# Jet stream changes cause climatically exceptional Greenland Ice Sheet melt

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This was taken at the south-west margin of the Greenland Ice Sheet near Kangerlussuaq/Sondre Stromfjord. Credit: University of Sheffield

(Phys.org) —Research from the University of Sheffield has shown that unusual changes in atmospheric jet stream circulation caused the exceptional surface melt of the Greenland Ice Sheet (GrIS) in summer 2012.

An international team led by Professor Edward Hanna from the University of Sheffield's Department of Geography used a computer model simulation (called SnowModel) and satellite data to confirm a record surface melting of the GrIS for at least the last 50 years - when on 11 July 2012, more than 90 percent of the ice-sheet surface melted. This far exceeded the previous surface melt extent record of 52 percent in 2010.

The team also analysed weather station data from on top of and around the GrIS, largely collected by the Danish Meteorological Institute but also by US programmes, which showed that several new high Greenland temperature records were set in summer 2012.

The research, published today in the *International Journal of Climatology*, clearly demonstrates that the record surface melting of the GrIS was mainly caused by highly unusual atmospheric circulation and jet stream changes, which were also responsible for last summer's unusually wet weather in England.

The analysis shows that ocean temperatures and Arctic sea-ice cover were relatively unimportant factors in causing the extra Greenland melt.

Professor Hanna said: "The GrIS is a highly sensitive indicator of regional and global climate change, and has been undergoing rapid warming and mass loss during the last 5-20 years. Much attention has been given to the NASA announcement of record surface melting of the GrIS in mid-July 2012. This event was unprecedented in the satellite record of observations dating back to the 1970s and probably unlikely to have occurred previously for well over a century.

"Our research found that a 'heat dome' of warm southerly winds over the ice sheet led to widespread surface melting. These jet stream changes over Greenland do not seem to be well captured in the latest

Intergovernmental Panel on Climate Change (IPCC) computer model predictions of climate change, and this may indicate a deficiency in these models. According to our current understanding, the unusual atmospheric circulation and consequent warm conditions of summer 2012 do not appear to be climatically representative of future 'average' summers predicted later this century.

"Taken together, our present results strongly suggest that the main forcing of the extreme GrIS surface melt in July 2012 was atmospheric, linked with changes in the summer North Atlantic Oscillation (NAO), Greenland Blocking Index (GBI, a high pressure system centred over Greenland) and polar jet stream which favoured southerly warm air advection along the western coast.

"The next five-10 years will reveal whether or not 2012 was a rare event resulting from the natural variability of the NAO or part of an emerging pattern of new extreme high melt years. Because such atmospheric, and resulting GrIS surface climate, changes are not well projected by the current generation of global climate models, it is currently very hard to predict future changes in Greenland climate. Yet it is crucial to understand such changes much better if we are to have any hope of reliably predicting future changes in GrIS mass balance, which is likely to be a dominant contributor to global sea-level change over the next 100-1000 years."

**More information:** onlinelibrary.wiley.com/doi/10 … 02/joc.3743/abstract

Provided by University of Sheffield

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