

Increasing anthropogenic nitrogen in the North Pacific and North Atlantic Oceans

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The recent increase in anthropogenic emissions of reactive nitrogen and the subsequent enhanced deposition over the extensive regions of the North Pacific and North Atlantic Oceans has led to a detectable increase in the nitrate (N) concentration of the upper ocean. The rate of increase of excess N relative to phosphate (P) was highest in the vicinity of the source continent, with rates decreasing eastward across the basins, consistent with the magnitude and distribution of atmospheric nitrogen deposition. This increase in the N content of the upper ocean may enhance primary production in these N limited regions, potentially leading to a long-term change of these regions from being N-limited to P-limited. Our results suggest that the input of airborne pollutant nitrogen has been a major driver of the temporal dynamics of seawater N content relative to P in the North Pacific and North Atlantic upper ocean over the past half century.