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Remote sensing in the TIR of mineral dust over arid land from satellite and ground surface

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During the campaign AMMA (African Monsoon Multidisciplinary Analysis), an automated TIR 4-channel radiometer CLIMAT has been continuously observing the sky for the study of mineral dust, from February to November 2006, at the meteorological station of Tamanrasset (southern Algeria), in association with the mobile station TReSS. At the same time, dust was observed from space through quasi identical spectral TIR channels, from MSG/SEVIRI and CALIPSO/IIR (the latter from June 2006 onwards), giving the opportunity to compare the simultaneously derived desert dust radiances, at this Saharan site and over this long period, from space and from ground surface.
In addition, this mineral dust could be characterized from the ground station, (i) with Sun-photometer measurements (AERONET) for its atmospheric abundance and particle size distribution, (ii) with the MiniLidar of the TreSS station for its vertical distribution and (iii) with in situ dust sampling analysed as to its elemental and mineral compositions. Moreover, the spaceborne lidar CALIOP observed the atmosphere when passing over the station, the balloon meteorological profiles were performed twice a day (4 times during the special observation periods) and last but not least, the medium IR channel of SEVIRI (at 3.9 μm) made it possible to extract the ground surface "skin" temperature and its emissivity in the TIR channels of concern.
From this comprehensive experimental database, it has been possible (i) to calculate the TIR atmospheric spectral radiances using an accurate radiative transfer code, (ii) to simulate the radiometric measurements of CLIMAT, SEVIRI and IIR channels and (iii) to compare the real and simulated measurements from these instruments. This approach, if decisive (agreement between measurements and their simulations), defines a closure experiment allowing to validate the experimental database as well as the instrumental, analytical and numerical techniques applied. The aim of this study is to reach a sufficient skill of the aforementioned techniques for a satisfactory determination of the TIR radiative parameters (such as the optical depth) of dust observed from the ground or from space, over arid surfaces.
The method of control of consistency between measurements from space and from ground surface will be explained. The scheme for simulating the measurements will be presented. Instrumental techniques of interest – especially using MiniLidar for dust profile and the X-ray diffraction for dust mineral composition - will be described. Results of measured and simulated radiances will be compared and discussed, with examples of daytime and nighttime mesurements, for cases of clean and dusty atmospheres.
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