Development of the FIM (Flow-Following Finite Volume Icosahedral Model) Global Model Toward an Earth System Model Including Inline Treatment of Aerosols and Trace Gases

S.G. Benjamin[1], G.A. Grell[2], R. Bleck[2], J.L. Lee[1], J.W. Bao[1], T.G. Smirnova[2], J.M. Brown[1], T.B. Henderson[3], J.F. Middlecoff[3], C.W. Harrop[2], N. Wang[3], A.E. MacDonald[1] and A.R. Jacobson[2]

[1]NOAA Earth System Research Laboratory, 325 Broadway, Boulder, CO 80305; 303-497-6387, E-mail: stan.benjamin@noaa.gov
[2]Cooperative Institute for Research in Environmental Sciences, University of Colorado, Boulder, CO 80309
[3]Cooperative Institute for Research in Atmospheres, Colorado State University, Ft Collins, CO 80521

Development of the FIM, ESRL's new global model, is now being extended beyond medium-range weather forecasts to include aerosols and trace gases. 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). This design greatly reduces cross-coordinate transport and resulting artificial numerical dispersion over that in most other atmospheric models. Atmospheric forecasts from the FIM now generally match those from the NCEP GFS model, necessary for planned inclusion of FIM as part of NCEP's Global Ensemble Forecast System. The FIM-chem inline coupled model is now in development, starting with a simple aerosol model from the GOCART including a global emissions inventory. (demo FIM-chem 3-day forecast in figure below). ESRL scientists from all four divisions are planning toward extension of FIM-chem to add trace gases, and also working toward a possible ocean component, and new land-surface, cloud, and boundary-layer parameterizations. This gives FIM potential for becoming an Earth Systems Model research tool, as well as having a real-time prediction capability.

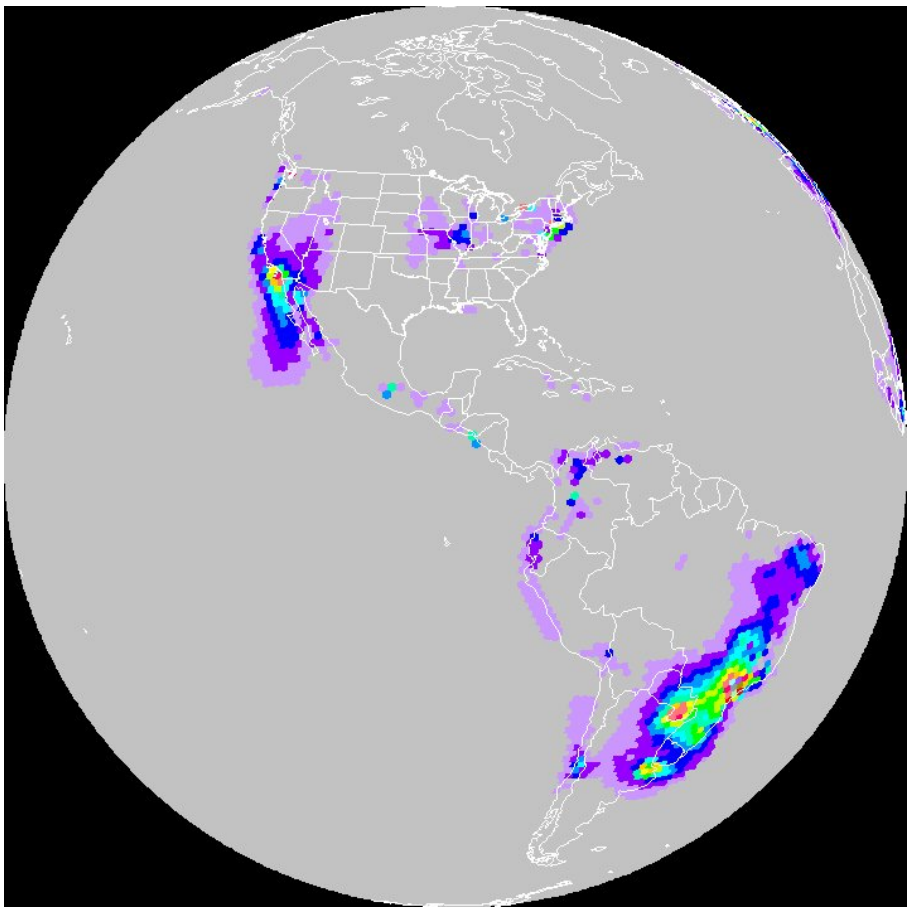

Figure 1. 3-day forecast of organic carbon aerosol at approximately 120 hPa above surface from preliminary FIM-chemistry global model developed in ESRL.