EGU2020-19425
https://doi.org/10.5194/egusphere-egu2020-19425
EGU General Assembly 2020
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Changing atmospheric acidity as a modulator of nutrient deposition and ocean biogeochemistry

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Anthropogenic emissions of nitrogen and sulphur oxides and ammonia have altered the pH of aerosol, cloud water and precipitation, with significant decreases over much of the marine atmosphere. Some of these emissions have led to an increased atmospheric burden of reactive nitrogen and its deposition to ocean ecosystems. Changes in acidity in the atmosphere also have indirect effects on the supply of labile nutrients to the ocean. For nitrogen, these changes are caused by shifts in the chemical speciation of both oxidized (NO_3^- and HNO_3) and reduced (NH_3 and NH_4^+) forms that result in altered partitioning between the gas and particulate phases that affect transport. Other important nutrients, notably iron and phosphorus, are impacted because their soluble fractions increase due to exposure to low pH environments during atmospheric transport. These changes affect not only the magnitude and distribution of individual nutrient supply to the ocean but also the ratios of nitrogen, phosphorus, iron and other trace metals in atmospheric deposition. Since marine microbial populations are sensitive to nutrient supply ratio, the consequences of atmospheric acidity change include shifts in ecosystem composition in

addition to overall changes in marine productivity. Nitrogen and sulphur oxide emissions are decreasing in many regions, but ammonia emissions are much harder to control. The acidity of the atmosphere is therefore expected to decrease in the future, with further implications for nutrient supply to the ocean.

This presentation will explore the impact of increased atmospheric acidity since the Industrial Revolution, and the projected acidity decreases, on atmospheric nutrient supply and its consequences for the biogeochemistry of the ocean.