Acceleration and retreat of Langhovde Glacier, East Antarctica, after the breakup of land-fast sea ice in 2016

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The Antarctic ice sheet drains ice into the ocean through floating ice shelves and outlet glaciers, which play key roles in the mass balance of the Antarctic ice sheet. Since iceberg calving and ice shelf basal melting are major ablation processes of the ice sheet, understanging the dynamics of floating ice is important. Land-fast sea ice affects the stability of ice shelves by exerting battressing force on the ice front. For example, previous studies reported glacier front retreat, disintegration of ice shelves and ice flow acceleration after breakup of sea ice in front of glaciers (e.g. Miles et al., 2017). Lützow-Holm Bay located in East Antarctica is usually covered with land-fast sea ice all year round, but a large portion of sea ice broke up in April 2016 (Aoki et al., 2017). In order to investigate the impact of the sea ice break up on outlet glaciers in the region, we carried out satellite observations on Langhovde Glacier, one of the outlet glaciers terminating in Lützow-Holm Bay. Glacier terminus position was deliniated from 2000 to 2020, using Landsat 7 Enhanced Thematic Mapper Plus (ETM+) and Landsat 8 Operational Land Imager (OLI) imagery. Changes in glacier surface area near the calving front were devided by the width of the calving front to obtain mean retreat/advance distance. Ice flow velocity field from 2014 to 2020 was measured, by applying a feature tracking method (Sakakibara and Sugiyama, 2014) to Landsat 8 OLI image pairs.

Terminus position has been relatively stable from 2000 to 2012, with only small fluctuations within a range of 200 m. The glacier then advanced by 400 m from 2012 to 2016. After 2016, the year of the land-fast sea ice break up, the terminus retreated rapidly by 720 m by 2020 as a result of large calving events in 2016 and 2019. The glacier front reached the most retreated position since 2000. After the sea ice breakup, ice speed increased from 110 m a^{-1} in 2017 to 135 m a^{-1} in 2019. The results of this study suggest the glacier had been stabilized by the land-fast sea ice by 2016. Rapid retreat and acceleration after the breakeup indicate significant influence of sea ice on the dynamics of outlet glaciers in Antarctica.

References

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キーワード：南極、氷床、氷河、海氷
Keywords: Antarctic, Ice sheet, Glacier, Sea ice

