Regional Air Quality Model Evaluation: Framework and Tools (2.1)

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To advance the comprehensive model evaluation effort that is a critical component of the Community Multiscale Air Quality (CMAQ) model program, we present an evaluation framework describing the roles of operational, diagnostic, dynamic, and probabilistic evaluation approaches. Comparison of criteria pollutant predictions to observations (e.g., ozone, fine particulate matter [$PM_{2.5}$] mass and species) is a fundamental part of evaluation protocols, and it is critical to assess the role of various processes and model inputs to those predictions. These operational and diagnostic evaluation approaches can provide important insights to issues that can inform and improve the air quality model or the meteorological or emission inputs. Further, evaluating an air quality model's response to emission changes is central to how the model is used for air quality management at the local, state, and federal levels. The NO_x State Implementation Plan (NO_x SIP) Call offered a unique opportunity to conduct a "dynamic evaluation" of CMAQ's predicted O_3 change as a result of a large, abrupt NO_x emission reduction in 2004. Uncertainties in model inputs and processes are very difficult to characterize in deterministic models such as CMAQ, but having reasonable uncertainty estimates could provide additional help and guidance to the air quality management community. Probabilistic evaluation approaches are under development to characterize the impact of uncertainties in emissions, meteorology, and chemistry on air quality predictions using CMAQ and the CMAQ-Decoupled Direct Method (CMAQ-DDM, Poster 2.3). Credible uncertainty estimates can provide valuable information to air quality management decisions about the confidence in the predicted air quality changes and likelihood for reaching attainment. Additionally, these uncertainty bounds can be useful to the research process by identifying model prediction errors outside the bounds of uncertainty that warrant further investigation. With this background on the structure and goals of the evaluation program, the individual posters in this session will describe specific research studies in more detail.