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Recent advances in retrieval of atmospheric aerosols based on satellite polarimeters

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The Particulate Observing Scanning Polarimeter (POSP) onboard the Chinese GaoFen-5 (02) satellite provides observation of the Earth in the spectral range from 380nm to 2250nm. By measuring both intensity and polarization in all spectral channels, POSP greatly enhances the sensitivity of observation to atmospheric aerosol properties. Exploring effective approaches for utilizing POSP observations to retrieve more aerosol parameters using physical and artificial intelligence (AI) methods is worth an in-depth study. Our recent advancements in atmospheric aerosol retrieval from POSP observations focus on two main aspects: 1) a high-precision aerosol optical depth (AOD) retrieval algorithm, and 2) the development of a fine mode fraction (FMF) retrieval algorithm using state-of-the-art AI methods. The validation results show that the POSP AOD and FMF have high consistency with ground-based measurement results. We also revealed that polarimetric observation at the POSP 865nm channel has great significance for FMF estimation. Leveraging the promising aerosol results obtained from POSP aerosol retrieval, higher-quality PM2.5 products have been produced from the PMRS model. In addition, sensitivity analysis indicates that polarimetric measurement in UV channels could be used for aerosol layer height (ALH) retrieval and further enhance the accuracy of PMRS-derived PM2.5. Based on our proposed aerosol retrieval algorithms, we can quantitatively retrieve the aerosol parameters with a continuous spatial distribution, effectively capturing dust and haze events in the China-North Plain region, as demonstrated by typical cases. We also present and analyze the global variations of AOD, FMF, and fine mode AOD (AODF) in 2022. Lastly, the future work of POSP is discussed, and the potential applications of artificial intelligence methods in aerosol remote sensing are summarized.

Keywords: satellite polarimeter, aerosol optical depth, fine mode fraction, retrieval algorithm, PM2.5

References
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