Comparison Evaluation of Two Leading Photochemical Air Quality Models for Particulate Matter

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USEPA's Air Quality Modeling Group at Office of Air Quality Planning and Standards has been undertaking a series of model application and evaluation efforts over multiple (urban, regional, and continental) scales using the Regional Modeling System for Aerosols and Deposition (REMSAD) developed by ICF Consulting/Systems Applications International and Models-3/Community Multi-scale Air Quality (CMAQ) modeling system developed by USEPA. The comparison evaluation of these two leading photochemical air quality models is to ascertain the feasibility of using either modeling system for applications on particulate matter (PM2.5) as well as other criteria pollutants such as ozone.

An annual 2001 simulation was conducted over the continental US. Both CMAQ and REMSAD were run with the same inputs, to the extent possible given somewhat differing requirements of each model. The 2001 modeling platform used for both models consisted of a 36 km model resolution for a Lambert conformal horizontal domain with 14 vertical layers. Identical inputs include: boundary/initial concentrations from global chemistry model (GEOS-CHEM); biogenic emissions (MCIP v2.2 outputs / BEIS 3.12); anthropogenic emissions based NEI 1999 (SMOKE); 2001 meteorological data (MM5 v3.6.1/ MCIP v2.2).

Model evaluation will include comparing ambient PM speciation data from observational networks such as the Clean Air Status and Trends Network (CASTNet), Interagency Monitoring of Protected Visual Environments (IMPROVE), Speciation Trend Network (STN), and the National Atmospheric Deposition Program (NADP) network data in 2001. Statistical significance and spatial patterns of pollutants (concentration and deposition) will also be considered in determining the advantages and disadvantages of both models. Preliminary results show that both models simulated the summer sulfate PM very well in the east (when sulfate PM was the dominant PM2.5 species), though REMSAD under predicts moderately. Both models under predict sulfate PM in the west. Similar performance across both models was observed when simulating the total nitrate reasonably well (nitrate PM and nitric acid, HNO3), while both models over predict nitrate PM moderately in the east and under predict in the west. For organic PM during the summer months, CMAQ under predicts in the east whereas REMSAD slightly over predicts. Both models over predict summer organic PM in the rural sites and under predict in the urban sites in the west. Likewise, for winter elemental carbon statistical measures were similar for both models, where both models under predict slightly in the east and under predict in the west.