GRISO – U.S. CLIVAR WORKING GROUP
Greenland Ice Sheet/Ocean Interactions

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Greenland Ice Sheet/Ocean Interactions Working Group

Goal

• To advance our understanding of the processes involved in the interaction of glaciers/ocean in Greenland and lead to their improved representation in climate models

• to foster and promote interaction between the diverse communities, oceanographic, glaciological, atmospheric and climate (including modelers, field and data scientists within each community), interested in glacier/ocean interactions around Greenland

Fully understanding glacier/ocean interactions in Greenland or developing a fully coupled ice sheet/ocean model is beyond the scope of this CWG
Greenland Ice Sheet/Ocean Interactions Working Group

Tasks

• Summarize the present state of knowledge and identify the big questions within each community and from the perspective of the ice-sheet, ocean and climate modeling.

• Organize a workshop that brings together the diverse communities
  - Forum for scientific exchange
  - Identify major gaps
  - Discuss how to move forward

• Report making specific recommendations on how to make progress on this topic
Understanding the Dynamic Response of Greenland’s Marine Terminating Glaciers to Oceanic and Atmospheric Forcing

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An interdisciplinary and multifaceted approach is needed to understand the forcings and mechanisms behind the recent retreat and acceleration of Greenland’s glaciers and its implications for future sea level rise.
Scientific Steering Committee
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- ~100 participants about ½ US and ½ international
- Co-sponsored by NSF
- Strong early career participation (over 1/3 of participants)
- Participation of program managers from NSF, NASA
INTERNATIONAL WORKSHOP ON UNDERSTANDING
THE RESPONSES OF GREENLAND’S MARINE-TERMINATING
GLACIERS TO OCEANIC AND ATMOSPHERIC FORCING
Challenges to improving observations, process understanding and modeling
June 4-7, 2013
Wylie Inn & Conference Center
Beverly, Massachusetts
Workshop Report Synthesizing Scientific Priorities

- Targeted process studies to fill specific gaps
- Megasite experiment – in depth study at one or two sites to study the interaction of the different components
- Greenland Ice Ocean Observing System (GrIOOS)
- Data Compilation and Sharing
- Improved Bottom Topography

Further discussed and finalized at a Townhall meeting organized by NSF held at the Fall AGU Meeting December 2013.

Understanding the response of Greenland’s marine terminating glaciers to oceanic and atmospheric forcing

Guest Editors:
Patrick Heinbach, Massachusetts Institute of Technology; Emma Straneo, Woods Hole Oceanographic Institution; Olga Serebrenko, Princeton University

Mass loss from the Greenland ice sheet quadrupled from 1992-2001 to 2001-2011, resulting in a net contribution to sea-level rise of approximately 7.5 mm over the 1992-2011 period, roughly twice the Antarctic contribution. Roughly half of this loss is due to the speed up, thinning, and retreat of marine-terminating glaciers that began in the late 1990s and continues to this date. The underlying causes are not well understood, but evidence suggests that it was associated with changes at the marine terminus. Thus, ice sheet-ocean interactions in Greenland have emerged as a new research frontier that is critical to understanding Greenland’s contribution to global sea-level rise.

Tackling this frontier, however, is far from trivial. Greenland’s largest glaciers terminate in deep, long fjords. These fjords are remote, inaccessible, and choked with ice-marginal calved icebergs and ice, posing major challenges to scientists and instrumentation. The records of oceanic changes near the

Greenland outlet glacier ice-flow variability

Twila Moon
University of Washington

Ice mass loss from the Greenland Ice Sheet is a primary contributor to global sea level rise. The rate of ice loss has accelerated over the last couple of decades and Greenland currently contributes about 0.7–1.1 mm/yr to sea-level rise (260-380 Gt/yr) per year; Enderlin et al. 2014; Shepherd et al. 2012). Predicting the potential rate and limits of future mass loss requires a clear understanding of ice sheet dynamics and how the ice sheet is coupled to the climate system. Roughly a third of a half of Greenland ice loss is due to discharge through icebergs calving at the ice-sheet margins, as opposed to in situ surface melt (Enderlin et al. 2014; Shepherd et al. 2012). Glacier velocity, as well as ice thickness, terminus advance and retreat, and the mechanisms controlling their variability, must be understood to calculate and predict ice sheet discharge. Characterization and understanding of ice sheet velocity contributes both to exploring the processes controlling ice dynamics and to constraining ice sheet models used to predict future mass loss and associated sea-level rise.

Modern satellite technology and analysis techniques now allow for a more comprehensive understanding of ice flow variability across the entire Greenland Ice Sheet, including year-to-year velocity changes. To take advantage of the lengthening satellite data record, an ice-sheet-wide survey of interannual velocity changes on Greenland outlet glaciers (glacier terminus width >1.5 km) was completed for 2000 through 2010 (Moon et al. 2012). The study examined winter velocities for 2000/01 and every year from 2005/06 through 2010/11 (subsequently referred to by the earlier year, e.g., 2010/11 = 2010). Prior to this study, outlet glacier velocities had only been examined for smaller groups of glaciers or by comparing broad velocity snapshots with ~5-year sampling. The study revealed variable regional and local variability underlying mean speedup across much of the ice sheet.

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Future of GRISO

Strong endorsement by the national and international scientific community (including the workshop participants, federal representatives) to continue the GRISO efforts

**International Working Group** – endorsed/sponsored by ?
(Have been in discussions with CliC and CLIVAR, ideally it will be backed by both).

Focus – improved understanding of processes involved in Greenland Ice Sheet/Ocean Interactions

Specifics –
- Design of integrated field/modeling experiments at a megasite
- Design of a long-term observing system