Geophysical Research Abstracts
Vol. 17, EGU2015-11711, 2015
EGU General Assembly 2015

The importance of rare events for dust uplift in northern Africa

Sophie Cowie (1), John Marsham (1), and Peter Knippertz (2)

(1) University of Leeds, Institute for Climate and Atmospheric Science, School of Earth and Environment, Leeds, (eesc@leeds.ac.uk), (2) Karlsruhe Institute of Technology, Institute for Meteorology and Climate Research

Dust uplift is a non-linear function of near-surface wind speed, commonly assumed to be a cubic-dependence with a threshold, which is determined by surface characteristics such as soil moisture and roughness. The probability density function of wind-speed is generally characterised using a Weibull function, which gives a skewed distribution and a long exponentially decreasing "tail" for high winds. The contribution of different wind speeds to total dust uplift therefore depends on two competing nonlinear functions: high winds which occur rarely but cause strong dust uplift and winds just above the threshold which occur much more often but generate weaker uplift. This work is the first attempt at quantifying the relative contribution from these two competing functions. This analysis is done for six different regions in the key global atmospheric dust-producing region of northern Africa.

Long-term records of winds and reported dust uplift events from surface stations in northern Africa are used to characterise the contributions of different wind-speeds to total dust uplift using a theoretical estimate based on the wind-dependent parts of an established dust emission parameterization. Results show that wind-speeds 2 - 5 ms-1 above the threshold (dependent on the subregion) generate the most uplift. Rare, high wind-speed events produce 50% of total uplift, yet occur only 0.3% to 1.5% of the time (again dependent on subregion). Based on a station that reports 5 times a day on average a 0.3% occurrence equates to only 5-6 observations per year. Models may struggle to accurately simulate events of this frequency, and could therefore potentially misrepresent a significant fraction of the annual dust load. The results are only weakly sensitive to different treatment of the errors present in the observational record and allowances for their diurnal sampling biases. Investigation into the inter-annual variability shows that the infrequent high-wind events explain more of the variability in uplift from year to year than the lower-intensity but more frequent events. This demonstrates that models must capture rare events to accurately represent inter-annual variability, and perhaps muti-annual trends, in dust emission.