IMAU
Institute for Marine and Atmospheric research Utrecht

EGU General Assembly
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Session CR 5.8

The extreme melt season of 2019 at the Kangerlussuaq transect

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Photo by the author, 2007

What

In this EGU display, we present a unique time series of 17 years of surface energy balance, including ***surface melt***, from 4 automatic weather stations on the western part of the Greenland Ice Sheet. We discuss the ***extreme melt season of 2019*** and put it in the context of the entire measurement period since 2003.

Why

Surface melt is the ***source*** for much of glacial hydrology. It is therefore critical to determine the amount of surface melt, as ***input for models*** of supraglacial, englacial and subglacial flow, percolation, refreezing, and runoff.

How

We have analyzed ***17 years of AWS observations*** (2003 - 2019), and provided these data to a ***surface energy balance*** model that solves for the surface temperature at which all energy fluxes (solar and thermal radiation, turbulence, heating/cooling of the surface, and melt) are in balance.

Where

In ***West Greenland***, extending eastward from the airport of Kangerlussuaq at approximately ***67°N***, the K-transect consists of a number of mass balance stakes, as well as ***4 automatic weather stations***: S5 (lower ablation area), S6 (upper ablation area), S9 (equilibrium line) and S10 (accumulation area).

MODIS image 29 Aug 2018

1. The year 2019 is among the strongest melt years at all sites, and the top melt year at the site of S6

In 2019, we observed record melt at S6 (upper ablation area) at 3275 mm w.e.

At S5 (lower ablation area), 2019 had the 3rd highest melt on record, and at S9 (equilibrium line altitude), melt was 5th highest, and at S10 (accumulation area, it was 4th highest.

From stake measurements, these rankings are the same: 1st (S6), 3rd (S5) and 5th (S9). No stake data for S10.

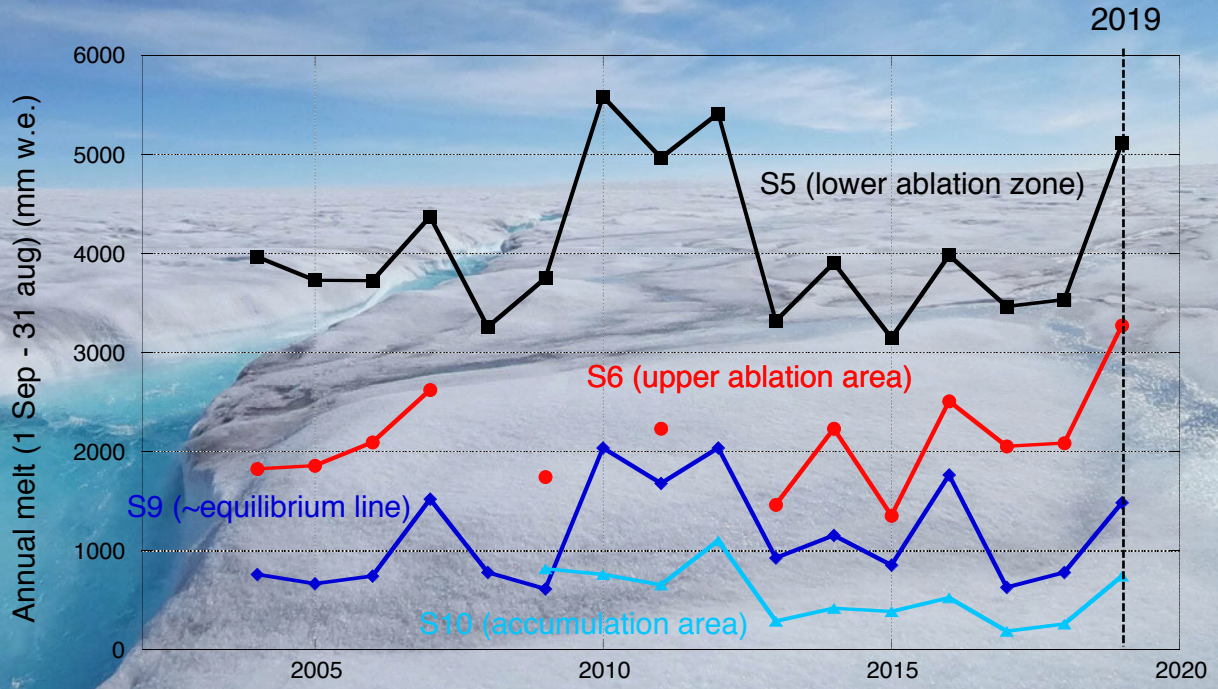
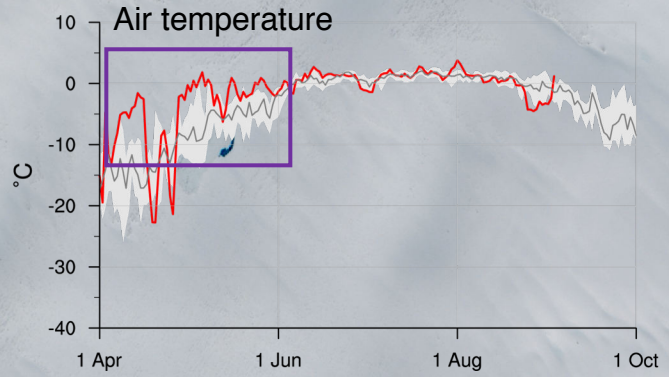
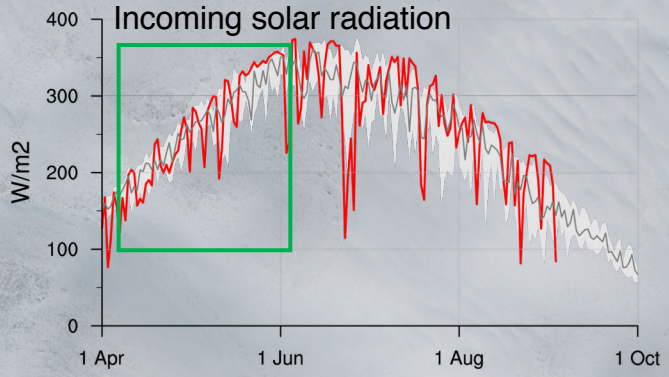


Image credit: Sean Peters

2. Greenland melt in 2019 was different from high-melt years like 2010 and 2012: it was concentrated in the ablation area





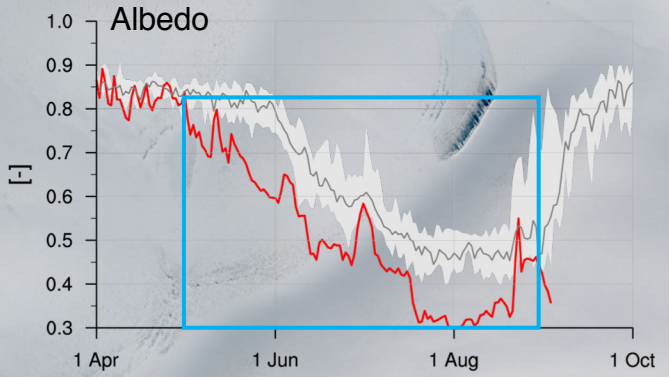
(2019 shown in red, median seasonal cycle

April and May 2019 saw ***record high temperatures*** and dominating ***clear skies*** over the K-transect.

It caused the shallow winter snowpack to disappear early, leading to ***record low albedo*** from May to September.

The ***surface melt*** season was longer and stronger than recorded previously.

We conclude that the 2019 melt season was strong ***mainly in the ablation area***, opposed to melt years 2010 and 2012, when extreme mass loss was caused by ***widespread melt*** even at high elevations.



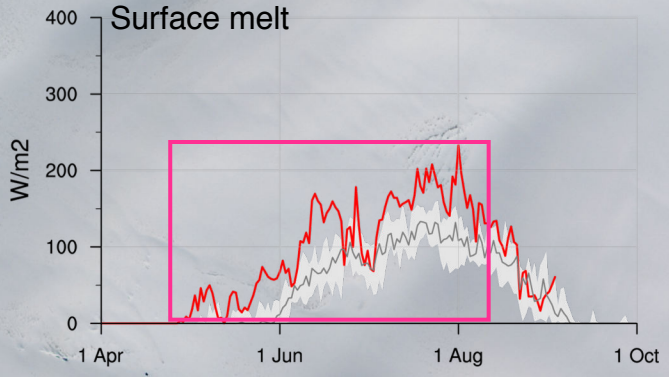
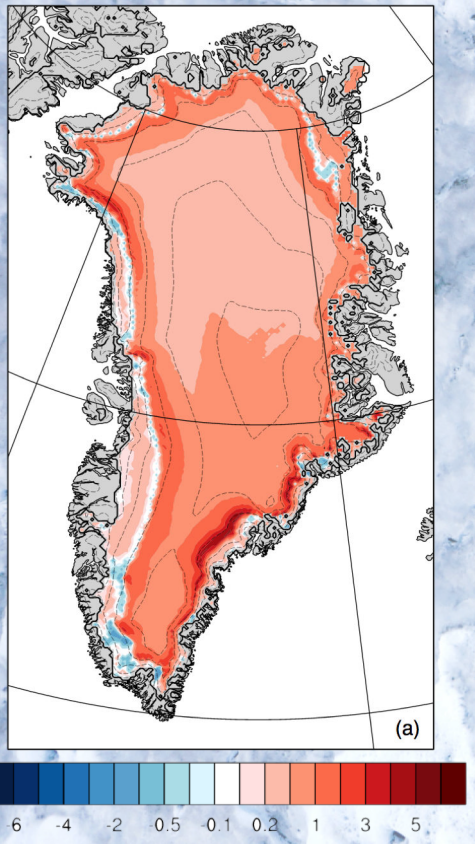


Image credit: NASA Earth Observatory

3. In the longer term, the equilibrium line is shifting inland, changing surface appearance, firn, and hydrology



Since the start of ***stake observations*** at the K-transect in 1990, the area around S9 has turned from an accumulation to an ablation area.

The smooth snow surface has turned into a surface with occasionally exposed ice, and ***surface meltwater features***.

Due to increased ***meltwater percolation***, firn density has increased, and deep firn temperature has warmed by up to 1 degree.

All these processes help to gradually change ice sheet hydrology of the Greenland Ice Sheet.

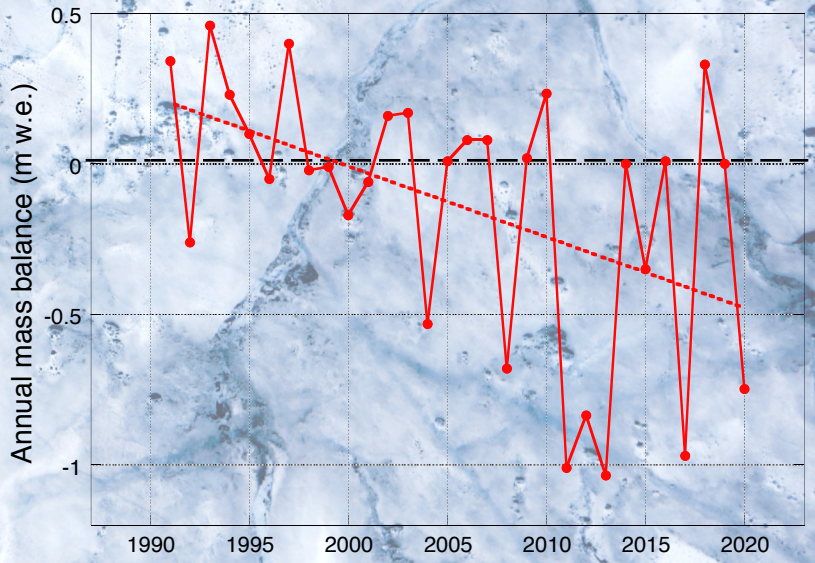


Image credit: cryoeco.eu