Evaluation of O_3 Predictions from the National Air Quality Forecast System to Support Transition of Air Quality Modeling Research to Operations (2.2)

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Although air quality has improved significantly in the decades following passage of the Clean Air Act and its Amendments, there are still many areas in the United States where the public is exposed to unhealthy levels of air pollutants, most notably ozone (O_3) and fine particulate matter ($PM_{2.5}$). The cost of poor air quality to the United States from pollution-related illnesses alone has been estimated at 150 billion dollars. For many citizens, especially those who suffer from respiratory problems, the availability of air quality forecasts (analogous to weather forecasts) could make a significant difference in how they plan their daily activities and in turn improve the quality of their lives. Accordingly, NOAA, which has environmental prediction as one of its core missions, has partnered with EPA, which has the protection of human health and welfare as a core mission, to develop, refine, and disseminate a real-time Nationwide Air Quality Forecast System (NAQFS).

The purpose of this research has been to provide a series of operational evaluations that characterize the performance of numerous iterations of the NAQFS (as it has expanded in both its capacity and coverage), supporting its transition into operational status. The evaluations have utilized a suite of metrics that examine the NAQFS performance of both *discrete forecasts* (observed versus modeled concentrations) for the maximum 8-hour O_3 concentrations (the focus of this poster), and *categorical forecasts* (observed versus modeled exceedances / non-exceedances) for the 8-hour (85 ppb) National Ambient Air Quality Standard. These evaluations typically covered five-month periods (1 May to 30 September) using O_3 concentration measurements obtained from EPA's AIRNow network.

Results of the numerous evaluations indicate that the NAQFS has performed well through its numerous refinements and expansions, and continues to do so. Mean, domain-wide correlations are typically ≥0.70. Values of normalized mean bias and error are generally within 10% and 20%, respectively. However, closer examination of these metrics over finer spatial and temporal scales has revealed some systematic deficiencies with the various NAQFS configurations. Recent examples include southern California, where the NAQFS tends to underpredict O_3 concentrations (especially on weekends), and the southeast Atlantic and Gulf coasts regions, where the model overpredicts. Subsequent analysis revealed that the incorrect temporal allocation of precursor emissions was likely the source of the underprediction in southern California, while inaccurate simulation of PBL heights likely contributed to the overprediction in the coastal regions.

When compared to the evolution of numerical weather prediction's incorporation into weather forecasting, which took decades, the success of this program, which involves numerical O_3 forecasts based on the WRF-CMAQ model, has been realized in a remarkably short time frame.