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# Impact of increased anthropogenic atmospheric nitrogen deposition on ocean biogeochemistry

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In the last century, the strong increase in anthropogenic emissions and agricultural activities brought about a tripling in atmospheric nitrogen deposition (AND) rates to oceans. There is growing evidence for a strong fingerprint of increased AND on aquatic systems. Increases in excess N over P (N*) have been attributed to the growing anthropogenically sourced N-deposition in the North western Pacific (Kim et al. 2011) and the North Pacific (Kim et al. 2014). In this study, we use the ocean component of the global earth system model CESM and forced it with transient atmospheric nitrogen deposition from 1850 to 2000 (Lamarque et al. 2013) to study the impact of increased N-deposition on ocean biogeochemistry. We simulate detectable signals in N* in the northern hemisphere as well as a complex pattern of increases and decreases in ocean productivity, with the former causing an expansion of oxygen minimum zones and an increase in water column denitrification. The increase in AND also reduces the ecological niches for N2-fixers, causing a substantial decrease in global ocean N-fixation. Despite this increase in N-loss by denitrification and decrease in N-gain by N-fixation, the increase in AND has put the global marine N-budget severely out of balance ( 10 $TgN.yr^{-1}$). Finally, we extend our simulation to 2100 using the RCP 8.5 emission scenario to find that these changes will probably grow in the future.