Providing Guidance and Advice to the Ecosystem Management Community Using CMAQ as a Laboratory (5.3)

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Atmospheric deposition of sulfur and nitrogen is a key contributor to ecosystem exposure and degradation, causing acidification of lakes and streams and eutrophication of coastal systems. Reductions in atmospheric deposition of sulfur and oxidized nitrogen due to human-health-driven regulations in the 1990 Clean Air Act Amendments (termed the Clean Air Act (CAA)) are expected to significantly benefit efforts to improve water quality. However, water quality managers are not taking advantage of information on anticipated deposition reductions in developing their management plans. Managers need to understand what to expect from atmospheric emissions and deposition. This understanding must come from an air quality model utilized as a laboratory; it cannot come from measurements. The goal is to bring air quality into ecosystem management through regional air quality modeling and to facilitate the air-ecosystem linkage. Through identification of basic management questions, we define what research and tool developments for the air quality modeling system are needed to make the linkage functional and the air-ecosystem modeling applicable and useful.

Our approach is to collaborate with select, motivated air-water partners who are willing to work together to provide a test laboratory with the atmospheric model to explore, assess, and apply improved techniques to advance water quality management goals and test linkage approaches. We develop an understanding of the needs of the water quality managers through real-world experience/participation with model applications. We then design model analyses and sensitivity studies to identify and direct what atmospheric science needs to deliver. Results help provide answers to nearly universal questions uncovered in the course of the application studies: How much is depositing? Who and where is the deposition from? How much will deposition change due to air quality regulations in the face of population and economic growth? Guidance on several fronts has been developed. For example:

- Local solutions are not very effective.
- Long-range transport dominates, so regional approaches are necessary.
- The uncertainty in ammonia emissions/concentrations is very important.
- CAA reductions are expected to be significant.

Air deposition reductions are now a vital component of Chesapeake Bay Program's restoration efforts. Critical air deposition information has also been provided to the Tampa Bay Estuary Program to address its Total Maximum Daily Load (TMDL) needs and assessment goals. Our efforts have opened the door for water quality managers to include air deposition and make their management plans more efficient and effective. The work has paved the way for using CMAQ in national NO_x-SO_x regulatory assessments to protect ecosystems, and for using CMAQ in U.S. critical loads analyses.