Application of BlueSky and CMAQ to investigate the impact of wildland fire on regional air quality.

Hee-Jin In1, Daewon W. Byun1*, Soontae Kim1, Sharon Zhong1, Xindi Bian2, Joseph J. Charney2, Warren E. Heilman2, and Brian E. Potter2
1Institute for Multidimensional Air Quality Studies, University of Houston, Houston, TX77204 2USDA Forest Service, North Central Research Station, East Lansing, MI 48823

We incorporated prescribed fire emissions from the BlueSky smoke modeling system with SMOKE processing to investigate the impact of episodic fire emissions on regional air quality in the eastern U.S. via the Community Multiscale Air Quality (CMAQ) model. We compared the simulated concentrations of the primary pollutants (CO, NO, and primary PM species) with and without the fire emissions and studied their effects on the formation of secondary species by photochemistry. The selected CMAQ simulation event occurred on 15 April 2004 with ignitions from four locations within 12-km model grid-spacing domain covering the eastern half of the U.S. Synoptic weather for this event was characterized by the passage of a developing low-pressure system from the Great Plains to the Eastern States. Winds varied from southerly to westerly as a trough passed over the western half of model domain. Surface winds exceeding 5 m s-1 prevailed across the whole domain, providing a favorable condition for smoke dispersion and transport to downwind areas. The daily fire emissions were merged with the annual emissions inventory data, US-EPA NEI99. Domain total emission rates from the fires were 300~500 Mmole hr-1 for CO, 60~120 tons hr-1 for elemental carbon, 200~400 tons hr-1 fine particulate mattere (PM), and 400~900 tons hr-1 of organic carbon. Maximum concentrations during the simulation day increased from 20 to 120 μg m-3 for PM2.5 and 40 to 1500 ppb for CO at the ignition locations in Michigan. Daily mean concentrations of PM2.5 and CO were also enhanced from 10 to 70 μg m-3 and 20 to 650 ppb, respectively. However, O3 and NOx concentrations showed little changes in response to the added fire emissions during the single day simulation because the BlueSky emissions data used for the simulation did not include emissions for the highly reactive volatile organic compounds (HRVOCs). We have performed several sensitivity tests to demonstrate the response of the CMAQ system to various levels of HRVOC emissions.