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Using geostationary satellite data to quantify the effects of mineral dust aerosol on the Earth's Radiation Budget

Helen Brindley and Jacqueline Russell
(h.brindley@imperial.ac.uk)

Recent work has shown that mineral dust can exert a significant impact on the Earth's radiation budget via its ability to scatter and absorb both shortwave and longwave radiation. However, the magnitude of the overall dust direct radiative effect is still highly uncertain owing to the variability seen in the dust size distribution, its chemical composition, its vertical profile and assumptions made concerning typical particle shapes.

The combination of the operational data records stretching back to 2004 available from the Geostationary Earth Radiation Budget (GERB) and Spinning Enhanced Visible and InfraRed Imager (SEVIRI) instruments flying on the Meteosat Second Generation series of satellites offers a unique tool with which to monitor the diurnally resolved impact of mineral dust on top of the atmosphere radiation fields. In this paper the algorithms that have been developed at Imperial College in order to identify and quantify dust loading over the GERB field of view using the SEVIRI observations will be introduced, focusing particularly on northern Africa and Arabia. The use of this dust loading information, in conjunction with the GERB measurements, to simultaneously diagnose the dust direct radiative effect will then be described, accounting for the effects of scene anisotropy and underlying meteorological variability. The results obtained will be placed in the context of previous satellite based analyses over the region. Radiative transfer modelling, ground based observations, and measurements from dedicated in-situ aircraft campaigns will be used to assess whether radiative closure in the presence of dust can be obtained, and to illustrate the strengths and weaknesses of the methodology employed. Finally, the means by which the derived satellite products can contribute to a number of forthcoming observational campaigns (e.g. FENNEC) and to numerical weather forecasting activities will be discussed.