

GRASP sensitivity to polarized scattered radiances on coarse-mode aerosol properties from a synergy between photometer and lidar data

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GRASP algorithm has become a powerful tool widely used to retrieve aerosol properties by means of several remote sensing instruments, including radiometers and lidar systems. In addition, polarized data contribute to improve the retrieval of the aerosol properties [1] [2]. This study aims to investigate the GRASP sensitivity to the polarized data in the synergy between a new polarized 7-channel sun-sky-lunar photometer (380, 440, 500, 675, 870, 1020, 1640 nm) at level 1.5 and a 3-wavelength elastic lidar system in which the range-square corrected signals were taken from the ACTRIS/EARLINET Single Calculus Chain at 355, 532 and 1064 nm. This study focuses on a coarse-mode dominant aerosol with Aerosol Optical Depth (AOD) at 440 nm > 0.5 in Barcelona, Spain. The analysis was performed using combinations of synthetic simulated data from both instruments, for both noise-free and random-noise conditions added to the simulated data which were generated for the conditions typically observed in Barcelona. The noise-free retrievals show good agreement with the simulated data for all combinations. The coarse-mode retrieval from the simulated data seems to improve when the Degree of Linear Polarization (DOLP) is introduced in the inversions. Specifically, the improvements are seen for coarse-mode size distribution and real part of refraction index. They are also seen for the fine-mode real part of refraction index, while the concentration of fine mode is slightly overestimated once the DOLP is added into retrieval, though for the considered coarse-mode dominated aerosols the fine mode is minor. The imaginary part retrieval has a sensitivity to the use of DOLP only at short wavelengths, and single scattering albedo shows a slight increase in the uncertainties at long wavelengths when DOLP is added. The retrievals with DOLP decrease the underestimation at long wavelengths for fine mode and have a great agreement for the coarse-mode lidar ratios. The AOD and the coarse-mode of vertical volume concentration seem not to be affected by use of DOLP. Thus, the use of combined data from the polarized photometer and the lidar system showed the highest improvements in the retrieval accuracy of aerosol properties compared to the retrieval without DOLP.

Keywords: GRASP algorithm, DOLP, photometer, lidar

References

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