EGU2020-21107
https://doi.org/10.5194/egusphere-egu2020-21107
EGU General Assembly 2020

Productivity and carbon export potential in the Weddell Sea, with a focus on the waters near Larsen C Ice Shelf

Raquel Flynn[1], Jessica Burger[1], Shantelle Smith[1], Kurt Spence[1], Thomas Bornman[2,3], and Sarah Fawcett[1]

[1]Department of Oceanography, University of Cape Town, South Africa
[2]South African Environmental Observation Network: Elwandle Coastal Node
[3]Institute for Coastal and Marine Research, Nelson Mandela University, South Africa

Net primary production (NPP) is indicative of the energy available to an ecosystem, which is central to ecological functioning and biological carbon cycling. The Southern Ocean's Weddell Sea (WS) represents a point of origin where water masses form and exchange with the atmosphere, thereby setting the physical and chemical conditions of much of the global ocean. The WS is particularly understudied near Larsen C Ice Shelf (LCIS) where harsh sea-ice conditions persist year-round. We measured size-fractionated rates of NPP, nitrogen (N; as nitrate, ammonium, and urea) uptake, and nitrification, and characterized the phytoplankton community at 19 stations in summer 2018/2019, mainly near LCIS, with a few stations in the open Weddell Gyre (WG) and at Fimbul Ice Shelf (FIS). Throughout the study region, NPP and N uptake were dominated by nanophytoplankton (3-20 µm), with microphytoplankton (>20 µm) becoming more abundant later in the season, particularly at FIS. Here, we observed high phytoplankton biomass and diversity, and the community was dominated by diatoms known to enhance carbon export (e.g., *Thalassiosira spp.*). At LCIS, by contrast, the community comprised mainly *Phaeocystis Antarctica*. In the open WG, a population of small and weakly-silicified diatoms of the genus *Corethron* dominated the phytoplankton community. Here, euphotic zone-integrated uptake rates were similar to those at LCIS even though the depth-specific rates were lower. Mixed-layer nitrification was below detection at all stations such that nitrate uptake can be used as a proxy for carbon export potential *sensu* the new production paradigm – this was highest near FIS in late summer. Our observations can be explained by melting sea ice near the ice shelves that supplies iron and enhances water column stratification, thus alleviating iron and/or light limitation of phytoplankton and allowing them to consume the abundant surface macronutrients. That the sea ice melted completely at FIS but not LCIS may explain why late-summer productivity and carbon export potential were highest near FIS, more than double the rates measured in early summer and near LCIS. The early-to-late summer progression near the ice shelves contrasts that of the open Southern Ocean where iron is depleted by late summer, driving a shift towards smaller phytoplankton that facilitate less carbon export.