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Dust aerosol radiative effect and forcing over west Africa:

A case study from the AMMA SOP

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Aerosols affect the Earth energy budget directly by scattering and absorbing radiation and indirectly by acting as cloud condensation nuclei. However, large uncertainties exist in current estimates of aerosol forcing.

In this presentation, the impact of aerosol on solar and visible fluxes and the heating rate due to dust over West Africa are investigated using the radiative code STREAMER, as well as airborne lidar and dropsondes observations acquired during the African Monsoon Multidisciplinary Analysis Special Observing Period. Aircraft operations were conducted on 13 and 14 June 2006, over Benin and Niger, before and after the passage of a mesoscale convective system (MCS). This enabled to determine the impact of the MCS on the vertical distribution of dust, and on the radiative forcing of aerosol over West Africa. On these days the dust observed over Benin and Niger originated from the Bodélé depression and from West Sudan.

STREAMER can be used for computing either radiances (intensities) or irradiances (fluxes) for a wide variety of atmospheric and surface conditions. In this study, we use aerosol extinction coefficient derived from lidar, as well as temperature, pressure and water vapour profiles derived from dropsondes. The surface albedo is determined according to MODIS.

A series of runs was carried out on 13 and 14 June 2006, around mid-day, to investigate the dust radiative forcing as a function of latitude, from 6˚N to 15˚N, i.e. between the vegetated coast of the Guinea Gulf and the arid Sahel. The simulations are made both in terrestrial and in solar spectrum and show a decrease of solar direct flux and an

increase of solar diffuse flux with presence of aerosol. No change is observed for long wave fluxes. The maximum heat rate associated with the dust plume on these days was comprised between 0.5 K/day and 0.7 K/day, depending on the latitude. Sensitivity studies to surface albedo, aerosol backscatter-to-extinction ratio, temperature and water vapor mixing ratio profiles were also conducted.