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Dust aerosol optical depth and altitude retrieved from 7 years of infrared sounders observations (AIRS, IASI) and comparison with other aerosol datasets (MODIS, CALIOP, PARASOL)

Sophie Peyridieu (1), Alain Chédin (1), Didier Tanré (2), Virginie Capelle (1), Clémence Pierangelo (3), Nicolas Lamquin (1), and Raymond Armante (1)

(1) Laboratoire de Météorologie Dynamique, CNRS/IPSL, Ecole Polytechnique, 91128 Palaiseau Cedex, France (sophie.peyridieu@lmd.polytechnique.fr), (2) Laboratoire d'Optique Atmosphérique, Université des Sciences et Technologies de Lille, 59655 Villeneuve d'Ascq Cedex, France, (3) Centre National d'Etudes Spatiales, DCT/SI/MO, BPI 811, 31401 Toulouse Cedex 9, France

Remote sensing of aerosol properties in the visible domain has been widely used for a better characterization of these particles and of their effect on solar radiation. On the opposite, remote sensing of aerosols in the thermal infrared domain still remains marginal. However, knowledge of the effect of aerosols on terrestrial radiation is needed for the evaluation of their total radiative forcing. A key point of infrared remote sensing is its ability to retrieve aerosol optical depth as well as mean dust layer altitude, a variable required for measuring their impact on climate. Moreover, observations are possible night and day, over ocean and over land.

Our algorithm is specifically designed to retrieve simultaneously coarse mode dust aerosol 10 μm optical depth (AOD) and mean layer altitude from high spectral resolution infrared sounders observations. Thanks to IASI higher spectral resolution, the selection of finer channels for aerosol detection allows an even more accurate determination of aerosol properties.

In this context, results obtained from 7 years (2003-2010) of AIRS/Aqua and more than 2 years (2007-2010) of IASI/Metop observations have been compared to other aerosol sensors. Compared to MODIS/Aqua optical depth product, 10 μm dust optical depth shows a very good agreement, particularly for tropical Atlantic regions downwind of the Sahara during the dust season. Comparisons with PARASOL non-spherical coarse mode product allows explaining small differences observed far from the sources. Time series of the mean aerosol layer altitude are compared to the CALIOP Level-2 products starting June 2006. For regions located downwind of the Sahara, the comparison again shows a good agreement with a mean standard deviation between the two products of about 400 m over the period processed, demonstrating that our algorithm effectively allows retrieving accurate mean dust layer altitude.

A 7-year global climatology of the aerosol 10 μm dust optical depth and of the layer mean altitude has also been established, emphasizing the natural cycles of Saharan dust.

Application of this method over continental surfaces, such as the Sahara desert, is currently being made possible by the retrieval of surface temperature and emissivity from IASI observations. This a priori knowledge opens the way to retrieving dust sources over land in the infrared.