Update on 47 Greenland glacier front positions 1999-2018

The Greenland marine terminating outlet glaciers have retracted in recent decades and most research suggest that the increased calving rates are a response to recent atmospheric and oceanic warming (Box et al. 2018; Moon et al. 2018). Now, new data from The Program for Monitoring of the Greenland Ice Sheet (PROMICE) further quantifies this (Andersen et al., 2019).

Marine terminating outlet glaciers flow to the ocean where they lose mass by e.g. iceberg calving. Currently, the mass loss from the Greenland ice sheet is the largest Arctic contributor to global sea-level rise (van den Broeke et al. 2009, 2017; Box et al. 2018). Therefore, monitoring changes in the Greenland ice sheet, such as the present study, is essential to provide policy makers with reliable data.

How much ice is lost from the glaciers and how fast (rate of dynamic mass loss) is determined by changes of the glacier calving front position, ice thickness and changes in ice flow. Change in calving front position is therefore an important indicator for monitoring the dynamic behaviour of the upstream area of the ice sheet, which is further modulated by local topographic features and buttressing effects (Rignot & Kanagaratnam 2006; Nick et al. 2009). The PROMICE researchers have analyzed the position of the calving front of 47 of these glaciers along the entire coast of Greenland (Fig. 1). The positions were measured from optical satellite imagery obtained from Landsat, Aster, and Sentinel-2 and show the front position at the end of the melting season every year from 1999 to 2018.

Analysis of the satellite images showed, that all but three glaciers out of the 47 (Rink, Qajuuttap, Sermia) have lost net area with the Zachariae glacier losing the most. 409.6 km² of ice has disappeared in the 19 year time span the researchers analyzed (Table 1).

Fig. 1: The position of the 47 glaciers analyses in the study

Table 1: The area change of each glacier
Based on these data, the researchers estimated that approximately 2100 km² of glacier ice have been lost in total from the 47 glaciers in the study (Fig. 2).

However, in the recent years the decline in area have flattened, and in 2018 there was a small increase in area. This is not to be mistaken for an overall progress in glacier fronts. This is largely due to the fact that the front of the fastest flowing glacier in Greenland, Sermeq Kujalleq (Jakobshavn), have moved forward in the last years of the 19-year period after a long period of consistent retrieve (Fig. 3). The researchers expect this to be the cause of extreme weather events in those years, but this is still being investigated.

The PROMICE calving front product is freely available for download as ESRI shapefiles.

Fig. 2: Cumulative net area change in the 47 marine terminating outlet glaciers from 1999-2018.

Fig. 3: An example of the satellite imaging with each of the calving front lines from respective years 1999-2018.
References:


