Insights on the Biological Carbon Pump from high resolution glider measurements

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Abstract (Oral Presentation)

The ocean biological carbon pump (BCP) is an important component of the carbon cycle; without it, atmospheric CO2 would be ~50% higher than it is now. Despite its importance, our understanding of the BCP is restricted given the scarce observations, limited by ship-board measurements or sediment traps moored at one given location. Recent work has highlighted the importance of variability in particulate organic carbon (POC) export on timescales from days to months. The long endurance capabilities of gliders, together with the ability to sample in Oral high spatial and temporal resolution, make them the ideal platform to fill some of the gaps left by classical measurements.

This study, part of the GOCART (Gauging Ocean organic Carbon fluxes using Autonomous Robotic Technologies) project, aims to evaluate the drivers of the spring bloom and understand the dynamics of the consequent carbon export in an iron enriched region of the Southern Ocean near the island of South Georgia. Waters around South Georgia are characterized by large and recurrent phytoplankton blooms fuelled by pulses of iron coming from the nearby islands. As these blooms are associated with the high estimates of carbon export in the Southern Ocean, understanding the physical controls of primary production and carbon export in this key region is critical to understanding the role of the Southern Ocean in carbon uptake. Three Slocum gliders were deployed between October and February, surveying a small triangular area NW of South Georgia. Gliders captured the transition from winter to summer with the onset of stratification, bloom initiation and consequent carbon export to the mesopelagic. Phytoplankton bloom dynamics were initially controlled by recurrent thermal re-stratification events while the later bloom decline was likely due to nutrient limitation. Post the peak of the bloom and throughout the following month, background chlorophyll fluorescence measured by the gliders gradually increased to a depth of 400 m. Optical backscattering can be used as a proxy for particle concentration in the water column, where spikes can be identified and Oral small and large particle concentration can be separately estimated. The pattern found in chlorophyll fluorescence was also seen in optical backscattering, where Oral small and large particle were found to be sinking to deeper depths in the mesopelagic. These particle dynamics can then be used to determine estimates of carbon flux to the mesopelagic.