Japan's Antarctic Research Highlights 2022 - 23

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Summary

Among various research activities carried out by the Japanese Antarctic Research Expedition (JARE) in the Japanese Antarctic Syowa Station area, three topics are introduced; (1) Year of Polar Prediction in the Southern Hemisphere (YOPP-SH); (2) Reconstruction of East Antarctic ice sheet fluctuations and rapid ice sheet melting mechanisms; (3) Elucidation of the mechanisms of sea ice fluctuations in the ice edge, the pack ice zone, and the fast ice.

***1. Introduction***

The headquarters of the Japanese Antarctic Research Expedition (JARE), Japan's national Antarctic program, was established in 1955 by the Ministry of Education, Science and Culture (now the Ministry of Education, Culture, Sports, Science and Technology, or MEXT). The headquarters comprises departments and agencies of various government ministries, including the Ministry of Foreign Affairs; the Ministry of the Environment; the Ministry of Defense; the Ministry of Land, Infrastructure, Transport and Tourism; and the Ministry of Agriculture, Forestry and Fisheries. The scientific research and observation programs of JARE are considered and adopted as midterm research plans at general meetings of the headquarters.

This Information Paper introduces selected highlights from scientific projects carried out by overwintering and summer members of the 63rd and 64th JAREs, respectively, at and around Syowa Station (69° 00′ S, 39° 35′ E) during the 2022 - 23 season. The JARE 63rd wintering team conducted as many year-round science projects at Syowa Station as in previous winters. The JARE 64th summer activities in the 2022-23 Antarctic season almost returned to the pre-pandemic level. The following WEB (in Japanese) displays a summary of those activities. https://www.nipr.ac.jp/antarctic/jare/topics63-64.html

***2. Selected Research Highlights***

Year-round observations have been carried out by JARE 63rd overwintering team at and around Syowa Station. Seasonal observations are also carried out by summer expedition personnel aboard the Shirase for oceanographic observations and in the vicinity of Syowa Station. In addition, the small seasonal team was deployed by the air bridge. After completing the appropriate MIQ, all expeditioners departed to the Antarctic, and no COVID-19 case was reported throughout the 2022-23 Antarctic summer season.

**2.1 Year of Polar Prediction in the Southern Hemisphere: YOPP-SH**

The World Meteorological Organisation (WMO) has been working on a polar forecasting project since 2013 to observe and study polar meteorology and oceanography in order to improve forecasts of climate, weather and sea ice conditions in the Antarctic and Arctic, where rapid environmental changes are occurring. 2022 was the second Year Of Polar Prediction in the Southern Hemisphere (YOPP-SH) planned in the Polar Prediction Project (PPP). During the intensified observation period, more high-precision meteorological sondes were deployed from stations and vessels in the Southern Hemisphere high latitudes, including many Antarctic stations, to capture significant precipitation events during the winter months. At Syowa Station, the JARE 63rd wintering team conducted high-precision meteorological observations up to four times daily during the 2022 winter.

More reliable predictions of Antarctic ice sheet mass loss and sea-level rise due to global warming are required. It is now known that significant precipitation events, which occur only a few times a year, contribute significantly to maintaining the mass of the Antarctic ice sheet. The enhanced observations will improve the accuracy of our understanding and forecasting capabilities for such phenomena. As a result, more accurate future predictions of Antarctic ice sheet mass changes will be possible

*Figure 1. YOPP-SH Radiosonde Sites（Winter TOPs） (left) and Ballon launching during Blizzard(right).*

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自動的に生成された説明

**2.2. Reconstruction of East Antarctic ice sheet fluctuations and rapid ice sheet melting mechanisms**

As the advance party of the JARE 64th, a team entered Antarctica earlier than the main body of the JARE 64th expedition team by air and conducted coring of sea and lake sediments (Fig. 2). In addition, the team mapped bottom topography using an ROV from sea and lake ice before the summer melting in the vicinity of Langhovde and Ongul Island. After the arrival of the Shirase, onshore sediments coring using a newly introduced boring machine and glacial topographic surveys and rock sample collection were carried out.

The project aims to reconstruct the changes in the Antarctic ice sheet since the last interglacial period about 120,000-130,000 years ago and to elucidate the mechanisms of these changes. The team successfully collected valuable sediment and rock samples from land, lakes and shallow waters. The samples collected were brought back to Japan for laboratory analysis and data analysis to reconstruct past Antarctic ice sheet fluctuations in detail and to elucidate the mechanisms behind the rapid and large-scale melting of the Antarctic ice sheet. Progress in this research is expected to lead to more accurate predictions of Antarctic ice sheet melting and sea-level rise in the near future.

*Figure 2. Coring of lake sediments on the ice.*

雪の山にスキーしている人たち

自動的に生成された説明

**2.3. Elucidation of the mechanisms of sea ice fluctuations in the ice edge, the pack ice zone, and the fast ice**

It is now known that in Lutzow-Holm Bay, where the Syowa Station is located, sea ice attached to the land collapses every few decades and flows out to the north. One of the causes of this sea ice break-up is thought to be swells generated by strong winds in the southern hemisphere, which penetrate the sea ice and shake the thick ice. This study will measure such waves travelling under the sea ice. In addition, by clarifying the relationship between the ice melting process and the difficulty of navigation based on the past navigation records of the icebreaker Shirase, the possibility of shortening the steaming time to Syowa Station by selecting an appropriate route will be examined

The JARE 64th summer Expedition carried out various observations, such as; ice thickness measurements by EM (electromagnetic induction ice thickness gauge), wave and seaice measurements by the stereo camera, seawater spray measurements by sea spray meter, and deploying wave buoys on fast ice and in the pack ice (Fig. 3). This observation is designed to measure the movement of the in fast ice the Lutzow-Holm Bay and drift ice and the swell penetration (from the ice edge through the pack ice zone and to the fast ice) that leads to the break-up of the fast ice. In addition, the relationship between Shirase's ice navigation performance and ice conditions will be clarified in the future. In particular, knowledge of the causes and responses to besetting in the drift ice zone is expected to be obtained.

*Figure 3.*  *The initial position of wave buoys deployed in Lutzow-Holm Bay and the trajectory of the buoys until the beginning of March 2023.*

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