Overview of the NASA Langley Chemistry and Physics of the Atmospheric Boundary Layer Experiment (CAPABLE)

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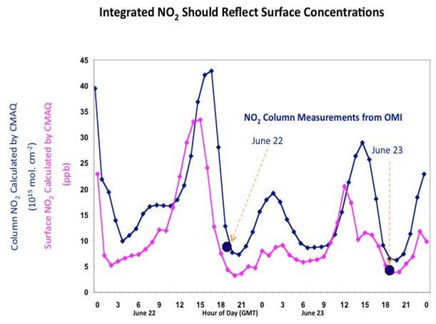
Background

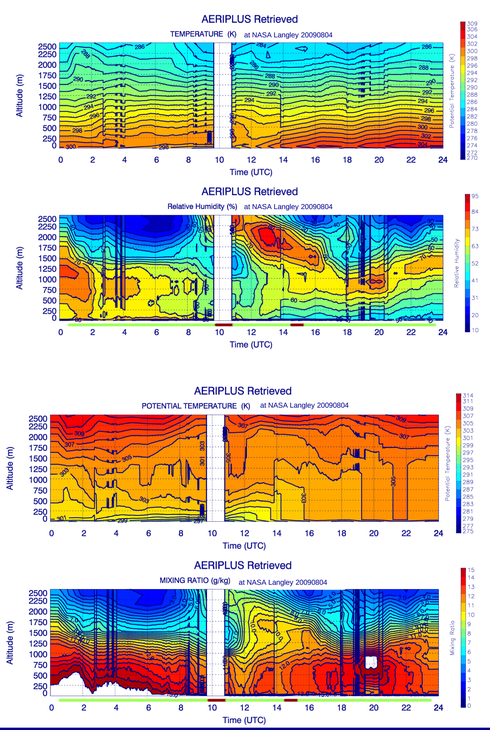
In support of NASA's GEO-CAPE mission, the CAPABLE site at NASA Langley Research Center has been established to assess the relationship between high temporal resolution measurements from space and continuous *in situ* surface observations. During Aug 2009, NO_2 column density measurements of high temporal and high spectral resolution were made using a ground-based Pandora spectrometer concurrently with a suite of *in situ* trace gas measurements provided by Penn State's NATIVE (Nittany Atmospheric Trailer and Integrated Validation Experiment) mobile research laboratory. Continuous boundary layer measurements of temperature, humidity and winds were provided using the University of Wisconsin Atmospheric Emitted Radiance Interferometer (AERI) and a wind lidar system. The use of this boundary layer information will provide valuable information relating spectrally derived NO_2 column measurements to what is observed at the surface by the *in situ* instruments. We present preliminary results of the correlation of co-located NO_2 column density with *in situ* NO_2 throughout the diurnal evolution of the boundary layer. We will also compare with daily satellite NO_2 column density from OMI and GOME-2.



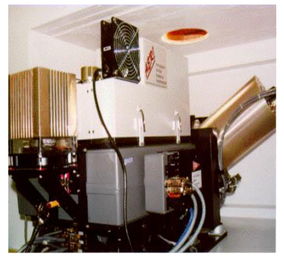
From theoretical calculations, there should be a relationship between surface concentrations and the integrated column of NO_2 as illustrated in the above figure. The values shown are from CMAQ runs for June 22-23, 2005 using a model with 12-km horizontal resolution. The magenta curve represents the surface concentration; the blue curve depicts the model-derived NO_2 column amount. The large circles represent column amounts derived from OMI overpasses on the two days.

One of the goals of the CAPABLE experiment is to derive a dataset to determine the diurnal behavior of surface and integrated column amounts. In conjunction with these two measurements, the CAPABLE site also measured the boundary layer behavior of temperature, humidity and wind so that the dilution and transport due to meteorological affects could be determined and also compared with models that calculated such quantities.

Boundary Layer Characterization

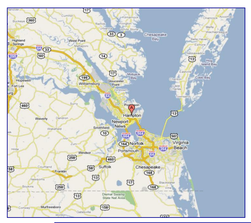


Instruments



Penn State NATIVE Facility: Provided *in situ* measurements of O_3, NO_2, CO, SO_2, and other measurements as well as several O_3 profiles from ozonesondes

GEO-CAPE Validation Site (2010 and beyond): Co-located with Permanent Virginia DEQ Site



Permanent DEQ Site will be built using existing site near Richmond as a prototype. NASA Langley site will house the PANDORA as well as other *in situ* instruments that may be tested by EPA for future monitoring activity

Participants

In July and August 2009, an *ad hoc* group assembled at NASA Langley to provide a set of measurements that eventually became know as CAPABLE. The participating groups were:

NASA Langley Research Center: M. Pippin, J. Fishman, D. Neil, L. Cowen, J. Geiger, J. Murray, P. Lucker, S. Bedka, J. Szykman

NASA Goddard Space Flight Center: J. Herman, A. Cede, N. Abuhassan

Pennsylvania State University: D. Martins, A. Jensen, D. Doughty, A. Thompson

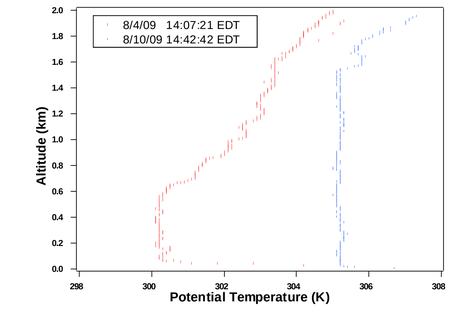
University of Wisconsin: D. Desolver, W. Feltz, E. Olson, R. Knuteson

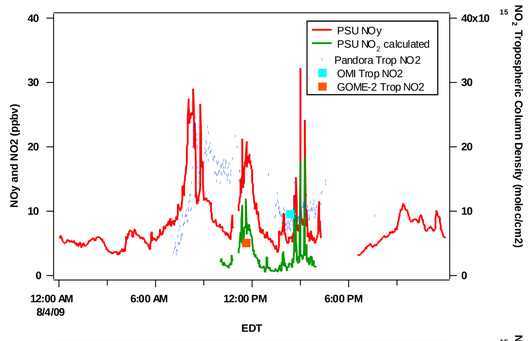
LEOSPHERE: W. Vogel, F. Pin, M. Boquet

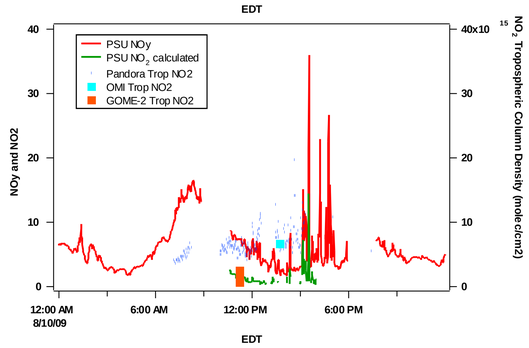
Hampton University: M. Yesalusky, W. Smith

Discussion of Initial Measurements

The plots below show tropospheric NO_2 measurements from PANDORA, NATIVE and OMI on two different days (August 4 and August 10) where the structure of the boundary layer was considerably different (as shown in the first plot below).







Preliminary Trace Gas Measurements