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Interannual variability of chlorophyll-a concentration in the Chukchi Sea Shelf during summer

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The Chukchi Sea, a part of the Arctic Ocean, has wide spread continental shelf and is one of the most productive region in the world. Recently, decrease of sea ice area has accelerated since 2002 and minimum ice extent was recorded in September 2007 which is 23% lower than the previous minimum extent in 2005. Recent data also indicate that the position of the seasonal ice edge in this region directly responds to warming from inflowing waters coming through Bering Strait.
The retreat of sea ice in the Arctic Ocean was consequently increase of open ocean area and growth rate of phytoplankton due to enough available light energy and lead to higher rate of annual primary production on the whole of the Arctic Ocean. However, localized responses of phytoplankton to such an abrupt decline of sea ice have not investigated. Here we revealed relationship between inter-annual change of summer chlorophyll a concentration of phytoplankton and physical environmental factors such as sea ice or sea surface wind, in the Chukchi Sea Shelf where influx of warm water from the Pacific is increasing.
The data used in this study are satellite and in situ data. Satellite data are chlorophyll a concentration (chl-a) and sea surface temperature (SST) of the Moderate Resolution Imaging Spectroradiometer (MODIS) on Aqua satellite, sea ice concentration (SIC) of the Advanced Microwave Scanning Radiometer-Earth Observing System (AMSR-E), and sea surface wind (SSW) of the SeaWind on Quick Scatterometer (QuikSCAT) satellite in July-September of 7 years from 2003 to 2009. We employed hydrographic/biogeochemical datasets from T/S Oshoro-Maru IPY cruises in 2007 and 2008.
As a result of the progressive loss of sea ice in recent years, summer average of chl-a in the Chukchi Sea Shelf gradually increased. The highest and lowest summer average chl-a are observed in 2008 and 2003, respectively. Monthly maps of chl-a indicates difference of spatial pattern, each year. In higher summer chl-a year, higher chl-a (> 1 mg m^{-3}) spread on Central Cannel, Hope Valley and Herald Valley. On the other hand, in lower summer chl-a year, higher chl -a (> 1 mg m^{-3}) looks like to spread on only Alaskan or Siberian coast.
Monthly maps of SST and SSW show spatial distribution of water masses at surface. In 2007, easterly winds, which promote westward advection at surface, were prevalent in summer. Then, Alaska Coastal Water (ACW; low nutrient, high temperature) spread to west, and Bering Shelf-Anadyr Water (BSAW; high nutrient, low temperature) was narrowed as evidenced by SST map. By contrast, northerly wind was prevalent in summer in 2008. SST map shows that ACW was narrower, and BSAW was broader than other years. Thus, year which easterly wind was prevalent, nutrient rich water spread in Central Chukchi Sea Shelf. Contrastively, year which easterly wind was weak, nutrient rich water did not spread in Central Chukchi Sea Shelf.

Keywords: Chukchi Sea, Chlorophyll-a, Sea Surface Wind, Sea Surface Temperature, Sea Ice