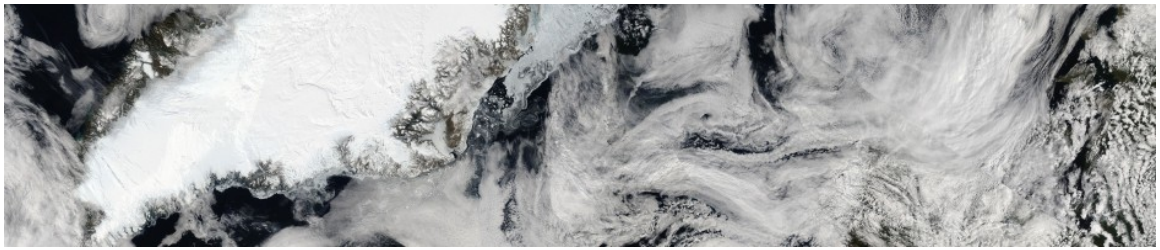

GRISO – U.S. CLIVAR WORKING GROUP

Greenland Ice Sheet/Ocean Interactions

Co-chairs

Fiamma Straneo (WHOI), P. Heimbach (MIT) O. Sergienko (Princeton/GFDL)

Ginny Catania	*University of Texas*
Robert Hallberg	*NOAA GFDL*
Gordon Hamilton	*University of Maine*
Ian Joughin	*University of Washington*
Stephen Price	*Los Alamos National Lab*
Eric Rignot	*NASA JPL*
Michael Spall	*WHOI*
Adrian Jenkins	*British Antarctic Survey*
Cecilia Bitz	*University of Washington*
David Bromwich	*Ohio State University*

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

Fiamma Straneo (WHOI), Patrick Heimbach (MIT),
Olga Sergienko (GFDL), Gordon Hamilton (UMaine),

C. Bitz (U. Washington), D. Bromwich (Byrd Polar & Ohio St.)
Ginny Catania (U. Texas), R. Hallberg (GFDL)
A. Jenkins (BAS), I. Joughin (U. Washington)
S. Price (LANL), E. Rignot (JPL/UC Irvine), M. Spall (WHOI)
S. Griffies (GFDL), R. Motyka (U. Alaska), A. Münchow (U. Delaware), F. Nick (Utrecht U.), L. Padman (ESR), W.T. Pfeffer (U. Colorado), T. Scambos (NSIDC), M. Truffer (U. Alaska), A. Vieli (Durham U.)

Peer-reviewed Publication with community input

Bulletin of the American Meteorological Society, August 2013

ARTICLES

CHALLENGES TO UNDERSTANDING THE DYNAMIC RESPONSE OF GREENLAND'S MARINE TERMINATING GLACIERS TO OCEANIC AND ATMOSPHERIC FORCING

BY FIAMMETTA STRANEO, PATRICK HEIMBACH, OLGA SERGIENKO, GORDON HAMILTON, GINNY CATANIA, STEPHEN GRIFFIES, ROBERT HALLBERG, ADRIAN JENKINS, IAN JOUGHIN, ROMAN MOTYKA, W. TAD PFEFFER, STEPHEN F. PRICE, ERIC RIGNOT, TED SCAMBOS, MARTIN TRUFFER, AND ANDREAS VIELI

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

Open, International Workshop – 4-7 June 2013 – Beverly MA

Scientific Steering Committee
F. Straneo (WHOI, USA); P. Heimbach (MIT, USA); O. Sergienko (GFDL, USA); G. Catania (U. Texas, USA); G. Hamilton (U. Maine, USA); S. Price (LANL, USA); R. Bindschadler (NASA/GSFC); A. Jenkins (BAS, UK); H. Johnson (Oxford U., UK); I. Joughin (APL-UW, USA); D. Menemenlis (JPL/Caltech, USA); J. Mortensen (GINR, Greenland); R. Motyka (U. Alaska, USA); L. Padman (ESR, USA); D. Roberts (U. Durham, UK); A. Vieli (U. Durham, UK); D. van As (GEUS, DK)

- ~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

Workshop Report Synthesizing Scientific Priorities

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.

Variations – US CLIVAR Newsletter – Spring 2014.

US CLIVAR Climate Variability & Predictability

VARIATIONS

Spring 2014 • Vol. 12, No. 2

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

Guest Editors: Patrick Heimbach, Massachusetts Institute of Technology; Fiamma Straneo, Woods Hole Oceanographic Institution; Olga Sergienko, 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 termini. 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 mélange composed of calved icebergs and sea 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/ice 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 to a half of Greenland ice loss is due to discharge through iceberg calving at the ice-ocean interface, 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, so 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 notable regional and local variability underlying mean speedup across much of the ice sheet.

IN THIS ISSUE

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