PROMICE
Programme for Monitoring of the Greenland Ice Sheet

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 resent 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 (Tabel 1).

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

Overview of net area change, average annual area change, and width for the 47 tidewater glaciers monitored between 1999–2018.

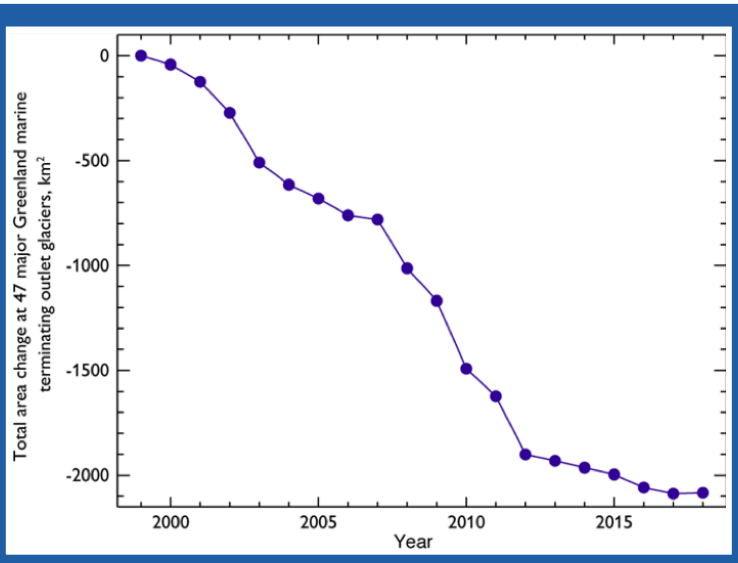
Glacier name	Lat. (°N)	Long. (°E)	Width (km)	Net area change (km²)	Average area change (km² a⁻¹)
Zachariae	78.90	−20.14	24.6	−409.6	−21.6
Petermann	80.10	−61.17	17.4	−289.5	−15.2
Humboldt	79.50	−64.61	89.0	−259.4	−13.7
Hagen	81.53	−28.50	9.1	−172.8	−9.1
Jakobshavn	69.18	−49.73	11.4	−137.0	−7.2
Storstrømmen	76.71	−22.47	31.9	−99.5	−5.2
Nunatakassaap Sermia	74.62	−56.34	5.4	−70.5	−3.7
Steensby	81.20	−53.90	4.5	−69.5	−3.7
Ostenfeld	81.60	−45.20	7.0	−65.0	−3.4
79 Fjorden	79.60	−20.17	42.2	−51.7	−2.7
Steenstrup	75.28	−57.89	16.2	−50.8	−2.7
Kangerdlugssuaq	68.61	−32.93	6.0	−45.9	−2.4
Midgaard	66.45	−36.73	3.8	−40.9	−2.2
Upernavik A	73.00	−54.47	7.3	−40.4	−2.1
Helheim	66.36	−38.12	5.8	−34.6	−1.8
Inngia	72.03	−52.61	4.0	−31.7	−1.7
Kong Oscars	75.98	−59.79	4.2	−21.5	−1.1
Sermeq Silardleq	70.80	−50.80	3.3	−19.7	−1.0
Academy	81.50	−32.65	8.8	−14.2	−0.7
Umiamako	71.72	−52.44	2.9	−13.3	−0.7
Ikertivaq A	65.67	−39.60	3.2	−13.1	−0.7
Docker–Smith	76.24	−61.00	5.1	−13.1	−0.7
Upernavik B	72.94	−54.38	3.8	−12.4	−0.7
Tingmjarmiut	62.76	−43.18	2.5	−11.3	−0.6
Ikertivaq D	65.49	−40.06	7.9	−10.6	−0.6
Daugaard–Jensen	71.92	−28.57	5.3	−10.1	−0.5
Sermeq Avannarleq	69.36	−50.31	4.4	−9.5	−0.5
Hayes	74.92	−57.00	9.6	−9.0	−0.5
Perdlerfiup Sermia	70.99	−50.92	2.7	−9.0	−0.5
Ikertivaq C	65.58	−39.96	5.3	−7.3	−0.4
Fenris	66.36	−37.54	2.8	−7.1	−0.4
Sermilik	61.00	−45.95	1.5	−6.3	−0.3
Kangia Nunata Sermia	63.33	−49.62	7.8	−6.2	−0.3
Ikertivaq B	65.63	−39.64	4.5	−3.6	−0.2
Kangerdluarssup Sermia	71.25	−51.47	3.2	−3.4	−0.2
Upernavik D	72.79	−54.22	2.3	−3.4	−0.2
Upernavik E	73.00	−54.65	2.0	−3.4	−0.2
Lille	70.43	−50.51	2.1	−2.8	−0.1
Upernavik C	72.85	−54.33	6.3	−2.7	−0.1
Ryder	81.30	−49.90	8.0	−2.3	−0.1
Rink	71.75	−51.64	5.1	2.0	0.1
Upernavik F	73.03	−54.84	1.8	−1.9	−0.1
Kangigdleq	70.72	−50.64	2.9	−0.8	0.0
Qajuuttap	61.32	−45.78	3.2	0.7	0.0
Nunatakavsaup Sermia	73.22	−55.14	3.6	0.5	0.0
Kangerdlugssup Sermerssua	71.46	−51.36	4.9	−0.1	0.0
Store	70.40	−50.55	5.2	−0.1	0.0

Tabel 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 Kujaleq (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.



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

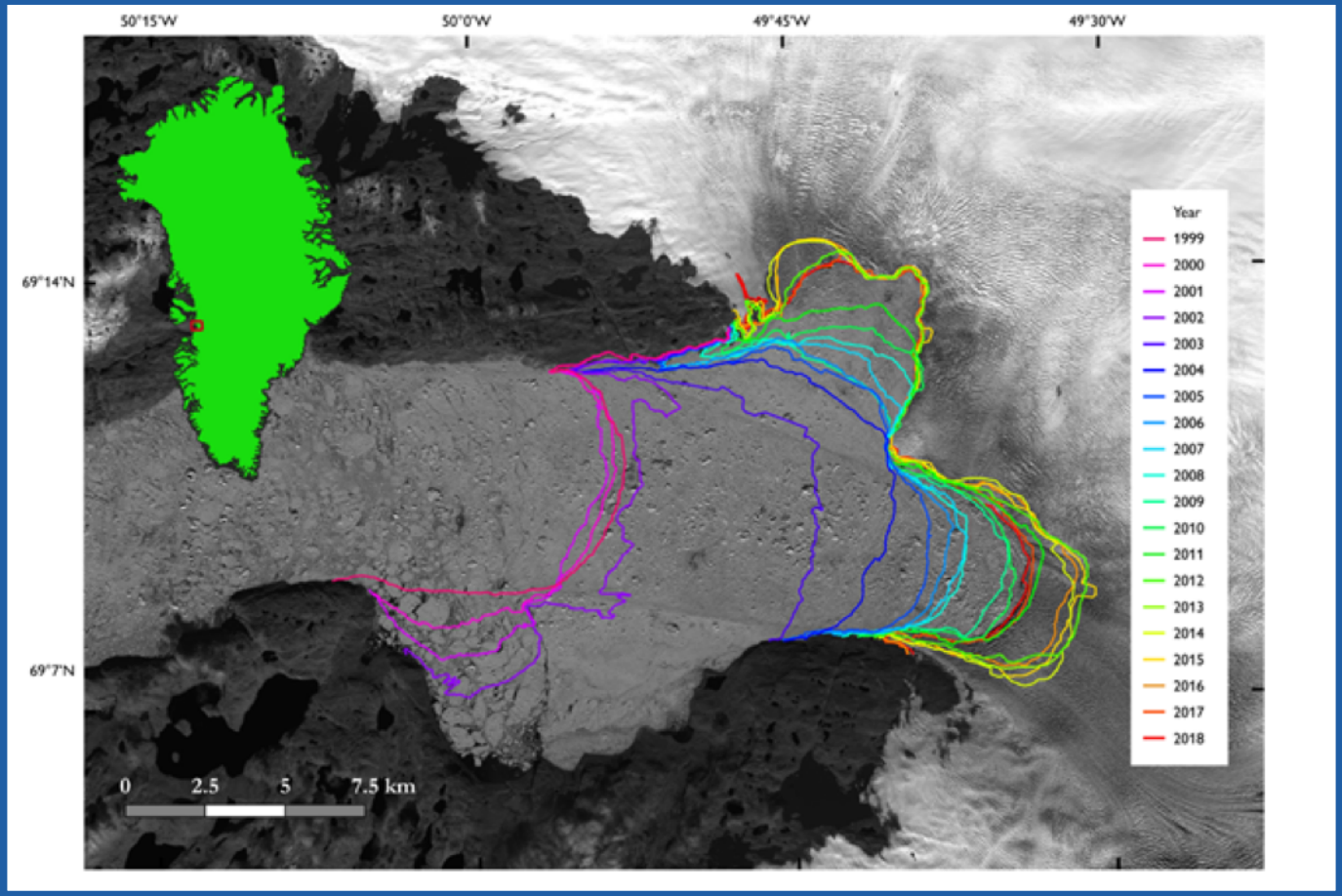


Fig. 3: An example of the satellite imaging with each of the calving front lines from respective years 1999-2018.

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PROMICE
Programme for Monitoring of the Greenland Ice Sheet

PROMICE is financed by the Ministry of Energy,Utilities and Climate through the climate support programme DANCEA (Danish Cooperation for Environment in the Arctic), which is managed by the Danish Energy Agency.

• The purpose of PROMICE is to monitor the mass loss of the Greenland ice sheet, both the melting on the surface and the volume of icebergs discharged into the sea

• PROMICE is headed in Denmark by GEUS in cooperation with DTU Space and Asiaq in Greenland. Furthermore the programme collaborates with the Danish Meteorological Institute and foreign universities and authorities.

• Read more about PROMICE on promice.org, where you can find photos and videos, get direct access to measuring data from the ice sheet and the PROMICE outreach material. On the website you can also subscribe to our newsletter.
• Information can also be found on polarportal.org a new website where Danish research institutions display the results of their monitoring of the Greenland ice sheet and the sea ice in the Arctic.

Further Information

http://www.promice.dk

http://www.undergroundchannel.dk

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