Variations of surface water carbonate chemistry from winter to summer in the Indian sector of the Southern Ocean

Manami Tozawa[1], Daiki Nomura[1, 2, 3], Shin-ichiro Nakaoka[4], Masaaki Kiuchi[1], Daisuke Hirano[3, 5], Shigeru Aoki[5], Hiroto Murase[6]

[1]*Faculty of Fisheries Sciences, Hokkaido University*, [2]*Field Science Center for Northern Biosphere, Hokkaido University,* [3]*Arctic Research Center, Hokkaido University,* [4]*National Institute for Environmental Studies*, [5]*Institute of Low Temperature Science, Hokkaido University,* [6]*Tokyo University of Marine Science and Technology*

To assess carbon cycling in the Indian sector of the Southern Ocean (80˚E–150˚E, south of 60˚S) quantitatively, we measured seawater temperature, salinity, chlorophyll-*a* concentration, partial pressure of carbon dioxide (pCO_2), dissolved inorganic carbon (DIC), alkalinity (TA), and nutrients. The survey was conducted during 2018/19 austral summer by *Kaiyo-maru*.
The air-sea CO_2 flux in this region was evaluated to be –7.6±10.9 mmol C m^{-2} day^{-1} (–75.6~+25.0 mmol C m^{-2} day^{-1}) suggesting that the region was a weak sink. Then, we estimated the change in pCO_2 from winter to summer (δ pCO_2) due to changes in seawater temperature, salinity, and biological activity on the basis of the assumption that the observed values of DIC and TA in the temperature minimum layer remain the same as in the winter under sea-ice with a temperature of –1.8℃ and salinity of 34.25. The spatial distribution of pCO_2 in the western area (80˚E–120˚E) observed from December to early January was influenced by biological activity, and that in the eastern area (120˚E–150˚E) observed from January to February was influenced by temperature and salinity.
We also examined the annual change in oceanic and atmospheric CO_2 concentrations (xCO_2) between 1996 and 2019. The mean values of oceanic and atmospheric xCO_2 increased by 24 ppm and 45 ppm, respectively. This suggests that the main reason of the rise in oceanic xCO_2 is that the ocean have absorbed CO_2 from atmosphere as a result of the rise in atmospheric xCO_2. However, it also indicates that the oceanic xCO_2 rise is due to the rise in sea water temperature and changes in the ocean circulation.

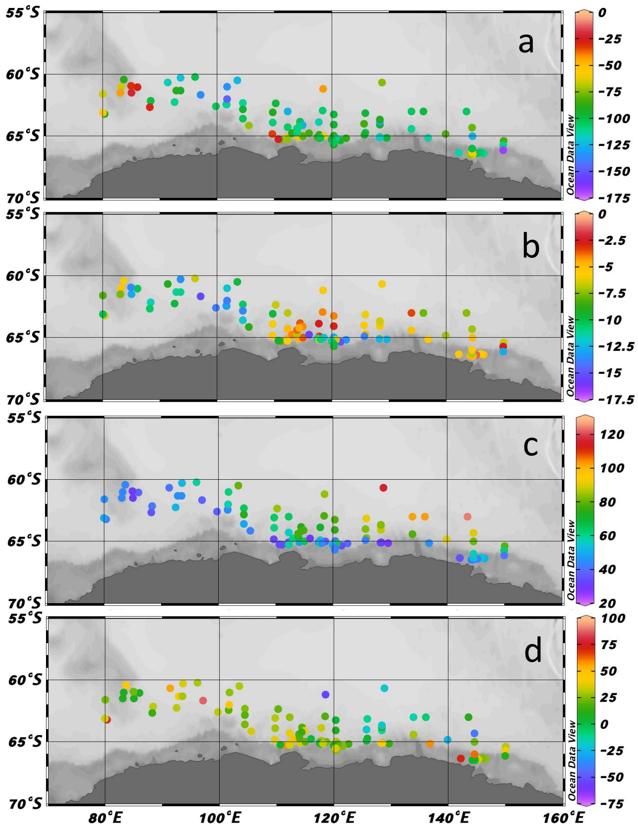

Figure 1. Spatial distribution of δpCO_2 (µatm) from winter to summer
(a: biological activity, b: salinity, c: temperature, d: other (other than a-c))