## 5B.2 WRF/Chem-CB05-MADE/VBS: Development and comprehensive evaluation of multi-year applications over North America

**Zhang, Yang,** Kai Wang, Khairunnisa Yahya, and Brittney Mitchell, *North Carolina State University*

The advancement of computer powers in recent years enables multi-year applications of WRF/Chem to evaluate its capability in simulating meteorology, air quality, and their interactions. In this work, a new chemistry-aerosol option has been developed in WRF/Chem v3.4.1 to enhance its capability in simulating aerosol indirect effects with the advanced Volatility Basis Set (VBS) approach for secondary organic aerosol (SOA) formation. This new chemistry-aerosol option uses the 2005 Carbon Bond mechanism (CB05) as the gas-phase chemical mechanism. CB05 is coupled with the existing aerosol module MADE/VBS (referred to as CB05-MADE/VBS), an updated aqueous-phase chemistry in both large scale and convective clouds, and existing treatments for aerosol feedback processes in WRF/Chem. WRF/Chem-CB05-MADE/VBS has been applied to three full years (2001, 2006, and 2010) to simulate variation trends of meteorology, air quality, and chemistry-aerosol-radiation-cloud feedbacks as well as their interannual variability. The model performs overall well for most meteorological variables and chemical concentrations of ozone (O3) and fine particles (PM2.5), but shows larger biases in cloud-related variables such as cloud condensation nuclei, cloud droplet number concentrations, cloud optical depth, and liquid water path, indicating potential areas of improvement in model treatments of aerosol and cloud microphysics, in particular, aerosol-cloud interactions. Sensitivity simulations using different initial and boundary conditions (ICs/BCs) from different global models are also performed to examine the impacts of ICs/BCs on overall model predictions. These results demonstrate the model's skill in reproducing long-term observations and simulating chemistry-aerosol-radiation-cloud feedbacks.