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Multi-Angle Aerosol Retrievals Without Lookup Tables: A Feasibility Study for MISR

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Currently, most satellite-based aerosol retrievals make use of lookup tables (LUTs) to store precomputed quantities and avoid expensive calculations. However, they inherently limit the extent and granularity of the solution space. The current retrieval algorithm for the Multi-angle Imaging SpectroRadiometer (MISR), for example, compares the observations to a discrete set of 74 aerosol mixtures, each composed of aerosol models having prescribed optical properties and size distributions. In a recent study comparing the performance of satellite retrieval algorithms against simulated data over a black surface [Kokhanovsky et al. (2010), *Atmos. Meas. Tech.* **3**, 909-932], the MISR algorithm performed reasonably well in recovering the "true" aerosol optical depths, but because the simulated aerosol model was not matched by the contents of the MISR LUT, the results were biased. This implies that some biases between instruments can be attributed to the use of different LUTs. These findings motivated an investigation of whether a retrieval approach that replaces the LUT-based aerosol models with a parametric approach, solved using least-squares optimization, could improve the results. Preliminary testing on the synthetic data demonstrates the viability of this approach. Superior results relative to the LUT-based retrievals were obtained using a successive orders of scattering (SOS) radiative transfer code and Levenberg-Marquardt optimization. These results were obtained using only intensity data. Use of polarization measurements from future missions is expected to further enhance the information content of the measurements, thereby improving the constraints on the inverse problem. Next steps include (1) further testing for sensitivity and robustness with more general aerosol models and surface reflectance, (2) improving computational efficiency to eventually satisfy the demands of a global, production-level algorithm, and (3) testing on actual MISR data. We will present the latest results of our study.