RESEARCH FLIGHTS of the DOE RAF DURING MILAGRO 2006

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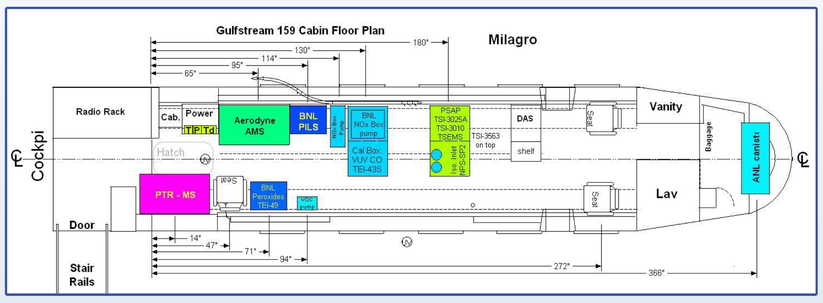
MAX-Mex and the DOE/ASP Research Aircraft Facility

MAX-Mex (Megacity Aerosol Experiment, Mexico City) was the DOE component of MILAGRO 2006. The program focused on chemical, physical, and optical characterization of aerosols, and aerosol transformations including aging of the black carbon during outflow into the region, and on the effects of the megacity aerosol plume on the regional radiative balance in and near this megacity. Multiple investigators aboard the DOE Gulfstream aircraft (G-1), measured aerosol properties and precursor gas contributions.



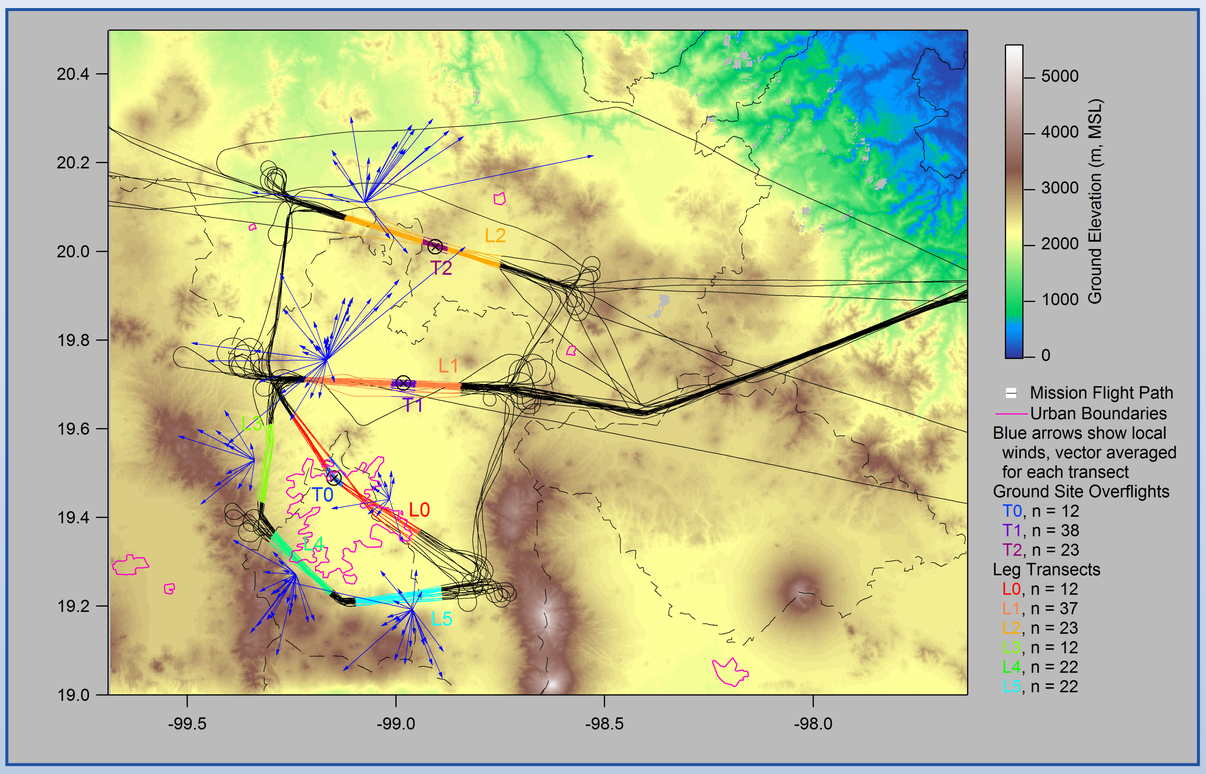
List of Organizations and Investigators:
PCASP, CAPS – PNNL, BNL: Senum, Hubbe
State – PNNL: Hubbe
PTRMS - EMSL: Alexander, Ortega
AMS - Aerodyne, EMSL: Alexander, Jayne
Peroxides - SUNY, BNL: Lloyd, Bowerman
VOCs – York: Hubbe, Rudolf
PILS – BNL: Lee
CO, NO, NO2, NOy O3, SO2 – BNL: Springston, Senum
PSAP, Neph, CNCs – PNNL: Group
TSEMs – BNL: Wang
MFRs – PNNL: Barnard
SPSP – DMT, CIRPAS: Kok, Jonsson, Senum
Balloons – PNNL: Zaveri, Hubbe
Data – PNNL, BNL: Hubbe, Springston, Senum

See:
http://www.pnl.gov/atmospheric/programs/raf.stm

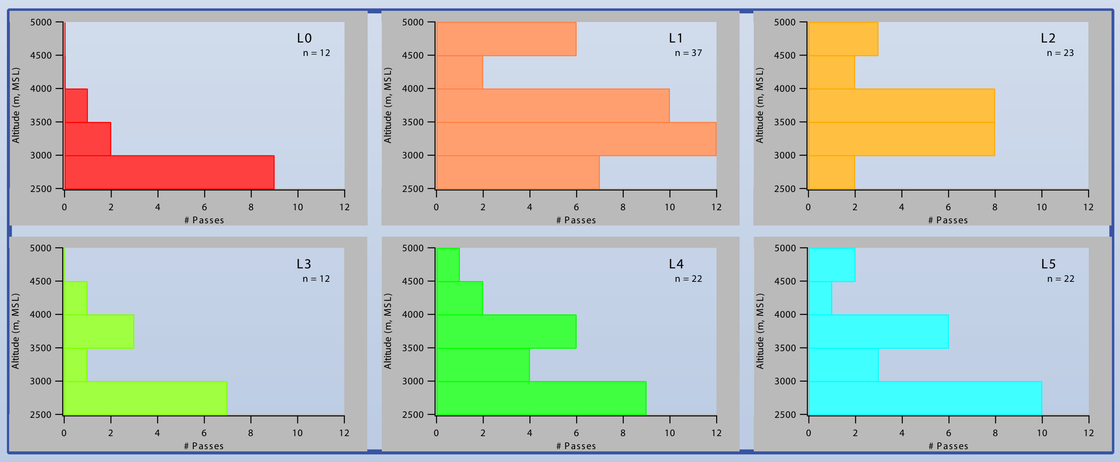
Summary of All Research Flights

15 Research Flights
Total Flight Time: 48:05
Distance: ~19,000 km

Flight plans varied to meet program objectives, accomodate air traffic control and avoid strong convective activity. In general flights sampled to the southeast of the city and at successive downwind transects corresponding to the three ground sites (T0, T1 and T2). The cumulative flight path is shown below with color coding for the five legs and overflight sections of the three ground sites.

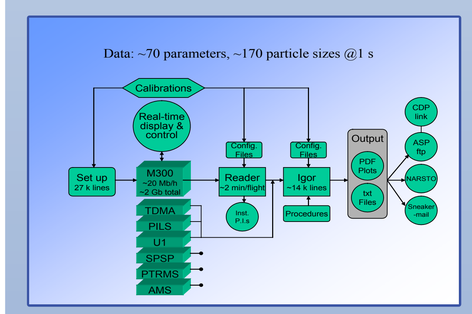


Sampling Altitude by Transect



Data Stream

Flow Diagram



Data Set Availability (3 Locations)

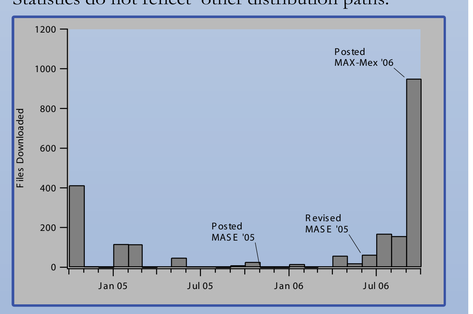
1. ASP anonymous ftp site: ftp://ftp.asd.bnl.gov/pub/ASP%20Field%20Programs/2006MAXMex All processed data are freely available. Data in varied formats from multiple instruments, investigators and data systems are merged into a common data set. Each flight is presented in tab-delimited, flat ASCII files with associated meta data. Size-resolved aerosol and spectrally resolved irradiance data are stored in subfolders. Data are available in 1- and 10-s resolutions on a common data base. PDF files of each flight provide graphical representations of the data sets. Consult the Read Me.txt file for revision history, citation procedures and other information. The ASP site should be considered the primary source of MAX-Mex data from the Research Aircraft Facility.

2. NCAR Community Data Portal: http://cdp.ucar.edu/home/home.htm This site requires login and password. G-1 data is accessed through a link to the ASP anonymous ftp site described above.

3. NARSTO Permanent Data Archive: http://eosweb.larc.nasa.gov/PRODOCS/narsto/table_narsto.html This site requires login and password. G-1 data is provided in the NARSTO Data Exchange Standard format.

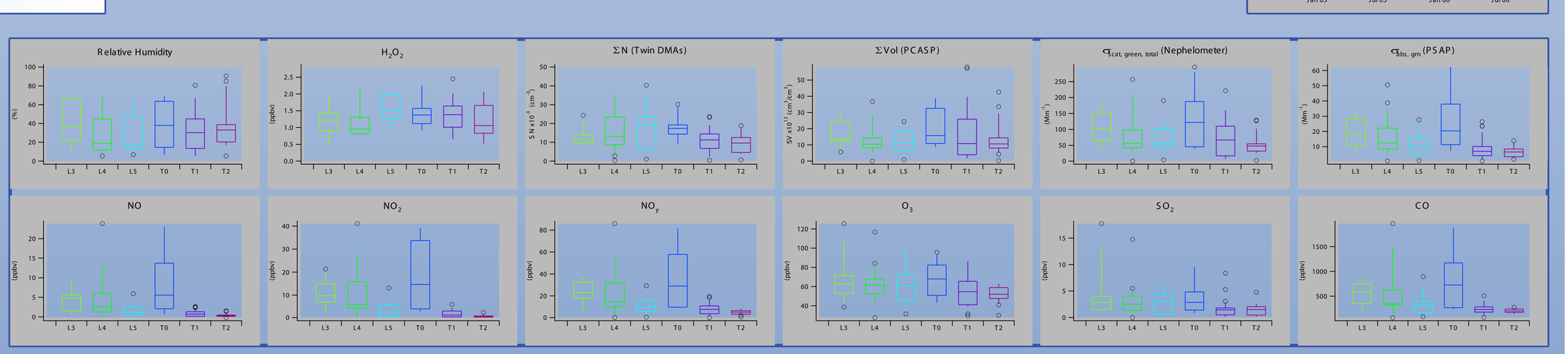
Download Statistics from ASP Site

Statistics do not reflect other distribution paths.

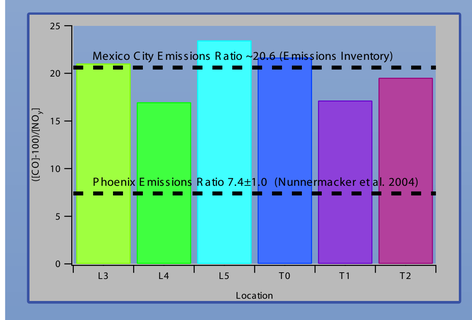


Species Distributions by Transect

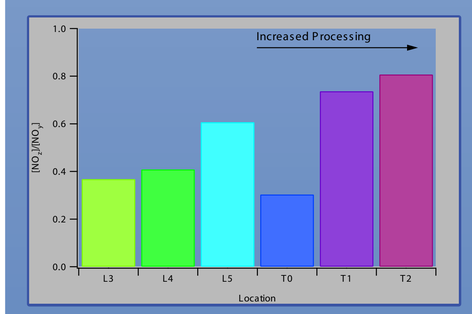
Whisker plots for various species plotted by geographical location. L3, L4 and L5 are between the city and the mountains. Airflow here is variable. T0, T1 and T2 are ±~3 km along the flight path above the ground sites. In general these segments represent successively more processing (and dilution). Graphs denotes the statistics for the means of all transects. (Median: horizontal line, 25th and 75th percentiles: box, 10th and 90th percentiles: whiskers, circles: outliers) Note! Transects were not sampled at the same altitudes.

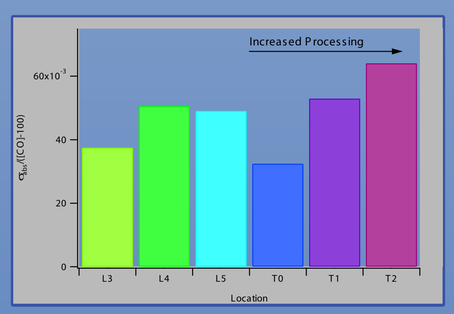


Observations

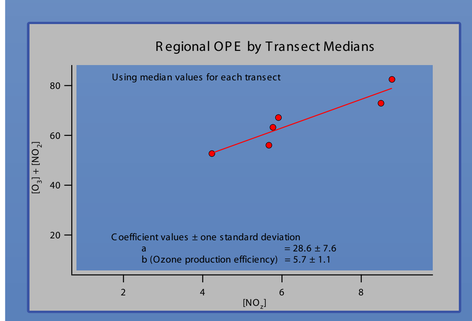


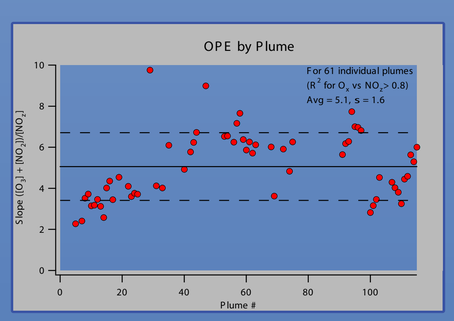
Both CO and NO_y are primary pollutants. The makeup of NO_y changes as NO and NO_2 are photochemically processed but loss of total NO_y is minimal over these processing times. The observed ratio agrees well with emissions inventories and is relatively constant over a broad range of photochemical ages, dilutions and locations. Note the ~3X difference in CO/NO_y ratio from Phoenix reflecting differing combustion patterns.





Combined statistics from T0, T1 and T2 show these locations represent succesive processing of gases and aerosols. The average NO_z fraction of total NO_y increases from 0.3 to 0.8 with increasing distance along the prevailing wind path. Similarly, aerosol absorbance increases by ~2X relative to a conservative tracer. Transport to the southwest legs (L3, L4 and L5) is less well-defined and regular trends are unapparent from the combined statistics.

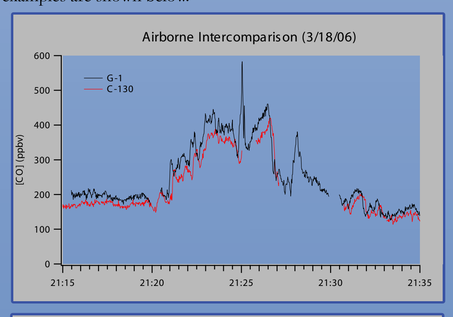


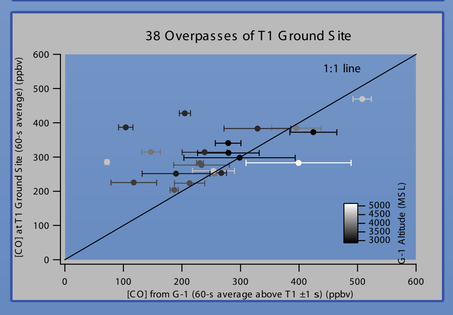


The Ozone Production Efficiency (OPE) was calculated in two ways. The ratio of the statistical medians (of [O_3], [NO_2] and [NO_z]) for all flights through each transect are plotted to the far left. This yielded the same OPE as the same ratio calculated for 61 individual plumes crossed during the program.

Intercomparisons

In addition to the normal QA/QC program for all instrumentation, MAX-Mex provided the opportunity to conduct intercomparisons between techniques, instruments and platforms. These intercomparisons are described in more detail elsewhere, but two examples are shown below.





Acknowledgements

We are indebted to the pilots and flight crew of the DOE G-1 for safe operations. Special acknowledgment is due to our Mexican colleagues for their many contributions at all levels. The Atmospheric Sciences Program supported this research as performed under the auspices of the U.S. Department of Energy under contract DE-AC02-98CH10886.