Evolution of Particulates and Direct Radiative Forcing Downwind of Mexico City during the 2006 MILAGRO Field Campaign

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MILAGRO

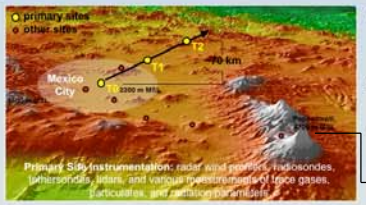
Several collaborative field campaigns were conducted in Mexico during March 2006 as part of the Megacity Initiative: Local and Global Research Observations (MILAGRO).

- MCMA (NSF, DOE, Mexican)
- MIRAGE-Mex (NSF)
- MAX-Mex (DOE)
- INTEX-B (NASA)

Some of the scientific questions of MAX-Mex include:

- How do anthropogenic particulates evolve downwind?
- What are the uncertainties of aerosol radiative forcing in the vicinity of megacities, such as Mexico City?
- What is the impact of Mexico City pollutants on local and regional climate?

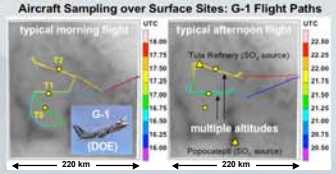
Instrumentation



T0, T1, T2 sites designed to sample aerosol and trace gas properties of the Mexico City pollutant plume during SW ambient flow conditions

Aircraft Operations Over Multiple Spatial Scales

Aircraft Sampling over Surface Sites: G-1 Flight Paths

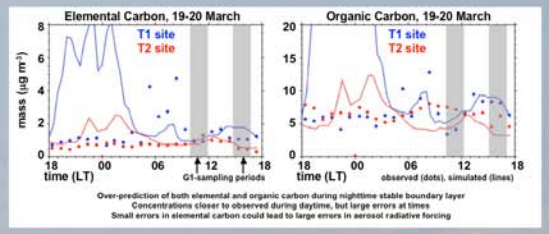


WRF-chem

- simulations use PNNL modules: CBM-Z trace gas chemical mechanism, FAST-J photolysis scheme, MOSAIC sectional aerosol model, and aerosol-radiation feedback

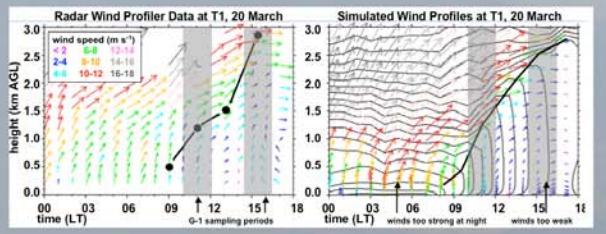
- 3 domains: Δx = 22.5, 7.5, 2.5 km
- 48-h simulations starting at 00 UTC (24 h spin-up period)
- anthropogenic emissions from 2000 inventory and SO_2 emissions for Tula Refinery and Popocatepetl volcano

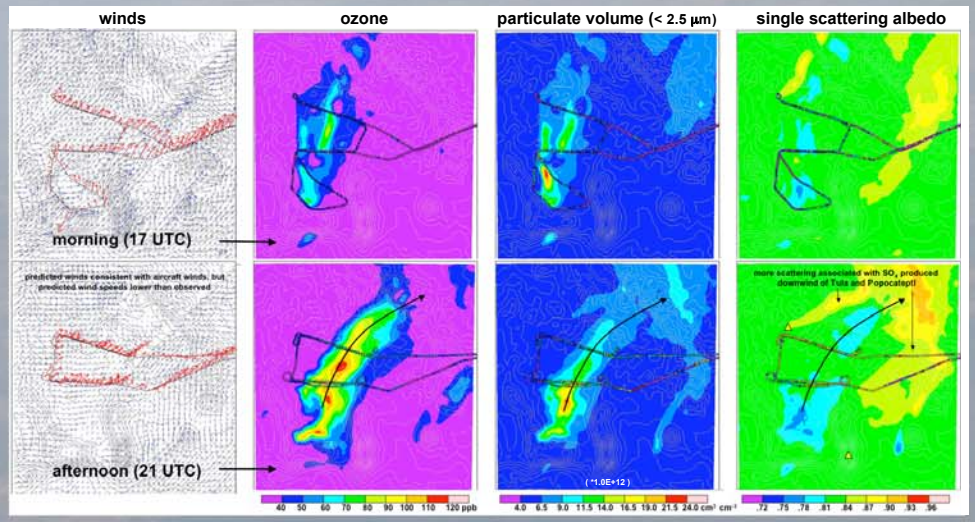
Future simulations will include data assimilation, chemistry boundary conditions from global model (MOZART), emissions from biomass burning source (*based on satellite fire counts*) and dust sources (*based on soil properties and predicted meteorology*), and more detailed evaluations when additional data becomes available.



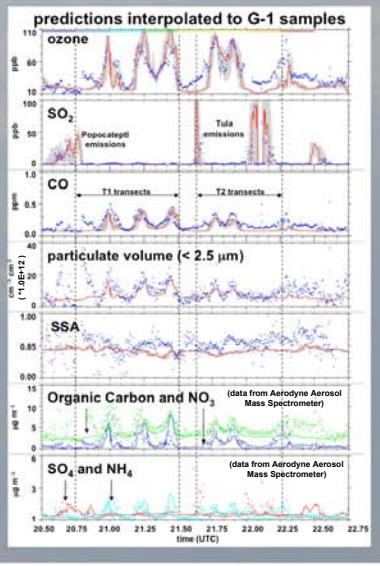
Preliminary Results

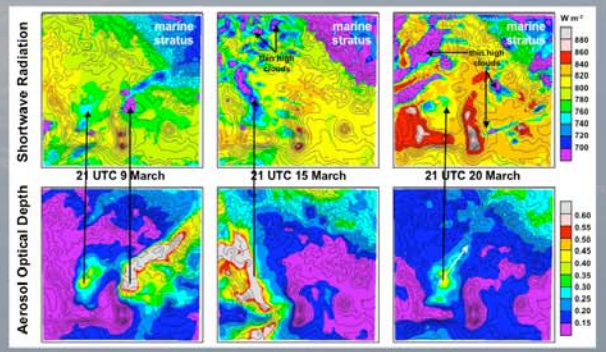
Preliminary simulations completed to evaluate performance of WRF-chem and examine model assumptions before running more comprehensive simulations. Results are shown primarily from 19-20 March that had meteorological conditions favorable for pollutant transport over T1 and T2.





model results at ~900 m AGL and at one time, but G-1 aircraft data at multiple altitudes and 2-3 h period





Summary:

- predicted mean meteorology and trace gases in qualitative agreement with observations; however,
- predicted particulate volume generally too low with largest uncertainties in aerosol optical properties
- refinements to model simulations needed before drawing conclusions about magnitude of direct radiative forcing