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Comparison of aerosol optical depths from the Ozone Monitoring Instrument (OMI) on Aura with results from airborne sunphotometry, other space and ground measurements during MILAGRO/INTEX-B

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Abstract. Airborne sunphotometer measurements are used to evaluate retrievals of extinction aerosol optical depth (AOD) from spatially coincident and temporally near-coincident measurements by the Ozone Monitoring Instrument (OMI) aboard the Aura satellite during the March 2006 Megacity Initiative-Local And Global Research Observations/Phase B of the Intercontinental Chemical Transport Experiment (MILAGRO/INTEX-B). The 14-channel NASA Ames Airborne Tracking Sunphotometer (AATS) flew on nine missions over the Gulf of Mexico and four in or near the Mexico City area. Retrievals of AOD from near-coincident AATS and OMI measurements are compared for three flights over the Gulf of Mexico for flight segments when the aircraft flew at altitudes 60–70 m above sea level, and for one flight over the Mexico City area where the aircraft was restricted to altitudes ~320–800 m above ground level over the rural area and ~550–750 m over the city. OMI-measured top of atmosphere (TOA) reflectances are routinely inverted to yield aerosol products such as AOD and aerosol absorption optical depth (AAOD) using two different retrieval algorithms: a near-UV (OMAERUV) and a multiwavelength (OMAERO) technique. This study uses the archived Collection 3 data products from both algorithms. In particular, AATS and OMI AOD comparisons are presented for AATS data acquired in 20 OMAERUV retrieval pixels (15 over water) and 19 OMAERO pixels (also 15 over water). At least four pixels for one of the over-water coincidences and all pixels for the over-land case were cloud-free. Coincident AOD retrievals from 17 pixels of the Moderate Resolution Imaging Spectroradiometer (MODIS) aboard Aqua are available for two of the over-water flights and are shown to agree with AATS AODs to within root mean square (RMS) differences of 0.00–0.06, depending on wavelength. Near-coincident ground-based AOD measurements from ground-based sun/sky radiometers operated as part of the Aerosol Robotic

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Network (AERONET) at three sites in and near Mexico City are also shown and are generally consistent with the AATS AODs (which exclude any AOD below the aircraft) both in magnitude and spectral dependence. The OMAERUV algorithm retrieves AODs corresponding to a non-absorbing aerosol model for all three over-water comparisons whereas the OMAERO algorithm retrieves best-fit AODs corresponding to an absorbing biomass-burning aerosol model for two of the three over-water cases. For the four cloud-free pixels in one over-water coincidence (10 March), the OMAERUV retrievals underestimate the AATS AODs by ~ 0.20 , which exceeds the expected retrieval uncertainty, but retrieved AODs agree with AATS values within uncertainties for the other two over-water events. When OMAERO retrieves AODs corresponding to a biomass-burning aerosol over water, the values significantly overestimate the AATS AODs (by up to 0.55). For the Mexico City coincidence, comparisons are presented for a non-urban region $\sim 50\text{--}70$ km northeast of the city and for a site near the center of the city. OMAERUV retrievals are consistent with AERONET AOD magnitudes for the non-urban site, but are nearly double the AATS and AERONET AODs (with differences of up to 0.29) in the center of the city. Corresponding OMAERO retrievals exceed the AATS and/or AERONET AODs by factors of 3 to 10.

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