PROMICE NEWSLETTER
Programme for Monitoring of the Greenland Ice Sheet No. 13 • 2017

The Greenland ice sheet melt season 2017

The year 2017 was in many ways unusual. The winter saw heavy snowfall, while the melt season was relatively short and cold with intermittent summer snowfall stalling melt. The net 2017 surface melt was at or below average at all *c.* 20 PROMICE sites. At the eight lowest-elevation sites where melting is highest, only three sites experienced positive melt anomalies beyond uncertainty, re-referenced to the 1961–1990 climate standard period.

In general each year, the Greenland ice sheet gains mass from snow (accumulation) and loses ice primarily through melting (ablation). Subtracting the ablation from the accumulation yields the annual surface mass budget (SMB). Typically, Greenland gains ice mass on its surface in the accumulation season from September to May and then loses ice in the ablation season in June, July and August. PROMICE's automatic weather stations (AWSs) have measured temperatures and annual net-ablation values from *c.* 16 locations in the ablation area of the Greenland ice sheet since 2007. At any given site seven to ten years' worth of temperature and ablation data exist. The most recent measurements feature in the international 2017 Arctic Report Card (www.arctic.noaa.gov/Report-Card/), which includes a range of physical and environmental observations throughout the Arctic.

A snowy winter and cold summer

Unusual weather and melt patterns prevailed over Greenland this year. The winter snowfall was dominated by ex-hurricanes *Nicole and Matthew*, which delivered massive snowfall in October 2016 contributing to an accumulation season with above normal snowfall. At the bare-ice edges of the ice sheet, a winter with a large amount of accumulated snow means that more snow has to be melted before ice melt can begin.

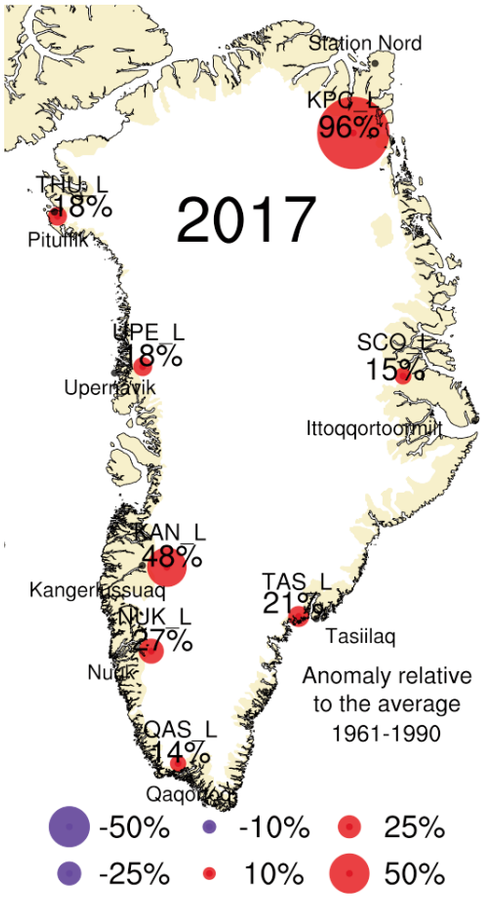

Fig. 1: The 2017 melt anomalies relative to the average of the reference period 1961–1990.

At the highest point on the Greenland ice sheet, Summit, two records were set for the month of July: Summit saw both the highest and lowest temperatures. On 4 July, the thermometer went down to –33.0°C, and almost three weeks later on July 28, the temperature rose above the melting point to 1.9°C, reflecting highly unusual weather and melt patterns. The PROMICE stations revealed July to be the coldest in the 2008–2017 period on the western ice sheet margin. For all summer months, temperatures were either at or below the 2008–2017 average at all stations.

Ablation records for 2008–2017

The 2017 ablation season for the Greenland ice sheet has been at or below average at all *c.* 20 PROMICE monitoring sites this year, mainly due to the heavy snowfall in winter and relatively short and cold melt season with intermittent summer snowfall to pause the melting. Recalculating the values to the 1961–1990 reference, only three out of eight 2017 ablation anomalies closest to the ice sheet margin were positive beyond uncertainty, while the rest were still positive but within the uncertainty (Fig. 1).

The PROMICE AWSs are equipped with a pressure transducer assembly and two sonic rangers that monitor surface-height change caused by accumulation and ablation. The pressure transducer assembly consists of a (non-freezing) liquid-filled hose with a pressure transducer located at its end/bottom, which is drilled into the ice (Fig. 2). The measured pressure is that of the vertical liquid column over the sensor, which can be scaled to depth using the density of the liquid. The free-standing AWS tripod (Fig. 2) moves down with the ablating surface while the hose melts out of the ice, reducing the hydrostatic pressure from the vertical liquid column in the hose. The reduction in pressure provides the ablation totals.

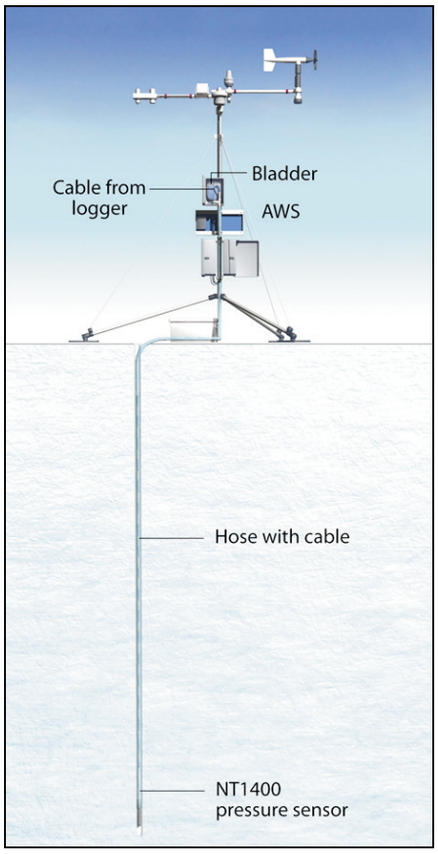

Fig. 2: Automatic weather station illustrating the pressure sensor setup measuring ablation totals..

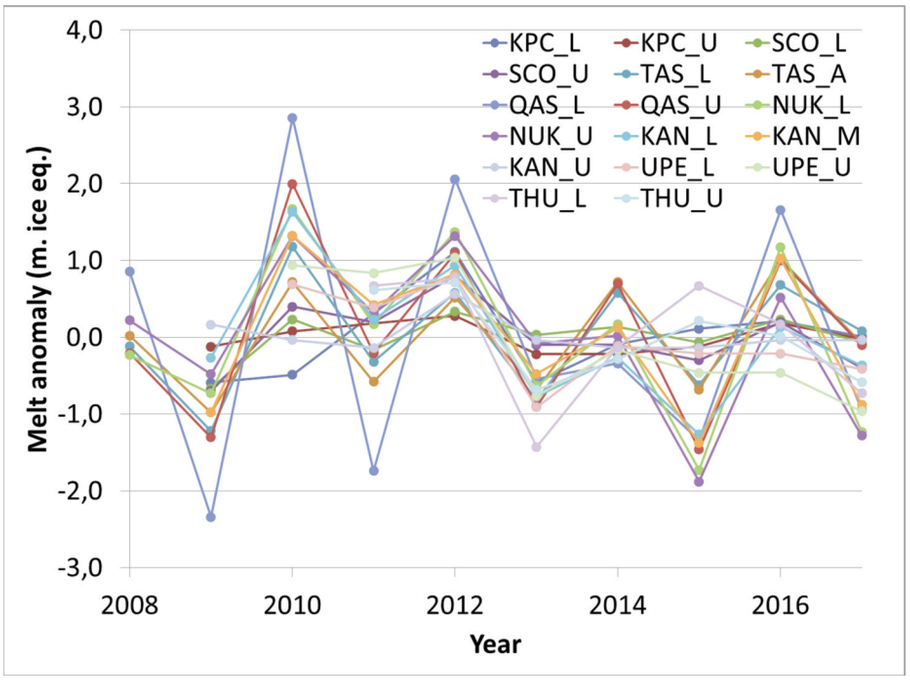

Fig. 3: Melt anomalies relative to the average of 2008-2017.

Twice every year all PROMICE data are quality checked before they are released to the public. As part of this effort, we have obtained 167 annual ablation totals for all AWSs covering the eight different regions in Greenland for the period of 2008–2017 (Fig. 3). In general, there are considerable latitudinal differences as the Greenland ice sheet is more than 2000 km long. Typically, ablation totals in the southern part of Greenland amount to 3–7 m (at the lower TAS, QAS and NUK stations), whereas ablation totals at the more northerly SCO_L and UPE_L stations only amount to 2–3 m at low altitudes (<500 m above sea level). The ablation totals from the upper stations (>500 m above sea level) typically amount to 0 to 4 m in the south (TAS, QAS, NUK, KAN) and 0–3 m in the north (KPC, SCO, UPE).

PROMICE in international science reports

Since 2015, the PROMICE AWSs have provided important input to the Arctic Report Card that annually assesses and highlights the changes that continue to occur in the physical and biological components of the Arctic environmental system. The 2017 edition of the Arctic Report Card will be released in mid-December. PROMICE data are also being used in other annually updated reports from e.g. the Polar Portal (www.polarportal.dk) or in the *State of the Climate* series, a report compiled by NOAA's Center for Weather and Climate, published in the Bulletin of the American Meteorological Society. PROMICE data are naturally accessible on www.promice.org at any time and for anyone.

Further information

http://www.promice.org

PROMICE

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 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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