

**Four Corners Air Quality Group
Four Corners Area Current Studies
November 2015**

Ozone Studies

- 2014 Uinta Basin Winter Ozone Study final report is available here: <http://www.deq.utah.gov/locations/U/uintahbasin/ozone/overview.htm>
- Field campaign to measure and speciate VOCs at Navajo Lake and Bloomfield in 2004/2005 and 2009. A PowerPoint on the results is available on the Four Corners Air Quality website: <http://www.nmenv.state.nm.us/aqb/4C/>.
- New Mexico Environment Department has conducted ozone precursor and passive ozone sampling from 4/2009 – 10/2009 at Substation and Navajo Lake sites.
- Mesa Verde National Park NPS ozone monitor conditions and trends tracked at <http://www.nature.nps.gov/air/Monitoring/O3Plots/index.cfm>.
- Ozone Precursors Emissions Inventory for San Juan and Rio Arriba Counties, New Mexico prepared for NMED by Environ (2006).
http://www.nmenv.state.nm.us/aqb/projects/San_Juan_Ozone/NM_Area_Emissions_report.pdf,
http://www.nmenv.state.nm.us/aqb/projects/San_Juan_Ozone/Errata_SanJuanRioArribaEI_0107.pdf

Mercury Studies

- Mark E. Sather, Shaibal Mukerjee, Kara L. Allen, Luther Smith, Johnson Mathew, Clarence Jackson, Ryan Callison, Larry Scrapper, April Hathcoat, Jacque Adam, Danielle Keese, Philip Ketcher, Robert Brunette, Jason Karlstrom, and Gerard Van der Jagt, "Gaseous Oxidized Mercury Dry Deposition Measurements in the Southwestern USA: A Comparison between Texas, Eastern Oklahoma, and the Four Corners Area," The Scientific World Journal, vol. 2014, Article ID 580723, 14 pages, 2014. Doi:10.1155/2014/580723. The article can be accessed at the following link: <http://www.hindawi.com/journals/tswj/2014/580723/> .
- Sather, M.E., Mukerjee, S., Smith, L., Mathew, J., Jackson, C., Callison, R., Scrapper, L., Hathcoat, A., Adam, J., Keese, D., Ketcher, P., Brunette, R., Karlstrom, J., Van der Jagt, G., 2013. Gaseous oxidized mercury dry deposition measurements in the Four Corners Area and Eastern Oklahoma, U.S.A. Atmospheric Pollution Research, doi: 10.5094/APR.2013.017. <http://www.atmospolres.com/articles/Volume4/issue2/abstract5.htm> .
- Mercury Fingerprinting Study (University of Michigan study - in process). Research on fingerprinting mercury from different combustion sources in the atmosphere was published in October 2008 Environmental Science and Technology Journal article "Mercury isotopes may put the finger on coal."
- Mesa Verde NPS Mercury Deposition Network (MDN) monitor. NADP-MDN website <http://nadp.sws.uiuc.edu/mdn/> includes temporal trend graph for mercury. Total Hg in wet deposition has been monitored at Mesa Verde NP since 2002.

- Pine River Watershed Group has studied mercury in the Upper Pine River Watershed and Vallecito Reservoir in SW Colorado. The group measures mercury in precipitation at the Vallecito Reservoir.
- Dr. Richard Grossman has studied the concentration of Hg in human hair in Four Corners area.
- US Geological Survey (USGS) has measured Hg concentrations in snowpack at a few sites in the San Juan Mountains.

Multiple Pollutant and Other Deposition Studies

- The Intermountain West Data Warehouse – Western Air Quality Study (IWDW-WAQS), sponsored by EPA Region 8, NPS, USFS, BLM, and the States of CO, NM, UT, and WY is completing a new regional modeling platform called 2011b, with future year projections out to the 2020-25 timeframe. The 2011b platform has extensive wintertime ozone modeling performance testing and improvement work included, as well as detailed model performance evaluation for year-round ozone, PM_{2.5}, nitrogen deposition, and visibility. The IWDW data are accessible at: <http://views.cira.colostate.edu/tsdw/>. The IWDW-WAQS provides air quality data and analysis tools to support regulatory, research, and academic applications. Available datasets include emissions inventories, meteorological data, monitoring data, and air quality modeling platforms. Modeling platforms available through the IWDW support consistent AQ/AQRV photochemical grid modeling (PGM) for NEPA projects and other modeling studies.
- 2014 BLM Drill Rig NO₂ Impacts Study: Effort to better predict 1-hour NO₂ impacts from drill rigs through a field study. Monitoring NO₂ concentrations at multiple locations near operating drill rights combined with stack testing and modeling. Data analysis, model evaluation and reporting will occur in late 2016. Project website: <http://www.wrapair2.org/DrillRig.aspx>.
- Eric A. Kort, Christian Frankenberg, Keeley R. Costigan, Rodica Lindenmaier, Manvendra K. Dubey, and Debra Wunch; Four corners: The largest US methane anomaly viewed from space; AGU Publications Geophysical Research Letters (2014).
- The University of Colorado is the recipient of \$12 million grant from the National Science Foundation to explore ways to maximize the benefits of natural gas development while minimizing negative impacts on ecosystems and communities. Collaborators include CU, CSU, Colorado School of Mines, Cal Poly, University of Michigan, NOAA, NREL, and Colorado School of Public Health.
- At the WESTAR-WRAP meeting on Nov. 4-5, 2015 in Scottsdale, AZ, (click [here](#) for interactive agenda with presentations) a status report on WRAP projects and future regional technical analysis work was presented. Click [here](#) for that presentation
- West-wide Jumpstart Air Quality Modeling Study (WestJumpAQMS) provides 2008 photochemical modeling input files to support future air quality planning in the western U.S., as well as modeling results for ozone and particulate matter that includes source apportionment. This work includes improved oil and gas emissions estimates for the major basins in the West. <http://www.wrapair2.org/WestJumpAQMS.aspx>.
- BLM is conducting an air quality analysis with photochemical modeling for development, including oil and gas production, in Colorado. This comprehensive study is called CARMMS, and will be expanded this fall to include the Mancos Shale development in

northwestern New Mexico. Report will be published in late 2015 with comparison to the new ozone standard.

- Western Regional Air Partnership (WRAP) Oil and Gas Phase III inventory for the San Juan Basin was completed in 2009. <http://www.wrapair2.org/PhaseIII.aspx> . An update to this inventory for the year 2014 is underway. The new project also updates the Permian Basin emissions in west TX and southeast NM. The project website is at: <http://www.wrapair2.org/SanJuanPermian.aspx>.
- “Detecting the Impacts of Nitrogen Pollution on Vegetation and Soils in Grand Canyon National Park.” Funded by NPS, Researchers from Northern Arizona University. Completed in 2013.
 - Results from nitrogen isotope studies show that emissions from vehicles in the park add excess nitrogen to pine trees near roadsides, and emissions from the Navajo Generating Station add excess nitrogen to plants and soils on the Paria plateau. The study also found that it is feasible to continue work on remote sensing techniques that may be used in the future to assess nitrogen inputs to desert plants and soils.
- “Assessing the Risk of Nitrogen Deposition to Natural Resources in the Four Corners Region of Colorado and Utah.” Funded by NPS. Researchers from USGS and Prescott College. NPS funded portion was completed in 2013, USGS work is ongoing.
 - Results from the first phase of this study indicate that NO_x represents a significant source of nitrogen deposition in Mesa Verde NP. Researchers are continuing to look at how excess nitrogen may be impacting cheat grass invasions in the area, using fertilization studies. Spatial and Seasonal Patterns and Temporal Variability of Haze and its Constituents in the United States: Report V June 2011. Hand et al.,
- Epidemiology Report on PM_{2.5} Exposure from Wildfires during 2011 Wallow Fire by the NM Department of Health <http://www.arb.ca.gov/carpa/wallow-fire-smoke-exposures.pdf>.
- A peer reviewed paper related to our Four Corners Air Quality Task Force work has been published in the Journal of Environmental Monitoring, "Passive ammonia monitoring in the United States: Comparing three different sampling devices (November 2011)." Here is also a link to supplemental information on the study: <http://www.nmenv.state.nm.us/aqb/4C/Documents/jemnov2011.pdf> .
- Beginning in 2010, the Southern Colorado Plateau Network (multi-park monitoring network) worked with Air Resources Division staff and EPA to sample waters for pesticides, pharmaceuticals and personal care products (PPCPs). Parks from the Four Corners area are included. Results will be reported in summer 2012 in SCPN's annual water quality summary report.
- Los Alamos National Laboratories deployed a solar-tracking Fourier Transform Spectrometer (FTS) at the NM Substation site in 2011. The sunlight is focused inside the observatory into the FTS which splits the light into the spectral regions between the near infrared and ultraviolet to measure absorption features from atmospheric gases. Analysis of the spectra provides column measurements of all greenhouse gases (CO₂, CH₄ and N₂O) and criteria pollutants (CO, NO₂, O₃, SO₂) every 3 minutes.

- Please contact the Principal Investigator of the Remote Sensing Verification Project (RSVP), Manvendra Dubey (dubey@lanl.gov), for technical information and Amon Haruta (amon@lanl.gov) for logistics and operations support.
- “Air Quality Modeling Study for the Four Corners Region,” Revised Report August 2009 <http://www.nmenv.state.nm.us/aqb/4C/Modeling.html>.
 - Detailed annual modeling of the Four Corners region for ozone and particulate matter impacts was conducted with updated emissions estimates for 2005, and a projected inventory for 2018. The resulting modeling database was used to examine the air quality impacts of five alternative mitigation scenarios focused on various combinations of emissions reductions from electric generating units (EGUs) and fuel combustion and evaporative sources associated with oil and gas exploration and production activities in the Four Corners region.
- Southern Ute Indian Tribe Air Quality Program
 - Maintains two State and Local Air Monitoring Stations (SLAMS) within the exterior boundaries of the Southern Ute Indian Reservation. Both SLAMS are configured and operated consistent with EPA requirements. Website: <http://www.southernute-nsn.gov/environmental-programs/air-quality/ambient-monitoring/>.
 - Working to improve reliability of the continuous PM10 and PM2.5 particulate monitor at the Ute 3 station and subsequently begin reporting these data to AQS and AirNow.
 - Purchasing two methane monitors to measure baseline, ambient concentrations of methane and to assist with identifying point source emissions of methane.
 - Participated in a methane study with NOAA in April 2015. The NOAA study included air and ground campaigns to identify sources of methane emissions contributing to the “methane hotspot” detected in the San Juan Basin.
- EPA Region 6 completed a passive ammonia study in 2007. A peer reviewed paper has been published in the Journal of Environmental Monitoring on "Baseline Ambient Gaseous Ammonia Concentrations in the Four Corners Area and Eastern Oklahoma, USA," September 25, 2008. Report available here: http://www.nmenv.state.nm.us/aqb/4C/Documents/Ogawa_Ammonia_4Corners_Sather_JEM08.pdf.
- EPA IMPROVE monitoring of aerosols for visibility continues at the Weminuche site north of Durango and at Mesa Verde.
- Kirby Chapman, KSU, Oil and Gas Engine Control Studies: <http://www.ngml.ksu.edu/>
 - "Characterization of NSCR Performance on Four Stroke Natural Gas-Fueled Rich Burn Engines," October 2008.
- FS has funded several nitrogen deposition studies over the past 15 years (ongoing long-term commitment).
 - Full analysis of existing Wilderness Lakes data, including spatial and temporal trends and correlation of measurements with watershed and lake characteristics, completed by USFS up to 2004.
 - High Lake Deposition Studies, NADP Program; Research results in: Musselman, R.C. and W. L. Slauson, 2004. Water chemistry of high elevation lakes in Colorado. Biogeochemistry 71:387-414. Also see: NADP 2006 Summary at <http://nadp.sws.uiuc.edu/lib/data/2006as.pdf>.

- FS/USGS High Alpine Snow Pack Studies (ongoing) at <http://pubs.usgs.gov/fs/FS-043-97/>.
- Atmospheric deposition/wilderness lake sampling.
- Chronic Respiratory Study (NM Health Dept, "The Association between Ambient Air Quality Ozone levels and Medical Visits for San Juan County (2007) <http://www.nmenv.state.nm.us/aqb/4C/Documents/SanJuanAsthmaDocBW.pdf>.
- Some trends research work was done by Dr. Winn Wright and the Pine River Watershed Group (Vallecito Reservoir).