Geophysical Research Abstracts,
Vol. 11, EGU2009-4106, 2009
EGU General Assembly 2009

Dust Emissions in the West African Heat Trough – The Role of the Diurnal Cycle and of Extratropical Disturbances

P. Knippertz

Johannes Gutenberg University Mainz, Institute for Atmospheric Physics, Mainz, Germany (knippertz@uni-mainz.de, +49(0)61313923532)

The summertime West African heat trough (HT) is one of the most active dust sources in the world, but the meteorological processes controlling dust emissions from this region are still not well understood. Recent studies have found that the annual cycle of dust activity in this region measured by the TOMS Aerosol Index is better correlated with the annual cycle of near-surface convergence and wind gustiness than with the more obvious parameter mean wind velocity (Engelstaedter and Washington, 2007 in JGR and GRL). The authors suggest that small-scale atmospheric phenomena that are not resolved by standard analysis data are responsible for dust emissions in this region.

The present study offers new ways to interpret the relation of dustiness with convergence and gustiness through a consideration of the distinct diurnal cycle of the PBL and low-level winds in the region of the West African HT. Albeit based on one detailed case study for the 6-day period 29 May to 03 June 2006 only, this work demonstrates that the results cited above do not necessarily indicate a small-scale organization of dust emissions. The investigations are based upon analyses from the European Centre for Medium-Range Weather Forecasts and a new Meteosat dust product. The results point to two important mechanisms of dust emissions:

(1) The dry continental-scale HT circulation exhibits a strong diurnal cycle characterized by nocturnal low-level jets and downward mixing of momentum to the surface during the build-up of the planetary boundary layer in the morning. This leads to strong gusty surface winds and dust emission, mostly along the northern side of the HT, but also within the southerly monsoon flow. This effect is much better reflected in the wind gustiness parameter valid for the time period 09–12 UTC than for the instantaneous mean wind velocity at 12 UTC used by Engelstadter and Washington. By the latter time dissipation of momentum in the then highly turbulent and much deeper mixed layer has already weakened the near-surface winds. After emissions to the north and south of the HT, transports of the dust with the mean flow lead to an accumulation near the HT axis, where the near-surface convergence maximizes.

(2) The second mechanism involves influences from the extratropics. Triggered by a lee cyclogenesis south of the Atlas Mountains, the Intertropical Discontinuity that separates dry Saharan and moist monsoonal air shifts northward and allows deep moist convection to penetrate into the Sahara. The evaporation of convective precipitation in the dry desert air at midlevels generates strong gusty winds and dust emissions near the surface.