An exploration of joint LIDAR and multiangle polarimeter aerosol retrieval capabilities using the GRASP algorithm and OSSE data derived from the GEOS model

W. Reed Espinosa[a,b,*], Patricia Castellanos[a], Andrew Sayer[a,b], Peter Colarco[a], Robert Levy[a], Ed Nowottnick[a,b], Kirk Knobelspiesse[a], Sabrina Thompson[a], Arlindo da Silva[a], J. Vanderlei Martins[c], Oleg Dubovik[d], Pavel Litvinov[e], and Rob Spurr[f]

[a]*Goddard Space Flight Center, Greenbelt, MD, USA*
[b]*Universities Space Research Association (USRA), Columbia, MD, USA*
[c]*University of Maryland, Baltimore County, Baltimore, MD, USA*
[d]*Laboratoire d'Optique Atmosphérique, UMR8518, CNRS - Université de Lille 1, Villeneuve d'Ascq, France*
[e]*GRASP-SAS, Remote Sensing Developments, Université de Lille, Villeneuve d'Ascq, 59655, France*
[f]*RT Solutions, Cambridge, MA 02138, USA*

[*]*Presenting author (reed.espinosa@nasa.gov)*

Aerosol sensors composing the present generation of space-based instrumentation generally permit measurements spanning the majority of the shortwave spectrum or observations at multiple viewing angles but rarely both. Moreover, very few of these instruments possess sensitivity to polarization, and those that do lack the accuracy required to fully utilize this quantity [1]. In the next decade, a variety of platforms are expected to launch with sensors that are capable of exceeding these prior measurement limitations [2]. The increased information content in these new observations is expected to drive significant improvements in aerosol remote sensing capabilities but, if this additional information is to be fully utilized, novel retrieval approaches will have to be developed. In this work, sub-sampled surface and aerosol fields, derived from the NASA Goddard Earth Observing System Model (GEOS) Nature Run, are input into a vector radiative transfer code (VLIDORT) [3] to simulate top of atmosphere polarized radiances and LIDAR profiles. These quantities then serve as the basis for synthetic observations that are fed into the Generalized Retrieval of Aerosol and Surface Properties (GRASP) [4] and the inverted aerosol parameters are compared with modeled inputs. This type of Observation System Simulation Experiment (OSSE) can be used to explore various retrieval approaches as well as optimize future instrumentation for sensitivity to particular aerosol properties. To ensure the simulated retrieval performance is driven primarily by true physical limitations of the inversion procedure, not inconsistencies in radiative transfer calculations, initial efforts have focused primarily on reducing differences between GRASP's forward model and VLIDORT in benchmark cases to levels that are significantly less than the uncertainties of the target sensors. The primary sources of discrepancy found be between the two codes, which include both differences in calculated single scattering properties as well as energy transport, will be discussed. An analysis of the inversion capabilities of different instrument configurations under various observation scenarios will also be presented, with an emphasis on the retrieval improvements afforded by polarized measurements.

References

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