7th International Workshop on Air Quality Forecasting Research
College Park, Maryland
Working Lunch Summary
September 3, 2015

Theme highlights, needs and next-steps from the conference:

(1) Satellite Data for Air Quality (AQ) Forecasting:
- Fire and dust emissions are increasingly more available near real time;
- Retrieved data assists both post-analysis and forecasting applications;
- Air quality and short-lived climate forcers are re-emerging as foci of interest;
- Observation system simulation experiments influence the design and operational protocols of AQ targeted space-based instruments.

(2) 3-day forecast lead times are the minimum requirement:
- This allows air quality managers to act and be more proactive in policy-relevant decision-making. "Pre-planned" actions from Chinese and Chilean cities need 3-day forecasts for implementation;
- Similar demand exists in the U.S.

(3) Multiple-scale and fine-scale modeling:
- Fine-scale modeling is needed for horizontal resolution, for urban, coastal and complex domain AQ forecasting applications;
- Fine-scale modeling is also needed for fine vertical grid structure at various heights to capture surface, planetary boundary layer, and tropopause specific phenomena.

(4) Atmospheric aerosol modeling:
- There are many challenges in forecasting chemistry (e.g., SOA, heterogeneous reactions);
- Surface-atmosphere exchange modeling is a challenge due to the large uncertainties involved;

(5) There is a challenge to model the optical properties of aerosols to properly characterize size, composition and mixing state Global village:
- The global village perspective reiterates the importance of background concentrations and long-range transport because the atmospheric continuum influences everyone;
- The science community should practice transparency and share rapid refresh of emissions: e.g., "pass it on" quickly if there are updated ship emissions in international waters;
- Venues exist to achieve the above and more: e.g., World Meteorological Organization's Working Group on Numerical Experimentation (WGNE), Global-Atmospheric-Watch Urban Research Meteorological and Environment (GURME), Global Emission InitiAtive (GEIA).

(6) Interoperability of modeling systems:
- Necessity of inter-operability among earth modeling systems highlights the importance of unification and simplification of comparable modeling systems;

- There is a recognized commitment by several national centers for inter-operability of modeling components through modules and couplers e.g. Weather Research Forecasting (WRF)-Community Multi-scale Air Quality model (CMAQ), WRF-chemical model (wrf-Chem), Non-hydrostatic Multi-scale Meteorological model with B grid-staggering (NMMB)-CMAQ coupled to the Community Radiative Transfer Model (CRTM), …etc.

(7) Ensemble and probabilistic forecasts:

- Global models are already running at mesoscales. Ensemble Kalman Filter (EnKF) based data assimilation systems are already providing ensemble output. These advances can be further explored.
- One can reproduce model random error characteristics by selection and configuration of members

(8) Communication to the general public:

- India's success story of securing funds due to their grass roots movement of emission inventory collection that stimulated public awareness can set precedence for others; The Chinese AQ monitoring network which provides real time information to the public, has been well received by the public and the science community.

(9) Clearing house for AQ campaign data and emissions:

- National centers should try to provide an archival service for measurement campaigns and in-situ measurements;
- These data sets are vital for model evaluation and development.

(10) A verification paradigm over-haul is required, especially for high-resolution modeling:

- The probabilistic content of a fine resolution forecast may be more readily available than many of us think, as data assimilation used to initialize chemical and meteorological fields can be generated entirely or partially from EnKF. Therefore, an ensemble of AQ results from the forward model is already available. Probabilistic evaluation of the forecast performance is therefore necessary;
- As hyperspectral remotely-sensed observations deliver increasingly more reliable speciated data with good sensitivity in the vertical distribution, species-specific verification should be emphasized.

(11) Bias correction

- It is a promising interim solution to improving PM forecasts as model research and development continues. It is not a replacement for physical understanding;

(12) Revolution in incorporating advancements in information technology and numerics

- New technologies in computational and computer science that specialize in solving higher order differential equations and large algebraic systems, etc., traditionally have a slow path to be adopted by atmospheric and air quality scientists;
- Large Eddy Simulations (LES), urban scale modeling, Observation Simulation System Experiments (OSSE), and reanalyses are typically large consumers of computer resources. Improvement in numerical efficiency and scalability in parallelization of these large computer codes is critical.