A Modeling Investigating of Climate Effects of Air Pollutants

Aijun Xiu, Rohit Mathur, Adel Hanna, Uma Shankar, and Francis Binkowski
UNC-Chapel Hill Carolina Environmental Program and US EPA

Brief Description:

Recently there has been a great concern on the possible feedback between climate and air pollution. While global climate chemistry models address successfully many aspects of the global climate and global chemistry, regional climate applications, on the other hand, are hindered by the coarse resolution generally adapted in those models and the details of chemical and physical mechanisms used. In this regard, regional air quality models might be provide useful tools for examining issues related to the climate and pollution feedbacks. However, the off line meteorology/chemistry link in those models is a limiting feature in their applicability for studies assessing the impacts of air pollution on regional radiation budgets and meteorology.

In this paper we describe the development and application of a modular, physically and numerically consistent, fully integrated regional-scale atmospheric dynamics and chemistry modeling system. The modeling system is based on further development and refinement of two existing models: the MM5 meteorological model, and a comprehensive atmospheric gas-aerosol model which has also served as a prototype to the Community Multiscale Air Quality Model (CMAQ). In developing the integrated model, we have included directly into the MM5, modules to represent transport, chemistry, and deposition of various chemical species (gas and aerosols), such that the dynamics and chemistry related model calculations are fully synchronized. The integration of the dynamics and chemistry calculations in a consistent modeling framework also enables the investigation of the potential effects and feedback of radiatively important trace species. Model applications and evaluation of model performance over the eastern United States will be presented. Differences in the online and offline mode of chemistry calculations will be described. Evaluation of the effects of radiative feedbacks related to aerosol loading will be discussed.