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# Development of an integrated chemical weather prediction system for environmental applications at meso to global scales: NMMB/BSC-CHEM

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This contribution presents the ongoing developments of a new fully on-line chemical weather prediction system for meso to global scale applications. The modeling system consists of a mineral dust module and a gas-phase chemistry module coupled on-line to a unified global-regional atmospheric driver. This approach allows solving small scale processes and their interactions at local to global scales. Its unified environment maintains the consistency of all the physico-chemical processes involved.

The atmospheric driver is the NCEP/NMMB numerical weather prediction model (Janjic and Black, 2007) developed at National Centers for Environmental Prediction (NCEP). It represents an evolution of the operational WRF-NMME model extending from meso to global scales. Its unified non-hydrostatic dynamical core supports regional and global simulations. The Barcelona Supercomputing Center is currently designing and implementing a chemistry transport model coupled online with the new global/regional NMMB. The new modeling system is intended to be a powerful tool for research and to provide efficient global and regional chemical weather forecasts at sub-synoptic and mesoscale resolutions.

The online coupling of the chemistry follows the approach similar to that of the mineral dust module already coupled to the atmospheric driver, NMMB/BSC-DUST (Pérez et al., 2008). Chemical species are advected and mixed at the corresponding time steps of the meteorological tracers using the same numerical scheme. Advection is eulerian, positive definite and monotone. The chemical mechanism and chemistry solver is based on the Kinetic PreProcessor KPP (Damian et al., 2002) package with the main purpose of maintaining a wide flexibility when configuring the model. Such approach will allow using a simplified chemical mechanism for global applications or a more complete mechanism for high-resolution local or regional studies. Moreover, it will permit the implementation of a specific configuration for forecasting applications in regional or global domains. An emission process allows the coupling of different emission inventories sources such as RETRO, EDGAR and GEIA for the global domain, EMEP for Europe and HERMES for Spain. The photolysis scheme is based on the Fast-J scheme, coupled with physics of each model layer (e.g., aerosols, clouds, absorbers as ozone) and it considers grid-scale clouds from the atmospheric driver. The dry deposition scheme follows the deposition velocity analogy for gases, enabling the calculation of deposition fluxes from airborne concentrations. No cloud-chemistry processes are included in the system yet (no wet deposition, scavenging and aqueous chemistry). The modeling system developments will be presented and first results of the gas-phase chemistry at global scale will be discussed.

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