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# Comparison of Airborne Sunphotometer and Satellite Sensor Retrievals of Aerosol Optical Depth during MILAGRO/INTEX-B

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The 14-channel Ames Airborne Tracking Sunphotometer (AATS-14) was operated on a Jetstream 31 (J31) aircraft based in Veracruz, Mexico in March 2006 during MILAGRO/INTEX-B (Megacity Initiative-Local And Global Research Observations /Phase B of the Intercontinental Chemical Transport Experiment). AATS measured aerosol optical depth (AOD) at 13 wavelengths (354-2139 nm) and water vapor column content in 13 flights that sampled clean and polluted airmasses over the Gulf of Mexico and Mexico City. Vertical differentiation of AOD and columnar water vapor data obtained during J31 vertical profiles yields vertical profiles of multiwavelength aerosol extinction and water vapor density, respectively. J31 flights were coordinated with overflights of several satellites, including Aqua, Aura, Terra, and Parasol, plus other aircraft, including the NASA DC-8 and King Air and the NCAR C-130. In this paper we will focus on comparing AATS retrievals of AOD with corresponding AOD values retrieved from spatially and temporally coincident or near-coincident measurements acquired by the satellite sensors MODIS (Aqua and Terra), MISR (Terra), and OMI (Aura).

Our preliminary analyses of 37 coincident observations by AATS and MODIS-Terra and 18 coincident observations between AATS and MODIS-Aqua indicate excel-

lent agreement between the aircraft and satellite retrievals of AOD. We find sufficient AOD at near-IR wavelengths to permit meaningful validation of the MODIS retrievals at those wavelengths. In the case of MODIS-Terra, 98% of near-IR AOD retrievals fall within the estimated uncertainty range of $\pm$ 0.03$\pm$0.05AOD, while 100% of MODIS-Aqua near-IR AOD retrievals fall within this uncertainty range. We note that in the small number of cases studied here, MODIS-Aqua has a tendency to overestimate the AATS-derived Angstrom exponents, while Angstrom exponents derived from MODIS-Terra agree well with the suborbital observations. Collocated measurements by AATS, MODIS-Terra and MISR within three MISR retrieval grid cells over the Gulf of Mexico on March 10 have been analyzed. Mid-visible (at 446 and 558 nm) AOD retrievals produced by the MISR standard operational algorithm Version 19 compare well both with AATS and with MODIS-Terra observations in two of the three MISR grid cells, while the MISR AOD retrievals in the third cell exceed those obtained from AATS or MODIS. MISR near-IR AOD retrievals agree with corresponding AATS and MODIS-Terra retrievals within measurement uncertainty. In two of the three MISR grid cells, the Angstrom exponents derived from MISR AOD retrievals are smaller than those measured by AATS, while the MISR Angstrom exponent in the third cell is similar to the AATS value.

Aerosol data products produced by OMI include AOD, single scattering albedo (SSA), and aerosol indices. These OMI aerosol products are derived using wavelengths and algorithms that differ significantly from those of MODIS and MISR. These differences produce some advantages (such as high sensitivity of the OMI UV retrieval algorithm to aerosol absorption, and the ability of OMI to retrieve aerosol information over bright surfaces and clouds) and some disadvantages (such as dependence on aerosol layer height) that lead to unique needs when validating and improving OMI aerosol retrievals.

We have identified four Aura overpasses during MILAGRO/INTEX-B for which OMI AOD spectra have been retrieved using the UV retrieval algorithm and AATS AOD spectra have been calculated at coincident or near-coincident times and locations. Three of these (March 3, 10 and 17) were over the Gulf of Mexico, and one (March 19) was over Mexico City. In general, OMI AOD retrievals exceed corresponding AATS AOD values. During the March 19 flight, AATS measured vertical profiles and horizontal transects of AOD at the T2 site NNE of Mexico City and at the T0 site in the heart of the City, both of which were in OMI grid cells where aerosol retrievals were performed. The suborbital data set is particularly rich, including AERONET retrievals of aerosol properties from T2 and T0, additional aerosol retrievals from radiometers on the J31, and lidar and in situ measurements from the DC-8. This data set provides not only AOD values for comparison to OMI results, but information on aerosol height, size, and composition for constraining the OMI aerosol retrieval model.