Linking CMAQ to Watershed/Estuarine Models (5.2)

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The key environmental issue addressed by this research is the improved estimation of ecosystem exposure to air pollutants. Atmospheric wet and dry deposition can be important nonpoint-source contributors to total pollutant loadings to water bodies, through both direct deposition to water bodies and deposition to watersheds with subsequent transport into water bodies, leading to harmful effects on ecosystems. Acidification of lakes and streams, caused primarily by atmospheric deposition of sulfur and reactive nitrogen, drives a number of adverse effects in aquatic and terrestrial ecosystems; these include reductions in species diversity, increased vulnerability of forest species to pests and diseases, and shifts in species composition. Atmospheric deposition of reactive nitrogen can be an important source of unintended fertilization, leading to eutrophication in coastal ecosystems. For exposure to occur, the stressor and the receptor must come together at the same time and in the same place, followed by uptake. Other ORD Laboratories perform research to quantify the uptake process. AMAD research is improving estimates of stressor exposure through improved characterization of wet and dry nitrogen deposition on ecosystem-relevant temporal and spatial scales, through incorporation of more detailed vegetation-class location and extent information into the CMAQ model, and through the development of land-cover-specific deposition estimates.

Examples of products and tools developed through this research are presented. The first example is the Watershed Deposition Tool (WDT), which allocates CMAQ gridded deposition results to HUCs (hydrological units) or other user-defined polygons; these can then be used for Total Maximum Daily Load (TMDL) and other nonpoint-source watershed analyses. Next, an example from a new National Land Cover Database (NLCD 2001) illustrates our improved ability to identify the location and extent of aggregate vegetation classes. Adoption of these new data increases CMAQ model consistency with watershed model inputs, and improves our ability to address issues of interest to the ecosystem services research community. Ecosystem services include products such as clean air, clean water, productive soils and generation of food and fiber for which there is a human demand and to which an economic value can be assigned. Finally, we present an example of vegetation-specific deposition results generated through application of a mosaic modeling approach.

AMAD is advancing the modeling science as well as building the tools and databases needed to facilitate the linkage of CMAQ to watershed and estuarine models, although further work is needed to implement, test, and evaluate these advances. Ongoing interaction with clients and cross-laboratory collaboration ensure that research outputs will support management decisions leading to more positive ecosystem health and service outcomes.