

First 3MI Aerosol Product – Advanced Aerosol Characterization using Multi-Angle Polarimeters

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A comprehensive understanding of the optical and microphysical characteristics of aerosols is essential for reducing one of the largest sources of uncertainty in climate and air-quality evaluations. In recent years, the aerosol community has increasingly recognized the value of leveraging the extensive information provided by satellite observations to enhance aerosol characterization. This has driven major efforts to improve retrieval algorithms as well as designing mission-driven sensors such as Multi-View, Multi-Channel, Multi-Polarisation Imager (3MI) [1]. Launched on-board Metop-SGA1 as part of the EPS-SG mission in August 2025 [2], 3MI is designed primarily for aerosol characterization, and exploits multi-angle polarimetric measurements that build upon the heritage established by the POLDER and PARASOL missions (Polarization and Anisotropy of Reflectances for Atmospheric Science coupled with Observations from a Lidar) since 1996. Compared with its predecessors, 3MI benefits from significant technological improvements, including a broader spectral range, alongside major advances in retrieval methodologies. These developments enable the retrieval of a more comprehensive set of aerosol properties, extending beyond conventional optical parameters to include enhanced microphysical information including chemical information. The provision of quantitative information on the amount of aerosol species takes aerosol products to a new level by going beyond simple aerosol typing.

This study presents the first aerosol retrieval results derived from 3MI and showcases recent developments in the representation of aerosol chemical components within the 3MI aerosol processor, a customized version of Generalized Retrieval of Atmosphere and Surface Properties (GRASP). Extensive preflight validation against ground-based observations (using POLDER-3), comparisons to models and other satellite-derived products, together with early 3MI validation results demonstrate significant improvements in aerosol characterization and highlights the added value of the polarimetric observations in bridging satellite remote sensing and aerosol modelling.

References

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