

Optimized Retrievals of Aerosol Optical Properties from Directional Polarimetric Camera Using Optimal Linear Mixture of Basis Aerosol Models Supported by the Non-negative Matrix Factorization

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Satellite aerosol retrievals have usually relied on aerosol models derived from climatological and observational statistics (e.g., averaging or clustering), which are probably unable to adequately represent the continuity of atmospheric aerosol and meet assumption of linear mixing [1-3]. This poses a challenge to improving retrieval accuracy and expanding the range of retrievable parameters. To address this issue, this study proposes an optimal aerosol model construction method based on the non-negative matrix factorization (NMF) approach [4]. It allows reconstructing large amounts of data using a small set of basis aerosol models (BAMs) and explicitly enforces the externally linear mixing, making the resulting aerosol models directly compatible with forward radiative transfer calculations in satellite retrieval algorithm. This NMF-based BAMs are successfully applied to the Directional Polarimetric Camera (DPC) over land combined with the GRASP framework to retrieve aerosol optical and microphysical properties. Results show that the retrieved aerosol optical depth (AOD), Ångström exponent, and single scattering albedo (SSA) show good performance comparing with the AERONET data, with the correlation coefficients of 0.935, 0.71, and 0.644 and the mean biases of 0.015, -0.196, and 0.007, respectively. Error analysis further indicates that biases are most obvious in dust-dominated desert regions, and the accurate retrieval of SSA relies on the correct separation of aerosol particle size and a high AOD conditions. Additionally, tests based on different samples indicate that the BAMs derived from the NMF exhibit good stability and representativeness, but their performance shows slight degradation under both very low and high AOD conditions. This is mainly due to the limited ability of a few aerosol models in linearly capturing the diversity and variability of real atmospheric aerosol conditions.

This conference presentation will introduce the specific methodological details and demonstrate the performance of the BAMs in retrievals. It is expected that this method will help promote the development of future sensors and advance aerosol retrieval technology.

References

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