Geophysical Research Abstracts
Vol. 15, EGU2013-10179, 2013
EGU General Assembly 2013

Saharan Airborne Dust Flux Measurements from the Fennec Campaign

Phil Rosenberg (1), Doug Parker (1), Claire Ryder (2), Luis Garcia-Carreras (1), John Marsham (1), James Dorsey (3,6), Ian Brooks (1), Angela Dean (4), Jonathan Crosier (3,6), Jim McQuaid (1), and Richard Washington (5)

(1) School Of Earth and Environment, University of Leeds, Leeds UK, (2) Department of Meteorology, University of Reading, Reading UK, (3) School of Earth, Atmospheric and Environmental Sciences, University of Manchester, Manchester, UK, (4) Facility for Airborne Atmospheric Research, Cranfield, UK, (5) School of Geography and the Environment, University of Oxford, Oxford UK, (6) National Centre for Atmospheric Science, School of Earth, Atmospheric and Environmental Sciences, University of Manchester, Manchester, UK

The Fennec campaign of 2011involved deployment of the Facility for Airborne Atmospheric Measurements BAe 146 (FAAM Bae 146) scientific research aircraft to Fuerteventura with research flights over the remote Saharan desert in Mali and Mauritania. The aims of the Fennec campaign were to characterise the dynamics, radiation and dust environment in this inaccessible region.

The FAAM BAe 146 operated a suite of instruments which measured size distributions of dust including a Passive Cavity Aerosol Spectrometer Probe, a Cloud Droplet Probe and a Cloud Imaging Probe (part of a Cloud, Aerosol and Precipitation Spectrometer). These instruments were able to reliably generate particle size distributions over the approximate range 0.1 to 200 μm and for the first time were simultaneously operated at high temporal resolution of at least 10 Hz. Combining these dust measurements with the measured 3D wind vectors has allowed size resolved dust flux estimates to be derived using the eddy covariance method. To the authors' knowledge this is the first time such estimates have been successfully derived from aircraft data.

Although the FAAM BAe 146 is capable of low level flying with straight and level runs at minimum altitudes of $\sim$100 m (higher in poor visibility), this is still significantly higher than mast based flux measurements making comparison of the total flux with surface based observations difficult. However, these observations give useful measures of the size dependence of the particle flux and the spectral signature of the dynamics of vertical dust transport.

The size resolved measurements show that dust mass flux includes significant contributions up to particle diameters $\sim$100 μm. This is much larger than the limit seen by other studies and is even more surprising given that the measurements were made at heights so far above the saltation layer. Spectral analysis shows three distinct dynamical regimes. The first appears to be linked to chaotic turbulence with horizontal scales of $\sim$100 m. The second seems to be linked to features on scales $\sim$1 km, similar to the order of the boundary layer depth. Finally, in the third regime, the concentration and wind measurements have a very asymmetric cross correlation series in the along flight direction which may indicate a preferred orientation for turbulent eddies caused buy e.g. shear. These characteristics are linked to the weather conditions and dust uplift mechanisms for each case.