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## The extreme Greenland melt season of 2019 in a 16-year time series of surface energy balance at the Kangerlussuaq transect

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In 2019, the Kangerlussuaq transect has experienced a record surface melt season at some stations, exceeding even the melt seasons of 2010 and 2012. We demonstrate that net radiation has been driving the high surface melt rates especially in the higher parts of the transect.

Since 2003, continuous measurements of the surface energy budget are made in a transect of four automatic weather stations, spanning the ablation area close to the ice edge to the accumulation area of the Greenland Ice Sheet. All available data have been homogenized and corrected, and an unprecedented time series of surface energy budget is presented here, including meltwater production. In this contribution, the melt season of 2019 is put into the longer-term context, and precise atmospheric drivers of the melt are exposed.

Sixteen years of data clearly reveal the inland and upward expansion of the ablation area. The weather station closest to the equilibrium line (S9) shows a clear and distinct reduction in albedo, and a relatively strong increase in surface melt, which has started to exceed accumulation during the period of observation. Photographs of the area around S9 show that the surface has undergone major changes between 2003 and 2019, now featuring many surface hydrological features that were completely absent in 2003.

These changes have important implications for the hydrology of the surface, the near-surface, and the underlying firn. A firn model calculation reveals that the entire firn column has been heating by several degrees Celsius in the percolation zone, due to refreezing of meltwater. Sudden, stepwise warming is seen in extreme melt seasons like 2019.