State-Level Oxidized Nitrogen Source Attribution from CMAQ for the Chesapeake Bay TMDL Process to Support Air-Water Trading

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Atmospheric deposition reductions from national CAA rules on NOx such as the Clean Air Interstate Rule (CAIR) are factored into the Chesapeake Bay Total Maximum Daily Load (TMDL) allocations. In their State Implementation Plans (SIPs) States may, however, go beyond national CAA rules to meet CAA air quality standards locally. The tributary nitrogen load reductions allocated to the states to meet the TMDL target for Chesapeake Bay are large and not easy to attain via controls on water point and nonpoint sources. It could be important to the TMDL process to take advantage of air emissions reductions that would occur with SIPs that go beyond the national air rules. The additional air deposition reductions could then be used to offset water quality controls (air-water trading). What is needed is a source to receptor transfer function that connects emissions from a state to deposition to a tributary. We would like to do this without having to run the regional air quality model many times over because it is computationally expensive. There is a special source attribution version of CMAQ (DDM-3D) that can estimate the fraction of deposition contributed by labeled emissions (labeled by source or region) to the total deposition across space. We use the CMAQ DDM-3D version to set up simplified state-level delta emissions–to-delta atmospheric deposition transfer coefficients by major source sectors within a state, since air regulations are generally at the state level. The CMAQ 4.7.1 calculations are performed at a 12 km grid size over the airshed domain covering Chesapeake Bay for 2020 CAIR emissions. For results, we first present the fractional contributions of state NOx emissions to the oxidized nitrogen deposition to the Chesapeake Bay watershed and Bay. We then present example tables of the fractional contributions of state NOx emissions from mobile, off road, power plant and industrial emissions to key tributaries: the Potomac, Susquehanna and James Rivers. Finally, we go through an example for a mobile source NOx reductions in Pennsylvania to show how the tributary load offset would be calculated using the factors generated by CMAQ DDM-3D.

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