Inclusion of Aerosol Impacts on Medium-Range Forecasts of Weather and Air Quality in the Flow-Following Finite Volume Icosahedral Model (FIM) Global Model

G. Grell[1], S. Freitas[2], S.G. Benjamin[3], R. Bleck[1], J. Lee[3], J.M. Brown[3], T. Henderson[4] and J.-W. Bao[3]

[1]Cooperative Institute for Research in Environmental Sciences, University of Colorado, Boulder, CO 80309; 303-497-6924, E-mail: Georg.a.Grell@noaa.gov
[2]Brazilian National Space Institute (INPE), Center for Numerical Weather Forecast and Climate Studies (CPTEC), Cachoeira Paulista, Brazil
[3]NOAA Earth System Research Laboratory, Boulder, CO 80305
[4]Cooperative Institute for Research in Atmospheres, Colorado State University, Fort Collins, CO 80521

Development of the FIM, the NOAA ESRL's new global model for medium-range weather forecasting, is now being extended to include aerosols, trace gases, and the impact of wild fires on air quality and weather. The FIM uniquely combines 3 key modeling design components (icosahedral horizontal grids, isentropic-hybrid vertical coordinate, finite volume numerics), all critical to provide improved transport over existing models (e.g. Global Forecast System – GFS). The isentropic-hybrid vertical coordinate is “flow-following” in that the vertical coordinate surfaces follow isentropic (constant potential temperature) surfaces through most of the atmosphere, from mid-troposphere upward to the model top (current testing at ~60 km). Inclusion of simple chemistry, aerosols and wildfire effects requires development of a numerical tool to generate emission data for several types of grid projection for global and regional models. Sources emission for anthropogenic (industrial, urban, transportation, biomass burning, charcoal production, waste burning, etc) and biogenic processes uses a set of published data and methodologies (e.g., RETRO, EDGAR, GEIA-POET, 3BEM, GFEDv2). In particular, the Brazilian biomass burning emission model (3BEM) uses remote sensing fire count data together with global carbon density to determine the timing, location, and intensity of fire emissions as well as information to initiate the plume rise module. Emissions of dust are included using the method from the Goddard Chemistry, Aerosol, Radiation and Transport model. Aerosol interaction with atmospheric radiation is included using the GFS physics. We will show results from runs with and without the aerosol direct effect, and focus on tropical regions that exhibit large areas with emissions from wild fires and dust.

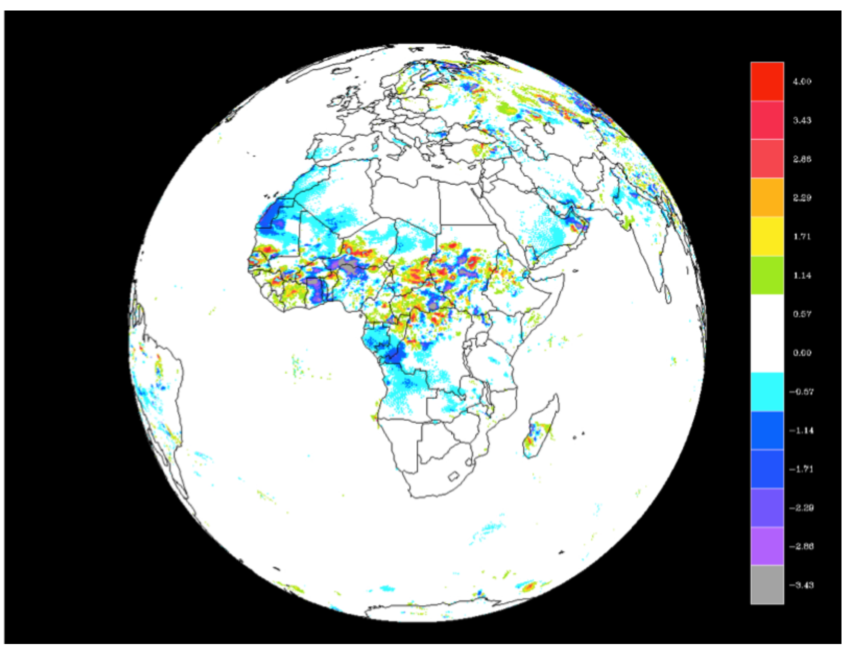

Figure 1. Surface temperature difference caused by aerosol direct effect for a 120 hr forecast using the FIM-Chem.