Airborne High Spectral Resolution Lidar Observations of Aerosol Spatial Distribution and Optical Properties from MILAGRO

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NASA Langley Research Center (LaRC) deployed an airborne High Spectral Resolution Lidar (HSRL) during the Megacity Aerosol Experiment in Mexico City (MAX-MEX) Intercontinental Chemical Transport Experiment-B (INTEX B) joint experiment in March 2006. The HSRL technique takes advantage of the spectral distribution of the lidar return signal to discriminate aerosol and molecular signals and thereby measure aerosol extinction and backscatter independently. The LaRC airborne HSRL measures aerosol backscatter and depolarization at 532 and 1064 nm and aerosol extinction at 532 nm. During this mission, the HSRL collected approximately 50 hours of data during 14 science flights on the NASA King Air B-200.

This experiment presented the first opportunity to deploy this recently developed lidar system on a major field campaign and enabled extensive opportunities for comparisons between the lidar-derived aerosol distribution and optical properties with in situ and remote measurements made on other platforms. Initial comparisons showed excellent agreement between the HSRL aerosol extinction profiles and the corresponding profiles derived from coincident airborne Sun photometer measurements and in situ measurements of aerosol scattering and absorption. The HSRL aerosol measurements are also used to evaluate coincident aerosol measurements from both MODIS and MISR.

During flights over Mexico City, HSRL measurements reveal significant variations in aerosol loading and optical properties. The HSRL measurements of aerosol "color" ratio, extinction/backscatter ratio ("lidar ratio"), and depolarization are used to infer variations in aerosol type over Mexico City. On one flight, aerosol optical thickness that was derived from the HSRL aerosol extinction profile, increased by nearly an order of magnitude over a distance of about 10 km. This increase was also well correlated with corresponding changes in aerosol properties and trace gas amounts measured simultaneously by in situ instruments flying on another aircraft. HSRL measurements of aerosol backscatter color ratio, lidar ratio, and depolarization indicate that dust and pollution were dominant aerosol types over the city.

The use of the HSRL measurements, along with other airborne, surface, and space-based measurements to investigate aerosol variability in the Mexico City region are discussed in this presentation.