

Potential Performance differences of the National Air Quality Forecasting Capability when upgrading the Chemical Transport Model

Pius Lee¹, Youhua Tang^{1,2}, Daniel Tong^{1,2,3}, Barry Baker^{1,2}, Jeff McQueen⁴, Jianping Huang^{4,5}, Ho-Chun Huang^{4,5}, Jose Tirado-Delgado^{6,7}, and Ivanka Stajner⁴

¹ NOAA/Air Resources Laboratory, College Park, MD,

² UMD/Cooperative Institute for Climate and Satellites, College Park, MD,

³ Center for Spatial Information Science and Systems, George Mason University, Fairfax, VA

⁴ National Oceanic and Atmospheric Administration (NOAA), National Centers for Environmental Prediction (NCEP), College Park, MD

⁵ I.M. Systems Group Inc., Rockville, MD

⁶ NOAA, Office of Science and Technology Integration, Silver Spring, MD

⁷ Syneren Technologies Corporation, Arlington, VA

Abstract

The National Oceanic and Atmospheric Administration (NOAA) National Air Quality Forecasting Capability (NAQFC) is a vital service that NOAA provides to safeguard public health as well as environmental resilience through information-driver mitigation, and remedial and adaptation actions. The NAQFC system is under a study to potentially upgrade its Chemical Transport Modeling component from using the Community Multiscale Air Quality Model (CMAQ) version 5.0.2 to version 5.2. This is a major upgrades in chemistry and their corresponding emission sciences. The following lists the major science upgrades: (a) upgrade of the gas chemistry for the Carbon-Bond Mechanism version 5 (CB05) to version 5 Revision1 (CB05R1); (b) Inclusion of Halogen chemistry; (c) Employment of more explicit speciation for isoprene and monoterpenes from biogenic sources; (d) Upgrade of the aerosol module using a more sophisticated secondary aerosol production suite of multi-generational oxidation mechanism; and (e) Application of a fuller set of National Emission Inventory (NEI) that aligns better with CMAQ version 5.2 from the base year of 2014. We tested the new system for a retrospective summer case and compared its forecast performance with the real-time operational NAQFC. The U.S. Environmental Protection Agency (EPA) AIRNow monitoring network was used to verify the forecast accuracy. We noticed considerable discrepancies in the performance of the two realization of forecasting simulations. Their performance statistical metrics were compared and ranked to provide a basis for implementation recommendation.