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SEA ICE ALGAE RESPONSE TO BEAUFORT GYRE VARIATION

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Seasonal and interannual variability in biogenic particle flux was captured by the multi-year bottom-tethered sediment trap moorings in the Northwind Abyssal Plain (Station NAP: 75°N, 162°W, 1975 m water depth) of Chukchi Borderland. The trapped sinking flux of biogenic particles had an obvious peak and the major component of diatom valve flux was sea ice-related species *Fossula arctica* in August 2011. On the other hand, the observed summer particle flux was considerably smaller in 2012 than those in 2011. The suppression of sinking materials would attribute to the extension of oligotrophic Beaufort Gyre water toward the Station NAP. In this study, to address an impact of water mass condition on biogenic particle flux during the summer season, sea ice algae component was newly incorporated into the lower-trophic marine ecosystem model NEMURO. The original NEMURO coupled to the pan-Arctic sea ice-ocean physical model COCO represented pelagic plankton species (i.e., diatom, flagellate, and copepod) and reproduced the early-winter peak of sinking flux of Particulate Organic Nitrogen (PON) [Watanabe et al., 2014]*. Whereas the mesoscale shelf-break eddies played a great role in the early-winter peak, the simulated summertime peak was significantly delayed behind the trap data partly owing to lack of sea ice algae component in the previous experiment.

In the developed model, the major habitat of sea ice algae was assumed to be a 2 cm-thick skeletal layer at sea ice-ocean boundary. Since sea ice bottom temperature was always kept at the freezing point of underlying sea water, the growth rate of sea ice algae was calculated following light availability and nutrient uptake terms. Light transmission through snow and sea ice column was given using empirical extinction rates. Sea ice-ocean nutrient exchange was formulated in the different manner for sea ice freezing and melting periods. We assume that sea ice algae can utilize nutrients (nitrate, ammonium, and silicate) both in the skeletal layer and in the ocean surface layer, according to nutrient availability in each layer. This “hybrid-type” nutrient uptake formulation is considered to represent more realistic characteristics of sea ice algae biology. In addition, the modeled PON was divided into two components with different sinking speeds so that sea ice assemblage could sink faster than other particles derived from pelagic plankton. The one-year experiment from October 2010 to September 2011 demonstrated reasonable spatial distribution and seasonal transition in sea ice algae biomass and the related sinking particle flux during the summer season. The interannual variability and possible background mechanisms (e.g., influence of Beaufort Gyre variation) will also be discussed.

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*Watanabe, E., J. Onodera, N. Harada, M. C. Honda, K. Kimoto, T. Kikuchi, S. Nishino, K. Matsuno, A. Yamaguchi, A. Ishida, and M. J. Kishi (2014) Enhanced role of eddies in the Arctic marine biological pump Nature Communications, 5:3950, doi:10.1038/ncomms4950.