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Combined COSMO-MUSCAT and RTTOV simulations of the sensitivity of SEVIRI Desert Dust RGB imagery to assumed dust optical properties

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Observed from the Meteosat series of geostationary satellites, SEVIRI 'Desert Dust' RGB imagery are widely used to track large-scale dust storm events over North Africa and neighbouring regions. In this rendering scheme, based on the differences between three of SEVIRI's infrared channels (at 8.7, 10.8, and 12.0 microns), atmospheric dust is characterised by a distinctive pink colour. This is a consequence primarily of the contrast in infrared emissivity between dust aerosol and the background desert surface. The precise atmospheric profiles of temperature and moisture, as well as the altitude, concentrations (i.e. optical depth) and size distributions of the dust, also modulate the colour of the resultant imagery.

The COSMO-MUSCAT aerosol transport model and the RTTOV radiative transfer program are used to simulate the influence of atmospheric dust on the infrared brightness temperatures that would be measured by SEVIRI, and hence the resultant colour that would be produced in the imagery. The strength of this approach is that it enables detailed sensitivity studies to be carried out, exploring the effects on the output imagery of the assumed dust infrared optical properties. To this end, we have analysed the varying effects of different dust infrared optical properties databases on the brightness temperatures and colours. Particularly important are the absorptions by the dust in the 10.8 and 12.0 micron channels, the difference between which defines the intensity of the red beam in the imagery. The COSMO-MUSCAT model defines dust in five size bins ranging from 0.1 to 24 microns in particle radius, we find that the bin which provides the most significant contribution to the dust-induced change in brightness temperatures is the third bin, which has an effective radius of 1.51 microns. We present further explorations of the relationships between dust optical depth, infrared optical properties, and the resultant brightness temperatures and colours, with reference also to the background meteorological conditions.