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Testing aerosol properties in MODIS Collection 4 and 5 using airborne sunphotometer observations in INTEX-B / MILAGRO

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Abstract. The 14-channel Ames Airborne Tracking Sunphotometer (AATS) was operated on a Jetstream 31 (J31) aircraft in March 2006 during MILAGRO/INTEX-B (Megacity Initiative-Local And Global Research Observations/Phase B of the Intercontinental Chemical Transport Experiment). We compare AATS retrievals of spectral aerosol optical depth (AOD) and related aerosol properties with corresponding spatially coincident and temporally near-coincident measurements acquired by the MODIS-Aqua and MODIS-Terra satellite sensors. These comparisons are carried out for the older MODIS Collection 4 (C4) and the new Collection 5 (C5) data set, the latter representing a reprocessing of the entire MODIS data set completed during 2006 with updated calibration and aerosol retrieval algorithm. Our analysis yields a direct, validated assessment of the differences between select MODIS C4 and C5 aerosol retrievals. Our analyses of 37 coincident observations by AATS and MODIS-Terra and 18 coincident observations between AATS and MODIS-Aqua indicate notable differences between MODIS C4 and C5 and between the two sensors. For MODIS-Terra, we find an average increase in AOD of 0.02 at 553 nm and 0.01 or less at the shortwave infrared (SWIR) wavelengths. The change from C4 to C5 results in less good agreement with the AATS derived spectral AOD, with average differences at 553 nm increasing from 0.03 to 0.05. For MODIS-Aqua, we find an average increase in AOD of 0.008 at 553 nm, but an increase of nearly 0.02 at the SWIR wavelengths. The change from C4 to C5 results in slightly less good agreement to the AATS derived visible AOD, with average differences at 553 nm increasing from 0.03 to 0.04. However, at SWIR wavelengths, the changes from C4 to C5 result in improved agreement between MODIS-Aqua and AATS, with the average differences at 2119 nm decreasing from −0.02 to −0.003. Comparing the Angstrom exponents calculated from AOD at 553nm and 855nm, we find an increased rms difference from AATS derived Angstrom exponents in going from C4 to C5 for MODIS-Terra, and a decrease in rms difference, hence an improvement, for the transition from C4 to C5 in MODIS-Aqua. Combining the AATS retrievals with in situ measurements of size-dependent aerosol extinction, we derive a suborbital measure of the aerosol submicron fraction (SMF) of AOD and compare it to MODIS retrievals of aerosol fine

mode fraction (FMF). Our analysis shows a significant rms-difference between the MODIS-Terra FMF and suborbitally-derived SMF of 0.17 for both C4 and C5. For MODIS-Aqua, there is a slight improvement in the transition from C4 to C5, with the rms-difference from AATS dropping from 0.23 to 0.16. The differences in MODIS C4 and C5 AOD in this limited data set can be traced to changes in the reflectances input to the aerosol retrievals. An extension of the C4-C5 comparisons from the area along the J31 flight track to a larger study region between 18–23° N and 93–100° W on each of the J31 flight days supports the finding of significant differences between MODIS C4 and C5.

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