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Direct aerosol radiative forcing based on combined A-Train observations – towards all-sky estimates and attribution to aerosol type

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We describe a technique for combining CALIOP aerosol backscatter, MODIS spectral AOD (aerosol optical depth), and OMI AAOD (absorption aerosol optical depth) measurements for the purpose of estimating full spectral sets of aerosol radiative properties, and ultimately for calculating the 3-D distribution of direct aerosol radiative forcing. We present results using one year of data collected in 2007 and show comparisons of the aerosol radiative property estimates to collocated AERONET retrievals.

Initial calculations of seasonal clear-sky aerosol radiative forcing based on our multi-sensor aerosol retrievals compare well with over-ocean and top of the atmosphere IPCC-2007 model-based results, and with more recent assessments in the "Climate Change Science Program Report: Atmospheric Aerosol Properties and Climate Impacts" (2009).

We discuss some of the challenges that exist in extending our clear-sky results to all-sky conditions. On the basis of comparisons to suborbital measurements, we present some of the limitations of the MODIS and CALIOP retrievals in the presence of adjacent or underlying clouds. Strategies for meeting these challenges are discussed.

We also discuss a methodology for using the multi-sensor aerosol retrievals for aerosol type classification based on advanced clustering techniques. The combination of research results permits conclusions regarding the attribution of aerosol radiative forcing to aerosol type.