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The Impact of Nutrient Inputs from Atmospheric and Riverine Sources on Oceanic Nitrous-oxide

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Nitrous-oxide (N2O) is a major greenhouse gas, and an important agent of stratospheric ozone depletion. Ocean emissions of nitrous-oxide account for over a quarter of present-day global natural N2O emissions to the atmosphere. This marine N2O source results from a combination of nitrification and denitrification reactions associated with the cycling of organic matter in the oxygenated and sub-oxic regions of the ocean. In addition, in intense sub-oxic and anoxic ocean zones, denitrification processes can provide a local sink of nitrous-oxide. It has been suggested that significant shifts in the global ocean-atmosphere N2O flux could result from changes in nutrient inputs to the ocean that stimulate marine productivity and hence influence N2O cycling and the net oceanic source to the atmosphere.

In this analysis we employ the NEMO-PlankTOM10 global ocean biogeochemistry model, in conjunction with embedded representations of the ocean N2O cycle, to assess the relative influences, on present-day ocean N2O, of nutrient inputs to the ocean from atmospheric deposition and riverine fluxes. Specifically, we investigate nutrient forcing from contrasting sources including anthropogenic atmospheric deposition of NO_y and NHx (Dentener et al 2006), atmospheric dust deposition (Jickells et al. 2005), and riverine inputs of Fe, Si, N, P, and organic and inorganic carbon (da Cunha et al. 2007). Model analyses are used to quantify the relative influences of these separate nutrient inputs on the net oceanic N2O source. We also characterize the uncertainty in our results associated with our modeled representation of N2O by evaluating the sensitivity to a set of empirically-based and process-based parameterizations of the marine N2O cycle.