Mid-Holocene deglacial history along the Lützow-Holm Bay verified by the geodetic observations and GIA modeling

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The Antarctic ice sheet variation deforms the solid Earth at various spatial and temporal scales. In particular, the viscoelastic deformation caused by the ice sheet melting since the Last Glacial Maximum (LGM), generally called the glacial isostatic adjustment (GIA), is essential to estimate the current Antarctic ice mass change precisely. Geodetic surveys are vital in constraining and calibrating the GIA models by measuring the recent crustal deformation.

Japan Antarctic Research Expedition (JARE) has been conducting GNSS observations along the coast of the Lützow-Holm Bay for more than 20 years to monitor the GIA crustal motion. Hattori et al. (2021) revealed that the uplift rates observed at these GNSS sites are inconsistent with the predicted velocities of conventional GIA models (e.g., ICE-6G: Argus et al., 2014) and suggested that conventional ice sheet history models do not represent the actual local ice sheet history sufficiently. Kawamata et al. (2020) reported from geographical surveys in Skarvsnes, one of the outcrop sites along the coast of Lüutzow-Holm Bay, experienced more than 400 m of ice sheet melting between 9 and 6 thousand years ago by the exposure ages. This rapid ice sheet retreat has not yet been implemented in the conventional GIA models.

In this study, we performed the GIA model calculations using ICE-6G (Argus 2014) model as a reference model and some different settings with changing the timing and amount of ice sheet melting around Lützow-Holm Bay according to Kawamata et al. (2020). Figure 1 shows the time series of ice sheet thickness in the ICE-6G model Lützow-Holm Bay and those in the modified models. Figure 2 summarizes the uplift rates observed by GNSS observations in Hattori et al. (2021) and the predicted values of GIA models at each site using our modified ice sheet melting history. As a result, the GIA predictions based on the modified ice history show better agreement with the geodetic observation values. This result suggests that geodetic observations also detected the rapid ice sheet retreat, as revealed by geographical investigations.

In this presentation, we would like to report these detailed GIA model settings and calculations and compare modeling results with the absolute gravity measurements at Syowa Station.

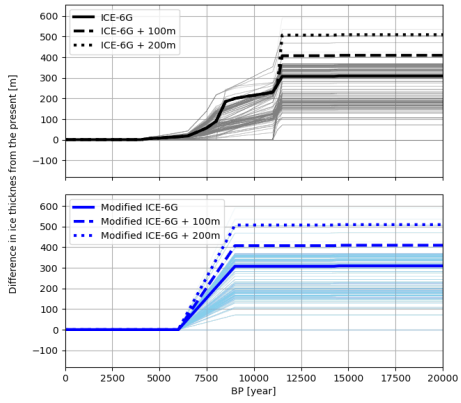

Figure 1 The time series of ice thickness around the Lützow-Holm Bay in ICE-6G and our modified models.

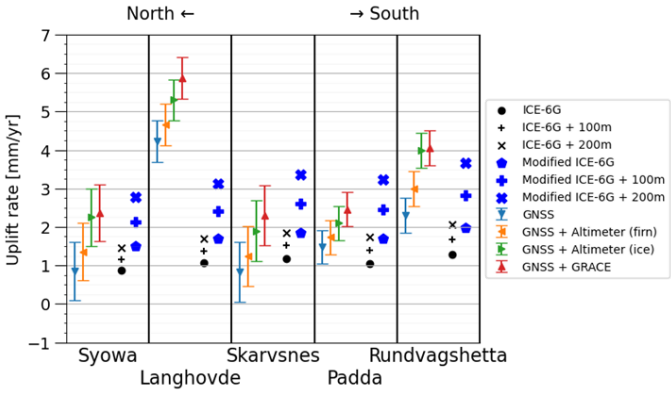

Figure 1 The predicted uplift rate calculated by GIA model and the observed values by GNSS measurements reported by Hattori et al., (2021).

References

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