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Environmental control of marine phytoplankton C:N stoichiometry in the North Atlantic Ocean today and under climate change

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The stoichiometric coupling of carbon to limiting nutrients in marine phytoplankton determines that of the main biogeochemical cycles through the process of biomass production by the phytoplankton. While clear links between phytoplankton stoichiometry and environmental drivers have been identified, the nature and direction of these links, as well as the underlying physiological and ecological mechanisms, remain uncertain. Here we compare the predictions of a well-constrained mechanistic model of plankton ecophysiology to multiple observational data sets to investigate the specific case of the C:N phytoplankton stoichiometry in the North-Atlantic. We show that N availability and temperature emerge as the main drivers of phytoplankton stoichiometry. The biological mechanisms involved however vary depending on the spatiotemporal scale and region considered, leading to opposite predictions regarding the evolution of phytoplankton primary productivity in response to environmental changes. At low to intermediate latitudes phytoplankton stoichiometry is predominantly driven by ecoevolutionary shifts in the functional composition of the phytoplankton communities while phytoplankton stoichiometric plasticity in response to dropping temperatures and increased grazing pressure dominates at higher latitudes. Those results shine a new light on what currently influences the circulation of elements through marine ecosystems but also have great implications regarding the evolution of oceans' primary productivity and of the main biogeochemical cycles under a regime of climate change.