Trends in Net Community Production and Surface pCO$_2$ during the Spring Ice Edge Bloom in Baffin Bay

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**Introduction**

During the spring 2016 GreenEdge scientific cruise aboard CGGS Amundsen, a series of transects were completed from open water, through the marginal ice zone, and into pack ice in Baffin Bay. Here, we investigate trends within the surface mixed layer of net community production (NCP) and pCO$_2$ along two of these transects (300- and 400-transects) at the sea ice cover transitions. NCP = gross primary production – community respiration.

**Data Collection**

**Underway pCO$_2$ System**
- Continuously measures the pCO$_2$, temperature, and salinity of surface seawater as the ship transits
- Calibrations performed twice daily against WMO traceable standards

**Sea Ice Concentration**
- Utilizes AMSR2 sea ice concentration product (Spreen et al., 2008)

**Equilibrator Mass Inlet Spectrometry (EIMS)**
- Continuously measures the O$_2$/Ar ratio of the surface mixed layer as the ship transits
- Because Ar has similar solubility properties to O$_2$, it can be used to subtract the effect of physical processes on O$_2$ supersaturation, leaving only the biological signal

**Results and Discussion**

**300-Transect**

**400-Transect**

NCP = $k_1$[O$_2$]-[pCO$_2$/Ar]

Estimates of NCP indicate a net autotrophic environment at the ice-edge and in open water, with a slightly net heterotrophic environment under dense sea ice cover. The greatest rates of NCP are observed right at the ice-edge, and quickly drop off under ice cover, whereas NCP decreases more slowly with distance from the ice-edge into the open water environment.

Trends in pCO$_2$ match well with NCP estimates. pCO$_2$ is found to be highest under pack ice, lowest at the ice edge, and increases slightly in open water. Increasing pCO$_2$ in open water is likely due to greater air-sea CO$_2$ exchange and lower NCP. Surface seawater pCO$_2$ never exceeds atmospheric levels (~ 400 ppm) and therefore both transects represent overall sinks of atmospheric CO$_2$.

Surface plumes of cold low-salinity water are present at the ice-edge, and below thick sea ice cover. Warm seawater temperatures (contours) are present in eastern Baffin Bay due to the northward transport of modified-Atlantic waters. Cold waters at depth in western Baffin Bay are Arctic-outflow waters.

Using fluorometer measurements as a proxy for primary production (and the presence of phytoplankton), we can see blooms develop in the vicinity of the ice-edge. In open waters most of the surface nutrients have been depleted, and so the phytoplankton bloom migrates deeper in the water column forming a sub-surface chlorophyll maximum (SCM).

**Conclusions and Future Work**

- Rates of net community production (NCP) dramatically decrease from the ice-edge into dense sea ice cover, resulting in higher pCO$_2$ in the under-ice environment
- High rates of NCP at the ice-edge promote net air-sea fluxes of CO$_2$ in open water and the marginal ice zone
- Plan to compare these estimates of spring bloom NCP with overall warm-season NCP in Baffin Bay, in order to determine how much of the annual NCP is accounted for solely by the spring bloom. Underway O$_2$/Ar and pCO$_2$ measurements from September 2016 will allow for the determination of total warm-season NCP

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