Texas A&M University

Sources and Properties of Atmospheric Aerosol in Texas: DISCOVER-AQ Measurements and Validation

Drs. Sarah D. Brooks and Ping Yang

Department of Atmospheric Sciences

Texas A&M University

1. Executive Summary

During this project (January-September, 2015) we have been working on the data collected by the Cloud and Aerosol Spectrometer with Polarization (CASPOL) during its first deployment in the field campaign— the National Aeronautics and Space Administration (NASA) Deriving Information on Surface conditions from Column and Vertically Resolved Observations Relevant to Air Quality (DISCOVER-AQ) campaign. As an instrument that measures the particle scattering properties, CASPOL shows the potential to assess the quality of satellite retrievals of aerosol features, which have been widely used to study the sources and properties of atmospheric aerosols.

During the fall of 2013, the Houston area was the site of the 2nd field intensive DISCOVER-AQ campaign. During the field campaign, we operated CASPOL on top of the 70 m tall Moody Tower (MT) on the University of Houston campus, a central urban location and site of many complementary measurements of air pollutants and meteorological parameters. After a theoretical analysis, we found that the statistics of CASPOL backward polarized scattering measurements of individual particles can be made to assess the aerosol typing criteria of the Cloud-Aerosol Lidar with Orthogonal Polarization (CALIOP), though the wavelengths of two instruments are not the same. In addition, the aerosol type assumption in the Moderate-resolution Imaging Spectroradiometer (MODIS) aerosol optical depth (AOD) retrievals can be assessed using CASPOL in combination with in situ sun photometer measurements in the same location. However, after checking the available CALIOP depolarization ratio profiles and MODIS AOD retrievals during the period when CASPOL data were of high quality, too few comparison cases could be found to make such an assessment of any significance. Thus, we focused our comparisons on the MODIS fine mode fraction (FMF) retrievals for which more comparison cases were found.

The high quality CASPOL measurements coincided with MODIS overpasses under cloud free conditions on 13 days. The forward scattering measurements from CASPOL were used to derive aerosol size distributions, which were then compared with the MODIS 3 km FMF retrievals. The sub-micrometer fraction (SMF) of aerosol particles sampled by CASPOL and Aqua MODIS FMF retrieval show close variations. However, the monthly mean MODIS FMF data from Terra differs from the MODIS on Aqua by a factor of ~3. Both MODIS FMF retrievals and CASPOL measurements show a significant

decrease of the proportion of coarse particles from noon to the early afternoon during the campaign. The decreased amount is dependent upon the particle size cutoff that discriminates fine and coarse particles. The comparison cases are not enough to make the results statistically significant, and hence long-termer CASPOL field measurements are needed to assess the satellite aerosol-property retrievals in the future.