2.15 Toward a US National Air Quality Forecast Capability: Current and Planned Capabilities

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Abstract In partnership with the US Environmental Protection Agency (EPA), the National Oceanic and Atmospheric Administration (NOAA) has deployed the initial stages of a national air quality forecast capability into the National Weather Service operational suite. Current capabilities provide next-day, hour-by-hour, 12-km resolution predictions of (1) ground-level ozone (O_3) for the Eastern U.S. and (2) smoke for the lower 48 states. These are generated twice daily by NOAA's National Centers for Environmental Prediction with linked weather and air quality models: the NOAA-EPA Community Multiscale Air Quality model driven by NOAA's operational North American mesoscale weather prediction model. Forecast accuracy is verified with O_3 observations compiled by EPA and with satellite-derived smoke observations. Future operational capabilities for nationwide O_3 forecasts are targetted within three years, to be followed by quantitative particulate matter forecasts, and extended forecast periods. Expansion will proceed as rapidly as resources and achievement of required test accuracy permit.

Keywords Air quality forecasts, O_3 forecasts, smoke forecasts, $PM_{2.5}$ prediction

1. Introduction

As mandated by Congress, NOAA is establishing a US national air quality (AQ) forecast capability. This capability is being built in partnership with EPA, to provide AQ forecast information with enough accuracy and lead-time so that people can take actions to limit harmful effects of poor AQ.

NOAA and EPA researchers recently celebrated 50 years of collaboration in AQ research. As a result of this collaboration and related research in atmospheric chemistry modeling, techniques to simulate atmospheric chemical transport driven by numerical weather models had progressed to the extent that by the mid-1990s, NOAA and EPA had built a retrospective modeling capability, the Community Multiscale Air Quality (CMAQ) model (Byun and Schere, 2006) appropriate for state and local agencies' EPA-required analyses of factors affecting air pollution. Several countries, e.g. Canada and Australia, began experimenting with real-time numerical AQ predictions, based on similar photochemical models to predict ground-level O_3 (CHRONOS; Pudykiewicz et al., 1997) and/or Lagrangian transport

C. Borrego and A.I. Miranda (eds.), *Air Pollution Modeling and Its Application XIX.*

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models (HYSPLIT; Draxler and Hess, 1998). In the US, constituents from the public and private sectors urged NOAA to begin providing AQ predictions operationally. Then Congress acted: the Senate passed an amendment to the Energy Policy Act of 2002 which directed NOAA to begin producing operational AQ forecast guidance, for which Congress began directing appropriations to NOAA. NOAA undertook to build this capability in partnership with EPA, to leverage the respective strengths of the two agencies in atmospheric prediction and air pollution science, as formalized in a Memorandum of Agreement for AQ forecasting activeties signed in 2003 by the EPA Administrator and the Deputy Director of the Department of Commerce (NOAA's parent organization).

The initial operational capability, deployed in September 2004, provided next-day O_3 predictions for a Northeast US domain. Additional development and testing succeeded in extending the operational forecast domain to the entire Eastern US (August 2005) and the contiguous 48 states (CONUS) (September 2007). The guidance products (example in Figure 1) provide hour-by-hour predicted ground-level O_3 concentrations, at 12 km grid resolution. Predicted O_3 concentrations are shown on NOAA dataservers and represented by the health-based AQ Index on EPA's AIRNow dataserver. In March 2007, an initial operational capability for smoke predictions over the CONUS was implemented. The smoke predictions, at12km resolution, updated once daily, simulate transport of smoke (O'Neill et al., 2007) from fires detected by satellite. Ongoing development efforts are aimed at expanding the capability to nationwide O_3 and smoke coverage within three years, and to begin providing particulate matter (PM) forecasts within five years.

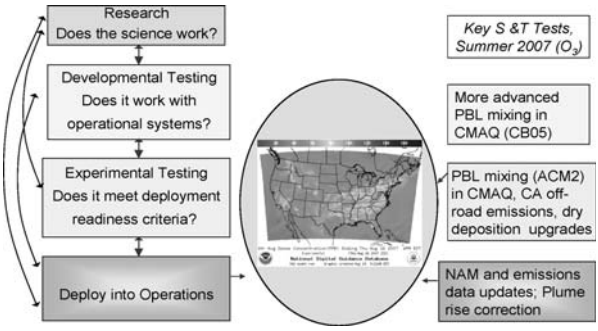

Fig. 1 Development and test phases to prepare for deployment into NWS operations, Summer 2005

Via phased development, testing, and implementation, the operational AQ forecast capability is being upgraded with advanced science, algorithms, and simulation techniques, in testing with expanded domains and additional forecasted elements. Figure 1 illustrates generalized transition phases employed by the NWS to move research capabilities into operations, along with specific tests during 2005 that led to the first expansion of the initial operational capability. To ensure required operational product accuracy and reliability, specific operational readiness benchmarks must be demonstrated within objective verification, subjective feedback, and engineering readiness categories. Some of the summer 2005 test improvements (e.g. better treatment of large-scale convective processes) to the AQ forecast system were needed merely to maintain required forecast accuracy over larger domains – contrary to expectation, initial developmental testing over expanded domains did