Photosynthetic physiology and primary productivity of phytoplankton in the Australian sector of the Southern Ocean

Shintaro TAKAO[1], Toru HIRAWAKE[2], Gen HASHIDA[3], Hiroshi HATTORI[4], Hiroshi SASAKI[5], Koji SUZUKI[1, 6]
[1]*Graduate School of Environmental Science, Hokkaido University*
[2]*Faculty of Fisheries Science, Hokkaido University*
[3]*Meteorology and Glaciology Group, National Institute of Polar Research*
[4]*Department of Marine Sciences and Technology, Tokai University*
[5]*Department of Biological Engineering, Senshu University of Ishinomaki*
[6]*Faculty of Environmental Science, Hokkaido University*

Phytoplankton population dynamics play an important role in biogeochemical cycles in the Southern Ocean during austral summer. However, the relationship between phytoplankton community composition and primary productivity remains elusive in this region. Therefore, we investigated phytoplankton community composition, photosynthetic physiology, and primary productivity on board the TR/V *Umitaka Maru* during Dec. 2010 – Jan. 2011, as part of a NIPR project. Significant latitudinal variations of the parameters along 110ºE were observed. Surface (at 5 m) chlorophyll *a* (Chl *a*) concentrations measured with high-performance liquid chromatography (HPLC) varied between 0.18 and 0.99 mg m^{-3}. The concentration of fucoxanthin, which can be used as a chemotaxonomic marker for diatoms, increased ca. 50-fold at the surface toward south, while concentrations of 19'-hexanoyloxyfucoxanthin and chlorophyll *b* (Chl *b*), indicators of haptophytes and green algae (chlorophytes and prasinophytes), respectively, decreased. Although macronutrient levels in surface waters were generally high in the area south of 55ºS, the maximum photochemical quantum efficiency (F_v/F_m) of photosystem II for the phytoplankton community in surface waters were low (< 0.25). These results indicated that macronutrients were not factor controlling the photosynthetic physiological condition of the phytoplankton. In our photosynthesis-irradiance (*P-E*) curve experiment (Fig. 1) using surface waters, higher values of maximum photosynthetic rate normalized to Chl *a* (P^*_{max}), initial slope (α^*), maximum quantum yield of carbon fixation ($\Phi_{c\ max}$), and photoinhibition index (β^*) were observed in the region where diatoms contributed to the Chl *a* biomass with > 60% between 55-60ºS. However, lower values of light saturation index (E_k) were found in the region, indicating that the diatom-dominated assemblages were acclimated with relatively low irradiance. These results suggested that latitudinal variations in the *P-E* parameters could be accompanied by changes in phytoplankton community composition in our study area.

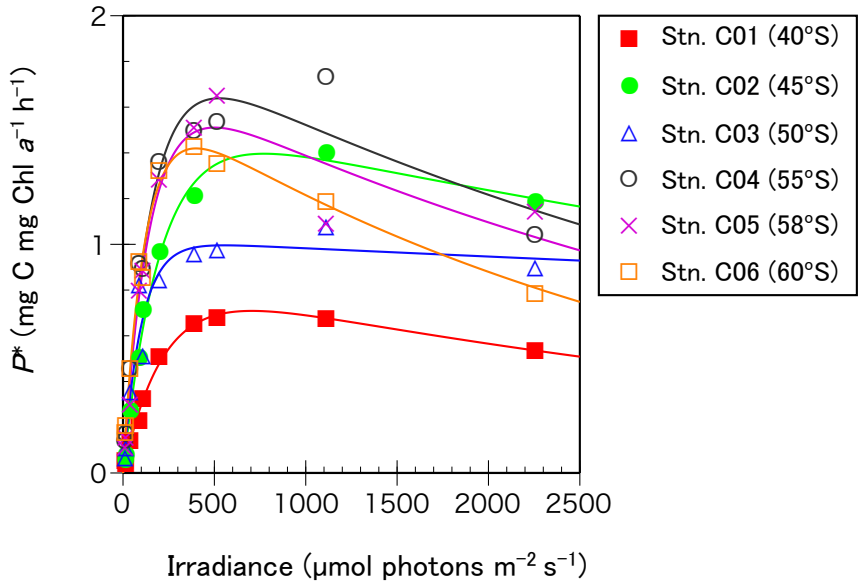

Figure 1. Photosynthesis-irradiance (*P-E*) relationships for surface phytoplankton assemblages along 110ºE in the Australian sector of the Southern Ocean.