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Atmospheric deposition and river runoff stimulate the utilization of dissolved organic phosphorus in coastal seas

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In coastal seas with relatively abundant macronutrients and trace metals, the role of atmospheric deposition and river runoff in biological DOP utilization is not well understood. Here, we address this knowledge gap by combining microcosm experiments with a global approach considering the relationship between the activity of alkaline phosphatases and changes in phytoplankton biomass in relation to the concentration of dissolved inorganic phosphorus (DIP). Our results suggest that the addition of aerosols and riverine water stimulate the biological utilization of DOP in coastal seas primarily by depleting DIP due to increasing nitrogen concentrations, which enhances phytoplankton growth. This “Anthropogenic Nitrogen Pump” was therefore identified to make DOP an important source of phosphorus for phytoplankton in coastal seas but only when the ratio of chlorophyll a to DIP [$\text{Log}_{10}(\text{Chl a} / \text{DIP})$] is larger than 1.20. Our study therefore suggests that nitrogen input through atmospheric and riverine sources might contribute to the phosphorus cycle in coastal seas.