

Rollout of Results from the Summer 2003 San Juan Co., NM Passive Ozone Monitoring Saturation Study

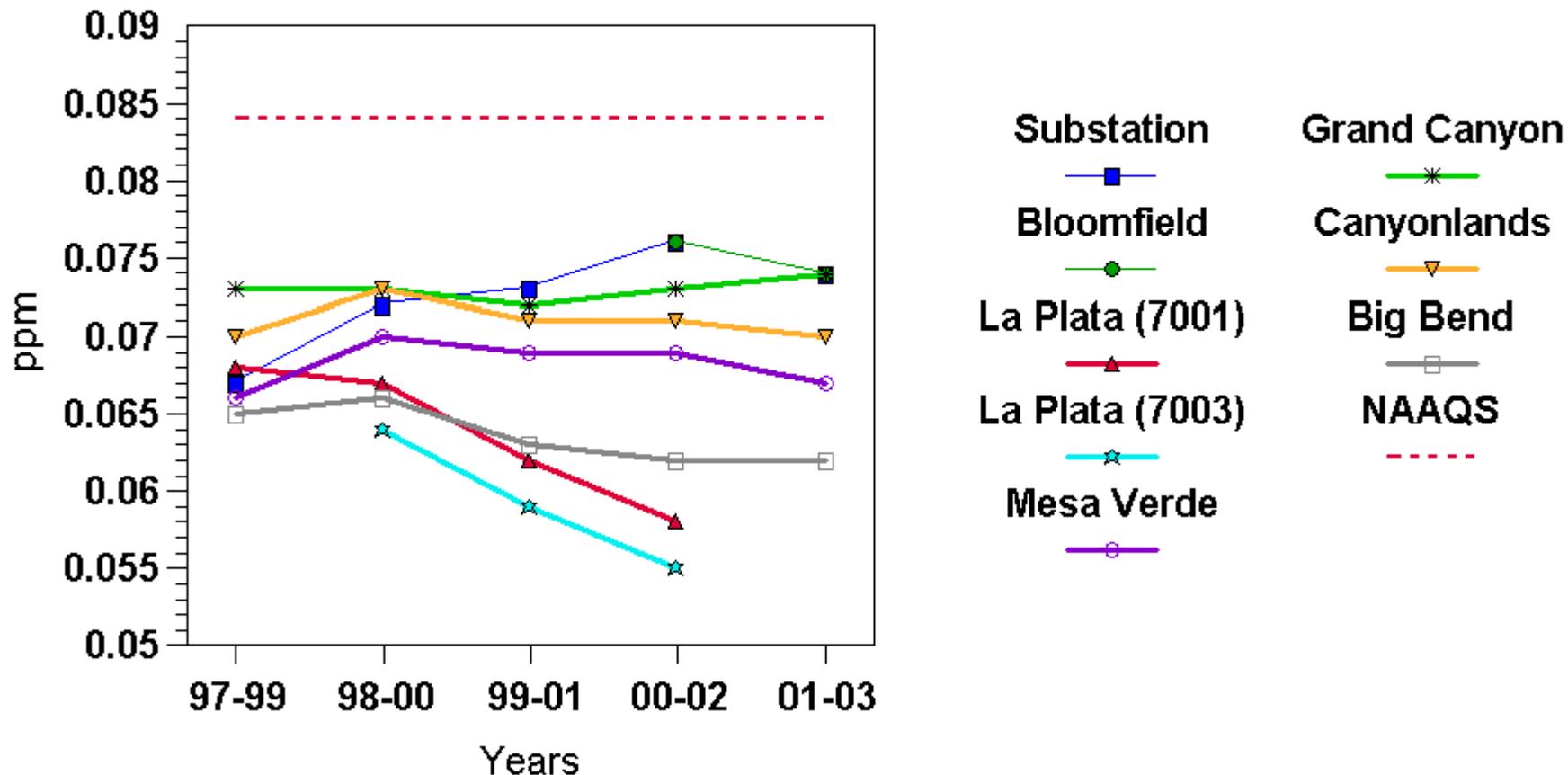
- ◆ December 16, 2003, Farmington, New Mexico
- ◆ EPA Regional Technical Contacts: Mark Sather, Air Quality Analysis Section (Dallas), Johnson Mathew, Management Division (Houston Lab)
- ◆ Email: sather.mark@epa.gov, mathew.johnson@epa.gov
- ◆ Phone: sather (214) 665-8353, mathew (281) 983-2132

Why was this monitoring study conducted?

- ◆ To get a better picture of the distribution of high ozone concentrations in San Juan County beyond the two existing continuous ozone monitoring stations at Substation and Bloomfield, both located in the north central part of the county.
- ◆ Eight hour ozone design values at Substation and Bloomfield are among the highest of 8-hour ozone design values recorded at Regional sites in NM, UT, CO, AZ, and TX as seen on the next slide.

8-hour Ozone Trends

Substation/Bloomfield Sites in San Juan Co., NM
 Compared to other Regional Sites
 3-year running design values



2003 data preliminary and not complete; not enough 2003 data in AQS for La Plata sites
 Substation ozone monitoring began 5/8/97
 Bloomfield ozone monitoring began 6/7/2000

Many Thanks to Many People!

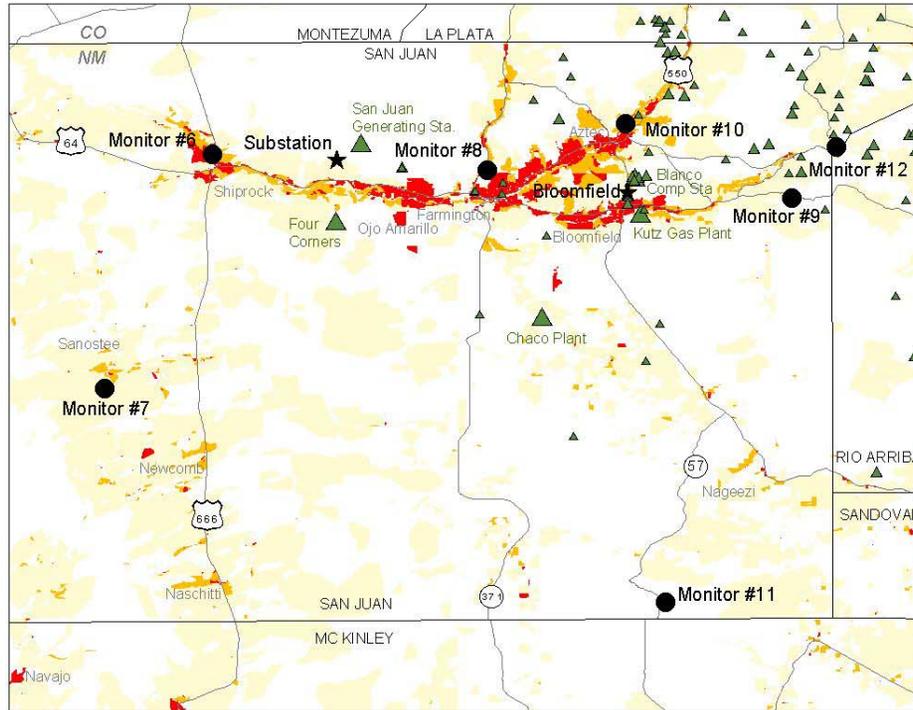
- ◆ Site Operators: Joe Cotie, NMED (Substation and Bloomfield), Maxine Walter (site #6), Lita Henderson and Charlene Nelson (site #7), Charlene Anderson (site #8), Brittany Benko (site #9), Bruce Gantner (site #10), Brad Shattuck (site #11), Doug Bryant (site #12).
- ◆ NMED – Tim Booker, Roger Polisar, Andy Berger, Josephine Ball, Mary Uhl, Erik Aaboe.
- ◆ Region 6 GIS Team – Melody Lister and Jeff Danielson for the great maps!

Sampling Site Locations

- ◆ Seven passive sites to supplement the two existing continuous sites
- ◆ The sites were located in a variety of areas including high populated areas, downwind rural areas, and different areas of complex terrain (e.g. on mesas/mountains or in valleys)
- ◆ 1,446 ft. elevation difference between site #6 (5,028 ft.) and site #9 (6,474 ft.)

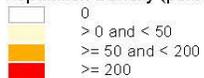
San Juan Co., NM - Passive Ozone Monitoring Saturation Study

Ozone Monitors, Stationary Sources, and Population Density

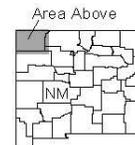
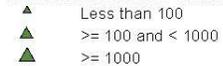


- ★ Continuous Ozone Monitor
- Passive Ozone Monitor
- ⚡ Interstate/Major Highway

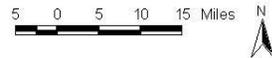
Population Density (persons per sq. mi.)



NOx Emissions from Stationary Sources (tpy)

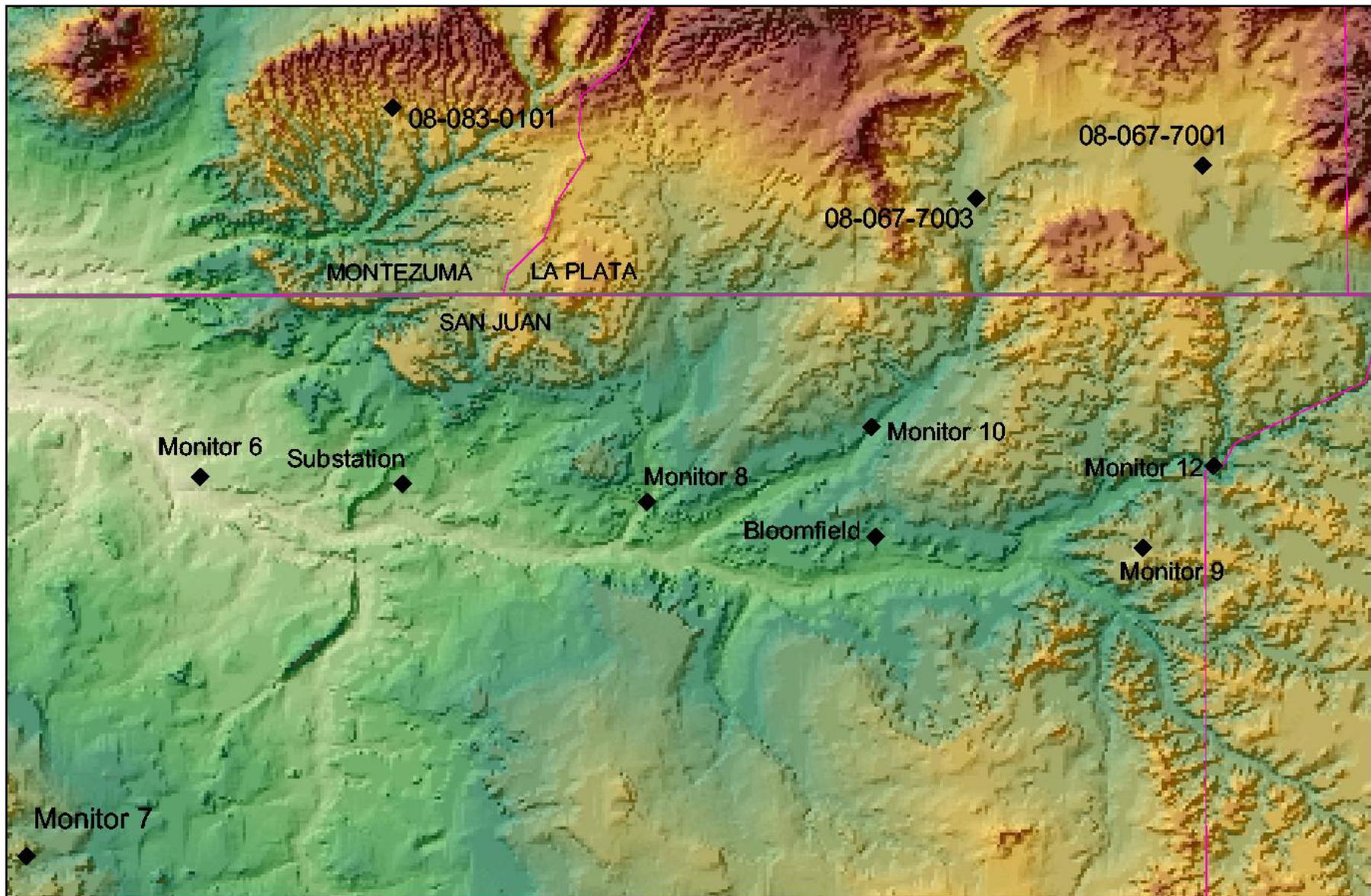


Sources
 AIRS Database
 EPA Region 6 PD
 ESRI StreetMap 2000
 Census Bureau 2000



EPA Region 6
 GIS Support Team
 November 20, 2003
 Map Number 20031120ML28

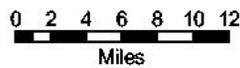




San Juan Co., NM - Passive Ozone Monitoring Saturation Study

Ozone Monitors and Local Elevation

Sources:
EPA Region 6 PD, USGS
National Elevation Dataset

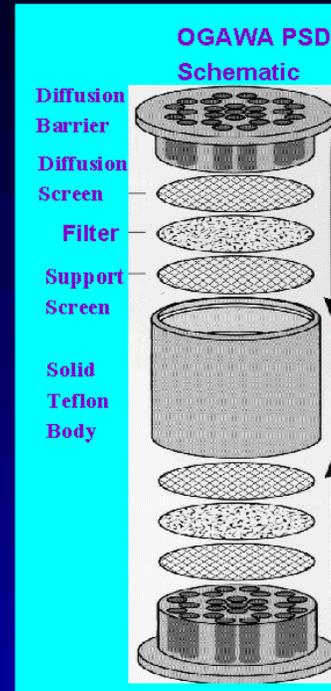
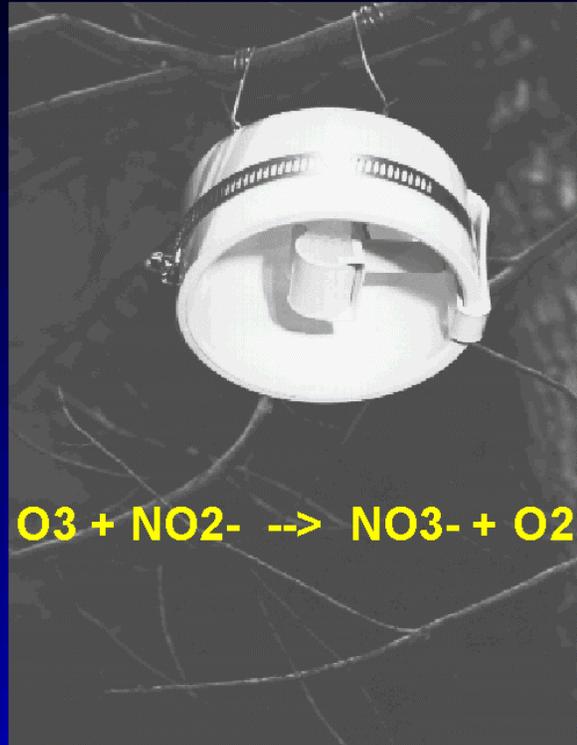


EPA Region 6
GIS Support Team
Dallas, TX
December 5, 2003



Schematic Passive Sampling Device

Networking an Ozone Passive Sampling Device



Sample Site Pictures

◆ Substation (site #5)



◆ Sanostee (site #7)



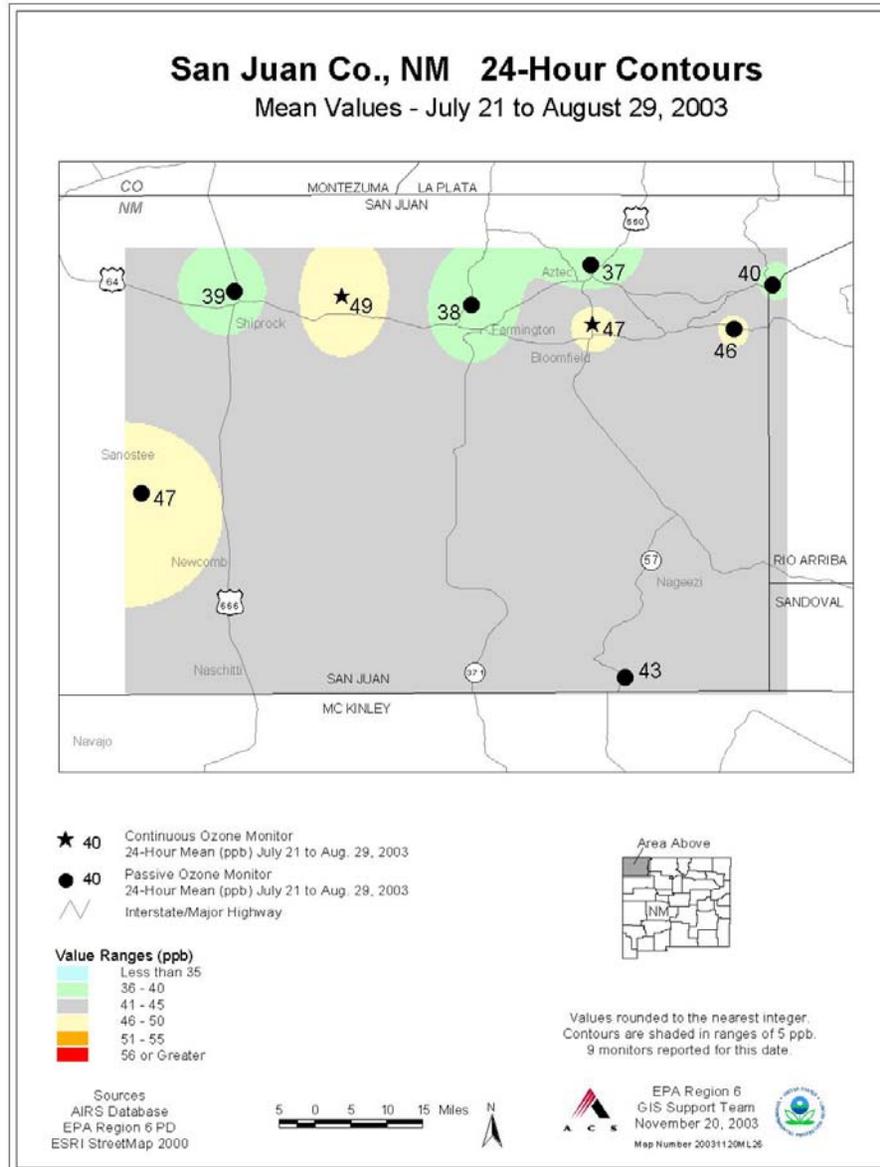
◆ BP (site #9)



Site #11 – Chaco Culture National Historical Park



Monitoring results showed significantly high ozone concentrations in the western and northeastern areas of San Juan Co, NM in addition to the high ozone concentrations already found in the north central area of the county

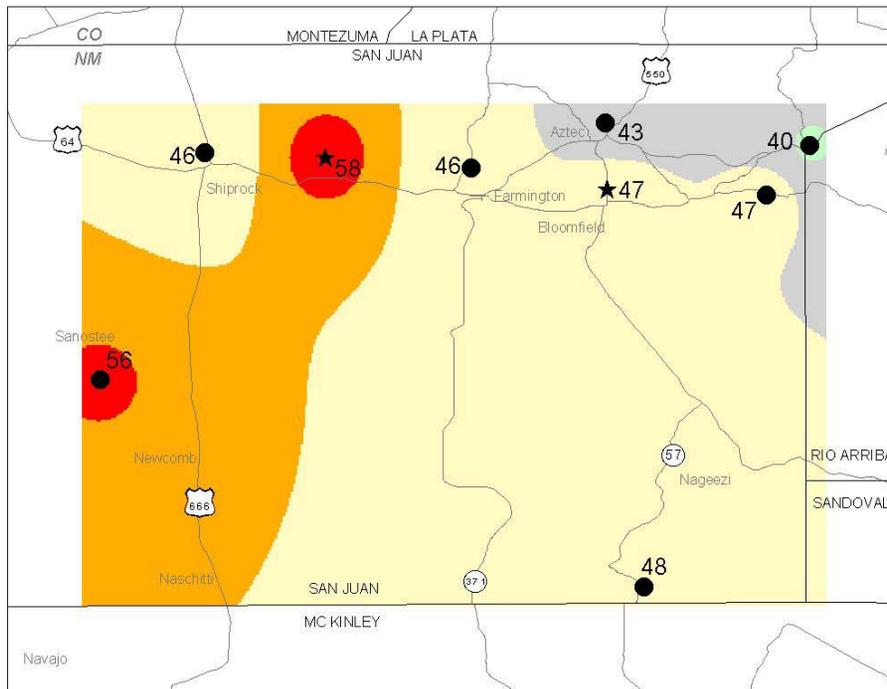


Six weeks of 24-hour weekday ozone sampling from July 21, 2003 – August 29, 2003

- ◆ Fortunate to capture the highest 8-hour ozone concentration days of the summer recorded at the continuous Substation and Bloomfield monitors during the first week of the saturation study.
- ◆ July 21 – 78 ppb max. 8-hour O₃ concentration at Substation (72 ppb at Bloomfield)
- ◆ July 22 – 75 ppb max. 8-hour O₃ concentration at Substation (74 ppb at Bloomfield)
- ◆ July 24 – 77 ppb max. 8-hour O₃ concentration at Bloomfield (75 ppb at Substation).
- ◆ All passive ozone data for all days has been provided to the NMED and can be used in checking model runs for this time period (July 21-August 29, 2003).

San Juan Co., NM 24-Hour Contours

July 21, 2003



- ★ 40 Continuous Ozone Monitor
24-Hour Value (ppb) 7am - 7am LST
- 40 Passive Ozone Monitor
24-Hour Value (ppb) 7am - 7am LST
- ≡ Interstate/Major Highway

Dominant resultant wind direction: SE/SW/NW
 Average resultant wind speed (mph): 8.7
 Low 24-hr ozone value (ppb): 40
 High 24-hr ozone value (ppb): 58
 Average temperature (°F): 87.6

Value Ranges (ppb)

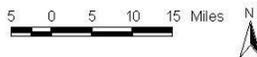
- Less than 35
- 36 - 40
- 41 - 45
- 46 - 50
- 51 - 55
- 56 or Greater



All meteorological data analyzed from 7am to 7pm LST from Substation site.

Values rounded to the nearest integer.
 Contours are shaded in ranges of 5 ppb.
 9 monitors reported for this date.

Sources
 AIRS Database
 EPA Region 6 PD
 ESRI StreetMap 2000



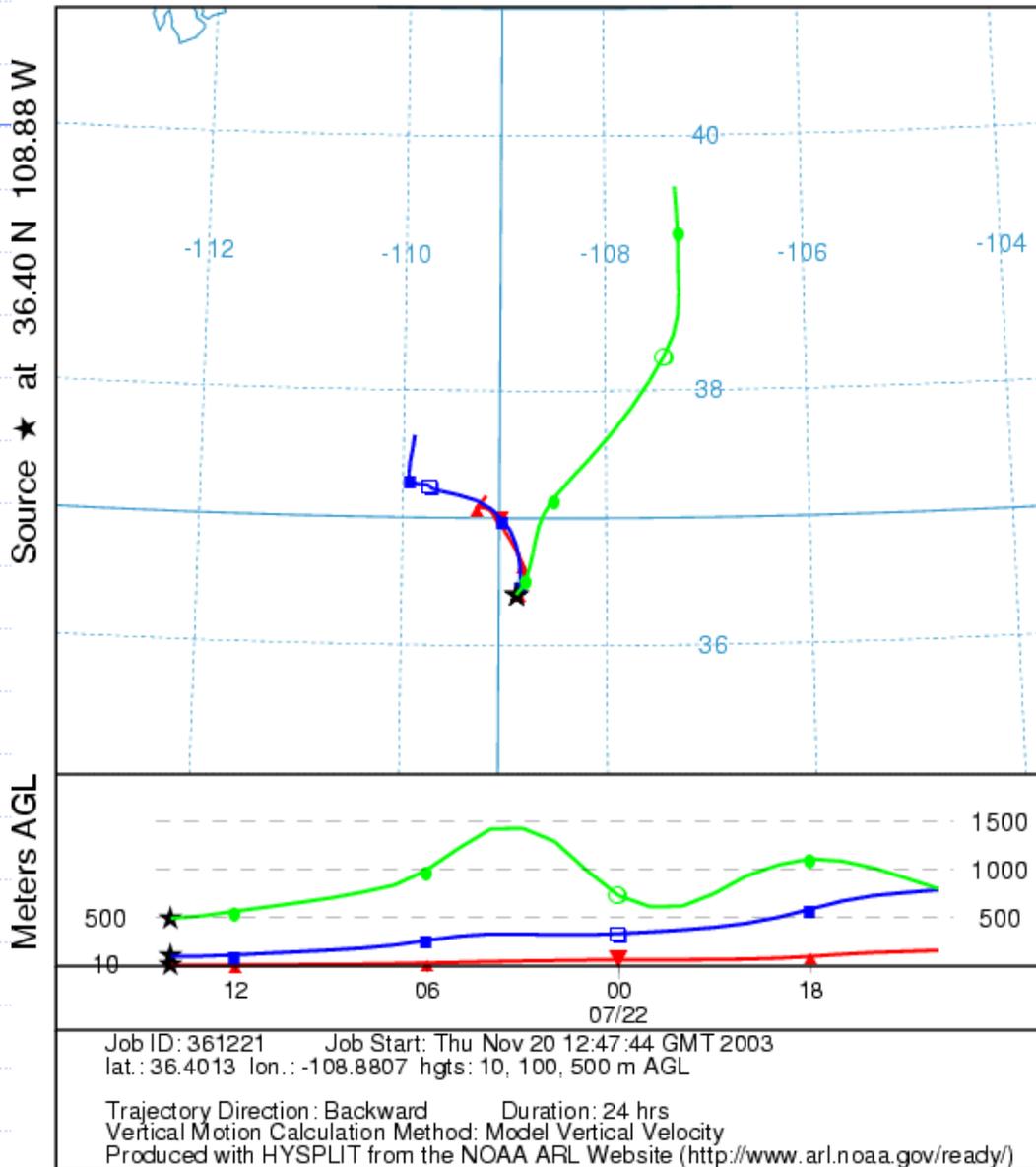
EPA Region 6
 GIS Support Team
 November 20, 2003
 Map Number 20031120M L02



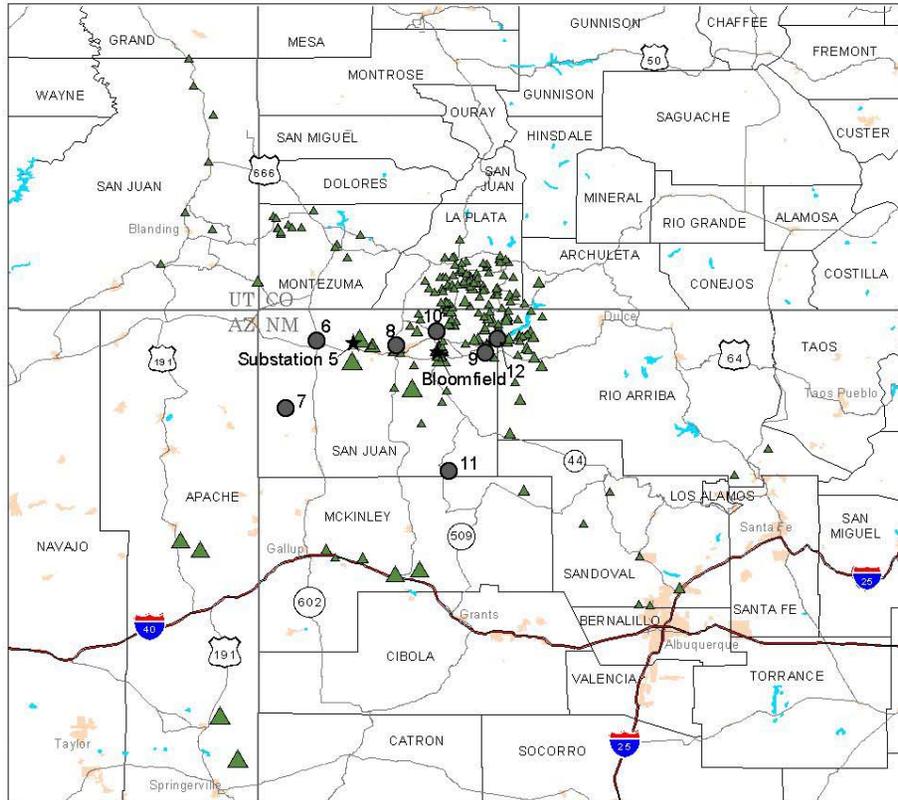
NOAA HYSPLIT MODEL

Backward trajectories ending at 14 UTC 22 Jul 03

EDAS Meteorological Data



San Juan Co., NM - Passive Ozone Monitoring Saturation Study July and August, 2003



★ 5 Continuous Ozone Monitor

● 7 Passive Ozone Monitor

≡ Interstate

≡ Major Highway

City Boundary

Water Feature

County Boundary

State Boundary

NOx Emissions from
Stationary Sources (tpy)

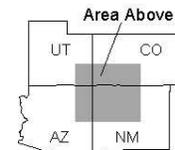
▲ Less than 100

▲ 100 - 499

▲ 500 - 999

▲ 1000 - 4999

▲ 5000 or More



Sources
AIRS Database
EPA Region 6 PD
ESRI StreetMap 2000



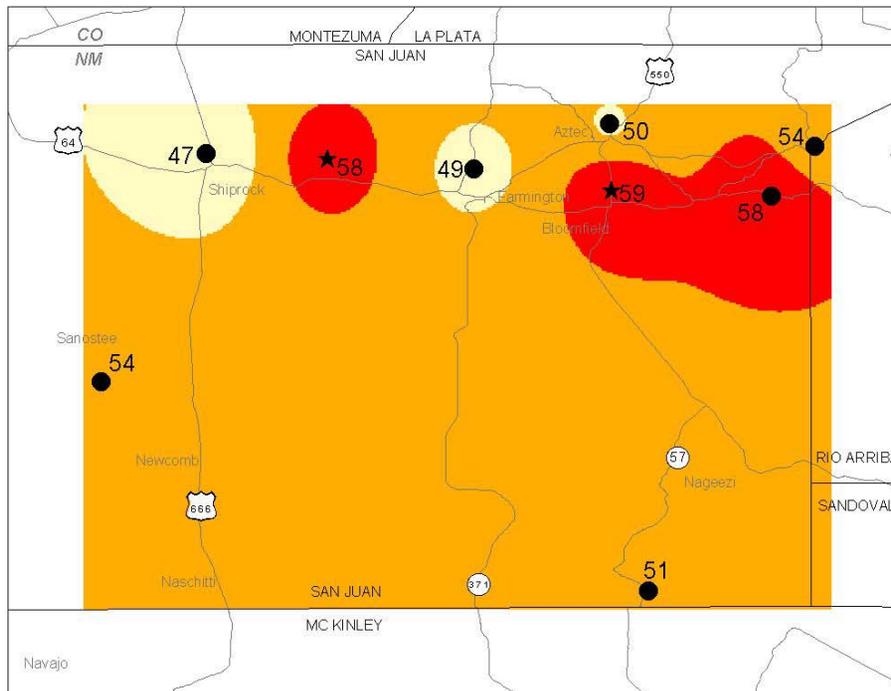
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GIS Support Team
November 20, 2003



Map Number 20031120M L01

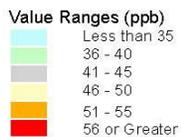
San Juan Co., NM 24-Hour Contours

July 22, 2003



- ★ 40 Continuous Ozone Monitor
24-Hour Value (ppb) 7am - 7am LST
- 40 Passive Ozone Monitor
24-Hour Value (ppb) 7am - 7am LST
- ≡ Interstate/Major Highway

Dominant resultant wind direction: SE
 Average resultant wind speed (mph): 7.8
 Low 24-hr ozone value (ppb): 47
 High 24-hr ozone value (ppb): 59
 Average temperature (°F): 91.4



All meteorological data analyzed from 7am to 7pm LST from Substation site.

Values rounded to the nearest integer.
 Contours are shaded in ranges of 5 ppb.
 9 monitors reported for this date.

Sources
 AIRS Database
 EPA Region 6 PD
 ESRI StreetMap 2000

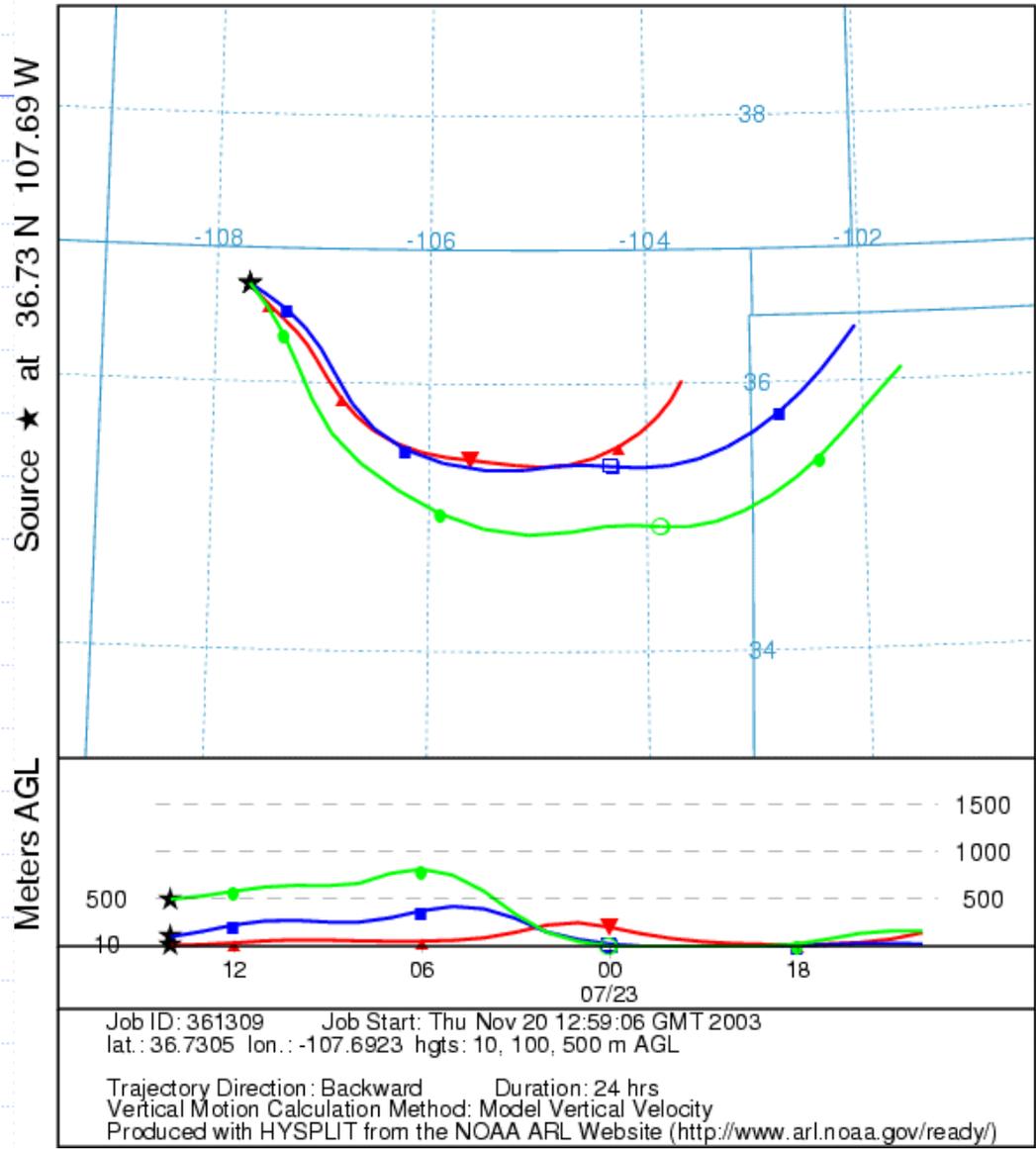
0 5 10 15 Miles



EPA Region 6
 GIS Support Team
 November 20, 2003
 Map Number 20031120M L03

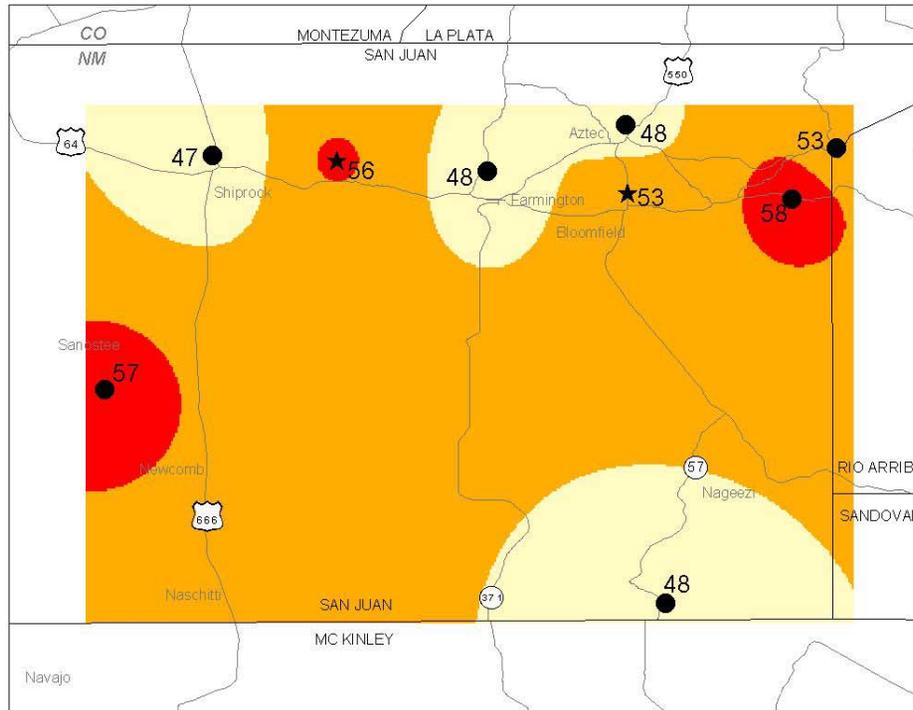


NOAA HYSPLIT MODEL
 Backward trajectories ending at 14 UTC 23 Jul 03
 EDAS Meteorological Data



San Juan Co., NM 24-Hour Contours

July 24, 2003



- ★ 40 Continuous Ozone Monitor
24-Hour Value (ppb) 7am - 7am LST
- 40 Passive Ozone Monitor
24-Hour Value (ppb) 7am - 7am LST
- Interstate/Major Highway



Dominant resultant wind direction: NVW
 Average resultant wind speed (mph): 6.9
 Low 24-hr ozone value (ppb): 47
 High 24-hr ozone value (ppb): 58
 Average temperature (°F): 87.8

All meteorological data analyzed from 7am to 7pm LST from Substation site.

Values rounded to the nearest integer.
 Contours are shaded in ranges of 5 ppb.
 9 monitors reported for this date.

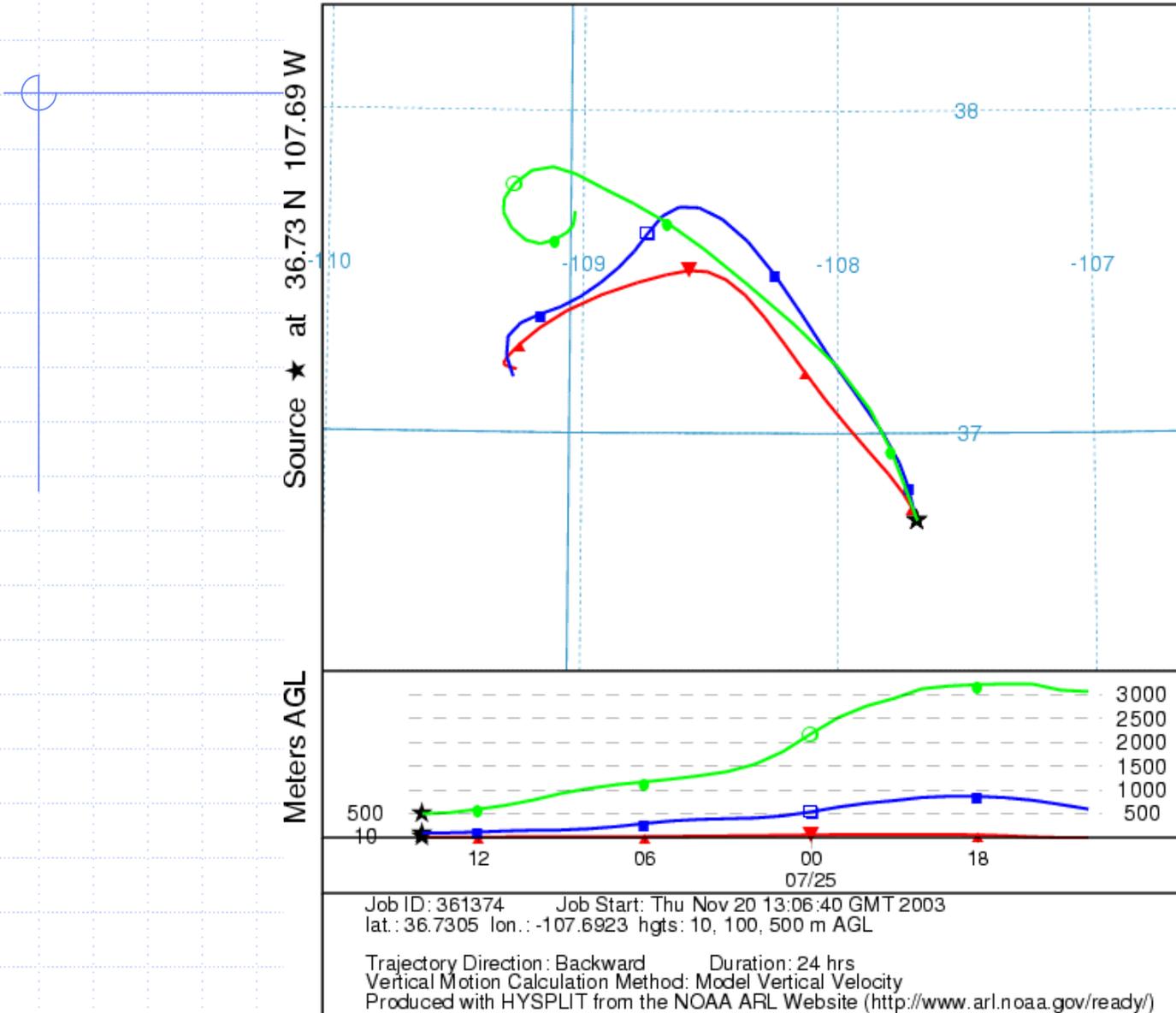
Sources
 AIRS Database
 EPA Region 6 PD
 ESRI StreetMap 2000



EPA Region 6
 GIS Support Team
 November 20, 2003
 Map Number 20031120ML05



NOAA HYSPLIT MODEL
 Backward trajectories ending at 14 UTC 25 Jul 03
 EDAS Meteorological Data



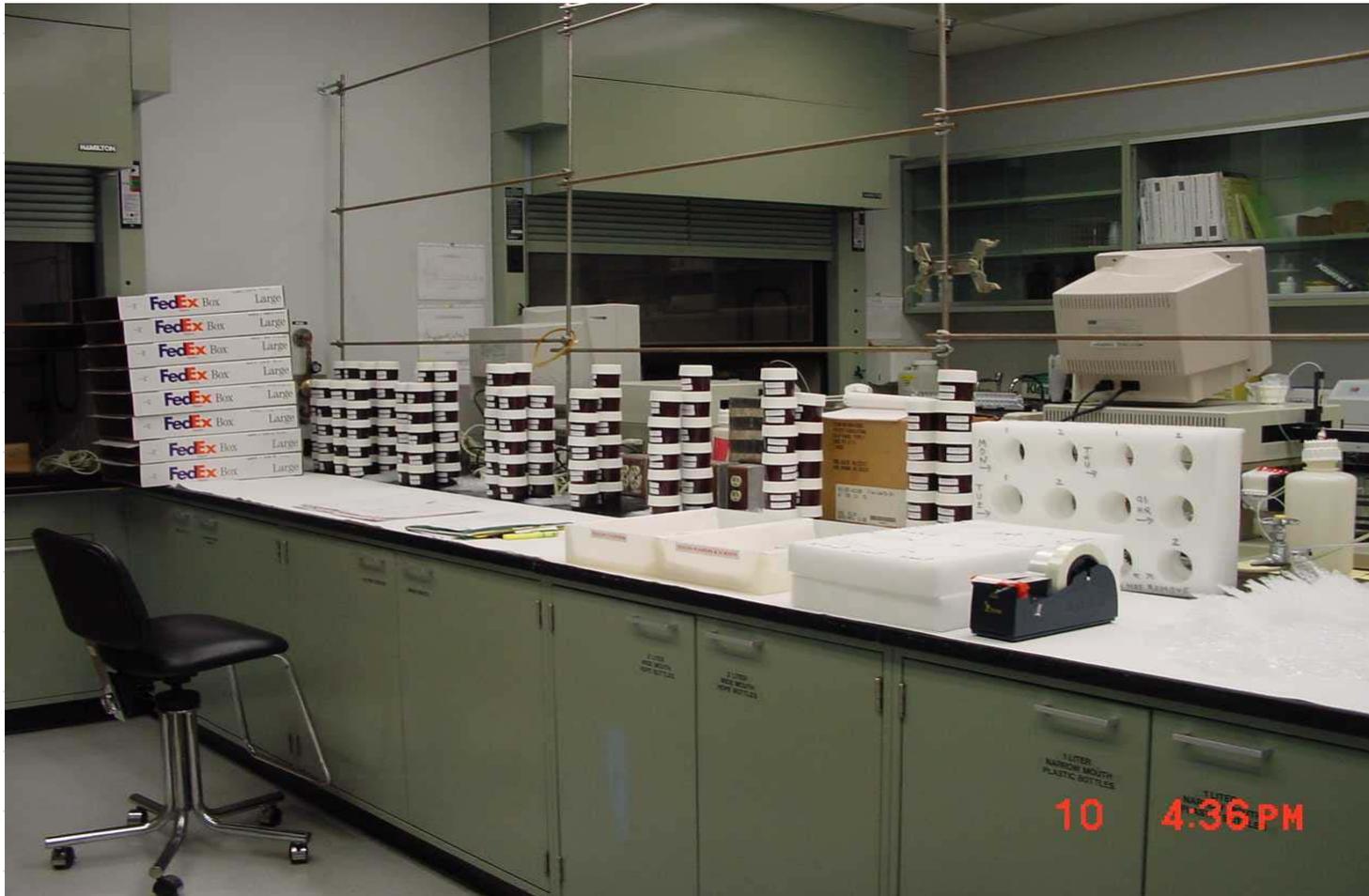
Overview Of Laboratory Responsibility

- ◆ COMMUNICATING WITH MARK SATHER
- ◆ SHIP MOUNTING POLES AND VIDEO TAPES FOR OPERATORS
- ◆ ASSEMBLE THE MONITORS & PREPARE LABELS
- ◆ SHIP THE PACKAGE CONTAINING MONITORS AND LOG SHEETS
- ◆ SET UP 1- 800 NUMBER FOR OPERATORS TO COMMUNICATE TO LABORATORY

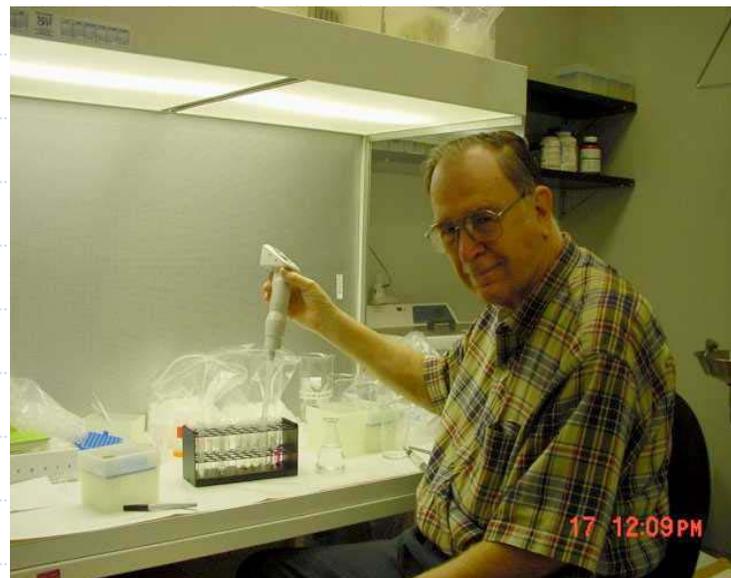
Overview Of Laboratory Responsibility (cont.)

- ◆ COMMUNICATING WITH FIELD OPERATORS
- ◆ LOGIN SAMPLES USING LIMS SYSTEM
- ◆ EXTRACTING SAMPLES
- ◆ SAMPLE ANALYSIS AND QC
- ◆ PEER REVIEW OF DATA
- ◆ FINAL REPORTING USING EXCEL TO MULTIMEDIA
PLANNING AND PERMITTING DIVISION

Assembly & Shipping Room



Support from Summer Interns & Chemist



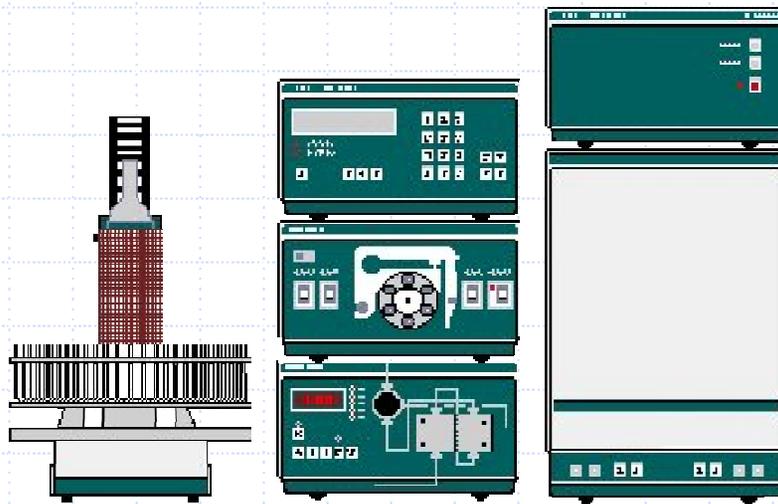
- Hillary and Patrick helped in assembling and shipping the monitors.
- Ray Clark helping in sample extraction and reports.

Analysis by Ion Chromatography

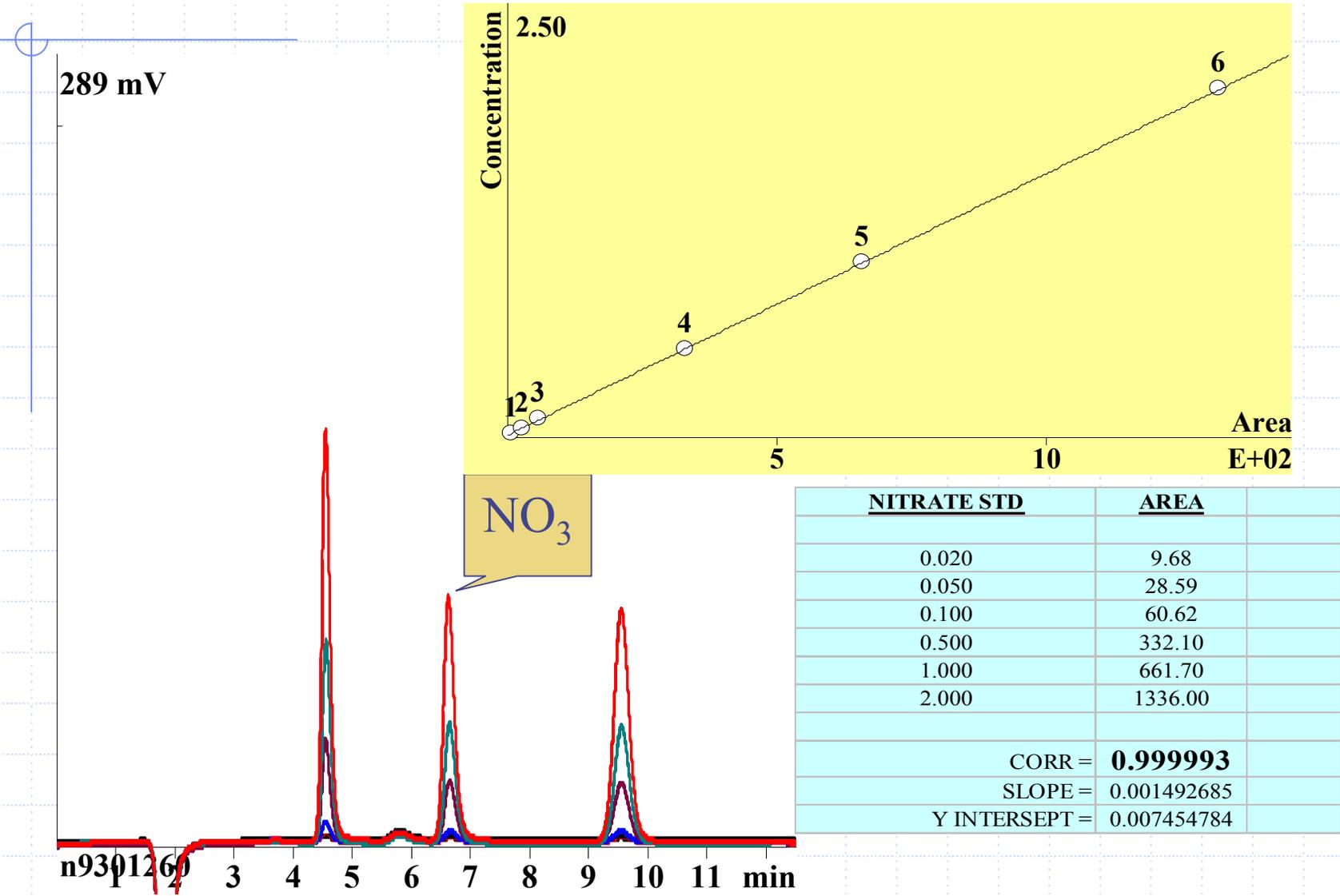


Johnson's Laboratory with Ion Chromatography Instrument

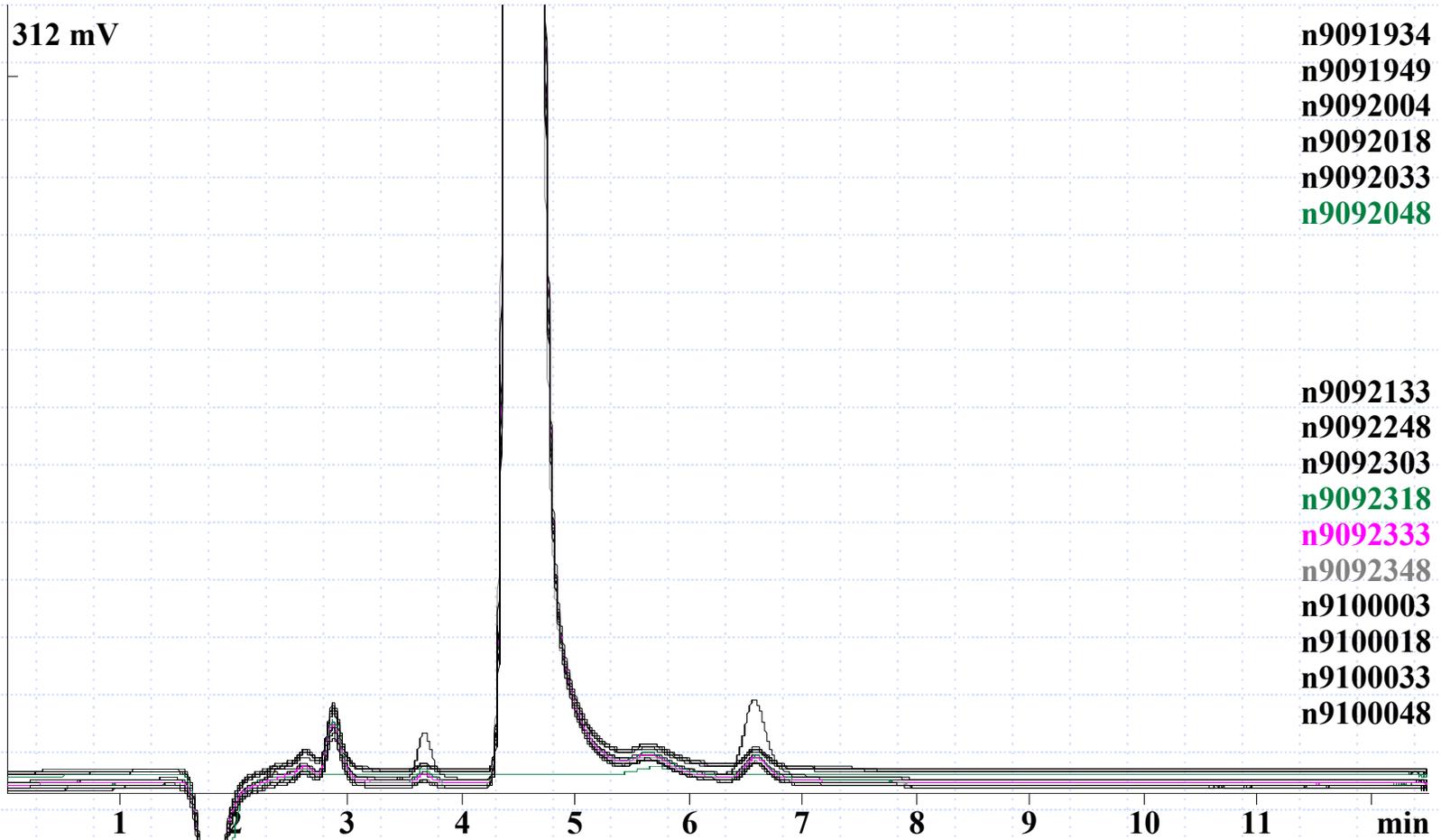
Ion Chromatography
Modular System



Calibration and Curve



Super-Imposed 16 Sample Chromatogram



MDL Precision for Nitrate

6.98 mV

0.05 PPM NITRATE	ANALYTE CONCENTRATION
------------------	-----------------------

1	0.051
2	0.047
3	0.049
4	0.051
5	0.047
6	0.048
7	0.051
8	0.048

AVERAGE	0.049
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SD	0.0018
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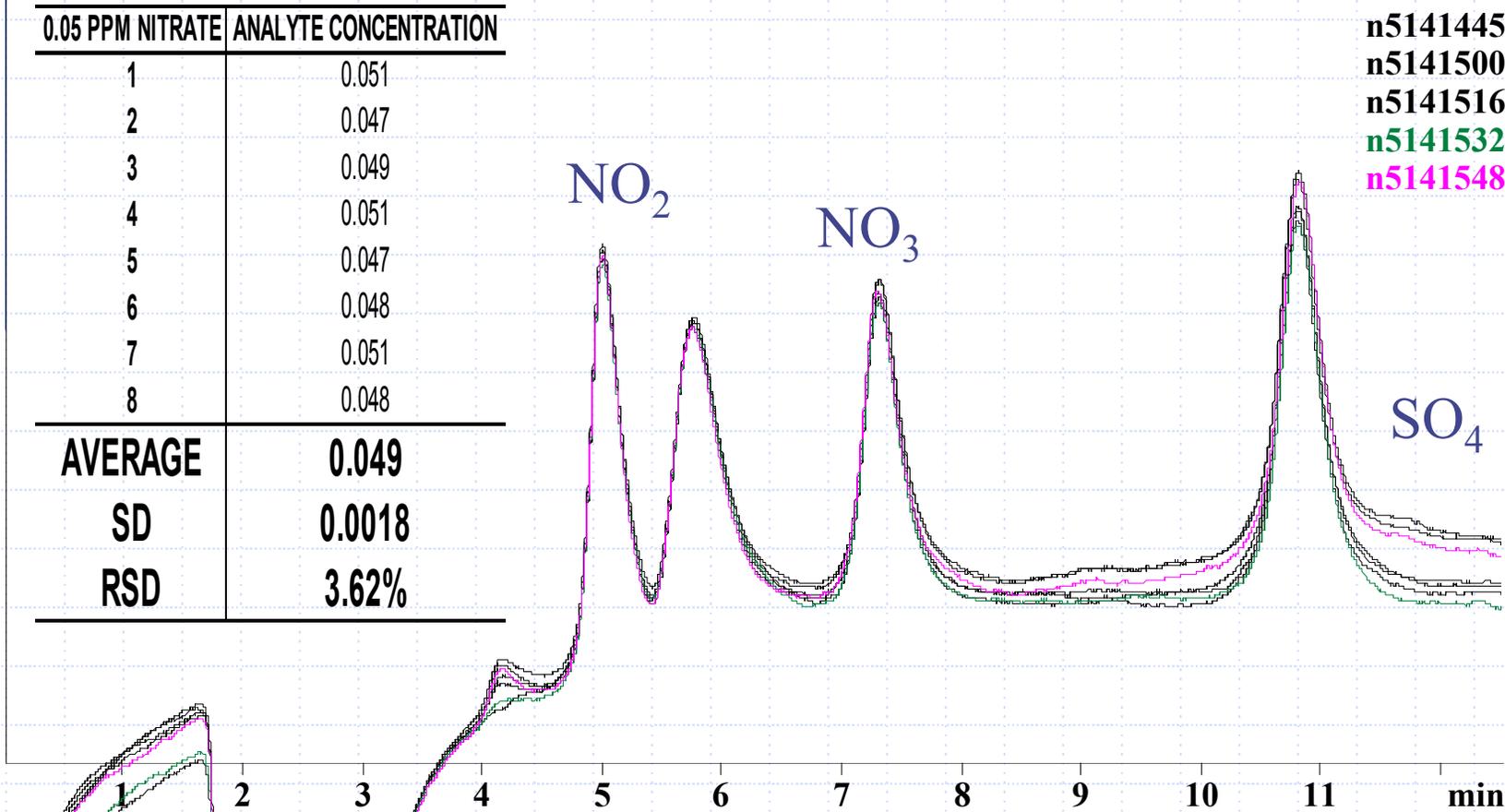
RSD	3.62%
------------	--------------

n5141413
n5141429
n5141445
n5141500
n5141516
n5141532
n5141548

NO₂

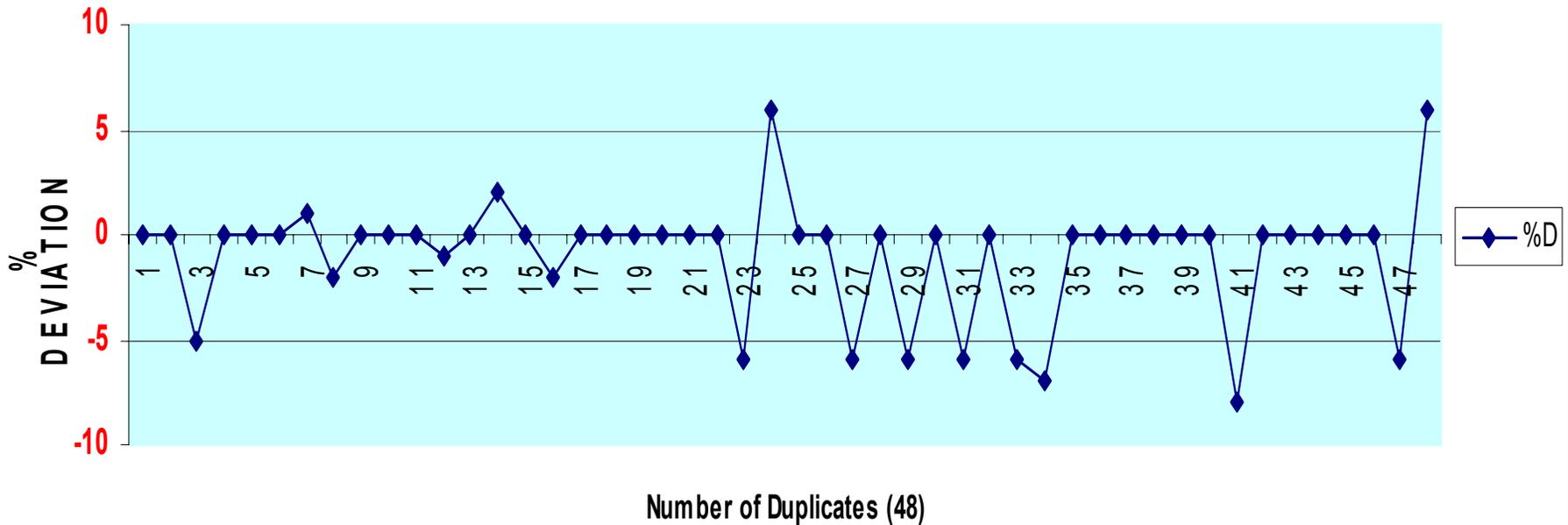
NO₃

SO₄

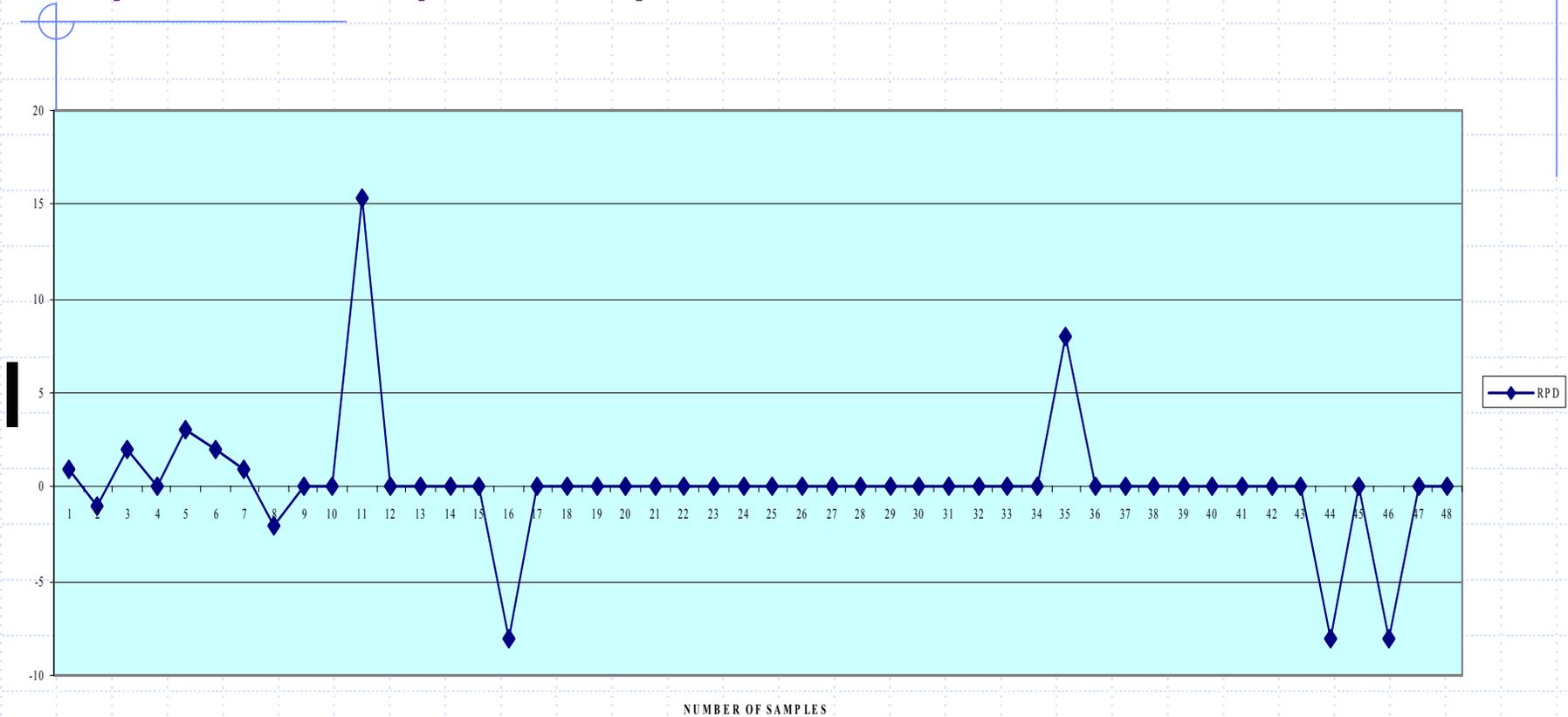


Duplicate Deviation

PERCENTAGE - DUPLICATE DEVIATION

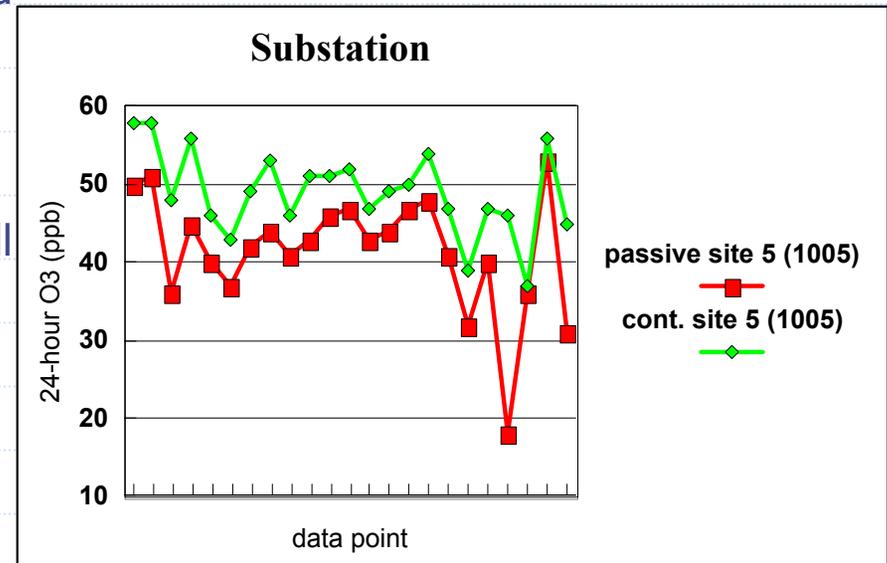


% RPD For Spike And Spike Duplicates

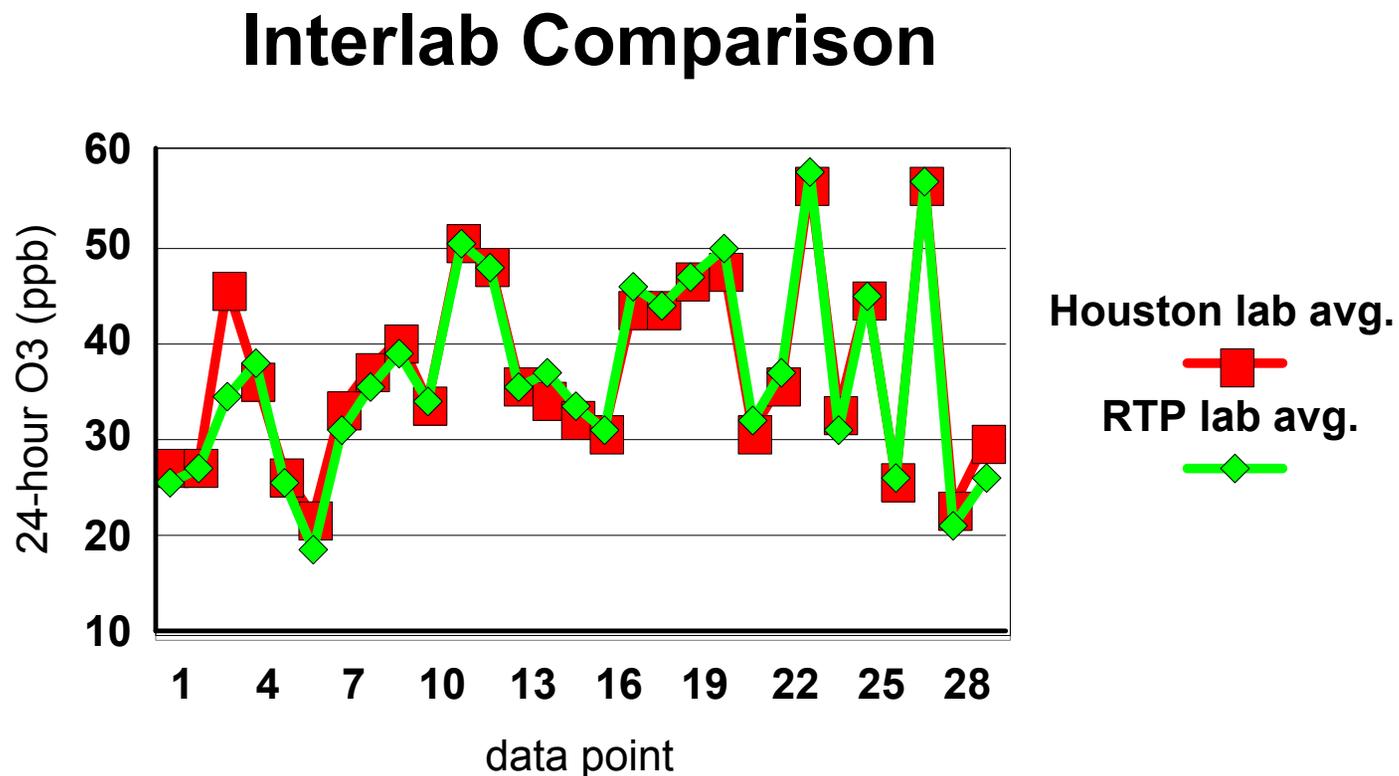


Collocated comparison of passive ozone data to continuous ozone data at the Substation site

- ◆ The passive sampler nicely followed the pattern of the continuous monitor over the 6 week study period.
- ◆ Correlation coefficient $r=0.72$ for all data.
- ◆ Correlation coefficient $r=0.86$ without low point from August 21.
- ◆ Passive data was on average 15% lower than the continuous data at the Substation site, so ozone data from the other 7 passive monitors probably biased a little low (i.e. the passive ozone data obtained from this study is conservative, not giving an overestimate of local ozone concentrations).



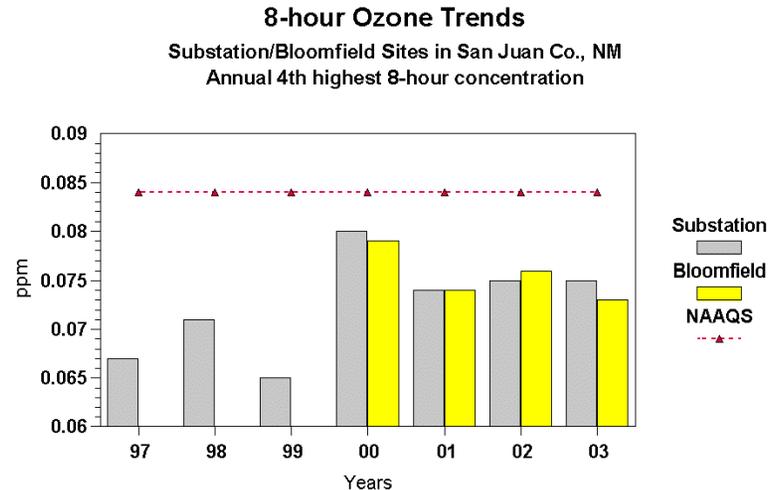
Interlab Comparison between Houston Lab and RTP Lab was Excellent



first 16 points from substation/bloomfield May, 2003 2 week pre-saturation study sampling
next 6 points from substation site during saturation study
last 7 points from fogir603 sites 3,23, and 27

Historical Analysis of Ozone and NO_x ambient monitoring data from the Substation and Bloomfield sites

- ◆ Note rise in annual 4th highest 8-hour ozone concentrations at Substation beginning in 2000.
- ◆ 2000-2003 concentrations all above 1997-1999 concentrations at Substation.

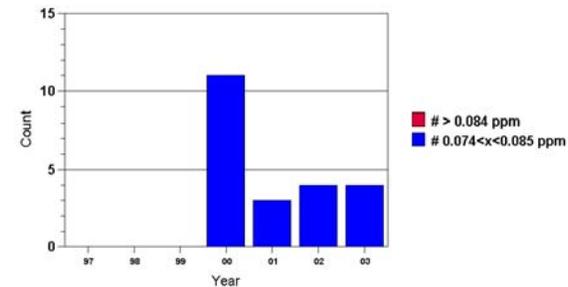


2003 data preliminary
Substation ozone monitoring began 5/8/97
Bloomfield ozone monitoring began 6/7/2000

Substation 8-hour Ozone Concentrations

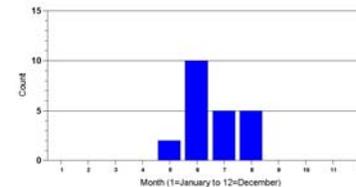
- ◆ No exceedances; values between 74 and 85 ppb began being recorded by monitor in 2000.
- ◆ Most high 8-hour ozone concentrations recorded June-August.
- ◆ Most high 8-hour ozone concentrations recorded during the day, not at night.

Substation High 8-hour Ozone Concentration Trends



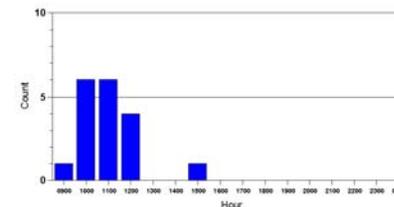
1997-2003 data
Data from EPA Air Quality System (AQS) national database

Substation High 8-hour Ozone Concentrations by Month
8-hour averages > 0.074 ppm



1997-2003 data
Data from EPA Air Quality System (AQS) national database

Substation High 8-hour Ozone Concentrations by Time of Day
Beginning hour of 8-hour average (LST)
8-hour averages > 0.074 ppm

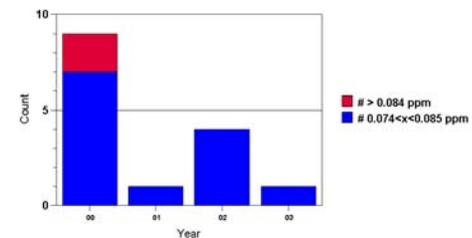


1997-2003 data
Data from EPA Air Quality System (AQS) national database

Bloomfield 8-hour Ozone Concentrations

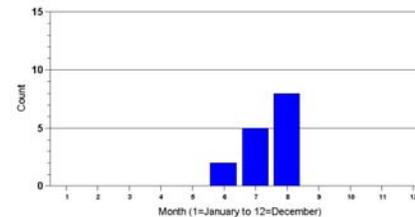
- ◆ Two exceedances in 2000 (both 85 ppb).
- ◆ All high 8-hour ozone concentrations recorded June-August.
- ◆ All high 8-hour ozone concentrations recorded during the day, not at night.

Bloomfield High 8-hour Ozone Concentration Trends



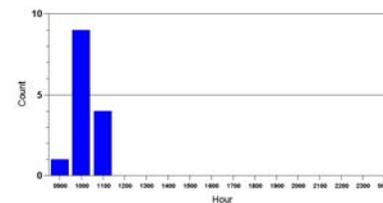
2000-2003 data
Data from EPA Air Quality System (AQS) national database

Bloomfield High 8-hour Ozone Concentrations by Month
8-hour averages > 0.074 ppm



2000-2003 data
Data from EPA Air Quality System (AQS) national database

Bloomfield High 8-hour Ozone Concentrations by Time of Day
Beginning hour of 8-hour average (LST)
8-hour averages > 0.074 ppm

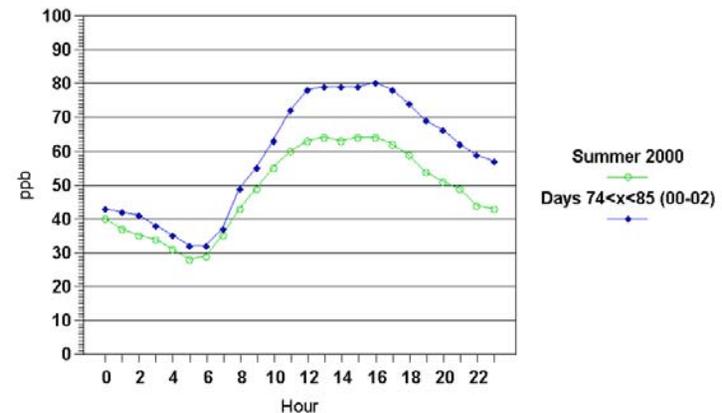


2000-2003 data
Data from EPA Air Quality System (AQS) national database

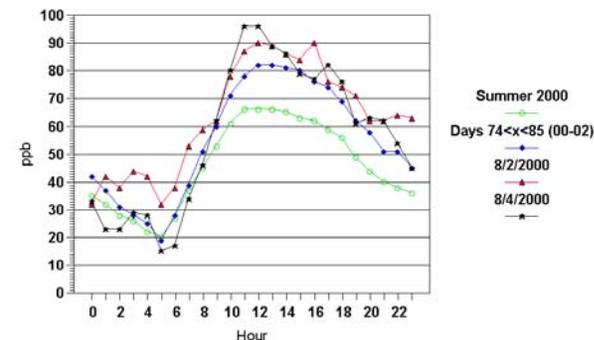
Ozone Diurnal Profiles at Substation and Bloomfield do not show evidence of significant impact from HRVOC (Highly Reactive Volatile Organic Compounds).

- ◆ Greatest hourly rise seen at Bloomfield site on 8/4/00 at just 18 ppb.
- ◆ Many Houston ozone exceedances attributed in large part to HRVOC exhibit hourly rises of over 40 ppb, some considerably over 40 ppb.
- ◆ Substation and Bloomfield ozone diurnal profiles show impact of more slowly forming ozone from photochemical reactions involving NO_x and alkanes.

Substation Ozone Diurnal Profiles

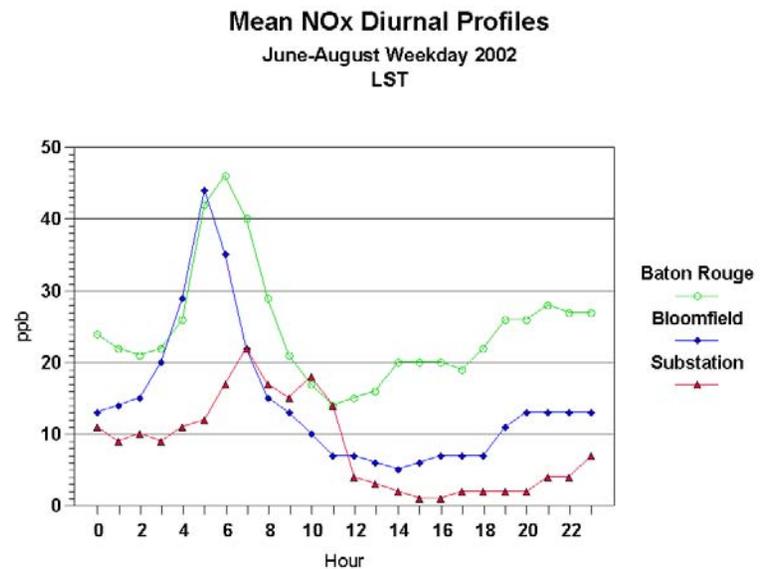


Bloomfield Ozone Diurnal Profiles



NO_x Diurnal Profiles

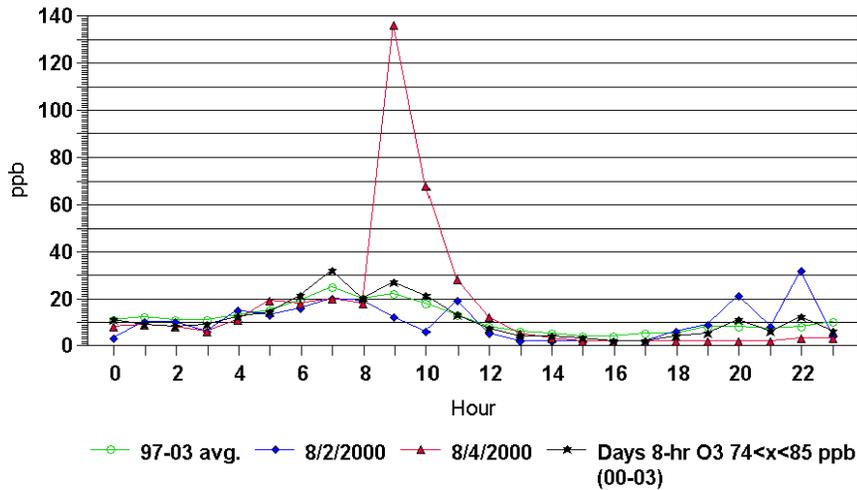
- ◆ Bloomfield NO_x peaks in morning but an hour earlier than larger cities such as Baton Rouge.
- ◆ Bloomfield morning concentration peak similar to Baton Rouge peak for 2002.
- ◆ Bloomfield monitor shows effect of morning commute mobile source NO_x emissions, and the ambient concentrations are significantly high.
- ◆ Substation monitor further away from cities; more impacted by transported NO₂ from cities and stationary source NO_x plumes as seen on next slide.



NO_x Diurnal Profiles (cont.)

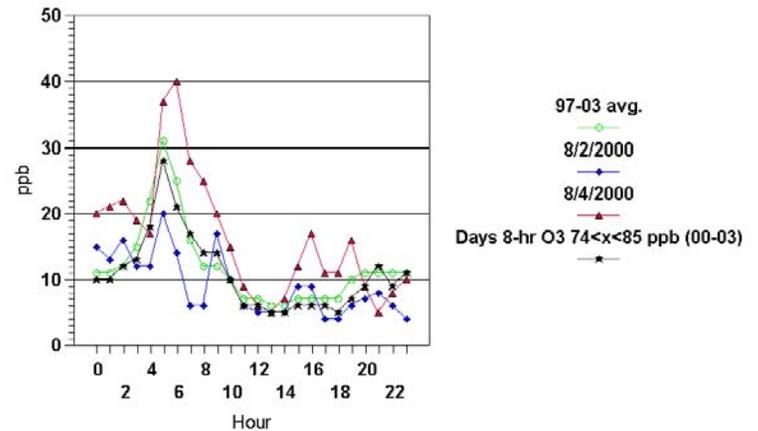
NO_x Diurnal Profiles

Substation
June-August; LST



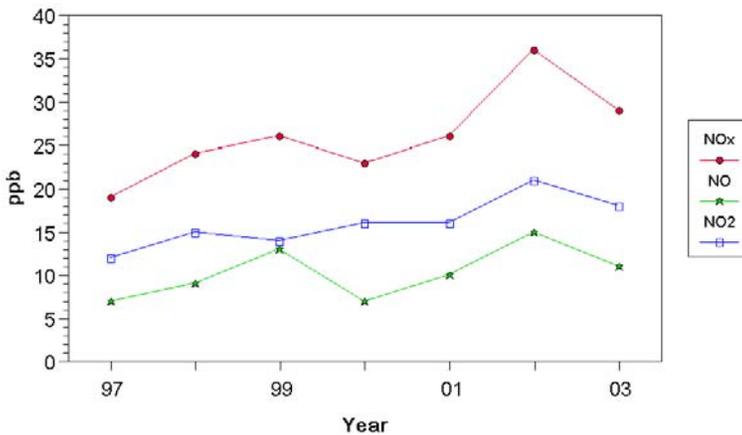
NO_x Diurnal Profiles

Bloomfield
June-August; LST

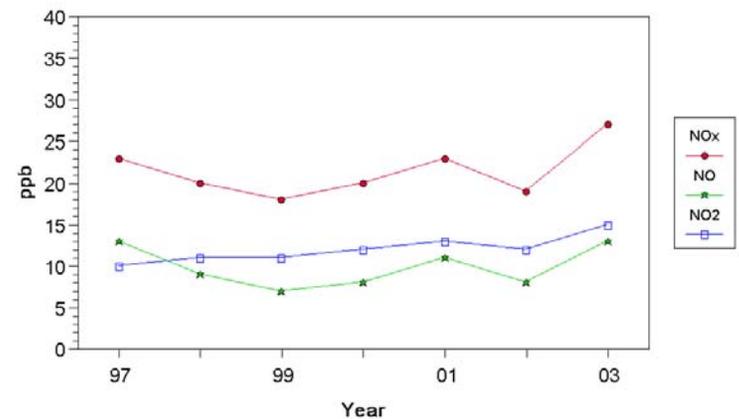


Ambient NO_x Concentrations Going Up at Bloomfield and Substation Sites

Bloomfield NO_x Trends
June-August Weekday 0400-0600 LST Arithmetic Means



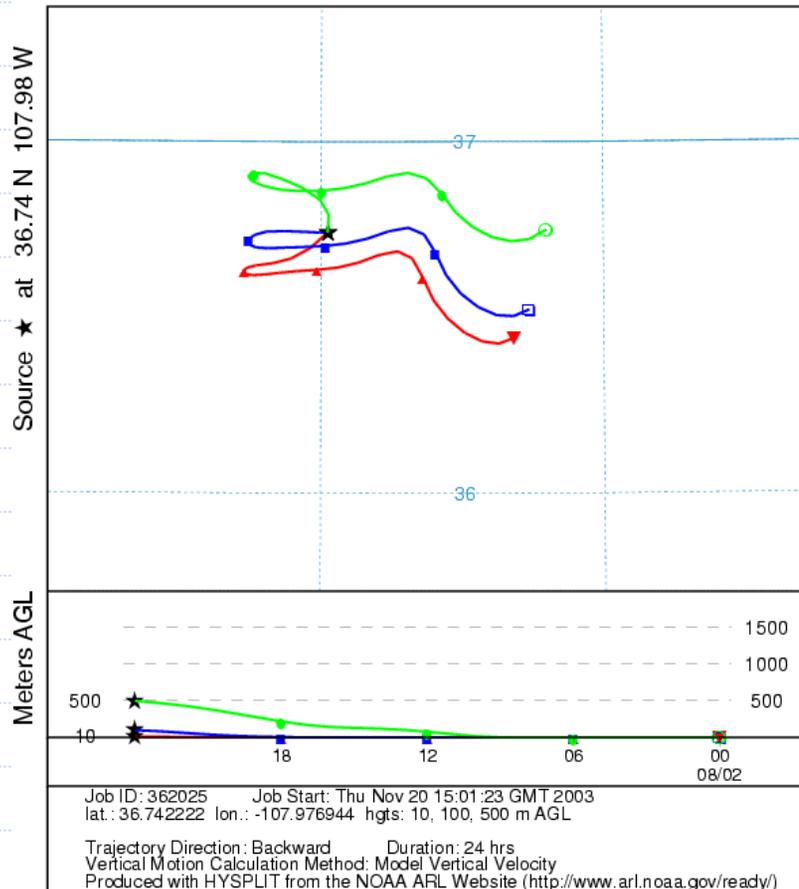
Substation NO_x Trends
June-August Weekday 0600-0800 LST Arithmetic Means



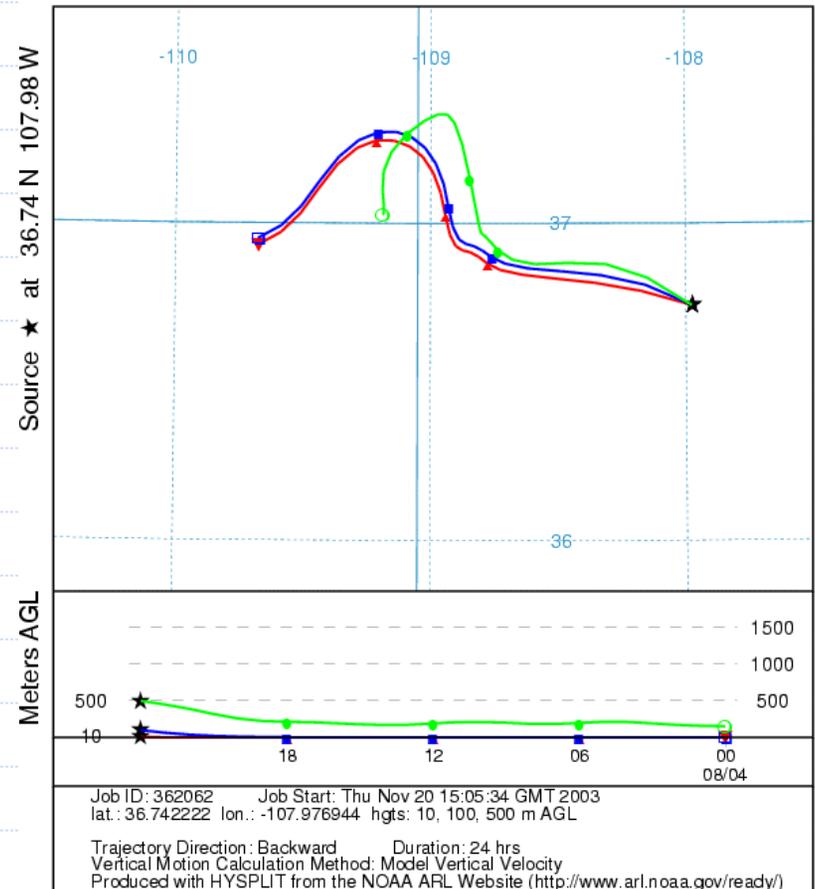
Twenty four hour back trajectories for two 8-hour ozone exceedance days at Bloomfield (8/2 and 8/4, 2000) go back through same source areas seen in 7/21, 7/22, and 7/24, 2003 back trajectories



NOAA HYSPLIT MODEL
Backward trajectories ending at 00 UTC 03 Aug 00
EDAS Meteorological Data

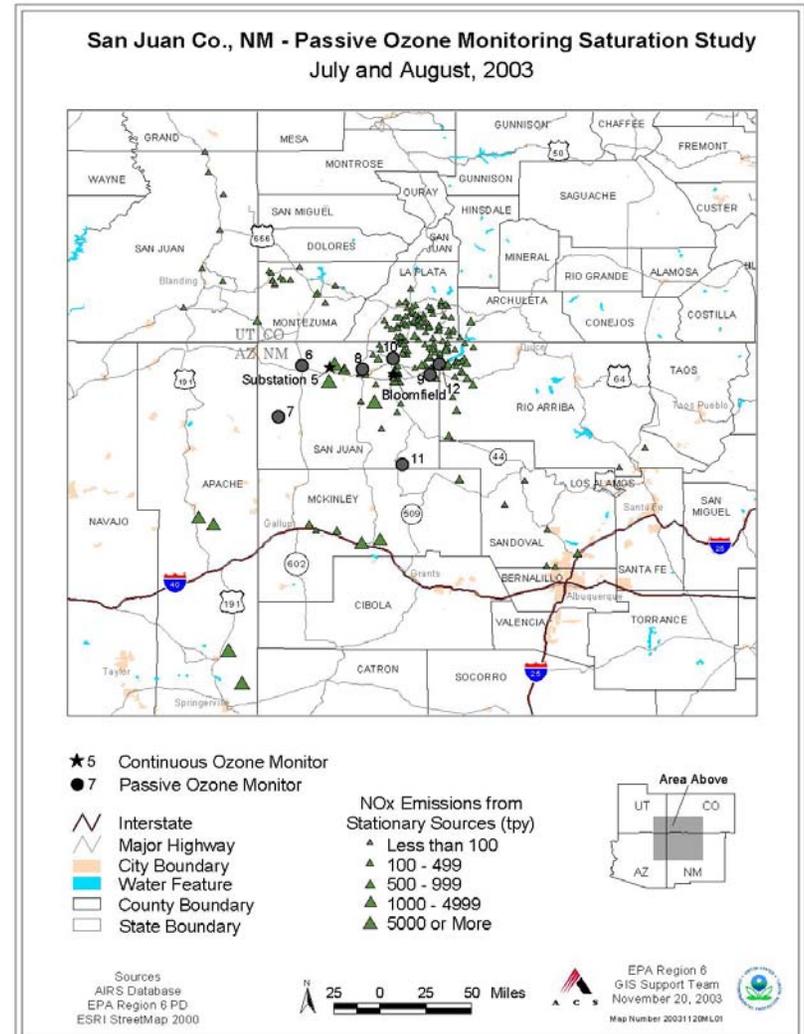


NOAA HYSPLIT MODEL
Backward trajectories ending at 00 UTC 05 Aug 00
EDAS Meteorological Data



NO_x/VOC Stationary Source Emissions in EPA AFS (Air Facility Subsystem) database

- ◆ San Juan Co., NM, Rio Arriba Co., NM, and La Plata Co., CO account for 67% of NO_x and VOC stationary source emissions shown in graphic, with San Juan Co., NM dominating (93% of the NO_x, and 63% of VOC from the 3 counties).
- ◆ These emission estimates in t/y are based on 1999 data.



Conclusions

- ◆ Eight hour ozone concentrations in San Juan Co., NM have risen to be among the highest levels seen at Regional sites in NM, UT, CO, AZ, and TX.
- ◆ The summer 2003 passive ozone monitoring saturation study showed significantly high ozone concentrations in the western and northeastern part of San Juan Co., NM in addition to the high ozone concentrations already found in the north central area of the county.
- ◆ NOAA Hysplit Model back trajectories on the three highest ozone days during the study went through 3 different source areas: (1) close to the Four Corners and San Juan power plants (July 21), (2) western Rio Arriba County (July 22), and (3) northeastern San Juan Co., NM and La Plata Co., CO (July 24).
- ◆ There are plenty of NO_x and VOC emissions in the Four Corners area to make significant amounts of ozone; Stationary source NO_x emissions are very high in San Juan Co., NM;; ambient NO_x concentrations at Bloomfield and Substation have been increasing; the 2002 morning peak NO_x concentration at Bloomfield was similar to the morning peak NO_x concentration recorded at a site in Baton Rouge, LA; Bloomfield NO_x diurnal profiles show important impact from morning mobile source emissions; review of diurnal profiles of ozone concentrations point to NO_x and alkanes as the predominant VOC subgroup driving the ozone formation process, and not HRVOC.
- ◆ Recommend collecting VOC monitoring data to see how high ambient concentrations are and how they compare to other areas with ozone pollution problems like Baton Rouge, LA.