

## **Towards Seamless Prediction of Chemical Weather**

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The onset of near-global and long-term measurements of chemical and aerosol constituents offers an opportunity to improve our capability to predict and assess chemical weather and air quality through the integration of these measurements with predictions from regional to global chemical transport models. Central to this integration is a chemical data assimilation (DA) system that is reasonably efficient, effective, and flexible in assimilating measurements spanning multiple spatiotemporal scales and multiple chemical/aerosol species. In this talk, I will introduce the main idea behind chemical weather prediction, as well as the advances and challenges in the development and application of DA and inverse modeling approaches in atmospheric chemistry and physics. In particular, I will introduce a data assimilation system for the Earth sciences based on community models and software packages being developed at the National Center for Atmospheric Research. This system includes a global chemistry-climate model (Community Atmosphere Model with Chemistry or CAM-Chem), a regional weather-air quality model (Weather Research and Forecasting with Chemistry or WRF-Chem), and an ensemble Kalman filter DA software (Data Assimilation Research Testbed or DART). I will present several challenges in its application to: 1) estimating sources and sinks of trace gases and aerosols, 2) assimilating multi-species and/or multi-platform chemical data, and 3) conducting observing system simulation experiments (or OSSEs) to support future satellite observations of global air quality. I will end this talk with a short description of the role of statistics and applied mathematics in addressing these challenges.