Geophysical Research Abstracts
Vol. 13, EGU2011-14220, 2011
EGU General Assembly 2011
© Author(s) 2011

Melting of the Great Ice Sheets in Greenland and Antarctica

Eric Rignot

(1) University of California Irvine, Dep. Earth System Sciences, Irvine, CA; and NASA's Jet Propulsion Laboratory, Pasadena, CA, USA (erignot@uci.edu)

The growth and decay of ice sheets is controlled by the delicate balance between the input of mass from snowfall over the continents and the outflow of mass at the periphery from iceberg calving, surface and subaqueous melt, and other processes of mass ablation. Estimating even the sign and the magnitude of this mass balance has only been possible with the advent of precise satellite techniques, modern airborne surveys and major progress in regional atmospheric climate modeling.

Data collected over the past twenty years unequivocally indicate that the ice sheets in Greenland and Antarctica have been losing mass, and the mass loss is accelerating with time. These data include a comparison of perimeter fluxes with interior accumulation, time series of time-variable gravity data, and altimeter measurements of changes in surface elevation. These approaches to ice sheet mass balance concur to indicate a net loss of mass from the ice sheets and an increase in the mass loss, but published values differ. In our synthesis, we show excellent agreement between the mass budget and gravity methods, and explain the lack of agreement with altimeter missions.

In terms of physical processes contributing to the losses, climate models indicate no long-term trend in precipitation despite large inter-annual variations and an increase in surface melt in Greenland. The other contributing process is a de-stabilization of glacier fronts that triggered glacier acceleration. While a lot of attention has been paid to the role of sub-glacial water, the results suggest that this has not yet been a dominant control on faster motion and glacier de-stabilization. In contrast, many new studies support the concept that ice-ocean interactions, i.e. the melting of the submerged faces of glaciers in contact with the ocean, play a fundamental role in glacier evolution. Ice-ocean interactions are understood in Antarctica but the evolution of thermal forcing from the Southern Ocean is not. In Greenland, studies of ice-ocean interactions are only beginning. This leaves considerable opportunities for developing an improved understanding of ice sheet evolution in a warmer climate.