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A decade of infrared versus visible AOD analysis within the dust belt

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Aerosols represent one of the dominant uncertainties in radiative forcing, partly because of their very high spatiotemporal variability, a still insufficient knowledge of their microphysical and optical properties, or of their vertical distribution. A better understanding and forecasting of their impact on climate therefore requires precise observations of dust emission and transport. Observations from space offer a good opportunity to follow, day by day and at high spatial resolution, dust evolution at global scale and over long time series. In this context, infrared observations, by allowing retrieving simultaneously dust optical depth (AOD) as well as the mean dust layer altitude, daytime and nighttime, over oceans and over continents, in particular over desert, appears highly complementary to observations in the visible.

In this study, a decade of infrared observations (Metop-A/IASI and AIRS/AQUA) has been processed pixel by pixel, using a "Look-Up-Table" (LUT) physical approach. The retrieved infrared 10μm coarse-mode AOD is compared with the Spectral Deconvolution Algorithm (SDA) 500nm coarse mode AOD observed at 50 ground-based Aerosol RObotic NETwork (AERONET) sites located within the dust belt. Analyzing their brings into evidence an important geographical variability. Lowest values are found close to dust sources ($\sim$0.45 for the Sahel or Arabian Peninsula, 0.6-0.7 for the Northern part of Africa or India), whereas the ratio increases for transported dust with values of $\sim$0.9-1 for the Caribbean and for the Mediterranean basin. This variability is interpreted as a marker of clays abundance, and might be linked to the dust particle illite to kaolinite ratio, a recognized tracer of dust sources and transport. More generally, it suggests that the difference between the radiative impact of dust aerosols in the visible and in the infrared depends on the type of particles observed. This highlights the importance of taking into account the specificity of the infrared when considering the role of mineral dust on the Earth's energy budget.