グリーンランド北西部における溢流氷河の末端位置と流動速度の季節変化

榊原大貴[1,2]、杉山慎[2]
[1] *北海道大学大学院環境科学院*
[2] *北海道大学低温科学研究所*

Seasonal variations in frontal positions and flow speeds of marine terminating outlet glaciers in northwestern Greenland

Daiki Sakakibara[1,2] and Shin Sugiyama[2]
[1]*Graduate School of Environmental Science, Hokkaido University*
[2] *Institute of Low Temperature Science, Hokkaido University*

Greenland ice sheet is losing mass as a result of increase in surface melting and ice discharge from marine terminating outlet glaciers (e.g. Enderlin et al., 2014). This mass loss from the Greenland ice sheet significantly contributes to the recent sea level rise. To accurately include the contribution of the marine terminating outlet glaciers to the future projection of the sea level rise, mechanisms controlling the glacier dynamics should be better understood. To this end, we analysed Landsat images to measure ice front positions and ice speeds of marine terminating outlet glaciers along the coast of the Prudhoe Land, northwestern Greenland between 1987 and 2015. The results were utilized to investigate relationships among frontal position, flow speed, and air temperature with special attention on seasonal variations.

All of studied glaciers retreated from the 1980s to 2014 by a distance between 5.34 and 0.23 km. Most of the glaciers began retreat around 2000, as demonstrated by the increase in the mean retreat rate from 5 m a^{-1} in 1980s–1999 to 60 m a^{-1} in 2000–2014. A possible driver of the more rapid retreat since 2000 is atmospheric warming because significant increase in the summer temperature was observed in the late 1990s. The studied glaciers flowed at a rate between 10 and 1800 m a^{-1}, and many of them accelerated in the early 2000s. The magnitude of the acceleration was correlated with the retreat rate as represented by rapid retreat and acceleration at Heilprin, Tracy, Farquhar, Bowdoin and Diebitsch Glaciers. Because the acceleration was greater near the front, the change in the flow regime enhanced stretching of ice along the glacier and induced dynamic thinning. These results suggest that thinning due to flow acceleration was the driver of the rapid retreat.

In general, studied glaciers advanced from spring to early summer, which was followed by retreat in late summer. Then, the front remained at the retreated positions throughout the following fall. Magnitude of seasonal front variations ranged in 50–400 m. The timing of the retreat agreed with the disappearance of sea ice / ice mélange in front of the terminus. Many of the studied glaciers accelerated from spring to mid-summer and then decelerated in late summer. Magnitude of the seasonal variations in ice speed was between 80 and 440 m a^{-1}. Because the speed variations were correlated with air temperature, the seasonal speedups were probably due to enhanced basal sliding driven by meltwater input to the bed.

References

Enderlin, E. M., I. M. Howat, S. Jeong, M. J. Noh, J. H. van Angelen, and M. R. van den Broeke, An improved mass budget for the Greenland ice sheet. Geophys. Res. Lett., 41, 866–872, 2014.