Acid Rain severely impacts Coastal Water

According to recent research, the impact of anthropogenic nitrogen and sulphur deposition on ocean acidification is minor on a global scale. Nevertheless, the impacts are more substantial in coastal water, which is more vulnerable, and therefore more affected due to pollution, overfishing and climate change.

Ocean acidification occurs when certain chemical compounds such as carbon dioxide, sulphur, or nitrogen mix with sea water, resulting in a decrease of the pH and a reduction in the storage of carbon. This can hamper the ability of certain marine organisms to use calcium carbonate for making hard outer shells or “exoskeletons”. Humans are changing the nitrogen and sulphur cycle through the emission of large quantities of nitrogen oxides, ammonia and sulphur dioxide to the atmosphere. Much of this anthropogenic sulphur and nitrogen, mainly generated by fossil fuel combustion and agriculture, is deposited after chemical transformation in the atmosphere on land, in coastal areas and in the open seas. Most studies have previously focussed on the impacts and role of carbon dioxide in ocean acidification, which is believed to be the most important issue, but little is known about the impact of nitrogen and sulphur deposition.

American researchers have recently analysed the impacts of anthropogenic atmospheric nitrogen and sulphur deposition on ocean acidification and the inorganic carbon system. To this end, they used an atmospheric and ocean model to simulate where the nitrogen and sulphur emissions were likely to have the most important impact. They also compared the results of their model with the observations made by other scientists in the coastal waters of the United States.

The results suggest that the net atmospheric input from anthropogenic nitrogen and sulphur is acidic almost everywhere. This drives a net sea-air efflux of CO$_2$, which in turn reduces surface dissolved inorganic carbon (DIC). Additionally, excess nitrogen inputs have a fertilizing effect, promoting the growth of phytoplankton and other marine plants. This in turn might cause more algae blooms and result in eutrophication (creation of oxygen depleted zones). Coastal waters also get excess anthropogenic nutrients from river water runoff. These two source pathways exacerbate the eutrophication problem. Nevertheless, on a global scale, changes to seawater chemistry due to anthropogenic nitrogen and sulphur deposition represent a small percentage compared with the changes due to the deposition of CO$_2$.

On the other hand, the results show that the impacts of anthropogenic nitrogen and sulphur on seawater chemistry can be much more important in coastal waters, in a range of 10%–50% of the total changes caused by the oceanic uptake of anthropogenic CO$_2$.

Overall, this study provides evidence of first-order impacts associated with anthropogenic nitrogen and sulphur, in particular in coastal waters. It highlights the need to also consider the effects of non-CO$_2$ sources of acidification coming from atmospheric nitrogen and sulphur deposition.


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