

The IASI Mineral Aerosol Profiling from InfraRed spectra version 5.1

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ABSTRACT

Mineral dust aerosols are particles lifted from barren regions, primarily deserts, by strong winds. These particles can travel thousands of kilometres, mostly within the tropical dust belt but occasionally reaching Europe and beyond. As the most significant tropospheric aerosol in terms of annual mass burden, dust aerosols play a crucial role in the climate system. They absorb, scatter, and emit radiation, affecting the Earth's energy balance across both the solar and terrestrial spectra. Additionally, they indirectly affect the Earth system by causing surface warming or cooling, atmospheric warming within the dust layer, altering atmospheric circulation, and changing the lifespan and physical properties of clouds, as well as the distribution and quantity of rainfall. Moreover, dust aerosols negatively affect human health and various activities such as aviation, solar energy production, and infrastructure. Therefore, studying atmospheric dust load, sources, and their temporal changes is of significant scientific and societal interest.

The Mineral Aerosol Profiling from Infrared Radiances (MAPIR) algorithm utilizes thermal infrared radiances to retrieve vertical profiles of mineral dust (coarse mode) concentration, in the troposphere. Applications for the data obtained are twofold. First, using the complete IASI time series, we can perform climate studies such as source or trend analyses. Second, providing data in near real time (NRT) allows their use for event alerts and in forecast models (aviation, health, weather, specific aerosol models ...). Those two types of applications have different requirements. In the first case, one needs consistency of the data and its quality along the whole time series, which sometimes also means not using the last/best version of some data. In the second case, one needs the data quickly processed and delivered with the best quality possible considering the time constraint.

In this contribution, we will describe the new MAPIR algorithm version 5.1, and especially the improvements since the last version such as extending the vertical range, removing pre-filtering linked to latitude and quick detection of dust signature, filtering out clouds in post-processing to avoid misclassification.

This algorithm exists in two “sub versions” linked to the different types of applications described earlier. The “climate” version uses the fully consistent IASI reprocessed spectra (PCA algorithm) and temperature / water vapour profiles (PWLR3 algorithm) for IASI/Metop-A, and corresponding data available for IASI/Metop-C from the EUMETSAT Data Centre. The “NRT” version uses the IASI/Metop-C NRT spectra and temperature / water vapour profiles distributed through EUMETCast, which is always of the last available processing algorithm and therefore varies over time.

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