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Optimal Estimation of Aerosol Properties from Multi-Spectral and Multi-Angle Polarimetric Measurements of Solar Radiation

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Current ground-based, passive aerosol retrievals often have difficulties with cloudy scenes. Usually this is dealt with by overly strict cloud screening. In the investigation of aerosol cloud interactions however cloudy environments are of particular interest to further our understanding of cloud development. Optimal estimation techniques allow for an alternative approach, where cloud contaminated sky areas can be detected and replaced by a sensible prior. We implemented a retrieval initially developed by the group around Otto Hasekamp (SRON, Netherlands). It employs a lookup table for the prior and successive Phillips-Tikhonov-Regularization for the optimal estimation of aerosol properties. Furthermore, this method provides estimates of the retrieval error based on the input uncertainties, as well as their correlations.

We derive Aerosol Optical Thickness (AOT) in cloudy scenes. Additionally, the complex refractive index and effective radius for two aerosol modes (fine and coarse) are retrieved.

Measurements for case studies of the retrieval have been made as part of the A-LIFE campaign in Cyprus in April 2017. The instrument used is the multi-spectral sun/sky radiometer SSARA developed and built at LMU Munich. In addition to direct sun and sky measurements, it can simultaneously measure linear polarization. During the campaign, several different aerosol situations have been observed, including a strong Saharan dust outbreak. Collocated instruments, including in-situ aircraft measurements and several Lidar systems can be used to verify our findings.