Geophysical Research Abstracts
Vol. 15, EGU2013-12800, 2013
EGU General Assembly 2013

Observations of the Shortwave Direct Radiative Effect of Saharan Mineral Dust from SEVIRI and GERB

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Current research has indicated that discrepancies seen between the UK Met Office (UKMO) NWP forecasts and observations may be due to the lack of an aerosol treatment within the model. The UKMO has tested the effect of assimilation of aerosol optical depth (AOD) observations from the SEVIRI retrieval algorithm which has been developed at Imperial College and this has been shown to add skill to its short term forecasting ability.

Prior to a longer assimilation trial, the internal and external factors which may affect the success of the SEVIRI retrieval algorithm were considered using data from the GERBILS airborne field campaign during June 2007. While the retrieved AODs using the standard algorithm were found to be in general, in good agreement with co-located flight and ground-based observations, a detailed sensitivity analysis was performed in order to assess whether an improved match could be achieved, and understand the limitations of the algorithm in the context of the needs for assimilation. It was found that of the factors tested, the retrieved AODs were most sensitive to the dust properties assumed in the radiative transfer modelling used to derive the expected dust signal. Using representative values derived from the GERBILS observations, variability in the coarse mode of the size distribution was found to have the largest impact on the retrieved AODs.

Following on from this work, co-located SEVIRI retrieved AODs and GERB fluxes at the top of atmosphere (TOA) were used to quantify the net direct radiative effect (DRE) of mineral dust over North Africa during June 2007. As expected, mineral dust aerosol was found to reduce the outgoing longwave radiation at all times of day with the peak reduction clearly following the diurnal cycle of skin temperature. Instantaneous SW DRE was found to be large under certain conditions and showed strong dependencies on pristine sky albedo and solar zenith angle such that a given aerosol loading could induce a positive or negative DRE. Overall, the mean SW DRE over June 2007 was found to be negligible. The net DRE for June 2007 was hence found to be dominated by the LW component with mineral dust inducing a reduction in outgoing net flux of the order 10 Wm-2.