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# Marine biogeochemical responses to the North Atlantic Oscillation in a coupled climate model

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In this study we use a coupled ocean-atmosphere general circulation model containing interactive marine biogeochemistry to analyze interannual, lagged, and decadal marine biogeochemical responses to the North Atlantic Oscillation (NAO), the dominant mode of North Atlantic atmospheric variability. The coupled model adequately reproduces the present-day climate and NAO atmospheric variability. We show that marine biogeochemical responses to the NAO are governed by different mechanisms according to the time scale considered. On interannual time scales, changes in air-sea heat fluxes affect ocean vertical mixing patterns, which in turn influence phytoplankton growth through light and nutrient limitation mechanisms. At subpolar latitudes, deeper mixing occurring during positive NAO winters causes a 10-20% increase in spring chlorophyll concentration and an amplification of its seasonal cycle. In general the biogeochemical lagged response to high NAO index winters is limited in subsequent years. An exception however occurs at middle latitudes where altered subsurface nutrient reservoirs affect downstream chlorophyll concentration with one year lag. On decadal time scales, local and remote mechanisms act contemporaneously in determining the chlorophyll response to the NAO. This occurs through the slow adjustment of ocean circulation to NAO wind stress curl changes, which causes a basin redistribution of sea surface physical and biogeochemical properties.