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Physical and biogeochemical observations of the Ross Sea polynya using Seagliders during the 2010-2011 austral spring

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The Antarctic is critical in regulating the global marine carbon cycle through its interactions with the atmosphere and its export of deep water. In particular, the Ross Sea is known to be one of the most productive regions of the Southern Ocean, partly due to the persistent large areas of open water, or polynyas, present there. It has been suggested that it is responsible for 28% of the total flux of atmospheric CO_2 and thus has a dominant role in global carbon sequestration. The polynyas remain largely under-sampled due to the challenges caused by sea-ice and weather conditions.

From November 2010 to February 2011, two Seagliders were deployed in the Ross polynya to observe the initiation and evolution of the spring bloom. Seagliders were a novel and effective tool to bypass the sampling difficulties at a fraction of the cost and inconvenience. Equipped with fluorometers, oxygen sensors, CTDs, and the ability to estimate current speeds, the gliders were able to obtain data in the polynya before access was possible by oceanographic vessels. Observations were also obtained along a 40 km transect under pack ice and during a 2 day excursion under the ice shelf.

We present observations of phytoplankton dynamics, export of organic matter and related fluctuations in dissolved oxygen concentrations during the spring bloom in the polynya. A bloom was first observed at the end of November in the McMurdo polynya whilst a much larger diatom bloom began the second week of December in the Ross polynya. A second bloom then started the second week of January with a different planktonic composition at the same location. A small decrease in dissolved oxygen saturation was present as this organic matter was exported. Alongside these data, we show hydrographic sections under the sea ice and the ice shelf. Oceanographic features identified by the Seagliders include mesoscale fronts and eddies. A thermocline formed gradually deepening to about 50m as the sea-ice melted. Strong vertical mixing was observed injecting warm fresh water down to 400m and carrying phytoplankton as far down as 200m.

The high spatial and temporal sampling frequency of Seagliders is compared with what would have been obtained using conventional ship-based surveys, highlighting the importance of scale in oceanographic surveys.