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Applications and Sensitivity Analysis with the 2-Way Coupled WRF-CMAQ Model

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A 2-way coupled meteorology and air quality model composed of the Weather Research and Forecasting (WRF) model and the Community Multiscale Air Quality (CMAQ) model has recently been developed. The design of the system facilitates coupling of the dynamical and chemistry/transport calculations at flexible user defined intervals as well as the investigation of the feedback effects of pollution loading on radiation and subsequent simulation of the dynamical state of the atmosphere, thereby enabling "2-way" interactions. A key uncertainty in quantification of aerosol radiative effects and their impacts on climate change is the verification of the spatial and temporal variability in its magnitude and directionality and, consequently, its cumulative effect on the radiation balance of the earth-atmosphere system.

Model applications with the 2-way coupled WRF CMAQ system will be discussed to highlight the sensitivity of the simulated aerosol fields and their optical and radiative properties to: (1) specification of lateral boundary conditions and (2) the radiation scheme used in the WRF-CMAQ system. The direct effects of aerosols on shortwave radiation have been implemented in both the CAM and the RRTM radiation schemes and the differences in simulated optical and radiative properties of the aerosols with these schemes will be presented. Extensions of the WRF-CMAQ system to hemispheric scales to address the uncertainties associated with specification of chemical lateral boundary conditions will be discussed. Additionally, analysis of the spatial heterogeneity in aerosol direct radiative forcing over the Northern hemisphere as well as comparisons against available measurements will be presented.