Improving Air Quality Forecasting Systems in Korea

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Introduction

- Air quality forecasting systems that employ various combinations of air quality models, emissions inventories, and meteorological data have been implemented and operated to predict PM\textsubscript{10} and PM\textsubscript{2.5}, and 1-hr ozone peak concentrations in Korea since May 2012.
- In detail, Community Multi-scale Air Quality (CMAQ) and Comprehensive Air quality Model with eXtensions (CAMx) are utilized for air quality prediction with 2006 the Intercontinental Chemical Transport Experiment-Phase B (INTEX-B) and 2010 Work Plans for Model Inter-Comparison Study - Asia Phase III inventories (MICS-Asia) for regional emissions and Clean Air Policy Support System (CAPSS) for Korean domestic emissions.
- To generate meteorological inputs for each forecasting day, National Centers for Environmental Prediction Global Forecasting System (NOAA/NCEP-GFS) and Korea Meteorological Administration (KMA)-Unified Model (UM) meteorological data area selectively tested in Weather Research and Forecasting (WRF) model simulations to improve forecasting skills for the target species.
- PM and ozone long-term trends over Seoul Metropolitan Area (SMA) are shown below.

Result 1: CMAQ Forecasts for PM and Ozone

- PM\textsubscript{10} Concentrations

- PM\textsubscript{2.5} Concentrations & Its Composition

- Comparison of monthly MODIS & CMAQ AOD

Result 2: CAMx Forecast for PM and Ozone concentrations and contributions

- Beijing Tianjin-Hebei
- Yangtze River Delta
- China (all others)
- South Korea
- North Korea

- Species: PM\textsubscript{10}, Period: 20150510 - 0615 (MAPS-Seoul Campaign Period)
- Receptor Region: SMA, South Korea

We will utilize PM\textsubscript{2.5} source contribution results and comparisons of modeled PM\textsubscript{2.5} with the observed PM\textsubscript{2.5}, including its composition to update emissions inventory and improve the overall forecasting skill over the region.

Result 3: MAPS-Seoul 2015 Field Campaign Support

- Based on what we have learned from the air quality forecasting practice during the 2015 MAPS-Seoul, the AQF system will be updated to support 2016 KORUS-AQ field campaign.

Concluding Remarks

- Long-term comparisons of simulated PM\textsubscript{10} and PM\textsubscript{2.5} concentrations to the observed concentrations show consistent under-predictions.
- The modeled-to-measured annual PM\textsubscript{10} concentration ratio is about 0.7 on average although it shows seasonal variations.
- Ozone peaks were mostly under-predicted especially for large cities. Ozone precursor conditions should be further investigated to improve local ozone production in the model.
- Among inorganic components, sulfate is apparently underestimated while nitrate and ammonium are comparable to the observations.
- As for future improvement, we consider (1) to incorporate data assimilation with surface measurements and satellite products to revise initial chemical fields for air quality simulations and (2) to add fugitive dust and wild fire emissions to examine the impacts on air quality forecasts. Some of these ensemble members will provide daily forecasts for 2016 KORUS-AQ field campaign.

Acknowledgement

This study was supported by Korean Ministry of Environment, National Institute of Environmental Research, and PM2.5 research center funded by Ministry of Science, ICT, and Future Planning (MSIP) and National Research Foundation (NSF) of Korea (2014M3C8A5030624).