Improvements in Emissions Inventories Using High Time Resolution Monitoring Data and Concentration Field Analysis

EPA STAR Grant
Novel Approaches to Improving Air Pollution Emissions Information,
US EPA, 16 Nov 2010

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Goals and Approach

- Overall Goal:
  - Couple high-resolution meteorological modeling with existing high time resolution atmospheric pollutant data sets to assess and improve emissions inventories.
- Approach:
  - Use Concentration Field Analysis (CFA) to map sources, or precursors, of pollutants
  - Evaluate CFA's performance will pollutants with well established inventories, such as sulfur dioxide and carbon monoxide
  - Compare CFA mapping to emissions inventories for other key pollutants including National Emissions Inventory (NEI), Toxic Release Inventory (TRI), and local and regional inventories.
  - Indentify and investigate missing and inconsistent sources, or precursors, of pollutants

CFA Applications

- Devil's Lake and Milwaukee, Wisconsin
  - Gaseous Elemental Mercury (GEM)
  - Reactive Gaseous Mercury (RGM)
  - Particulate Mercury
  - VOC Data from Chemical Ionization Mass Spectrometer (CIMS)
- EPA Sponsored St. Louis Midwest Supersite
  - PM2.5 Elemental Carbon (EC)
  - Ultrafine Particle Number
  - PM2.5 Organic Carbon (OC)
- Los Angeles, CA
  - PM2.5 Elemental Carbon (EC)
  - PM2.5 Organic Carbon (OC)
  - PM2.5 Organic Tracers for Sources

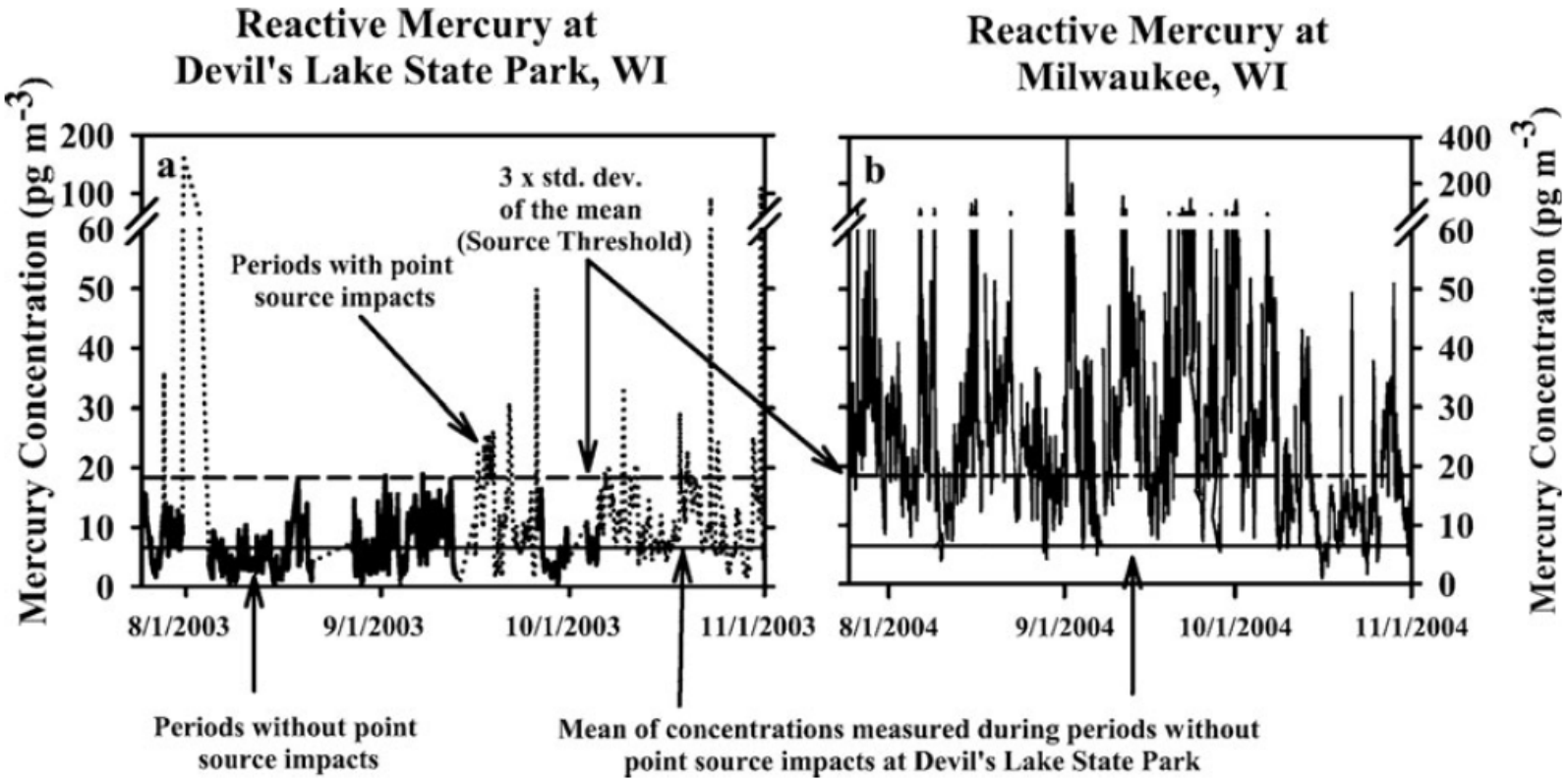
Wisconsin Data

- Atmospheric Mercury
  - Data from Previous EPA Star Grant
  - Full year of speciated mercury data collected in Milwaukee, Wisconsin and at Devil's Lake State Park in South Central Wisconsin
  - Clearly local sources that are not in TRI or other mercury Inventories
- Volatile Organic Compounds
  - High time resolution data collected in Milwaukee, Wisconsin using a CIMS

A comparison of speciated atmospheric mercury at an urban center and an upwind rural location†

Andrew P. Rutter,[a] James J. Schauer,*[a] Glynis C. Lough,[a] David C. Snyder,[a] Catherine J. Kolb,[a] Sara Von Klooster,[a] Todd Rudolf,[a] Helen Manolopoulos[a] and Mark L. Olson[b]

102 | *J. Environ. Monit.*, 2008, **10**, 102–108



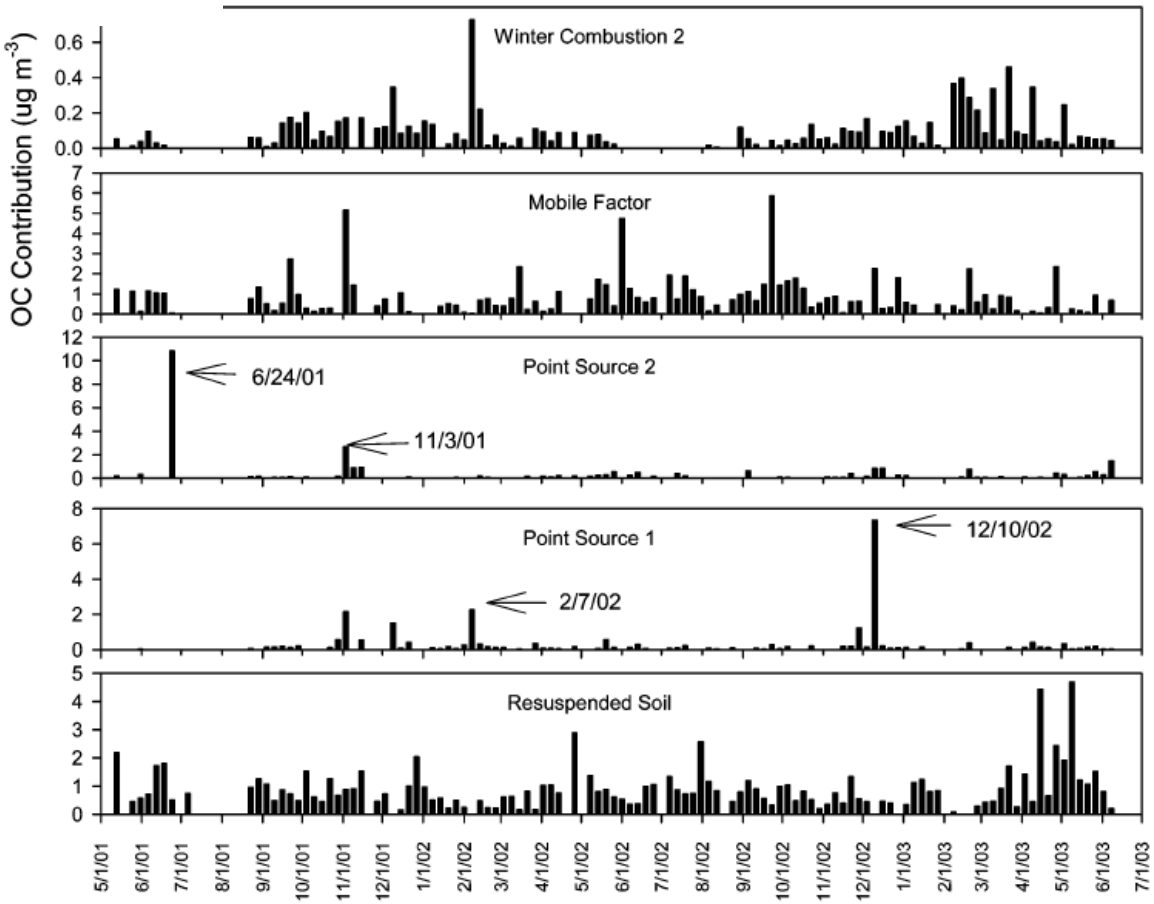
St. Louis Midwest Supersite

- Two Years of Comprehensive Data
  - Hourly ECOC
  - Daily Organic Tracers for Sources
  - Real Time Size Distribution and Particle Number Concentrations
  - Many supplemental measurements
- Extensive data analysis and source apportionment work that provides a foundation for current analysis
- First look at secondary pollutants

Positive Matrix Factorization (PMF) Analysis of Molecular Marker Measurements to Quantify the Sources of Organic Aerosols

JEFFREY M. JAECKELS,
MIN-SUK BAE, AND JAMES J. SCHAUER*
Environmental Chemistry and Technology, University of Wisconsin, Madison, Wisconsin 53706

Environ. Sci. Technol. **2007**, *41*, 5763–5769



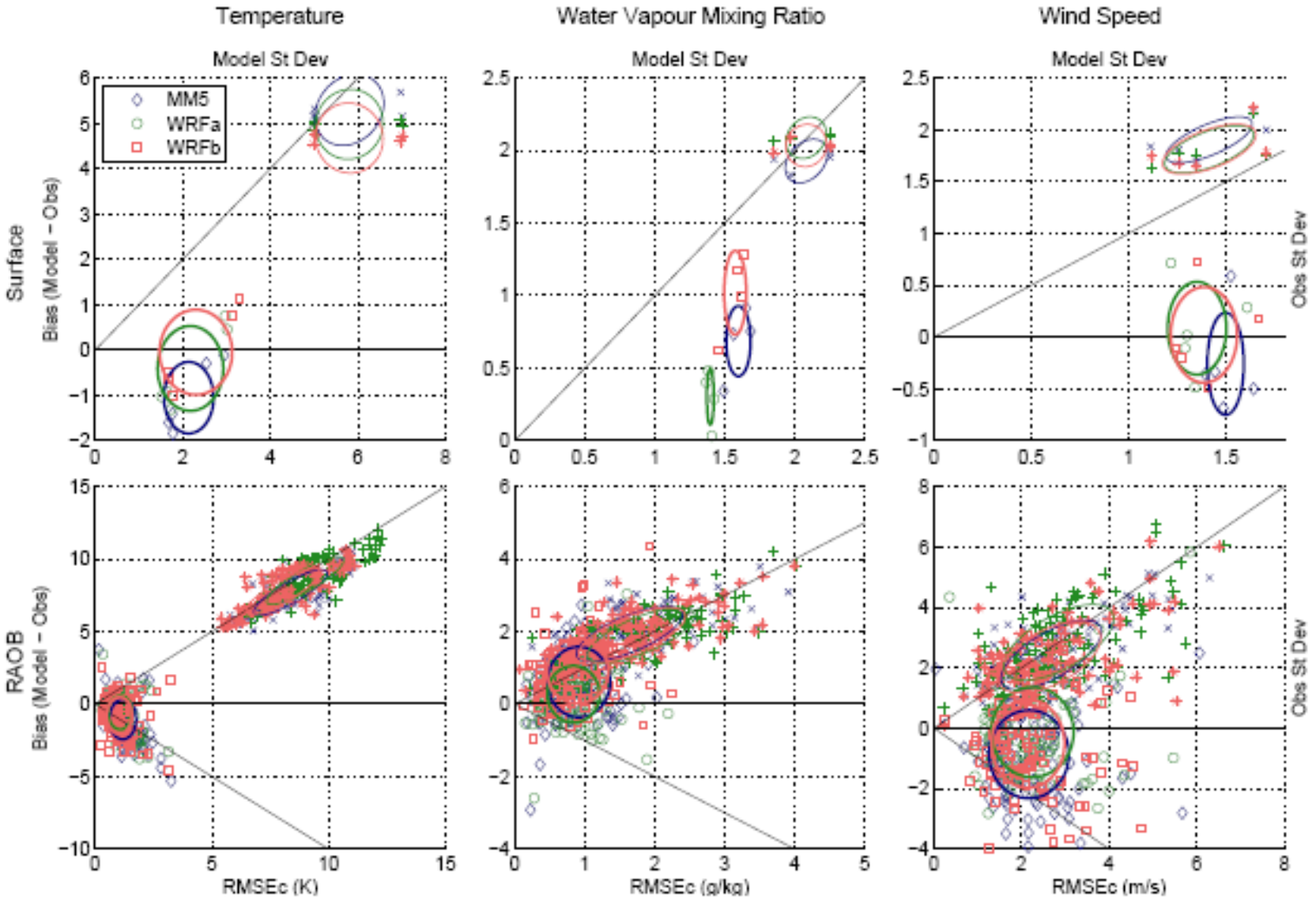
CARB LA Study

- Daily ECOC, WSOC and Organic Tracers
- Parallel study to the St. Louis Midwest Supersite but the distribution of sources is very different among the two sites
- Key focus is on the gasoline and diesel split for OC and EC
- Chemical measurements are nearly complete and will build on receptor modeling results

Mexico City seen from the NASA DC8

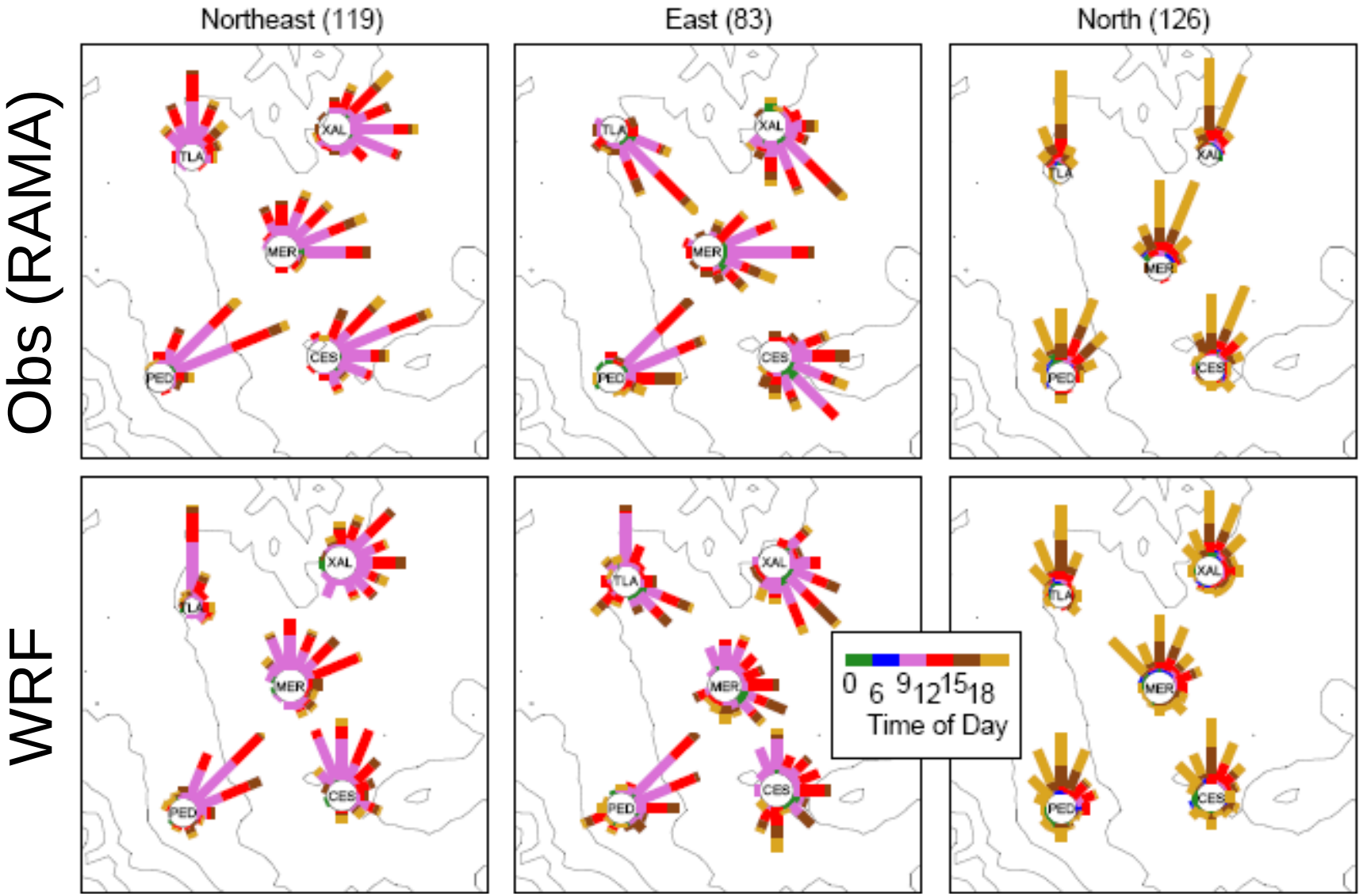
Photo courtesy of Cameron McNaughton, University of Hawai'i

Evaluating meteorological models



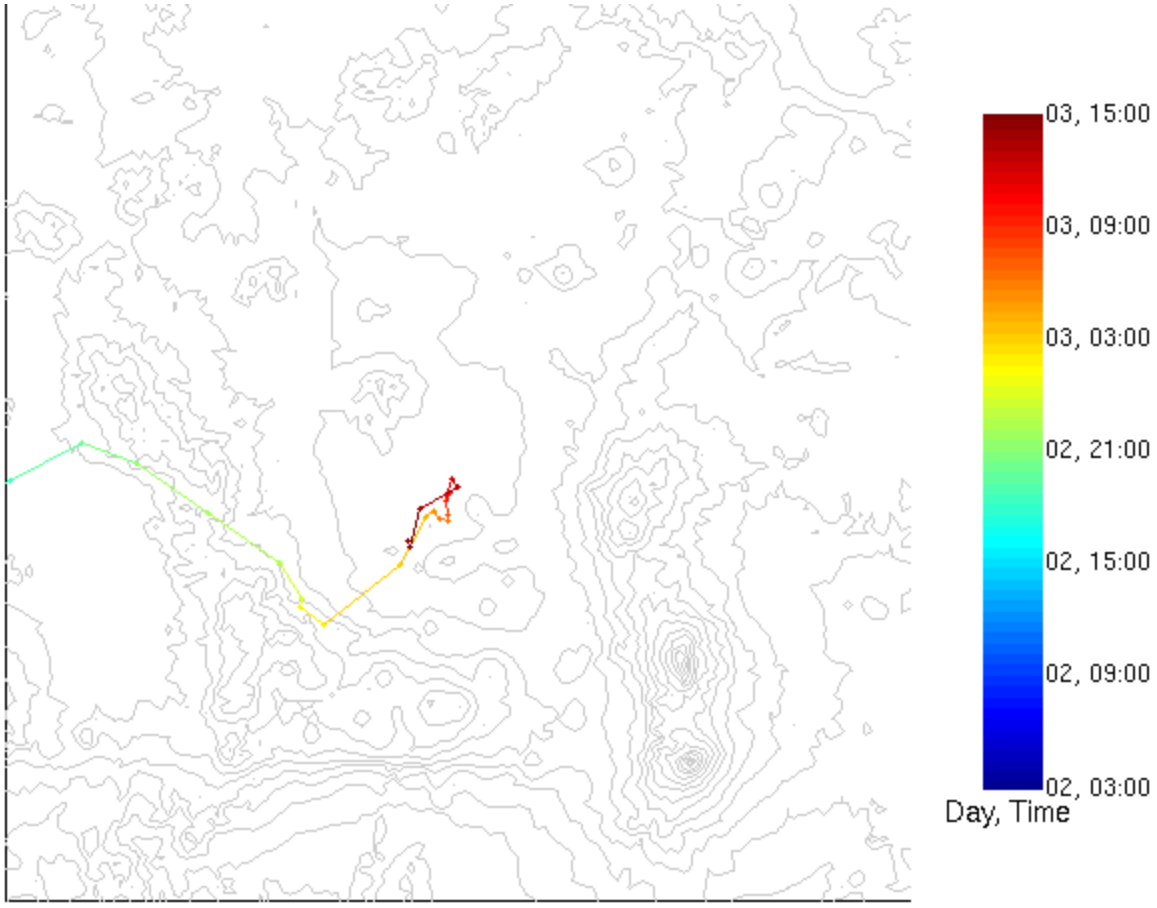
de Foy et al., Evaluation of WRF mesoscale simulations and particle trajectory analysis for the MILAGRO field campaign, *Atmospheric Chemistry and Physics*.

Evaluating meteorological models

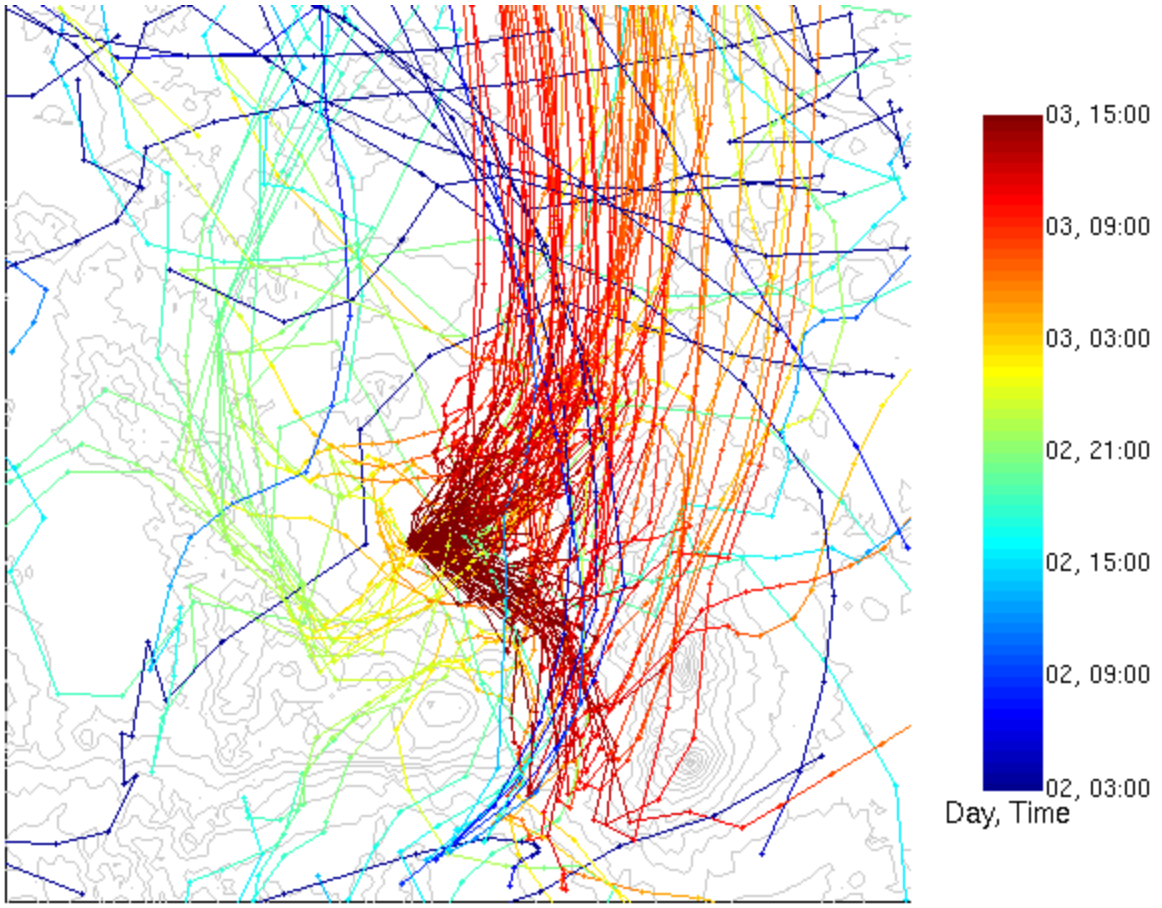


de Foy et al., Evaluation of WRF mesoscale simulations and particle trajectory analysis for the MILAGRO field campaign, *Atmospheric Chemistry and Physics*.

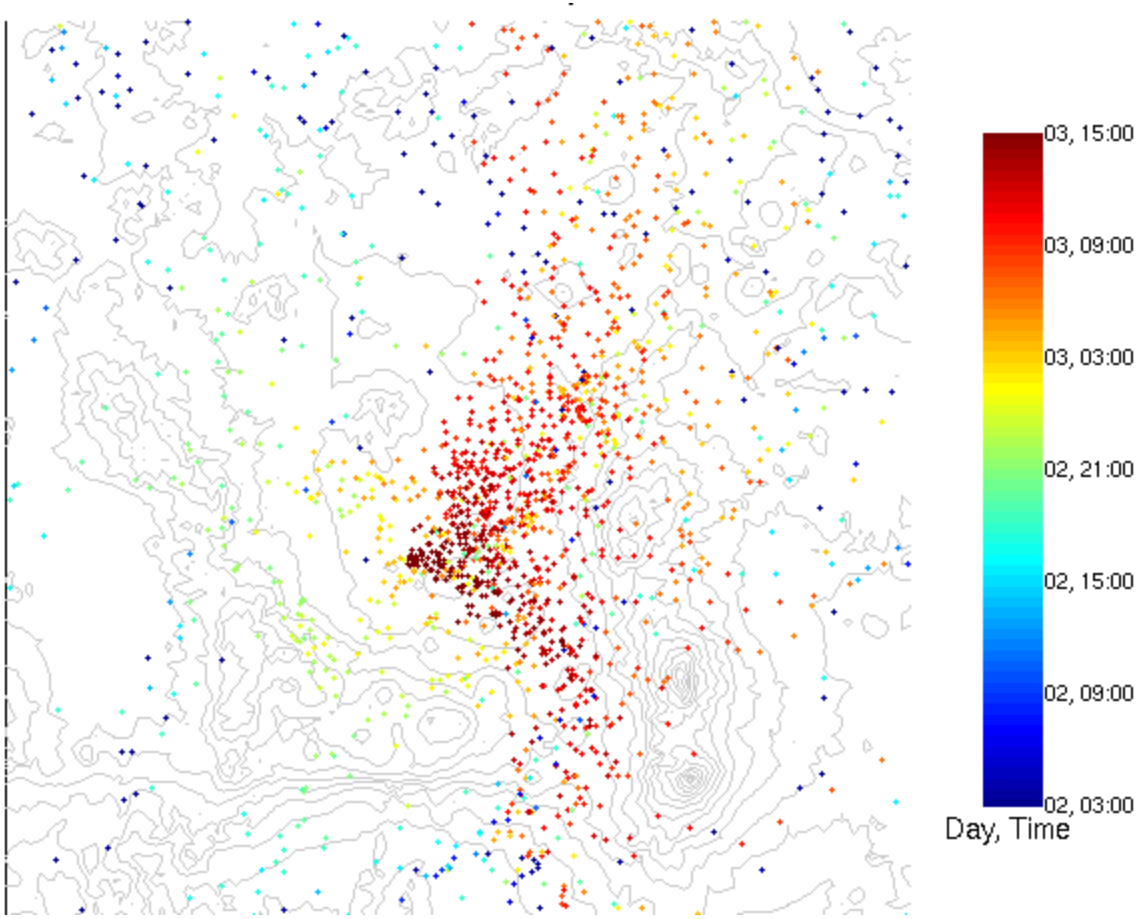
Single Backward Trajectory for CENICA (3 May 15:00)



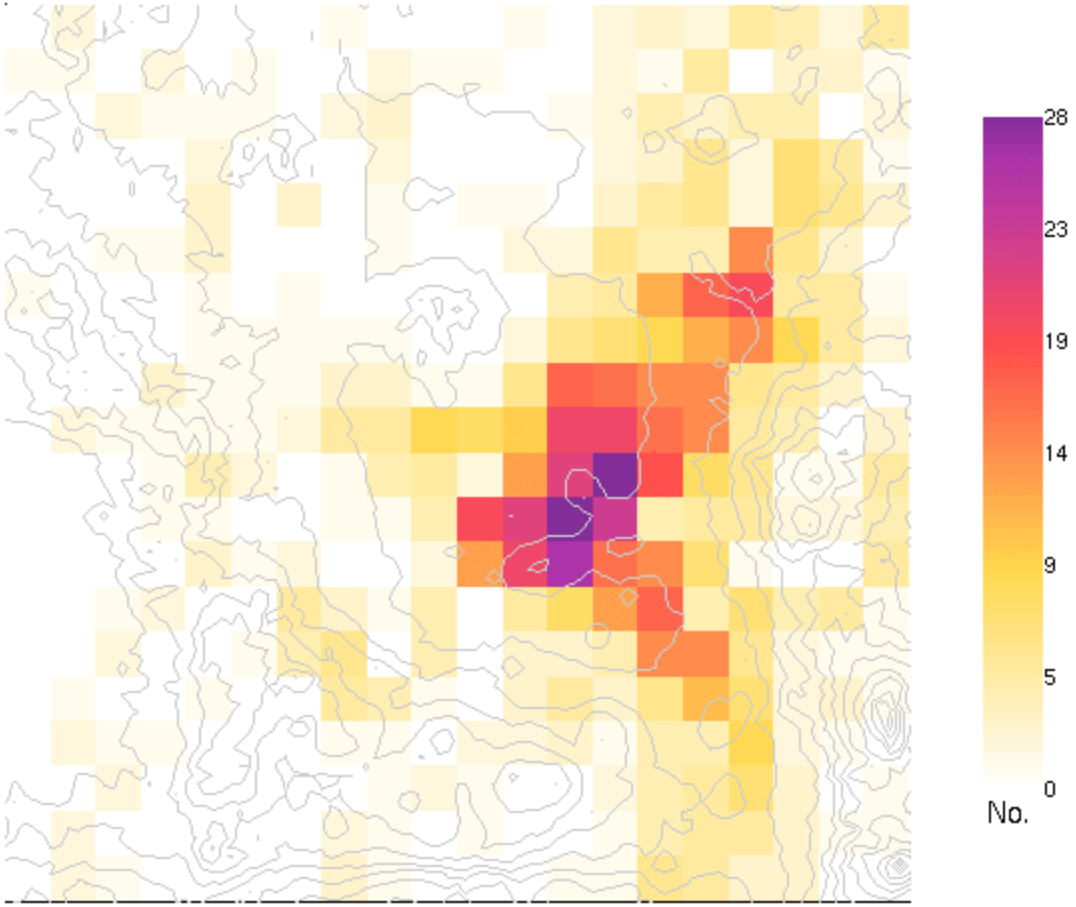
100 Backward Trajectories for CENICA (3 May 15:00)



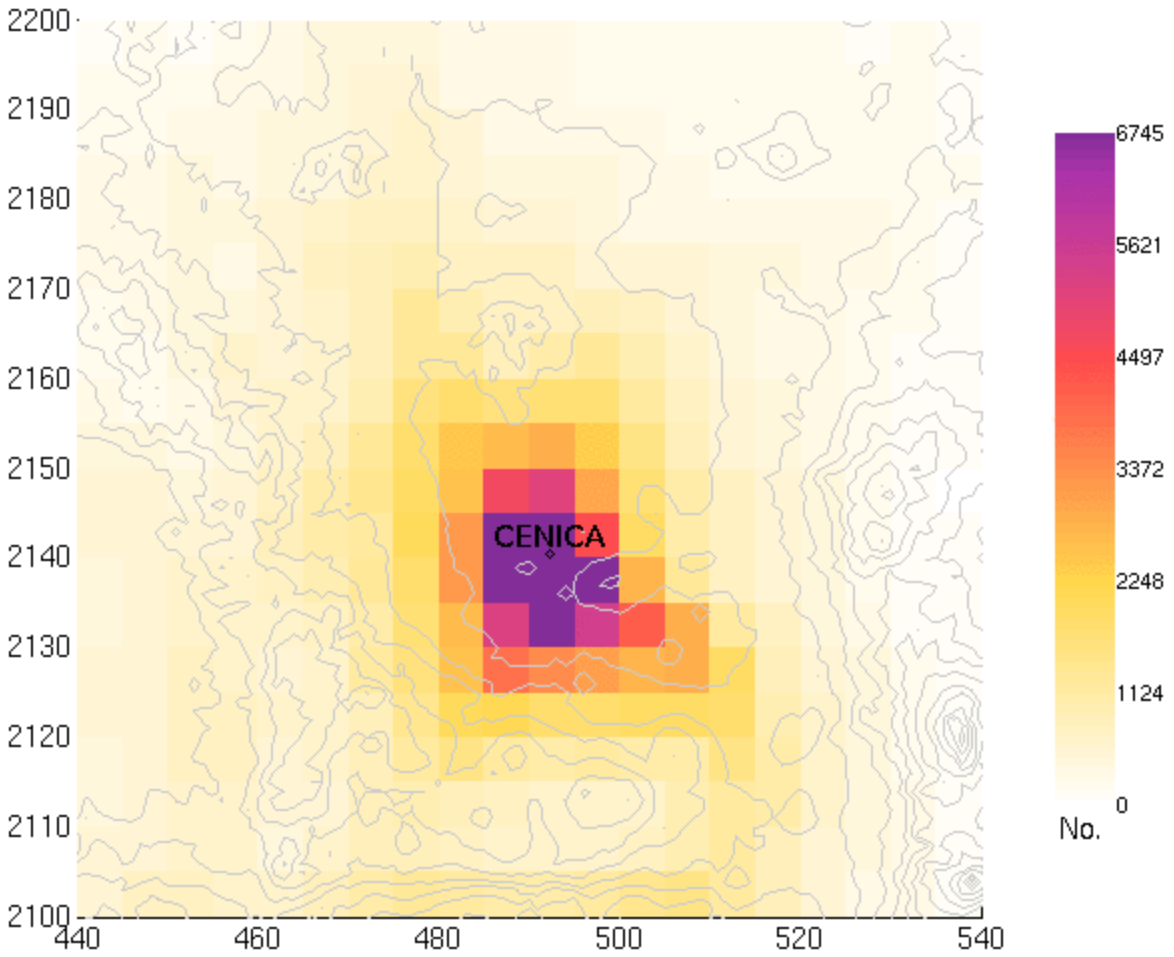
Backward Particle Cloud for CENICA (3 May 15:00)



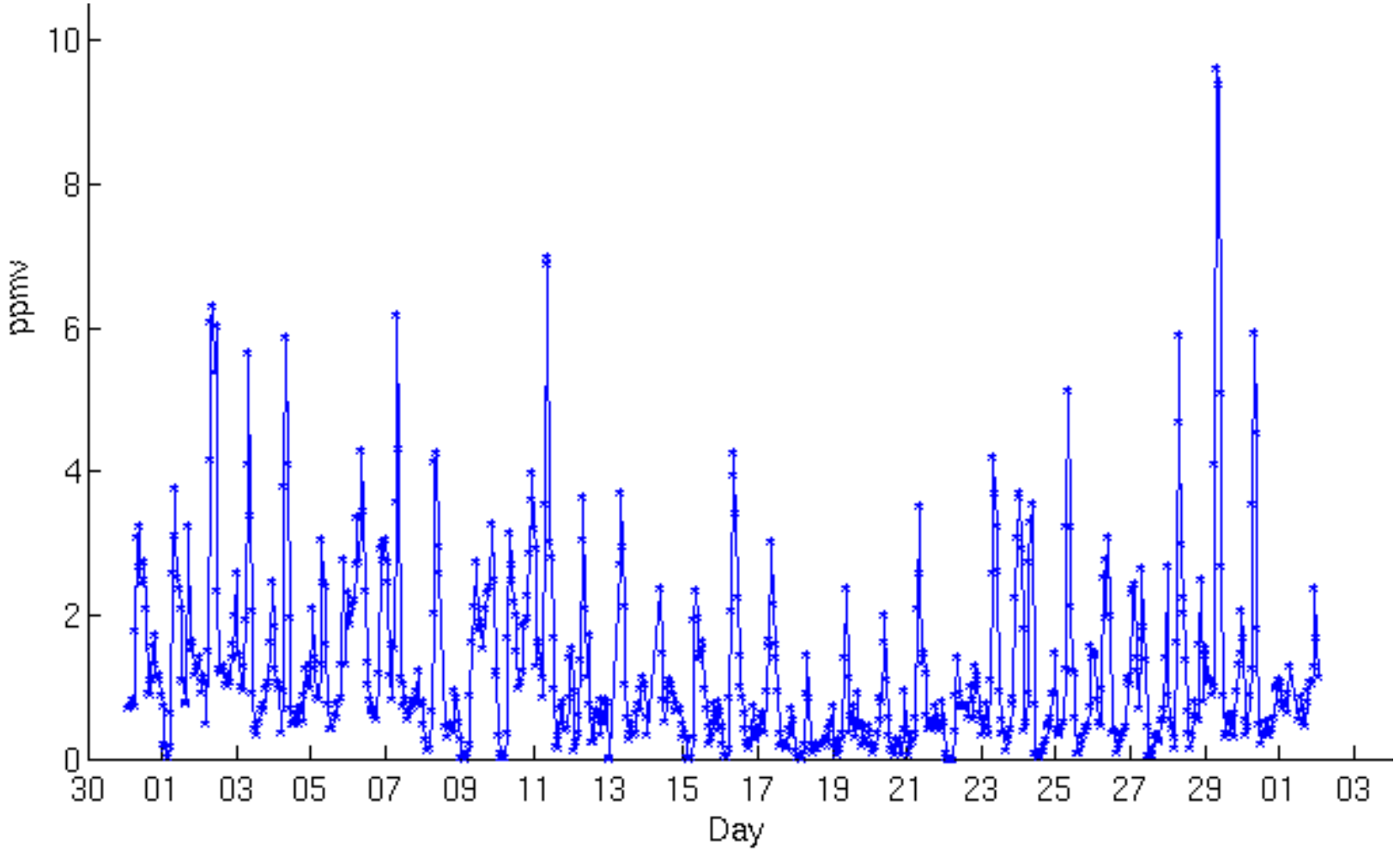
Residence Time Analysis for CENICA (3 May 15:00)



Sum of Residence Time Analysis for CENICA for MCMA-2003

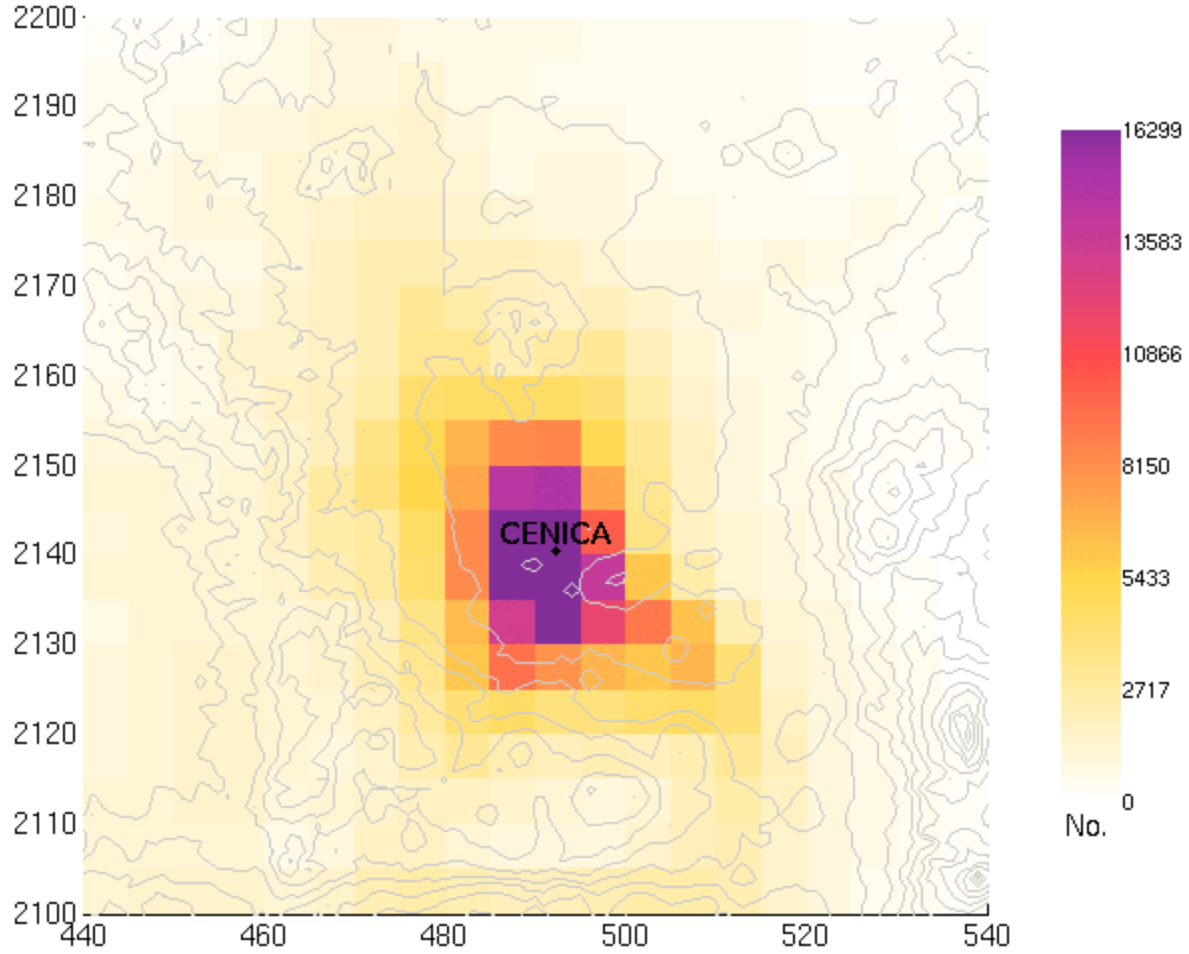


Carbon Monoxide Footprint – MCMA-2003



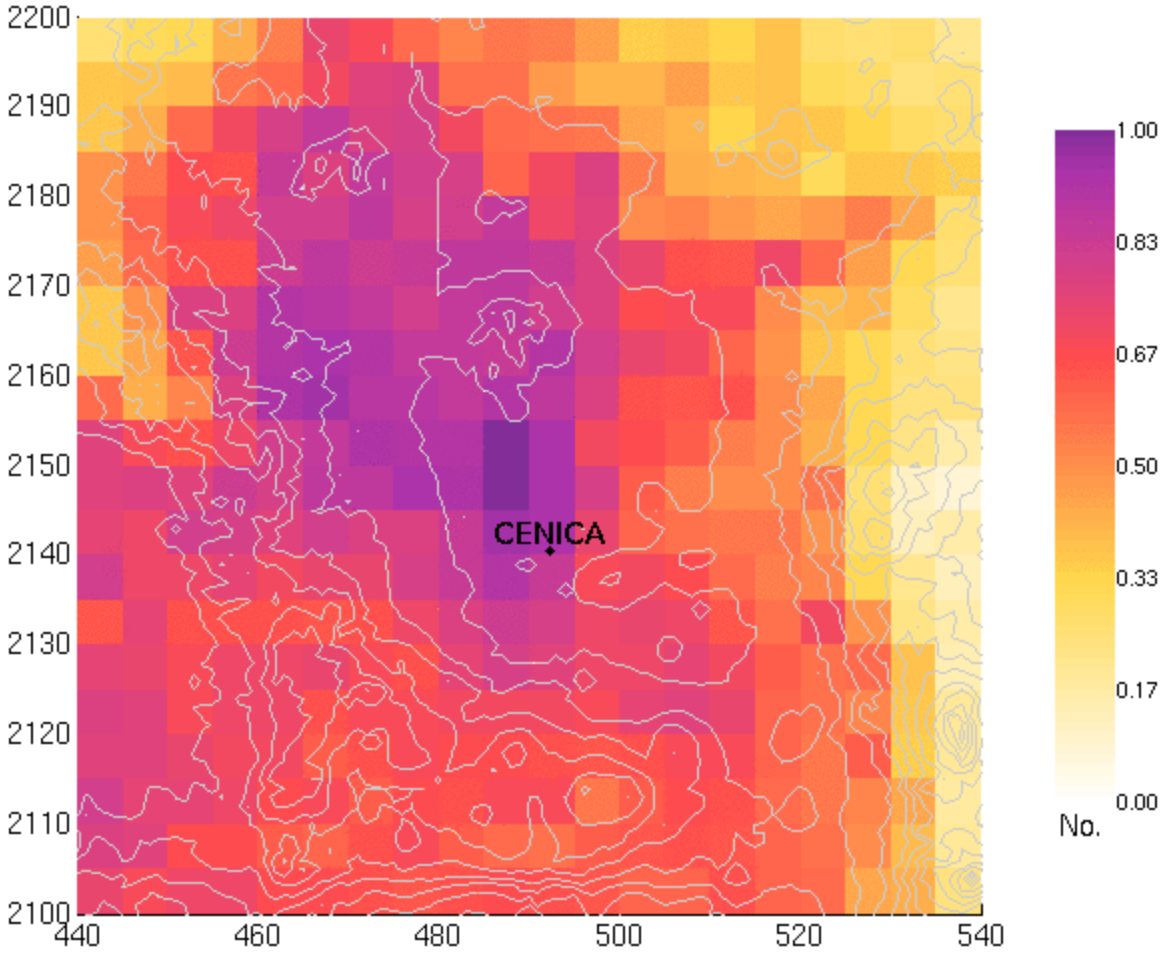
Carbon Monoxide Footprint

Sum (Residence Time Analysis * CO Conc. at release site) for all time steps

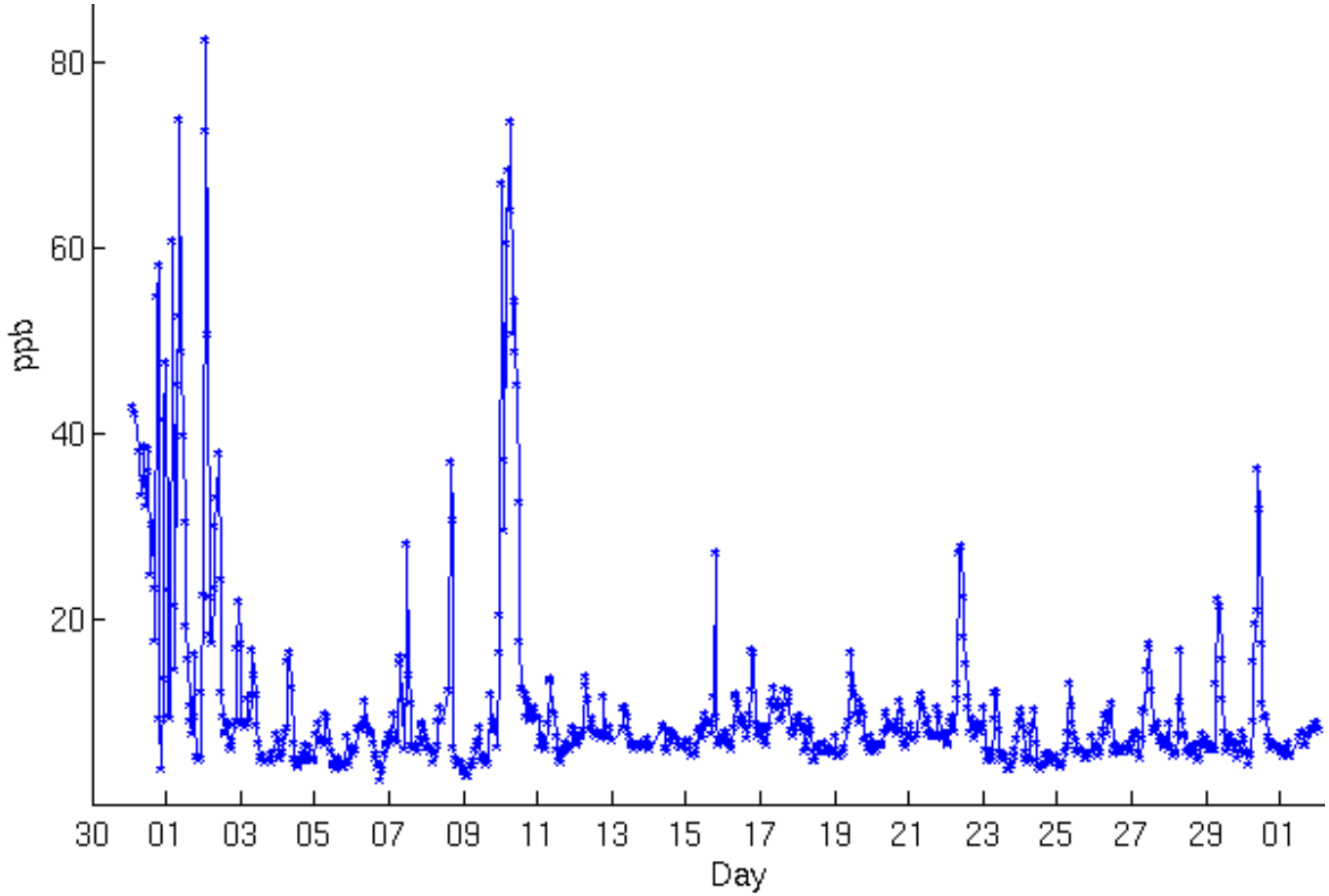


CO Concentration Field Analysis

Sum (Residence Time Analysis * CO Conc. at release site) for all time steps,
Divided by Sum (Residence Time Analysis)

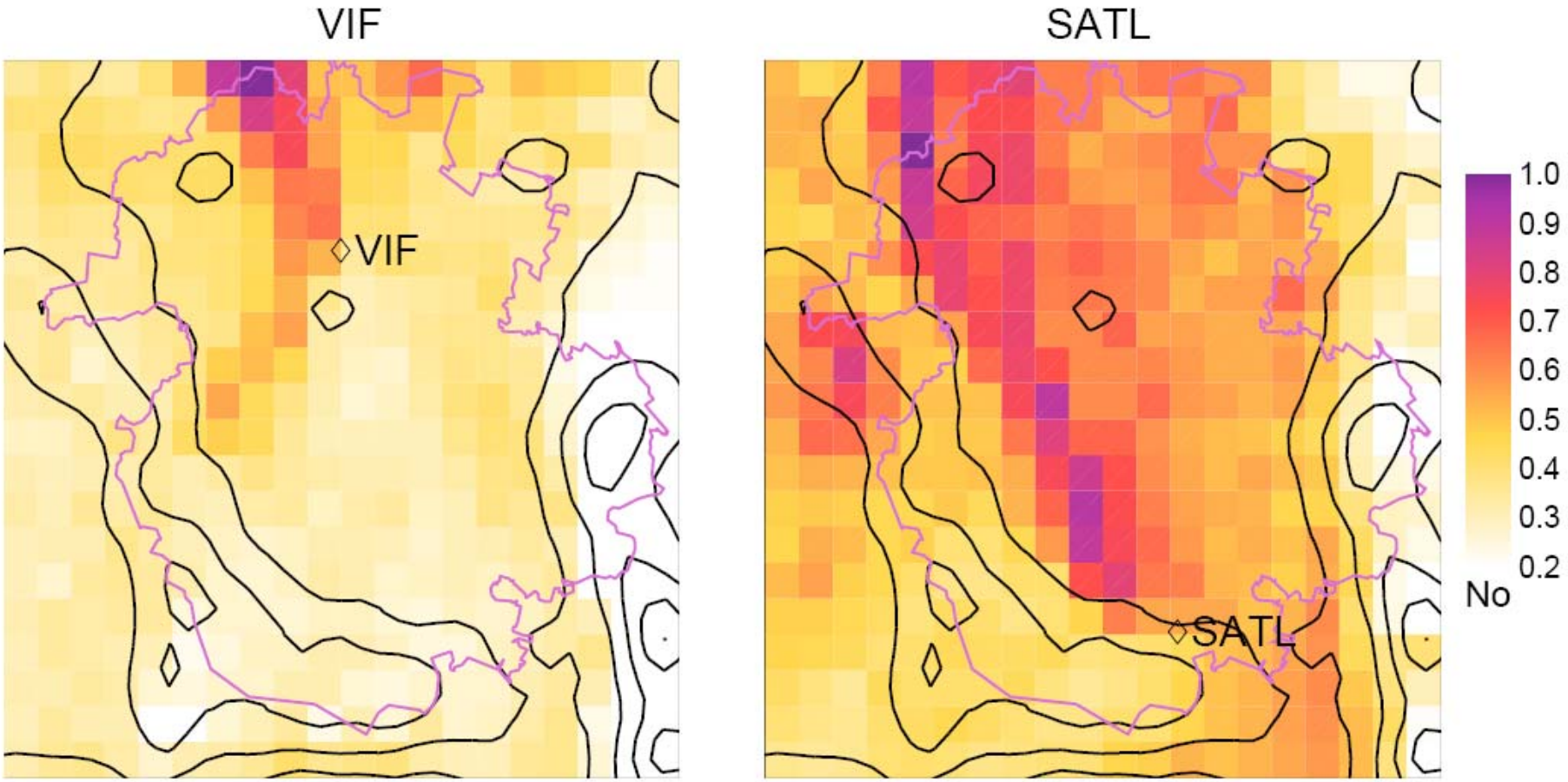


SO2 Time Series – MCMA-2003



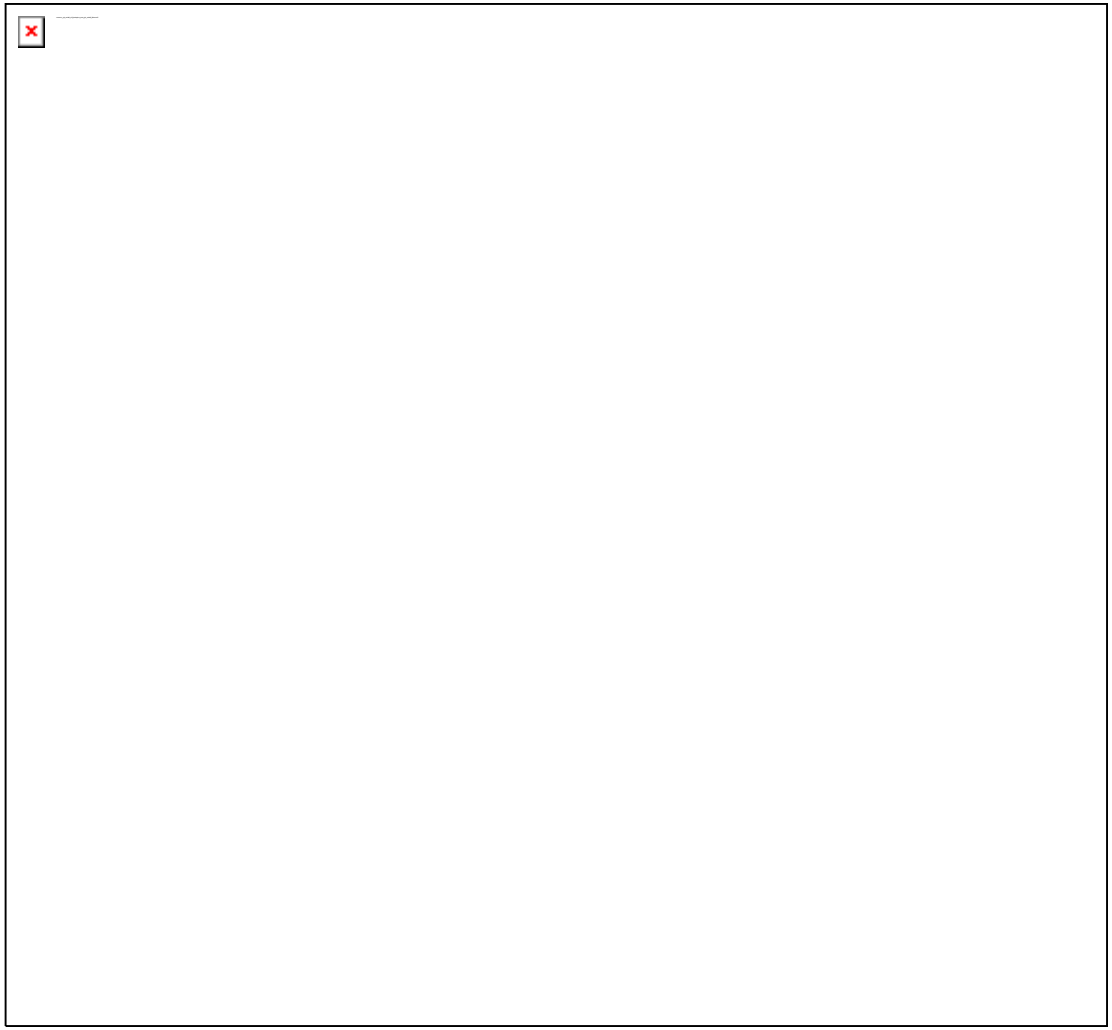
SO2 Concentration Field Analysis

Sum (Residence Time Analysis * SO2 Conc. at release site) for all time steps,
Divided bv Sum (Residence Time Analvsis)



B. de Foy et al., Modelling constraints on the emission inventory and on vertical dispersion for CO and SO2 in the Mexico City Metropolitan Area using Solar FTIR and zenith sky UV spectroscopy, *Atmospheric Chemistry & Physics*

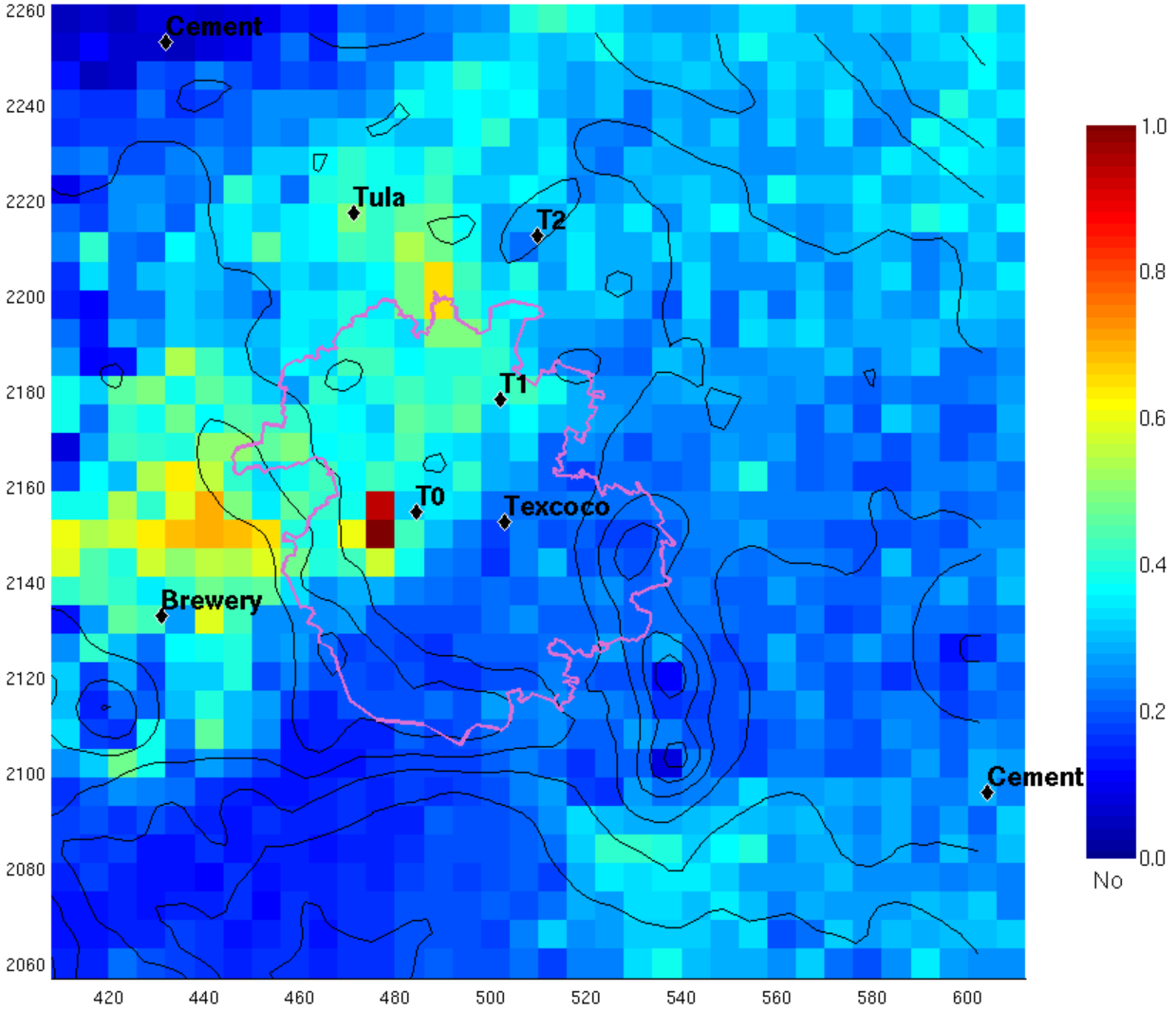
Pb Concentration Field Analysis – MILAGRO Aerosol Mass Spectrometer, Colorado University



Dara Salcedo et al., Determination of particulate lead during MILAGRO/MCMA-2006 using Aerosol Mass Spectrometry, ACP 2010.

Hg Concentration Field Analysis – MILAGRO
Schauer Group, UW-M, measurements at T0

Reactive Mercury



A. Rutter et al., In situ measurements of speciated atmospheric mercury and the identification of source regions in the Mexico City Metropolitan Area, ACP 2009

Additional Information

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