Geophysical Research Abstracts,
Vol. 10, EGU2008-A-04059, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-04059
EGU General Assembly 2008

Evaluation of the mechanisms of emission and impact in the radiative forcing in the Sahara Desert using a Regional Climate Model

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Mineral dust is the largest aersol component in the atmosphere by mass. Dust plays an important role in climate through direct and indirect effects on the radiation budget, and through nutrient inputs to terrestrial and marine ecosystems and hence the carbon cycle. Given the complex role of dust in climate there is a need to improve our coupled climate-aerosol models. The Sahara desert is the main source of dust globally. This work considers (i) the meteorological conditions associated with dust emission events and (ii) the direct radiative effects, the semi-direct and indirect effects(associated with aerosol-cloud interaction) associated with dust. A combination of analysis of observational datasets and experiments using the RegCM3 regional model with dust module is evaluated. A number of case study events that characterise different processes are considered including dust emission due to strong synoptic scale forcing (mostly wintertime) and emission associated with gravity currents from monsoon season mesoscale convective systems. Model output is used to quantify the radiative impact of dust at the surface and TOA during a selection of major dust events. The estimated radiative impact according to the RegCM3 model is compared to observational data derived during the African Monsoon and Multidisciplinary Analyses (AMMA) Intensive Operation Periods and satellite GERB data. In addition the semi-direct effect is determined by comparison to model simulations without the dust module active. Cloud-aerosol interaction is assessed by analysis of a suite of observational datasets

including satellite data from MODIS, CALIOP.