8.3 Towards the next generation integrated meteorology and atmospheric chemistry model

Pleim, J., R. Mathur, *United States Environmental Protection Agency;* M. Otte, *CSC,* Jia Xing, *NRC;* C. Nolte, D. Wong, and Rob Gilliam, *United States Environmental Protection Agency*

In recent years it has become increasingly evident that many air quality issues are influenced by processes operating on a range of spatial scales, from global to local. Current modeling typical focuses on limited area rectangular Eulerian grid configurations with multiple nested grids to telescope down from continental domains to local urban areas at much higher resolution. The specification of lateral boundary conditions (LBCs) for the outermost domain are typically derived from a different coarse resolution global model simulation and interpolated in space and time for the limited area model (LAM). There is also usually a need to map chemical species from the global model to LAM since they typically have different representations of chemical mechanisms. Since transport is efficient in the free troposphere, errors from larger scale models often propagate and influence the LAM calculations, thereby confounding interpretation of results. Thus, not only does the LAM inherit the errors of the global model but there are also additional errors due to interpolation and species mapping. Recently, we have developed a hemispheric version of WRF-CMAQ to reduce the errors in providing LBCs to the regional model. A new vision for the next generation system is to develop an integrated meteorology and atmospheric chemistry model that can span all spatial scales from global down to the mesoscale limit of about 1 km on a single grid eliminating the need for LBC specification in grid nesting. Examples of such systems for meteorology are already in use such as MPAS and OLAM. Both models use an unstructured variable resolution Voronoi mesh with non-hydrostatic dynamics.

We will present the needs and rationale for a global modeling system with examples from our current multiscale WRF-CMAQ system using a hemispheric outer domain to provide LBCs to a continental grid and a series of nested grids down to 1 km resolution over local areas such as the Richmond-Washington-Baltimore-Philadelphia corridor. We will also show examples of new modeling results from a prototype of the OLAM model with integrated photochemistry from CMAQ. The new OLAM-Chem demonstrates seamless grid refinement for atmospheric chemistry and transport on a global domain with high resolution refinement in regions of North America.