**Comparing remote-sensing observations of aerosols and clouds**

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The interaction of clouds and aerosols is one of the least well-understood phenomena affecting climate change, atmospheric dynamics and weather. The Dark Target (DT) satellite retrieval algorithm provides a 10 km aerosol product from the Moderate Resolution Imaging Spectroradiometer (MODIS) instrument on Terra and Aqua. This geospatial product provides daily coverage of the global distribution of aerosol optical depth (AOD). The coarse resolution leaves us with significant uncertainty in quantifying aerosol-cloud interactions, requiring us to use higher resolution data to improve our understanding. The DT algorithm was applied to high-resolution enhanced-MODIS Airborne Simulator (eMAS) data obtained during the “Studies of Emissions, Atmospheric Composition, Clouds and Climate Coupling by Regional Surveys (SEAC4RS) campaign over the U.S. in 2013. The instrument was deployed on the ER-2 high-altitude aircraft along side the Cloud Physics Lidar (CPL), which took vertical profiles along the eMAS swath centerline.

We identified 53 collocations with eMAS over ground-based AERONET sunphotometer sites, and found that eMAS AOD was biased by a factor of 2. When eMAS was far from clouds, and the AOD was low, there was little bias. However, in moderate or high aerosol regimes, eMAS retrieved rings of enhanced AOD around some of the identified clouds. Can we validate these rings of enhanced AOD? A distance-from-cloud layer was created for eMAS to study these areas and determine which cloud conditions might be correlated with them. In most cases, the AOD measurements converged to a clear sky value with increasing distance from cloud. Comparing these new values to Aeronet, the bias was reduced to a factor of 1.4. A direction-to-cloud layer was also created which revealed that within 5 km of clouds, there was generally a high bias on the sunward facing side of a cloud and low bias on the “shadow” side. Furthermore, there were many cases where the CPL indicated clouds that were not detected by the eMAS retrievals. Our study confirms that clouds are not defined by simple boundaries, but as gradients, making a universal cloud mask difficult to delineate. Continued exploratory analysis is needed to explain the remaining bias and further characterize the gradient behavior of aerosols near-cloud and the conditions under which they occur.