

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

Principle Investigator

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Project Description

The Antarctic climate system, consisting of atmosphere, ocean, and cryosphere, plays important roles in shaping the global environments through its vast exchange and storage of heat and freshwater. The accelerating ice mass loss in West Antarctica is a significant process affecting the global climate and the understanding of the ice-ocean interaction there is of primary importance. In contrast, the status of ice mass change in East Antarctica is still in debates. Recent studies show some fingerprints of huge mass loss in the past warming world (Cook et al., 2013) and the ice mass loss from the glaciers including Totten Glacier is increasing (Rignot et al., 2013). However the processes of heat supply and sequent ice-ocean interaction are poorly known for these East Antarctic glaciers.

The East Antarctic coast is important in the oceanic overturning circulation through providing varieties of Antarctic Bottom Water. The large sea ice production in the Cape Darnley Polynya gives rise to a variety of Weddell Sea Deep Water (Tamura et al., 2008; Ohshima et al., 2013). Even less prominent polynya, Vinceness Bay Polynya, ventilates the abyss of the Australian-Antarctic Basin (Kitade et al., 2014). Given the changing properties of Antarctic Bottom Water in recent decades (eg. Couldrey et al., 2103), further understanding of the processes from polynya formation to ambient water mixing is strongly needed. In addition, the process of open water polynya, Cosmonaut Polynya, needs investigation in comparison with the Weddell Polynya.

Along the coast without active polynyas, land fast sea ice generally covers the sea surface. However, the behavior of fast ice is far from steady. The land fast ice in Lutzow-holm Bay, where the Japanese Syowa Station is located, has revealed a stability of quasi-cycle about a decade or two (Ushio, 2006), and a large break-up occurred in 2016 after a long period of stable condition. The brake-up of the fast ice allowed a calving of the edge of Shirase Glacier Tongue, which may have affected the glacier and ice mass discharge with less buttressing. The decadal change in fast ice condition will impact the exchange of materials and under-ice ecosystem. However, the physical/geochemical behavior and mechanism of the land fast ice in this region are not adequately understood.

Under the framework of the Japanese Antarctic Research Expedition (JARE), National Institute of Polar Research (NIPR) and Institute of Low Temperature Science (ILTS), Hokkaido University, have implemented a research project called ROBOTICA (Research of Ocean-ice BOUNDary InTeraction and Change around Antarctica), as the core program of the prioritized studies of the 9th six-year plan (2016-2022) of the JARE for the above mentioned processes and mechanisms of the ocean, sea ice, and ice sheet/glaciers. The major target areas are the regions off the Totten Glacier, off Cape Darnley Polynya, and Lutzow-holm Bay/Cosmonaut Sea. With fully utilizing the capability of icebreaker Shirase and developing/implementing automated multi-disciplinary research techniques including remotely-operated vehicles, we explore the fields which have not been observed ever. With utilization and analysis of the satellite observation and numerical modellings, we aims at understandings of phenomena and underlying dynamics. Our science questions are related to all of the six themes of SOOS science priorities. We will promote participation of young and junior researchers for the field

campaign. We will seek opportunities for international collaborations. Through these activities, we will contribute to Antarctic science.

Project Timeline

April 2016 – March 2022

Key deliverables

1. Seasonal and interannual variability of water mass property around Syowa station.
2. Summer melt water volume and ocean heat flux under the fast ice.
3. Flow velocity and basal melt rate of the glacier in summer.
4. Seasonal and interannual variability of flow velocity of the glacier.
5. Sea bottom topography under the glacier

Funding

Ministry of Education, Culture, Sports, Science and Technology

Data Management

We will submit all the data to the National Institute of Polar Research Science Database.
(http://scidbase.nipr.ac.jp/?ml_lang=en)