The impact of more complexity in aerosol and chemistry modules on the aerosol predictions within a global online modeling system

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Theme 1: Operational Forecasting and Communicating Impacts

The global Flow-following finite-volume Icosahedra Model (FIM), which was developed in the Global Systems Division of NOAA/ESRL, has been coupled online with aerosol and gas-phase chemistry schemes (FIM-Chem). Within the aerosol and chemistry modules FIM-Chem handles wet and dry deposition, simple aqueous phase chemistry, biogenic emissions, biomass burning, dust and sea-salt. FIM-Chem is able to simulate and forecast aerosol and gas-phase species at various spatial resolutions and with different levels of complexity. For our tests we tried approximate horizontal resolutions of 240x240 km, 120x120 km, 60x60 km and 30x30 km). Currently, ESRL produces experimental 7 day forecasts twice a day in real-time on 60km global resolution (http://fim.noaa.gov/FIM/Welcome.cgi?dsKey=fimx_jet). The simplest aerosol modules are from the Goddard Global Ozone Chemistry Aerosol Radiation and Transport (GOCART) model that includes only simplified sulfur chemistry. The photochemical gas-phase mechanism RACM was included to determine the impact of the additional complexity on the aerosols simulations. We compare the more sophisticated chemistry and aerosol package (GOCART_RACM) with the simpler package (GOCART) that uses the default climatological model fields for OH, H_2O_2, and NO_3 to calculate sulfate production rates. The $PM_{2.5}$ and PM_{10} concentrations show enhancements over major polluted areas. Because of online chemistry and updated emissions, reductions of sulfate are on the order of 40 to 80% over the eastern US and are up to 40% near the Beijing region over China when using GOCART_RACM. In both locations, there are large sulfate reductions in the main source regions, but small increases for larger areas downwind. Additional work is ongoing to evaluate a more complex aerosol model that includes secondary organic aerosol formation based on the volatility basis set approach.