A BIOLOGICAL CONTRIBUTION TO PARTIAL PRESSURE OF CO₂ IN THE WESTERN ARCTIC OCEAN AND BERING SEA

Ryosuke Futsuki (Graduate School of Fisheries Sciences, Hokkaido University, Japan)
Toru Hirawake (Faculty of Fisheries Sciences, Hokkaido University, Japan)
Amane Fujiwara (Arctic Environment Research Center, National Institute of Polar Research, Japan)
Takashi Kikuchi (Research and Development Center for Global Change, Japan Agency of Marine-Earth Science and Technology, Japan)
Shigeto Nishino (Research and Development Center for Global Change, Japan Agency of Marine-Earth Science and Technology, Japan)
Daisuke Sasano (Meteorological Research Institute, Japan Meteorological Agency, Japan)
Masao Ishii (Meteorological Research Institute, Japan Meteorological Agency, Japan)
Hiroshi Uchida (Research and Development Center for Global Change, Japan Agency of Marine-Earth Science and Technology, Japan)
Seiichi Saitoh (Faculty of Fisheries Sciences, Hokkaido University, Japan)

hirawake@salmon.fish.hokudai.ac.jp

Arctic Ocean contributes 5-14% to the global balance of CO₂ sink and source; particularly Chukchi Sea is large ocean sink for CO₂. Major controlling factor of partial pressure of CO₂ in seawater ($pCO₂$) in seasonal ice zone is physical processes, such as temperature, salinity, fraction of sea ice melt water, and wind-driven mixing. On the other hand, contribution of biological processes is also significant, such as blooming season after sea ice retreat. However, few studies have focused on the quantitative relationship between the biological process and $pCO₂$. Therefore, little is known about how much biological processes affect $pCO₂$. Objective in this study is to clarify biological contribution to $pCO₂$ in the western Arctic and Bering Sea. We conducted cluster analysis to infer the controlling factor of $pCO₂$ variability using in-situ sampled $pCO₂$, sea surface temperature, sea surface salinity and Chl.a, and satellite derived wind speed, sea-ice concentration and primary productivity as the input variable. The northern Bering Sea and the northern shelf of Chukchi Sea were classified into relatively low $pCO₂$ with high primary productivity, weak wind and less stratified region (Fig.1). Our result suggests that biological contribution to $pCO₂$ in the two regions is greater than other regions.

Fig.1. (A) distribution of $ΔpCO₂$ ($pCO₂$ in sea water – $pCO₂$ in atmosphere), (B) result of cluster analysis. Northern Bering and northern Shelf of Chukchi Sea (Cluster 2, 3) had significant CO₂ sink condition. In these regions, mean primary productivity and in-situ Chl.a were relatively high, and mean wind speed was relatively weak, and then there is less stratification due to a little fraction of sea ice melt water.