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How surface properties influence mineral dust emissions in the Sahelian region? A modelling case study during AMMA.

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Tropical mesoscale convective systems (MCSs) are a prominent feature of the African meteorology. A continuous monitoring of the aeolian activity in an experimental site located in Niger shows that such events are responsible for the major part of the annual local wind erosion, i.e. for most of the Sahelian dust emissions [Rajot, 2001]. However, the net effect of these MCSs on mineral dust budget has to be estimated: on the one hand, these systems produce extremely high surface wind velocities leading to intense dust uptake, but on the other hand, rainfalls associated with these systems can efficiently remove the emitted dust from the atmosphere.
High resolution modelling appears as a relevant approach to correctly reproduce the surface meteorology associated with such meteorological systems [Bouet et al., submitted]. The question now arising concerns the reliability of surface characteristics available for the Sahelian region, especially soil texture and surface roughness, which are critical parameters for dust emissions. Contrary to arid regions, which are now well documented, data is still missing to correctly characterize semi-arid regions like the Sahel. This is in particular due to the well pronounced annual cycles of precipitations and vegetation in these regions and to the impact of land-use on surface properties. This study focuses on a case study of dust emission associated with the passage of a MCS observed during one of the Special Observing Periods of the international African Monsoon Multidisciplinary Analysis (AMMA – SOPs 1-2) program. The simulations were made using the Regional Atmospheric Modeling System (RAMS, Cotton et al. [2003]) coupled online with the dust production model developed by Marticorena and Bergametti [1995] and recently improved by Laurent et al. [2008] for Africa. The sensitivity of dust emission associated with the passage of the MCS to surface features is investigated using different data sets of surface properties (Harmonized World Soil Database, HWSD) and land-use (GLOBCOVER). In-situ measurements of dust concentrations (both ground-based and airborne), and of dust emission flux are used to validate the simulations.