Atmospheric Chemistry Transport Modeling of Organic Nitrogen Input to the Ocean

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Atmospheric deposition of reactive nitrogen (N) species from air pollutants is a significant source of exogenous nitrogen in marine ecosystems. Here we use a process-based chemical transport model to investigate global supply of soluble organic nitrogen (ON) from continental sources to the ocean. The present-day emissions of NO, NH_3, and the primary ON are 46, 42, and 11 Tg N yr^{-1}. Comparisons of modeled deposition with observations at coastal and marine locations show overall good agreement for inorganic nitrogen and total nitrogen, but significant underestimates for ON when we explicitly calculated volatile ON and particulate ON in the model. The model results suggest that including soluble ON potentially emitted with carbonaceous aerosols and/or transformed from NH_4^+ on carbonaceous and dust aerosols contributes to a better predictive capability of the deposition rates. The estimated annual total deposition rates of ON to the ocean range from 0.9 to 5.9 Tg N yr^{-1}, depending on the solubility at emission and/or the transformation on aerosols. The model results show a clear distinction in the vertical distribution of ON between different sources (i.e., the primary or secondary formation). These results highlight the necessity of improving the process-based quantitative understanding of the solubility of ON in emitted particles and

the chemical reactions of inorganic nitrogen species with organics in aerosol and cloud water.