The Role of Ground-based Aerosol Networks in Evaluating Satellite-retrieved Aerosol Radiative Properties over Mountainous Regions

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Satellite-based retrievals of aerosol radiative properties are being used increasingly for climate and air quality studies, due to their near-global spatial coverage and recent improvements in the aerosol retrieval algorithms. However, these retrievals often suffer (or are not even attempted) over complex mountainous terrain. Satellite validation studies match 'ground-truth' AOD measured by sunphotometers within a time window centered at the satellite overpass with satellite-measured AOD within a fixed radius of the sunphotometer site. However, the agreement between the satellite and ground-truth AOD is affected by the choice of this spatio-temporal window, which becomes even more critical over mountainous terrain. Even when the spatio-temporal collocation window is optimized for a given ground site, agreement between satellite and ground-truth AOD is affected by the assumed surface reflectance and aerosol intensive radiative properties (single-scattering albedo, size distribution) used by the satellite AOD retrieval algorithm. Ground sites with co-located sunphotometers (as part of NASA AERONET or NOAA SURFRAD) and NOAA ESRL aerosol measurements are uniquely positioned to evaluate satellite-retrieved AOD accuracy and the influence of aerosol intensive property assumptions on the AOD accuracy. The current study evaluates AOD retrieved by MODIS and Multi-angle Imageing SpectroRadiometer (MISR) over four mountainous U.S. sites: (1) Appalachian State University (APP; Boone, NC); (2) Walker Branch TN (WB); (3) Storm Peak Laboratory (SPL; Steamboat Springs, CO); and (4) University of Nevada-Reno (Reno). Each site is home to a NASA AERONET site and/or has a multi-filter rotating shadowband radiometer (MFRSR). In addition, the APP and SPL sites are also part of the NOAA ESRL aerosol monitoring network. The four sites collectively represent aerosol and terrain types present in mountainous U.S. regions. In this presentation, we first illustrate a simple method for optimizing the spatio-temporal collocation window over mountainous sites. The method can be easily extended to more spatially-homogeneous regions. We than evaluate the performance of AOD retrieved by MODIS dark target and deep blue algorithms and MISR over the mountainous sites, including the influence of surface reflectance and (for APP and SPL) aerosol-intensive radiative properties. Overall, the satellite-based AOD retrievals agree well with ground-truth measurements over the eastern U.S. mountain sites (APP and WB) and the choice of spatio-temporal collocation window does not strongly influence the AOD agreement. Greater sensitivity to the satellite sensor and spatio-temporal collocation window is demonstrated at the western U.S. mountain sites (SPL and Reno). Aerosol and surface properties influencing this agreement (or lack thereof) are also presented.

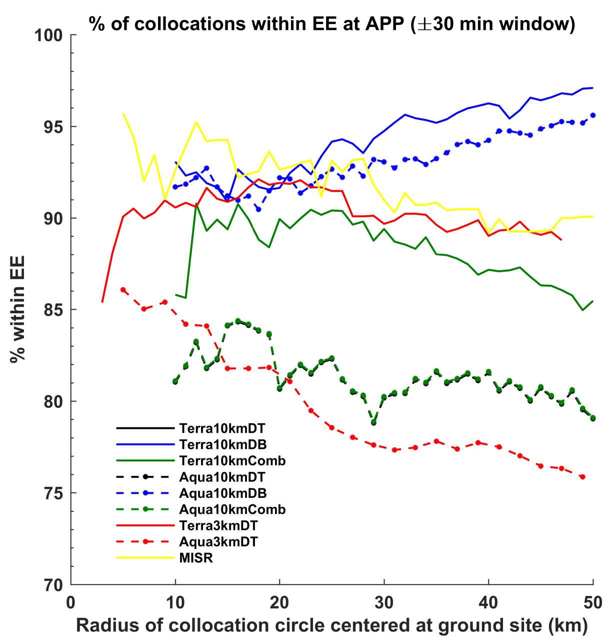

Figure 1. Percent of satellite AOD retrievals lying within the expected error envelope for that sensor, as a function of the radius of spatio-temporal collocation circle centered at the APP site. Traces are shown for MISR and for the various MODIS products onboard the Aqua and Terra satellites. MODIS products are the 10-km dark target (DT) product, the 3-km DT product, the 10-km deep blue (DB) product, and the combined product.