Research of Ocean-ice BOundary InTeraction and Change around Antarctica (ROBOTICA)

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Antarctica and surrounding Southern Ocean are changing. Acceleration of ice mass loss and warming of the coastal ocean in the West Antarctica are the problems of substantial impacts on the global climate system. In the East Antarctica, which has been considered to be stable and attracted relatively less attention, regional characteristics of interactions among climate subsystems have been recently revealed and evidences of variations on various time scales from decades to millennium have been accumulating. Off Wilks Land underneath the Totten Glacier Ice Shelf, whose ice discharge is accelerating, a potential pathway of warm water access has been discovered (Greenbaum et al., 2015). Along the East Antarctic coast, at the same time, sea ice formation and subsequent brine rejection in polynyas, including Cape Darnley Polynya as the head ofthe list, result in production of Dense Shelf Water and lead to the export of bottom water (Ohshima et al., 2013; Kitade et al., 2014). In the Lutzow-holm Bay off Enderby Land, oceanic temperature variability on decadal time scale was observed, and disintegration/stabilization of the landfast ice and Shirase Glacier Tongue seem to have a quasi-periodicity of one to two decades. In the deep past during the Pliocene when the surface temperature was higher by several degrees than that of the present climate, geological evidence was found for the substantial disintegration of Ice Sheet for the George V Land (Cook et al., 2013). Despite the growing awareness on the importance of ice-ocean interaction and long-term variabilities off the East Antarctic Coast, quantitative descriptions and understandings of the mechanisms are still insufficient. Given the global impact of the coastal variability through the bottom water export, investigations of the mechanisms and variabilities in the East Antarctica are indispensable.
As for the oceans and ice sheets, importance of repeated observations to describe their variabilities and changes, even at an interval of two to three decades, was stressed at least as early as IGY period. From 1976, year-round hydrographic observations have been conducted occasionally in Lutzow-holm Bay by Japanese parties, which provides one of the longest observational records. Together with the asset of long record of tide gauge near Syowa station, Lutzow-holm Bay is the important monitoring site for the description of temporal variability. However, a constant and sustained observation system is not yet established due to the logistic difficulties of sea ice. Even the bathymetric information, which is essential in any discipline of oceanography, is still insufficient. However, recent rapid progress in the techniques of remote autonomous observation and satellite communication are beginning to change this situation. Hence, under the project called ROBOTICA for the coming 9th six-year plan (2016-2023), we plan to utilize state-of-the-art unmanned observations such as under-ice oceanographic, seafloor and cryospheric observations using ROV/AUVs, geodetic network observations of ice/ocean motion and deformation using GPS/ GNSS, and oceanographic observations using tethered and moored profiling observation systems. Combinations with the conventional and robust observational techniques will enable us to acquire the detailedenvironmental information both in time and space. Implementation of this project can provide us a big step forward for realization of the dream of the sustained observation system around Antarctica. Application of the remote observation techniques to the new horizons such as Totten Glacier and Cape Darnley regions will enhance the understandings of the mechanisms of different ice-ocean interaction regimes.

