Geophysical Research Abstracts
Vol. 14, EGU2012-6559, 2012
EGU General Assembly 2012

Sea ice primary productivity in the central Arctic during summer 2011

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Arctic sea ice is a very dynamic habitat which is currently suffering a rapid decline in extent and thickness. Changes such as increased thawing and thinning may also affect the distribution and magnitude of biogeochemical processes occurring in the ice matrix and the water column such as photosynthetic carbon fixation. In the Arctic Ocean, sea ice algae contribute substantially to primary production, but our knowledge about the natural variability of their composition and activity is limited. Of special interest for future predictions of the Arctic carbon cycle is the question which factors are limiting sea ice productivity, and if the sea ice retreat has positive or negative consequences for total Arctic productivity.

This study provides recent data from the central Arctic, collected during August and September 2011 on board of the RV Polarstern (TransArc 2011). Net primary productivity (NPP) was measured using the 14C method in a range of ice types and features sampled along a transect from Atlantic to Pacific waters, including annual and multiyear ice flows and surface melt ponds. In addition, transparent exopolymers (TEP), particulate organic carbon (POC) and inorganic nutrients were determined.

The preliminary results show high spatial variability of NPP rates for the ice (7-24 mg C m-2 d-1) and the water column mixed layer depth integrated (2-333 mg C m-2 d-1) with remarkable differences between the Atlantic and the Pacific influenced waters. However, TEP concentrations in sea ice (254-1293 μg Xeq L-1) were significantly higher than in the water column. In addition, algal aggregates found in the melt ponds show very high activities and concentrations of TEP. Regarding the nutrients, nitrate and phosphate concentrations are lower in the ice compared to the water column indicating a possible nutrient limitation for sea ice algae. Furthermore, the very low N:P ratio ($\sim$2 for the ice and $\sim$8 for the water column) points to a general nitrogen limitation.

The results of this study will contribute to a better understanding of the biogeochemical and ecological processes taking place in the Central Arctic sea ice at the end of the melt season and will help to estimate the contribution of sea ice to the carbon budget of the Arctic Ocean.