Glacier, grounding line and ice shelf dynamics
― the driver of the rapid mass loss of the Antarctic ice sheet ―

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Recent observations show mass loss of the Antarctic ice sheet along the coast. The loss of ice is attributed to increasing amount of ice shelf basal melting and subsequent retreat of grounding line, which leads to acceleration of outlet glaciers. Overview of the changes are reported by satellite remote sensing, but in-situ measurements are necessary to understand the mechanisms driving the changes occuring at glaciers and ice shelves. To improve our understanding of dynamic changes observed at Antarctic outlet glaciers, grounding line and ice shelf, we perform field observations on outlet glaciers teminating in Lützow-Holm Bay, East Antarctica (Figure 1 left).

We plan field campains under the framework of Japanese Antarctic Research Expedition in the austal summers in 2023/24 and 2026/27. The activity in 2023/24 is focused on ground-based and airborne measurements of glacier and ice sheet surfaces (Figure 1 middle). We utilize geophysical instruments (e.g. GNSS, seismic sensor, ice radar) to investigate the mechanisms of ice flow, calving, subshelf melting and grounding line migration. Measurements are also performed by devices mounted on an aircraft, helicopter and unmanned aerial vehicle. Using the two different approaches, we acquire data in high temporal and spatial resolutions, as well as those covering a broad area and glaciers inaccessble on foot. During the second field campaing in 2026/27, a hot-water drilling system is used to drill boreholes for subglacial and englacial measurements (Figure 1 right). Based on our experience of previous borehole studies in the region (Sugiyama et al., 2014; Minowa et al., 2022), glacier dynamics and its interaction with the ocean are investigated by direct observations. Borehole data will be analyzed with aids of surface measurements, so that a link between subglacial processes and glacier dynamics is accurately understood.

In the presentation, we introduce recently performed hot-water drilling on Langhovde Glacier, as well as the background and overview of the research project. The goal of the presentation is to brush up and refine our research plans through discussion with the audience.

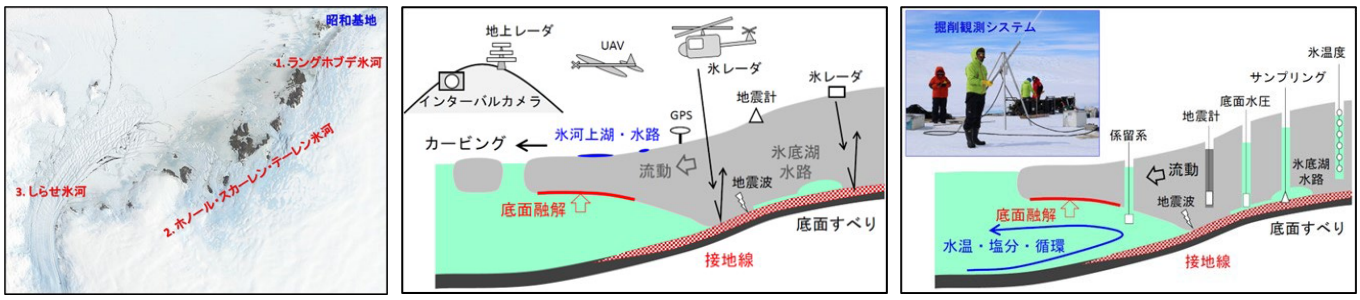

Figure 1. (Left) Study site of the project, outlet glaciers terminating in Lützow-Holm Bay, East Antarctica. Research activities planned in the project: (middle) surface measurements on and above the glacier and (right) hot-water drilling and borehole measurements.

References

Minowa, M., S. Sugiyama, M. Ito, S. Yamane, and S. Aoki. 2021. Thermohaline structure and circulation beneath the Langhovde Glacier ice shelf in East Antarctica. Nature Communications, 12, 3929.

Sugiyama, S., T. Sawagaki, T. Fukuda and S. Aoki. 2014. Active water exchange and life near the grounding line of an Antarctic outlet glacier. Earth and Planetary Science Letters, 399C, 52-60.