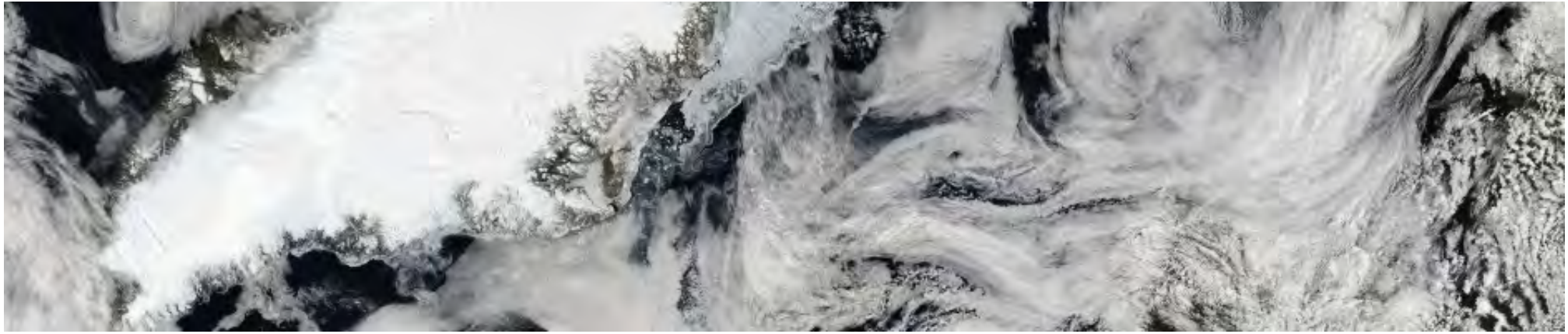


US CLIVAR Working Group

GReenland Ice Sheet-Ocean interactions (GRISO)

Fiammetta Straneo (WHOI) Patrick Heimbach (MIT)
Olga Sergienko (Princeton/GFDL)

Cecilia Bitz (U. Washington), David Bromwich (Ohio State University),
Ginny Catania (U. Texas), Robert Hallberg (GFDL), Gordon Hamilton (U. Maine)
Adrian Jenkins (British Antarctic Survey), Ian Joughin (APL/UW),
Stephen Price(LANL), Eric Rignot (UC Irvine/JPL), Michael Spall (WHOI)

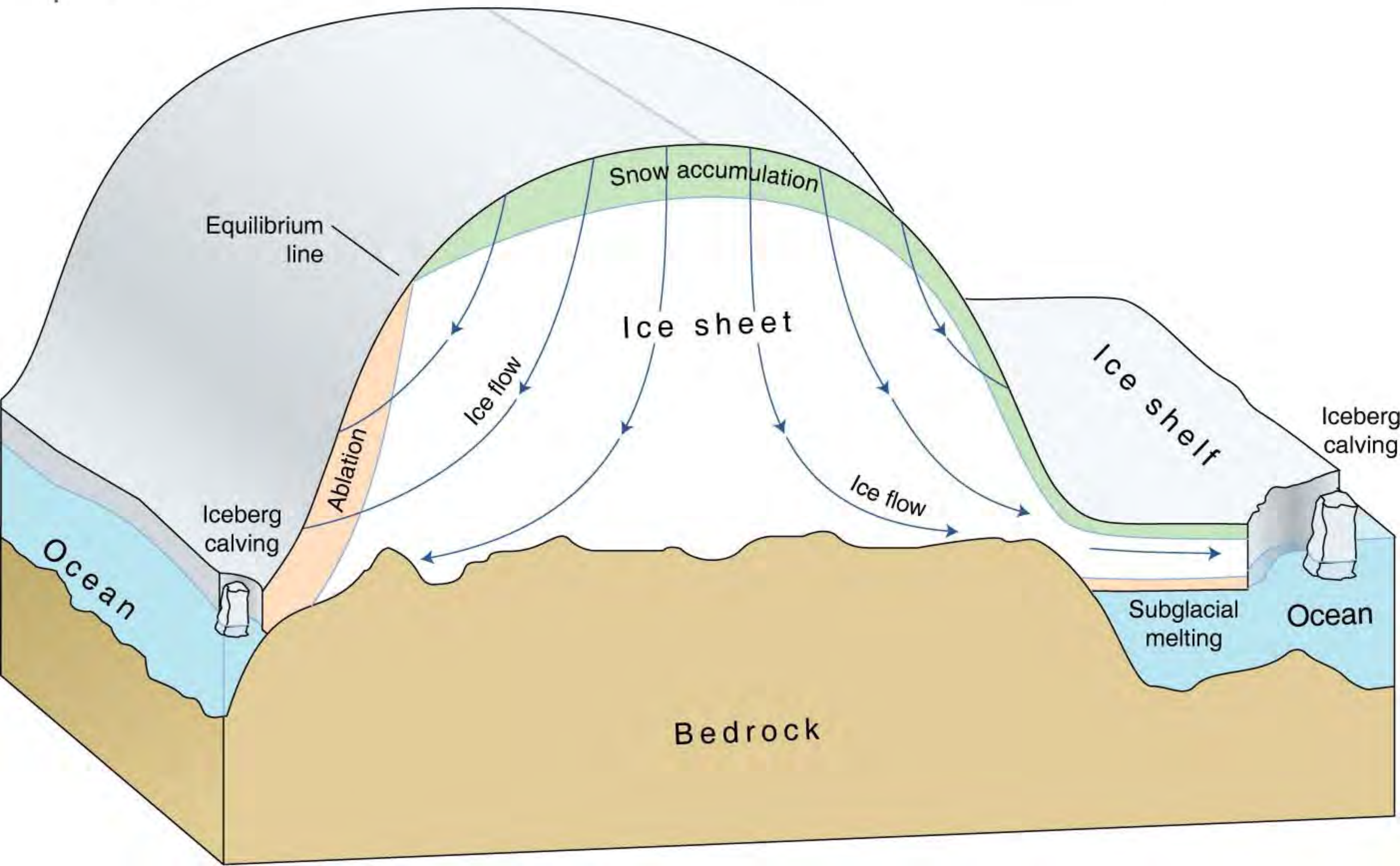
www.griso-wg.org

~ 7 m

~ 65 m

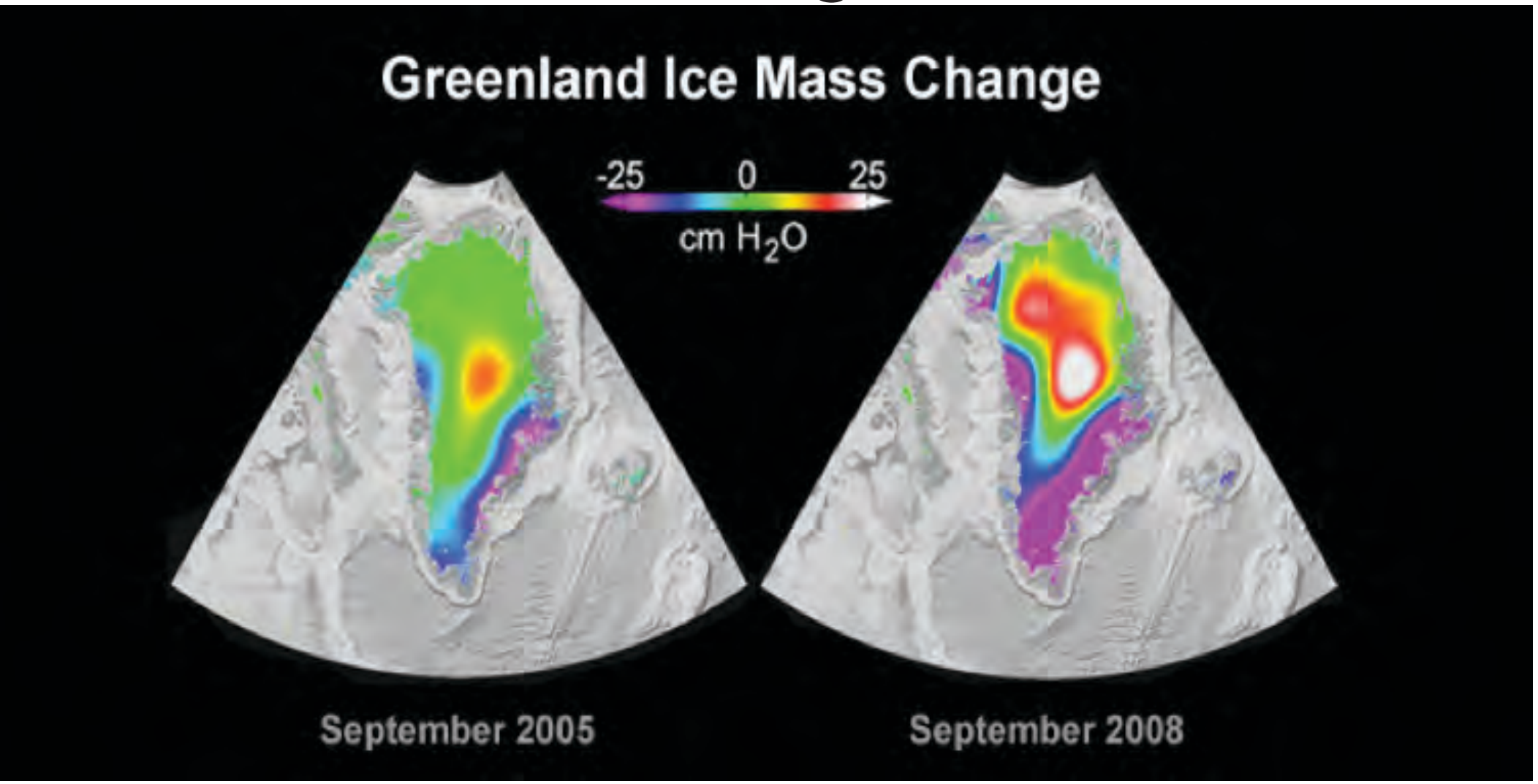
Greenland
Melting on the lower parts of the surface, icebergs calve off from ice sheet edges into ice fjords and the sea

Antarctica
Ice shelves, with subglacial melting. Icebergs calve off from ice shelves



Motivation

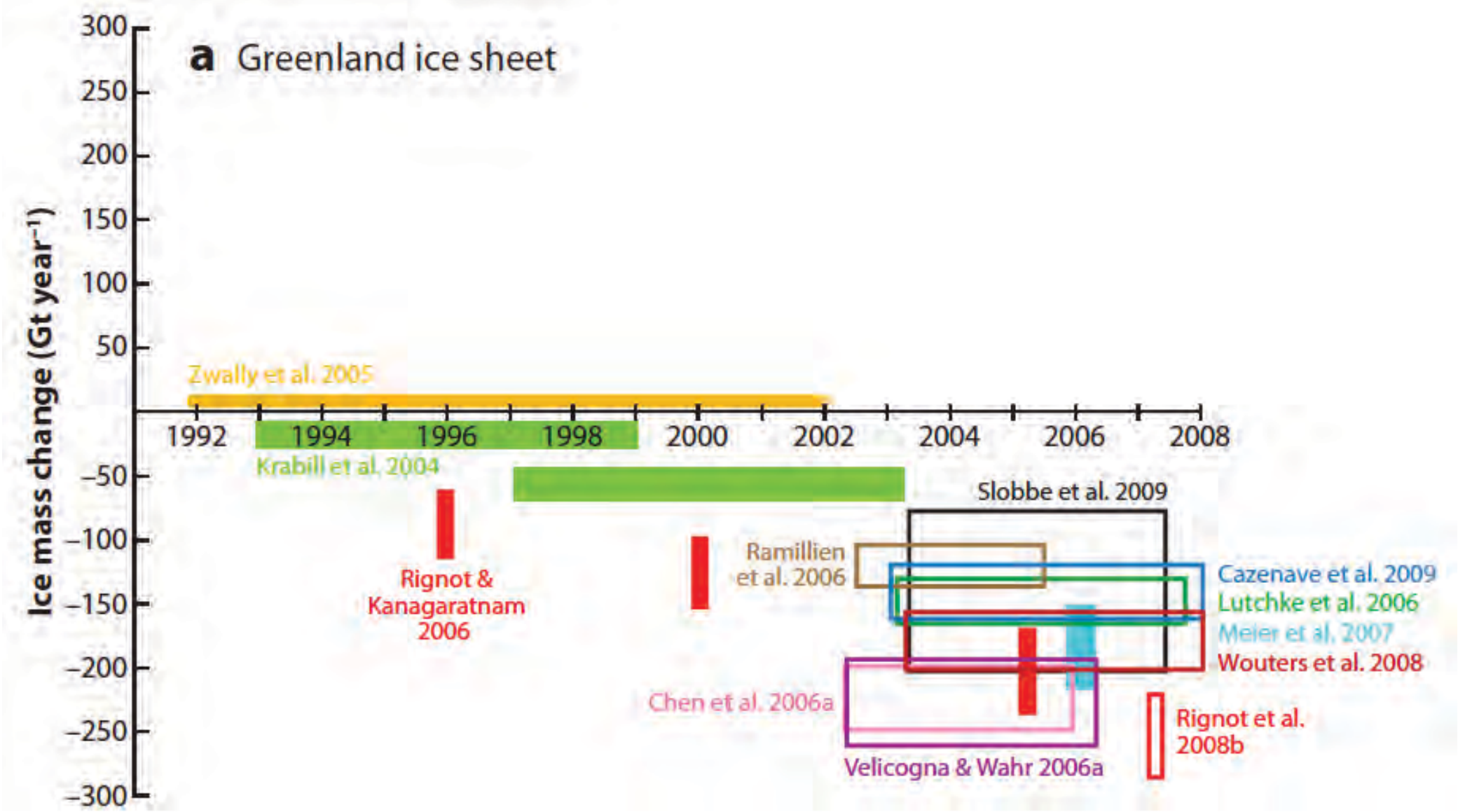
Greenland has been losing mass for a while...



GRACE observations (Khan et al, 2010)

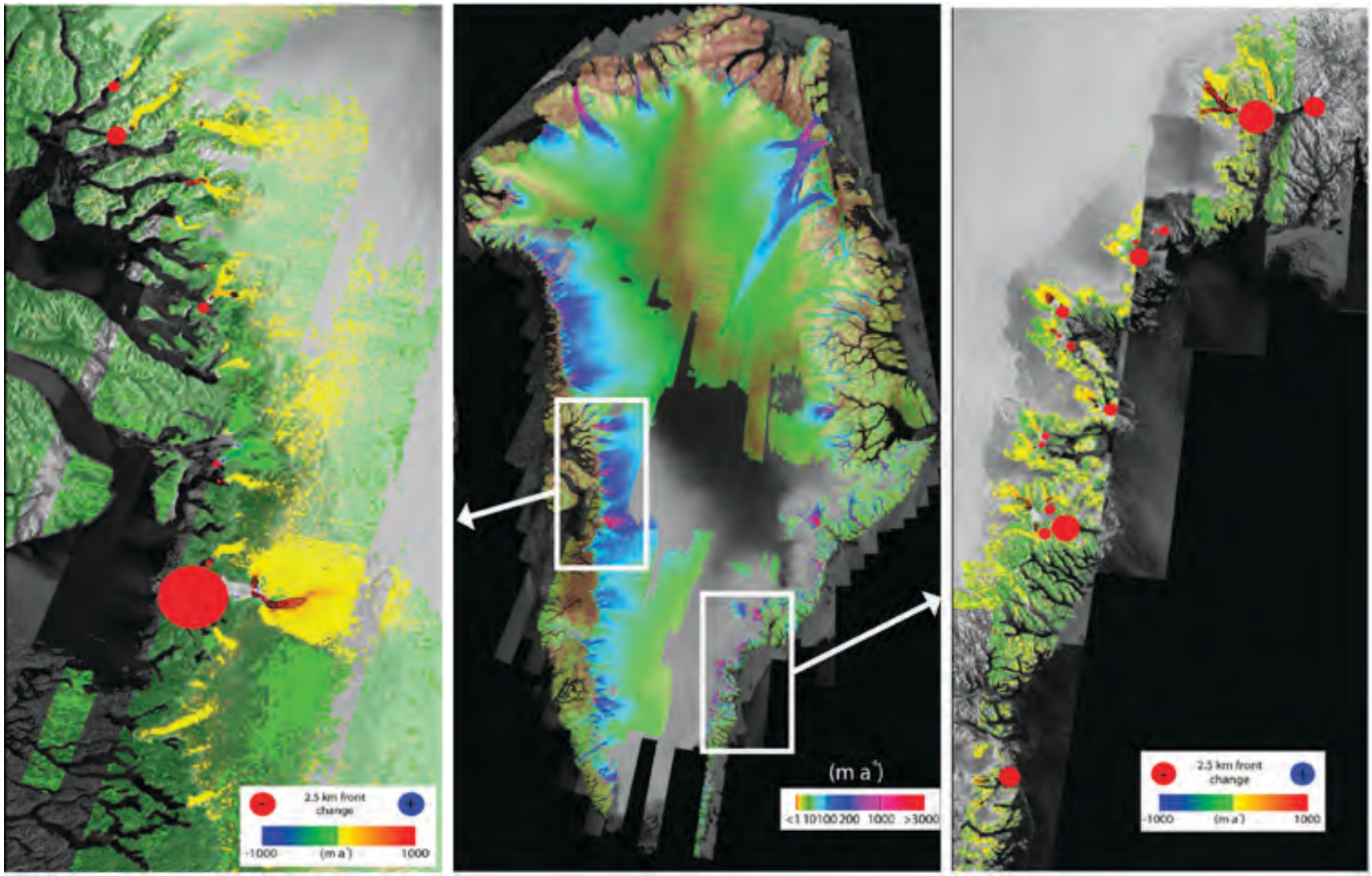
... and recently with accelerated rate

it presently accounts for 25 % of global sea level rise



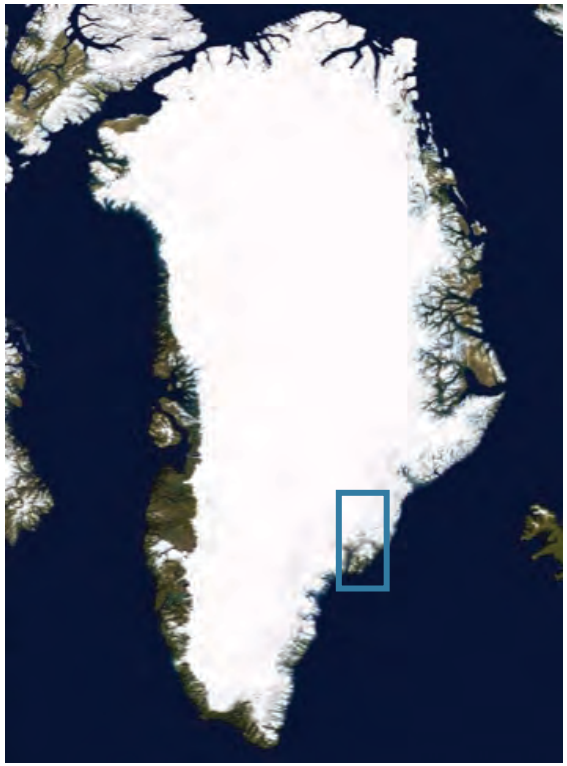
Cazenave (2010)

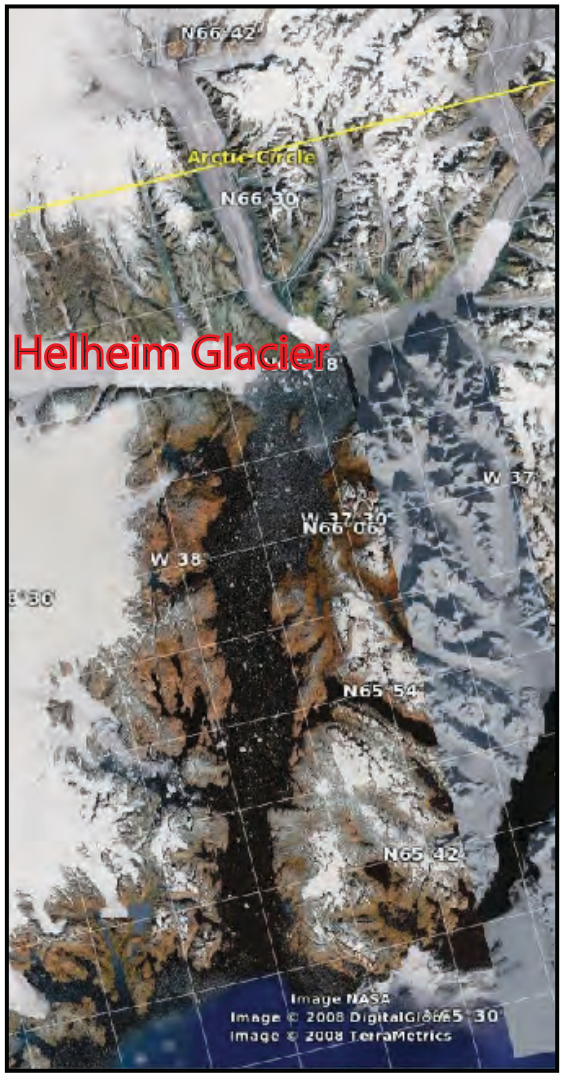
Half of the loss is due to the retreat and acceleration of marine terminating glaciers

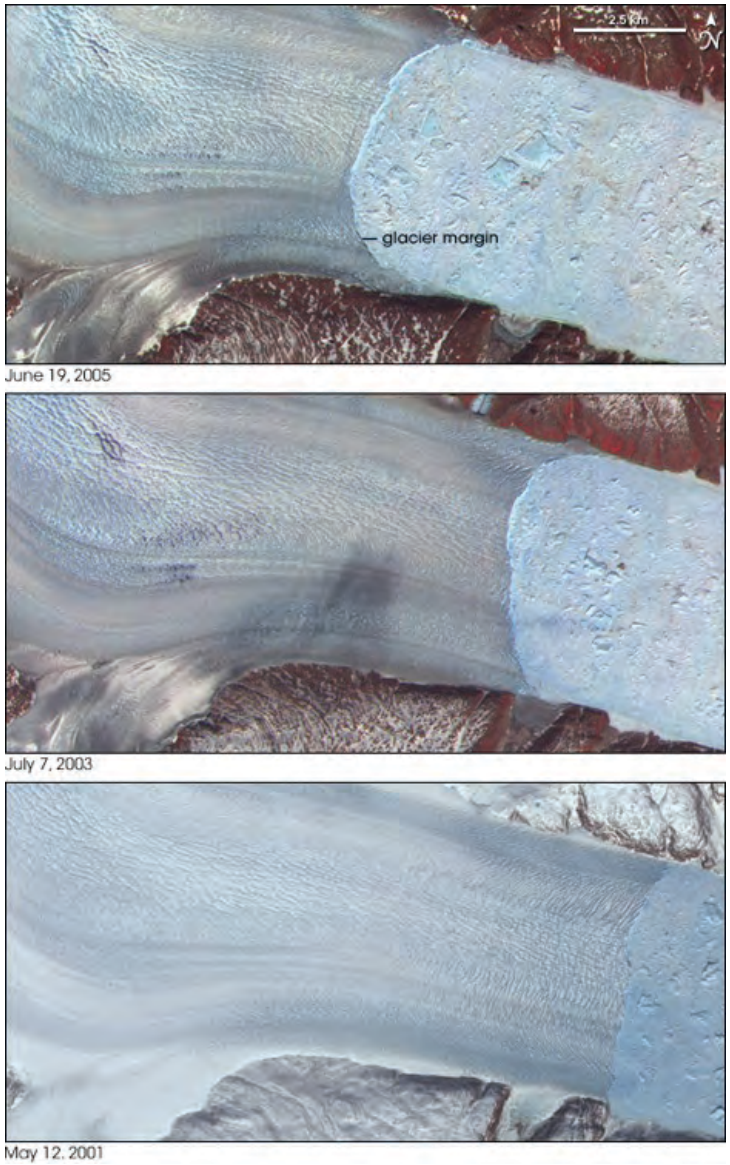


Acceleration of outlet glaciers between 2000/2001 and 2005/2006 in western and southeast Greenland (Joughin et al., 2010).

Half of the loss is due to the retreat and acceleration of marine terminating glaciers





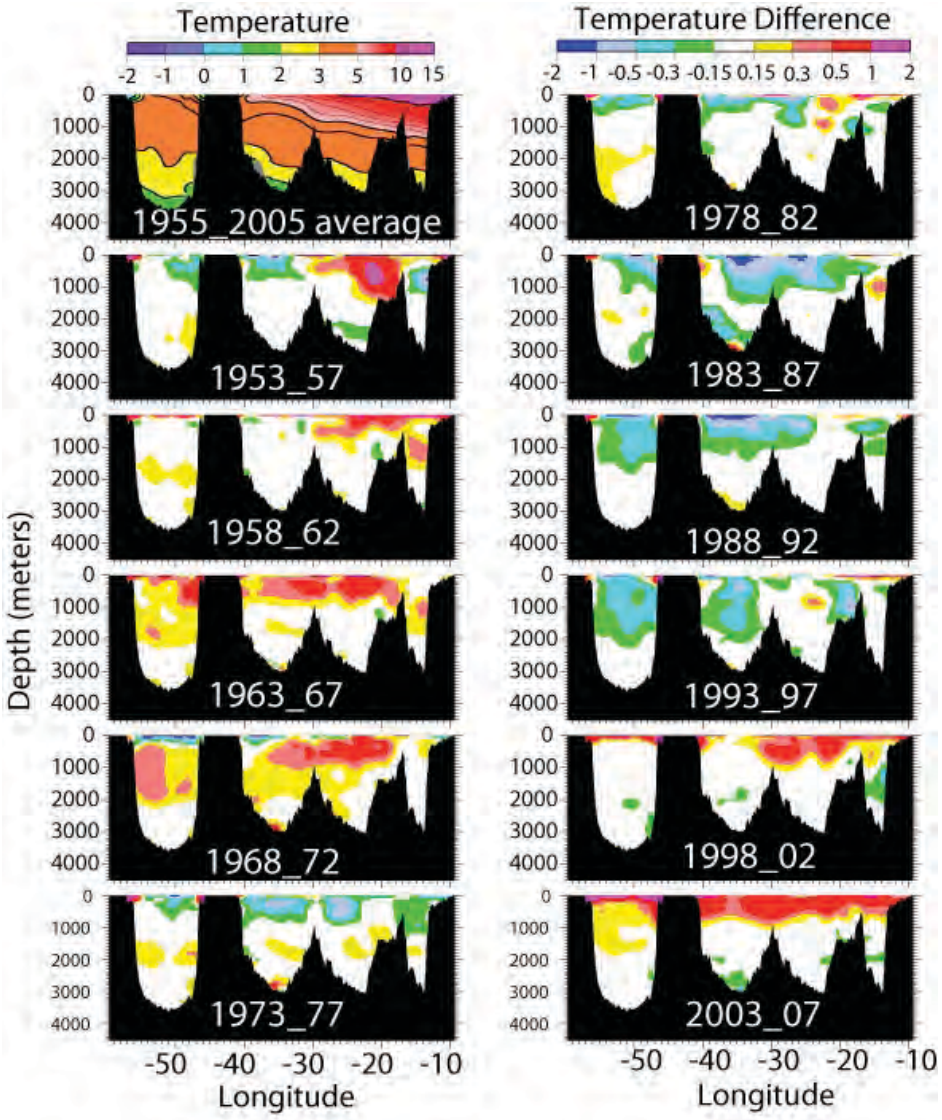


Thinned 200 m
Doubled its speed
Retreated 7.5 km

Stearns and Hamilton 2007; van den Broeke et al. 2009

Outlet glacier acceleration coincided with a period of oceanic and atmospheric warming

Oceanic



R. Curry (WHOI) from HydroBase II

Atmospheric

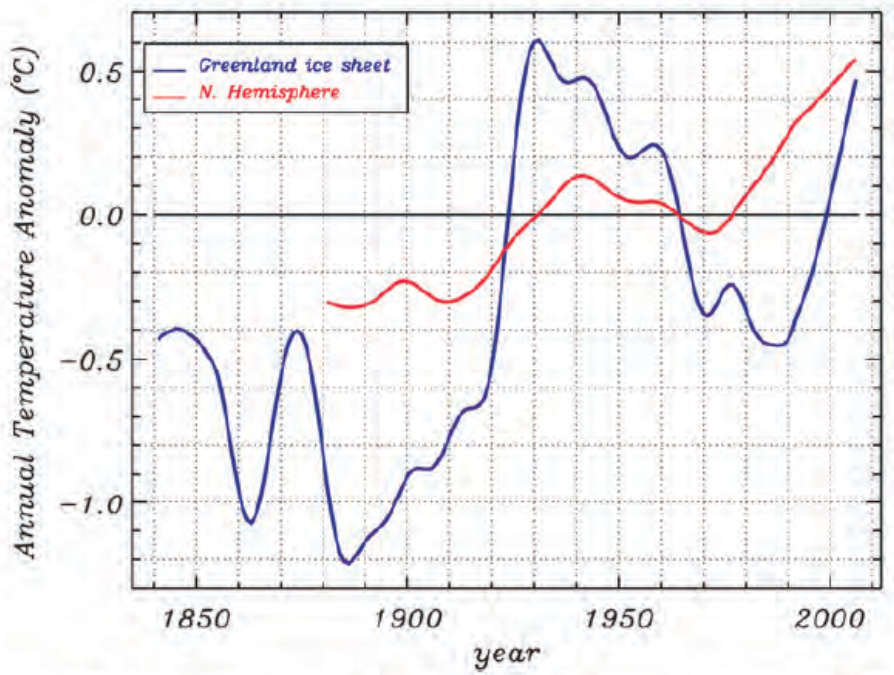


FIG. 14. Time series of low-pass-filtered Greenland inland ice and Northern Hemisphere near-surface air temperature anomalies with respect to the 1951–80 base period.

Box et al (2009)

Ice Sheet Dynamics and the IPCC

1990

no mention of ice sheet dynamics (time scales thought too long)

1995

West Antarctic collapse mentioned high risk / low probability event

2001

Feedback emphasizing importance of ice dynamics all but ignored

2007

“dramatic” ice dynamics clearly identified as major uncertainty

Projections of SLR from Greenland by 2100 range from 0.006-0.5 m

GRISO WG
Overarching Goals

- to foster interaction between the diverse communities

  (oceanographic, glaciological, atmospheric and climate),

  interested in glacier/ocean interactions around Greenland,

  including modelers, field and data scientists within each community

- promote exchange of data and model products

- coordinate field programs

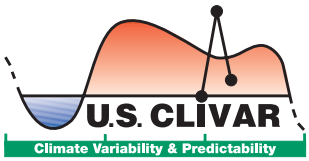
- advance our understanding of the dominant process and improve their representation and/or parameterization in Eath system and climate models

GRISO WG
Specific Goals

- Summarize the present state of knowledge, the ongoing efforts, identify the big questions within each community and from the perspective of ice-sheet, ocean, and climate science;

- Develop strategies to address these questions, whilst identifying the short-term and long-term needs of each community;

- Make specific recommendations on how to move forward and make progress in obtaining the required information and products;



U.S. CLIVAR: Climate Variability and Predictability

Understanding the Dynamic Response of Greenland's Marine Terminating Glaciers to Oceanic and Atmospheric Forcing

A White Paper
by the U.S. CLIVAR Working Group on
Greenland Ice Sheet-Ocean Interactions (GRISO)

May 2012

U.S. CLIVAR Report
No. 2012-2

May 2012

U.S. CLIVAR
Project Office
Washington, DC

Au: is the change in the title, "understand" to "understanding" okay?

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

Mass loss from the Greenland and Antarctic ice sheets tripled over the last two decades, from 100 ± 92 Gt yr^{-1} (0.28 ± 0.26 mm yr^{-1} sea level equivalent) during 1992–2000 to 298 ± 58 Gt yr^{-1} (0.83 ± 0.16 mm yr^{-1}) during 2000–11 [see Shepherd et al. (2012) and references therein]. It presently accounts for about one-quarter of the observed global sea level rise (SLR) from 1992 to 2008 of 3.4 ± 0.4 mm yr^{-1} (Cazenave and Llovel 2010; Church and White 2011). This increase is largely due to Greenland, whose loss rose from 51 ± 65 Gt yr^{-1} (1992–2000) to 211 ± 37 Gt yr^{-1} (2000–11) (Shepherd et al. 2012). Independent geodetic measurements of continental uplift and Earth rotation support these changes (e.g., Jiang et al. 2010; Nerem and Wahr 2011; Bevis et al. 2012). Greenland's loss, in turn, is approximately equally partitioned between increased surface melting due to rising air temperatures (Cappelen 2010) and the unpredicted, surprising, and rapid speedup, retreat, and thinning of glaciers (Howat et al. 2007; Luckman et al. 2006; van den Broeke et al. 2009). Even though the precise chain of events is still debated, the widespread and near-synchronous glacier retreat and its coincidence with a period of oceanic and atmospheric warming suggest a common climate driver. A growing body of evidence points to the marine margins of these glaciers as the region from which this dynamic response originated (Figs. 1 and 2), leading to the hypothesis that the recent dynamic mass loss from the Greenland Ice Sheet

Au: please provide a reference for Church and White (2011), otherwise delete the citation.

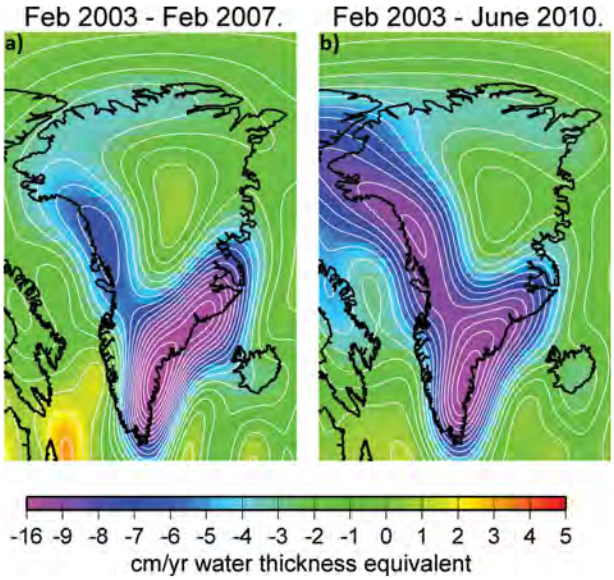
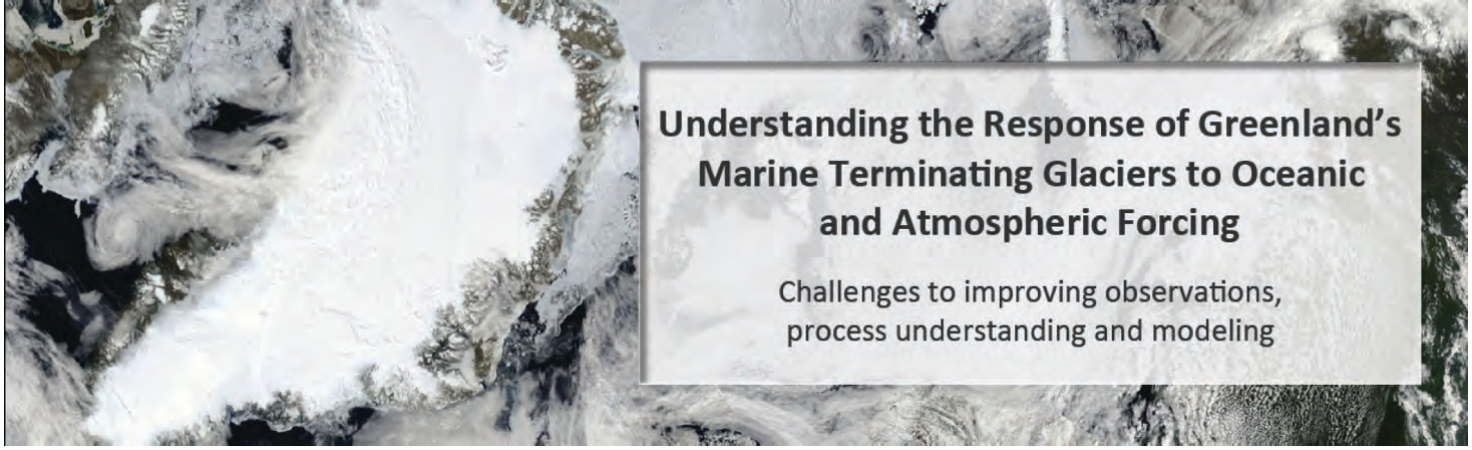


FIG. 1. Recent mass loss from Greenland is concentrated along the coastal margins of southern Greenland and spreading along western Greenland. Rate of mass loss (in centimeters per year water equivalent thickness) from Gravity Recovery and Climate Experiment (GRACE) measurements (a) between Feb 2003 and Feb 2007 and (b) between Feb 2003 and Feb 2010 [redrawn and extended from Khan et al. (2010); courtesy of S. A. Khan, DTU, Denmark].



U.S. CLIVAR International Workshop

June 4, 2013 to June 7, 2013

Wylie Inn & Conference Center, Beverly, MA

GRISO Workshop

— Well attended

89 particpants

10 contries

32 early career scientists

— Program

Overview talks

Posters

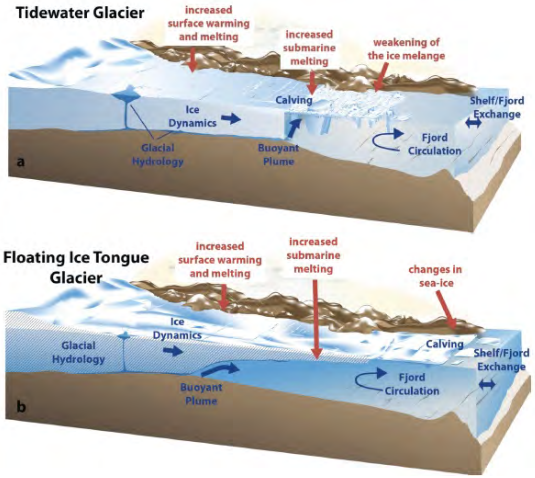
Discussions, discussions, discussions

— Very well organized

Jill and Jennifer, THANK YOU!!!

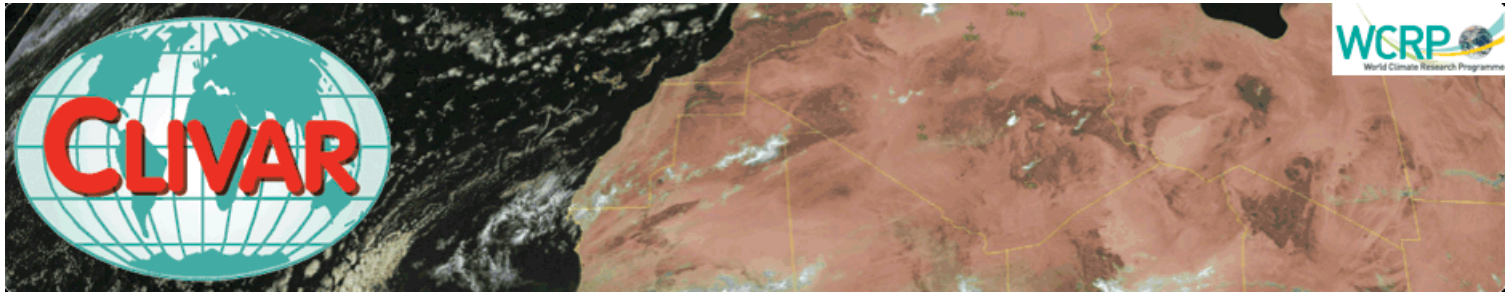
Proposed Research Strategy

1. Data compilation
   - Bathymetry
   - Outlet glacier bed elevation
   - Other (from you)?
   - New surveys?
2. Mega-sites (2)*
   - Floating-tongue type
   - Vertical-face type
   - Characteristics & Measurements (from you)
3. Greenland-wide Observation Network*
   - Primarily ocean observations
   - Locations & Measurements (from you)
4. Targeted Experiments
   - idealized studies (in-situ/lab/numerical)



* seek international partnerships, where possible

Future plans



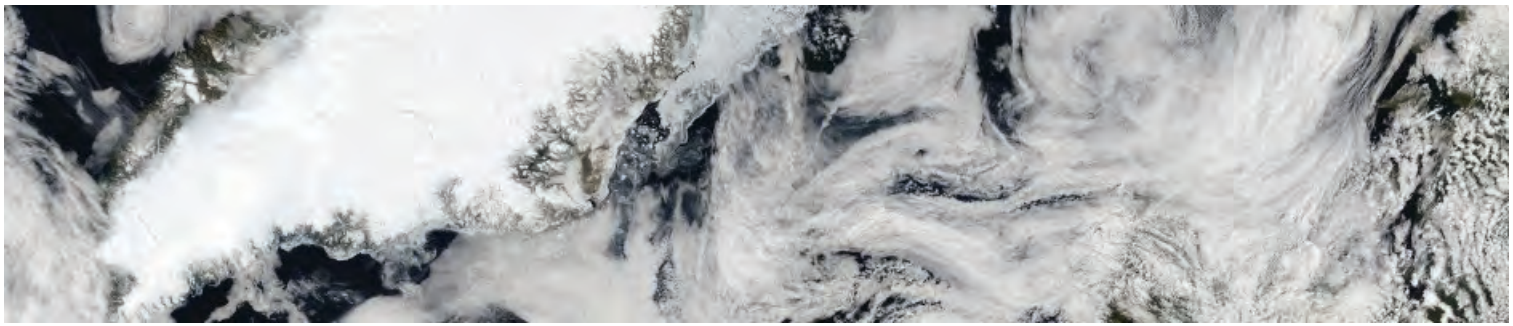
— WG of International Clivar?

CliC Climate and Cryosphere

Understanding the changing cryosphere and its climate connections

— WG of CliC?

Greenland Ice-Sheet Ocean Interactions



— Community-based project?