Prediction of fine particulate matter (PM2.5) by the NAQFC

Ivana Stajner1, Jeff McQueen2, Pius Lee3, Jianping Huang4,5, Li Pan2,6, Ho-Chun Huang2,4, Daniel Tong6, Ariel Stein6, Phil Dickerson6, Sikchy Upadhyay7

1 NOAA/NWS/STI, 2 NOAA/NWS/NCEP, 3 NOAA ARL, 4 IMSG, 5 CICS, 6 EPA and 7 Syneren Technologies

Ivanka Stajner (ivanka.stajner@noaa.gov) For more information please visit http://www.weather.gov/sti/stimodeling_airquality

National Air Quality Forecast Capability (NAQFC) operational predictions
- PM2.5 - nationwide from CMAQ-NAM since February 2016
- Ozone - nationwide from CMAQ-NAM
- Smoke - nationwide from HYSPLIT-NAM
- Dust - for 48 states from HYSPLIT-NAM

Ozone, smoke and dust predictions are available at http://airquality.weather.gov/

CMAQ Model Upgrade in February 2016 - currently operational model
- First public release of raw model predictions and bias-corrected PM2.5 predictions from CMAQ based on v4.6
- Lateral boundary conditions from a global dust model and a GEOS-Chem climatology for gaseous species
- Increased vertical resolution from 22 to 35 levels
- Analog forecast technique for PM2.5 bias correction (Djalalova et. al. and Huang et. al.)

This example shows transport of Saharan dust across the Atlantic:

PM2.5 Predictions
Daily average of PM2.5 (μg/m³) prediction from 6z cycle on Sep. 15, 2016

Regional mean of PM2.5 for each of the 48 prediction hours

Current model
- Predicted daily max of hourly average PM2.5 concentrations that agree with observed values (circles) much better than the current model.

New model
- New model produces higher PM2.5 concentrations that agree with observed values (circles) much better than the current model.

Observations
- BlueSky model predictions (blue).

Bias-corrected predictions
- KFAN bias corrected predictions (red).

Bias correction using KFAN algorithm (red) produces better agreement with observations (black) than the AN algorithm (dashed blue).

PM2.5 Predictions
Daily maximum of 8 hour average ozone concentrations

Summary
- First public release of operational PM2.5 predictions
- Updated BlueSky and inclusion of wildfire emissions using 24-hour “analysis cycle” provide improved PM2.5 predictions especially near forest fires
- CMG 5.0.2 with updated NOx emissions reduces ozone overpredictions in the eastern U.S.
- Initial testing with KFAN bias correction method shows further improvements over the operational analog forecast technique

Plans
- Continued testing of CMAQ 5.0.2 for potential transition to operations
- Update display, dissemination and web presence
- Linkage with additional aerosols from global predictions
- Extend predictions to 72 hours
- Finer resolution of predictions (longer term)

References
- Tong et al. (2015) Long-term NOx trends and large cities in the United States during the 2008 Recession, Atmospheric Environment, 107, 50-64.
- Huang et al. (2016) Improving NOAA NAQFC PM2.5 predictions with a bias correction approach, manuscript submitted to Weather and Forecasting.