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Intercomparison of observations and model aerosol parameters during two Saharan dust events over the southern United Kingdom

Joelle Buxmann (1), Mariana Adam (1), Carlos Ordonez (1), Marie Tilbee (1), Tim Smyth (2), Bernard Claxton (1), Jacqueline Sugier (1), and Paul Agnew (1)

(1) The Met Office, UK, (2) Plymouth Marine Laboratory, UK

Saharan desert dust lifted by convection over the hot desert surface can reach high altitudes and be transported over great distances. In the UK, Saharan dust episodes occur several times a year, usually during the spring. Dust lifted by cyclonic circulation is often blown into the Atlantic and transported to the UK. This can result in a rapid degradation of air quality due to the increase in the levels of particulate matter (PM). The ability to model the transport and deposition of dust remains an important challenge in order to characterize different pollution events.

We present a comparison of observed Aerosol Optical Depth (AOD) with modelled AOD from the Met Office Air Quality Unified Model (AQUM), performed for two dust events in March 2014 (at 380nm, 440nm, 870nm and 1020nm). The observations are derived from five sun photometers located in the southern UK at Exeter, Cardington, Bayfordbury, Chilbolton, and Plymouth. Correlations are investigated between model column integrated PM2.5 and PM10, and observed fine and coarse mode AOD from AERONET. Vertical profiles of attenuated backscatter and extinction from the Jenoptik Nimbus ceilometers part of the Met Office Laser Cloud Base Recorder (LCBR) network are investigated as well (see also session AS3.17/GI2.2 Lidar and Applications).

The Met Office air quality model AQUM is an on-line meteorology, chemistry and aerosol modelling system. It runs at a resolution of 12km over a domain covering the UK and north-western Europe. Atmospheric composition modelling employs two-way coupling between aerosol and chemistry evolution, with explicit modelling of sulphate, nitrate, black carbon, organic carbon, biomass burning and wind-blown mineral dust aerosol components.

Both the model and observations show an increase in AOD during the first period from 12 -13 March 2014. For example AOD levels of up to 0.52 for the 380nm channel were recorded by the sun photometer in Exeter. This is relatively high compared to average February 2014 values of 0.07 for 380nm. These high AOD values are attributed to poor surface air quality and elevated Saharan dust levels over much of the UK and Europe. The presence of particles above the boundary layer were observed in the vertical profiles of the attenuated backscatter signal from the LCBR in Exeter. During the evening periods of both days, the Angstrom Exponent (AE) decreased. This effect can be attributed to larger particles, with larger optical depth, indicating dust particles - in agreement with the model predictions of dust.

An increase in AOD from below 0.2 at 440nm up to $\sim$0.8 was observed at all sun photometer sites for the second period analyzed starting on 29. March. The AQUM forecasts an AOD of up to 1 at 440nm across the UK, i.e. 20% higher than the observations. The correlations of modelled PM10 with total AOD, PM2.5 with fine mode AOD and PM10-PM2.5 with coarse mode AOD, show an over-estimation of the fine mode particles. The vertical profiles of the LCBR of backscatter and extinction coefficients, plus a comparison of the integrated extinction coefficient, give further insight into the model performance.