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NMMB/BSC-DUST: model validation at regional scale in Northern Africa

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While mineral dust distribution and effects are important at global scales, they strongly depend on dust emissions that are controlled on small spatial and temporal scales. Indeed, the accuracy of surface wind speed used in dust models is crucial. Due to the cubic higher-order power dependency on wind friction velocity and the threshold behaviour of dust emissions, small errors on surface wind speed lead to large dust emission errors. Most global dust models use prescribed wind fields provided by meteorological centres (e.g., NCEP and ECMWF) and their spatial resolution is currently never better than about $1^{\circ}\times1^{\circ}$. Such wind speeds tend to be strongly underestimated over large arid and semi-arid areas and do not account for reflect mesoscale character of systems responsible for a significant fraction of dust emissions regionally and globally. Other Another strong uncertainties in dust emissions from such approaches are related to the missrepresentation originates from of coarse representation of high subgrid-scale spatial heterogeneity in soil and vegetation boundary conditions, mainly in semi-arid areas.

With the development of the new model NMMB-BSC/DUST [Pérez et al., 2008], we are now focusing on the evalution of the model sensitivity to several processes related to dust emissions. The results presented here are an intermediate step to provide global dust forecasts up to 7 days at sub-synoptic resolutions in the near future. NMMB-BSC/DUST is coupled online with the NOAA/NCEP/EMC global/regional NMMB atmospheric model [Janjic, 2005] extending from meso to global scales an being fully embedded into the Earth System Modeling Framework (ESMF).

We performed regional simulations for the Northern African domain, including the Arabian peninsula and southern/central Europe (0 to 65ºN and 25ºW to 55ºE) at 1/3ºx1/3º and 1/6x1/6º horizontal resolution with 64 vertical layers. The model is initialized with 6-hourly updated NCEP 1x1º analysis data with a dust spin up of 5 days in advance. Dust columnal load, dust concentration at the surface, AOD and extinction coefficient are extracted for two time periods: March 2005 - corresponding with BoDEx campaign [Todd et al., 2008] - and May/June 2006 - corresponding with SAMUM I field campaign [Haustein et al., 2009]. Several model simulations were run with dust RRTM longwave and shortwave radiative feedback switched on or off, with dust vertical flux after Marticorena and Bergametti [1995] or after Alfaro and Gomez [2001], including viscous sublayer approach [Janjic, 1994] applied or not, and with or without preferential sources following Ginoux [2001]. Additionally, two new observational datasets of surface "aeolian" roughness length [Laurent, 2006; Prigent, 2005] are applied either for drag partition correction, or as substitution for the empirical model roughness length. These simulations are compared with detailed observational data. The atmospheric wind field is analyzed in terms of its capability to reproduce the low level jet in the Bodélé.

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