

Greenland and Climate Science

Greenland's Ice Sheet

Ice sheets (larger than 50,000 km²) exist in only two places on Earth, in Greenland and in Antarctica. The Greenland ice sheet covers about 80% of the island, or more than 1.7 million km². At its highest point, the ice sheet rises 3,200 meters above sea level.

This enormous ice sheet contains 8% of Earth's total fresh water. It is believed that were the ice sheet to completely melt, global mean sea level would rise by about 7 meters. Current research suggests that the Greenland ice sheet is losing about 100 gigatons (or 100 billion tons) of mass a year, which is equivalent to a rise in sea level of about 0.28 mm/year.

Ice Melt and Acceleration

The balance between snow accumulation and melt water runoff affects how much the Greenland ice sheet contributes to sea level rise at any given time; however, scientists also believe that ice dynamics, or changes in how the ice flows towards the sea, play an important role in determining whether the ice sheet gains or loses mass.

Satellite observations suggest that Greenlandic glaciers have accelerated by 20-100% and are draining ice into the sea at a more rapid rate than before.³ Jakobshavn Isbrae is Greenland's largest outlet glacier and it is the fastest moving glacier in the world. Discharge from the Jakobshavn glacier increased from 24 km³ of ice per year in 1996 to 46 km³ of ice per year in 2005.

Glacial earthquakes, sometimes called icequakes, or sudden glacial-sliding motions, may also quicken the processes by which outlet glaciers thin and discharge ice into the sea.

Scientists also believe that meltwater acts as a lubricant at the base of the ice sheet, speeding up the ice as it slides towards the coast. The meltwater makes its way from the surface of the ice sheet to the bedrock via a network of crevasses and large tunnels called moulins that may be up to 10 meters in diameter. Using Global Positioning Satellite measurements, researchers have discovered that the ice flow speeds up from 31.3 cm/day in winter to a peak of 40 cm/day in the summer, when more melting occurs.



Greenland Ice and Melt Pond

Swiss Camp

Swiss Camp, a research station located about 300 km north of Kangerlussuaq and 30 km from the ice edge, is located strategically near the equilibrium line altitude of the ice sheet – the altitude which divides the regions of net annual accumulation and ablation (mass loss).

Swiss Camp was built by Dr. Konrad Steffen, a native of Switzerland and the current director of the Cooperative Institute for Research in Environmental Sciences. Dr. Steffen is also a Professor of Geography at the University of Colorado at Boulder.

Swiss Camp is just one point in the Greenland Climate Network (GC-Net), which consists of 23 automatic weather stations, most of which were established between 1995 and 2006.

Living and Working at Swiss Camp



Swiss Camp, all photos courtesy of J. Maurer.



Greenland Climate Network

GC-Net is part of NASA's Program for Arctic Regional Climate Assessment (PARCA) and is managed by Dr. Steffen.



Working at a GC-Net station, courtesy K. Steffen

The stations, which are five-meter-tall towers, host instruments that measure a variety of climate variables:

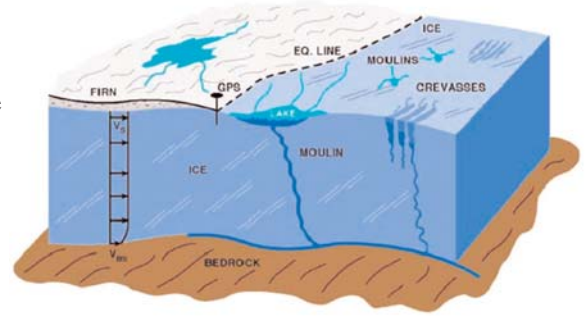
- air temperature, wind speed, wind direction, and humidity at multiples levels
- snow accumulation rate
- surface radiation balance in visible and infrared wavelengths
- sensible and latent heat flux fluxes
- snowpack conductive heat fluxes

Because of snow accumulation or melt around the stations, each station requires maintenance every few years.

Studying Greenland from Space

In addition to using the in situ automatic weather stations, scientists study Greenland

remotely using satellites. NASA's GRACE satellites, which measure changes in Earth's gravity field caused by variations in our planet's mass, allowed scientists to determine that from 2004 to 2006, Greenland lost ice 2.5 times faster than in the previous two years. Scientists also use radar, laser, and passive microwave technologies to measure Greenland ice melt remotely.



Schematic of glaciological features, courtesy of NASA.

International Polar Year

Greenland research during the 2007 and 2008 field seasons will be an integral part of International Polar Year or IPY, which kicked off in March 2007. IPY is an international effort involving thousands of scientists from 63 countries who will be working on climate-related research efforts in the Arctic and



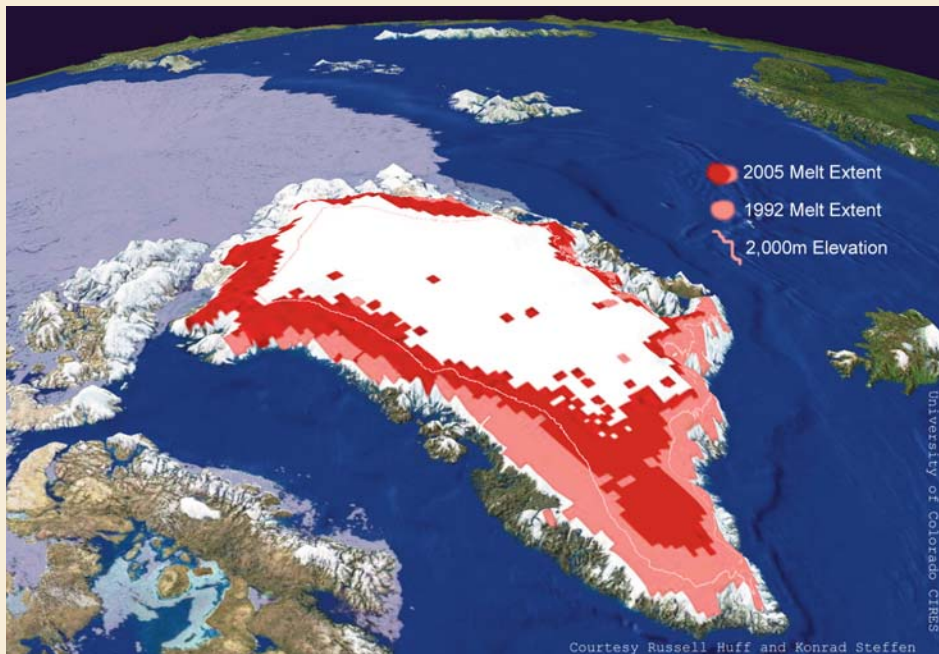
Antarctica, studying ice, oceans, ecosystems, the atmosphere and their links with each other. Learn more at www.ipy.org.

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CIRES is a cooperative institute of the National Oceanic and Atmospheric Administration and the University of Colorado at Boulder.

2005 Melt Extent



Greenland melt extent, K. Steffen and R. Huff.

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