Press Release

GEOMAR
Helmholtz Centre for Ocean Research Kiel

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Greenland: Rainy weather events trigger increased surface melting
New study shows overlooked consequence of global warming

07.03.2019/Kiel. **The Greenland ice sheet is shrinking. Measurements show that it is losing around 270 billion tons of ice annually large part of which is driven by surface melting. A German-American working group led by GEOMAR Helmholtz Centre for Ocean Research Kiel has discovered that increasing rainfall over Greenland contributes to the long-term weakening of the ice sheet. The team has now published this study in the journal The Cryosphere.**

Greenland's ice sheet is the second largest permanently frozen area on earth, after the Antarctica. However, the ice sheet is shrinking. Since the 1990s, average temperatures above the ice have risen up to 1.8 degrees Celsius in summer and up to 3 degrees Celsius in winter. As a result, the ice cap loses about 270 billion tons of ice annually. Icebergs that break off from glacier tongues and drift into the ocean had been believed to make up the largest part of the ice loses. However, recent studies show that direct meltwater runoff contributes up to 70 percent to the loss.

A new study by scientists from Germany and the USA, published in the international journal The Cryosphere, shows that precipitation events over the Greenland ice are increasingly triggering surface melting. "Rain and the associated surface melting have become more frequent in parts of the Greenland ice sheet, also in winter," summarises Dr. Marilena Oltmanns of the GEOMAR Helmholtz Centre for Ocean Research Kiel.

In order to investigate the exact triggers of surface melting, the researchers combined satellite images with weather observations on site from 1979 to 2012. Satellites can map the melting of ice in real time, as their images can distinguish between snow and liquid water. A comprehensive set of automated weather stations spread across the ice provide simultaneous data on temperature, wind and precipitation.

Combining the two data sets, the researchers were able to identify more than 300 events in which large-scale precipitation events were the first trigger of surface melting throughout the year. "That was a surprise," says Dr. Oltmanns. In the course of the studied period, the melting initiated by these precipitation events doubled in summer and tripled from autumn to spring. However, the total precipitation above the ice sheet did not change. What changed was the form of precipitation.

Precipitation events are connected with enhanced southerly winds that carry warm, humid air from the ocean over the ice sheet. The superimposed long-term warming increases the likelihood for the atmospheric conditions to exceed the threshold at which precipitation occurs as rain rather than snow. In addition to the warm air, liquid water includes a lot of heat that is released over the ice sheet. Meanwhile the warm winds that have brought the heat and moisture form clouds that retain the heat near the surface.

Although the rain falling on the ice, and the melt, may refreeze, it turns bright, reflective snow into darker, denser masses of ice. If the sun shines again later, the ice warms up and melts faster. "A precipitation event in summer or spring can thus contribute to an extended melt episode even weeks later," explains Marilena Oltmanns.

Greenland's glaciers are shrinking because more ice melts in summer than is being added by precipitation throughout the year. However, due to the spatial and temporal shift of the snow-rain boundary, precipitation events themselves are increasingly contributing to ice loss. "These weather events and their manifold implications should be taken into account in climate and ocean models. After all, ice loss in Greenland is also an important factor in global sea-level rise," stresses Marilena Oltmanns.

Reference:
Oschlies, A. (2018): Solar engineering must take temperature into account. Nature 554, 423 (2018), https://www.nature.com/articles/d41586-018-02203-x

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