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Regional Modelling of Saharan Dust Aerosol in the Framework of the German SAMUM project

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Global dust models have been used to evaluate dust distributions and their interactions with climate, but many uncertainties remain. While such models give some indications about the controls of large-scale atmospheric patterns on dust aerosol processes, such models do not operate on the same scale as the small scale dust emission and deposition processes. Actual dust sources are relatively small compared to the size of a gridcell of a global model. To predict dust emissions with a global model, subgridscale variability in surface winds must be taken into consideration. In addition, comparison of modelled dust concentration and deposition fluxes with observations at specific sites is usually hindered by the fact that the actual topography which in turn influences the meteorological parameters at the measurement sites cannot be adequately represented within global scale models. Regional models of the dust cycle can help to improve subgridscale parameterization of global dust models. Results from field studies like the recent SAharan Mineral DUst experiment (SAMUM), which was carried out in May and June 2006 in Morocco and aimed at improving the estimates of dust radiative forcing caused by Saharan dust, help to evaluate the performance for such models near the sources. Parallel to the SAMUM field measurements the regional model system LM-MUSCAT-DES of Saharan dust sources, transport and deposition was developed. The performance of the regional dust model system was evaluated with measurements of dust properties and meteorological parameters during the field campaign. The evaluation focused on days when many co-located measurements were available. Dust optical thickness and size distributions are mostly well matched by the model. However, the spatio-temporal evolution of the dust plumes is not always

satisfactorily reproduced. Much of the disagreement of model results with observations is related to the inaccuracies of the placement of dust sources by the model. A strong mismatch between modelled and observed surface wind speed is found in areas characterized by strong variations in small-scale topography that cannot be resolved explicitly even in the high resolution of the regional model. While simulated dust distributions are well matched for dust events caused by large-scale dynamics, the model often misrepresents dust emissions related to moist convective events. The still insufficiently fine resolved spacing of the vertical model layers leads to an absence of inversions in the model vertical profiles, which is the likely cause for the absence of sharply defined dust layers. The evaluation with the large number of available observations in proximity to dust source regions demonstrates the limits of the applicability regional dust model system.