Observation of plagic system using a drifter off Wilkes land during sea ice melting season

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Ice edge phytoplankton bloom is one of the most important events to regulate primary production, which accelerates biological carbon pump in the seasonal ice zone in the Southern Ocean. Improvement of light condition and iron supply with sea ice melt are thought to be critical factors for development of the ice edge bloom. Thus, relationship between sea ice dynamics and biological activity is essential for understanding not only ecosystem structure and its dynamics but also carbon sequestration. Ice edge blooms were found only in situation with <40% sea ice cover. In that time, amount of sea ice had already melted, i.e. most of materials and algae in sea ice had already been released into water column. Therefore, time-series observation should be started at earlier phase of sea ice melt to understand dynamics of ice edge bloom and related biogeochemical cycles. We designed an ice guard GPS buoy for drifter observation attached with sensor frames and time series sediment traps at various depth to reveal surface condition and export flux during ice melting season.

A drifter observation was conducted in austral summer 2019/2020 during ice breaker *Shirase* cruise under 61st Japanese Antarctic Research Expedition. A drifter was deployed at 64.26˚S, 115.96˚E on 9th Dec., 2019 and retrieved at 64.55˚S, 104.79˚E on 16th Feb., 2020. All instruments, i.e. sensors attached to GPS frame and four sensor frames, two time-series sediment traps and an Acoustic Doppler Current Profiler (ADCP, 300 kHz) worked. At the deployment and retrieval sites, a CTD cast for vertical profiles of physical parameters and water sampling for determination of chlorophyll *a* (chl. *a*), particulate organic carbon/nitrogen (POC/N) and phytoplankton community structure. Three closing net tows for zooplankton analyses were conducted from 200-100, 100-50 and 50-0 m depth layers. Ten sea ice collections for analyzing sea ice components (salinity, chl. *a*, POC/N, taxonomic composition of ice algae) were also obtained at deployment site.
Less variability in depth of all instruments indicates that the drifter array was relatively stable even in dense sea ice situation. Sea ice concentration at deployment site was over 90%, which rapidly decreased from end of December to early January. Chlorophyll fluorescence at 20 m depth increased with decrease of sea ice concentration. However quite rapid increase in the fluorescence in higher (>50%) sea ice concentration. The euphotic layer depth (1% PAR) was still shallower than 20 m at the same time, and an increase in dissolved oxygen at 20 m depth occurred after the fluorescence peak. These suggested that the fluorescence peak at 20 m depth was caused by rather released ice algae than primary production in surface water column. After then, increase in fluorescence was also found at 30 m depth following the increase at 40 m depth. These changes in peak depth of fluorescence means that temporal changes of productive layer, i.e. transition from ice edge bloom to sub-surface chlorophyll maximum. Size composition of chl. *a* and taxonomic composition of algae in sea ice showed dominance of diatom. The abundance in the water column at deployment site was dominated by smaller taxa (<10 μm), and this was replaced by larger taxa (>10 μm) at retrieval site. Macro-nutrients at surface layer decreased indicates amount of diatom production as well as microbial degradation during the study period. We will also discuss zooplankton composition and the vertical migration pattern during ice melting season by using ADCP data.

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