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High-resolution view of the spring bloom initiation and net community production in the Subantarctic Southern Ocean using glider data

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Abstract

In the Southern Ocean, there is increasing evidence that seasonal to subseasonal temporal scales, and meso- to submesoscales play an important role in understanding the sensitivity of ocean primary productivity to climate change. This drives the need for a high-resolution approach to resolving biogeochemical processes. In this study, 5.5 months of continuous, high-resolution (3 h, 2 km horizontal resolution) glider data from spring to summer in the Atlantic Subantarctic Zone is used to investigate: (i) the mechanisms that drive bloom initiation and high growth rates in the region and (ii) the seasonal evolution of water column production and respiration. Bloom initiation dates were analysed in the context of upper ocean boundary layer physics highlighting sensitivities of different bloom detection methods to different environmental processes. Model results show that in early spring (September to mid-November) increased rates of net community production (NCP) are strongly affected by meso- to submesoscale features. In late spring/early summer (late-November to mid December) seasonal shoaling of the mixed layer drives a more spatially homogenous bloom with maximum rates of NCP and chlorophyll biomass. A comparison of biomass accumulation rates with a study in the North Atlantic highlights the sensitivity of phytoplankton growth to fine-scale dynamics and emphasizes the need to sample the ocean at high resolution to accurately resolve phytoplankton phenology and improve our ability to estimate the sensitivity of the biological carbonpump to climate change.