Geophysical Research Abstracts
Vol. 12, EGU2010-5548, 2010
EGU General Assembly 2010

The central west Saharan dust hotspot and its relation to African easterly waves and extratropical disturbances

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A vast, arid, and virtually uninhabited region covering eastern Mauritania and northern Mali appears in many satellite estimates of dust loading as the global maximum during boreal summer. Here the complex meteorological conditions that create this central western Sahara (CWS) dust hotspot are investigated on the basis of regression analyses and case study examples using a wide range of satellite analysis products (TOMS, OMI, MISR, SEVIRI). The results confirm the importance of African easterly waves (AEWs), previously hypothesized on the basis of case studies. The main ingredients to create this connection are: (I) Strengthened southerlies to the east of an AEW trough advect moist air into the southern Sahara. Daytime heating and orography trigger moist convection in this airmass. Strong evaporation in dry midlevel air generates extended cold pools and haboob dust storms. (II) Vertical mixing brings dust into the upper parts of the deep Saharan boundary layer, from where it can be advected back into the CWS region with the northerlies ahead of the next AEW trough. (III) If the associated surface vortex is strong enough, more dust emission occurs within or just upstream of the CWS. (IV) High-amplitude waves in the subtropics enhance the meridional flow associated with the AEW. Although there is a considerable case-to-case variability, it can be concluded that AEWs in concert with extratropical disturbances substantially contribute to the hotspot creation both through emission and the organization of transport. Disagreement between different satellite products and the presence of clouds complicate the analysis and underline the necessity for improved in-situ observations.