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Multidecadal trend of increasing iron stress in Southern Ocean phytoplankton

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Abstract

Southern Ocean primary productivity is principally controlled by adjustments in light and iron limitation, but the spatial and temporal determinants of iron availability, accessibility, and demand are poorly constrained, which hinders accurate long-term projections. We present a multidecadal record of phytoplankton photophysiology between 1996 and 2022 from historical in situ datasets collected by Biogeochemical Argo (BGC-Argo) floats and ship-based platforms. We find a significant multidecadal trend in irradiance-normalized nonphotochemical quenching due to increasing iron stress, with concomitant declines in regional net primary production. The observed trend of increasing iron stress results from changing Southern Ocean mixed-layer physics as well as complex biological and chemical feedback that is indicative of important ongoing changes to the Southern Ocean carbon cycle.