NOAA's National Air Quality Forecast Capability for Ozone and Fine Particulate Matter

Jeffery McQueen[1], Pius Lee[2], Ivanka Stajner[1], Jianping Huang[3], Ho-Chun Huang[3] and Li Pan[3]

[1]NWS/NCEP/EMC – College Park, MD, [2]NOAA/OAR/ARL–College Park, MD, [3]IMSG–College Park, MD
Email: Jeff.McQueen@noaa.gov

The operational NOAA National Air Quality Forecast Capability, NAQFC, provides two day model forecasts of ozone and fine particulate matter surface concentrations twice per day at the 06 and 12 UTC cycles. The NAQFC operational forecast for ozone (O3) for the nation was implemented in September 2007 and for fine particulate matter (PM2.5) in January 2015 (Lee, et al., 2018). The NAQFC is made up of the North American Non-Hydrostatic Multiscale Model (NAM-NMMB) 12 km numerical weather prediction model and the EPA Community Model for Air Quality (CMAQ), using Carbon Bond-V (CB-V) gas phase chemistry and AERO-VI particulate matter processing. Predictions are available in real-time for the continental U.S., Alaska and Hawaii. Offline coupling between the NAM and CMAQ is achieved at hourly intervals by interpolation from the NAM to the CMAQ horizontal and vertical grids. Anthropogenic emissions are updated monthly from the EPA National Emission Inventory for the base year 2014V2. Wild fire smoke emissions were included in 2015 and are based on the U.S. Forest Service BlueSky smoke emission system and the NESDIS Hazardous Mapping System (HMS) fire locations, which are updated daily. Dust emissions were also updated with the NOAA/ARL Fengsha land use based dust emissions system (Dong, 2016). Dust lateral boundary conditions are provided by the NCEP NEMS Global Aerosol Capability (NGAC) V2 with climatological values from NASA GEOS-Chem for other species (Lu, et al., 2016; Wang, et al., 2018). In December 2018, the 12km L35 NAM-CMAQ V5.0.2 model analog ensemble bias correction was extended for both ozone and PM2.5 with improvements to adjust rare events (Huang, et al., 2018). Emissions for oil and gas sector activities were also updated. Predictions are available to U.S. state air quality forecasters and the public from the NWS National Digital Guidance Database (NDGD): http://airquality.weather.gov/ with experimental model predictions at http://www.emc.ncep.noaa.gov/mmb/aq/.

In 2019, Tests with a Unified Forecast System (UFS) based on the Global Forecast System (GFS) with a finite volume on cubed-sphere dynamic core continued with forecasts extended to 72 hours. Monthly average PM2.5 errors for August 2019 (Fig. 1) over CONUS show improvements with the experimental GFS-CMAQ model configuration. Smoke emissions from the NOAA/NESDIS Global Biomass Burning Emissions Product (GBBEPx) with fire radiative power (for plume rise) are included here as well as the provision of full aerosol lateral boundary conditions from the GEFS-Aerosol global model. GEFS-Aerosol is based on the GFS dynamic core inline aerosol global model at ~ 25 km out to 5 days with an expected implementation in the fall of 2020. The experimental GFS-CMAQ is expected to be implemented with upgrades to CMAQ version V5.3 with CB-VI gas phase and AERO-7 aerosol processes. These changes to NAQFC along with updates to anthropogenic emissions are also expected to be implemented in 2022.

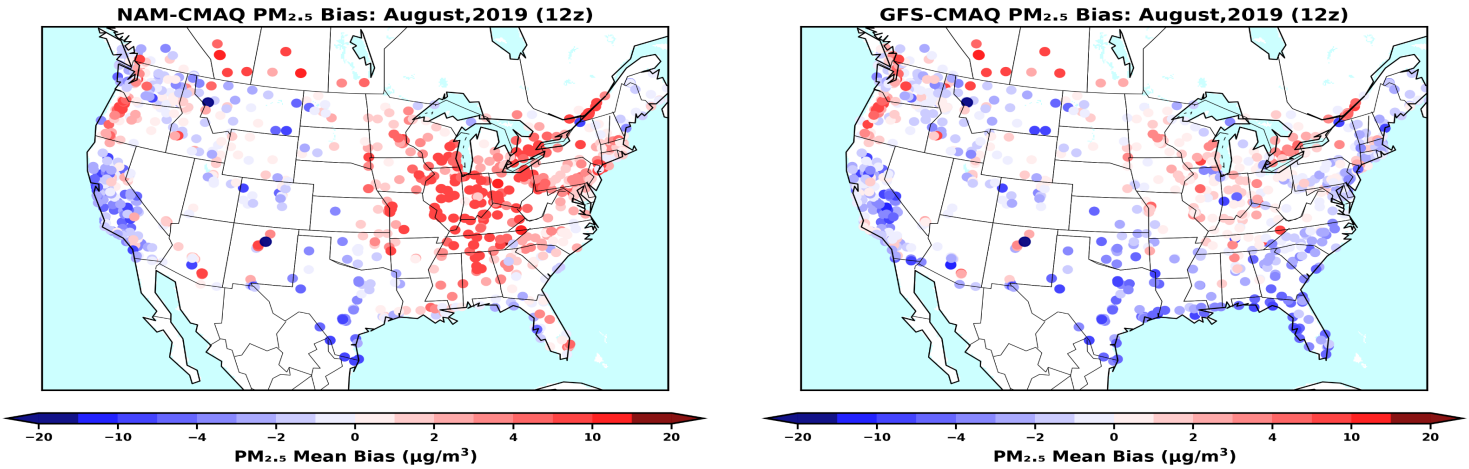

Figure 1. Comparison of Operational NAM-CMAQ day 1 24h avg PM2.5 model prediction bias vs experimental GFS-CMAQ averaged for all days during August 2019.

References

Huang, J., J. McQueen, J. Wilczak, I. Djalalova, I. Stajner, P. Shafran, D. Allured, P. Lee, L. Pan, D. Tong,H.-C. Huang, G. DiMego, S. Upadhayay, L. Delle Monache.(2017) Improving NOAA NAQFC PM2.5 predictions with a bias correction approach. Wea. Forec., 32,2. DOI: http://dx.doi.org/10.1175/WAF-D-16-0118.1

Lee, P., and Coauthors, 2017: NAQFC developmental forecast guidance for fine particulate matter PM2.5). Wea. Forecasting, doi:https://doi.org/10.1175/WAF-D-15-0163.1.

Lu, C.-H., A. da Silva, J. Wang, S. Moorthi, M. Chin, P. Colarco, Y. Tang, P. S. Bhattacharjee, S.-P.

Chen, H.-Y. Chuang, H-M. H. Juang, J. McQueen, and M. Iredell, 2016: The implementation of NEMSGFS Aerosol Component (NGAC) Version 1.0 for global dust forecasting at NOAA/NCEP, Geosci.Model Dev. Discuss., 9, 1-37.

Wang, J., Bhattacharjee, P. S., Tallapragada, V., Lu, C.-H., Kondragunta, S., da Silva, A., Zhang, X.,Chen, S.-P., Wei, S.-W., Darmenov, A. S., McQueen, J., Lee, P., Koner, P., and Harris, A.: The implementation of NEMS GFS Aerosol Component (NGAC) Version 2.0 for global multispecies forecasting at NOAA/NCEP – Part 1: Model descriptions. Geosci. Model Dev., 11, 2315–2332, 2018 https://doi.org/10.5194/gmd-11-2315-2018