicted (red) MDA8 ozone for May through September 2011 at site 390610006 in Hamilton Co., Ohio.

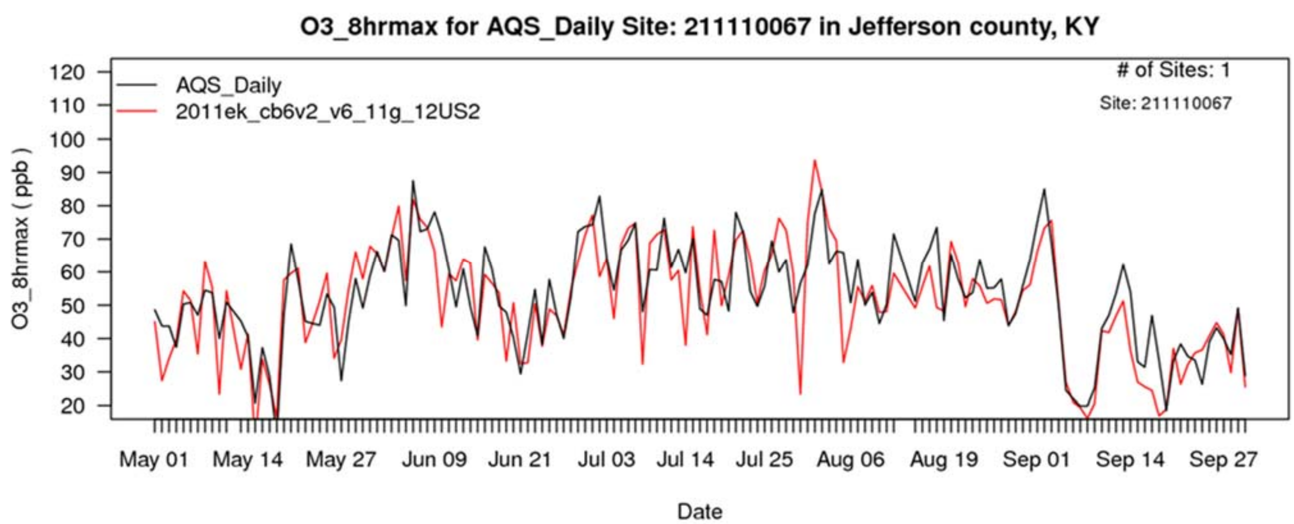


Figure A-17j. Time series of observed (black) and predicted (red) MDA8 ozone for May through September 2011 at site 211110067 in Jefferson Co., Kentucky.

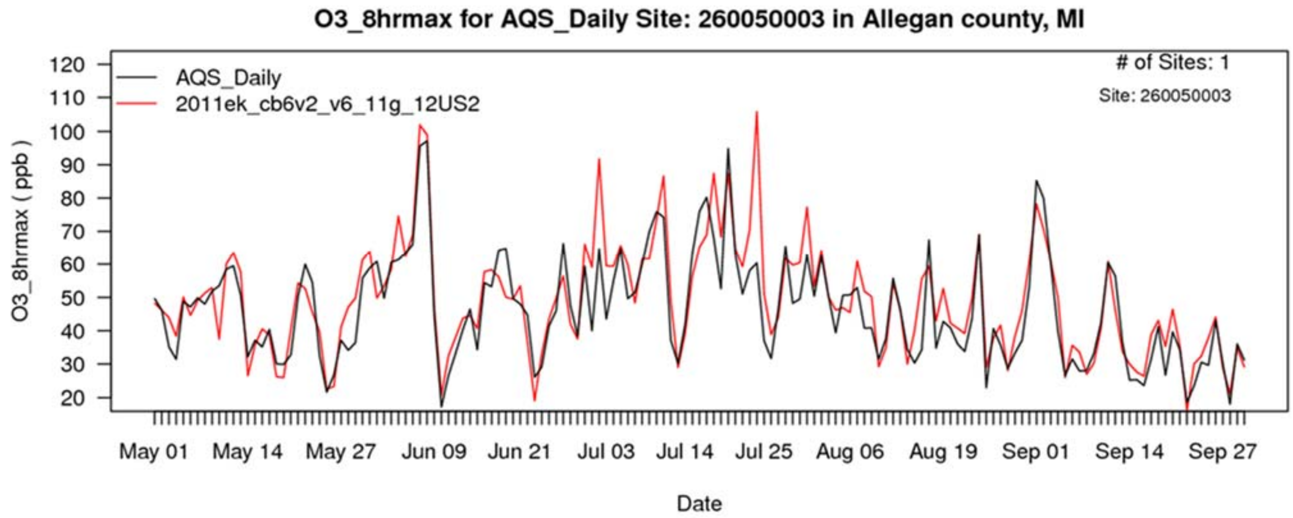


Figure A-17k. Time series of observed (black) and predicted (red) MDA8 ozone for May through September 2011 at site 26005003 in Allegan Co., Michigan.

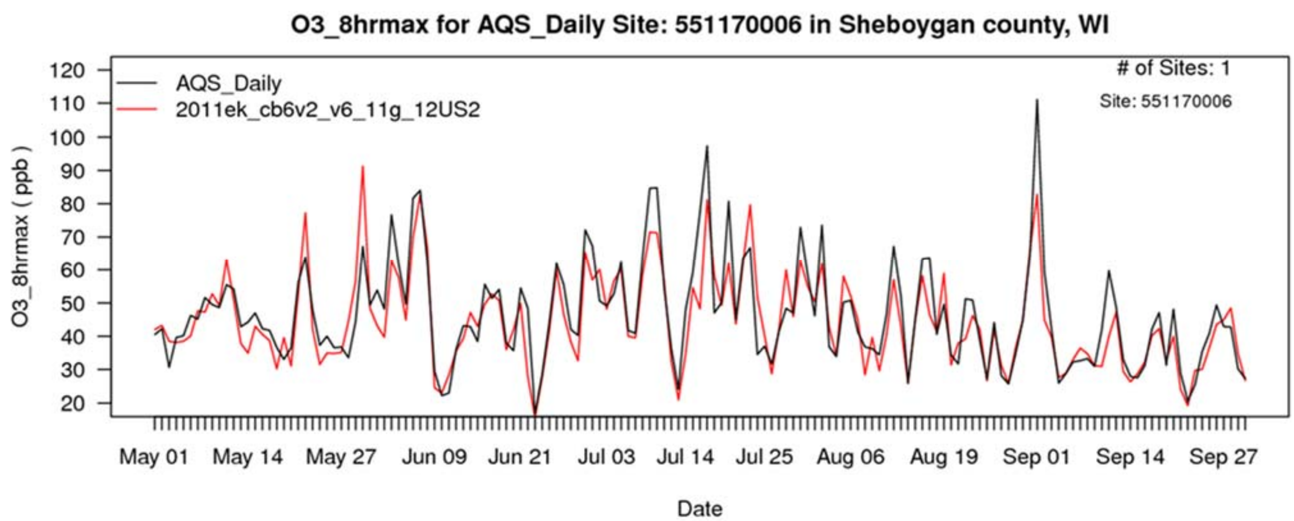


Figure A-17l. Time series of observed (black) and predicted (red) MDA8 ozone for May through September 2011 at site 551170006 in Sheboygan Co., Wisconsin.

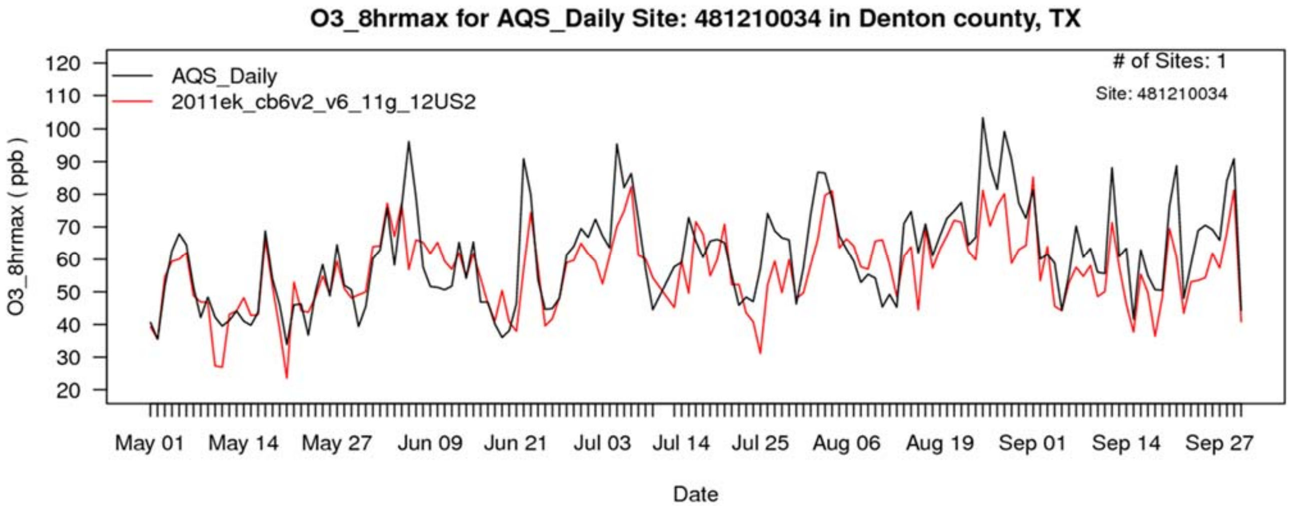


Figure A-17m. Time series of observed (black) and predicted (red) MDA8 ozone for May through September 2011 at site 481210034 in Denton Co., Texas.

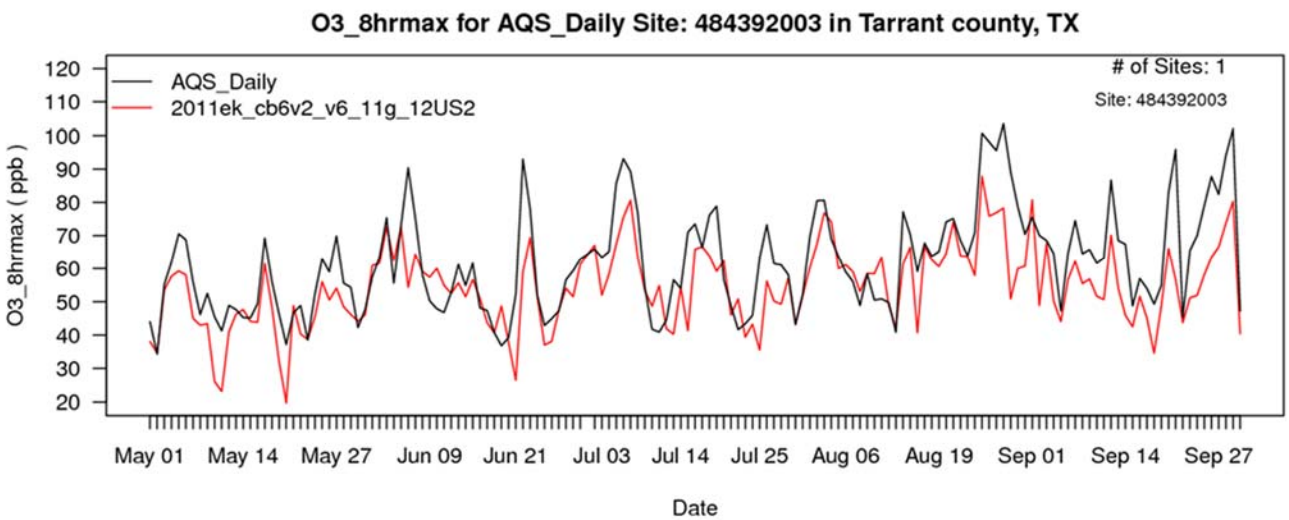


Figure A-17n. Time series of observed (black) and predicted (red) MDA8 ozone for May through September 2011 at site 484392003 in Tarrant Co., Texas.

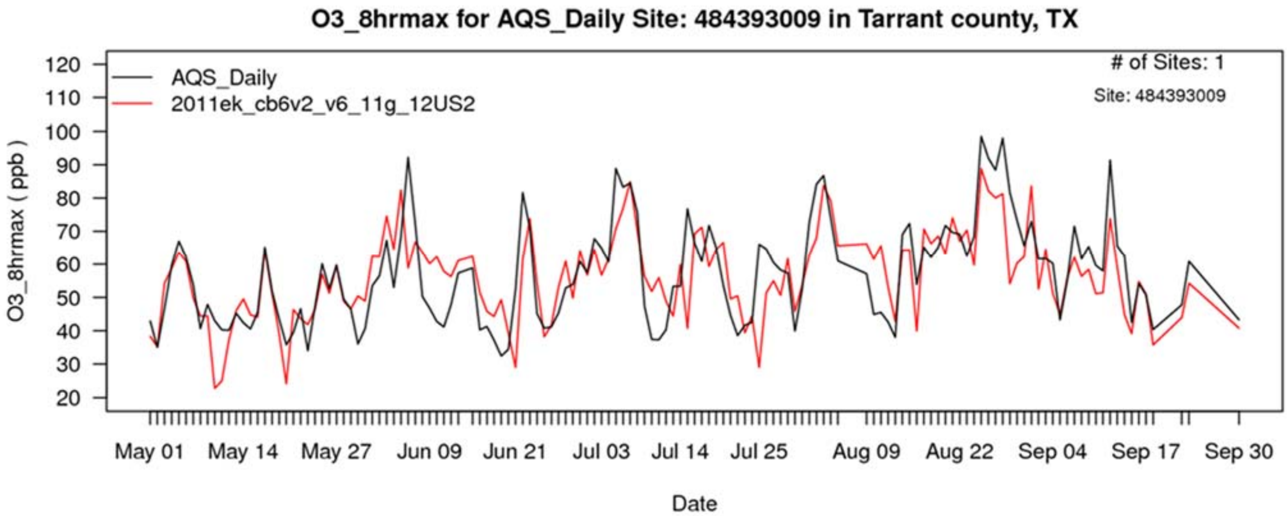


Figure A-17o. Time series of observed (black) and predicted (red) MDA8 ozone for May through September 2011 at site 484393009 in Tarrant Co., Texas.

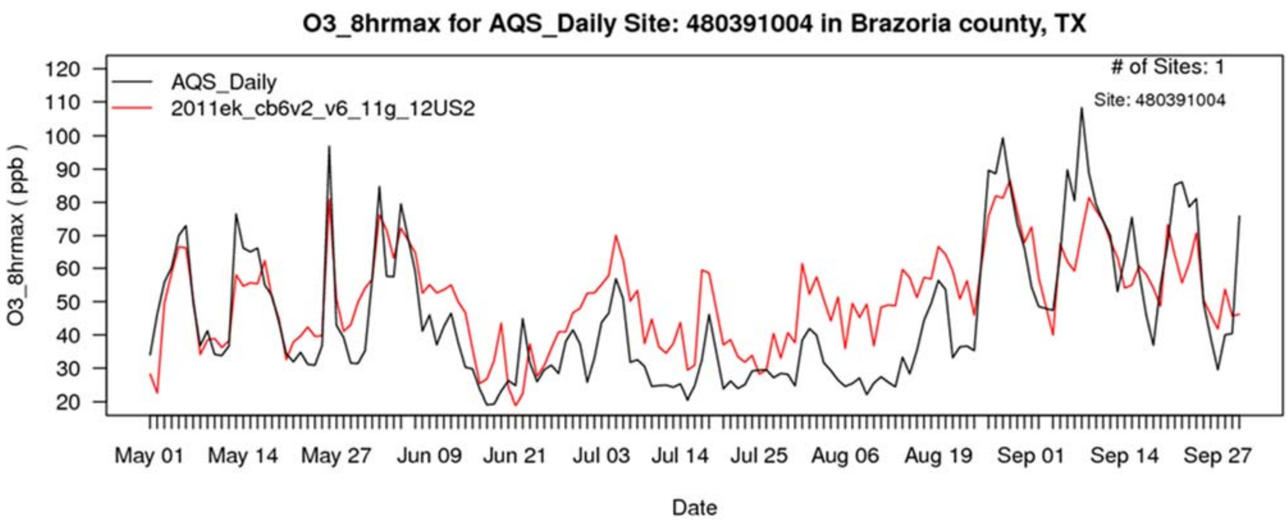


Figure A-17p. Time series of observed (black) and predicted (red) MDA8 ozone for May through September 2011 at site 480391004 in Brazoria Co., Texas.

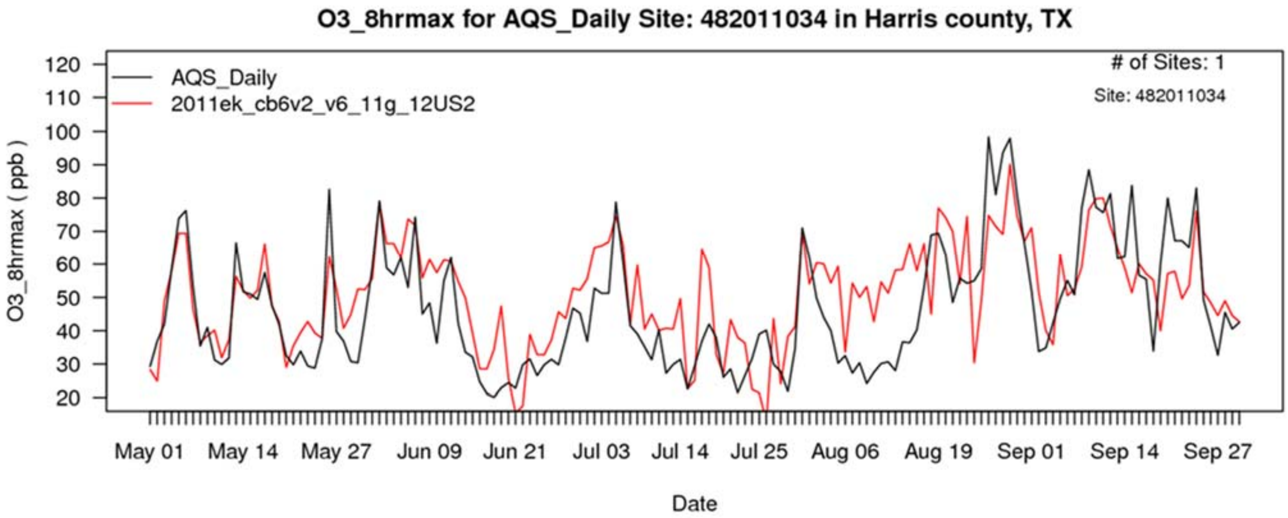


Figure A-17q. Time series of observed (black) and predicted (red) MDA8 ozone for May through September 2011 at site 482011034 in Harris Co., Texas.

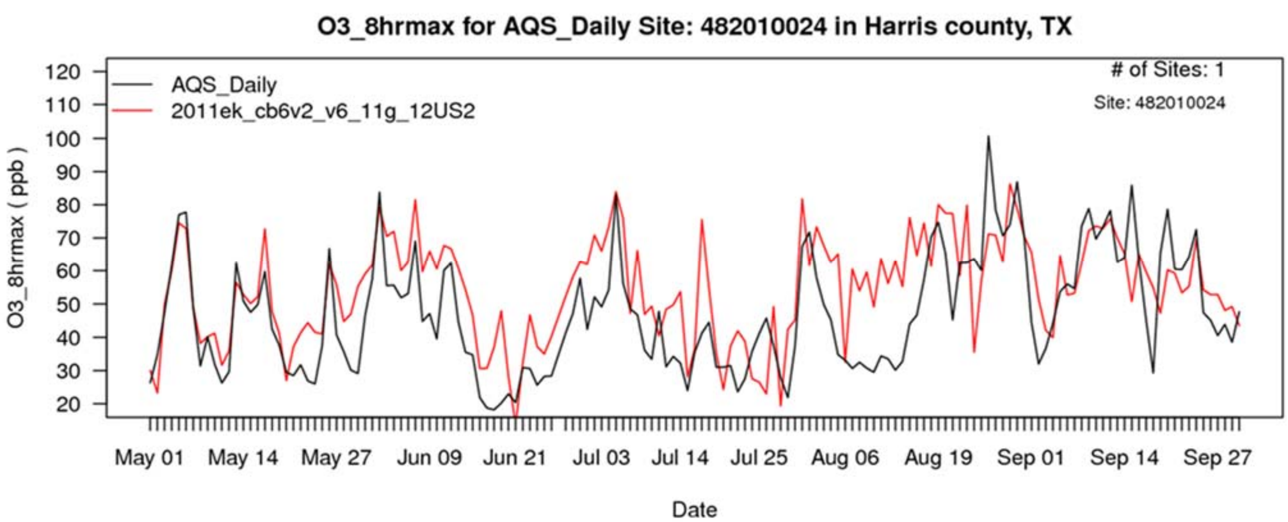


Figure A-17r. Time series of observed (black) and predicted (red) MDA8 ozone for May through September 2011 at site 482010024 in Harris Co., Texas.

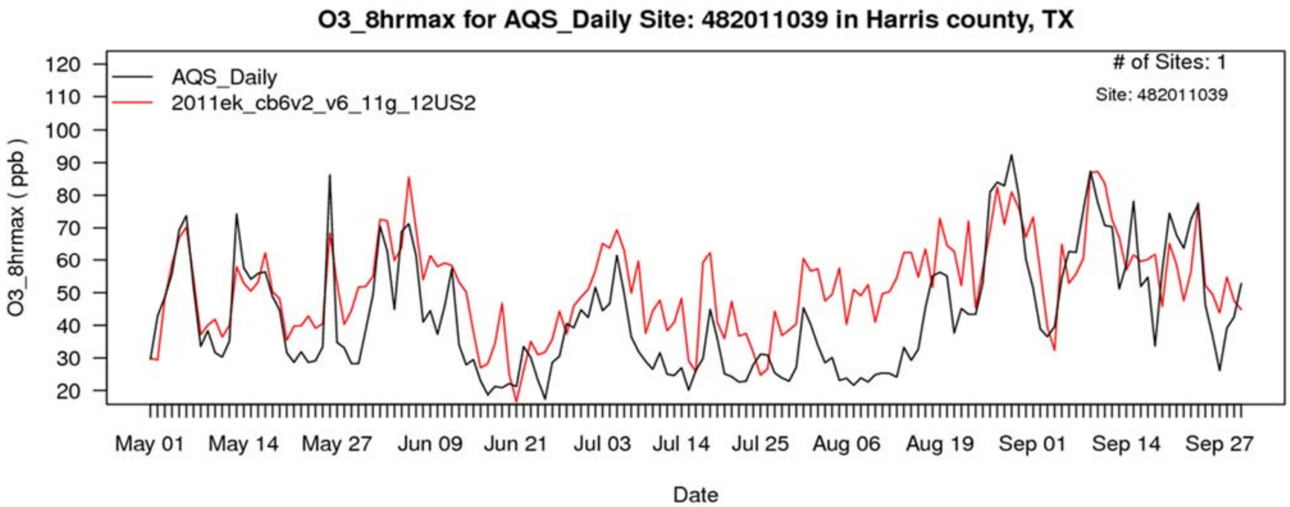


Figure A-17s. Time series of observed (black) and predicted (red) MDA8 ozone for May through September 2011 at site 482011039 in Harris Co., Texas.

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# Appendix C

# Contributions to 2017 8-Hour Ozone Design Values at Projected 2017 Nonattainment and Maintenance-Only Sites

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This appendix contains tables with the projected ozone contributions from 2017 anthropogenic NOx and VOC emissions in each state to each projected 2017 nonattainment receptor and each maintenance-only receptor in the eastern U.S. Nonattainment and maintenance-only receptors are defined in section 3 of this TSD. In addition to the state contributions, we have included the contributions from each of the other categories tracked in the contribution modeling including point source emissions on Tribal lands, anthropogenic emissions in Canada and Mexico, emissions from Offshore sources, Fires, Biogenics, as well as contributions from Initial and Boundary concentrations.

For each monitoring site we provide the site ID, state name, and county name in the first three columns of the table. This information is followed by columns containing the projected 2017 average and maximum design values. Next we provide the contributions from each state and the District of Columbia, individually. Lastly, we provide the contributions from the Tribal, Canada and Mexico, Offshore, Fires, Initial and Boundary concentrations, and Biogenics categories. The units of the 2017 design values and contributions are “ppb”. Note that the contributions presented in these tables may not sum exactly to the 2017 average design value due to truncation of the contributions to two places to the right of the decimal.

# Contributions to 2017 Nonattainment and Maintenance-Only Sites in the East (Part 1)

| Monitor ID | State | County | 2017 Average DV | 2017 Maximum DV | AL | AZ | AR | CA | CO | CT | DE | DC | FL | GA | ID | IL | IN | IA | KS | KY | LA | ME | MD | MA | MI | MN | MS | MO | MT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 90010017 | Connecticut | Fairfield | 74.1 | 76.6 | 0.11 | 0.04 | 0.10 | 0.03 | 0.09 | 6.04 | 0.26 | 0.06 | 0.03 | 0.13 | 0.01 | 0.47 | 0.64 | 0.11 | 0.17 | 0.40 | 0.05 | 0.01 | 1.61 | 0.06 | 0.49 | 0.08 | 0.07 | 0.26 | 0.02 |
| 90013007 | Connecticut | Fairfield | 75.5 | 79.7 | 0.14 | 0.04 | 0.15 | 0.03 | 0.11 | 5.18 | 0.31 | 0.07 | 0.02 | 0.19 | 0.01 | 0.48 | 0.75 | 0.10 | 0.22 | 0.44 | 0.06 | 0.00 | 2.11 | 0.04 | 0.86 | 0.11 | 0.09 | 0.28 | 0.03 |
| 90019003 | Connecticut | Fairfield | 76.5 | 79.5 | 0.15 | 0.04 | 0.15 | 0.03 | 0.11 | 3.89 | 0.34 | 0.07 | 0.02 | 0.20 | 0.01 | 0.47 | 0.76 | 0.10 | 0.22 | 0.45 | 0.05 | 0.00 | 2.12 | 0.03 | 0.84 | 0.11 | 0.09 | 0.28 | 0.03 |
| 90099002 | Connecticut | New Haven | 76.2 | 79.2 | 0.08 | 0.04 | 0.09 | 0.04 | 0.09 | 7.55 | 0.38 | 0.05 | 0.03 | 0.09 | 0.02 | 0.54 | 0.69 | 0.11 | 0.17 | 0.44 | 0.06 | 0.00 | 1.60 | 0.12 | 0.47 | 0.10 | 0.05 | 0.29 | 0.03 |
| 211110067 | Kentucky | Jefferson | 76.9 | 76.9 | 0.04 | 0.03 | 0.06 | 0.06 | 0.13 | 0.00 | 0.00 | 0.00 | 0.03 | 0.04 | 0.05 | 1.14 | 12.32 | 0.24 | 0.28 | 23.56 | 0.09 | 0.00 | 0.00 | 0.00 | 1.16 | 0.36 | 0.03 | 0.29 | 0.18 |
| 240251001 | Maryland | Harford | 78.8 | 81.4 | 0.29 | 0.07 | 0.22 | 0.07 | 0.16 | 0.00 | 0.03 | 0.86 | 0.09 | 0.30 | 0.03 | 0.78 | 2.13 | 0.24 | 0.36 | 2.18 | 0.14 | 0.00 | 26.35 | 0.00 | 0.78 | 0.13 | 0.10 | 0.63 | 0.07 |
| 260050003 | Michigan | Allegan | 74.7 | 77.7 | 0.32 | 0.08 | 2.07 | 0.05 | 0.22 | 0.00 | 0.00 | 0.00 | 0.13 | 0.20 | 0.01 | 23.61 | 8.33 | 0.81 | 1.22 | 0.47 | 0.53 | 0.00 | 0.01 | 0.00 | 2.86 | 0.07 | 0.42 | 3.78 | 0.01 |
| 360850067 | New York | Richmond | 75.8 | 77.4 | 0.29 | 0.08 | 0.11 | 0.08 | 0.15 | 0.38 | 0.66 | 0.08 | 0.10 | 0.36 | 0.03 | 0.68 | 0.94 | 0.20 | 0.27 | 1.03 | 0.12 | 0.00 | 2.49 | 0.05 | 0.66 | 0.13 | 0.10 | 0.41 | 0.04 |
| 361030002 | New York | Suffolk | 76.8 | 78.4 | 0.18 | 0.07 | 0.16 | 0.07 | 0.15 | 0.46 | 0.32 | 0.04 | 0.05 | 0.19 | 0.05 | 0.76 | 1.01 | 0.30 | 0.37 | 0.65 | 0.12 | 0.00 | 1.42 | 0.01 | 1.27 | 0.18 | 0.10 | 0.59 | 0.07 |
| 390610006 | Ohio | Hamilton | 74.6 | 77.4 | 0.73 | 0.06 | 0.61 | 0.08 | 0.18 | 0.00 | 0.00 | 0.00 | 0.11 | 0.58 | 0.04 | 1.25 | 7.24 | 0.30 | 0.43 | 10.88 | 0.24 | 0.00 | 0.00 | 0.00 | 0.93 | 0.23 | 0.29 | 0.80 | 0.10 |
| 421010024 | Pennsylvania | Philadelphia | 73.6 | 76.9 | 0.60 | 0.10 | 0.27 | 0.09 | 0.18 | 0.03 | 1.32 | 0.18 | 0.16 | 0.62 | 0.02 | 0.75 | 2.06 | 0.20 | 0.32 | 2.36 | 0.20 | 0.00 | 5.22 | 0.02 | 0.34 | 0.08 | 0.19 | 0.62 | 0.04 |
| 480391004 | Texas | Brazoria | 79.9 | 80.8 | 0.58 | 0.08 | 1.00 | 0.22 | 0.25 | 0.00 | 0.00 | 0.00 | 0.20 | 0.31 | 0.10 | 0.87 | 0.24 | 0.43 | 0.63 | 0.13 | 3.01 | 0.00 | 0.01 | 0.00 | 0.05 | 0.40 | 0.81 | 1.01 | 0.16 |
| 481210034 | Texas | Denton | 75.0 | 77.4 | 0.68 | 0.09 | 0.51 | 0.13 | 0.25 | 0.00 | 0.00 | 0.00 | 0.31 | 0.40 | 0.06 | 0.11 | 0.12 | 0.08 | 0.56 | 0.13 | 1.89 | 0.00 | 0.00 | 0.00 | 0.11 | 0.04 | 0.50 | 0.23 | 0.09 |
| 482010024 | Texas | Harris | 75.4 | 77.9 | 0.22 | 0.03 | 0.31 | 0.12 | 0.14 | 0.00 | 0.00 | 0.00 | 0.75 | 0.29 | 0.06 | 0.26 | 0.05 | 0.13 | 0.19 | 0.05 | 2.21 | 0.00 | 0.00 | 0.00 | 0.02 | 0.05 | 0.27 | 0.47 | 0.09 |
| 482011034 | Texas | Harris | 75.7 | 76.6 | 0.53 | 0.04 | 0.60 | 0.11 | 0.14 | 0.00 | 0.00 | 0.00 | 0.75 | 0.33 | 0.06 | 0.54 | 0.09 | 0.41 | 0.61 | 0.05 | 3.03 | 0.00 | 0.01 | 0.00 | 0.12 | 0.36 | 0.66 | 0.94 | 0.13 |
| 482011039 | Texas | Harris | 76.9 | 78.8 | 0.41 | 0.03 | 1.23 | 0.10 | 0.16 | 0.00 | 0.00 | 0.00 | 0.16 | 0.22 | 0.05 | 0.87 | 0.15 | 0.33 | 0.46 | 0.07 | 3.20 | 0.00 | 0.01 | 0.00 | 0.27 | 0.23 | 0.79 | 1.16 | 0.11 |
| 484392003 | Texas | Tarrant | 77.3 | 79.7 | 0.79 | 0.09 | 0.54 | 0.11 | 0.31 | 0.00 | 0.00 | 0.00 | 0.34 | 0.48 | 0.07 | 0.17 | 0.16 | 0.20 | 1.13 | 0.16 | 1.75 | 0.00 | 0.01 | 0.00 | 0.22 | 0.11 | 0.54 | 0.31 | 0.11 |
| 484393009 | Texas | Tarrant | 76.4 | 76.4 | 0.99 | 0.09 | 0.34 | 0.13 | 0.24 | 0.00 | 0.00 | 0.00 | 0.71 | 0.60 | 0.06 | 0.10 | 0.12 | 0.07 | 0.44 | 0.14 | 1.93 | 0.00 | 0.02 | 0.00 | 0.11 | 0.04 | 0.59 | 0.16 | 0.09 |
| 551170006 | Wisconsin | Sheboygan | 76.2 | 78.7 | 0.24 | 0.08 | 0.55 | 0.08 | 0.17 | 0.00 | 0.00 | 0.00 | 0.11 | 0.12 | 0.02 | 17.90 | 6.49 | 0.58 | 0.95 | 0.68 | 1.05 | 0.00 | 0.02 | 0.00 | 2.62 | 0.07 | 0.54 | 1.67 | 0.03 |

# Contributions to 2017 Nonattainment and Maintenance-Only Sites in the East (Part 2)

| Monitor ID | State | County | 2017 Average DV | 2017 Maximum DV | NE | NV | NH | NJ | NM | NY | NC | ND | OH | OK | OR | PA | RI | SC | SD | TN | TX | UT | VT | VA | WA | WV | WI | WY |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 90010017 | Connecticut | Fairfield | 74.1 | 76.6 | 0.07 | 0.01 | 0.02 | 9.38 | 0.05 | 18.81 | 0.38 | 0.03 | 1.42 | 0.21 | 0.00 | 7.78 | 0.01 | 0.08 | 0.02 | 0.20 | 0.37 | 0.04 | 0.01 | 1.72 | 0.00 | 0.82 | 0.14 | 0.12 |
| 90013007 | Connecticut | Fairfield | 75.5 | 79.7 | 0.08 | 0.01 | 0.00 | 8.14 | 0.08 | 16.82 | 0.49 | 0.04 | 1.83 | 0.23 | 0.00 | 8.77 | 0.01 | 0.14 | 0.02 | 0.31 | 0.42 | 0.04 | 0.00 | 1.77 | 0.01 | 0.94 | 0.16 | 0.11 |
| 90019003 | Connecticut | Fairfield | 76.5 | 79.5 | 0.08 | 0.01 | 0.00 | 9.52 | 0.08 | 17.22 | 0.51 | 0.04 | 1.83 | 0.23 | 0.00 | 9.28 | 0.00 | 0.15 | 0.02 | 0.32 | 0.42 | 0.04 | 0.00 | 1.92 | 0.01 | 1.04 | 0.16 | 0.12 |
| 90099002 | Connecticut | New Haven | 76.2 | 79.2 | 0.08 | 0.01 | 0.02 | 7.27 | 0.05 | 18.50 | 0.35 | 0.04 | 1.52 | 0.24 | 0.00 | 7.37 | 0.03 | 0.06 | 0.02 | 0.19 | 0.41 | 0.05 | 0.01 | 1.11 | 0.01 | 0.71 | 0.17 | 0.14 |
| 211110067 | Kentucky | Jefferson | 76.9 | 76.9 | 0.16 | 0.02 | 0.00 | 0.00 | 0.08 | 0.00 | 0.01 | 0.22 | 3.78 | 0.33 | 0.02 | 0.44 | 0.00 | 0.01 | 0.12 | 0.12 | 0.61 | 0.05 | 0.00 | 0.00 | 0.07 | 0.64 | 0.54 | 0.28 |
| 240251001 | Maryland | Harford | 78.8 | 81.4 | 0.16 | 0.02 | 0.00 | 0.06 | 0.12 | 0.13 | 0.45 | 0.08 | 3.59 | 0.41 | 0.02 | 4.66 | 0.00 | 0.10 | 0.06 | 0.65 | 0.80 | 0.07 | 0.00 | 5.21 | 0.03 | 3.31 | 0.24 | 0.19 |
| 260050003 | Michigan | Allegan | 74.7 | 77.7 | 0.16 | 0.01 | 0.00 | 0.00 | 0.21 | 0.00 | 0.05 | 0.01 | 0.09 | 1.62 | 0.00 | 0.02 | 0.00 | 0.05 | 0.02 | 0.69 | 2.64 | 0.06 | 0.00 | 0.02 | 0.00 | 0.03 | 2.52 | 0.11 |
| 360850067 | New York | Richmond | 75.8 | 77.4 | 0.12 | 0.02 | 0.00 | 11.90 | 0.13 | 5.32 | 0.50 | 0.05 | 2.41 | 0.33 | 0.01 | 14.61 | 0.00 | 0.13 | 0.04 | 0.48 | 0.69 | 0.08 | 0.01 | 2.31 | 0.01 | 1.92 | 0.31 | 0.19 |
| 361030002 | New York | Suffolk | 76.8 | 78.4 | 0.20 | 0.02 | 0.00 | 11.07 | 0.09 | 16.82 | 0.36 | 0.13 | 2.34 | 0.47 | 0.01 | 8.77 | 0.00 | 0.08 | 0.08 | 0.34 | 0.72 | 0.09 | 0.00 | 1.53 | 0.02 | 0.98 | 0.25 | 0.24 |
| 390610006 | Ohio | Hamilton | 74.6 | 77.4 | 0.18 | 0.03 | 0.00 | 0.00 | 0.14 | 0.11 | 0.13 | 0.11 | 16.83 | 0.67 | 0.03 | 0.35 | 0.00 | 0.13 | 0.06 | 1.82 | 1.55 | 0.08 | 0.00 | 0.11 | 0.04 | 0.98 | 0.54 | 0.21 |
| 421010024 | Pennsylvania | Philadelphia | 73.6 | 76.9 | 0.12 | 0.02 | 0.00 | 1.39 | 0.18 | 0.19 | 0.46 | 0.04 | 3.70 | 0.40 | 0.01 | 20.14 | 0.00 | 0.18 | 0.04 | 1.04 | 0.99 | 0.08 | 0.00 | 2.35 | 0.01 | 3.03 | 0.16 | 0.17 |
| 480391004 | Texas | Brazoria | 79.9 | 80.8 | 0.25 | 0.08 | 0.00 | 0.00 | 0.12 | 0.00 | 0.08 | 0.06 | 0.04 | 0.73 | 0.05 | 0.02 | 0.00 | 0.08 | 0.08 | 0.38 | 37.06 | 0.14 | 0.00 | 0.04 | 0.05 | 0.03 | 0.33 | 0.30 |
| 481210034 | Texas | Denton | 75.0 | 77.4 | 0.17 | 0.06 | 0.00 | 0.00 | 0.14 | 0.00 | 0.08 | 0.02 | 0.10 | 1.28 | 0.02 | 0.03 | 0.00 | 0.09 | 0.03 | 0.19 | 32.33 | 0.15 | 0.00 | 0.03 | 0.02 | 0.04 | 0.06 | 0.27 |
| 482010024 | Texas | Harris | 75.4 | 77.9 | 0.07 | 0.05 | 0.00 | 0.00 | 0.05 | 0.00 | 0.23 | 0.02 | 0.05 | 0.21 | 0.03 | 0.03 | 0.00 | 0.30 | 0.02 | 0.09 | 30.98 | 0.10 | 0.00 | 0.07 | 0.02 | 0.05 | 0.02 | 0.18 |
| 482011034 | Texas | Harris | 75.7 | 76.6 | 0.27 | 0.04 | 0.00 | 0.00 | 0.05 | 0.00 | 0.21 | 0.06 | 0.04 | 1.02 | 0.02 | 0.02 | 0.00 | 0.26 | 0.07 | 0.12 | 29.80 | 0.08 | 0.00 | 0.07 | 0.03 | 0.05 | 0.24 | 0.22 |
| 482011039 | Texas | Harris | 76.9 | 78.8 | 0.21 | 0.04 | 0.00 | 0.00 | 0.05 | 0.01 | 0.06 | 0.05 | 0.03 | 0.79 | 0.02 | 0.02 | 0.00 | 0.05 | 0.05 | 0.32 | 32.53 | 0.07 | 0.00 | 0.03 | 0.03 | 0.02 | 0.28 | 0.21 |
| 484392003 | Texas | Tarrant | 77.3 | 79.7 | 0.35 | 0.05 | 0.00 | 0.00 | 0.15 | 0.02 | 0.10 | 0.04 | 0.16 | 2.24 | 0.03 | 0.09 | 0.00 | 0.11 | 0.07 | 0.21 | 31.46 | 0.16 | 0.00 | 0.05 | 0.03 | 0.07 | 0.13 | 0.33 |
| 484393009 | Texas | Tarrant | 76.4 | 76.4 | 0.15 | 0.05 | 0.00 | 0.00 | 0.14 | 0.02 | 0.18 | 0.02 | 0.12 | 0.86 | 0.02 | 0.07 | 0.00 | 0.15 | 0.03 | 0.23 | 33.69 | 0.14 | 0.00 | 0.08 | 0.02 | 0.07 | 0.05 | 0.25 |
| 551170006 | Wisconsin | Sheboygan | 76.2 | 78.7 | 0.09 | 0.02 | 0.00 | 0.00 | 0.21 | 0.02 | 0.06 | 0.04 | 0.72 | 1.59 | 0.01 | 0.19 | 0.00 | 0.04 | 0.02 | 0.50 | 2.18 | 0.07 | 0.00 | 0.07 | 0.01 | 0.29 | 12.44 | 0.11 |

NMED Exhibit 9g

# Contributions to 2017 Nonattainment and Maintenance-Only Sites in the East (Part 3)

| Monitor ID | State | County | 2017 Average DV | 2017 Maximum DV | Tribal | Canada & Mexico | Offshore | Fires | Initial & Boundary | Biogenics |
|---|---|---|---|---|---|---|---|---|---|---|
| 90010017 | Connecticut | Fairfield | 74.1 | 76.6 | 0.01 | 0.95 | 0.73 | 0.16 | 15.73 | 3.21 |
| 90013007 | Connecticut | Fairfield | 75.5 | 79.7 | 0.02 | 1.20 | 1.28 | 0.19 | 16.38 | 3.92 |
| 90019003 | Connecticut | Fairfield | 76.5 | 79.5 | 0.02 | 1.19 | 1.18 | 0.19 | 16.17 | 3.93 |
| 90099002 | Connecticut | New Haven | 76.2 | 79.2 | 0.02 | 1.22 | 2.49 | 0.17 | 16.96 | 3.59 |
| 211110067 | Kentucky | Jefferson | 76.9 | 76.9 | 0.02 | 0.45 | 0.05 | 0.18 | 21.86 | 6.54 |
| 240251001 | Maryland | Harford | 78.8 | 81.4 | 0.03 | 0.55 | 0.28 | 0.31 | 15.55 | 5.45 |
| 260050003 | Michigan | Allegan | 74.7 | 77.7 | 0.04 | 0.27 | 0.31 | 0.69 | 11.20 | 8.46 |
| 360850067 | New York | Richmond | 75.8 | 77.4 | 0.03 | 1.40 | 0.86 | 0.26 | 17.14 | 4.86 |
| 361030002 | New York | Suffolk | 76.8 | 78.4 | 0.03 | 1.25 | 1.38 | 0.29 | 15.67 | 4.70 |
| 390610006 | Ohio | Hamilton | 74.6 | 77.4 | 0.03 | 0.64 | 0.18 | 0.49 | 16.97 | 6.89 |
| 421010024 | Pennsylvania | Philadelphia | 73.6 | 76.9 | 0.04 | 0.45 | 0.70 | 0.38 | 15.56 | 5.56 |
| 480391004 | Texas | Brazoria | 79.9 | 80.8 | 0.03 | 0.35 | 1.06 | 1.52 | 19.95 | 6.32 |
| 481210034 | Texas | Denton | 75.0 | 77.4 | 0.03 | 0.39 | 1.62 | 0.82 | 24.26 | 6.24 |
| 482010024 | Texas | Harris | 75.4 | 77.9 | 0.01 | 0.13 | 5.71 | 0.77 | 27.73 | 2.56 |
| 482011034 | Texas | Harris | 75.7 | 76.6 | 0.01 | 0.21 | 3.73 | 1.78 | 23.26 | 4.29 |
| 482011039 | Texas | Harris | 76.9 | 78.8 | 0.01 | 0.27 | 2.91 | 2.56 | 21.10 | 4.99 |
| 484392003 | Texas | Tarrant | 77.3 | 79.7 | 0.03 | 0.51 | 1.61 | 1.54 | 24.13 | 5.79 |
| 484393009 | Texas | Tarrant | 76.4 | 76.4 | 0.03 | 0.39 | 2.00 | 1.29 | 23.94 | 5.19 |
| 551170006 | Wisconsin | Sheboygan | 76.2 | 78.7 | 0.03 | 0.41 | 0.72 | 0.50 | 14.35 | 7.31 |

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# Appendix D

# Analysis of Contributions from Florida

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Reports by the CAMx model developer on the impact of modeling with the latest CAMx halogen chemistry indicates that the updated chemistry results in lower modeled ozone in air transported over saltwater marine environments for multiple days (Yarwood et al., 2012 and 2014). Specifically, the Ramboll Environ 2014 report notes that on days with multi-day transport across the Gulf of Mexico, modeling with the updated chemistry could lower 8-hour daily maximum ozone concentrations by up to 2 to 4 ppb in locations in eastern Texas, including Houston. To determine whether modeling with the updated chemistry could lower the contribution from Florida to these two receptors, we analyzed back trajectories from these receptors on those days when Florida was modeled to contribute at or above the 0.75 ppb threshold. The days analyzed were July 5 and 6 for Harris Co. receptor site 482010024 and June 2 and July 5 for Harris Co. receptor site 482011034. Specifically we created 4-day back trajectories based on the meteorological data used in the air quality modeling with separate trajectories starting at 8:00 am, 12:00 pm, and 3:00 pm LST for each of four vertical levels (250 m, 500 m, 750 m, and 1000 m). The back trajectories which crossed Florida upstream of these days are shown in Figures 4-1a and b. The results show that the paths of the air parcel trajectories for days with contributions at or above the threshold from Florida to the Houston receptors do indeed cross the Gulf of Mexico over multiple days before reaching the receptors in Houston.

In addition to Florida, Mississippi is the only other Gulf Coast state that is only linked to receptors in Houston. We therefore also looked at back trajectories for the linkages between Mississippi and receptors in the Houston area (i.e., receptors in Brazoria Co. site 480391004 and Harris Co., site 4802011039). Specifically, we examined back trajectories from Brazoria Co., TX on June 6 and Harris Co., TX on June 6 and September 11 which are the days that Mississippi contributed at or above the threshold to each of these receptors. The back trajectories for these days that passed over Mississippi upstream of the Houston area are shown in Figure 4-2a and b. These trajectories indicate that air parcels that crossed Mississippi did not traverse the Gulf of Mexico, but rather remained over land for most of the transport time between Mississippi and each of these receptors. Therefore, there is no reason to believe that the contributions from Mississippi to receptors in Brazoria Co., TX and Harris Co., TX would be lower if we had modeled using the updated halogen chemistry. Thus, we can conclude that the source-receptor transport pattern between Florida and Houston involving multi-day transport over the Gulf of

Mexico is unique such that modeling with the updated halogen chemistry would not be expected to affect linkages from other upwind states to receptors in Houston or any other linkages from upwind states to downwind nonattainment and maintenance receptors for the final rule.

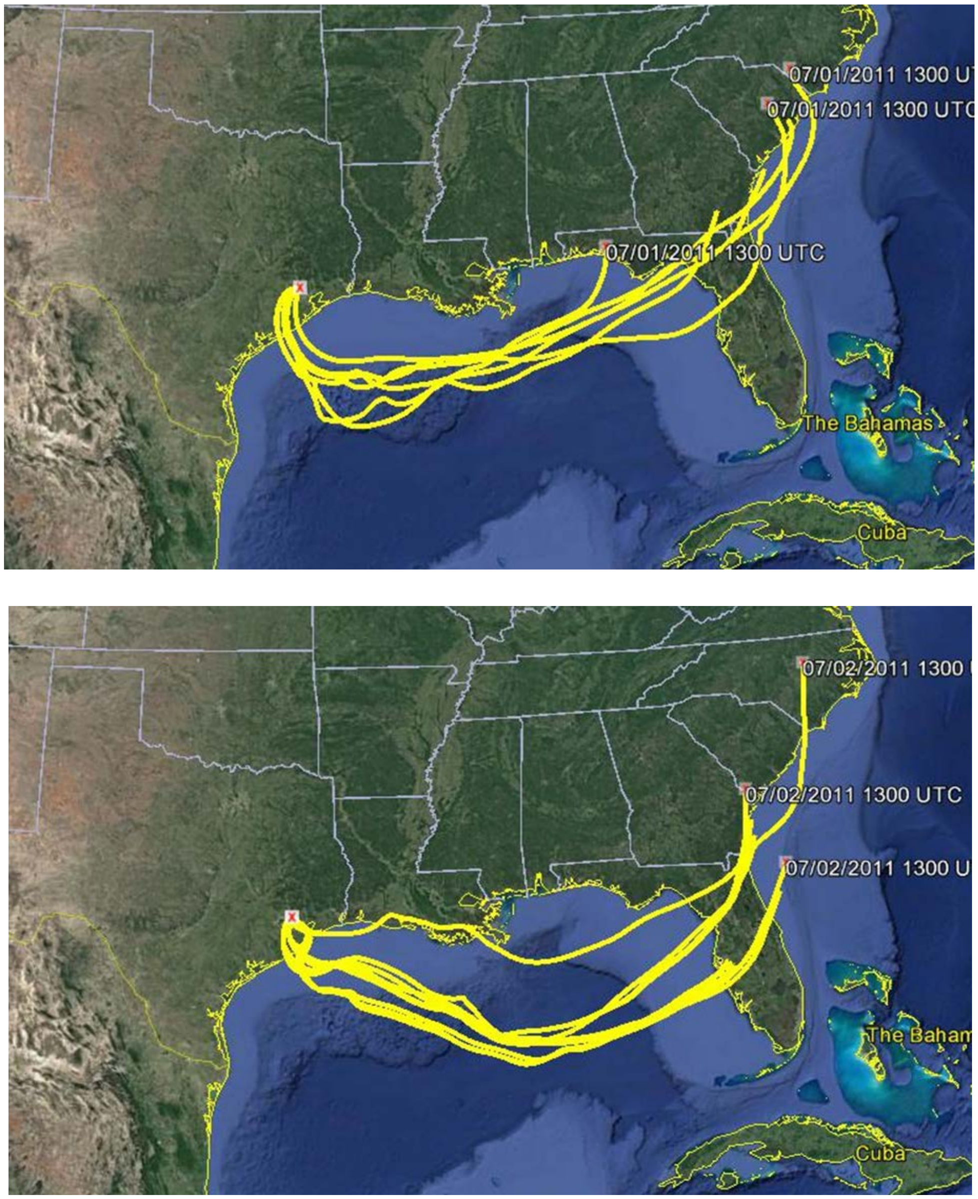
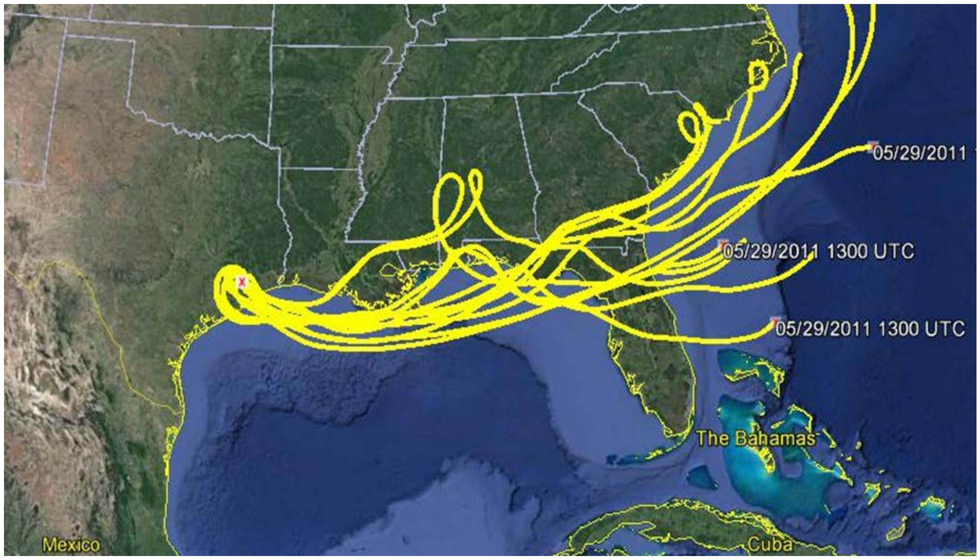



Figure D-1a. Back trajectories from Harris Co., TX site 482010024 on July 5 (top) and July 6 (bottom) when Florida was modeled to contribute at or above the 1 percent threshold to this site.



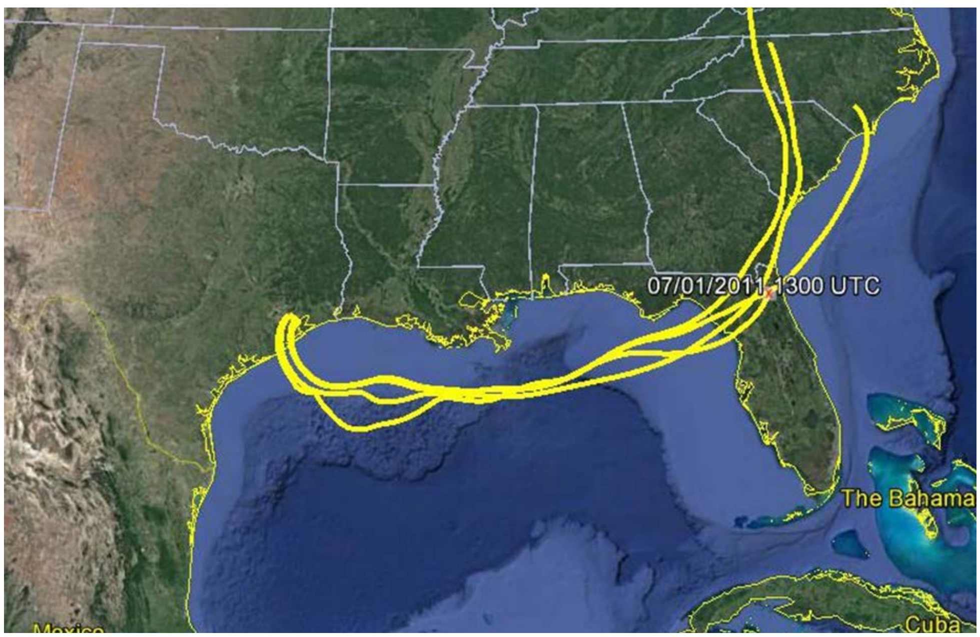




Figure D-1b. Back trajectories from Harris Co., TX site 482011034 on June 2 (top) and July 5 (bottom) when Florida was modeled to contribute at or above the 1 percent threshold to this site.

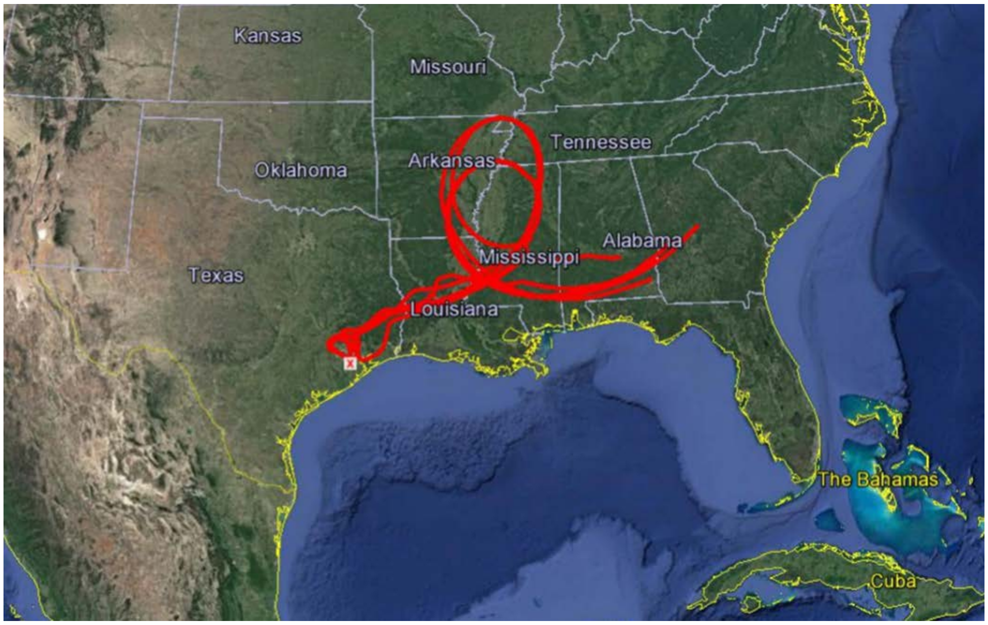
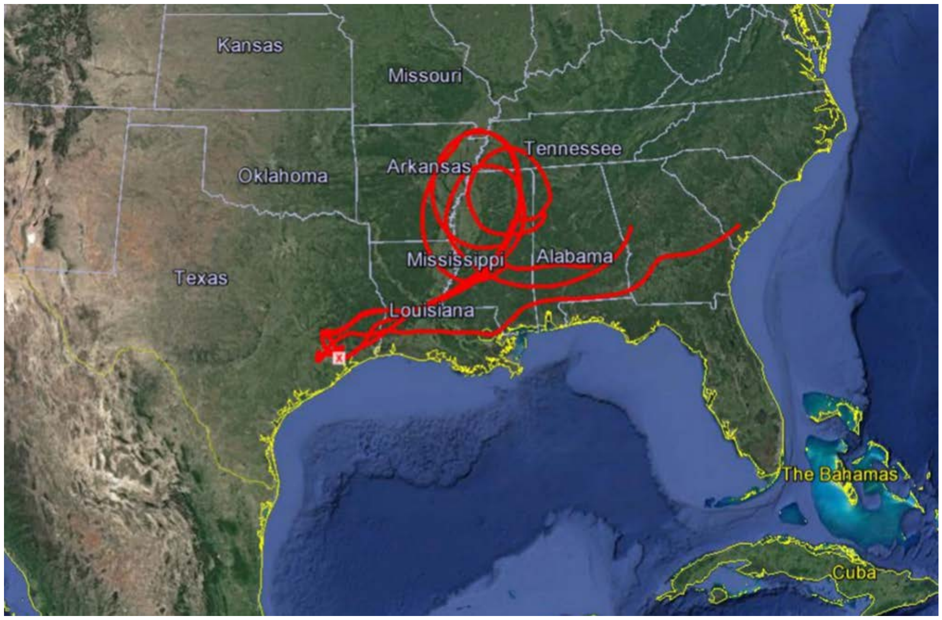



Figure D-2a. Back trajectories from Brazoria Co., TX site 480391004 on June 6 when Mississippi was modeled to contribute at or above the 1 percent threshold to this site.



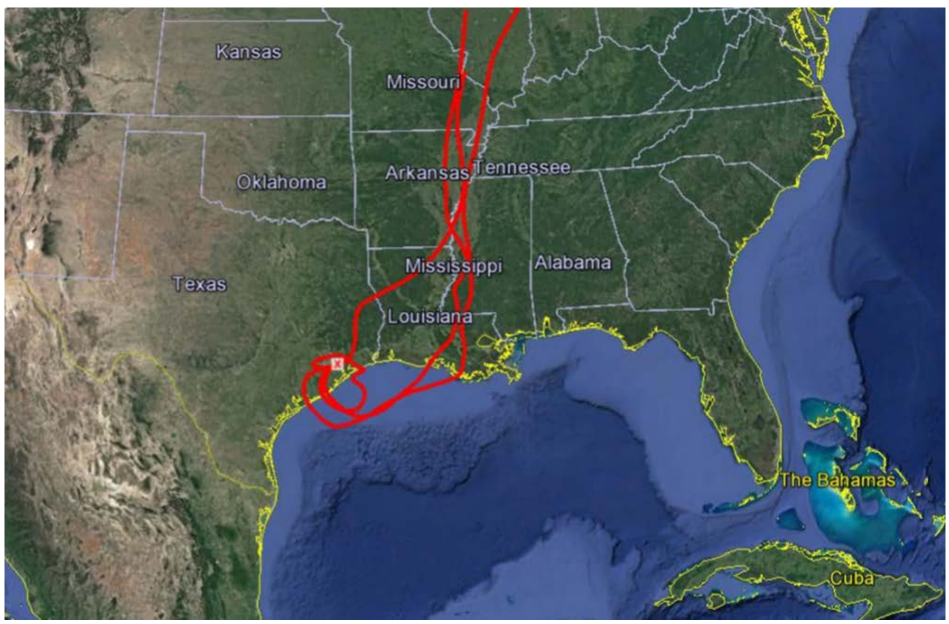




Figure D-2b. Back trajectories from Harris Co., TX site 482011039 on June 6 (top) and September 11 (bottom) when Mississippi was modeled to contribute at or above the 1 percent threshold to this site.

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# Appendix E

# Back Trajectory Analysis of Transport Patterns

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## I. Introduction

This appendix describes the back trajectory analysis performed for each of the 19 nonattainment and maintenance receptors in the final CSAPR Update. The purpose of this analysis is to qualitatively compare the transport patterns, as indicated by back trajectories, to the upwind state-to-downwind receptor linkages identified based on detailed photochemical modeling performed as part of the final CSAPR Update. The modeled contributions of emissions from upwind states to ozone at downwind receptors are the result of the modeled transport meteorology and the emissions of precursor pollutants in combination with the chemical transformation and removal processes simulated by the model. In this analysis, we use back trajectories in a qualitative way to examine one of the factors, the transport patterns, on days with measured ozone exceedances. The back trajectories were calculated using meteorological fields determined based on observations that were constructed in a nearly independent manner from the simulated meteorological fields used in the photochemical modeling for this rule. Therefore, the general consistency between the transport patterns indicated by back trajectories and the upwind/downwind linkages corroborate and add confidence to the validity of the linkages for this rule.

## II. Methodology

For the back trajectory EPA used a technique involving independent meteorological inputs to examine the general plausibility of these linkages. Using the HYSPLIT (HYbrid Single-Particle Lagrangian Integrated Trajectory) model along with observation-based meteorological wind fields, EPA created air flow back trajectories for each of the 19 nonattainment or maintenance-only receptors on days with a measured exceedance in 2011 and on exceedence days in several other recent high ozone years (i.e., 2005, 2007, 2010, and 2012). One focus of this analysis was on trajectories for exceedance days occurring in 2011, since this was the year of meteorology that was used for air quality modeling to support this rule. The trajectories during the four additional years were compared to the transport patterns in 2011 to examine whether common transport patterns are present.

The HYSPLIT model developed as a joint effort between NOAA and Australia's Bureau of Meteorology[1] is capable of computing the trajectory (i.e., path) of air parcels through a meteorological wind field. A "back trajectory" calculated by HYSPLIT is essentially the series of locations in the atmosphere that an air parcel occupied prior to arriving at a particular location of interest. Thus, the HYSPLIT model can be used to estimate the history of an air mass prior to arrival over a given air quality monitor at a given time.

Air parcels can follow highly complex, convoluted patterns as they move through the atmosphere. Circular pathways are common due to the clockwise air circulation around high-pressure systems and counter-clockwise circulation around low-pressure systems. A simple west-to-east trajectory could also occur for a parcel following the prevailing westerlies. Local meteorological effects due to land- and sea-breeze air circulations or terrain-induced flows can also influence air-parcel trajectories. Strong variations in wind speed and direction often occur in the vertical direction due to the diminishing impact of the Earth's surface on air motion with vertical distance from the ground. The Earth's surface impacts both

[1] (http://www.arl.noaa.gov/HYSPLIT_info.php)

wind speed and direction because the frictional effect of the surface opposes both the pressure-driven movement of air as well as the turning of the air due to large scale planetary motion. Thus, air masses may come from different directions at different heights. Highly complex air-parcel trajectories are common, because a given air parcel often experiences the combined effects of numerous interacting air flow systems. Pollutants emitted from sources in one area mix upward during the day and are transported with the wind flow at the surface and aloft. At night, the pollutants remaining aloft from emissions on the previous day can travel long distances due to the presence of phenomena such as the "nocturnal jet", which is a ribbon of strong winds that forms at night just above the boundary layer under certain meteorological conditions.

Air-parcel trajectories were calculated based on meteorological fields obtained from the Eta Data Assimilation System (EDAS)[2]. EDAS is an intermittent data assimilation system that uses successive three-hour model forecasts to generate gridded meteorological fields that reflect observations. The three-hour analysis updates allow for the assimilation of high-frequency observations, such as wind profiler data, Next Generation Weather Radar (NEXRAD) data, and aircraft-measured meteorological data. In this manner, the forecast wind fields are aligned to measured wind data.

For this analysis, site-specific backward air-parcel trajectories were calculated with the HYSPLIT model from heights at 250-m, 500-m, 750-m, 1000-m, and 1500 m above ground level on days with measured exceedances at the given receptor site. The trajectories were initialized at multiple elevations aloft in order to consider the effects of vertical variations in wind flows on transport patterns. Trajectories were tracked backward in time for 96 hours (i.e., 4 days) for each of several time periods (i.e., initialization times) on each exceedance day[3]. Back trajectories were initialized at 0800, 1200, and 1500 local Standard Time (LST). The morning initialization time roughly corresponds to the time when the morning boundary layer is rising and pollutants that were transported aloft overnight begin to mix down to the surface. The afternoon initialization times roughly span the time of the day with highest ozone concentrations.

Once the trajectories were created, they were converted to geographic files that can be read by programs such as Google Earth or ArcGIS. These files enable the characterization of the geographic location of each trajectory for every hour that was run. The point locations along the trajectory paths were used to create line densities that correlate to the number of times a trajectory passed through a geographic area. These line densities provide a general sense of the frequency at which an air parcel passed over given areas.

The back trajectories are considered to corroborate the upwind state-downwind receptor linkages if the density plots indicate that air parcels cross over some portion of each upwind state that is linked to that receptor, as determined from the final CSAPR Update modeling. Such a connection indicates that the observed wind patterns can transport pollutants from the upwind state to the downwind receptor and

[2] (EDAS; http://ready.arl.noaa.gov/edas40.php)

[3] We selected 96 hours for calculating back trajectories to reveal multi-day interstate transport patterns while recognizing that the accuracy of the trajectory paths decreases with time.

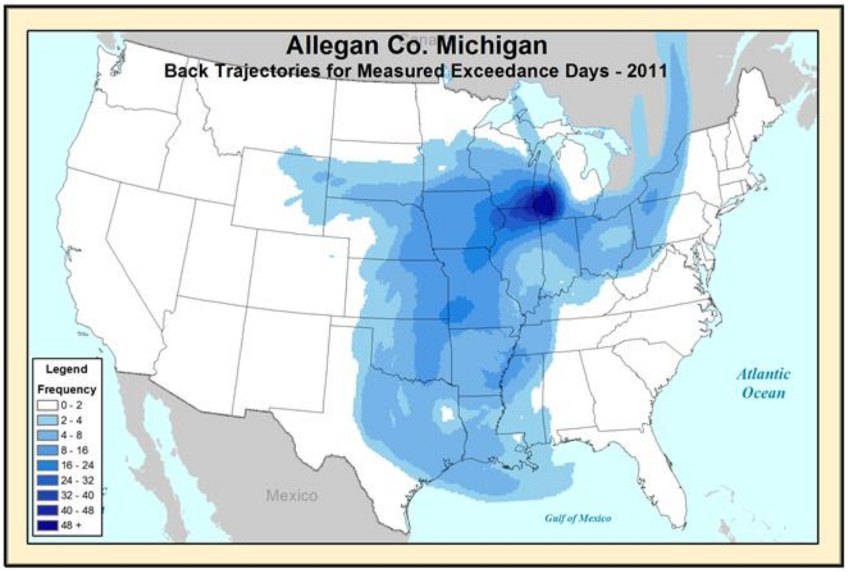
potentially impact ozone concentrations on exceedance days at the receptor. Due to vertical and temporal variations in wind speed and direction, not all trajectories from upwind states are expected to have traversed each upwind state at all vertical levels and times.

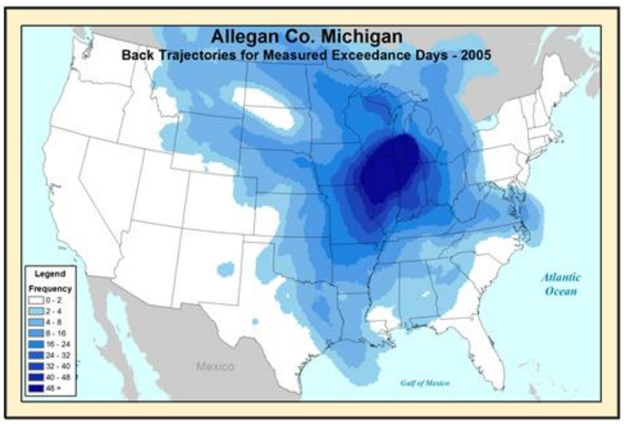
The photochemical modeling, which combines spatially refined hourly pollutant precursor emissions with hourly wind fields, and additional meteorological effects is specifically designed to treat time varying pollutant formation and transport. Thus, while a finding that the transport patterns based on the HYSPLIT back trajectories are consistent with the transport patterns evident from upwind state-downwind receptor linkages provides a means to corroborate the robustness of the linkages, the failure of backward trajectories to align precisely with any individual linkage does not undermine the credibility of that linkage.

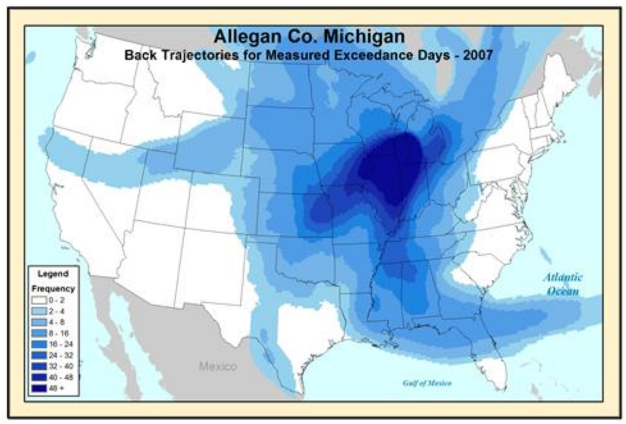
Furthermore, since the back trajectory calculations do not account for any air pollution formation, dispersion, transformation, or removal processes as influenced by emissions, chemistry, deposition, etc., the trajectories cannot be used to develop quantitative contributions and, thus, cannot be used to quantitatively evaluate the magnitude of the existing photochemical contributions from upwind states to downwind receptors. The intersection of upwind states by back trajectories from a particular receptor does not necessarily imply how much the upwind state contributes to ozone at that receptor. Also, there are cases in which the back trajectories from certain receptors cross other states that are not "linked" to that receptor. This is most likely due to the influence on pollution concentrations of meteorological conditions (e.g., temperature, clouds, and mixing) that are present when the air parcels cross these other states. In this regard, photochemical model simulations with chemistry and detailed source-apportionment tracking of pollutants, as used for the final CSAPR Update, are needed in order to quantify the magnitude of upwind state-to-downwind receptor contributions. However, if the transport patterns for observed exceedance days are consistent with the upwind/downwind relationships based on the modeled linkages then this provides important corroborative support for the modeled linkages because it indicates that the modeled transport patterns are consistent with transport patterns based on observed meteorological data.

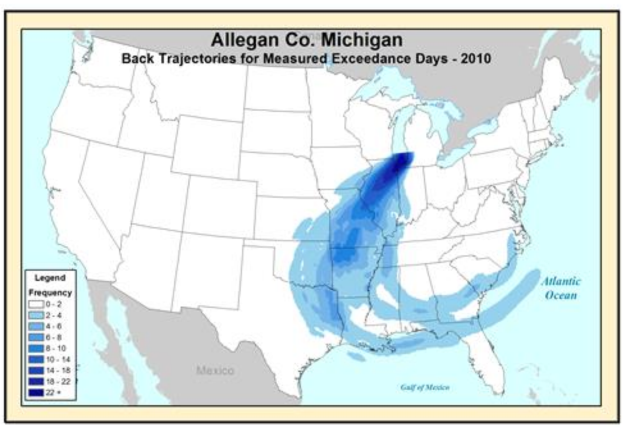
Back trajectories for each of the 19 nonattainment and maintenance receptors on days with measured exceedances in 2005, 2007, 2010, 2011, and 2012 are provided in the remainder of this appendix. At the top of each page we identify the receptor and the upwind states that are linked to that receptor.

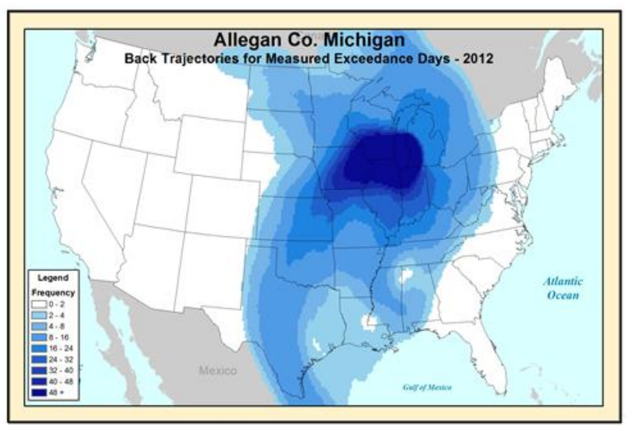
Upwind states linked to Allegan Co., MI site 260050003: AR, IL, IN, IA, KS, MO, OK, TX, and WI.



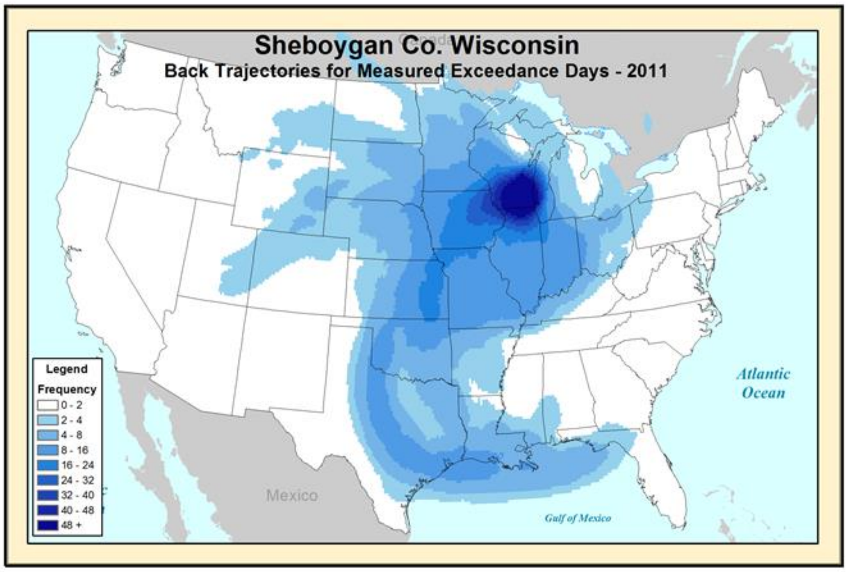



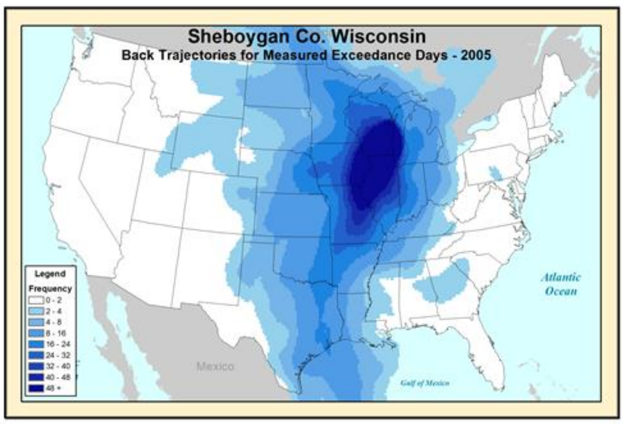



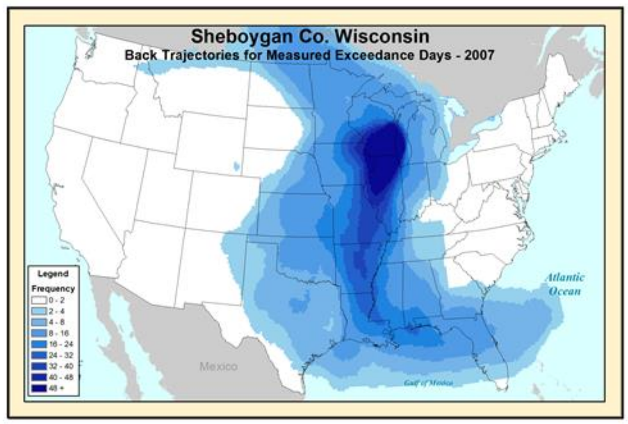



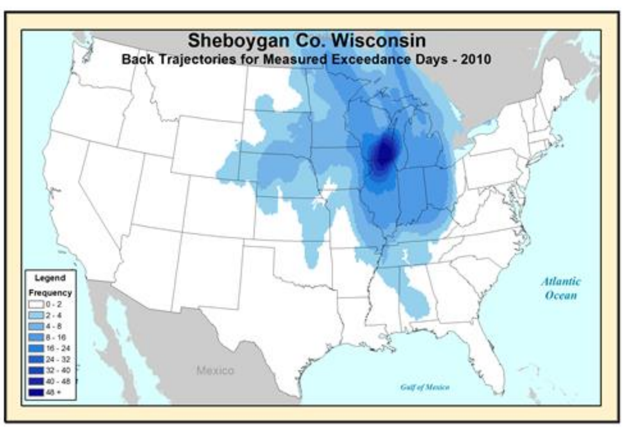



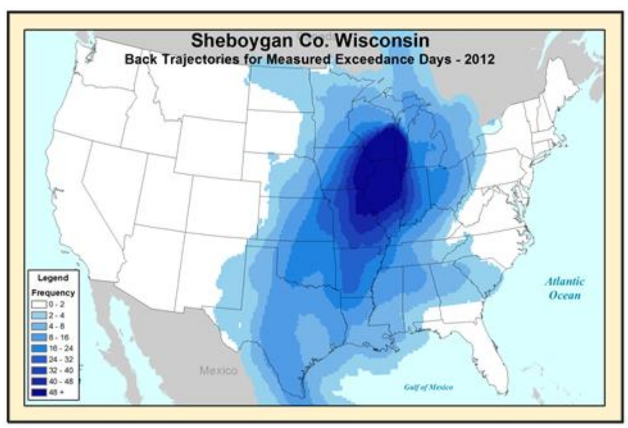
Upwind states linked to Sheboygan Co., WI site 551170006: IL, IN, KS, LA, MI, MO, OK, and TX.



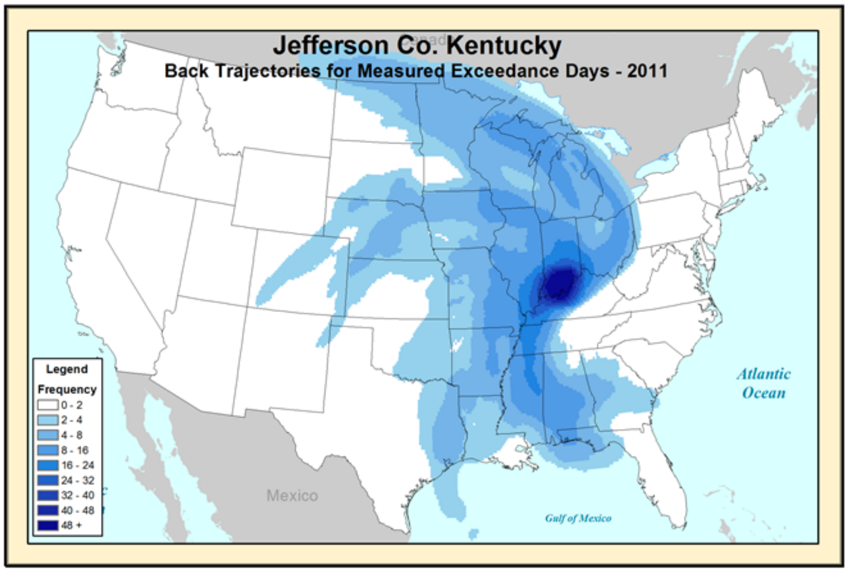



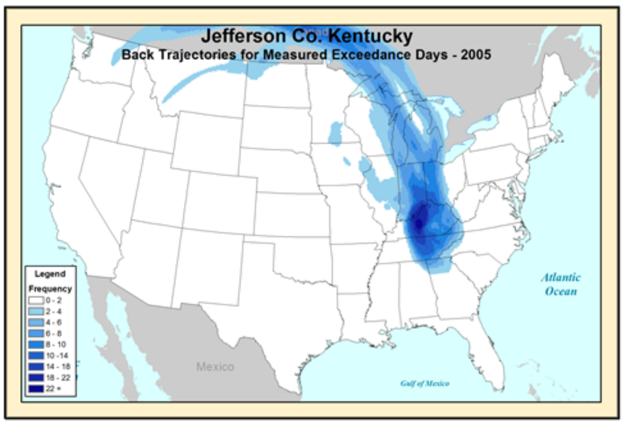



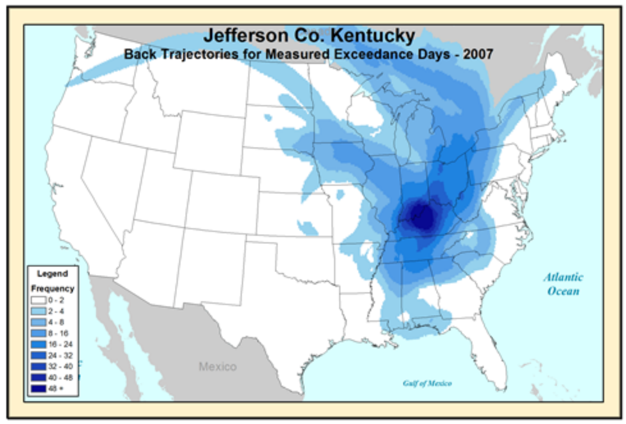



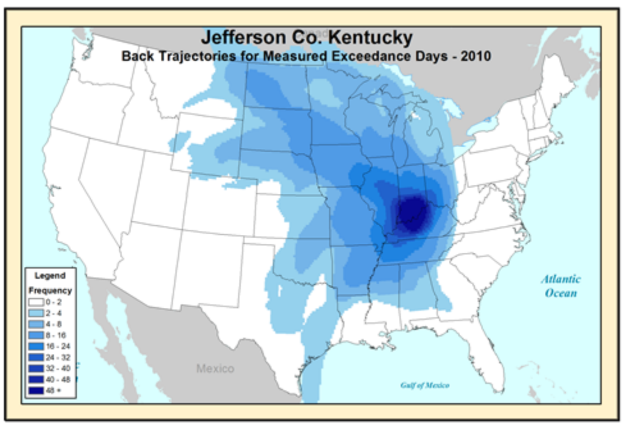



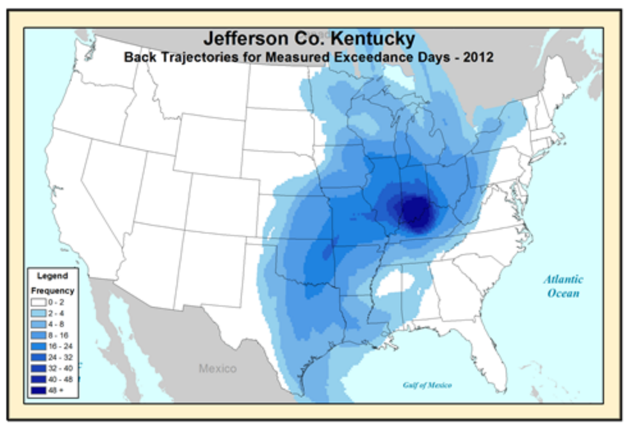
Upwind states linked to Jefferson Co., KY site 211110067: IL, IN, MI, and OH.



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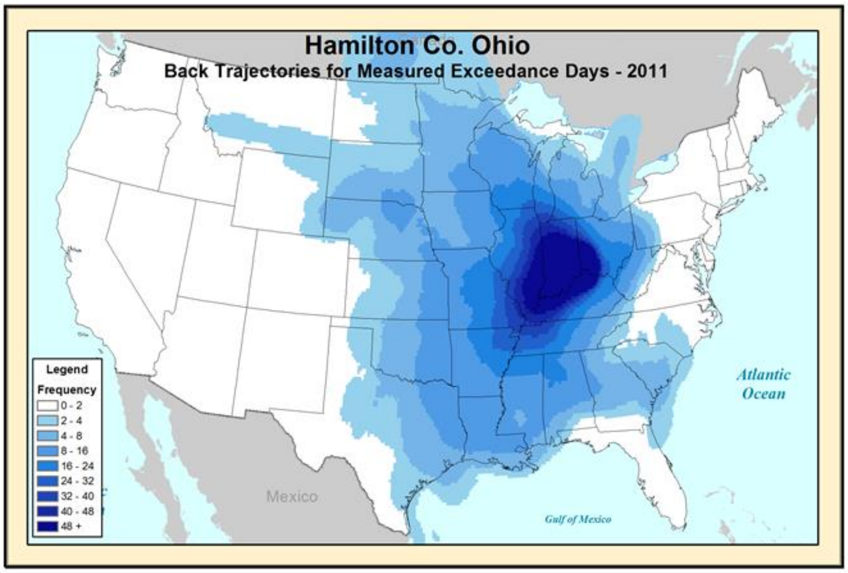
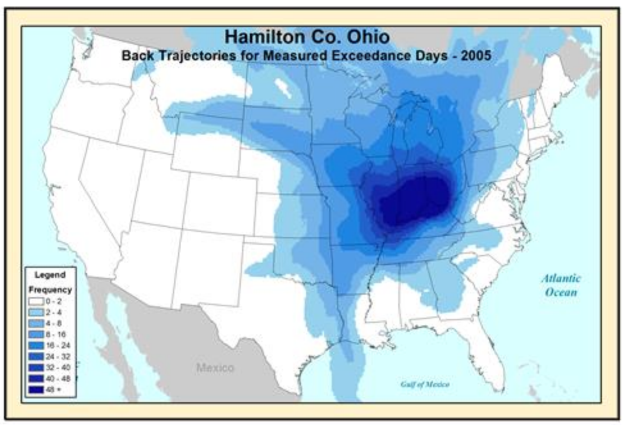
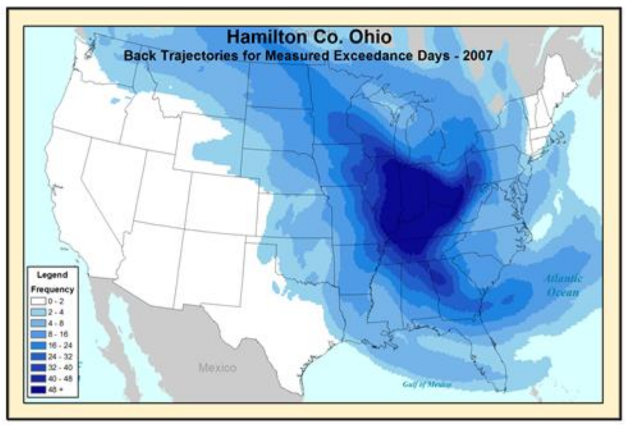
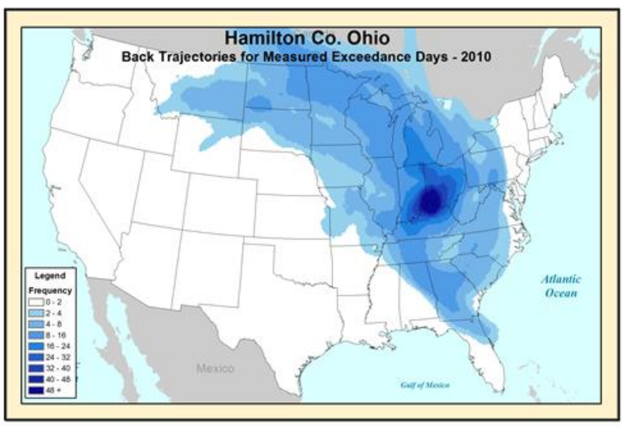
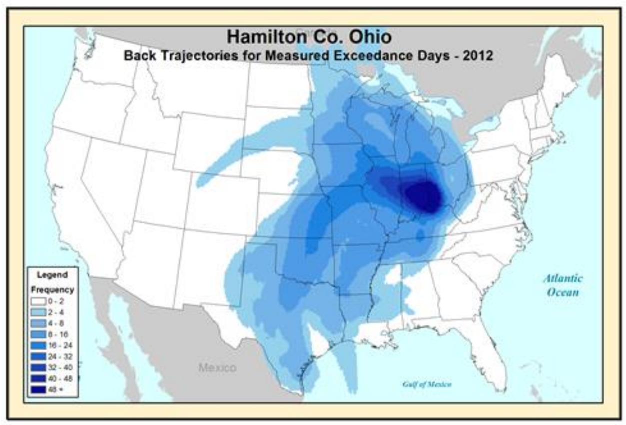
Upwind states linked to Hamilton Co., OH site390610006: IL, IN, KY, MI, MO, TN, TX, and WV.



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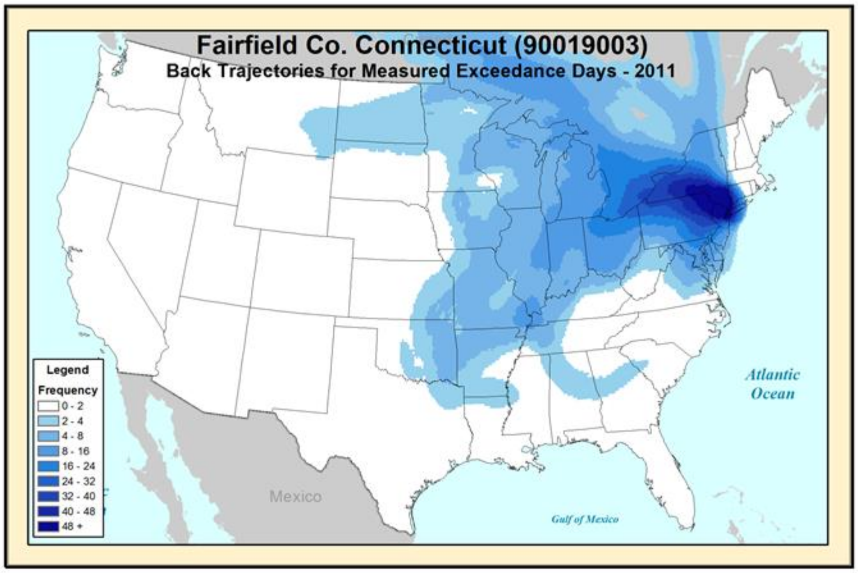
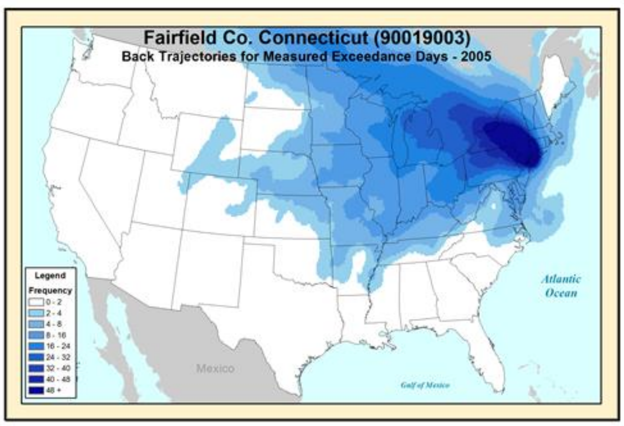
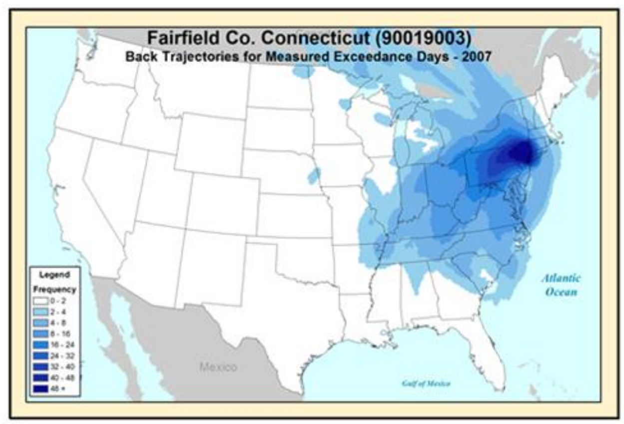
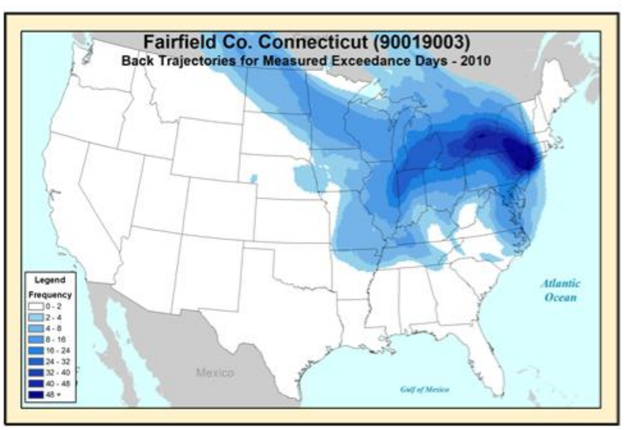
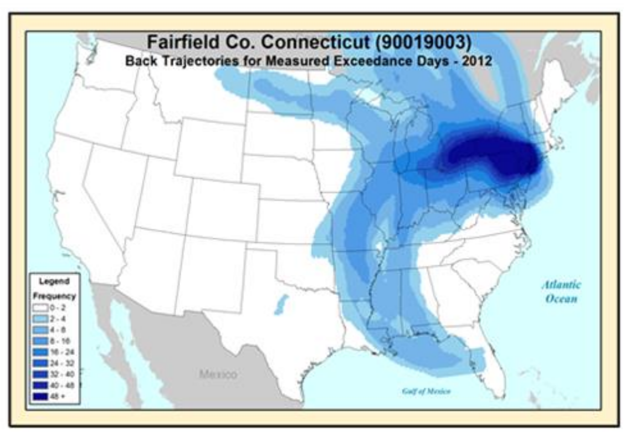
Upwind states linked to Fairfield Co., CT site 090019003: IN, MD, MI, NJ, NY, OH, PA, VA, and WV.



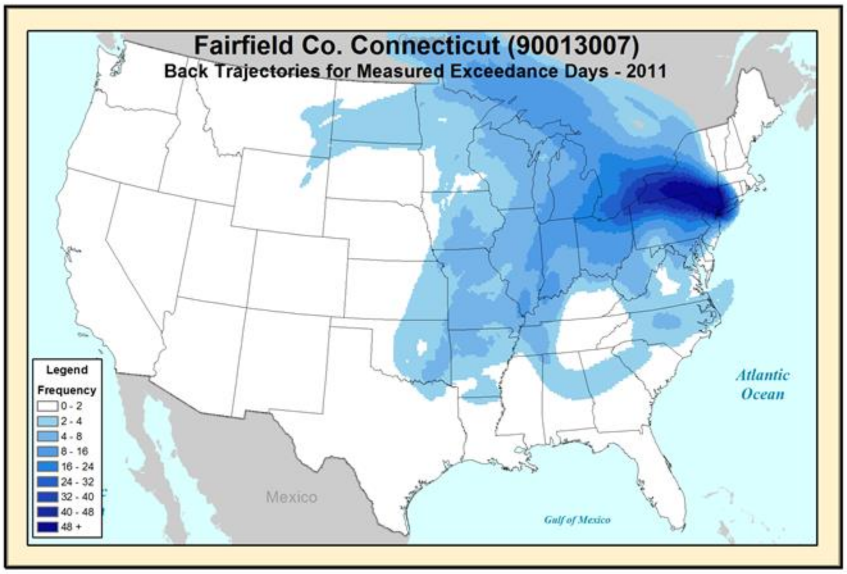



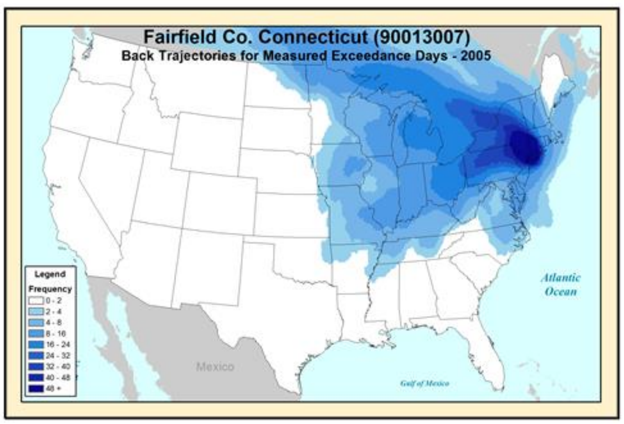



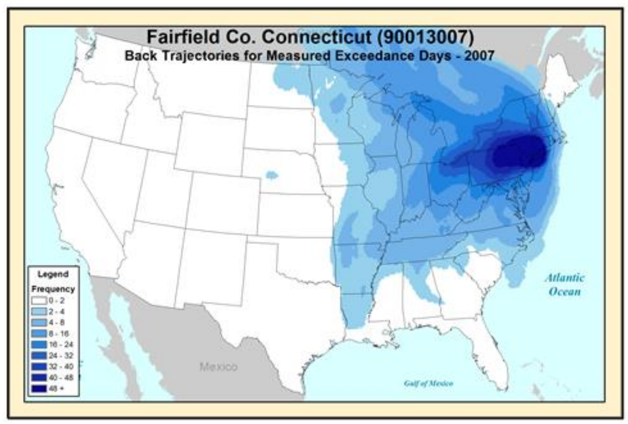



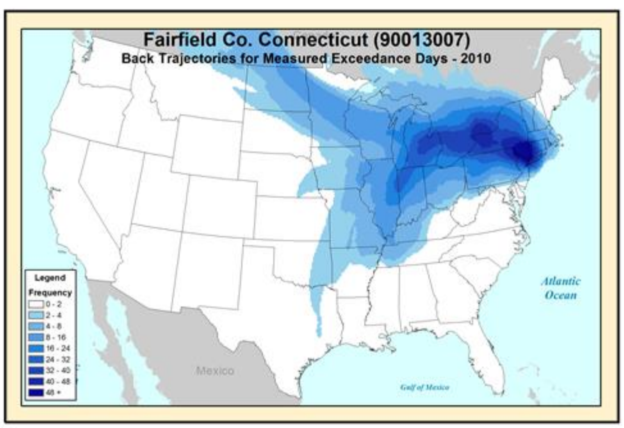



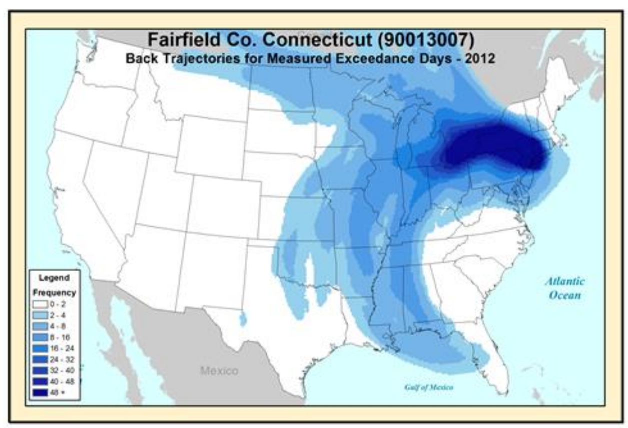
Upwind states linked to Fairfield Co., CT site 090013007: IN, MD, MI, NJ, NY, OH, PA, VA, and WV.



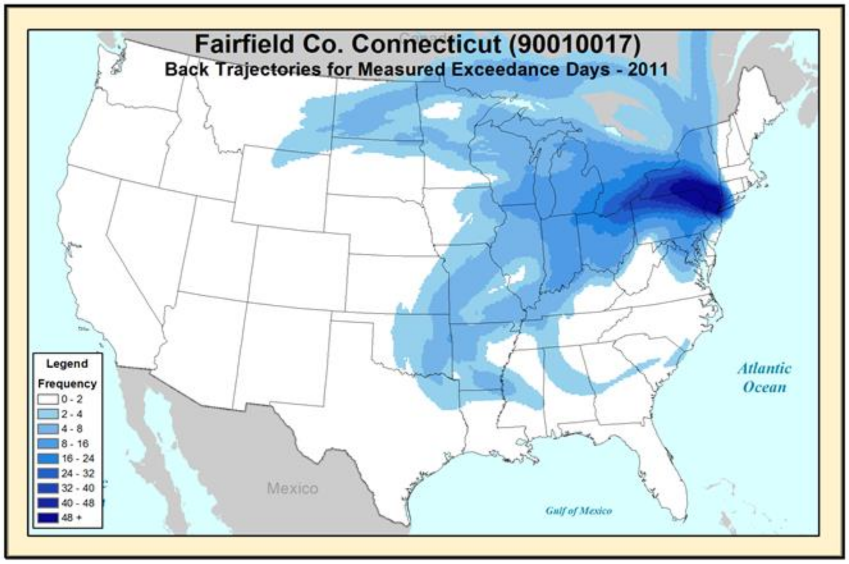



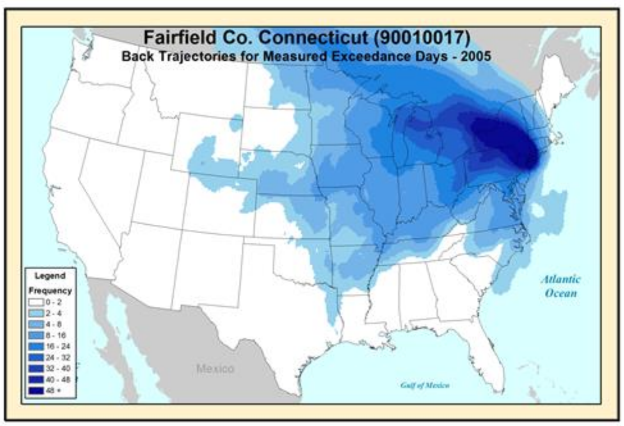



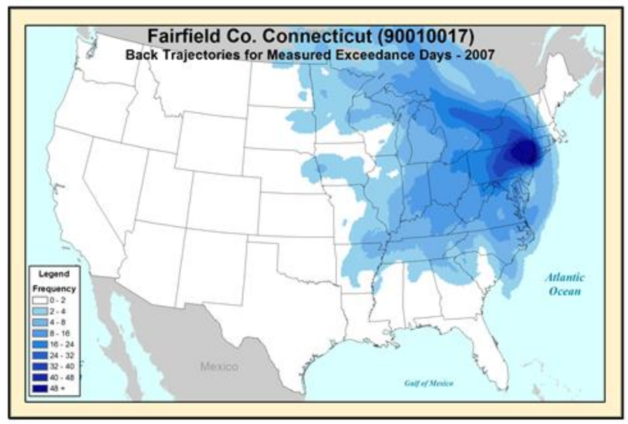



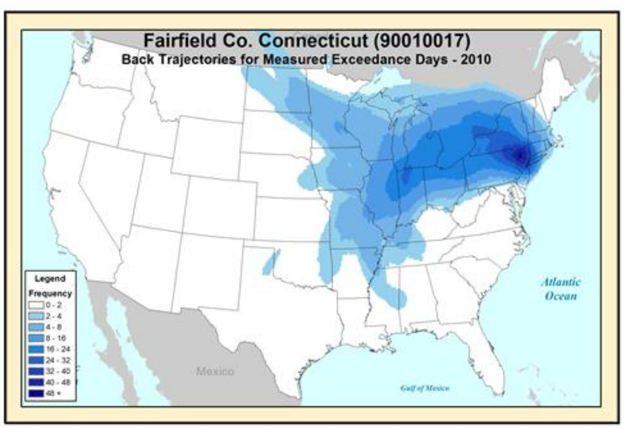



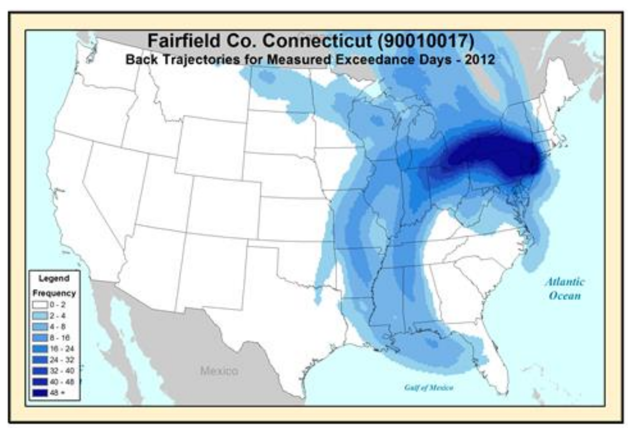
Upwind states linked to Fairfield Co., CT site 090010017: MD, NJ, NY, OH, PA, VA, and WV.



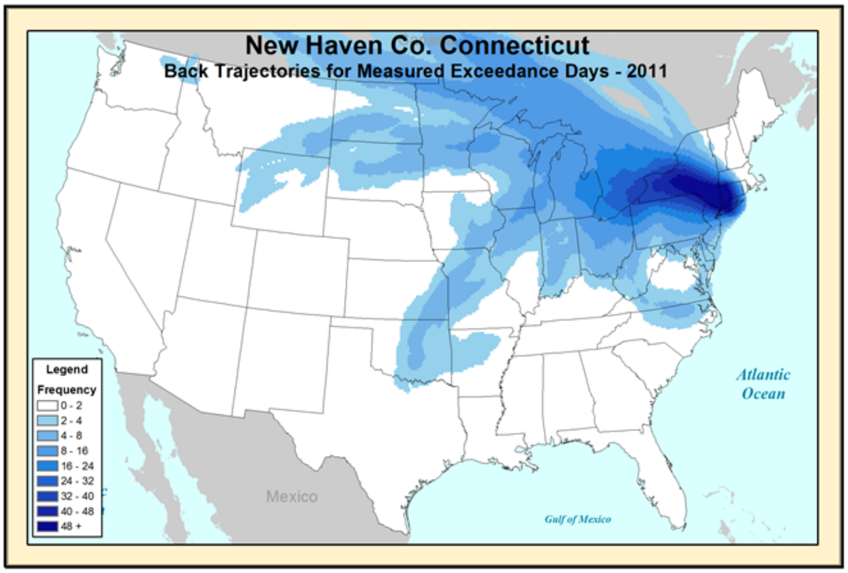



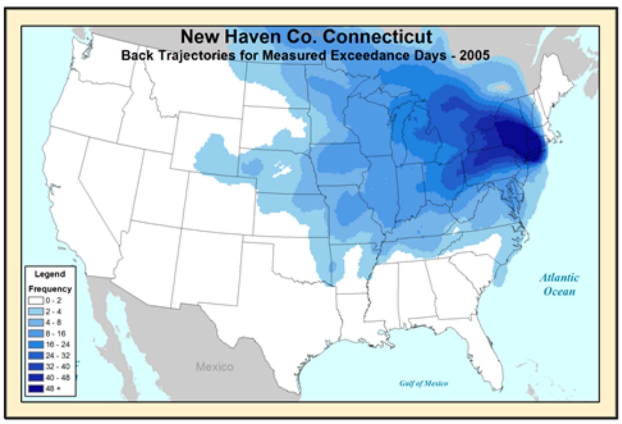



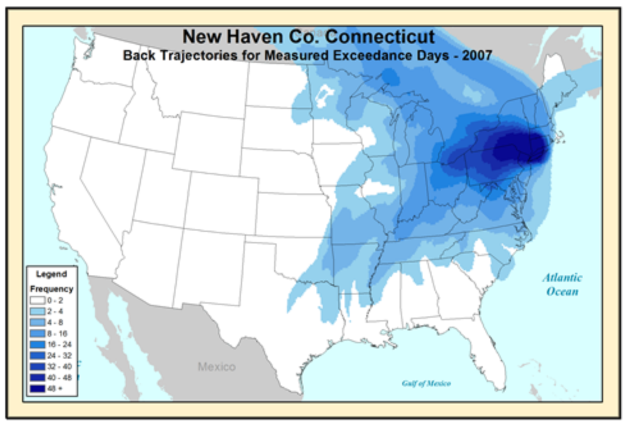



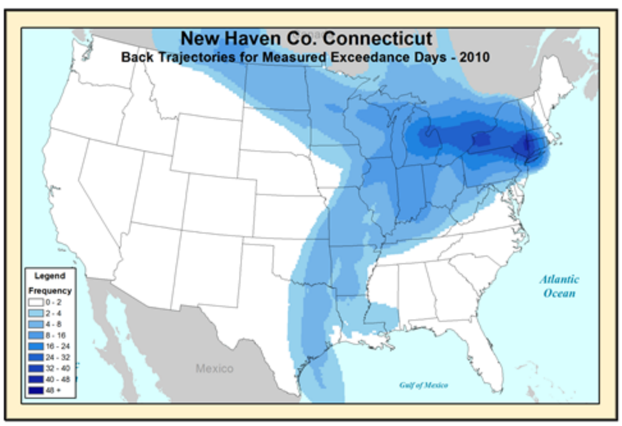



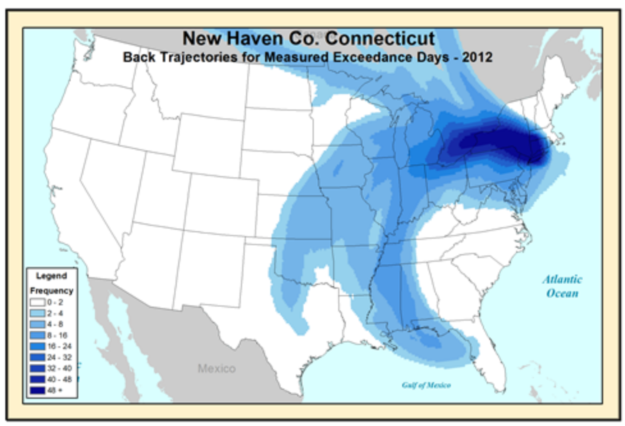
Upwind states linked to New Haven Co., CT site 090099002: MD, NJ, NY, OH, PA, and VA.



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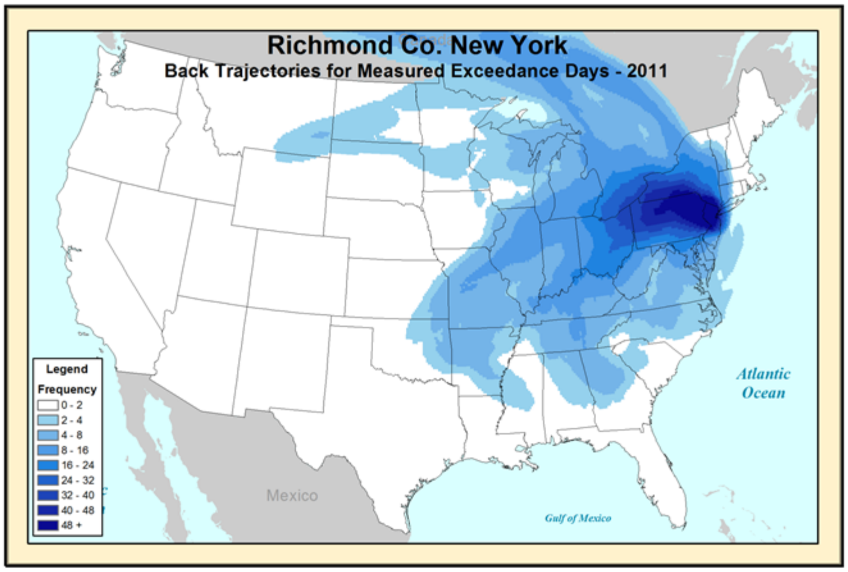
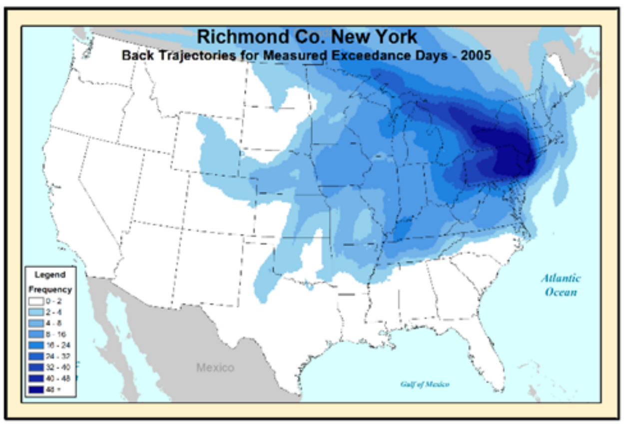
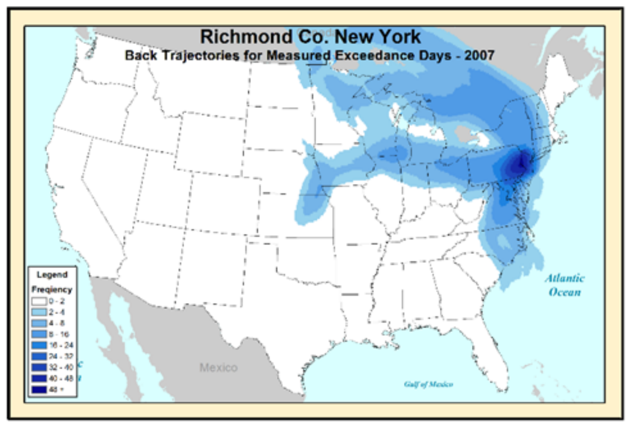
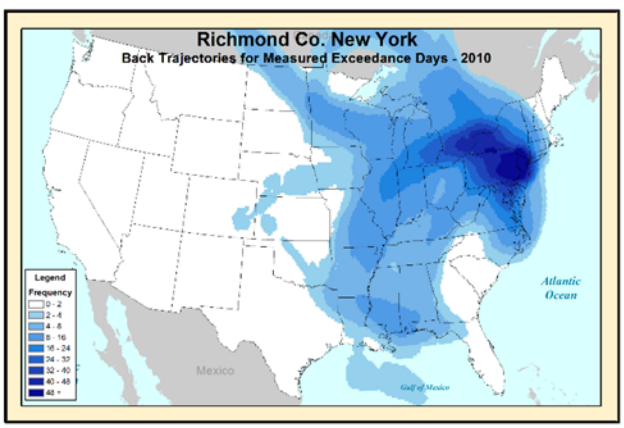
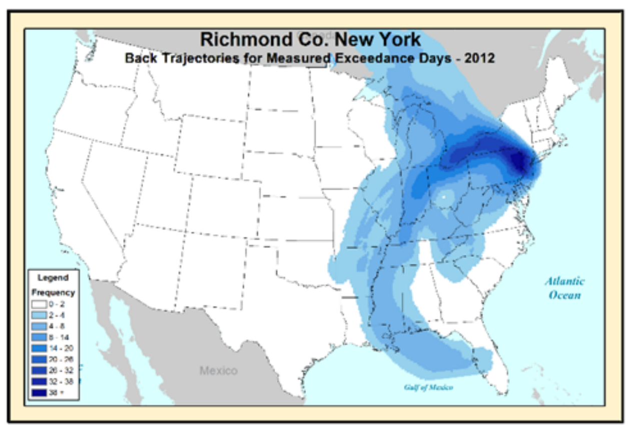
Upwind states linked to Richmond Co., NY site 360850067: IN, KY, MD, NJ, OH, PA, VA, and WV.



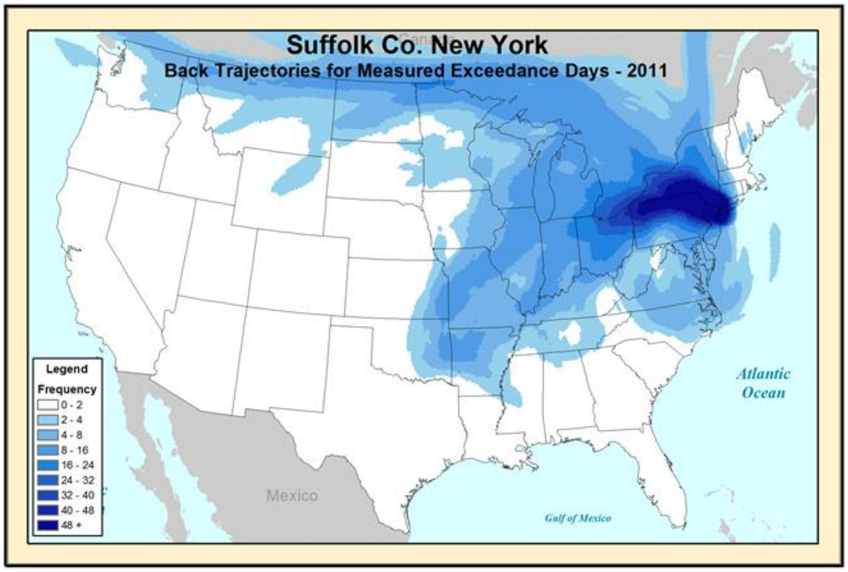



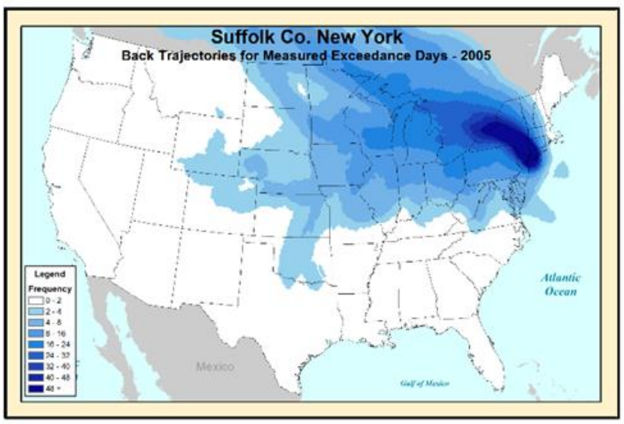



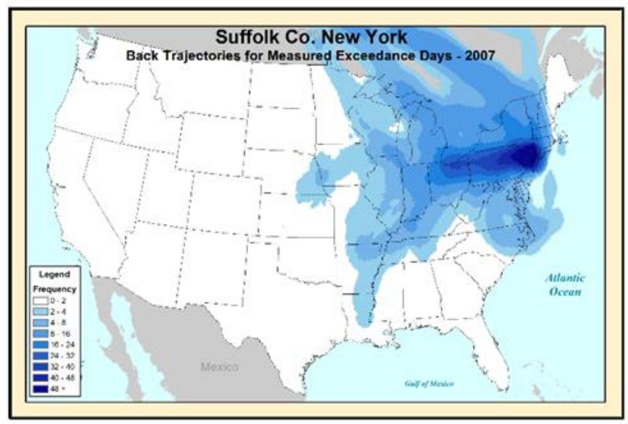



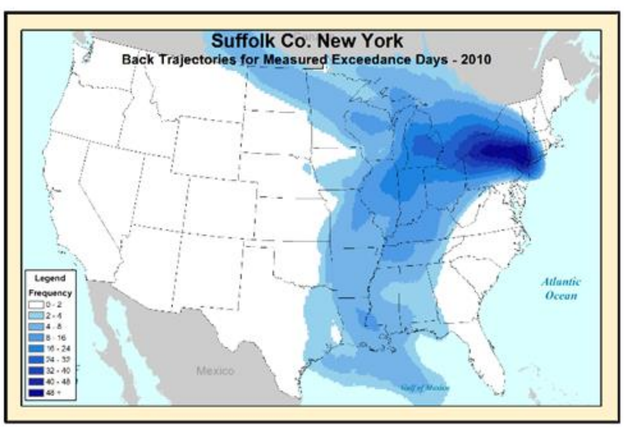



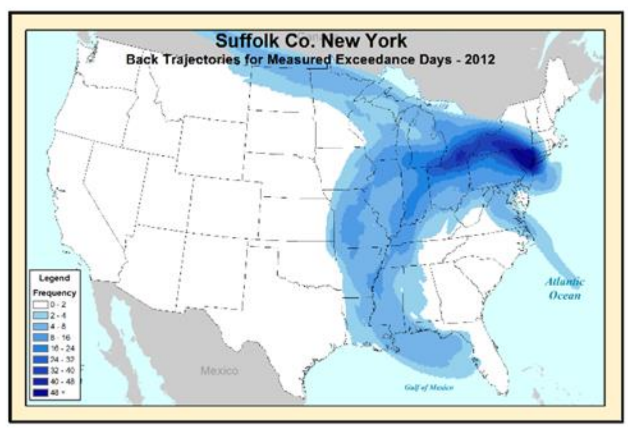
Upwind states linked to Suffolk Co., NY site 36030002: IL, IN, MD, MI, NJ, OH, PA, VA, and WV.



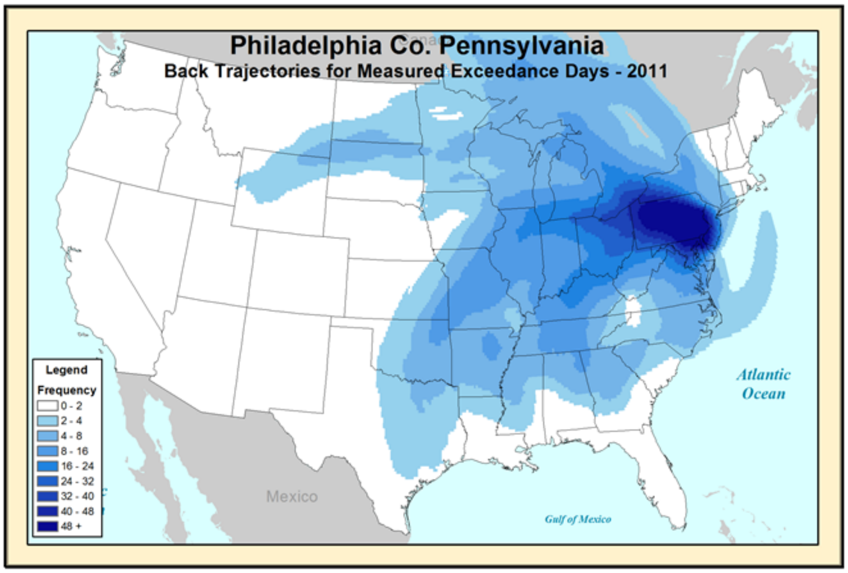



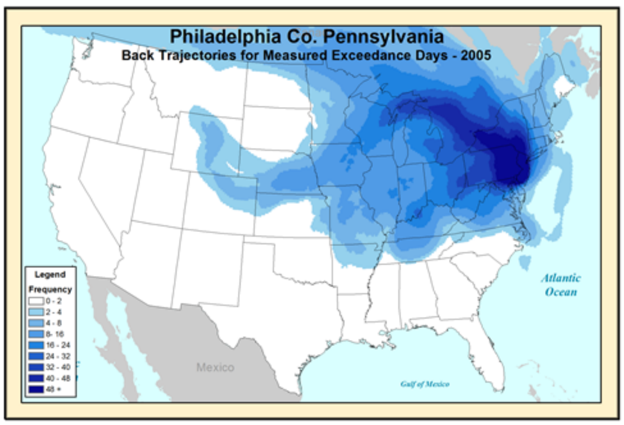



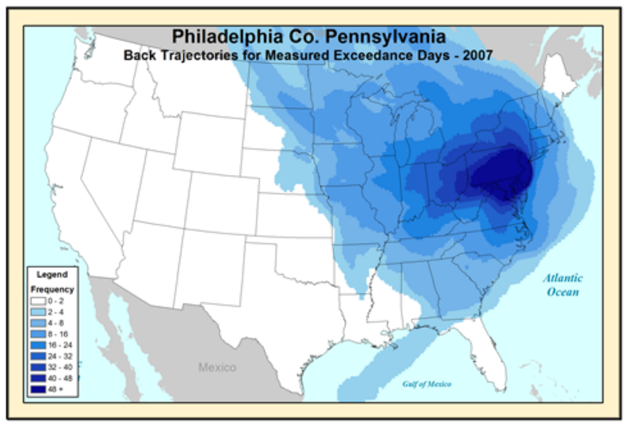



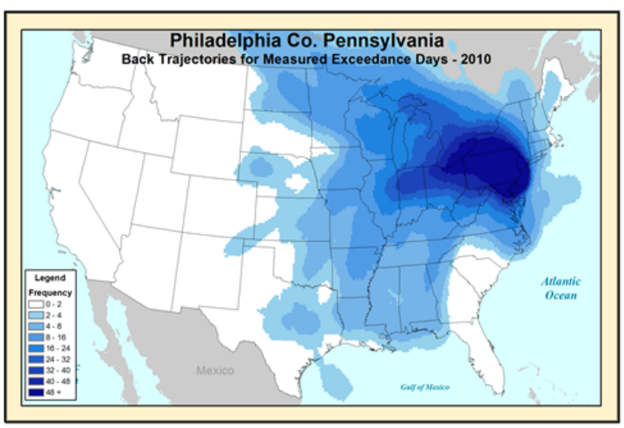



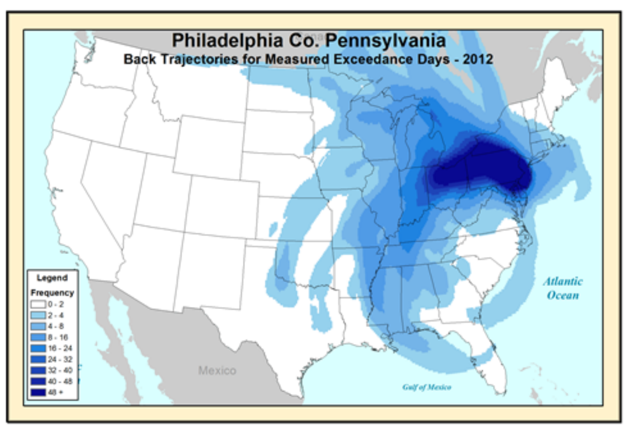
Upwind states linked to Philadelphia Co., PA site 421010024: DE, IL, IN, KY, MD, NJ, OH, TN, TX, VA, and WV.



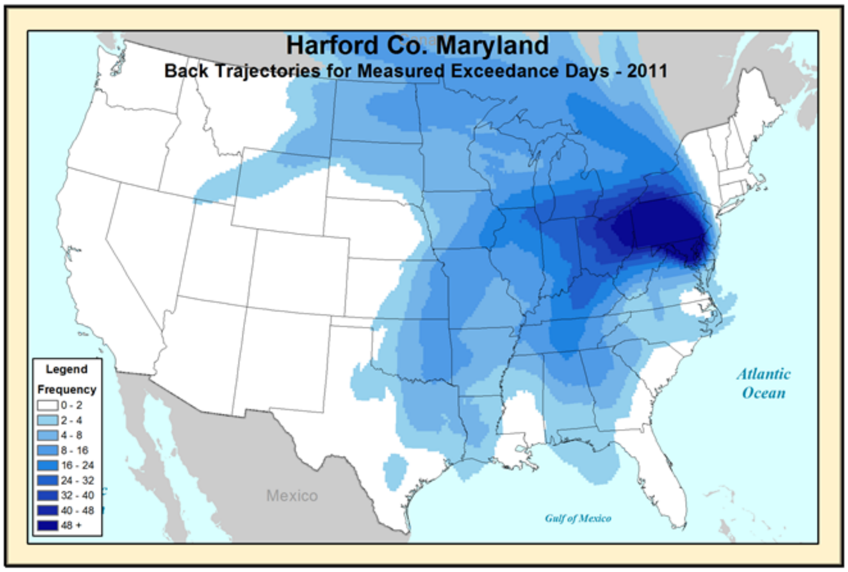



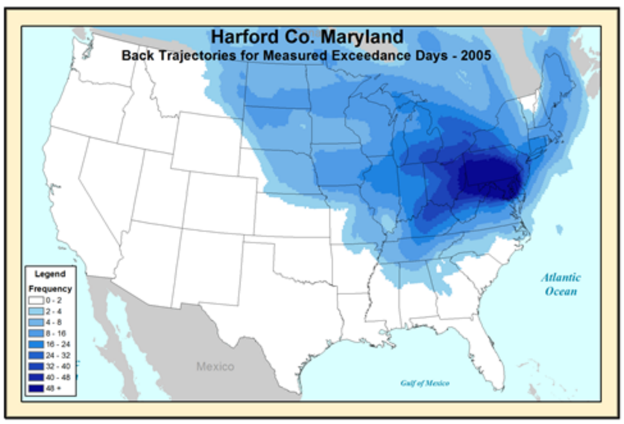



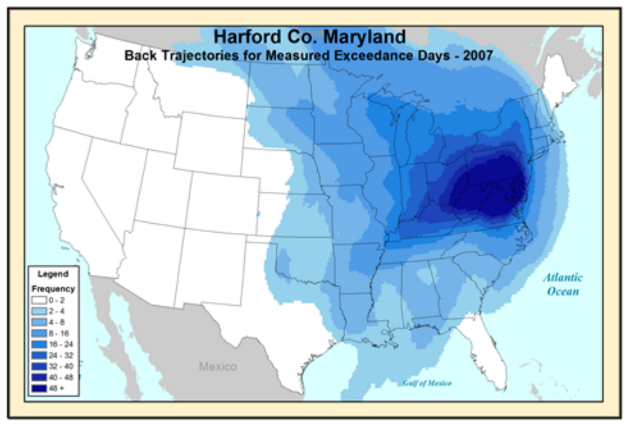



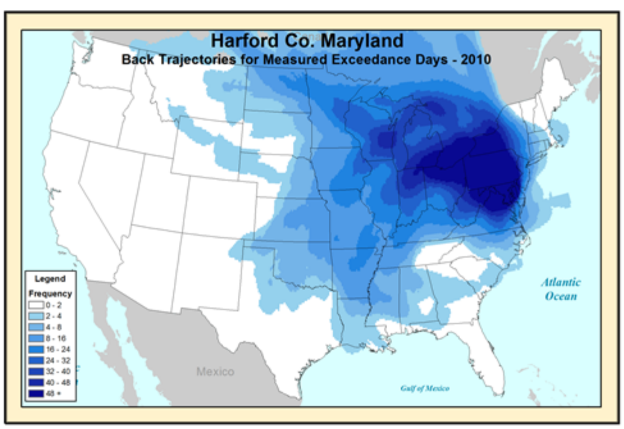



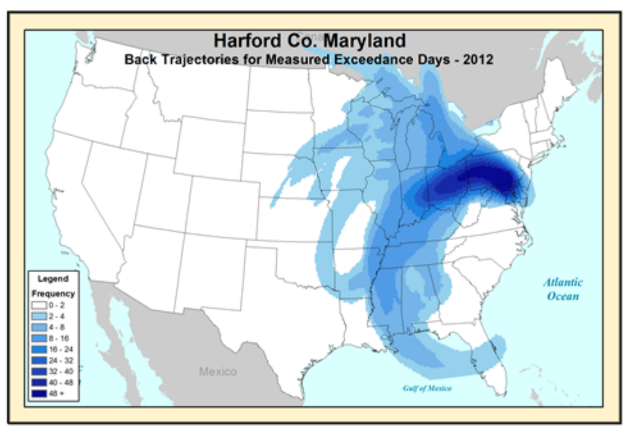
Upwind states linked to Harford Co., MD site 240251001: IL, IN, KY, MI, OH, PA, TX, VA, and WV. Washington, D.C. is also linked to this receptor.



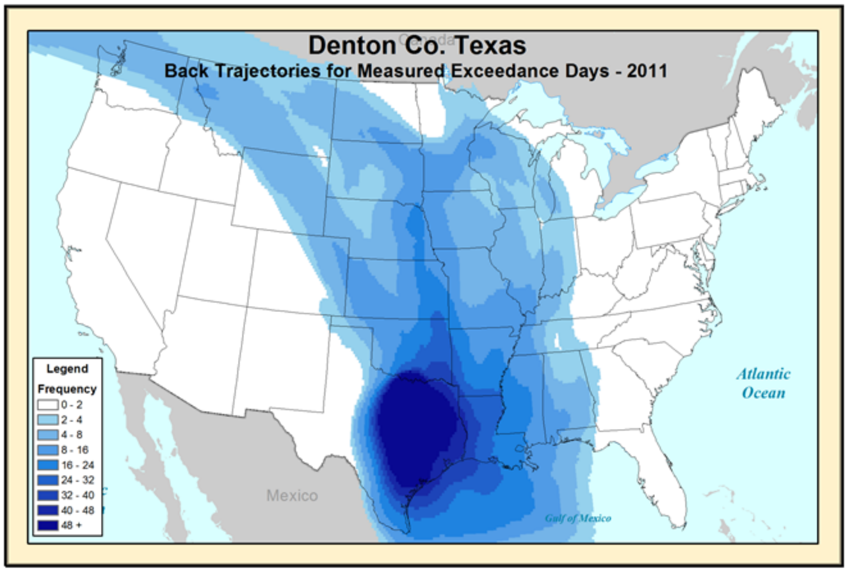



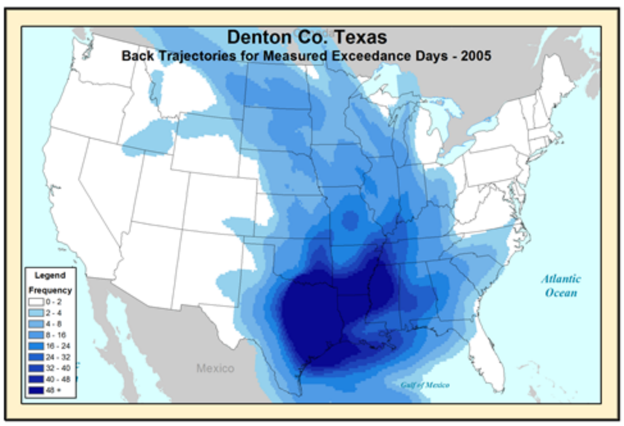



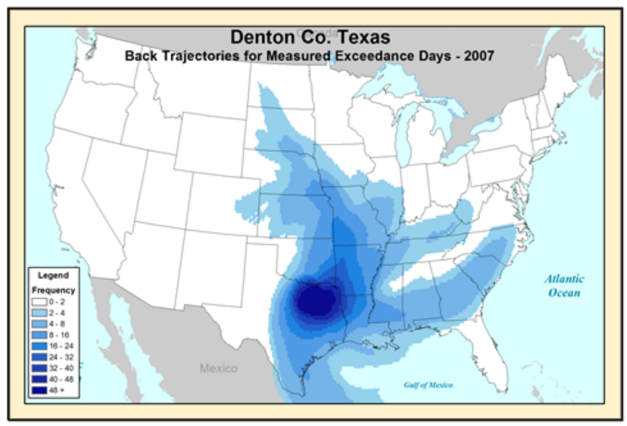



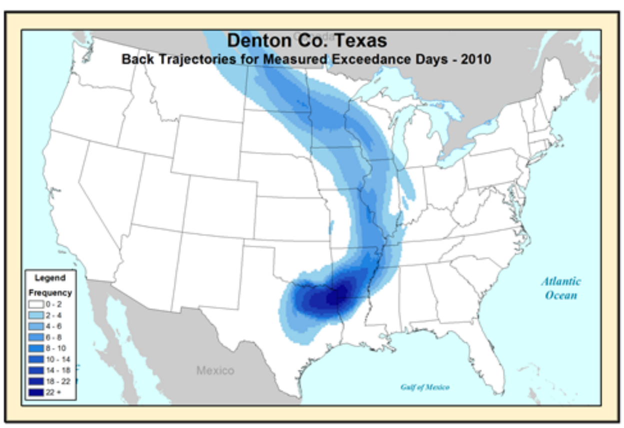



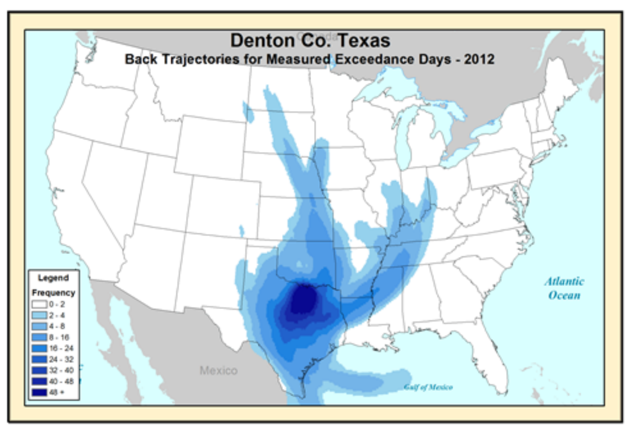
Upwind states linked to Denton Co., TX site 481210034: LA and OK.



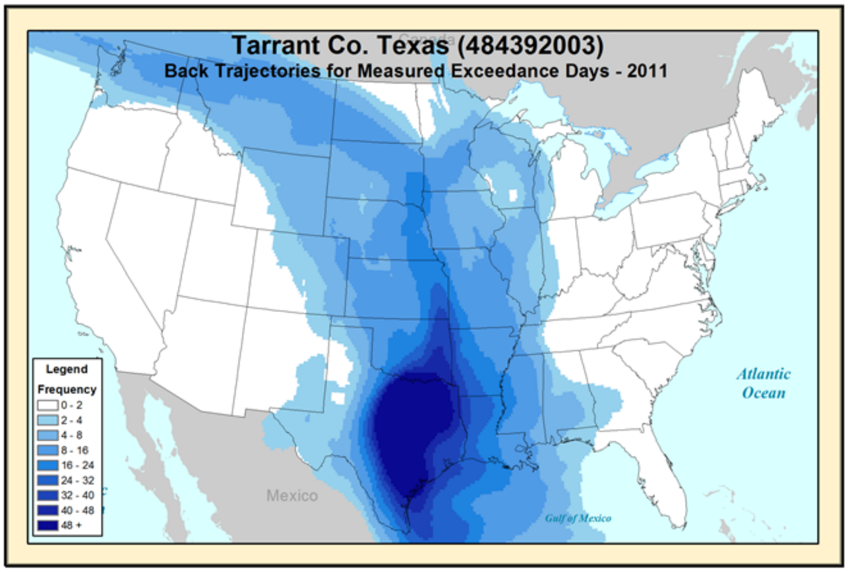



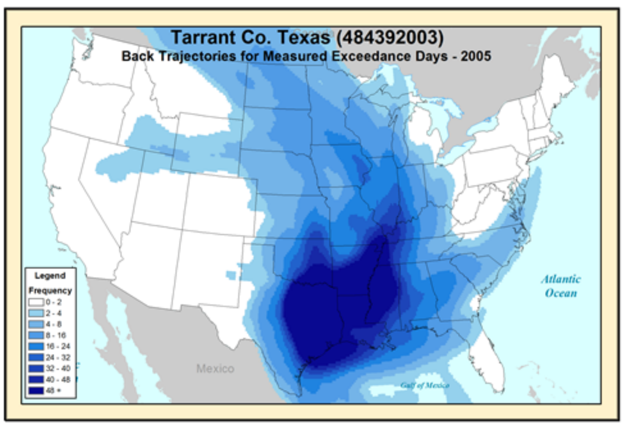



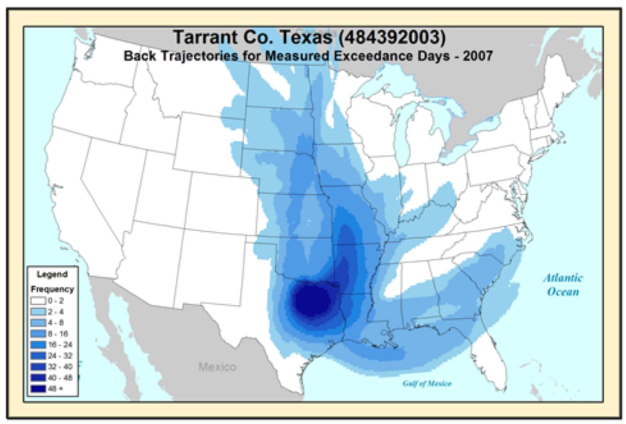



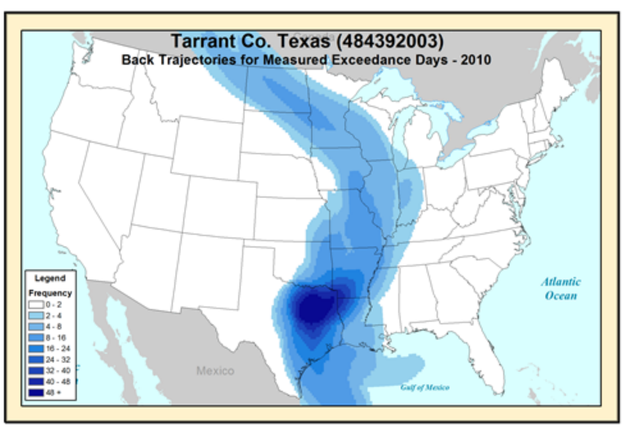



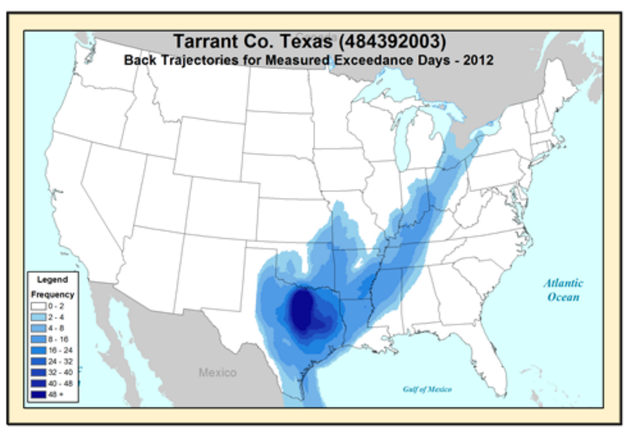
Upwind states linked to Tarrant Co., TX site 484392003: AL, KS, LA, and OK.



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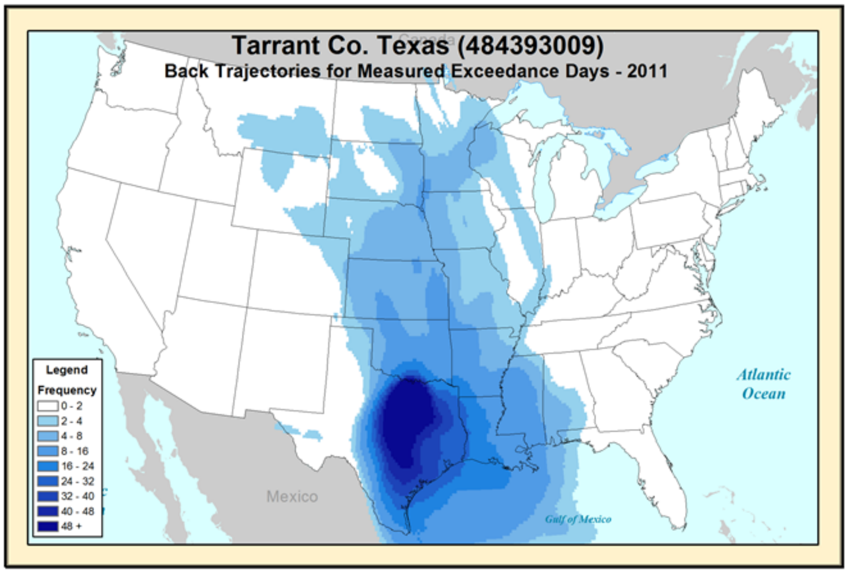
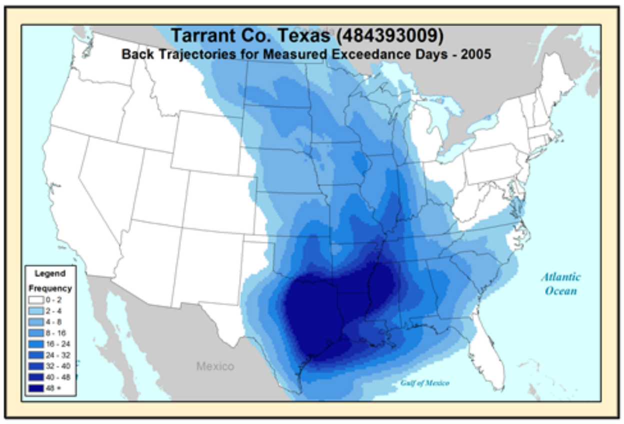
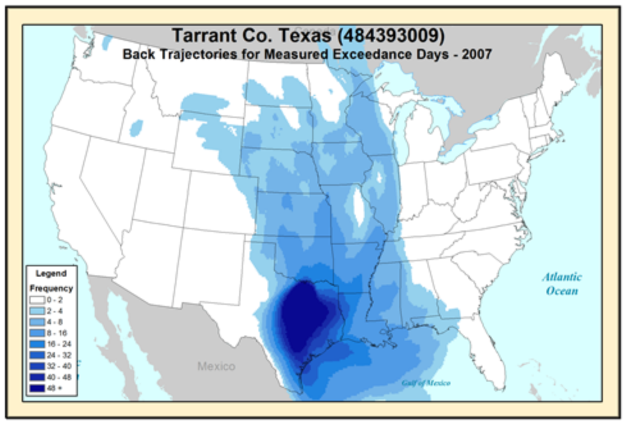
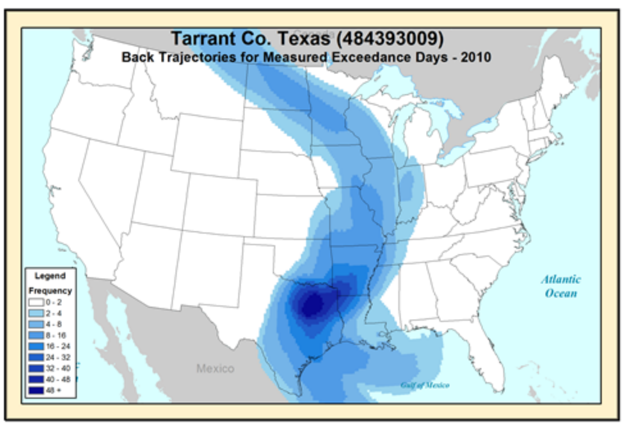
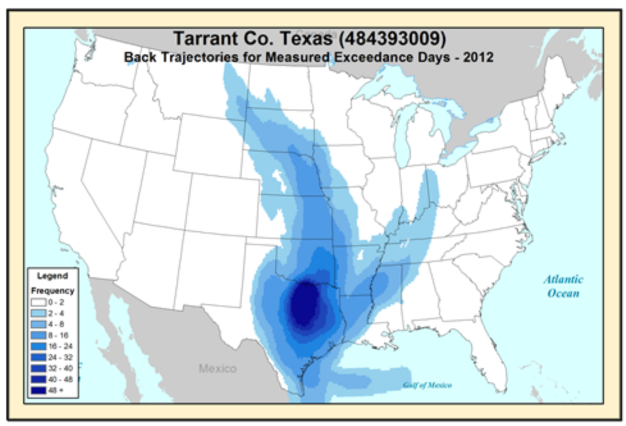
Upwind states linked to Tarrant Co., TX site 484393009: AL, LA, and OK.



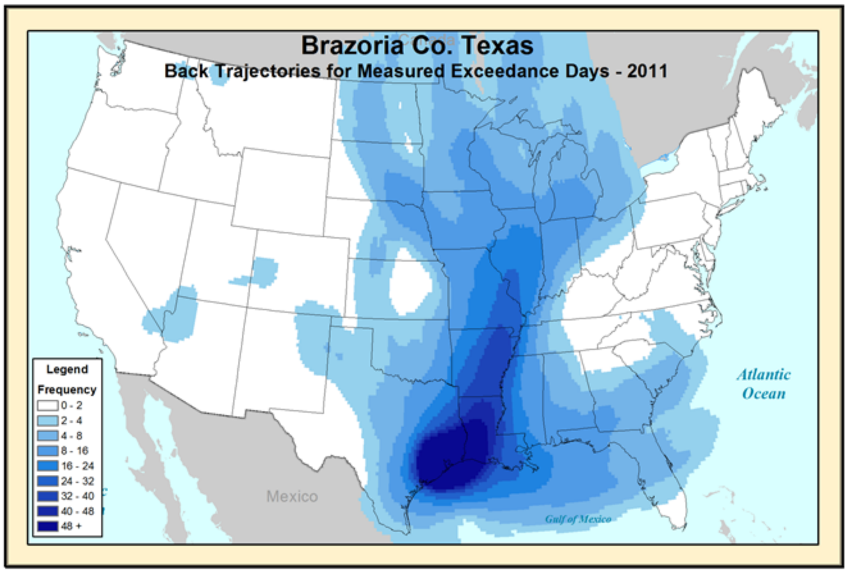



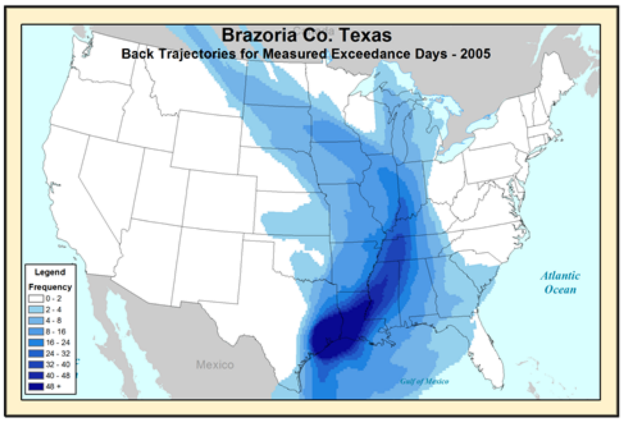



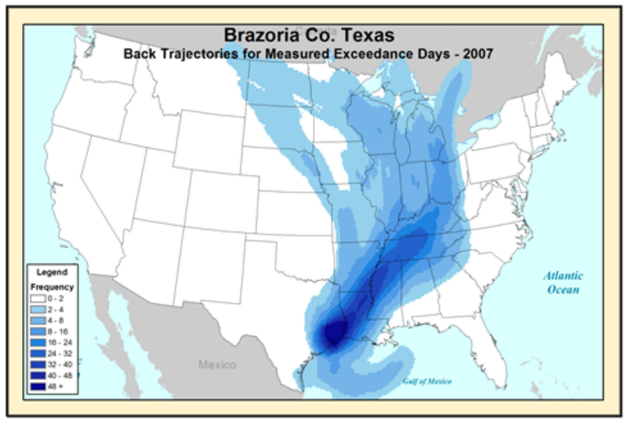



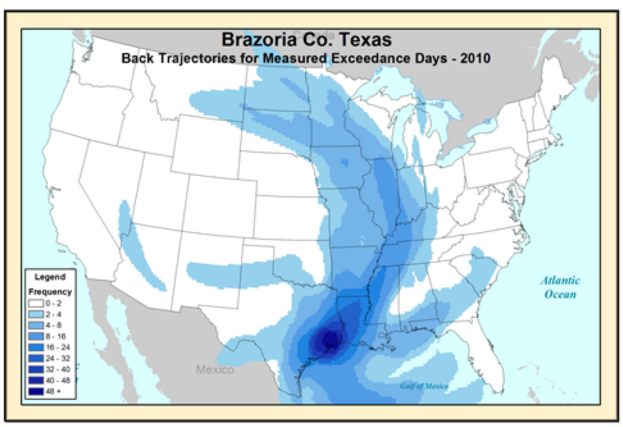



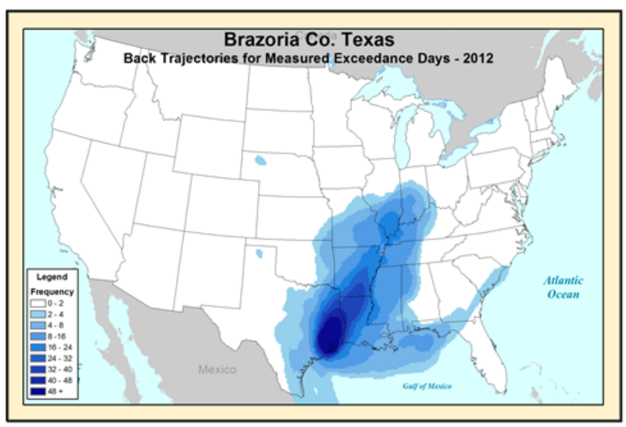
Upwind states linked to Brazoria Co., TX site 480391004: AR, IL, LA, MS, and MO.



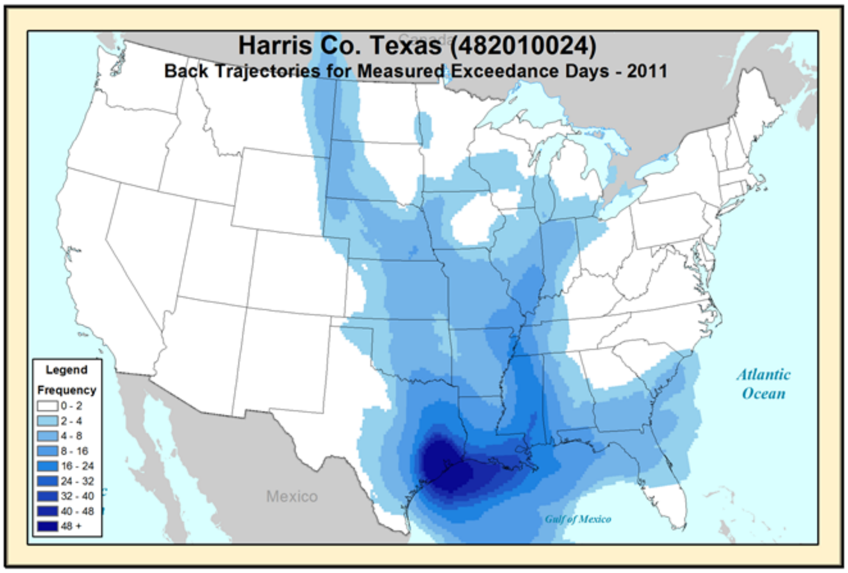



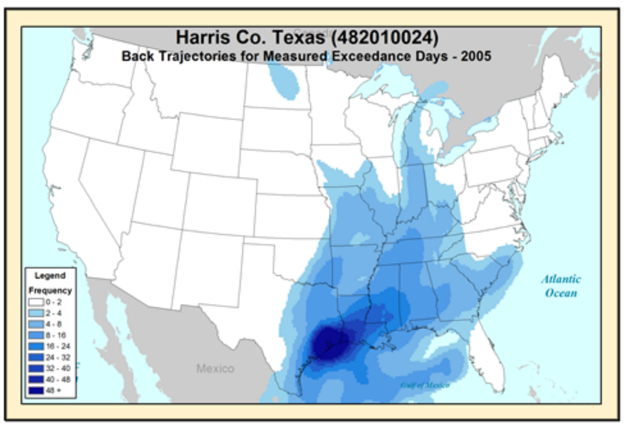



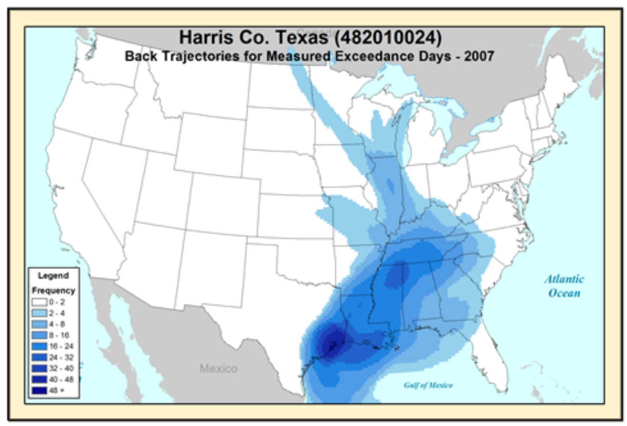


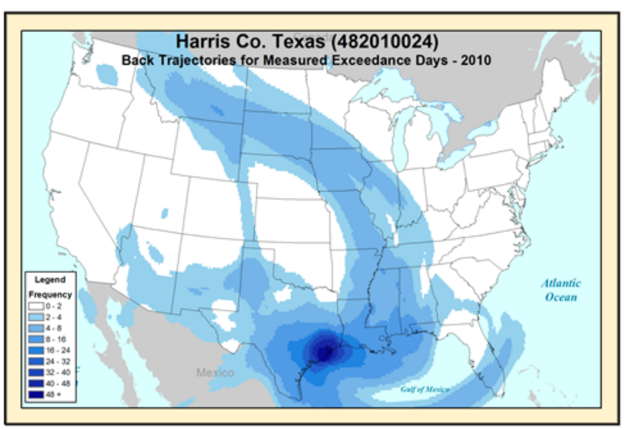

NMED Exhibit 9g

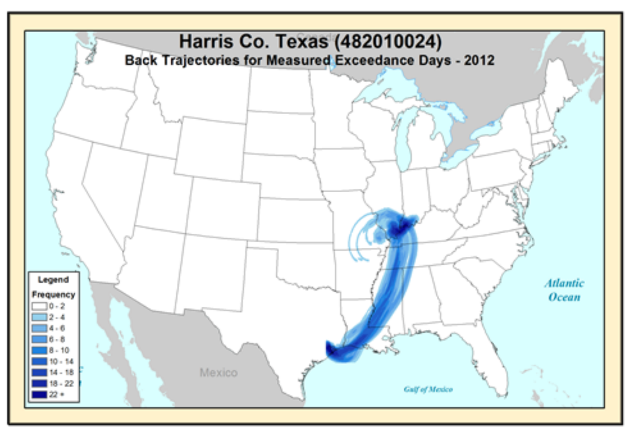
Upwind state linked to Harris Co., TX site 482010024: LA.



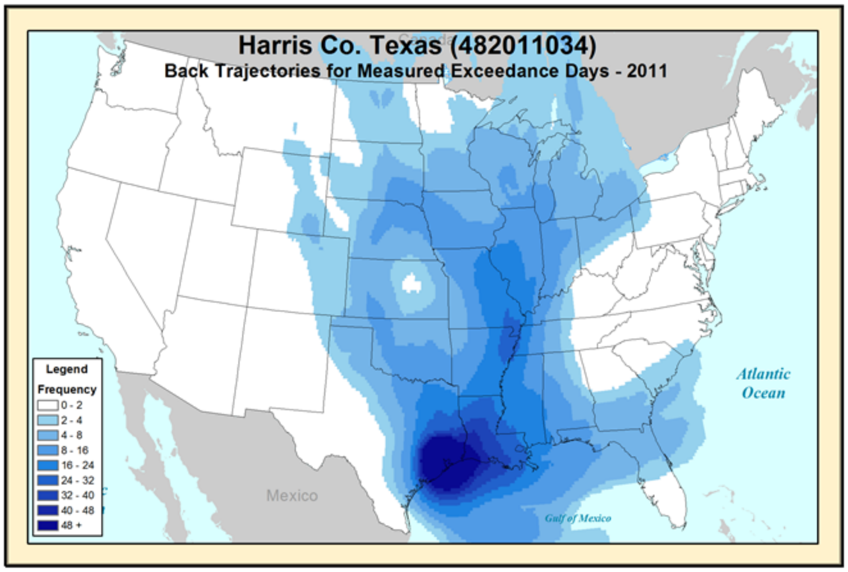



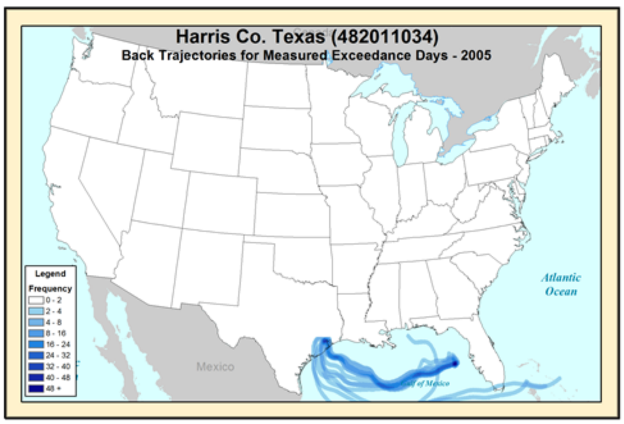



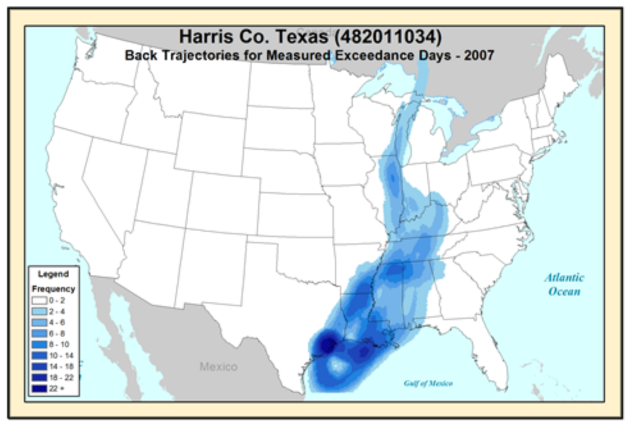


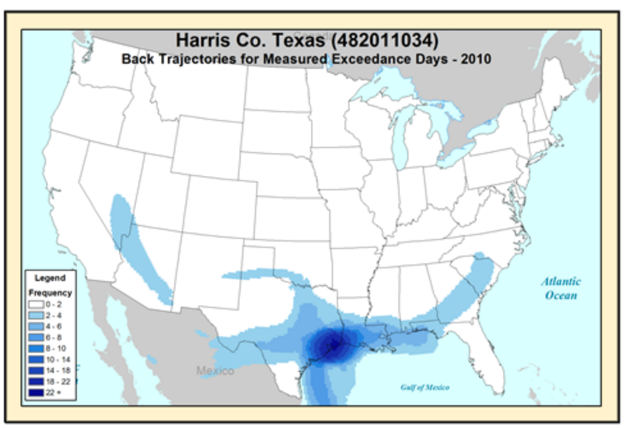

NMED Exhibit 9g

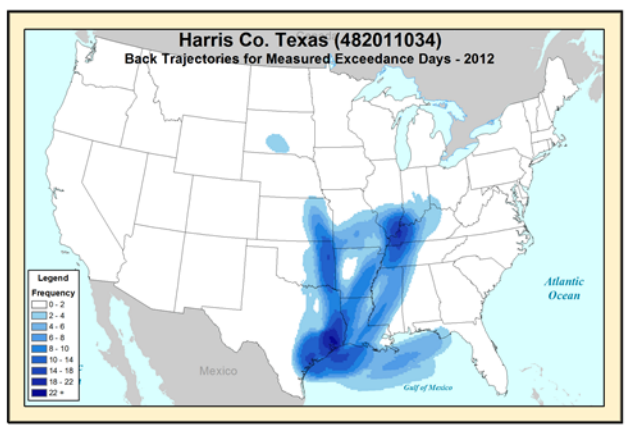
Upwind states linked to Harris Co., TX site 482011034: LA, MO, and OK.



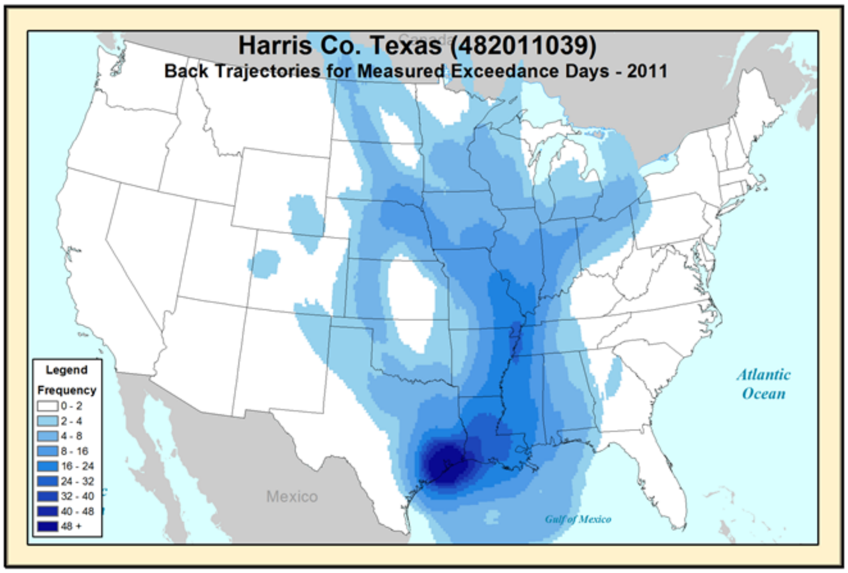



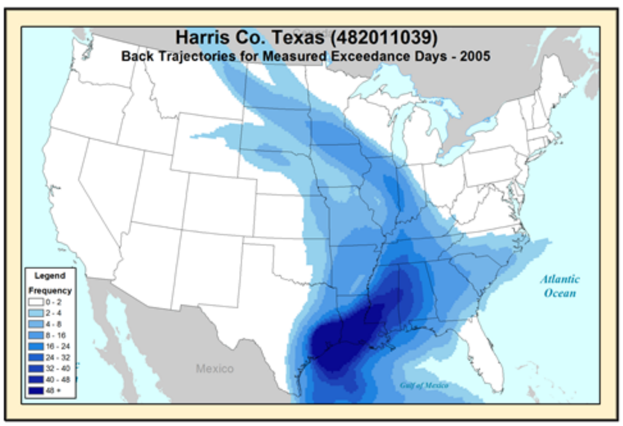



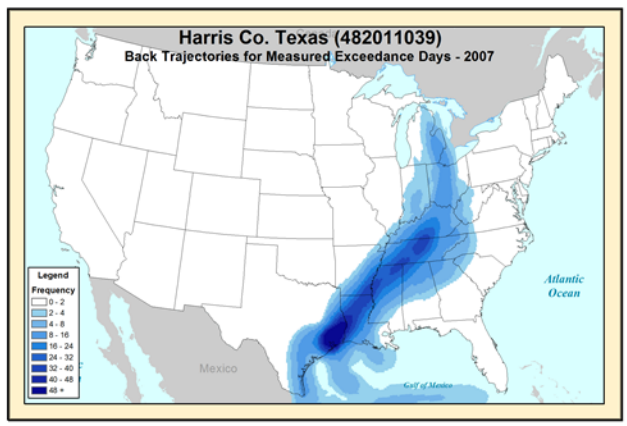


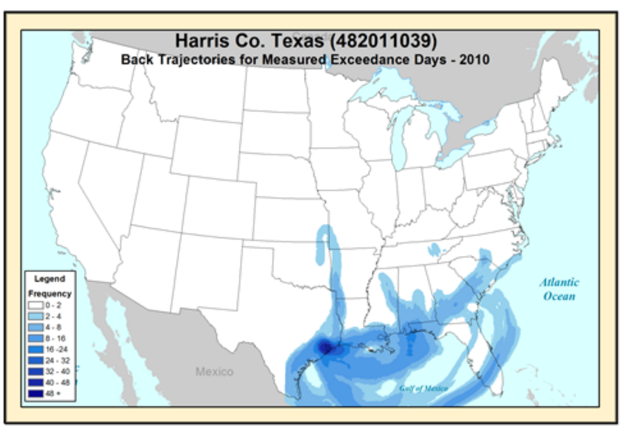

NMED Exhibit 9g

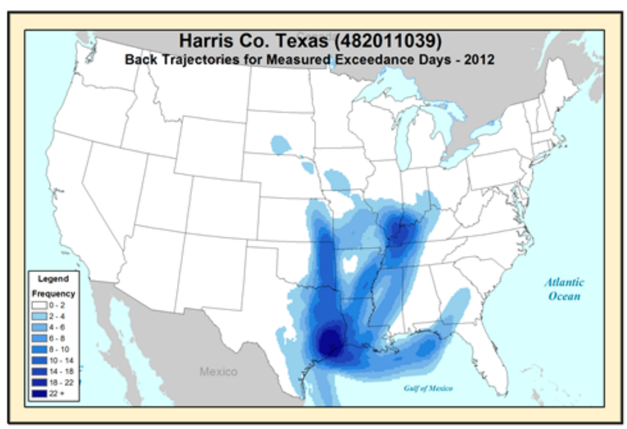
Upwind states linked to Harris Co., TX site 482011039: AR, IL, LA, MS, MO, and OK.



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# Appendix F

# Analysis of Contribution Thresholds

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This appendix contains tables with data relevant for the analysis of alternative contribution thresholds, as described in section 5 of the main document.

Table F-1. Data for contribution metrics 1, 2, 3, and 4 for each nonattainment and maintenance receptor.

| | | | | Metric 1 | Metric 2 | Metric 3 | Metric 4 |
|---|---|---|---|---|---|---|---|
| **Site** | **County** | **State** | **2017 Average Design Value (ppb)** | **In-State Contribution (ppb)** | **Total Contribution from All Upwind States (ppb)** | **Percent of 2017 Design Value from Upwind States** | **Percent of US Anthropogenic Ozone from Upwind States** |
| 90010017 | Fairfield | CT | 74.1 | 6.0 | 47.2 | 63.7% | 88.7% |
| 90013007 | Fairfield | CT | 75.5 | 5.1 | 47.3 | 62.6% | 90.3% |
| 90019003 | Fairfield | CT | 76.5 | 3.8 | 49.9 | 65.2% | 92.9% |
| 90099002 | New Haven | CT | 76.2 | 7.5 | 44.1 | 57.9% | 85.5% |
| 211110067 | Jefferson | KY | 76.9 | 23.5 | 24.2 | 31.5% | 50.7% |
| 240251001 | Harford | MD | 78.8 | 26.3 | 30.2 | 38.3% | 53.5% |
| 260050003 | Allegan | MI | 74.7 | 2.8 | 50.8 | 68.0% | 94.8% |
| 360850067 | Richmond | NY | 75.8 | 5.3 | 45.9 | 60.6% | 89.6% |
| 361030002 | Suffolk | NY | 76.8 | 16.8 | 36.6 | 47.7% | 68.5% |
| 390610006 | Hamilton | OH | 74.6 | 16.8 | 32.5 | 43.6% | 65.9% |
| 421010024 | Philadelphia | PA | 73.6 | 20.1 | 30.7 | 41.7% | 60.4% |
| 480391004 | Brazoria | TX | 79.9 | 37.0 | 13.6 | 17.0% | 26.9% |
| 481210034 | Denton | TX | 75 | 32.3 | 9.3 | 12.4% | 22.4% |
| 482010024 | Harris | TX | 75.4 | 30.9 | 7.4 | 9.8% | 19.3% |
| 482011034 | Harris | TX | 75.7 | 29.8 | 12.6 | 16.6% | 29.7% |
| 482011039 | Harris | TX | 76.9 | 32.5 | 12.5 | 16.3% | 27.8% |
| 484392003 | Tarrant | TX | 77.3 | 31.4 | 12.2 | 15.8% | 28.0% |
| 484393009 | Tarrant | TX | 76.4 | 33.6 | 9.8 | 12.8% | 22.6% |
| 551170006 | Sheboygan | WI | 76.2 | 12.4 | 40.4 | 53.0% | 76.5% |

Table F-2. Data for contribution metric 5 for each nonattainment and maintenance receptor.

| | | | Metric 5: Number of States Contributing for the Given Threshold | | |
|---|---|---|---|---|---|
| **Site** | **County** | **State** | **0.5% Threshold (0.375 ppb)** | **1% Threshold (0.75 ppb)** | **5% Threshold (3.75 ppb)** |
| 90010017 | Fairfield | CT | 12 | 7 | 3 |
| 90013007 | Fairfield | CT | 13 | 9 | 3 |
| 90019003 | Fairfield | CT | 13 | 9 | 3 |
| 90099002 | New Haven | CT | 13 | 6 | 3 |
| 211110067 | Jefferson | KY | 8 | 4 | 2 |
| 240251001 | Harford | MD | 14 | 10 | 2 |
| 260050003 | Allegan | MI | 13 | 9 | 3 |
| 360850067 | Richmond | NY | 16 | 8 | 2 |
| 361030002 | Suffolk | NY | 14 | 9 | 2 |
| 390610006 | Hamilton | OH | 14 | 8 | 2 |
| 421010024 | Philadelphia | PA | 16 | 11 | 1 |
| 480391004 | Brazoria | TX | 11 | 5 | 0 |
| 481210034 | Denton | TX | 7 | 2 | 0 |
| 482010024 | Harris | TX | 3 | 2 | 0 |
| 482011034 | Harris | TX | 10 | 4 | 0 |
| 482011039 | Harris | TX | 8 | 6 | 0 |
| 484392003 | Tarrant | TX | 7 | 4 | 0 |
| 484393009 | Tarrant | TX | 7 | 3 | 0 |
| 551170006 | Sheboygan | WI | 14 | 8 | 2 |

Table F-3. Data for contribution metric 6 for each nonattainment and maintenance receptor.

| | | | Metric 6: Total Contribution from All Upwind States | | |
|---|---|---|---|---|---|
| **Site** | **County** | **State** | **0.5% Threshold (0.375 ppb)** | **1% Threshold (0.75 ppb)** | **5% Threshold (3.75 ppb)** |
| 90010017 | Fairfield | CT | 44.0 | 41.6 | 36.0 |
| 90013007 | Fairfield | CT | 43.9 | 42.0 | 33.8 |
| 90019003 | Fairfield | CT | 46.4 | 44.6 | 36.0 |
| 90099002 | New Haven | CT | 41.1 | 37.4 | 33.2 |
| 211110067 | Jefferson | KY | 20.7 | 18.4 | 16.1 |
| 240251001 | Harford | MD | 26.5 | 24.4 | 9.9 |
| 260050003 | Allegan | MI | 48.8 | 46.6 | 35.7 |
| 360850067 | Richmond | NY | 42.1 | 37.7 | 26.5 |
| 361030002 | Suffolk | NY | 32.1 | 29.2 | 19.9 |
| 390610006 | Hamilton | OH | 29.1 | 25.5 | 18.1 |
| 421010024 | Philadelphia | PA | 27.0 | 24.3 | 5.2 |
| 480391004 | Brazoria | TX | 9.9 | 6.7 | 0.0 |
| 481210034 | Denton | TX | 5.9 | 3.2 | 0.0 |
| 482010024 | Harris | TX | 3.5 | 3.0 | 0.0 |
| 482011034 | Harris | TX | 9.1 | 5.8 | 0.0 |
| 482011039 | Harris | TX | 8.9 | 8.1 | 0.0 |
| 484392003 | Tarrant | TX | 7.5 | 5.9 | 0.0 |
| 484393009 | Tarrant | TX | 6.1 | 3.8 | 0.0 |
| 551170006 | Sheboygan | WI | 38.1 | 34.5 | 24.4 |

Table F-4. Data for contribution metric 7 for each nonattainment and maintenance receptor.

| | | | **Metric 7: Percent of Total Transport Captured** | | |
|---|---|---|---|---|---|
| **Site** | **County** | **State** | **0.5% Threshold (0.375 ppb)** | **1% Threshold (0.75 ppb)** | **5% Threshold (3.75 ppb)** |
| 90010017 | Fairfield | CT | 93.1% | 88.0% | 76.2% |
| 90013007 | Fairfield | CT | 92.7% | 88.8% | 71.3% |
| 90019003 | Fairfield | CT | 93.0% | 89.3% | 72.2% |
| 90099002 | New Haven | CT | 92.9% | 84.6% | 75.0% |
| 211110067 | Jefferson | KY | 85.3% | 76.0% | 66.5% |
| 240251001 | Harford | MD | 87.6% | 80.5% | 32.6% |
| 260050003 | Allegan | MI | 95.9% | 91.7% | 70.2% |
| 360850067 | Richmond | NY | 91.7% | 82.0% | 57.7% |
| 361030002 | Suffolk | NY | 87.6% | 79.6% | 54.1% |
| 390610006 | Hamilton | OH | 89.3% | 78.3% | 55.7% |
| 421010024 | Philadelphia | PA | 87.7% | 78.8% | 17.0% |
| 480391004 | Brazoria | TX | 72.9% | 49.4% | 0.0% |
| 481210034 | Denton | TX | 62.9% | 34.1% | 0.0% |
| 482010024 | Harris | TX | 46.0% | 39.7% | 0.0% |
| 482011034 | Harris | TX | 72.5% | 45.7% | 0.0% |
| 482011039 | Harris | TX | 71.3% | 64.4% | 0.0% |
| 484392003 | Tarrant | TX | 61.4% | 48.5% | 0.0% |
| 484393009 | Tarrant | TX | 62.2% | 38.4% | 0.0% |
| 551170006 | Sheboygan | WI | 94.2% | 85.3% | 60.3% |

Table F-5. Comparison of transport captured by a 0.5 percent threshold versus a 1 percent threshold.

| Site | County | State | Percent of the total upwind transport captured by a 0.5 percent threshold that is captured by a 1 percent threshold. |
|---|---|---|---|
| 90010017 | Fairfield | CT | 94.5% |
| 90013007 | Fairfield | CT | 95.8% |
| 90019003 | Fairfield | CT | 96.0% |
| 90099002 | New Haven | CT | 91.1% |
| 211110067 | Jefferson | KY | 89.1% |
| 240251001 | Harford | MD | 91.9% |
| 260050003 | Allegan | MI | 95.6% |
| 360850067 | Richmond | NY | 89.4% |
| 361030002 | Suffolk | NY | 90.9% |
| 390610006 | Hamilton | OH | 87.7% |
| 421010024 | Philadelphia | PA | 89.9% |
| 480391004 | Brazoria | TX | 67.8% |
| 481210034 | Denton | TX | 54.2% |
| 482010024 | Harris | TX | 86.2% |
| 482011034 | Harris | TX | 63.0% |
| 482011039 | Harris | TX | 90.2% |
| 484392003 | Tarrant | TX | 79.0% |
| 484393009 | Tarrant | TX | 61.7% |
| 551170006 | Sheboygan | WI | 90.5% |

# Air Quality Modeling Technical Support Document for the Final Revised Cross-State Air Pollution Rule Update

Office of Air Quality Planning and Standards
United States Environmental Protection Agency
March 2020

## 1. Introduction

In this technical support document (TSD) we describe the air quality modeling performed to support the Revised Cross State Air Pollution Rule Update.[1] For this rule, the focus of the air quality modeling is to project ozone design values[2] at individual monitoring sites to 2021[3] and to estimate state-by-state contributions to those 2021 concentrations. The projected 2021 ozone design values are used to identify ozone monitoring sites that are projected to be nonattainment or have maintenance problems in 2021 for the 2008 ozone NAAQS. Ozone contribution information for 2021 is then used to quantify projected interstate contributions from emissions in each upwind state to ozone design values at projected nonattainment and maintenance sites in other states (i.e., in downwind states). This TSD also describes air quality modeling and results for the 2023 and 2028 projection years which were used to support this rule.[4]

The remaining sections of this TSD are as follows. Section 2 describes the air quality modeling platform and the evaluation of model predictions using measured concentrations. Section 3 defines the procedures for projecting ozone design value concentrations and the approach for identifying monitoring sites projected to have nonattainment and/or maintenance problems in 2021. Section 4 describes (1) the source contribution (i.e., apportionment) modeling and (2) the procedures for quantifying contributions to individual monitoring sites including nonattainment and/or maintenance sites. For questions about the information in this TSD please contact Norm Possiel at possiel.norm@epa.gov.

[1] Note that the air quality modeling for the final rule did not change from the proposed rule.

[2] The ozone design value for a monitoring site is the 3-year average of the annual fourth-highest daily maximum 8-hour average ozone concentration.

[3] The rationale for using 2021 as the future analytic year for this transport assessment is described in the preamble for this rule.

[4] The input and output data for the air quality modeling, as described in this TSD, can be found on data drives in the docket for this rule. The contents of the data drives are listed in the following file which is in the docket: AQ Modeling Data Drives_Proposed Revised CSAPR Update.docx.

## 2. Air Quality Modeling Platform

The EPA used a 2016-based air quality modeling platform which includes emissions, meteorology and other inputs for 2016 as the base year for the modeling described in this document. The emissions were developed as part of the 2016 Platform Collaborative Project that included participation from EPA, Multi-State Jurisdictional Organizations (MJOs) and states. This process resulted in a common-use set of emissions data for a 2016 base year and 2023 and 2028 projection years that can be leveraged by EPA and states for regulatory air quality modeling. The 2016 modeling platform including the projected 2023 and 2028 emissions were used to drive the 2016 base year and 2023 and 2028 base case air quality model simulations for this rule. Because projected emissions inventory data were not available for the 2021 analytic year at the time this modeling was conducted, we used the 2016-Centered measured ozone design values coupled with 2023 model-predicted design values to estimate design values in 2021, based on linear interpolation between these two data points.[5] To quantify ozone contributions in 2021 we applied modeling-based contributions in 2023 to the 2021 ozone design values. The methods for developing design values and contributions for 2021 are described in sections 3 and 4, below. In addition, we modeled the 2028 base case emissions to project ozone design values and contributions in that year. The projected design values and contribution data were used in Step 3 of the four-step transport framework, as described in the preamble for the final rule. The Step 3 analysis is described in Ozone Transport Policy Analysis Technical Support Document.

### *2.1 Air Quality Model Configuration*

The photochemical model simulations performed for this rule used the Comprehensive Air Quality Model with Extensions (CAMx version 7beta 6).[6,7] CAMx is a three-dimensional

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[5] As explained in preamble section V.C, EPA conducted a separate sensitivity analysis using 2021 emissions inventory information that became available before this final action in order to assess the validity of certain comments on the proposed rule.

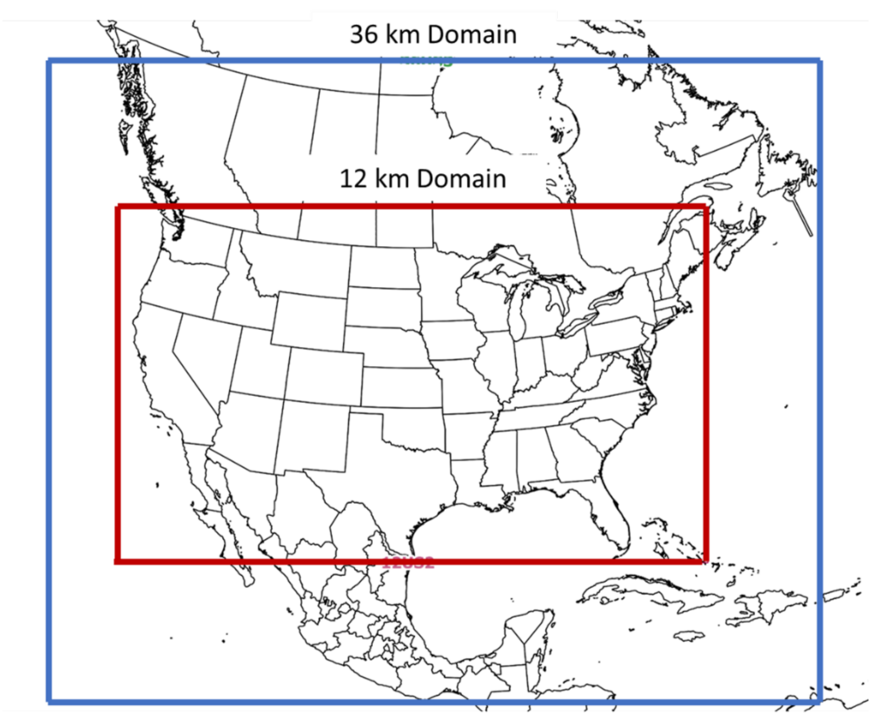
[6] Ramboll Environment and Health, May 2020, www.camx.com. Note that CAMx v7beta6 is a pre-lease of CAMx version 7 that was used by EPA because the official release of version 7 did not occur until May 2020, which was too late for use in the air quality modeling for this rule.

[7] The scripts used for the CAMx model simulations can be found in the following file in the docket: CAMx Model Simulation Scripts.docx

grid-based Eulerian air quality model designed to simulate the formation and fate of oxidant precursors, primary and secondary particulate matter concentrations, and deposition over regional and urban spatial scales (e.g., the contiguous U.S.). Consideration of the different processes (e.g., transport and deposition) that affect primary (directly emitted) and secondary (formed by atmospheric processes) pollutants at the regional scale in different locations is fundamental to understanding and assessing the effects of emissions on air quality concentrations.

Figure 2-1 shows the geographic extent of the modeling domains that were used for air quality modeling in this analysis. The large domain covers the 48 contiguous states along with most of Canada and all of Mexico with a horizontal resolution of 36 x 36 km. Air quality modeling for the 36 km domain was used to provide boundary conditions for the nested 12 km x 12 km domain for the 2016 and projection year emissions scenarios. Both modeling domains have 25 vertical layers with a top at about 17,550 meters, or 50 millibars (mb). The model simulations produce hourly air quality concentrations for each grid cell across each modeling domain.

Figure 2-1. Air quality modeling domains.




CAMx requires a variety of input files that contain information pertaining to the modeling domain and simulation period. These include gridded, hourly emissions estimates and meteorological data, and initial and boundary concentrations. Separate emissions inventories were prepared for the 2016 base year and the 2023 and 2028 projections. All other inputs (i.e. meteorological fields, initial concentrations, and boundary concentrations) were specified for the 2016 base year model application and remained unchanged for the projection-year model simulations.[8]

*2.2 Meteorological Data for 2016*

The 2016 meteorological data for the air quality modeling were derived from running Version 3.8 of the Weather Research Forecasting Model (WRF) (Skamarock, et al., 2008). The meteorological outputs from WRF include hourly-varying horizontal wind components (i.e., speed and direction), temperature, moisture, vertical diffusion rates, and rainfall rates for each grid cell in each vertical layer. Selected physics options used in the WRF simulations include Pleim-Xiu land surface model (Xiu and Pleim, 2001; Pleim and Xiu, 2003), Asymmetric Convective Model version 2 planetary boundary layer scheme (Pleim 2007a,b), Kain-Fritsch cumulus parameterization (Kain, 2004) utilizing the moisture-advection trigger (Ma and Tan, 2009), Morrison double moment microphysics (Morrison, et al., 2005; Morrison and Gettelman, 2008), and RRTMG longwave and shortwave radiation schemes (Iacono, et.al., 2008).

Both the 36 km and 12 km WRF model simulations utilize a Lambert conformal projection centered at (-97,40) with true latitudes of 33 and 45 degrees north. The 36 km domain contains 184 cells in the X direction and 160 cells in the Y direction. The 12 km domain contains 412 cells in the X direction and 372 cells in the Y direction. The atmosphere is resolved with 35 vertical layers up to 50 mb (see Table 2-1), with the thinnest layers being nearest the surface to better resolve the planetary boundary layer (PBL).

The 36 km WRF model simulation was initialized using the 0.25-degree GFS analysis and 3-hour forecast from the 00Z, 06Z, 12Z, and 18Z simulations. The 12 km model was initialized using the 12km North American Model (12NAM) analysis product provided by

[8] The CAMx annual simulations for 2016, 2023, and 2028 were each performed using two time segments (January 1 through April 30, 2011 with a 10-day ramp-up period at the end of December 2010 and May 1 through December 31, 2016 with a 10-day ramp-up period at the end of April 2011). The CAMx 2023 and 2028 contribution modeling was performed for the period May 1 through September 30, 2016 with a 10-day ramp-up period at the end of April 2016.

National Climatic Data Center (NCDC).[9] The 40km Eta Data Assimilation System (EDAS) analysis (ds609.2) from the National Center for Atmospheric Research (NCAR) was used where 12NAM data was unavailable.[10] Analysis nudging for temperature, wind, and moisture was applied above the boundary layer only. The model simulations were conducted continuously. The 'ipxwrf' program was used to initialize deep soil moisture at the start of the run using a 10-day spinup period (Gilliam and Pleim, 2010). Landuse and land cover data were based on the USGS for the 36NOAM simulation and the 2011 National Land Cover Database (NLCD 2011) for the 12US simulation. Sea surface temperatures were ingested from the Group for High Resolution Sea Surface Temperatures (GHRSST) (Stammer et al., 2003) 1 km SST data.

Additionally, lightning data assimilation was utilized to suppress (or force) deep convection where lightning is absent (or present) in observational data. This method is described by Heath et al. (2016) and was employed to help improve precipitation estimates generated by the model.

Table 2-1. Vertical layers and their approximate height above ground level.

| WRF Layer | Height (m) | Pressure (mb) | Sigma |
|---|---|---|---|
| 35 | 17,556 | 5000 | 0.000 |
| 34 | 14,780 | 9750 | 0.050 |
| 33 | 12,822 | 14500 | 0.100 |
| 32 | 11,282 | 19250 | 0.150 |
| 31 | 10,002 | 24000 | 0.200 |
| 30 | 8,901 | 28750 | 0.250 |
| 29 | 7,932 | 33500 | 0.300 |
| 28 | 7,064 | 38250 | 0.350 |
| 27 | 6,275 | 43000 | 0.400 |
| 26 | 5,553 | 47750 | 0.450 |
| 25 | 4,885 | 52500 | 0.500 |
| 24 | 4,264 | 57250 | 0.550 |
| 23 | 3,683 | 62000 | 0.600 |
| 22 | 3,136 | 66750 | 0.650 |
| 21 | 2,619 | 71500 | 0.700 |
| 20 | 2,226 | 75300 | 0.740 |
| 19 | 1,941 | 78150 | 0.770 |
| 18 | 1,665 | 81000 | 0.800 |
| 17 | 1,485 | 82900 | 0.820 |
| 16 | 1,308 | 84800 | 0.840 |
| 15 | 1,134 | 86700 | 0.860 |

[9] https://www.ncdc.noaa.gov/data-access/model-data/model-datasets/north-american-mesoscale-forecast-system-nam

[10] https://www.ready.noaa.gov/edas40.php.

| WRF Layer | Height (m) | Pressure (mb) | Sigma |
|---|---|---|---|
| 14 | 964 | 88600 | 0.880 |
| 13 | 797 | 90500 | 0.900 |
| 12 | 714 | 91450 | 0.910 |
| 11 | 632 | 92400 | 0.920 |
| 10 | 551 | 93350 | 0.930 |
| 9 | 470 | 94300 | 0.940 |
| 8 | 390 | 95250 | 0.950 |
| 7 | 311 | 96200 | 0.960 |
| 6 | 232 | 97150 | 0.970 |
| 5 | 154 | 98100 | 0.980 |
| 4 | 115 | 98575 | 0.985 |
| 3 | 77 | 99050 | 0.990 |
| 2 | 38 | 99525 | 0.995 |
| 1 | 19 | 99763 | 0.9975 |
| Surface | 0 | 100000 | 1.000 |

Details of the annual 2016 meteorological model simulation and evaluation are provided in a separate technical support document which can be found in the docket for this rule.[11]

The meteorological data generated by the WRF simulations were processed using wrfcamx v4.7 (Ramboll 2019) meteorological data processing program to create model-ready meteorological inputs to CAMx. In running wrfcamx, vertical eddy diffusivities (Kv) were calculated using the Yonsei University (YSU) (Hong and Dudhia, 2006) mixing scheme. We used a minimum Kv of 0.1 $m^2$/sec except for urban grid cells where the minimum Kv was reset to 1.0 $m^2$/sec within the lowest 200 m of the surface in order to enhance mixing associated with the nighttime "urban heat island" effect. In addition, we invoked the subgrid convection and subgrid stratoform cloud options in our wrfcamx run for 2016.

*2.3 Initial and Boundary Concentrations*

The lateral boundary and initial species concentrations for the 36 km modeling domain are provided by a three-dimensional global atmospheric chemistry model, the Hemispheric version of the Community Multi-scale Air Quality Model (H-CMAQ) version 3.1.1. The H-CMAQ predictions were used to provide one-way dynamic boundary concentrations at one-hour intervals and an initial concentration field for the 36 km CAMx simulations. The air quality predictions from the 36 km CAMx simulations were used to provide boundary concentrations for

[11] Meteorological Modeling for 2016.docx.

the 12 km modeling. More information about the H-CMAQ model and other applications using this tool is available at: https://www.epa.gov/cmaq/hemispheric-scale-applications.

*2.4 Emissions Inventories*

CAMx requires detailed emissions inventories containing temporally allocated (i.e., hourly) emissions for each grid-cell in the modeling domain for a large number of chemical species that act as primary pollutants and precursors to secondary pollutants. Annual emission inventories for 2016, 2023, and 2028 were preprocessed into CAMx-ready inputs using the Sparse Matrix Operator Kernel Emissions (SMOKE) modeling system (Houyoux et al., 2000). Information on the emissions inventories used as input to the CAMx model simulations can be found in the emissions inventory technical support document.[12]

*2.5 Air Quality Model Evaluation*

An operational model performance evaluation for ozone was conducted to examine the ability of the CAMx modeling system to simulate 2016 measured concentrations. This evaluation focused on graphical analyses and statistical metrics of model predictions versus observations. Details on the evaluation methodology, the calculation of performance statistics, and results are provided in Appendix A. Overall, the ozone model performance statistics for the CAMx 2016 simulation are within or close to the ranges found in other recent peer-reviewed applications (e.g., Simon et al, 2012 and Emory et al, 2017). As described in Appendix A, the predictions from the 2016 modeling platform correspond closely to observed concentrations in terms of the magnitude, temporal fluctuations, and geographic differences for 8-hour daily maximum (MDA8) ozone. Thus, the model performance results demonstrate the scientific credibility of our 2016 modeling platform. These results provide confidence in the ability of the modeling platform to provide a reasonable projection of expected future year ozone concentrations and contributions. Model performance statistics for individual monitoring sites for the period May through September are provided in a spreadsheet file in the docket for this rule.[13]

[12] Preparation of Emissions Inventories for the 2016v1 North American Emissions Modeling Platform.docx.

[13] CAMx 2016 MDA8 O3 Model Performance Stats by Site.xls.

## 3. Identification of Future Nonattainment and Maintenance Receptors in 2021

### *3.1 Definition of Nonattainment and Maintenance Receptors*

The ozone predictions from the 2016 base year and future case CAMx model simulations were used to calculate average and maximum ozone design values for the 2021 analytic year using the approach described in this section. Following the general approach in the CSAPR Update, we evaluated 2021 projected average and maximum design values in conjunction with the most recent measured ozone design values (i.e., 2019)[14] to identify sites that may warrant further consideration as potential nonattainment or maintenance sites in 2021. Those monitoring sites with 2021 average design values that exceed the NAAQS (i.e., 2021 average design values of 76 ppb or greater)[15] and that are currently measuring nonattainment are considered to be nonattainment receptors in 2021. Similarly, monitoring sites with a projected 2021 maximum design value that exceeds the NAAQS would be projected to be maintenance receptors in 2021. In the CSAPR Update approach, maintenance-only receptors include both those monitoring sites where the projected average design value is below the NAAQS, but the maximum design value is above the NAAQS, and monitoring sites with projected 2021 average design values that exceed the NAAQS, but for which current design values based on measured data do not exceed the NAAQS.

The procedures for calculating projected 2021 average and maximum design values are described below. The monitoring sites that we project to be nonattainment and maintenance receptors for the ozone NAAQS in the 2021 base case are used for assessing the contribution of emissions in upwind states to downwind nonattainment and maintenance of the 2008 ozone NAAQS as part of this rule.

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[14] The 2019 design values are the most current official design values available for use in this rule. The 2019 ozone design values, by monitoring site, can be found in the following file in the docket: 2010 thru 2019 Ozone Design Values.xls.

[15] In determining compliance with the NAAQS, ozone design values are truncated to integer values. For example, a design value of 70.9 parts per billion (ppb) is truncated to 70 ppb which is attainment. In this manner, design values at or above 71.0 ppb are considered to be violations of the NAAQS.

### *3.2 Approach for Projecting Ozone Design Values*

As noted above, the projected design values for 2021 are based on an interpolation between the 2016-Centered average and maximum design values and the corresponding average and maximum design values projected for 2023.[16] In this section we describe the approach for projecting 2023 design values followed by the method for calculating design values in 2021.

The ozone predictions from the CAMx model simulations were used to project ambient (i.e., measured) ozone design values (DVs) to 2023 based on an approach that follows from EPA's guidance for attainment demonstration modeling (US EPA, 2018),[17] as summarized here. The modeling guidance recommends using 5-year weighted average ambient design values centered on the base modeling year as the starting point for projecting average design values to the future. Because 2016 is the base emissions year, we used the average ambient 8-hour ozone design values for the period 2014 through 2018 (i.e., the average of design values for 2014-2016, 2015-2017 and 2016-2018) to calculate the 5-year weighted average design values (i.e., 2016-Centered design values). The 5-year weighted average ambient design value at each site was projected to 2023 and 2028 using the Software for Model Attainment Test Software – Community Edition (SMAT-CE). This program calculates the 5-year weighted average design value based on observed data and projects future year values using the relative response predicted by the model. Equation (3-1) describes the recommended model attainment test in its simplest form, as applied for monitoring site *i*:

$$(\mathrm{DVF})_\mathrm{i} = (RRF)_i * (DVB)_i \qquad \text{Equation 3-1}$$

$\mathrm{DVF_i}$ is the estimated design value for the future year at monitoring site $i$; $\mathrm{RRF_i}$ is the relative response factor for monitoring site *i*; and $\mathrm{DVB_i}$ is the base period design value monitored at site *i*. The relative response factor for each monitoring site $(RRF)_i$ is the fractional change in MDA8 ozone between the base and future year. The RRF is based on the average ozone on model-predicted "high" ozone days in grid cells in the vicinity of the monitoring site. The modeling guidance recommends calculating RRFs based on the highest 10 modeled ozone days in the base year simulation at each monitoring site. Specifically, the RRF was calculated based on the 10 highest days in the 2016 base year modeling in the vicinity of each monitor location.

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16 The approach for projecting ozone design values in 2023 was also applied to project ozone design values in 2028.

17 EPA's ozone attainment demonstration modeling guidance is referred to as "the modeling guidance" in the remainder of this document.

For cases in which the base year model simulation did not have 10 days with ozone values greater than or equal to 60 ppb at a site, we used all days with ozone >= 60 ppb, as long as there were at least 5 days that meet that criteria. At monitor locations with less than 5 days with modeled 2016 base year ozone >= 60 ppb, no RRF or DVF was calculated for the site and the monitor in question was not included in this analysis.

The modeling guidance recommends calculating the RRF using the base year and future year model predictions from the cells immediately surrounding the monitoring site along with the grid cell in which the monitor is located. In this approach the RRF was based on a 3 x 3 array of 12 km grid cells centered on the location of the grid cell containing the monitor.

In light of comments on the Notice of Data Availability (82 FR 1733; January 6, 2017) and other analyses, EPA also projected design values based on a modified version of the "3 x 3" approach for those monitoring sites located in coastal areas. In this alternative approach, EPA eliminated from the RRF calculations the modeling data in those grid cells that are dominated by water (i.e., more than 50 percent of the area in the grid cell is water) and that do not contain a monitoring site (i.e., if a grid cell is more than 50 percent water but contains an air quality monitor, that cell would remain in the calculation). The choice of more than 50 percent of the grid cell area as water as the criteria for identifying overwater grid cells is based on the treatment of land use in the Weather Research and Forecasting model (WRF).[18] Specifically, in the WRF meteorological model those grid cells that are greater than 50 percent overwater are treated as being 100 percent overwater. In such cases the meteorological conditions in the entire grid cell reflect the vertical mixing and winds over water, even if part of the grid cell also happens to be over land with land-based emissions, as can often be the case for coastal areas. Overlaying land-based emissions with overwater meteorology may be representative of conditions at coastal monitors during times of on-shore flow associated with synoptic conditions and/or sea-breeze or lake-breeze wind flows. But there may be other times, particularly with off-shore wind flow when vertical mixing of land-based emissions may be too limited due to the presence of overwater meteorology. Thus, for our modeling EPA calculated 2023 projected average and maximum design values at individual monitoring sites based on

[18] https://www.mmm.ucar.edu/weather-research-and-forecasting-model.

both the “3 x 3” approach as well as the alternative approach that eliminates overwater cells in the RRF calculation for near-coastal areas (i.e., “no water” approach).

For both the “3 x 3” approach and the “no water” approach, the grid cell with the highest base year MDA8 ozone concentration on each day in the applicable array of grid cells surrounding the location of the monitoring site[19] is used for both the base and future components of the RRF calculation. That is, the base and future year data are paired in space for the grid cell that has the highest MDA8 concentration on the given day.

The approach for calculating 2023 projected maximum design values is similar to the approach for calculating the projected average design values. To calculate the projected maximum design values we start with the highest (i.e., maximum) ambient design value from the 2016-Centered 5-year period (i.e., the maximum of design values from 2014-2016, 2014-2017, and 2016-2018). The base period maximum design value at each site was projected to 2023 using the site-specific RRFs, as determined using the procedures for calculating RRFs described above.

The 2023 average and maximum design values for both the “3x3” and “no water” approaches were then paired with the corresponding base period measured design values at each ozone monitoring site. Design values for 2021 for both the “3 x 3” and “no water” approaches were calculated by linearly interpolating between the 2016 base period and 2023 projected values. The steps in the interpolation process for estimating 2021 average and maximum design values are as follows:

(1) Calculate the ppb change in design values between the 2016 base period and 2023;

(2) Divide the ppb change by 7 to calculate the ppb change per year over the 7-year period between 2016 and 2023;

(3) Multiply the ppb per year value by five to calculate the ppb change in design values over the 5-year period between 2016 and 2021;

(4) Subtract the ppb change between 2016 to 2021 from the 2016 design values to produce the design values for 2021.

[19] For the “3 x 3” approach the applicable array contains the 9 grid cells that surround and include the grid cell containing the monitoring site. The applicable array for the “no water” approach includes the grid cell containing the monitoring site along with the subset of the “3 x 3” grid cells that are not classified as “water” grid cells using the criteria described in this TSD.

As noted in the preamble, EPA is soliciting public comment on the use of the "3 x 3" and "no water" approaches for this rulemaking. For this rule, EPA is relying upon design values based on the "no water" approach for identifying nonattainment and maintenance receptors and for calculating contributions, as described in section 4, below.

Consistent with the truncation and rounding procedures for the 8-hour ozone NAAQS, the projected design values are truncated to integers in units of ppb.[20] Therefore, projected design values that are greater than or equal to 76 ppb are considered to be violating the 2008 ozone NAAQS. For those sites that are projected to be violating the NAAQS based on the average design values in 2021, we examined the preliminary measured design values for 2019, which are the most recent available measured design values at the time of this rule. As noted above, we identify nonattainment receptors as those sites that are violating the NAAQS based on current measured air quality and also have projected average design values of 76 ppb or greater. Maintenance-only receptors include both (1) those sites with projected average design values above the NAAQS that are currently measuring clean data and (2) those sites with projected average design values below the level of the NAAQS, but with projected maximum design values of 76 ppb or greater.[21]

Table 3-1 contains the 2016-Centered base period average and maximum design values, the 2021 base case average and maximum design values[22], and the 2019 design values for the two sites that are projected to be nonattainment receptors in 2021 and the two sites that are projected to be maintenance-only receptors in 2021.[23,24]

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[20] 40 CFR Part 50, Appendix P to Part 50 – Interpretation of the Primary and Secondary National Ambient Air Quality Standards for Ozone.

[21] In addition to the maintenance-only receptors, the 2021 ozone nonattainment receptors are also maintenance receptors because the maximum design values for each of these sites is always greater than or equal to the average design value.

[22] The design values for 2021 in this table are based on the "no water" approach.

[23] Using design values from the "3 x 3" approach does not change the total *number* of receptors in 2021. However, with the "3 x 3" approach the maintenance-only receptor in New Haven County, CT has a projected maximum design value of 75.5 ppb and would, therefore, not be a receptor using this approach. In contrast, monitoring site 090010017 in Fairfield County, CT has projected average and maximum design values of 75.7 and 76.3 ppb, respectively with the "3 x 3" approach and would, therefore, be a maintenance-only receptor with this approach.

[24] The projected 2021and 2023 design values using both the "3 x 3" and "no-water" approaches along with the 2016-Centered and 2019 design values at individual monitoring sites are provided in the following file which is in the docket for this rule: Projected 2021_2023 3x3 & No Water O3 Design Values.xls.

Table 3-1. 2016-Centered, 2021 average and maximum design values, and 2019 design values at projected nonattainment and maintenance-only receptor sites in the East[25] (units are ppb).[26]

| Monitor ID | State | Site | Average Design Value 2014-2018 | Maximum Design Value 2014-2018 | Average Design Value 2021 | Maximum Design Value 2021 | 2019 Design Value |
|---|---|---|---|---|---|---|---|
| Nonattainment Receptors | | | | | | | |
| 090013007 | CT | Stratford | 82.0 | 83 | 76.5 | 77.4 | 82 |
| 090019003 | CT | Westport | 82.7 | 83 | 78.5 | 78.8 | 82 |
| Maintenance-Only Receptors | | | | | | | |
| 090099002 | CT | Madison | 79.7 | 82 | 73.9 | 76.1 | 82 |
| 482010024 | TX | Houston | 79.3 | 81 | 75.5 | 77.1 | 81 |

## 4. Ozone Contribution Modeling

The method for estimating contributions in 2021 is based, in part, on source apportionment for 2023. In this section we first describe the source apportionment modeling for 2023 followed by the method for using these data to calculate contributions in 2021 and 2023.

The EPA performed nationwide, state-level ozone source apportionment modeling using the CAMx Ozone Source Apportionment Technology/Anthropogenic Precursor Culpability Analysis (OSAT/APCA) technique[27] to provide data on the expected contribution of 2023 base case $NO_X$ and VOC emissions from all sources in each state.

In the source apportionment model run, we tracked the ozone formed from each of the following contribution categories (i.e., "tags"):

- States – anthropogenic $NO_X$ and VOC emissions from each of the contiguous 48 states and the District of Columbia tracked individually (emissions from all anthropogenic sectors in a given state were combined);

[25] In this analysis the East includes all states from Texas northward to North Dakota and eastward to the East Coast.

[26] In the preamble and Air Quality Modeling TSD for the proposed rule there were two typographical errors in this table, as follows: (1) the maximum design value in 2021 at the Westport receptor was incorrectly given as 78.9 ppb instead of 78.8 ppb and (2) the average design value in 2021 at the Madison receptor was incorrectly given as 74.0 ppb instead of 73.9 ppb.

[27] As part of this technique, ozone formed from reactions between biogenic VOC and $NO_X$ with anthropogenic $NO_X$ and VOC are assigned to the anthropogenic emissions.

- Biogenics – biogenic $NO_X$ and VOC emissions domain-wide (i.e., not by state);
- Initial and Boundary Concentrations – air quality concentrations used to initialize the 12 km model simulation and air quality concentrations transported into the 12 km modeling domain from the lateral boundaries;
- Tribes – the emissions from those tribal lands for which we have point source inventory data in the 2016 emissions platform (we did not model the contributions from individual tribes);
- Canada and Mexico – anthropogenic emissions from sources in the portions of Canada and Mexico included in the 12 km modeling domain (contributions from Canada and Mexico were not modeled separately);
- Fires – combined emissions from wild and prescribed fires domain-wide within the 12 km modeling domain (i.e., not by state); and
- Offshore – combined emissions from offshore marine vessels and offshore drilling platforms (i.e., not by state).

The source apportionment modeling provided hourly contributions for 2023 to ozone from anthropogenic $NO_X$ and VOC emissions in each state, individually to ozone concentrations in each model grid cell. The contributions to ozone from chemical reactions between biogenic $NO_X$ and VOC emissions were modeled and assigned to the "biogenic" category. The contributions from wild fire and prescribed fire $NO_X$ and VOC emissions were modeled and assigned to the "fires" category. The contributions from the "biogenic", "offshore", and "fires" categories are not assigned to individual states nor are they included in the state contributions.

CAMx OSAT/APCA model run was performed for the period May 1 through September 30 using the projected 2023 base case emissions and 2016 meteorology for this time period. The hourly contributions[28] from each tag were processed to calculate an 8-hour average contribution metric value for each tag at each monitoring site. The contribution metric values at each individual monitoring site are calculated using model predictions for the grid cell containing the monitoring site. The process for calculating the average contribution metric uses the source apportionment outputs in a "relative sense" to apportion the projected average design value at each monitoring location into contributions from each individual tag. This process is similar in

[28] Contributions from anthropogenic emissions under "$NO_X$-limited" and "VOC-limited" chemical regimes were combined to obtain the net contribution from $NO_X$ and VOC anthropogenic emissions in each state.

concept to the approach described above for using model predictions to calculate future year ozone design values.

The basic approach used to calculate the average contribution metric values for 2021 and 2023[29] is described by the following steps:

(1) For the model grid cells containing an ozone monitoring site, calculate the 8-hour average contribution from each source tag to each monitoring site for the time period of the 8-hour daily maximum modeled (i.e., MDA8) concentration on each day;

(2) Average the MDA8 concentrations for each of the top 10 modeled ozone concentration days in 2023 and average the 8-hour contributions for each of these same days for each tag;

(3) Divide the 10-day average contribution for each tag by the corresponding 10-day average concentration to obtain a Relative Contribution Factor (RCF) for each tag for each monitoring site;

(3) Multiply the 2021 and 2023 average design values by the corresponding RCF to produce the average contribution metric values at each monitoring site in 2021 and 2023, respectively.

The contribution metric values calculated from step 3 are truncated to two digits to the right of the decimal (e.g., a calculated contribution of 0.78963… is truncated to 0.78 ppb). As a result of truncation, the tabulated contributions may not always sum to the 2021 and 2023 average design values. The details on how this approach is applied in the computer code to perform the contribution calculations is provided in Appendix B.

### *4.2 Contribution Modeling Results*

The contribution metric values from each state and the other source tags at individual nonattainment and maintenance-only sites in the East in 2021 are provided in Appendix C. The largest contribution values from each state subject to this rule to 2021 downwind nonattainment sites and to downwind maintenance-only sites are provided in Table 4-1.[30]

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[29] The approach described for calculating contributions in 2023 was also applied to the 2028 modeling to calculate contributions for 2028.

[30] The 2021, 2023, and 2028 contribution metric values from each state and from the other source tags to individual monitoring sites nationwide are provided in a file in the docket for this rule: Ozone Design Values & Contributions_Proposed Revised CSAPR Update.xls

Table 4-1. Largest contribution from each state to downwind nonattainment and maintenance-only Receptors in 2021 (units are ppb).

| Upwind State | Largest Downwind Contribution to Nonattainment Receptors for Ozone | Largest Downwind Contribution to Maintenance-Only Receptors for Ozone |
|---|---|---|
| Alabama | 0.11 | 0.27 |
| Arkansas | 0.18 | 0.15 |
| Illinois | 0.81 | 0.80 |
| Indiana | 1.26 | 1.08 |
| Iowa | 0.17 | 0.22 |
| Kansas | 0.13 | 0.11 |
| Kentucky | 0.87 | 0.79 |
| Louisiana | 0.27 | 4.68 |
| Maryland | 1.21 | 1.56 |
| Michigan | 1.71 | 1.62 |
| Mississippi | 0.10 | 0.37 |
| Missouri | 0.36 | 0.33 |
| New Jersey | 8.62 | 5.71 |
| New York | 14.44 | 12.54 |
| Ohio | 2.55 | 2.35 |
| Oklahoma | 0.20 | 0.14 |
| Pennsylvania | 6.86 | 5.64 |
| Texas | 0.59 | 0.36 |
| Virginia | 1.30 | 1.69 |
| West Virginia | 1.49 | 1.55 |
| Wisconsin | 0.23 | 0.23 |

*4.4 Upwind/Downwind Linkages*

In CSAPR and the CSAPR Update, the EPA used a contribution screening threshold of 1 percent of the NAAQS to identify upwind states that may significantly contribute to downwind nonattainment and/or maintenance problems and which warrant further analysis to determine if emissions reductions might be required from each state to address the downwind air quality problem. The EPA determined that 1 percent was an appropriate threshold to use in the analysis for those rulemakings because there were important, even if relatively small, contributions to identified nonattainment and maintenance receptors from multiple upwind states mainly in the eastern U.S. The agency has historically found that the 1 percent threshold is appropriate for identifying interstate transport linkages for states collectively contributing to downwind ozone nonattainment or maintenance problems because that threshold captures a high percentage of the total pollution transport affecting downwind receptors.

Based on the approach used in CSAPR and the CSAPR Update, upwind states that contribute ozone in amounts at or above the 1 percent of the NAAQS threshold to a particular downwind nonattainment or maintenance receptor are considered to be "linked" to that receptor in Step 2 of the CSAPR framework for purposes of further analysis in Step 3 to determine whether and what emissions from the upwind state contribute significantly to downwind nonattainment and interfere with maintenance of the NAAQS at the downwind receptors. For the 2008 ozone NAAQS the value of a 1 percent threshold is 0.75 ppb. The individual upwind state to downwind receptor "linkages" and contributions based on a 0.75 ppb threshold are identified in Table 4-2. In summary, Indiana, Kentucky, Maryland, Michigan, New Jersey, New York, Ohio, Pennsylvania, Virginia, and West Virginia are each linked to the nonattainment receptors in Westport and Stratford, and the maintenance-only receptor in Madison, Connecticut; Illinois is linked to the nonattainment receptor in Westport and the maintenance-only receptor in Madison; and Louisiana is linked to the maintenance-only receptor in Houston, Texas.

As noted above, when applying the CSAPR framework, an upwind state's linkage to a downwind receptor alone does not determine whether the state significantly contributes to nonattainment or interferes with maintenance of a NAAQS to a downwind state. The determination of significant contribution is made in Step 3 as part of a multi-factor analysis, as described in the Ozone Transport Policy Analysis Technical Support Document.

Table 4-2. Contributions from upwind states that are "linked" to each downwind nonattainment and maintenance receptor in the East.[31]

| | Nonattainment Receptors | | | Maintenance-Only Receptors |
|---|---|---|---|---|
| Upwind State | Stratford, CT | Westport, CT | Upwind State | Madison, CT |
| Illinois | 0.69 | 0.81 | Illinois | 0.80 |
| Indiana | 0.99 | 1.26 | Indiana | 1.08 |
| Kentucky | 0.78 | 0.87 | Kentucky | 0.79 |
| Maryland | 1.21 | 1.20 | Maryland | 1.56 |
| Michigan | 1.16 | 1.71 | Michigan | 1.62 |

[31] Note that for the purpose of completeness we have included the contribution from Illinois to the receptor in Stratford, CT, even though Illinois is not linked to this receptor.

| | Nonattainment Receptors | | | Maintenance-Only Receptors |
|---|---|---|---|---|
| New Jersey | 7.70 | 8.62 | New Jersey | 5.71 |
| New York | 14.42 | 14.44 | New York | 12.54 |
| Ohio | 2.34 | 2.55 | Ohio | 2.35 |
| Pennsylvania | 6.72 | 6.86 | Pennsylvania | 5.64 |
| Virginia | 1.29 | 1.30 | Virginia | 1.69 |
| West Virginia | 1.45 | 1.49 | West Virginia | 1.55 |
| | | | | |
| | | | | Houston, TX |
| | | | Louisiana | 4.68 |



NMED Exhibit 9h

## 5. References

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# Appendix A

# 2016 Model Performance Evaluation

An operational model evaluation was conducted for the 2016 base year CAMx v7beta6 simulation performed for the 12 km U.S. modeling domain. The purpose of this evaluation is to examine the ability of the 2016 air quality modeling platform to represent the magnitude and spatial and temporal variability of measured (i.e., observed) ozone concentrations within the modeling domain. The evaluation presented here is based on model simulations using the 2016 emissions platform (i.e., scenario name 2016fh_16j)). The model evaluation for ozone focuses on comparisons of model predicted 8-hour daily maximum concentrations to the corresponding observed data at monitoring sites in the EPA Air Quality System (AQS). The locations of the ozone monitoring sites in this network are shown in Figure A-1.

Included in the evaluation are statistical measures of model performance based upon model-predicted versus observed concentrations that were paired in space and time. Model performance statistics were calculated for several spatial scales and temporal periods. Statistics were calculated for individual monitoring sites, and in aggregate for monitoring sites within each state and within each of nine climate regions of the 12 km U.S. modeling domain. The regions include the Northeast, Ohio Valley, Upper Midwest, Southeast, South, Southwest, Northern Rockies, Northwest and West[1,2], which are defined based upon the states contained within the National Oceanic and Atmospheric Administration (NOAA) climate regions (Figure A-2)[3] as defined in Karl and Koss (1984).

[1] The nine climate regions are defined by States where: Northeast includes CT, DE, ME, MA, MD, NH, NJ, NY, PA, RI, and VT; Ohio Valley includes IL, IN, KY, MO, OH, TN, and WV; Upper Midwest includes IA, MI, MN, and WI; Southeast includes AL, FL, GA, NC, SC, and VA; South includes AR, KS, LA, MS, OK, and TX; Southwest includes AZ, CO, NM, and UT; Northern Rockies includes MT, NE, ND, SD, WY; Northwest includes ID, OR, and WA; and West includes CA and NV.

[2] Note most monitoring sites in the West region are located in California (see Figures 2A-2a and 2A-2b), therefore statistics for the West will be mostly representative of California ozone air quality.

[3] NOAA, National Centers for Environmental Information scientists have identified nine climatically consistent regions within the contiguous U.S., http://www.ncdc.noaa.gov/monitoring-references/maps/us-climate-regions.php.

For maximum daily average 8-hour (MDA8) ozone, model performance statistics were created for the period May through September.[4] The aggregate statistics by state and by climate region are presented in this appendix. Model performance statistics for MDA8 ozone at individual monitoring sites based on days with observed values $\geq$ 60 ppb can be found in the docket in the file named "2016v1 CAMx Ozone Model Performance Statistics by Site".

In addition to the above performance statistics, we prepared several graphical presentations of model performance for MDA8 ozone. These graphical presentations include:
(1) maps that show the mean bias and error as well as normalized mean bias and error calculated for MDA8 $\geq$ 60 ppb for May through September at individual AQS and CASTNet monitoring sites;
(2) bar and whisker plots that show the distribution of the predicted and observed MDA8 ozone concentrations by month (May through September) and by region and by network; and
(3) time series plots (May through September) of observed and predicted MDA8 ozone concentrations for selected monitoring sites.

The Atmospheric Model Evaluation Tool (AMET) was used to calculate the model performance statistics used in this document (Gilliam et al., 2005). For this evaluation we have selected the mean bias, mean error, normalized mean bias, and normalized mean error to characterize model performance, statistics which are consistent with the recommendations in Simon et al. (2012) and the draft photochemical modeling guidance (U.S. EPA, 2014a).

Mean bias (MB) is the average of the difference (predicted – observed) divided by the total number of replicates (*n*). Mean bias is given in units of ppb and is defined as:

MB = $\frac{1}{n}\sum_{1}^{n}(P - O)$ , where P = predicted and O = observed concentrations

Mean error (ME) calculates the absolute value of the difference (predicted - observed) divided by the total number of replicates (*n*). Mean error is given in units of ppb and is defined as:

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[4] In calculating the ozone season statistics we limited the data to those observed and predicted pairs with observations that are $\geq$ 60 ppb in order to focus on concentrations at the upper portion of the distribution of values.

$$\text{ME} = \frac{1}{n}\sum_1^n |P - O|$$

Normalized mean bias (NMB) is the average the difference (predicted - observed) over the sum of observed values. NMB is a useful model performance indicator because it avoids over inflating the observed range of values, especially at low concentrations. Normalized mean bias is given in percentage units and is defined as:

$$\text{NMB} = \frac{\sum_1^n (P-O)}{\sum_1^n (O)} * 100$$

Normalized mean error (NME) is the absolute value of the difference (predicted - observed) over the sum of observed values. Normalized mean error is given in percentage units and is defined as:

$$\text{NME} = \frac{\sum_1^n |P-O|}{\sum_1^n (O)} * 100$$

As described in more detail below, the model performance statistics indicate that the 8-hour daily maximum ozone concentrations predicted by the 2016 CAMx modeling platform closely reflect the corresponding 8-hour observed ozone concentrations in each region of the 12 km U.S. modeling domain. The acceptability of model performance was judged by considering the 2016 CAMx performance results in light of the range of performance found in recent regional ozone model applications (Emery et al., NRC, 2002; Phillips et al., 2007; Simon et al., 2012; U.S. EPA, 2005; U.S. EPA, 2009; U.S. EPA, 2010.[5] These other modeling studies

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[5] Christopher Emery, Zhen Liu, Armistead G. Russell, M. Talat Odman, Greg Yarwood & Naresh Kumar (2017) Recommendations on statistics and benchmarks to assess photochemical model performance, Journal of the Air & Waste Management Association, 67:5, 582-598, DOI: 10.1080/10962247.2016.1265027

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U.S. Environmental Protection Agency, Proposal to Designate an Emissions Control Area for Nitrogen Oxides, Sulfur Oxides, and Particulate Matter: Technical Support Document. EPA-420-R-007, 329pp., 2009. (http://www.epa.gov/otaq/regs/nonroad/marine/ci/420r09007.pdf) represent a wide range of modeling analyses that cover various models, model configurations, domains, years and/or episodes, chemical mechanisms, and aerosol modules. Overall, the ozone model performance results for the 2016 CAMx simulations are within the range found in other recent peer-reviewed and regulatory applications. The model performance results, as described in this document, demonstrate that the predictions from the 2016 modeling platform correspond closely to observed concentrations in terms of the magnitude, temporal fluctuations, and geographic differences for 8-hour daily maximum ozone.

The 8-hour ozone model performance bias and error statistics by network for the period May-September for each region and each state are provided in Tables A-1 and A-2, respectively. The statistics shown were calculated using data pairs on days with observed 8-hour ozone of ≥ 60 ppb. The distributions of observed and predicted 8-hour ozone by month in the period May through September for each region are shown in Figures A-3 through A-11. Spatial plots of the mean bias and error as well as the normalized mean bias and error for individual monitors are shown in Figures A-12 through A-15.

Time series plots of observed and predicted MDA 8-hour ozone during the period May through September for 2021 nonattainment and/or maintenance sites are provided in Figure A-16, (a) through (d).

As indicated by the statistics in Table A-1, the base year 2016 modeling tends to under predict MDA8 ozone, although the bias and error are relatively low in each region. Generally, mean bias for 8-hour ozone ≥ 60 ppb during the period May through September is close to or within ± 10 ppb[6] in nearly all of the regions. The mean error is less than 10 ppb in the Northeast, Ohio Valley, Southeast, South, and Southwest. Normalized mean bias is within ± 10 percent for

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Phillips, S., K. Wang, C. Jang, N. Possiel, M. Strum, T. Fox, 2007. Evaluation of 2002 Multi-pollutant Platform: Air Toxics, Ozone, and Particulate Matter, 7th Annual CMAS Conference, Chapel Hill, NC, October 6-8, 2008. (http://www.cmascenter.org/conference/2008/agenda.cfm).

U.S. Environmental Protection Agency, 2010, Renewable Fuel Standard Program (RFS2) Regulatory Impact Analysis. EPA-420-R-10-006. February 2010. Sections 3.4.2.1.2 and 3.4.3.3. Docket EPA-HQ-OAR-2009-0472-11332. (http://www.epa.gov/oms/renewablefuels/420r10006.pdf)

Simon, H., Baker, K.R., and Phillips, S. (2012) Compilation and interpretation of photochemical model performance statistics published between 2006 and 2012. *Atmospheric Environment* **61**, 124-139.

[6] Note that "within ± 5 ppb" includes values that are greater than or equal to -5 ppb and less than or equal to 5 ppb.

sites in the Northeast, Ohio Valley, Southeast, and Southwest with somewhat larger values in the other regions where the normalized mean bias is less than 20 percent. The normalized mean error is less than 15 percent for the Northeast, Ohio Valley, Southeast, South, and Southwest and less that 20 percent in the Upper Midwest, Northern Rockies, Northwest, and West regions.

The monthly distributions of MDA8 model-predicted ozone for each region are provided in Figures A-3 through A-11. In the Northeast, Ohio Valley, and Upper Midwest, the model under predicts in May and June followed by over prediction in the remainder of the ozone season. In the Southeast, the distribution of predictions generally corresponds well with that of the observed concentrations in May and June with over prediction during the remainder of the ozone season. The distribution of predicted concentrations tends to be close to that of the observed data at the 25$^{th}$ percentile, median and 75th percentile values in the South with a tendency for under-prediction in the Southwest and Northern Rockies. In the Northwest modeled MDA8 ozone under predicts in May and June, but then closely tracks the observed values in July, August, and September. Measured MDA8 ozone is under predicted in the West region.

Figures A-12 through A-15 show the spatial variability in bias and error at monitor locations for MDA8 ozone on days with measured concentrations $\geq$ 60 ppb. Mean bias, as seen from Figure A-12, is within $\pm$ 5 ppb at many sites from portions of Texas northeastward to the Northeast Corridor. In this area, the normalized mean bias is within $\pm$ 10 percent, the mean error is mainly between 4 and 8 ppb and the normalized mean error is between 5 to 15 percent. At most monitoring sites across the remainder of the East the model under predicts by 5 to 10 ppb, the normalized mean bias is between 5 and 10 percent, the mean error is in the range of 8 to 12 ppb, and normalized mean error of 5 to 10 percent. The exceptions are at some monitoring sites in mainly the interior parts of Michigan, Wisconsin, and Upstate New York where the magnitude of under prediction is 10 to 15 ppb, the normalized mean bias is -10 to 30 percent, the mean error is 12 to 16 ppb, and the normalized mean error is 15 to 25 percent.

Elsewhere in the U.S., mean bias is generally in the range of -5 to -10 ppb. The most notable exceptions are in portions of Arizona, California, and Wyoming where the mean bias is in the range of -10 to -15 ppb and up to -15 to 20 ppb at some sites in the Central Valley of California. At monitoring sites in the vicinity of Denver Las Vegas, Phoenix, San Francisco, and along the California coastline the normalized mean bias is within ± 10 percent. Model predictions at monitoring sites in these areas also have the lowest mean error (e.g., 6 to 10 ppb) and the lowest normalized mean error (e.g., $\leq$ 15 percent) in the western U.S.

In addition to the above analysis of overall model performance, we also examine how well the modeling platform replicates day to day fluctuations in observed 8-hour daily maximum concentrations for the four monitoring sites that are projected to be receptors in 2021 (i.e., Stratford, CT, Westport, CT, New Haven-Madison, CT, and Houston-Aldine, TX). For this site-specific analysis we present the time series of observed and predicted 8-hour daily maximum concentrations by site over the period May through September. The results, as shown in Figures A-16 (a) through (d), indicate that the modeling platform generally replicates the day-to-day variability in ozone during this time period at these sites. That is, days with high modeled concentrations are generally also days with high measured concentrations and, conversely, days with low modeled concentrations are also days with low measured concentrations in most cases. For example, model predictions at these sites not only accurately capture the day-to-day variability in the observations, but also appear to capture the timing and magnitude of multi-day high ozone episodes as well as time periods of relatively low concentrations.

Model performance statistics for MDA8 ozone $\geq$ 60 ppb during the period May through September at each of the four receptor sites are provided in Table A-2. These statistics indicate that, overall, the model predictions are close in magnitude to the corresponding measurements. As evident from the mean bias and normalized mean bias, the model under predicts the corresponding measured data to some extent. The magnitude of the performance statistics is consistent across these sites. The general range of mean bias 4 to 6 ppb, normalized mean is -6 to -8 ppb, mean error is 7 to 9 ppb, and the normalized mean error is less than 10 to 13%.

In summary, the ozone model performance statistics for the CAMx 2016 simulation are within or close to the ranges found in other recent peer-reviewed applications (e.g., Simon et al, 2012 and Emory et al, 2017). As described in this appendix, the predictions from the 2016 modeling platform correspond closely to observed concentrations in terms of the magnitude, temporal fluctuations, and geographic differences for 8-hour daily maximum ozone.  Thus, the model performance results demonstrate the scientific credibility of our 2016 modeling platform.

These results provide confidence in the ability of the modeling platform to provide a reasonable projection of expected future year ozone concentrations and contributions.

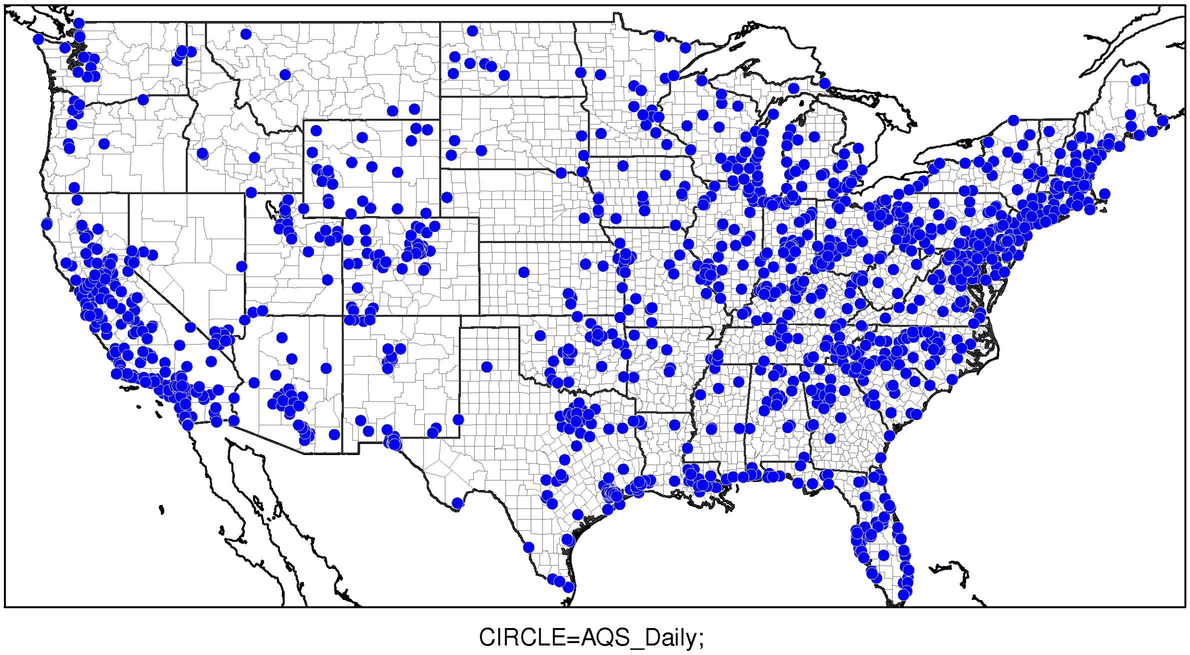


Figure A-1a. AQS ozone monitoring sites.

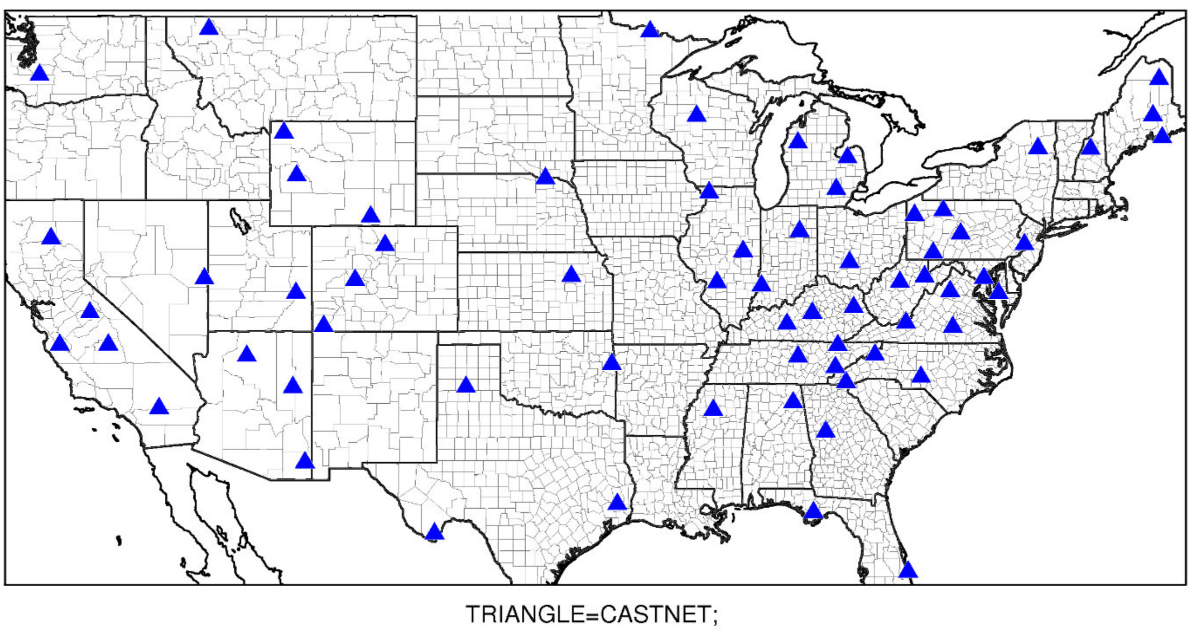


Figure A-1b. CASTNet ozone monitoring sites.

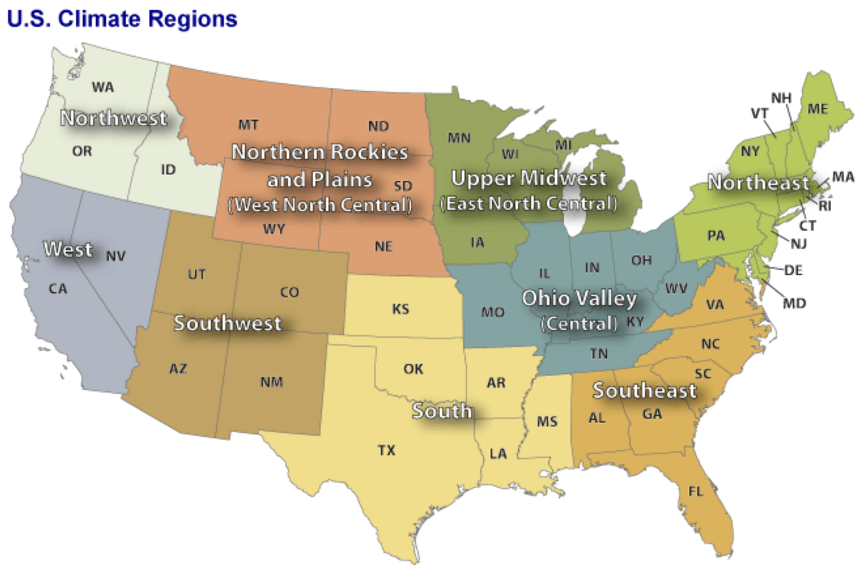


Figure A-2. NOAA climate regions (source: http://www.ncdc.noaa.gov/monitoring-references/maps/us-climate-regions.php#references)

Table A-1. Performance statistics for MDA8 ozone ≥ 60 ppb for May through September by climate region.

| Climate Region | Number of Days ≥ 60 ppb | MB (ppb) | ME (ppb) | NMB (%) | NME (%) |
|---|---|---|---|---|---|
| Northeast | 2962 | -3.7 | 7.2 | -5.6 | 10.7 |
| Ohio Valley | 3201 | -5.3 | 7.9 | -8.1 | 12.0 |
| Upper Midwest | 1134 | -10.3 | 11.0 | -15.6 | 16.6 |
| Southeast | 1401 | -3.8 | 6.6 | -5.8 | 10.2 |
| South | 983 | -6.2 | 8.2 | -9.6 | 12.6 |
| Southwest | 3076 | -7.8 | 9.3 | -12.0 | 14.3 |
| Northern Rockies | 206 | -11.3 | 11.7 | -18.0 | 18.6 |
| Northwest | 84 | -7.9 | 11.0 | -12.1 | 17.0 |
| West | 8274 | -10.9 | 11.8 | -15.4 | 16.7 |

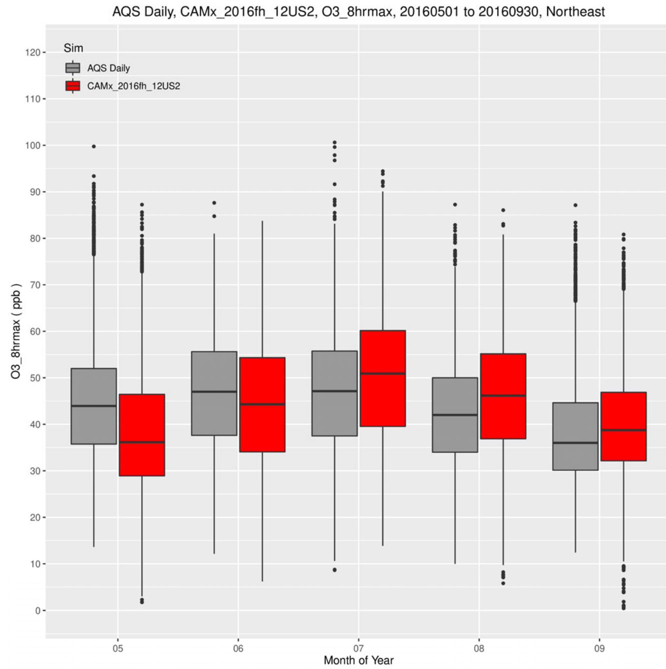


Figure A-3. Distribution of observed and predicted MDA8 ozone by month for the period May through September for the Northeast region, [symbol = median; top/bottom of box = 75th/25th percentiles; top/bottom dots = peak/low values]

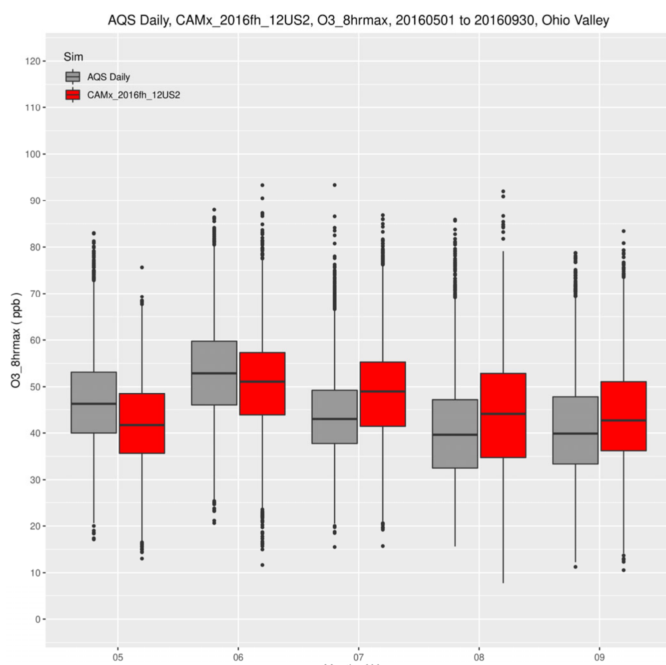


Figure A-4. Distribution of observed and predicted MDA8 ozone by month for the period May through September for the Ohio Valley region.

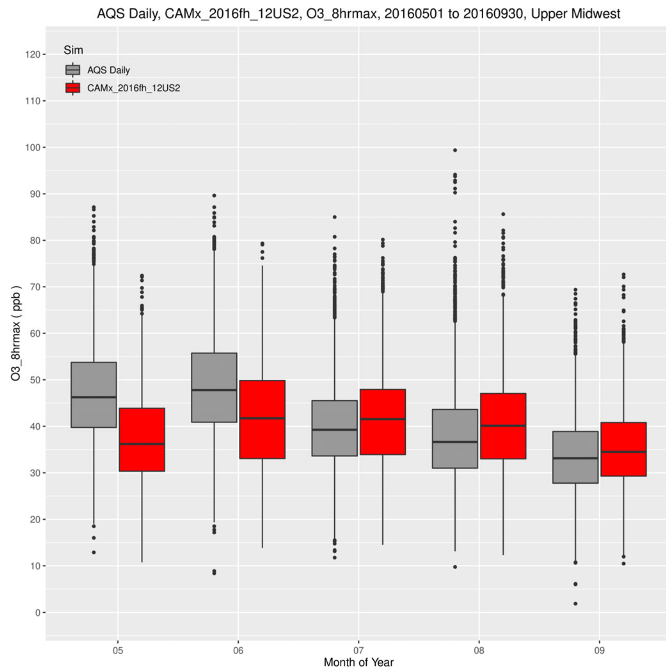


Figure A-5. Distribution of observed and predicted MDA8 ozone by month for the period May through September for the Upper Midwest region.

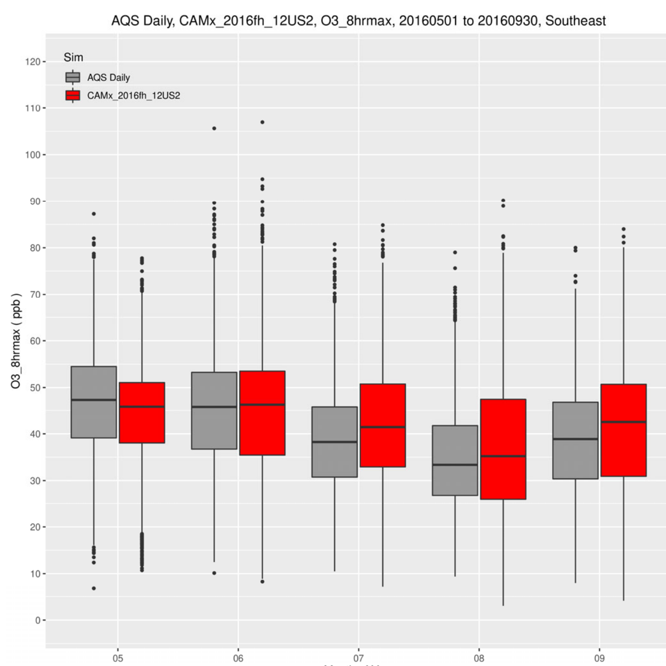


Figure A-6. Distribution of observed and predicted MDA8 ozone by month for the period May through September for the Southeast region.

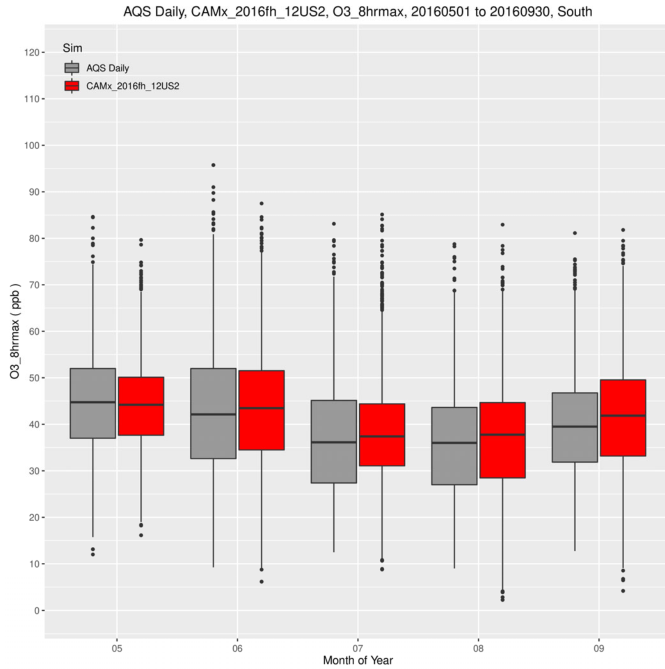


Figure A-7. Distribution of observed and predicted MDA8 ozone by month for the period May through September for the South region.

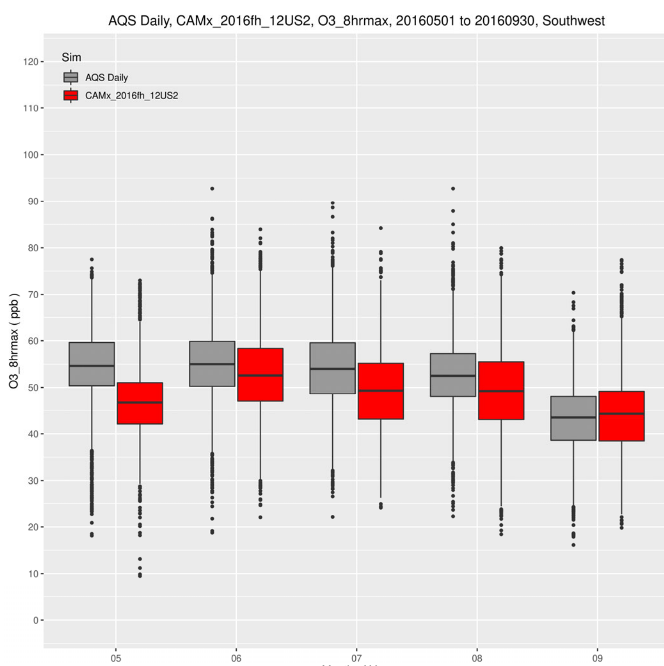


Figure A-8. Distribution of observed and predicted MDA8 ozone by month for the period May through September for the Southwest region.

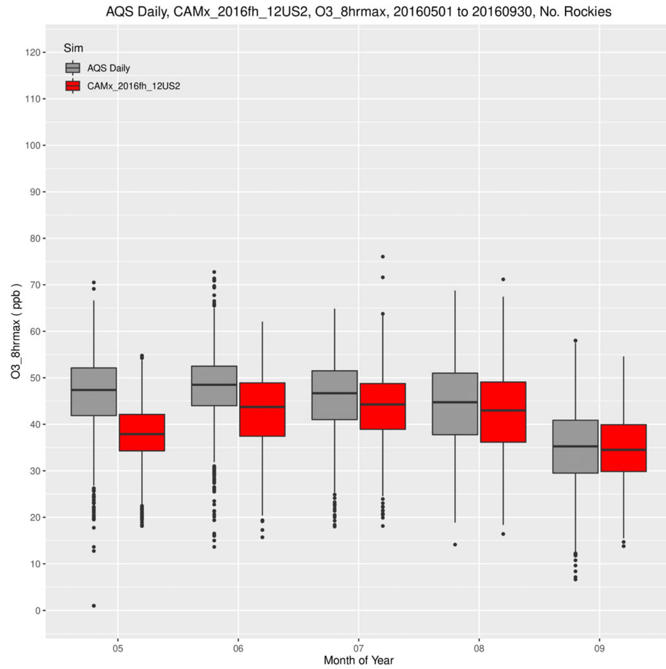


Figure A-9. Distribution of observed and predicted MDA8 ozone by month for the period May through September for the Northern Rockies region, AQS Network (left) and CASTNet (right).

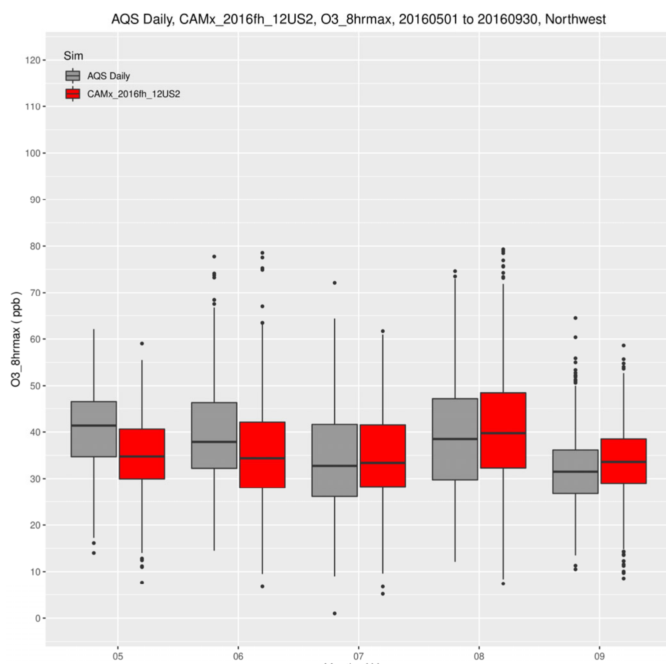


Figure A-10. Distribution of observed and predicted MDA8 ozone by month for the period May through September for the Northwest region.

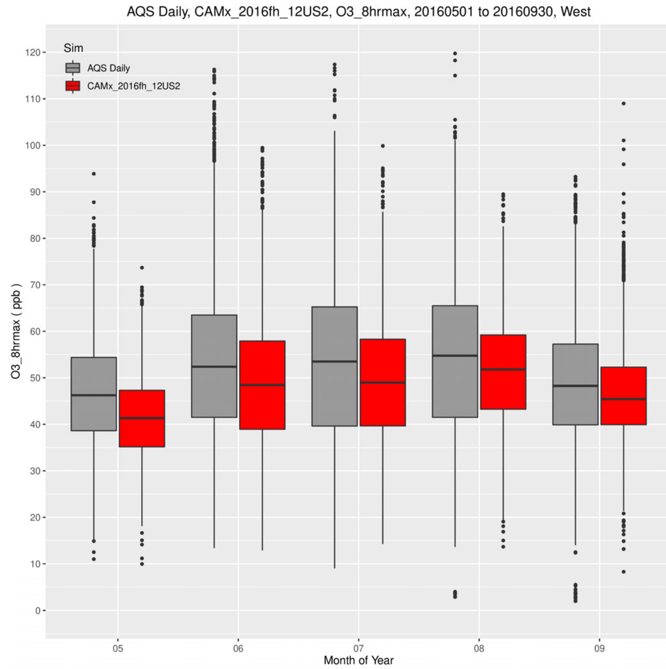


Figure A-11. Distribution of observed and predicted MDA8 ozone by month for the period May through September for the West region.

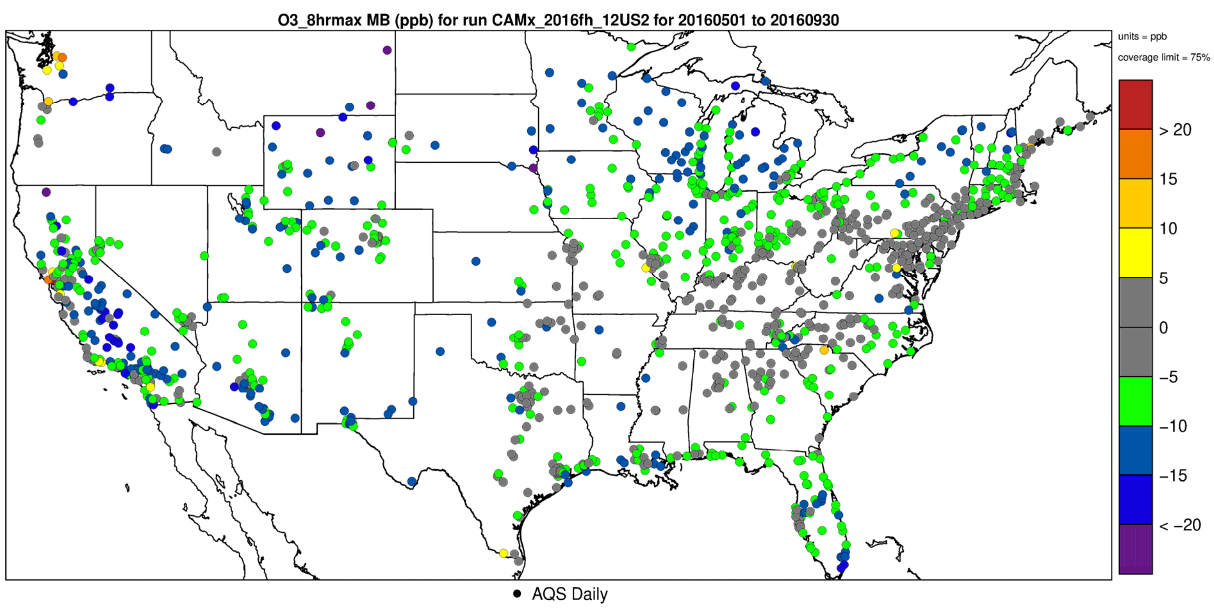


Figure A-12. Mean Bias (ppb) of MDA8 ozone ≥ 60 ppb over the period May-September.

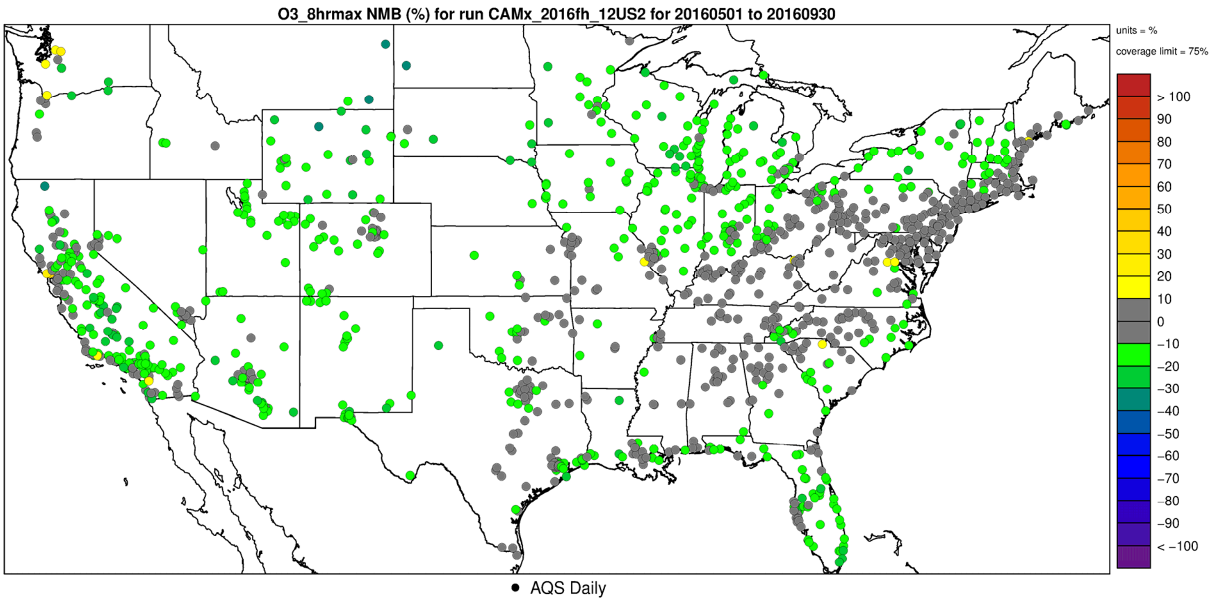


Figure A-13. Normalized Mean Bias (%) of MDA8 ozone ≥ 60 ppb over the period May-September 2016.

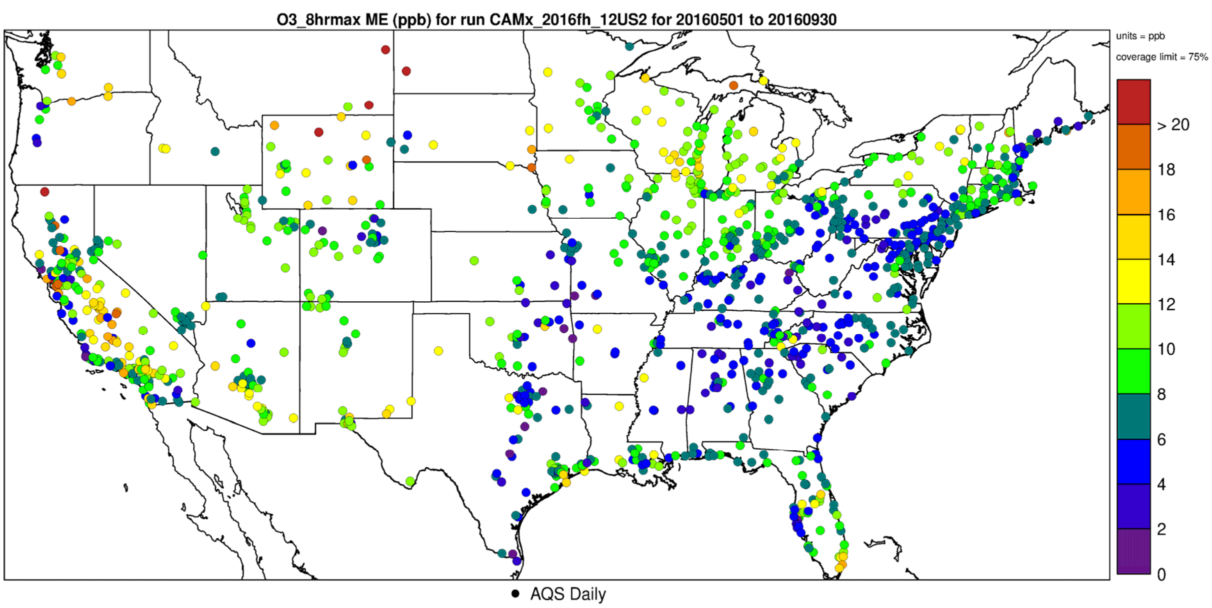


Figure A-14. Mean Error (ppb) of MDA8 ozone ≥ 60 ppb over the period May-September 2016.

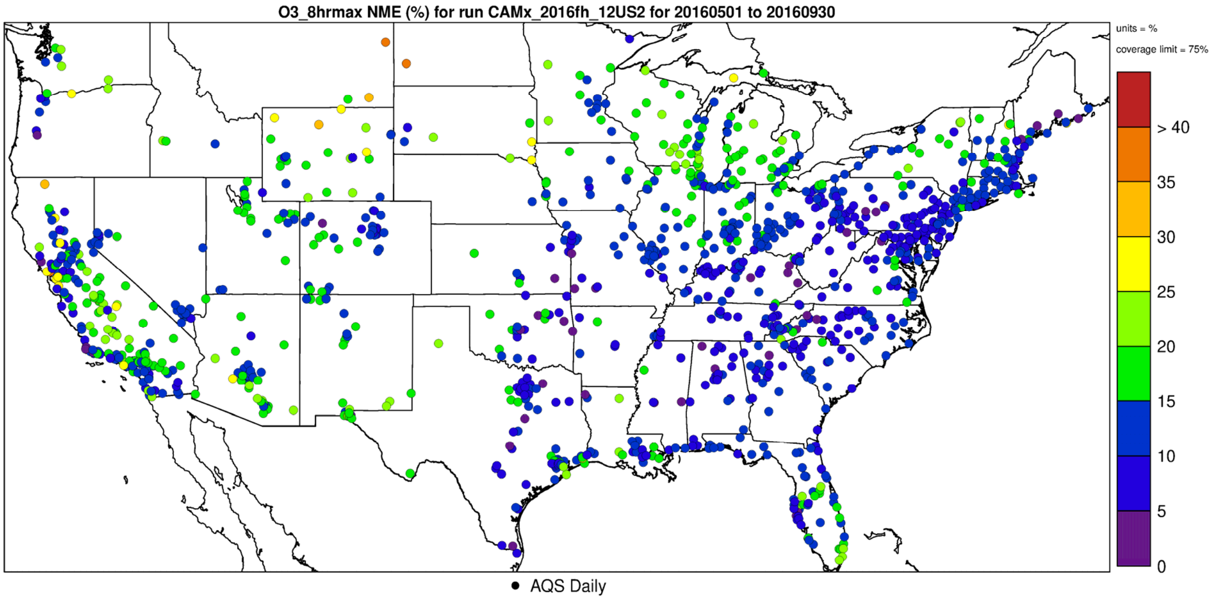


Figure A-15. Normalized Mean Error (%) of MDA8 ozone ≥ 60 ppb over the period May-September 2016.

Table A-2. Performance statistics for MDA8 ozone ≥ 60 ppb for May through September for monitoring sites in Stratford, CT, Westport, CT, New Haven-Madison, CT, and Houston-Aldine, TX.

| State | Site Name | Number of Days ≥ 60 ppb | MB (ppb) | ME (ppb) | NMB (%) | NME (%) |
|---|---|---|---|---|---|---|
| CT | Stratford | 36.0 | -4.6 | 9.1 | -6.4 | 12.9 |
| CT | Westport | 29.0 | -5.7 | 9.2 | -7.8 | 12.7 |
| CT | New Haven-Madison | 29.0 | -4.6 | 7.3 | -6.5 | 10.4 |
| TX | Houston-Aldine | 15.0 | -4.2 | 8.8 | -6.5 | 13.4 |

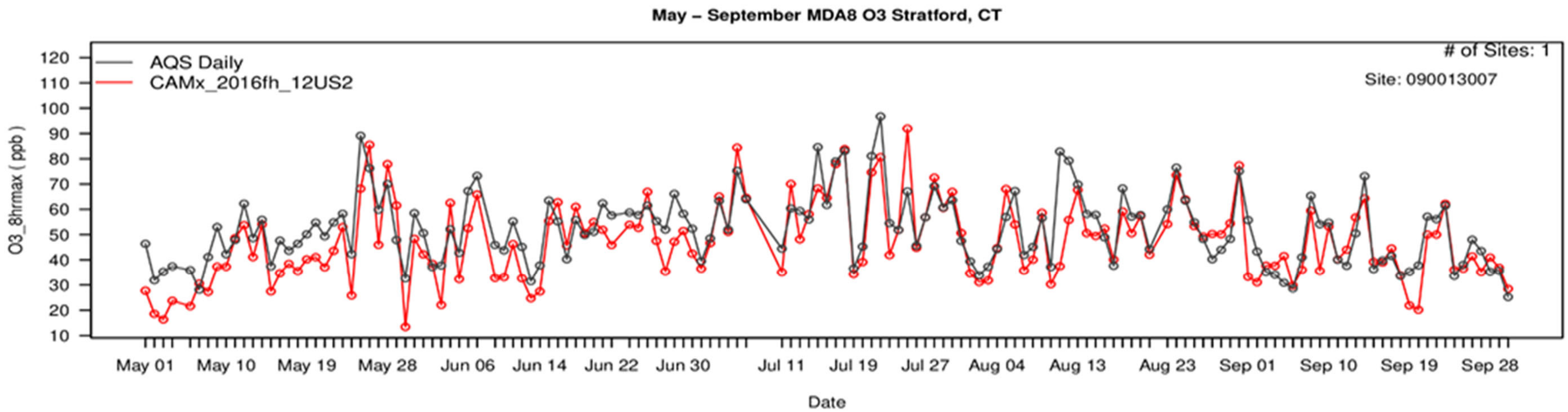


Figure A-16a. Time series of observed (black) and predicted (red) MDA8 ozone for May through September 2016 at site 090013007 in Stratford, Fairfield Co., Connecticut.

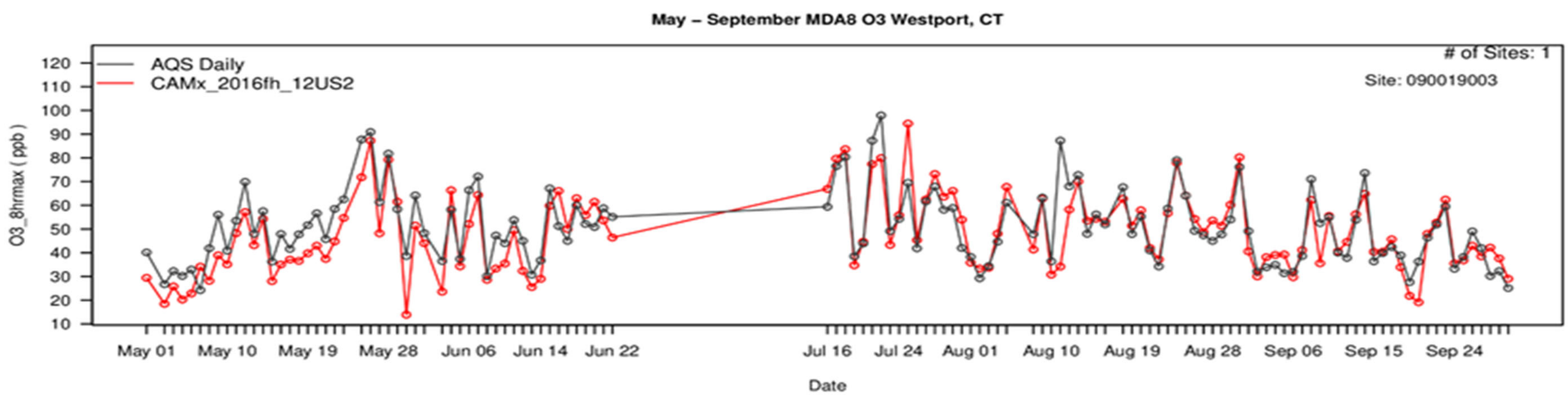


Figure A-16b. Time series of observed (black) and predicted (red) MDA8 ozone for May through September 2016 at site 090019003 in Westport, Fairfield Co., Connecticut.

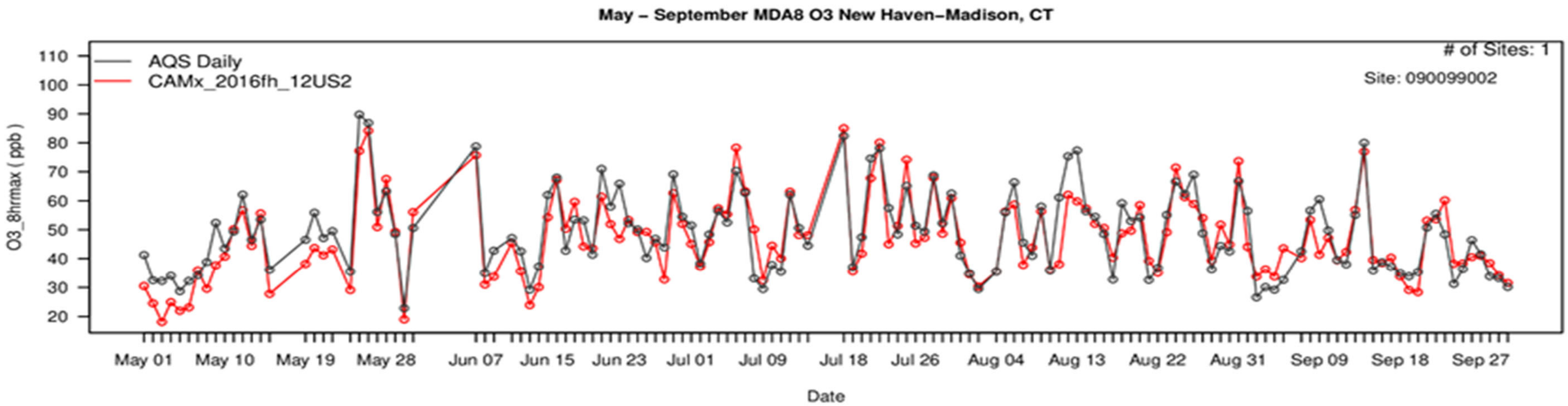


Figure A-16c. Time series of observed (black) and predicted (red) MDA8 ozone for May through September 2016 at site 090099002 in Madison, New Haven Co., Connecticut.

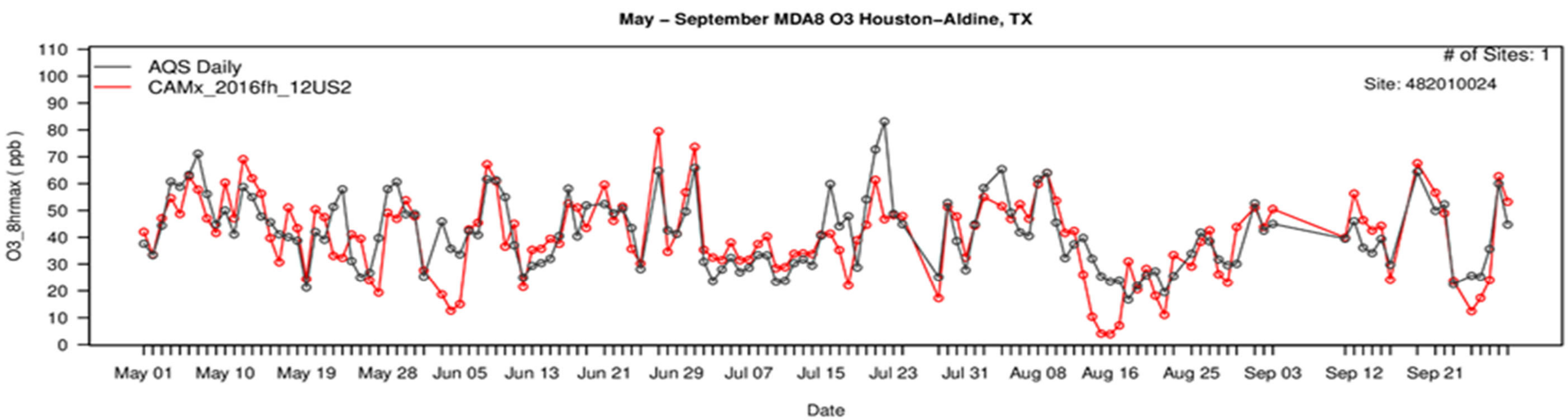


Figure A-16d. Time series of observed (black) and predicted (red) MDA8 ozone for May through September 2016 at site 482010024 in Harris Co., Texas.

## Appendix B

## Computation Steps for Calculating the Average Contribution Metric

**Step 1.** Modeled hourly ozone concentrations are used to calculate the 8-hour daily maximum ozone (MDA8) concentration in each grid cell on each day.

**Step 2.** The gridded hourly ozone contributions from each tag are subtracted from the corresponding gridded hourly total ozone concentrations to create a "pseudo" hourly ozone value for each tag for each hour in each grid cell.

**Step 3.** The hourly "pseudo" concentrations from Step 2 are used to calculate 8-hour average "pseudo" concentrations for each tag for the time period that corresponds to the MDA8 concentration from Step 1. Step 3 results in spatial fields of 8-hour average "pseudo" concentrations for each grid cell for each tag on each day.

**Step 4.** The 8-hour average "pseudo" concentrations for each tag and the MDA8 concentrations are extracted for those grid cells containing ozone monitoring sites. We used the data for the 10 days with the highest MDA8 modeled concentrations in 2023 (i.e., top 10 2023 modeled concentration days) in the downstream calculations. If there were fewer than 52023 exceedance days at a particular monitoring site then the data from the top five 2023 MDA8 concentration days are extracted and used in the calculations.[1]

**Step 5.** For each monitoring site and each tag, the 8-hour "pseudo" concentrations are then averaged across the days selected in Step 4 to create a multi-day average "pseudo" concentration for tag at each site. Similarly, the MDA8 concentrations were average across the days selected in Step 4.

**Step 6.** The multi-day average "pseudo" concentration and the corresponding multi-day average MDA8 concentration are used to create a Relative Contribution Factor (RCF) for each tag at each monitoring site. The RCF is the difference between the MDA8 concentration and the corresponding "pseudo" concentration, normalized by the MDA8 concentration.

[1] If there were fewer than 5 days with a modeled 2023 MDA8 concentration ≥ 60 ppb for the location of a particular monitoring site, then contributions were not calculated at that monitor.

**Step 7.** The RCF for each tag is multiplied by the 2023 average ozone design value to create the ozone contribution metrics for each tag at each site. Note that the sum of the contributions from each tag equals the 2023 average design value for that site.

**Step 8.** The contributions calculated from Step 7 are truncated to two digits to the right of the decimal (e.g., a calculated contribution of 0.78963… is truncated to 0.78 ppb). As a result of truncation the tabulated contributions may not always sum to the 2023 average design value.

# Appendix C

## Ozone Contributions to 2021 Nonattainment & Maintenance-Only Receptors

The tables in this appendix provide the contribution metric data from each state and the other source tags to the 2021 nonattainment and maintenance-only receptors. The table also contains the 2016-Centered and 2021 projected ozone design values at each site. The contributions and design values are in units of ppb.

A spreadsheet file with the 2021, 2023, and 2028 contributions to monitoring sites nationwide can be found in the following file in the docket for this proposed rule: Ozone Design Values & Contributions_Proposed Revised CSAPR Update.xls. Note that not all monitoring sites are included in the data sets for all three projection years because of the criteria used in the calculation of projected design values and contributions as described in this TSD.

| | | | | | | | | Contributions | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AQS Site ID | State | County | Location | 2016-Centered Average DV | 2016-Centered Maximum DV | 2021 Average DV | 2021 Maximum DV | AL | AZ | AR | CA | CO | CT |
| 90013007 | CT | Fairfield | Stratford | 82.0 | 83 | 76.5 | 77.4 | 0.11 | 0.01 | 0.18 | 0.03 | 0.06 | 4.16 |
| 90019003 | CT | Fairfield | Westport | 82.7 | 83 | 78.5 | 78.8 | 0.11 | 0.01 | 0.17 | 0.03 | 0.06 | 2.73 |
| 90099002 | CT | New Haven | Madison | 79.7 | 82 | 73.9 | 76.1 | 0.07 | 0.01 | 0.15 | 0.02 | 0.05 | 3.96 |
| 482010024 | TX | Harris | Houston | 79.3 | 81 | 75.5 | 77.1 | 0.27 | 0.00 | 0.08 | 0.00 | 0.01 | 0.00 |

| | | | | Contributions | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AQS Site ID | State | County | Location | DE | DC | FL | GA | ID | IL | IN | IA | KS | KY | LA | ME |
| 90013007 | CT | Fairfield | Stratford | 0.43 | 0.04 | 0.07 | 0.16 | 0.03 | 0.69 | 0.99 | 0.15 | 0.13 | 0.78 | 0.27 | 0.01 |
| 90019003 | CT | Fairfield | Westport | 0.43 | 0.04 | 0.07 | 0.16 | 0.02 | 0.81 | 1.26 | 0.17 | 0.13 | 0.87 | 0.27 | 0.00 |
| 90099002 | CT | New Haven | Madison | 0.53 | 0.05 | 0.02 | 0.08 | 0.02 | 0.80 | 1.08 | 0.22 | 0.11 | 0.79 | 0.15 | 0.01 |
| 482010024 | TX | Harris | Houston | 0.00 | 0.00 | 0.19 | 0.05 | 0.00 | 0.02 | 0.02 | 0.01 | 0.01 | 0.02 | 4.68 | 0.00 |

| | | | | Contributions | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AQS Site ID | State | County | Location | MD | MA | MI | MN | MS | MO | MT | NE | NV | NH | NJ | NM |
| 90013007 | CT | Fairfield | Stratford | 1.21 | 0.35 | 1.16 | 0.16 | 0.10 | 0.36 | 0.08 | 0.07 | 0.01 | 0.10 | 7.70 | 0.03 |
| 90019003 | CT | Fairfield | Westport | 1.20 | 0.08 | 1.71 | 0.19 | 0.10 | 0.36 | 0.07 | 0.07 | 0.01 | 0.01 | 8.62 | 0.03 |
| 90099002 | CT | New Haven | Madison | 1.56 | 0.16 | 1.62 | 0.27 | 0.07 | 0.33 | 0.08 | 0.09 | 0.00 | 0.02 | 5.71 | 0.02 |
| 482010024 | TX | Harris | Houston | 0.00 | 0.00 | 0.00 | 0.00 | 0.37 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.03 |

| | | | | Contributions | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AQS Site ID | State | County | Location | NY | NC | ND | OH | OK | OR | PA | RI | SC | SD | TN | TX |
| 90013007 | CT | Fairfield | Stratford | 14.42 | 0.56 | 0.10 | 2.34 | 0.20 | 0.03 | 6.72 | 0.04 | 0.17 | 0.04 | 0.31 | 0.58 |
| 90019003 | CT | Fairfield | Westport | 14.44 | 0.56 | 0.08 | 2.55 | 0.19 | 0.02 | 6.86 | 0.01 | 0.18 | 0.04 | 0.32 | 0.59 |
| 90099002 | CT | New Haven | Madison | 12.54 | 0.57 | 0.12 | 2.35 | 0.14 | 0.02 | 5.64 | 0.01 | 0.08 | 0.06 | 0.24 | 0.36 |
| 482010024 | TX | Harris | Houston | 0.00 | 0.00 | 0.00 | 0.00 | 0.08 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.05 | 32.68 |

| | | | | Contributions | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AQS Site ID | State | County | Location | UT | VT | VA | WA | WV | WI | WY | TRIBAL | CN & MX | Offshore | Fires | IC/BC | Biogenics |
| 90013007 | CT | Fairfield | Stratford | 0.03 | 0.02 | 1.29 | 0.06 | 1.45 | 0.21 | 0.08 | 0.00 | 2.35 | 0.76 | 0.26 | 19.93 | 4.60 |
| 90019003 | CT | Fairfield | Westport | 0.03 | 0.01 | 1.30 | 0.05 | 1.49 | 0.23 | 0.08 | 0.00 | 2.58 | 0.68 | 0.35 | 21.07 | 4.78 |
| 90099002 | CT | New Haven | Madison | 0.02 | 0.01 | 1.69 | 0.06 | 1.55 | 0.23 | 0.07 | 0.00 | 3.02 | 1.07 | 0.25 | 20.84 | 4.72 |
| 482010024 | TX | Harris | Houston | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.01 | 0.00 | 0.25 | 3.60 | 1.14 | 29.65 | 2.07 |