学 位 論 文 内 容 の 要 旨

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学 位 論 文 題 名

Changes in marine-terminating outlet glaciers in northwestern Greenland from remote sensing
（リモートセンシングを用いたグリーンランド北西部における溢流氷河の変動に関する研究）

Mass loss from the Greenland Ice Sheet has accelerated over the past two decades. This change is due to melt increase in the ablation area and accelerated ice discharge from marine-terminating outlet glaciers, which are linked to the warming climate. Understanding the glacier changes under the rapidly changing Arctic climate is crucial for constraining the contribution of the Greenland Ice Sheet to sea-level rise. To study glacier changes over a broad area on a decadal scale, satellite remote sensing is a suitable and commonly employed approach. The goal of this dissertation is to use multi-source remote sensing datasets to improve our knowledge of glacier changes in the Prudhoe Land region in northwestern Greenland over the last four decades.

We use digital elevation models derived from satellite images and aerial photographs to quantify the mass loss of 16 outlet glaciers in the study area from surface elevation change from 1985 to 2018. The mean rate of the surface elevation change over the studied glaciers was −0.55 m a^{-1} for 1985–2018. Detailed analysis of the data revealed a clear shift from slight thickening (0.14 m a^{-1}) in 1985–2001 to rapid thinning (−1.31 m a^{-1}) in 2001–2018. Glaciers terminating in shallower fjords directly connected to Baffin Bay showed a thinning rate 40% lower than those in the Inglefield Bredning region. Among the glaciers studied, Tracy and Farquhar Glaciers located in Inglefield Bredning thinned most rapidly, at a rate exceeding −9 m a^{-1} in the period 2001–2018.

Since the late 1990s, warming trends were observed in both atmospheric (0.09°C a^{-1} in 1996–2009) and ocean temperatures (0.18°C a^{-1} in 1996–2012), which are the most likely triggers of the regime shift at around 2000. In addition to the climatic influence, ice speed acceleration might have enhanced the observed surface lowering as a result of dynamic thinning. The glacier change showed a substantially large spatial heterogeneity, which is attributed to the glacier geometry and fjord bathymetry. Glaciers terminating in deep fjords have lost greater mass because they are subjected to greater acceleration and are more affected by ocean warming.

The data clearly showed a rapid increase in the glacier mass loss in the 21st century for the first time in northwestern Greenland. Together with the drivers of the regime shift identified by the analysis, the study results help our understanding of ongoing glacier changes as well as the future evolution of the Greenland ice sheet.