

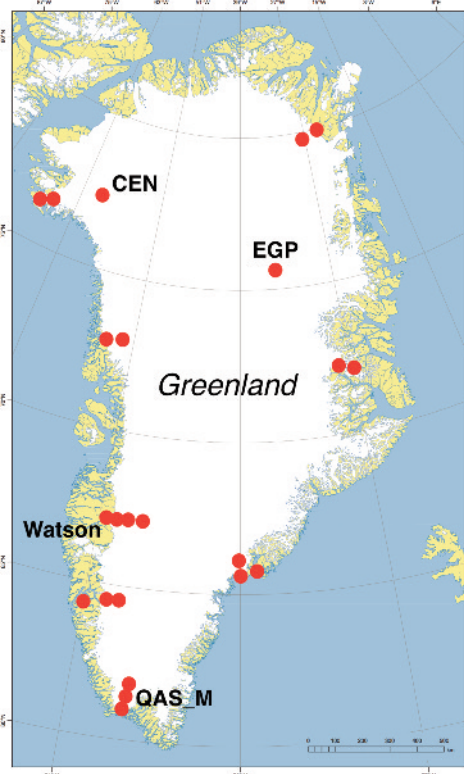
New Greenland ice sheet monitoring activities in extreme climate settings

The Programme for Monitoring of the Greenland Ice Sheet (PROMICE) has expanded its network of surface mass balance monitoring with 3 automatic weather stations and a hydrometric gaging station. The added infrastructure provides powerful new research possibilities while keeping track of the ice sheet's response to the extraordinary Greenland climate of recent years.

PROMICE is always on the lookout for ways to expand its database for the benefit of those interested in Greenland ice sheet mass loss. This year, PROMICE celebrates its 10-year jubilee. What started out with 5 automatic weather stations in 2007, grew to the most widespread weather station network on the ice sheet. Thanks to collaboration with other projects and research groups, this year the PROMICE automatic weather station network counts 23 stations, 9 more than in the original blueprints (Van As and others, 2011).

The Q-transect

In the past decade, PROMICE has been monitoring climate and surface mass balance primarily in 8 ice sheet regions. Recently, the programme started specifically targeting the Qassimiut Lobe at the southern tip of the ice sheet where the Geological Survey of Denmark and Greenland (GEUS) has been performing measurements since 2001. Here we observed 9.3 m of ice ablation in 2010, the largest net ablation ever recorded in Greenland (Fausto and others, 2016). In September 2013, a transect of 6 stakes was



Map of Greenland showing the locations of the newly included monitoring sites: the QAS_M, EGP and CEN automatic weather stations and the Watson River discharge station.



April 2017: A PROMICE ski traverse team performs snow density measurements at the new QAS_M automatic weather station, nearly entirely buried by 2.7 m of winter snow (source: Jason Box).

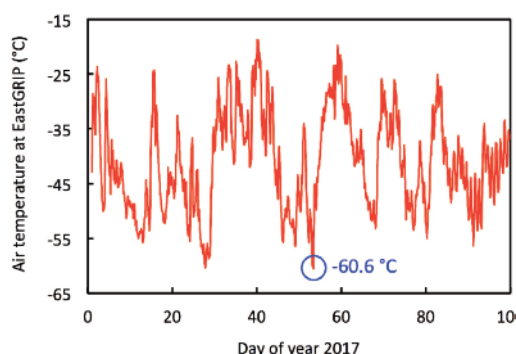
installed in the ablation area, in addition to the 2 already present automatic weather stations. In August 2016, a third weather station was erected by the name of QAS_M, providing valuable detail in our understanding of the interaction between ice sheet and climate in this Greenland melt hotspot. In April 2017 an expedition was undertaken to the QAS sites to measure the abundant winter snow accumulation in the region (Hermann and others, in review). The fieldwork was made by ski traverse to reduce PROMICE's carbon footprint from helicopter usage, and to benefit from having more time in the field for high-detail measurements.

East GRIP

Through the logistical platform offered by the East GRIP deep ice coring camp, in May 2016, friends of PROMICE installed a new automatic weather station (named EGP) in the high interior of the ice sheet, 2660 m above sea level. Climate monitoring at this location is anticipated to be of considerable value to the interpretation of the deep ice core being extracted here, and to the validation of satellite-derived snow reflectivity. The extreme location provided us with a new PROMICE low-temperature record of -60.6°C , well below the previous lowest value of -49.4°C at the now third highest weather station (KAN_U) at 1840 m altitude.

Camp Century

The most recent addition to the network is the CEN automatic weather station installed in July 2017 and funded by the Camp



A record-setting PROMICE low temperature of -60.6°C was measured at the new EGP automatic weather station on 22 February 2017.



A satellite image from 17 July 2012 showing the result of the 11 July Watson River flood washing away two road dams of the Kangerlussuaq bridge (source: Google Earth).

Century Climate Monitoring programme (www.campcenturyclimate.dk). The station monitors the climate and snow accumulation rate at the former Camp Century site in the remote northwest corner of the high interior ice sheet (Colgan and others, 2017). We anticipate this to be a challenging measurement location due to very low temperatures, high accumulation rates burying instrumentation, and occasional storms.

Watson River

Automatic weather stations on the Greenland ice sheet provide a lot of detail on how much snow is gained or ice is lost at a specific site, and for what reason. But there is also a method for monitoring mass loss from larger areas all at once, by measuring the water flux in rivers that transport meltwater from large ice sheet catchments to the sea. PROMICE is for instance allied with Asiaq (the Greenland survey) in monitoring how much meltwater exits the ice sheet at Tasersiaq lake in southwest Greenland (Ahlstrøm and others, *in review*). And since 2016 PROMICE includes the now 12-year time series collected at Watson River,

running through the Kangerlussuaq settlement and draining a 12 thousand square kilometer sector of the ice sheet (Van As and others, 2017). Not only are these meltwater discharge measurements important for studying various aspects of the ice sheet's mass balance, they can also prove valuable to the Kangerlussuaq municipality if/when the bridge over Watson River again suffers flooding damage as it did in July 2012.

With the addition of 3 automatic weather stations and a river gaging station to the programme, PROMICE's spatial coverage was boosted considerably. The QAS_M and Watson River sites are located at warm, southerly, low-elevation locations where melting is abundant in summer. In contrast, the EGP and CEN sites are located at high elevations in the remote and inaccessible north of Greenland, where direct observations of the ice sheet surface are scarce at best.

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Further information

<http://www.promice.dk>

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PROMICE

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- 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 porlarportal.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.



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