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The NMMB/BSC-CHEM online chemical weather prediction system: current status of development and feedback interactions

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The model NMMB/BSC-CHEM is a new fully on-line chemical weather prediction system under development at the Earth Sciences Department of the BSC in collaboration with several research institutions. The basis of the development is the NCEP new global/regional Nonhydrostatic Multiscale Model on the B grid (NMMB). The NCEP NMMB atmospheric model is an evolution of the operational WRF-NMME model extending from meso to global scales. Its unified nonhydrostatic dynamical core allows regional and global simulations and forecasts. A mineral dust module has been coupled within the NMMB. The new system, NMMB/BSC-DUST, simulates the atmospheric life cycle of the eroded desert dust. The main characteristics are its on-line coupling of the dust scheme with the meteorological driver, the wide range of applications from meso to global scales, and the dust shortwave and longwave radiative feedbacks on meteorology. In order to complement such development, the BSC works also in the implementation of a fully on-line gas-phase chemical mechanism within NMMB/BSC-DUST. The chemical mechanism and chemistry solver is based on the Kinetic PreProcessor KPP package with the main purpose of maintaining a wide flexibility when configuring the chemical part of the model. Two Carbon Bond family chemical mechanism have already been implemented, CB-IV and CB05. The photolysis scheme is based on the Fast-J scheme, coupled with physics of each model layer (e.g., aerosols, clouds, absorbers as ozone). Chemical species are advected and mixed at the corresponding time steps of the meteorological tracers using the same numerical scheme of the NMMB. Advection is eulerian, positive definite and monotone. The final objective is to develop a fully chemical weather prediction system, namely NMMB/BSC-CHEM, able to resolve gas-aerosol-meteorology interactions from global to local scales.

In the present contribution we will describe the status of development of the system and first evaluation results. Future efforts will be oriented to incorporate a multi-component aerosol module within the system with the aim to solve the life-cycle of relevant aerosols at global scale (dust, sea salt, sulphate, black carbon and organic carbon). The new aerosol module will include the following processes: emission of anthropogenic and natural primary aerosol and aerosol precursors; aerosol diffusion and advection, size distribution effects, aerosol chemistry, and dry and wet removal. Additionally, radiative feedback between aerosol and meteorology and the effects of aerosol on photolysis rates of the gas-phase chemistry will be included for all relevant aerosols.