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Sensitivity of desert dust emission modelling to horizontal resolution: the example of the Bodélé Depression

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Atmospheric aerosols are known to play an important role in the Earth's climate system. However, the quantification of aerosol radiative impact on the Earth's radiative budget is very complex because of the high variability in space and time of aerosol mass and particle number concentrations, and optical properties as well. In many regions, like in desert regions, dust is the largest contribution to aerosol optical thickness [Tegen et al., 1997]. Consequently, it appears fundamental to well represent mineral dust emissions to reduce uncertainties concerning aerosol radiative impact on the Earth's radiative budget.

Recently, several studies (e.g. Prospero et al. [2002]) underlined that the Bodélé depression, in northern Chad, is probably the most important source of mineral dust in the world. However many models fail in simulating these large dust emissions. Indeed, dust emission is a threshold phenomenon mainly driven by the intensity of surface wind velocity. Realistic estimates of dust emissions then rely on the quality and accuracy of the surface wind fields. Koren and Kaufman [2004] showed that the reanalysis data (NCEP), which can be used as input data in numerical models, underestimates surface wind velocity in the Bodélé Depression by up to 50%. Such an uncertainty on surface wind velocity cannot allow an accurate simulation of the dust emission. In mesoscale meteorological models, global reanalysis datasets are used to initialize and laterally nudge the models that compute meteorological parameters (like wind velocity) with a finer spatial and temporal resolutions. The question arises concerning the precision of the wind speeds calculated by these models.

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 influence of the horizontal resolution of the mesoscale meteorological model on the simulation of dust emission in the Bodélé Depression is investigated. A one year simulation is run in order to test the capability of the model to represent the pronounced seasonal cycle of dust emission in this region. Routine measurements from meteorological stations as well as satellite imagery are used to evaluate the accuracy of the simulations.