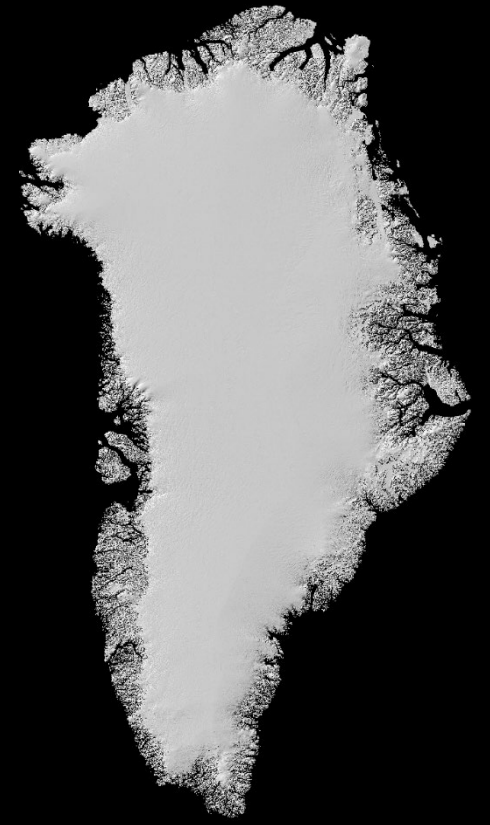
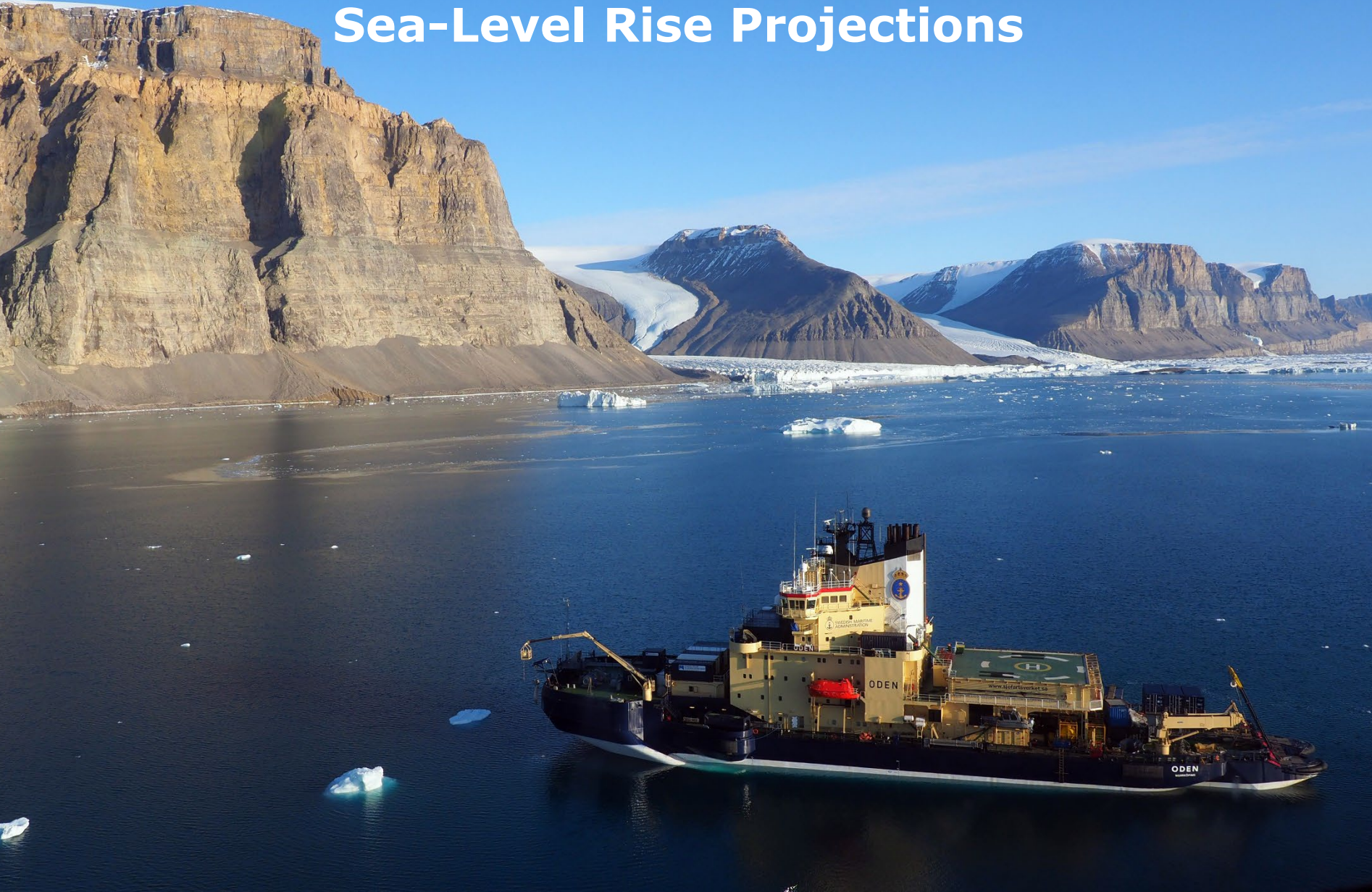


Mapping Uncharted Northern Greenland Waters: Implications for Glacier Dynamics and Future Sea-Level Rise Projections



Martin Jakobsson
Department of
Geological Sciences



Ryder 2019 Expedition

Petermann 2015 Expedition



Explorers Club Flag Expedition #51



Photo: Lars Lehnert

Ryder 2019 Expedition



Christian Stranne
Liz Weidner
Sam Reed
Brian Calder
Julia Muchowski
Larry Mayer
Björn Eriksson
Kevin Jerram



Scientific Party

Lee-Gray	Boze	USGS	USA
Volker	Brüchert	SU	Sweden
Brian	Calder	UNH	USA
Christian	Carøe	Copenhagen Univ.	Denmark
Julek	Chawarski	MUN	Canada
Tom	Cronin	USGS	USA
Love	Dalé	SNMH	Sweden
Fredrik	Dalerum	SU & Oviedo Univ.	Sweden
Björn	Eriksson	SU	Sweden
John	Farrell	USARC	USA
Jonas	Fredriksson	SU	Sweden
Laura	Gemery	USGS	USA
Anna	Glüder	OSU	USA
Anders	Götherström	SU	Sweden
Björn	Gunnarson	SU	Sweden
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Tamara	Handl	SU	Sweden
Felicity	Holmes	SU	Sweden
Martin	Jakobsson	SU	Sweden
Kevin	Jerram	UNH	USA
Carina	Johansson	SU	Sweden
Markus	Karasti	SU	Sweden
Hans	Linderholm	UG	Sweden
Johannes	Mäsviken	SU	Sweden
Larry	Mayer	UNH	USA
Alan	Mix	OSU	USA
Julia	Muchowski	SU	Sweden
Johan	Nilsson	SU	Sweden
Matt	O'Regan	SU	Sweden
June	Padman	OSU	USA
Abhay	Prakash	SU	Sweden
Sam	Reed	UNH	USA
Brendan	Reilly	OSU	USA
Emelie	Ståhl	SU	Sweden
Christian	Stranne	SU	Sweden
Brett	Thornton	SU	Sweden
Adam	Ulfsbo	UG	Sweden
Elizabeth	Weidner	UNH & SU	USA
Gabriel	West	SU	Sweden

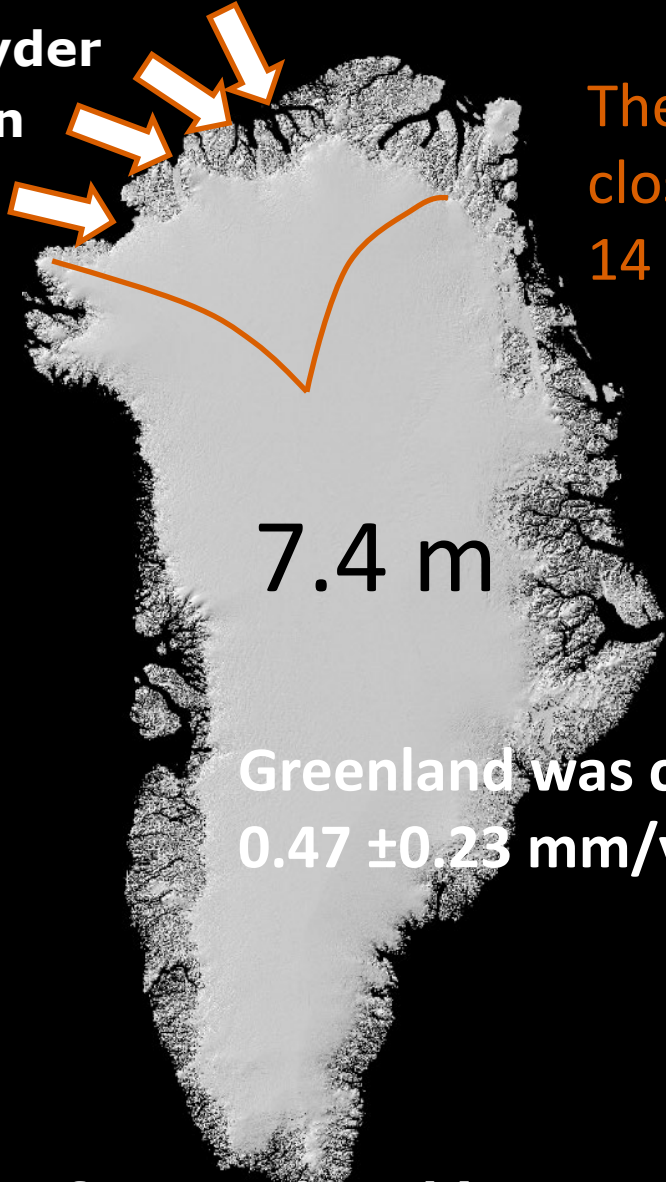
Air/Marine Chemistry-Archaeology-Biology-Ecology-Geology-Geophysics-Glaciology-Paleoclimatology

Greenland ice volume in global sea-level equivalence and sub-ice topography

C.H. Ostefeld

Ryder

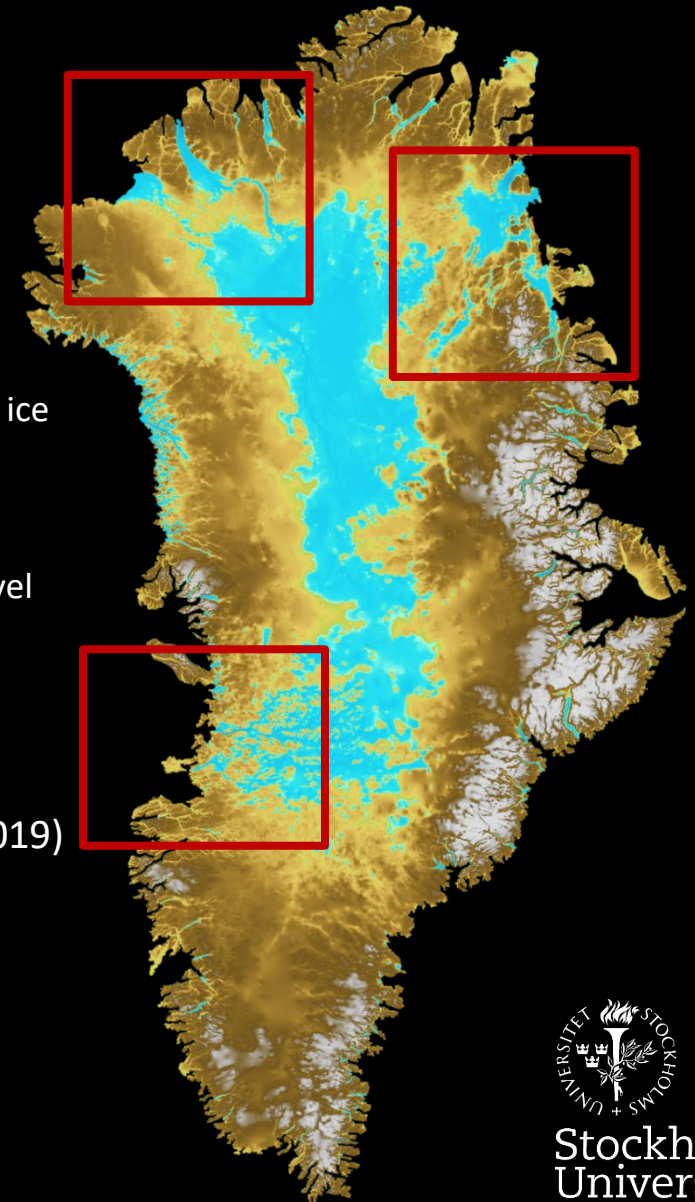
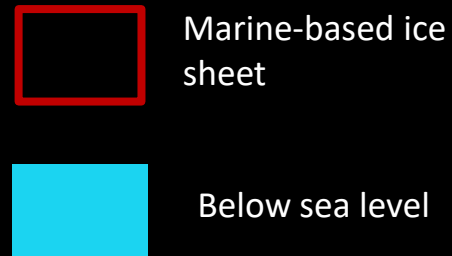
Petermann
Humbolt

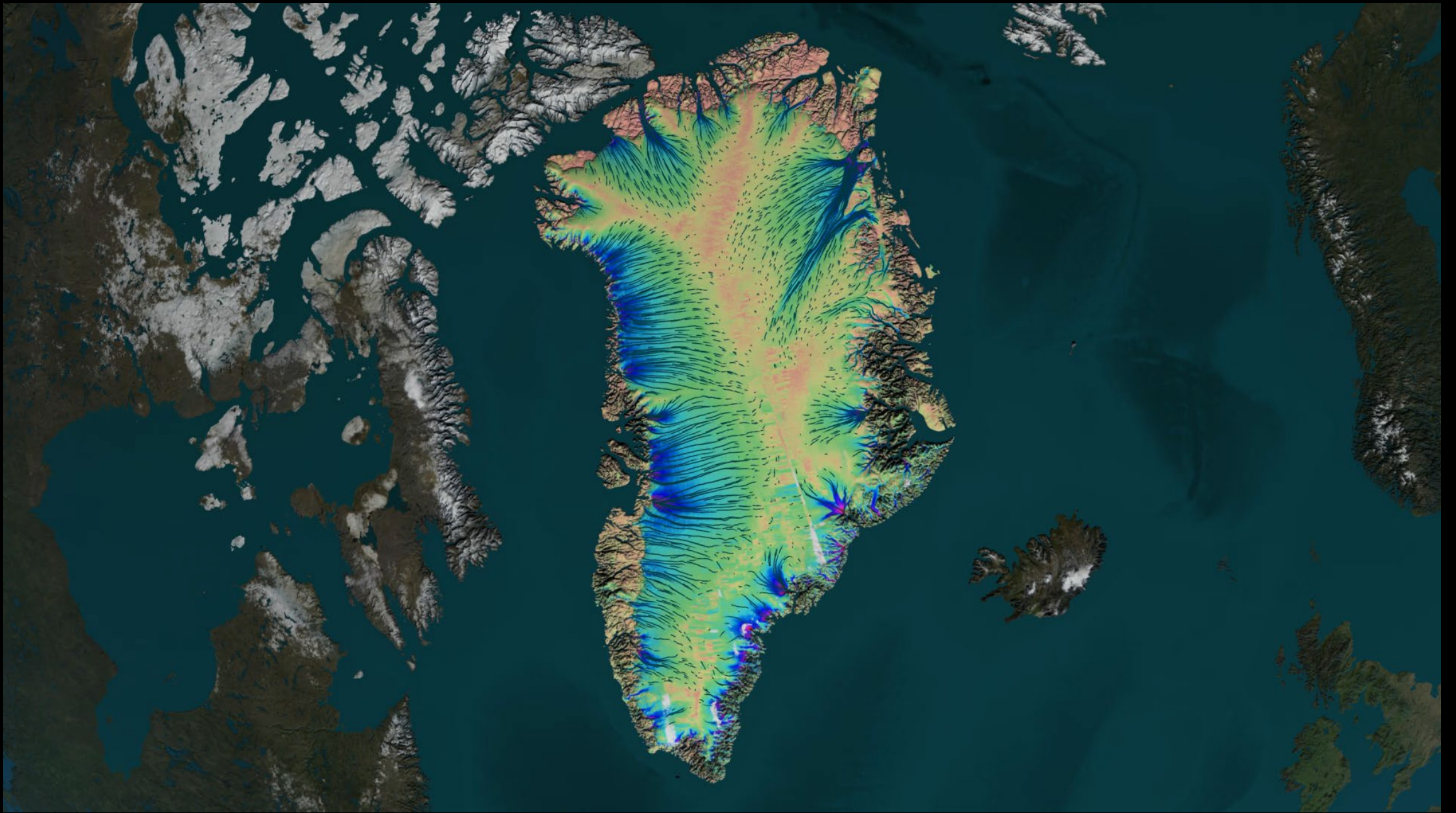


7.4 m

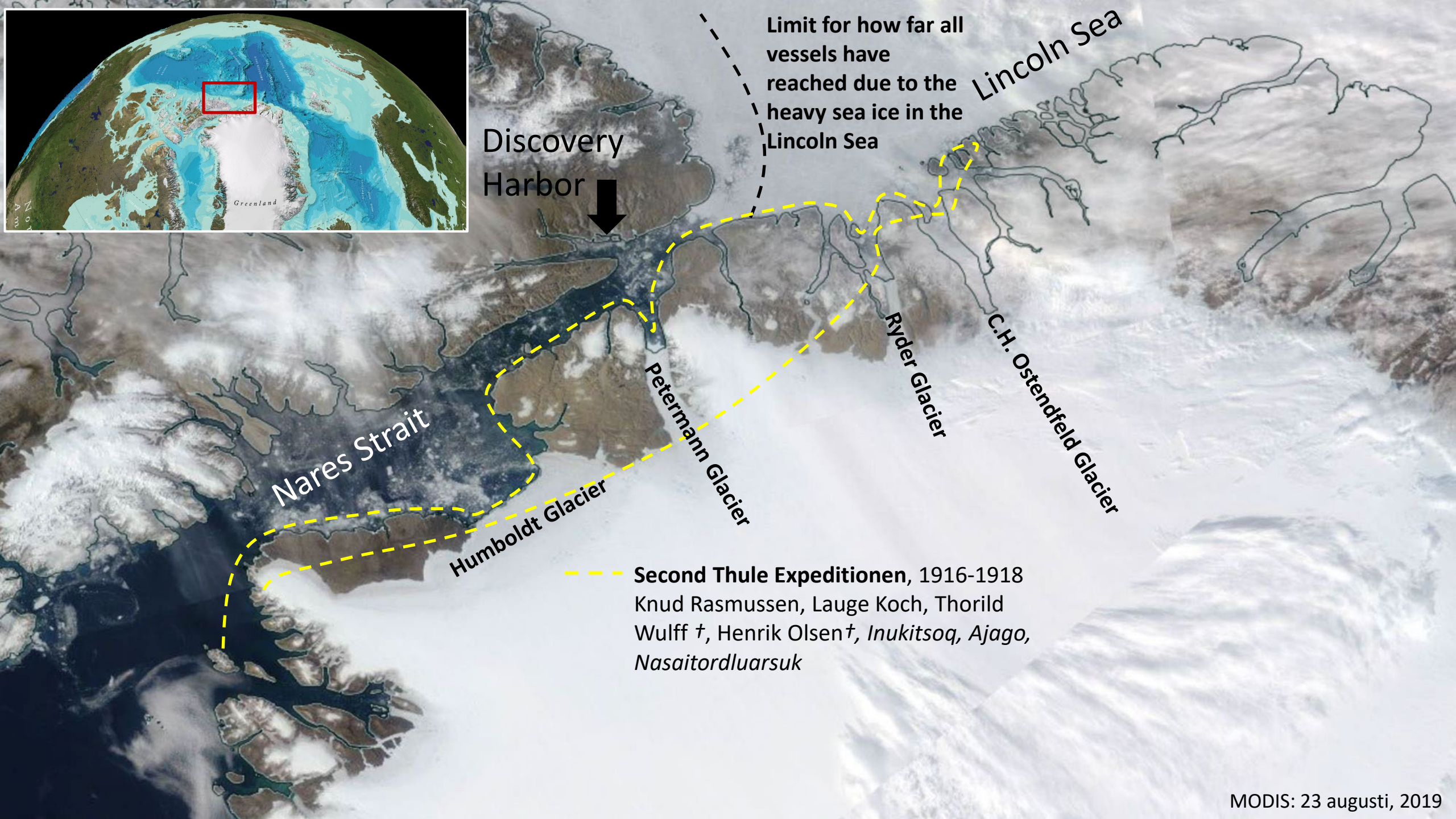
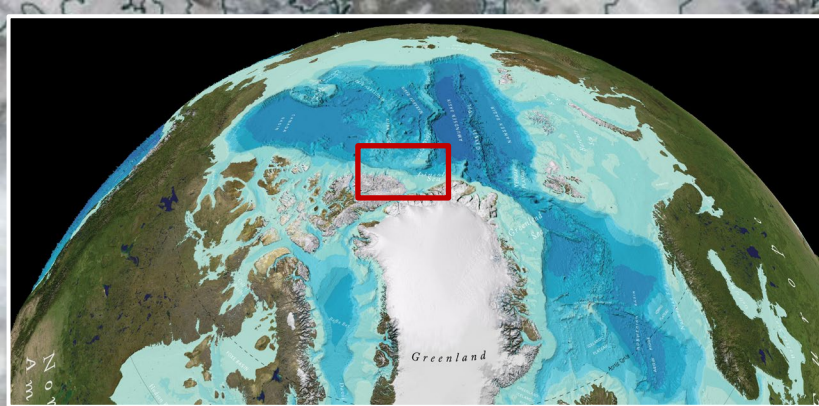
Greenland was contributing on average
 0.47 ± 0.23 mm/year (1991-2015) (Mottram et al., 2019)

The north sector holds close to 1 m, and drains 14 % of the surface area.





Nasa Visualization Studio, Cindy Starr



Discovery
Harbor

Limit for how far all
vessels have
reached due to the
heavy sea ice in the
Lincoln Sea

Lincoln Sea

Nares Strait

Humboldt Glacier

Petermann Glacier

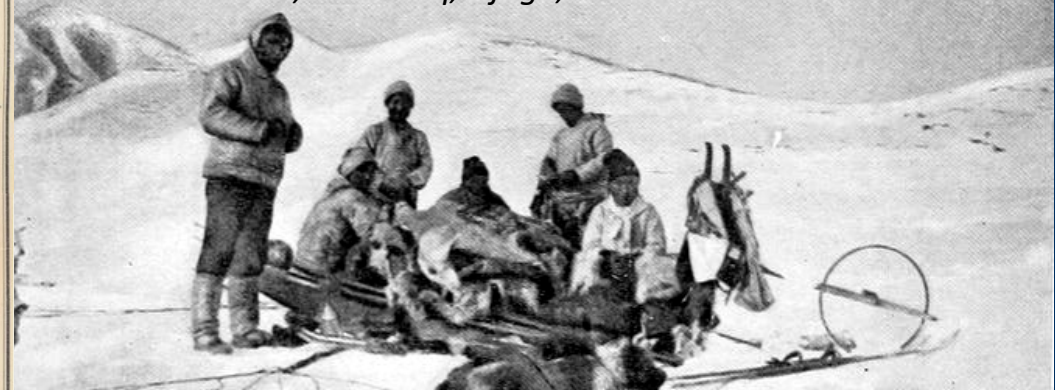
Ryder Glacier

C.H. Ostendfeld Glacier

--- Second Thule Expeditionen, 1916-1918
Knud Rasmussen, Lauge Koch, Thorild
Wulff †, Henrik Olsen†, *Inukitsoq*, *Ajago*,
Nasaitordluarsuk



Second Thule Expedition, 1916-1918
 Knud Rasmussen, Lauge Koch, Thorild Wulff †,
 Henrik Olsen †, Inukitsoq, Ajago, Nasaitordluarsuk





2010-08-05

Atlantic water >0°

Ice front 2010

40% reduction

2012

Koch, 1917

Ryder Glacier

CH Ostenfeld Glacier

Petermann Glacier

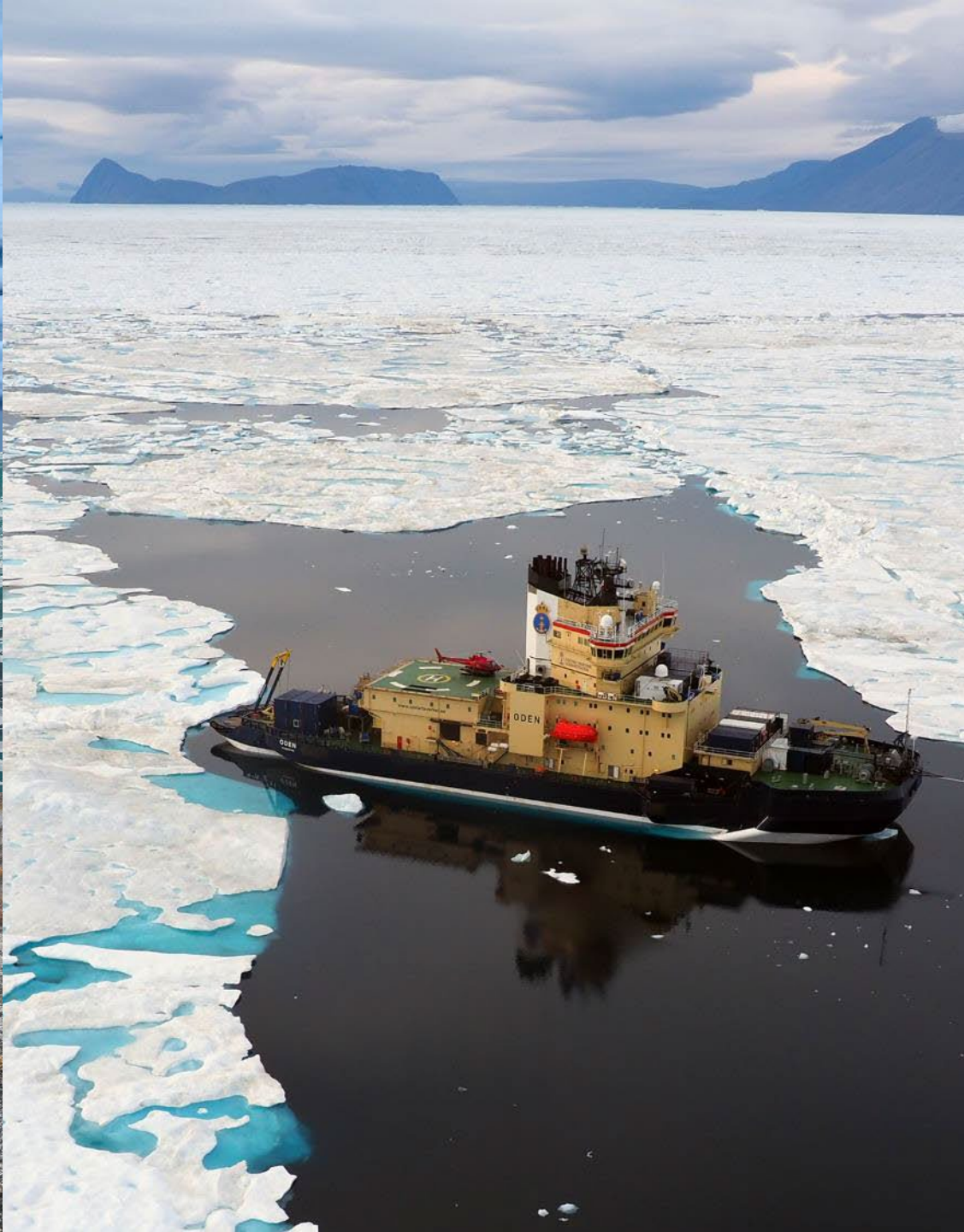


Scientific motivations

- Outlet glaciers drain ~40 % of the North Greenland Ice Sheet margin, but are poorly studied due to their remote location
- Petermann Glacier has undergone substantial reduction: grounding line retreat, two major calving events (2010 and 2012) reduced the thinned ice tongue with ~40 %
- C.H. Ostenfeld lost most of its ice tongue between 2000 and 2006. Less than 2 km remains. Will it soon begin calving directly from an ice cliff?
- Atlantic water was found to enter Petermann Fjord causing thinning of the ice tongue, which makes it more prone to calving
- The long-term glacial history of the Lincoln Sea is poorly known due to absence of marine data



Foto: Christian Carøe



Ryder 2019 Expedition

Start: Thule Aug 5

End: Thule Sept 10

Petermann Expedition

Start: Thule July 30

End: Thule Sept 3

IB Oden echo sounders



ADCP, 75 kHz



Split beam

EK 80, 18/38/70 kHz



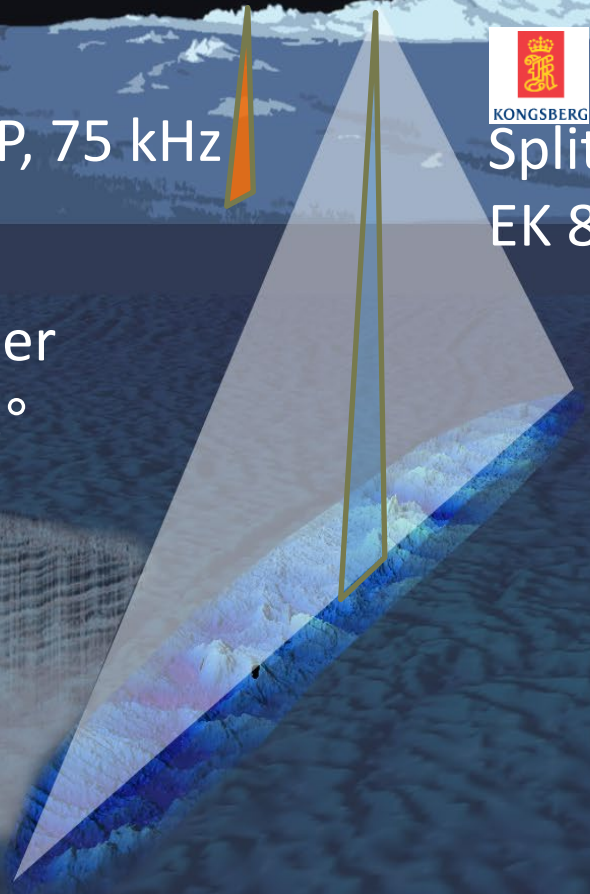
Sub-bottom profiler

SBP 120, 2-7 kHz, 3°x3°



Multibeam echo sounder

EM 122, 12 kHz, 1°x1°



Multibeam in Swedish icebreaker *Oden*: Installed in 2007 and Financed by the Knut och Alice Wallenbergs Foundation, Swedish Research Council, och Swedish Maritime Administration



Upgraded in 2022 with EK80 and ADCP





RV Skidbladner

Survey Equipment:

Multibeam: EM2040p, 200-700 kHz, 1°x1°

Navigation: Seapath 320+ GPS/GLONASS RTK

Side-scan: Klein 3000, 100/500 kHz

Sub-bottom profiler: Kongsberg EA640, chirp,
centered around 15 kHz

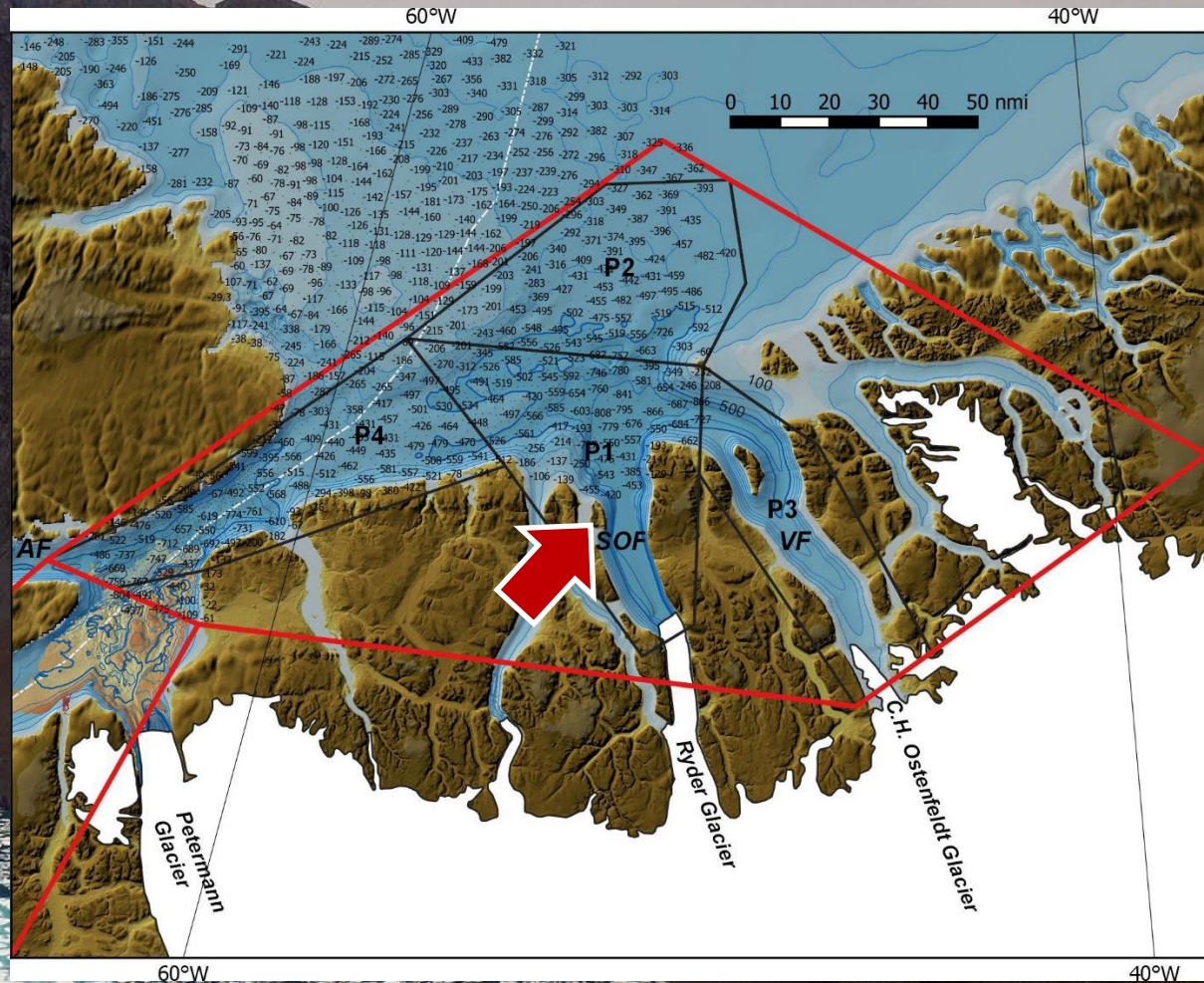
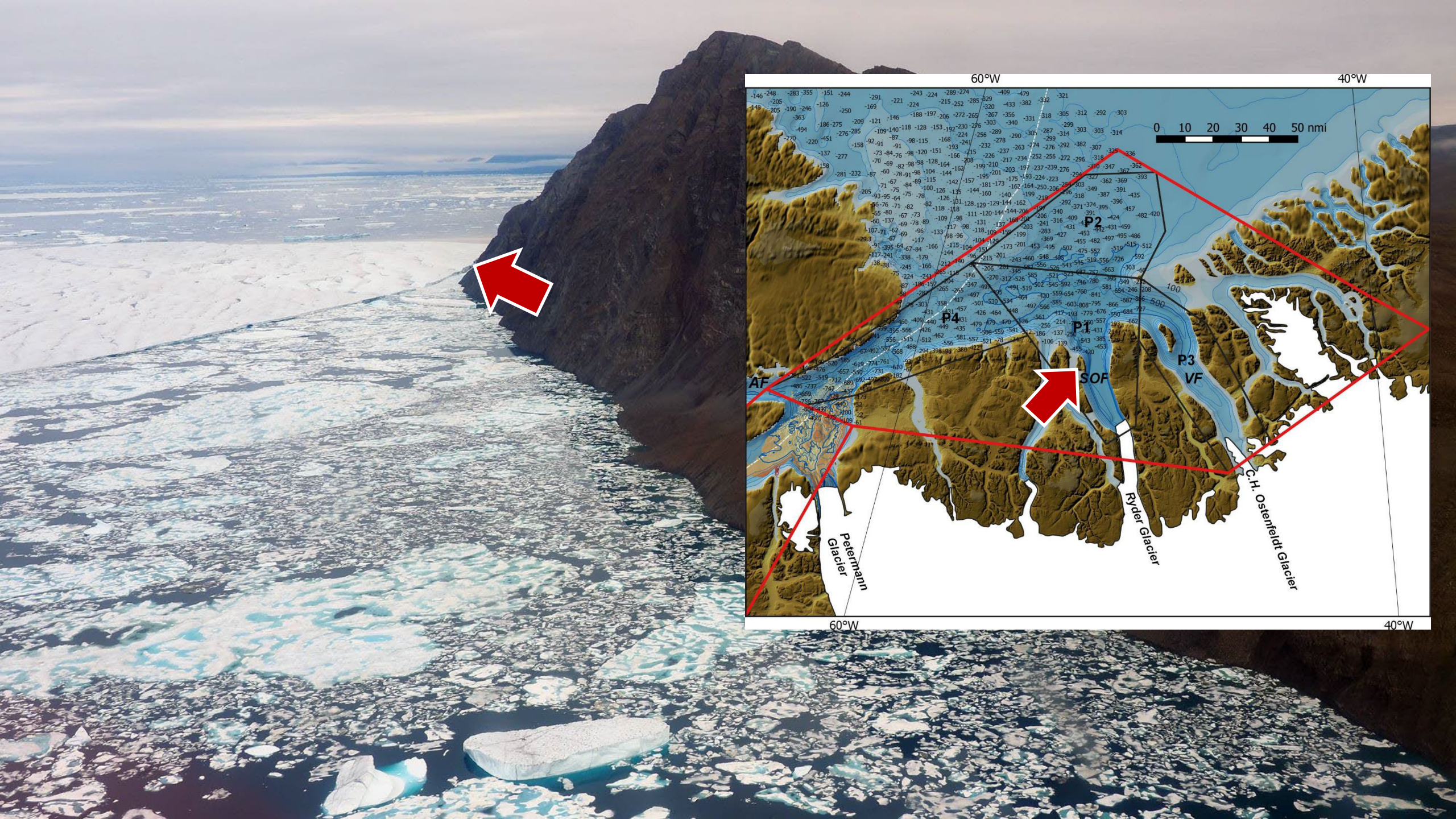




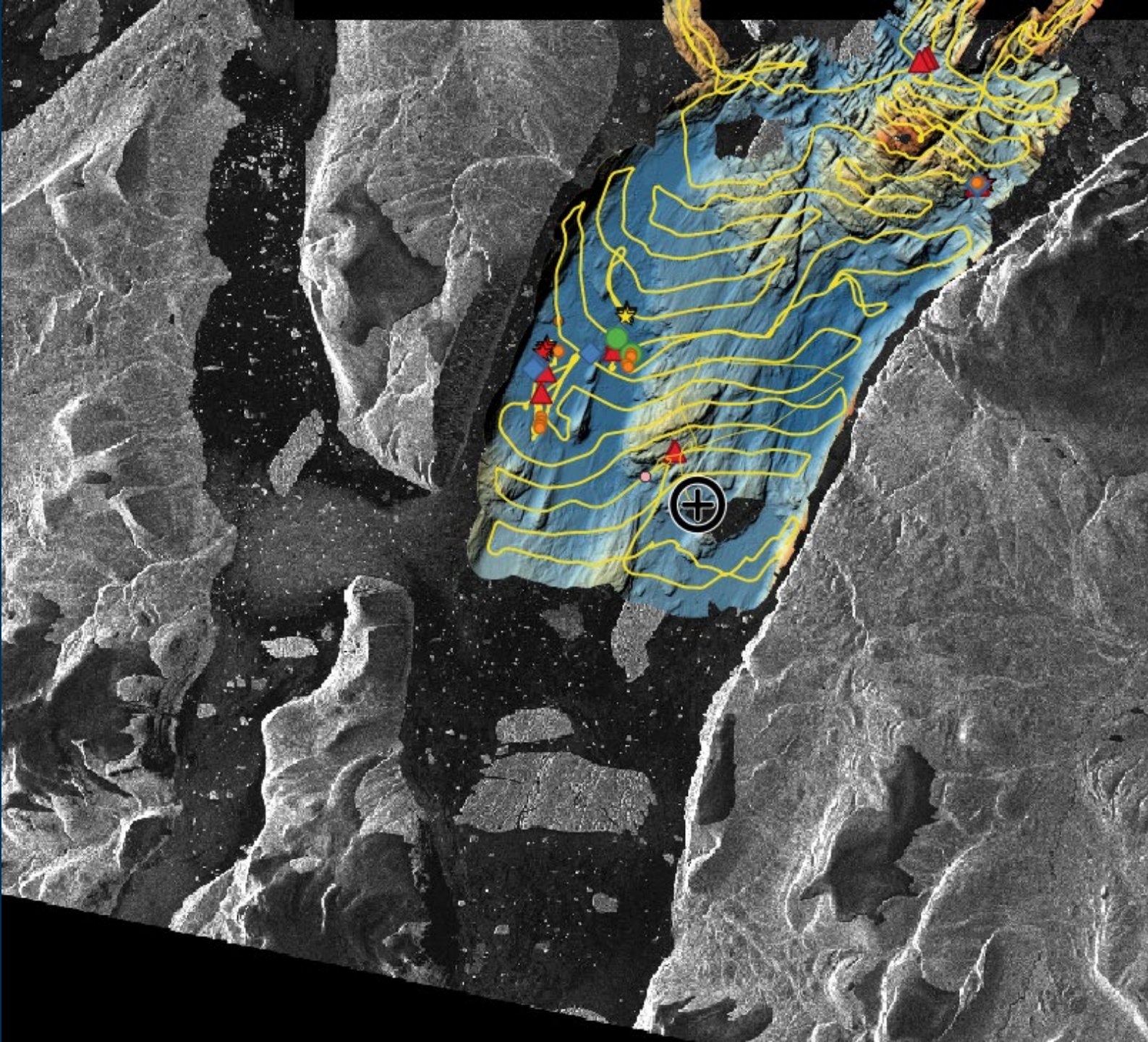
Photo: Markus Karasti



Stockholm
University





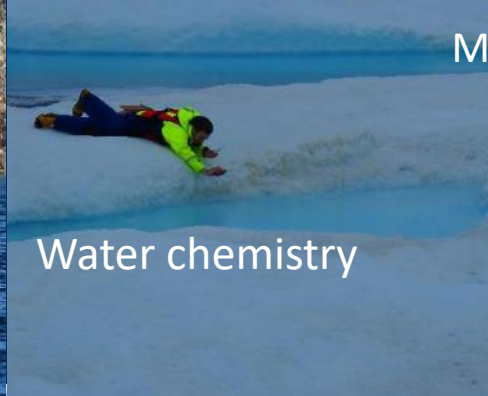




Sediment sampling



Lake coring and mapping



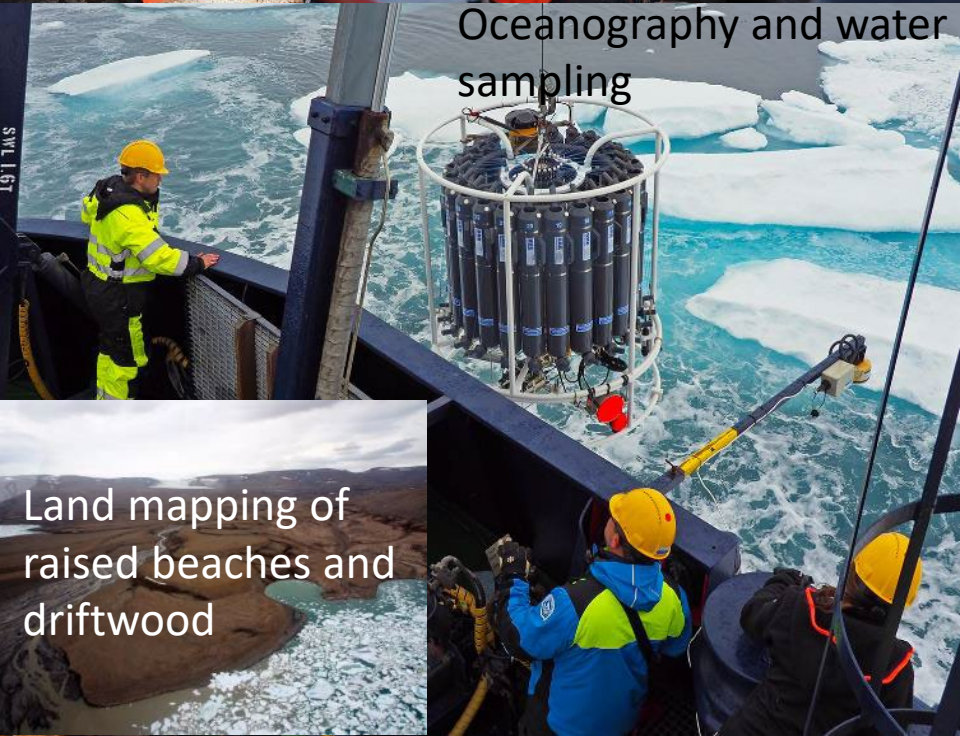
Water chemistry



Marine plankton



Land ecology and archeology



Oceanography and water sampling



Sampling for DNA-studies



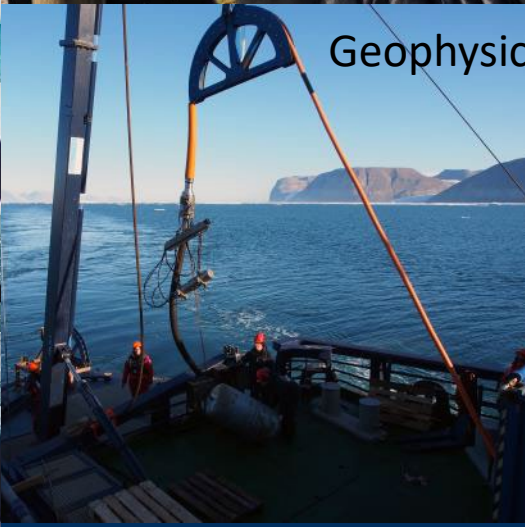
Glaciology



Air chemistry



Land mapping of raised beaches and driftwood

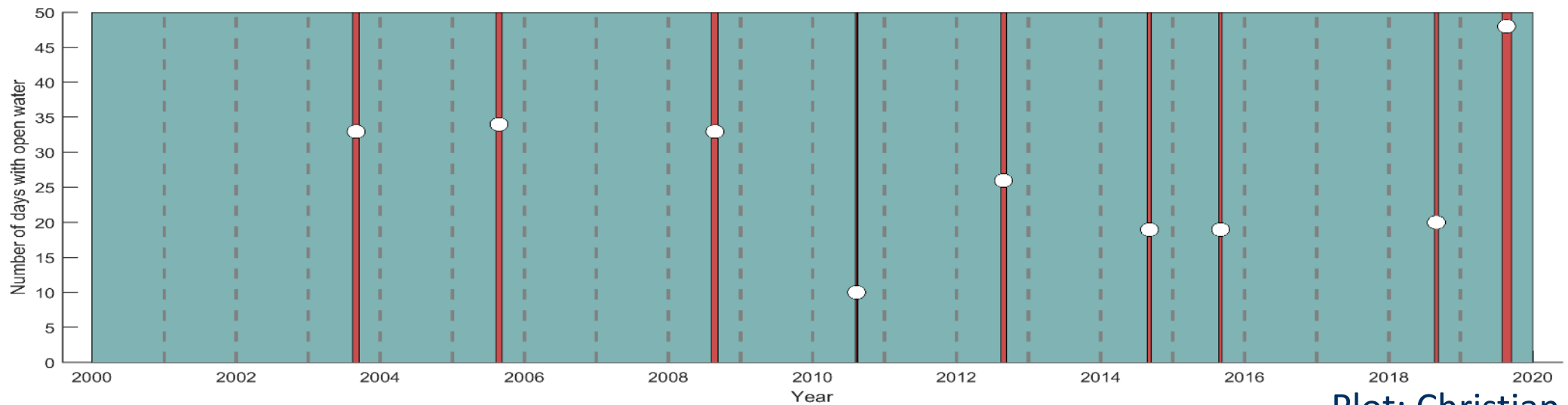


Geophysical mapping





Years when Sherard Osborn Fjord is covered with ice to <50 %



Plot: Christian Stanne

Ice-Ocean Interaction

Special edition:
PRESTIGIOUS PROJECTS

Empowering the subsea survey industry
www.hydro-international.com

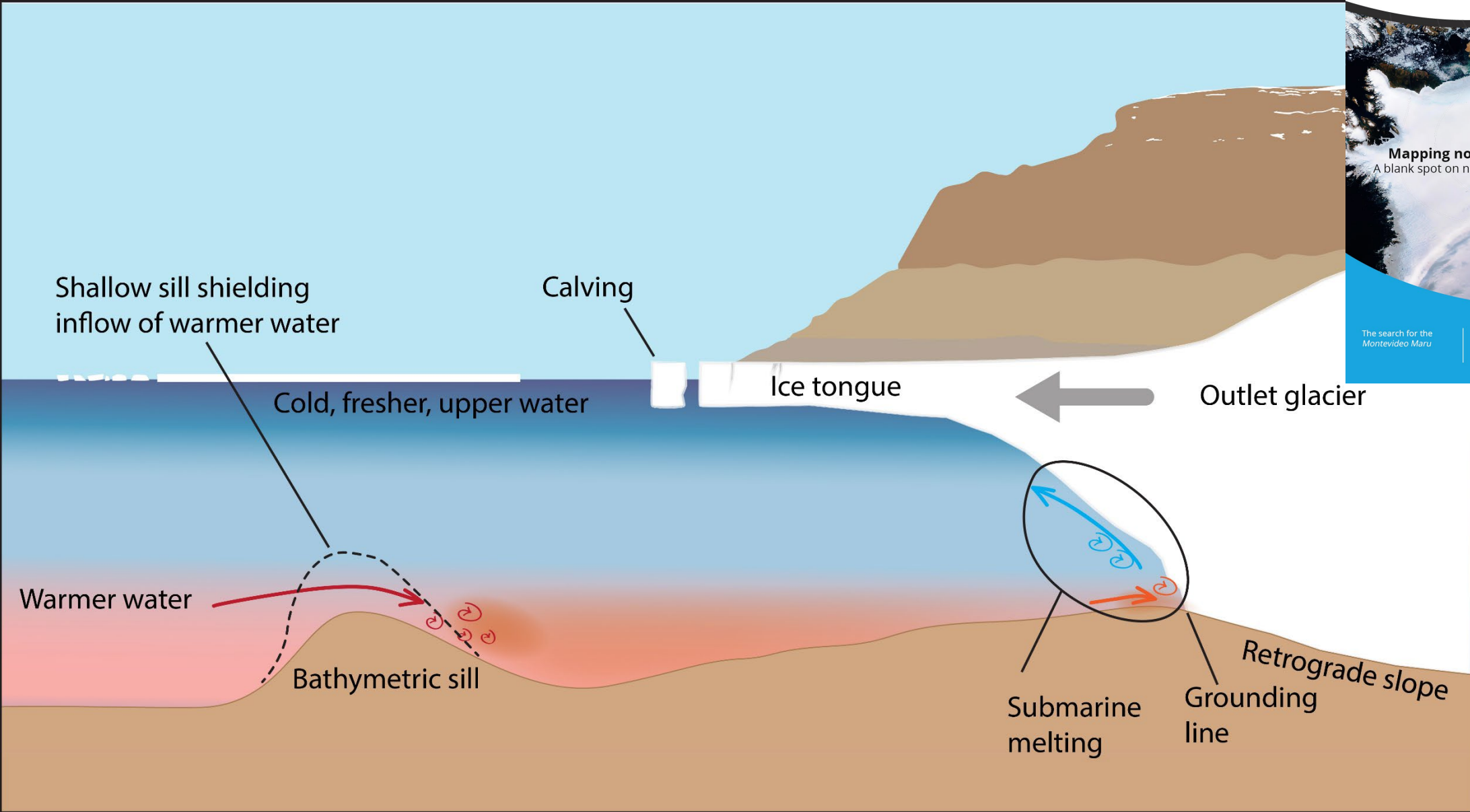
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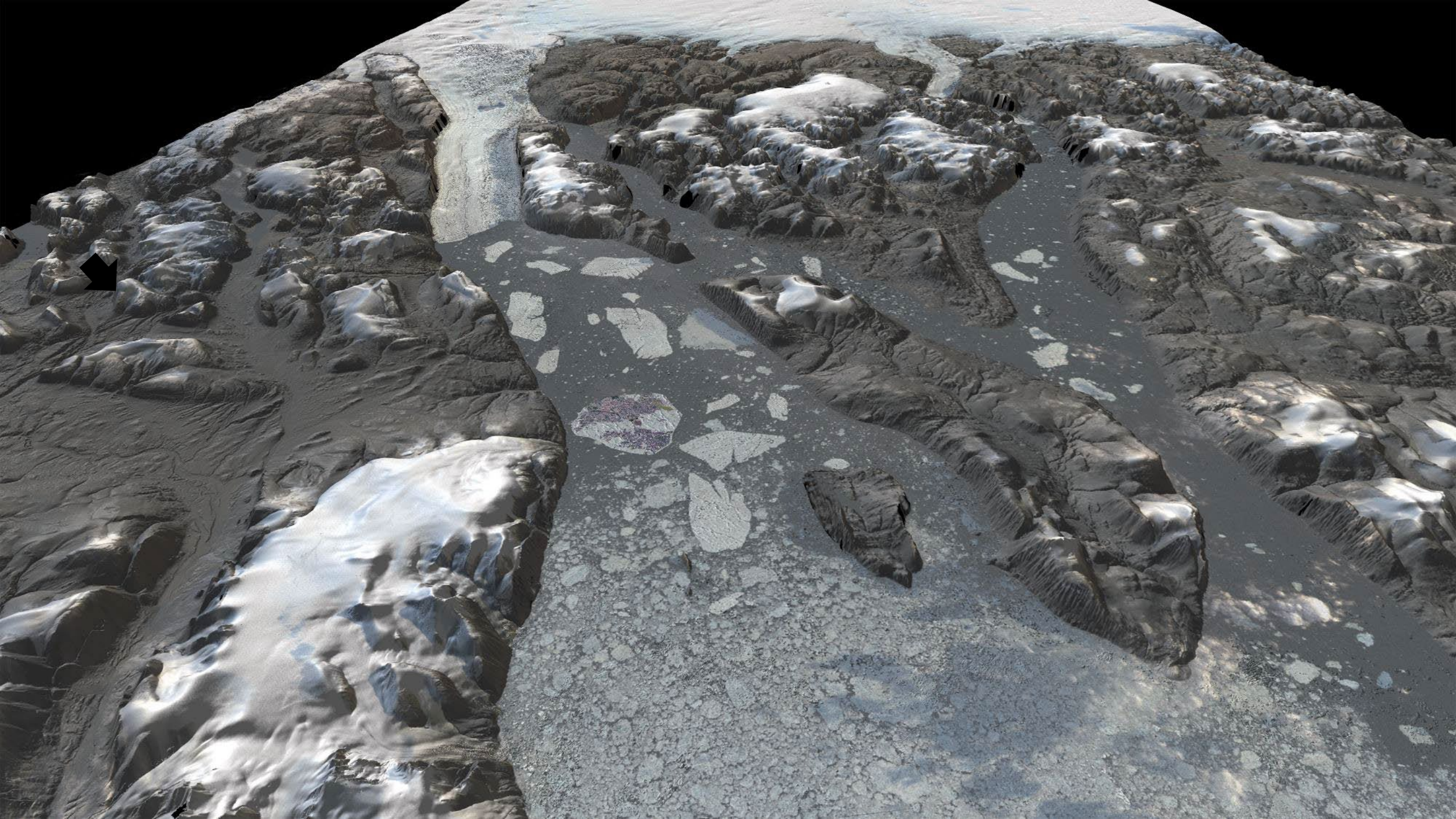
Issue 3 2023
Volume 27

Mapping northern Greenland waters
A blank spot on nautical charts in ice-infested waters

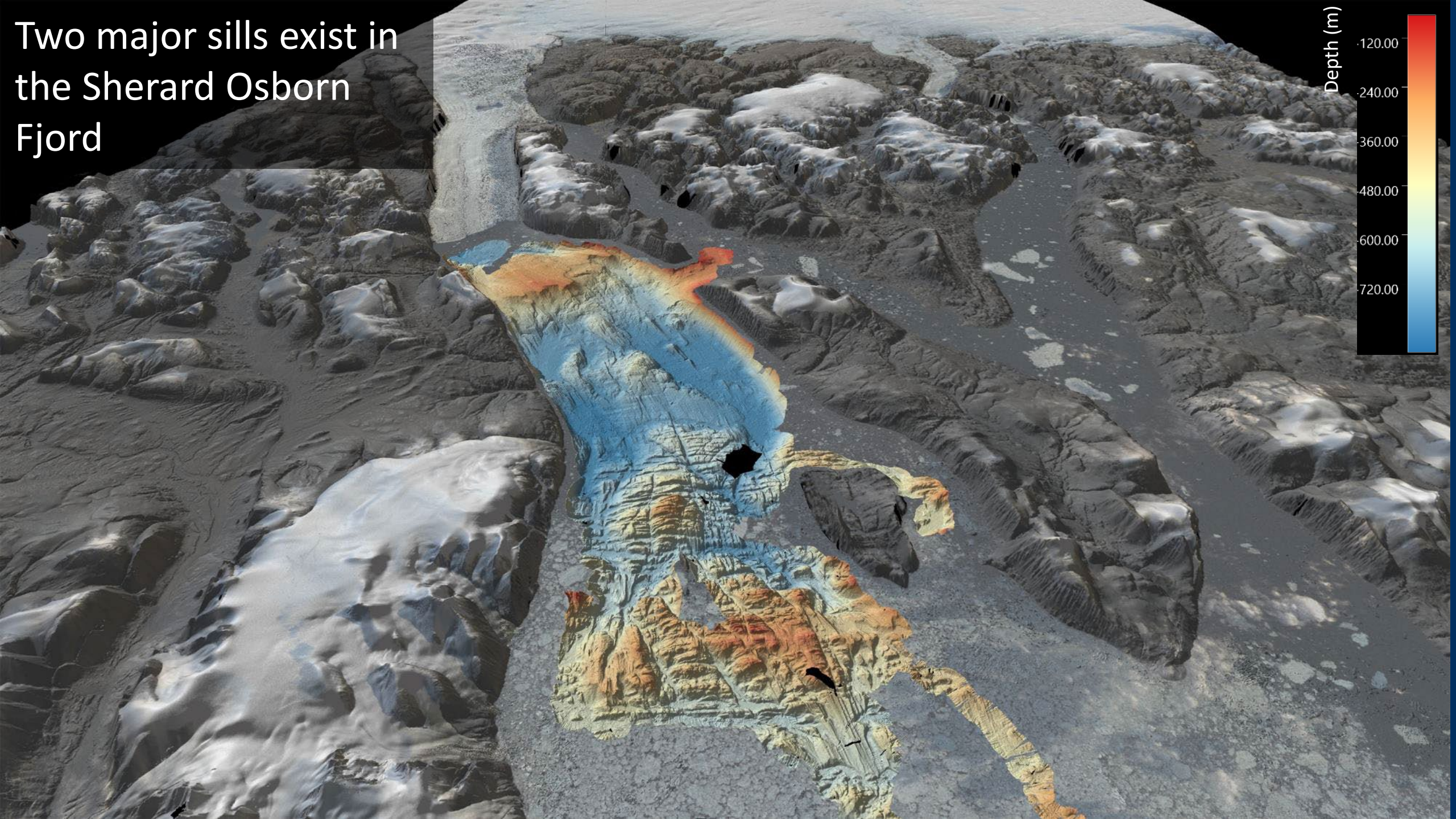
The search for the *Montevideo Maru* | North Sea wrecks: Toxic legacies of war | Hydrography's key role in a sustainable world

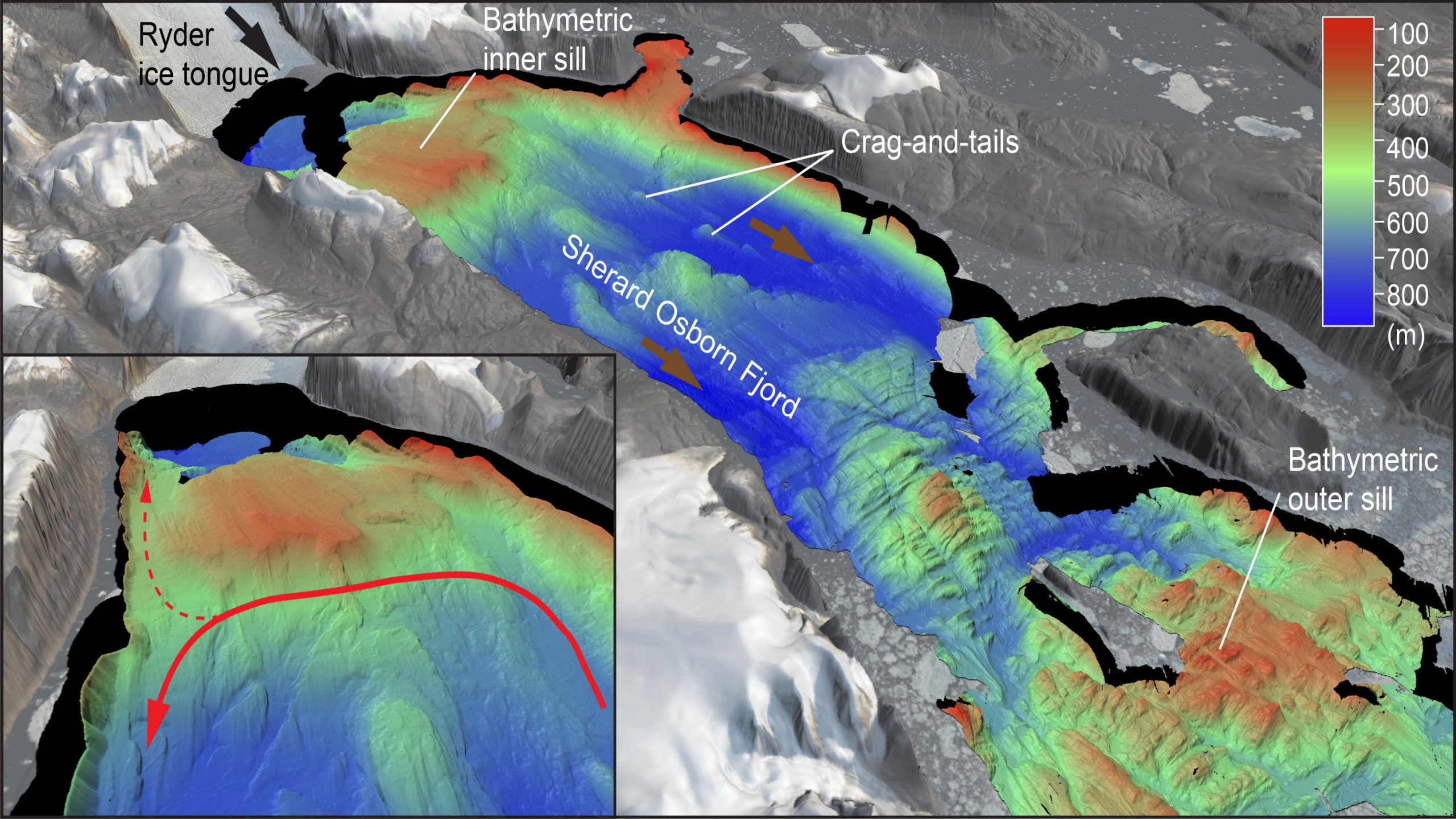


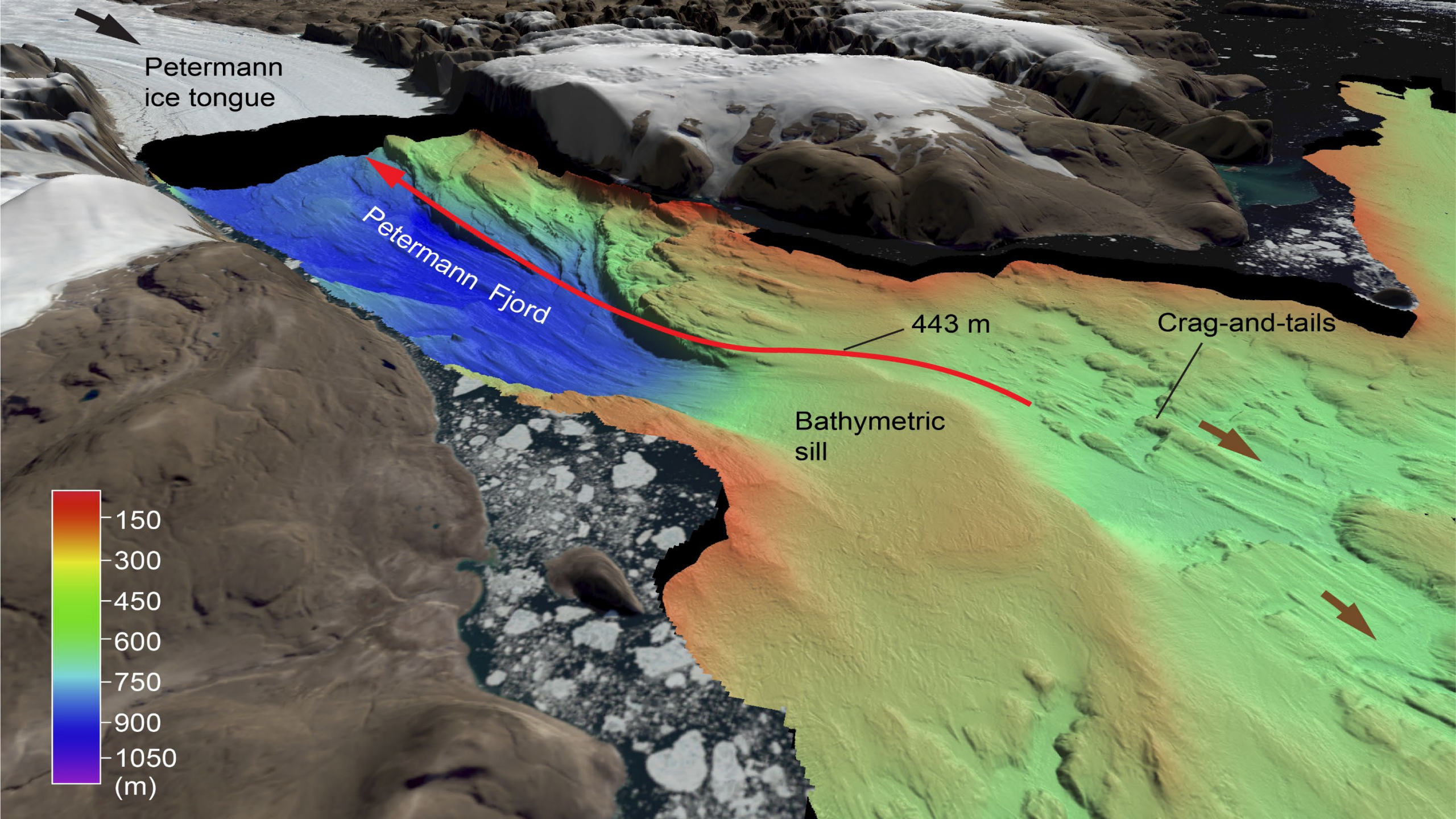


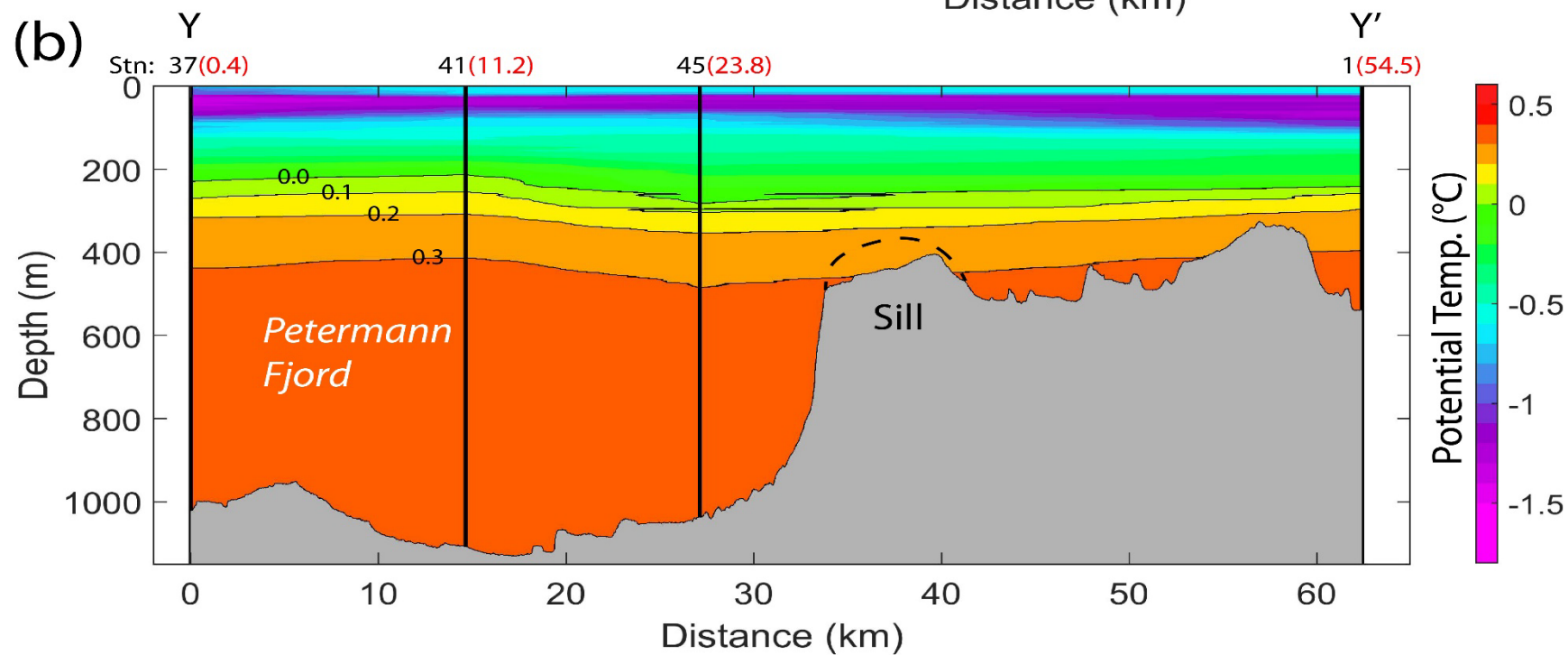
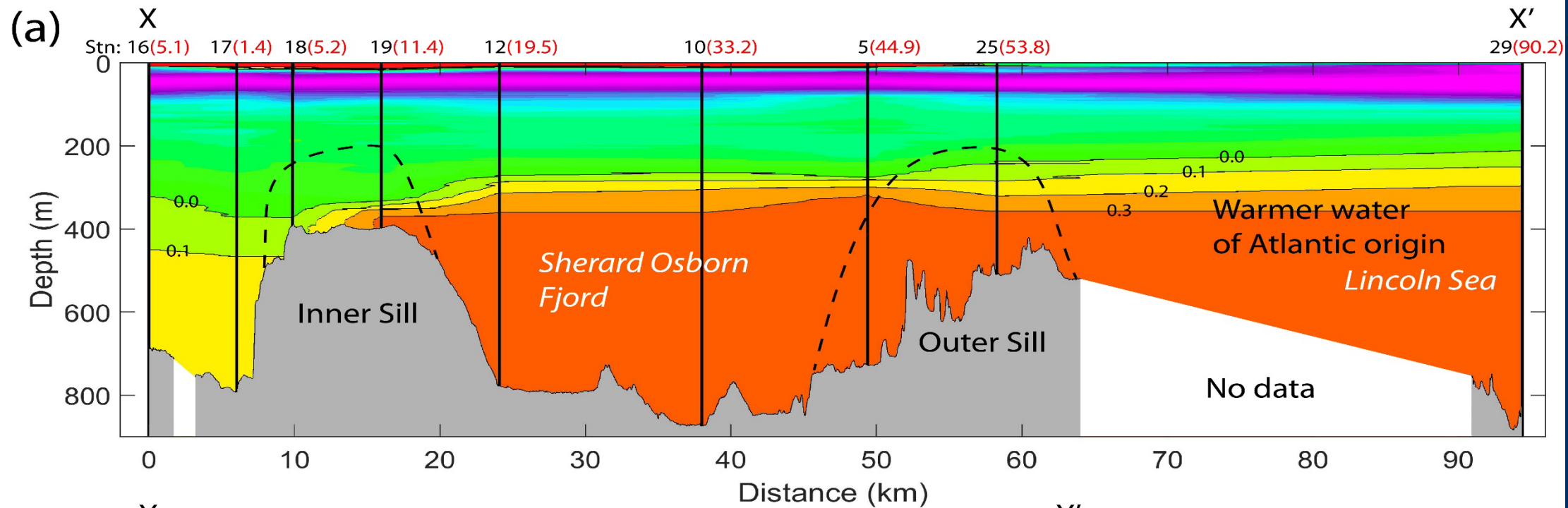


Two major sills exist in the Sherard Osborn Fjord









Main conclusion

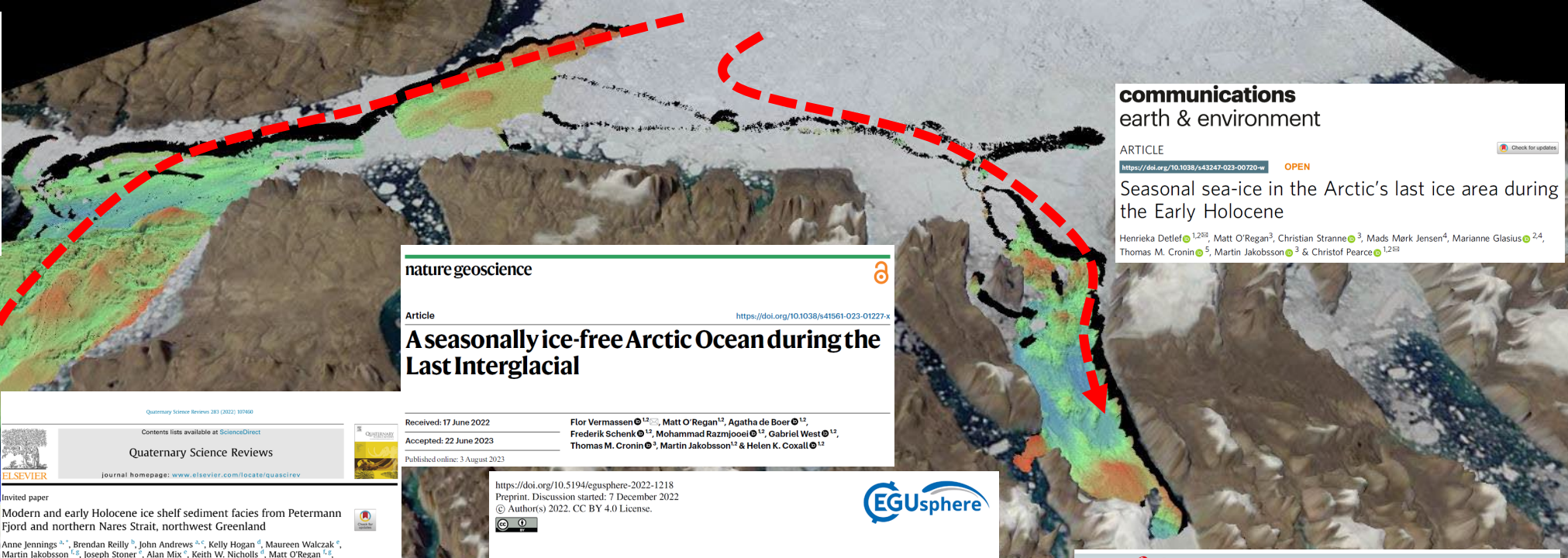
- Warmer subsurface water of Atlantic origin enters both Sherard Osborn and Petermann fjord, but Ryder Glacier's floating tongue is at its present location partly protected from the inflow by the bathymetric sill located in the innermost fjord.
- This sill reduces under-ice melting of the glacier, and may be part of the explanation for why Ryder Glacier has behaved quite different compared to Petermann Glacier

COMMUNICATIONS
EARTH & ENVIRONMENT

ARTICLE
<https://doi.org/10.1038/s43247-020-00043-0> OPEN [Check for updates](#)

Ryder Glacier in northwest Greenland is shielded from warm Atlantic water by a bathymetric sill

Martin Jakobsson^{1,2}, Larry A. Mayer³, Johan Nilsson^{2,4}, Christian Stranne^{1,2}, Brian Calder³, Matthew O'Regan^{1,2}, John W. Farrell⁵, Thomas M. Cronin⁶, Volker Brüchert^{1,2}, Julek Chawarski⁷, Björn Eriksson^{1,2}, Jonas Fredriksson^{1,2}, Laura Gemery⁸, Anna Glueder⁹, Felicity A. Holmes^{2,9}, Kevin Jerram⁹, Nina Kirchner^{2,9}, Alan Mix⁴, Julia Muchowski^{1,2}, Abhay Prakash^{2,9}, Brendan Reilly¹⁰, Brett Thornton^{1,2}, Adam Ulfsoo^{1,2}, Elizabeth Weidner^{1,2,7}, Henning Åkesson^{1,2}, Tamara Handl^{1,2}, Emelie Ståhl^{1,2}, Lee-Gray Boze^{1,2}, Sam Reed^{1,2}, Gabriel West^{1,2} & June Padman¹



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earth & environment

ARTICLE
<https://doi.org/10.1038/s43247-023-00720-w> OPEN [Check for updates](#)

Seasonal sea-ice in the Arctic's last ice area during the Early Holocene

Henrieka Detlef^{1,2,9}, Matt O'Regan³, Christian Stranne³, Mads Mørk Jensen⁴, Marianne Glasius^{2,4}, Thomas M. Cronin⁵, Martin Jakobsson³ & Christof Pearce^{1,2,6,8}

nature geoscience

Article
<https://doi.org/10.1038/s41561-023-01227-x>

A seasonally ice-free Arctic Ocean during the Last Interglacial

Received: 17 June 2022
Accepted: 22 June 2023
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Flor Vermassen^{1,2,9}, Matt O'Regan^{1,2}, Agatha de Boer^{1,2}, Frederik Schenk^{1,2}, Mohammad Razmjooei^{1,2}, Gabriel West^{1,2}, Thomas M. Cronin³, Martin Jakobsson³ & Helen K. Coxall^{1,2}

Quaternary Science Reviews 281 (2022) 107860

Contents lists available at ScienceDirect

Quaternary Science Reviews

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journal homepage: www.elsevier.com/locate/quascirev

Invited paper

Modern and early Holocene ice shelf sediment facies from Petermann Fjord and northern Nares Strait, northwest Greenland

Anne Jennings^{4,5}, Brendan Reilly⁶, John Andrews^{4,5}, Kelly Hogan⁴, Maureen Walczak⁴, Martin Jakobsson^{1,6}, Joseph Stoner⁴, Alan Mix⁴, Keith W. Nicholls⁴, Matt O'Regan^{1,6}, Maarten A. Prins⁴, Simon R. Troelstra⁴

EGUsphere

<https://doi.org/10.5194/egusphere-2022-1218>
Preprint. Discussion started: 7 December 2022
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nature COMMUNICATIONS

RESEARCH ARTICLE
10.1029/2020JF005921

IJR Earth Surface

Future Projections of Petermann Glacier Under Ocean Warming Depend Strongly on Friction Law

Mathieu Morlighem³, Matt O'Regan^{1,2}, and Martin Jakobsson^{1,2}

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Hydraulic suppression of basal glacier melt in sill fjords

Johan Nilsson^{1,2}, Eef van Dongen^{1,2}, Martin Jakobsson^{3,2}, Matt O'Regan^{3,2}, and Christian Stranne^{3,2}

¹Department of Meteorology, Stockholm University, 10691 Stockholm, Sweden
²Bolin Center for Climate Research, Stockholm University, 10691 Stockholm, Sweden
³Department of Geological Sciences, Stockholm University, 10691 Stockholm, Sweden
Correspondence: J. Nilsson (nilsson@misu.su.se)

nature COMMUNICATIONS

ARTICLE
<https://doi.org/10.1038/s41467-022-29529-9> OPEN [Check for updates](#)

Petermann ice shelf may not recover after a future breakup

Henning Åkesson^{1,2,3,8}, Mathieu Morlighem^{4,5}, Johan Nilsson^{2,6}, Christian Stranne^{1,2} & Martin Jakobsson^{1,2}

nature COMMUNICATIONS

ARTICLE
DOI: 10.1038/s41467-018-04573-2 OPEN

The Holocene re-advance of Petermann Glacier

IJR Earth Surface

RESEARCH ARTICLE
10.1029/2020JF005872

Calving at Ryder Glacier, Northern Greenland

F. A. Holmes^{1,2}, N. Kirchner^{2,2}, A. Prakash^{1,2}, C. Stranne^{1,2}, S. Dijkstra^{1,2}, and M. Jakobsson^{1,2}

¹Department of Physical Geography, Stockholm University, Stockholm, Sweden, ²Bolin Centre for Climate Research, Stockholm University, Stockholm, Sweden, ³Department of Geological Sciences, Stockholm University, Stockholm, Sweden, ⁴Center for Coastal and Ocean Mapping, University of New Hampshire, Durham, NH, USA

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Calibrated relative sea levels constrain isostatic adjustment and ice history in northwest Greenland

Anna Glueder^{4,5}, Alan C. Mix⁴, Glenn A. Milne⁶, Brendan T. Reilly⁶, Jorie Clark⁴, Martin Jakobsson⁴, Larry Mayer⁴, Stewart J. Fallon¹, John Southon⁴, June Padman⁴, Andrew Ross⁴, Thomas Cronin⁴, Jennifer L. McKay⁴

The Holocene dynamics of Ryder Glacier and ice tongue in north Greenland

Matt O'Regan^{1,2}, Thomas M. Cronin³, Brendan Reilly⁴, Aage Kristian Olsen Alstrup⁵, Laura Gemery⁶, Anna Golub⁵, Larry A. Mayer⁶, Mathieu Morlighem⁷, Matthias Moros⁸, Ole L. Munk³, Johan Nilsson³, Christof Pearce^{1,6}, Henrieka Detlef^{1,6}, Christian Stranne^{1,2}, Flor Vermassen^{1,2}, Gabriel West^{1,2}, and Martin Jakobsson^{1,2}

<https://doi.org/10.1038/s41467-022-29529-9>

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<https://doi.org/10.1038/s43247-021-00140-8> OPEN [Check for updates](#)

The climate sensitivity of northern Greenland fjords is amplified through sea-ice damming

Martin Jakobsson^{1,2}, Kelly A. Hoga³, Björn Eriksson^{1,2}, Kevin Jerram⁴, Christian Stranne^{1,2}

The Cryosphere, 15, 4357–4380, 2021
<https://doi.org/10.5194/tc-15-4357-2021>
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Marine Micropaleontology

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Holocene paleoceanography and glacial history of Lincoln Sea, Ryder Glacier, Northern Greenland, based on foraminifera and ostracodes

T.M. Cronin^{6,8}, B.M. Olds¹, A.M. Regnier¹, M. O'Regan^{6,8}, L. Gemery⁶, H. Detlef⁶, C. Pearce⁴, M. Jakobsson^{6,8}

Christian Stranne^{1,2,8}, Johan Nilsson^{2,3}, Adam Ulfsoo⁴, Matt O'Regan^{1,2}, Helen K. Coxall^{1,2}, Lorenz Meire^{5,6}, Julia Muchowski^{1,2}, Larry A. Mayer⁷, Volker Brüchert^{1,2}, Jonas Fredriksson^{1,2}, Brett Thornton^{1,2}, Julek Chawarski⁸, Gabriel West^{1,2}, Elizabeth Weidner^{1,2,7} & Martin Jakobsson^{1,2}

Holocene sea-ice dynamics in Petermann Fjord in relation to ice tongue stability and Nares Strait ice arch formation

Henrieka Detlef^{1,2}, Brendan Reilly³, Anne Jennings⁴, Mads Mørk Jensen⁵, Matt O'Regan⁶, Marianne Glasius⁵, Jesper Olsen^{2,7,8}, Martin Jakobsson⁶, and Christof Pearce^{1,2}

Research Theme resulting from the Polar Research Process:

North Greenland Earth-Ocean-Ecosystem Observatory

GEOEO

Theme Leaders
Martin Jakobsson
Nina Kirchner













Builds on the legacy of Petermann 2015 and Ryder 2019 expeditions

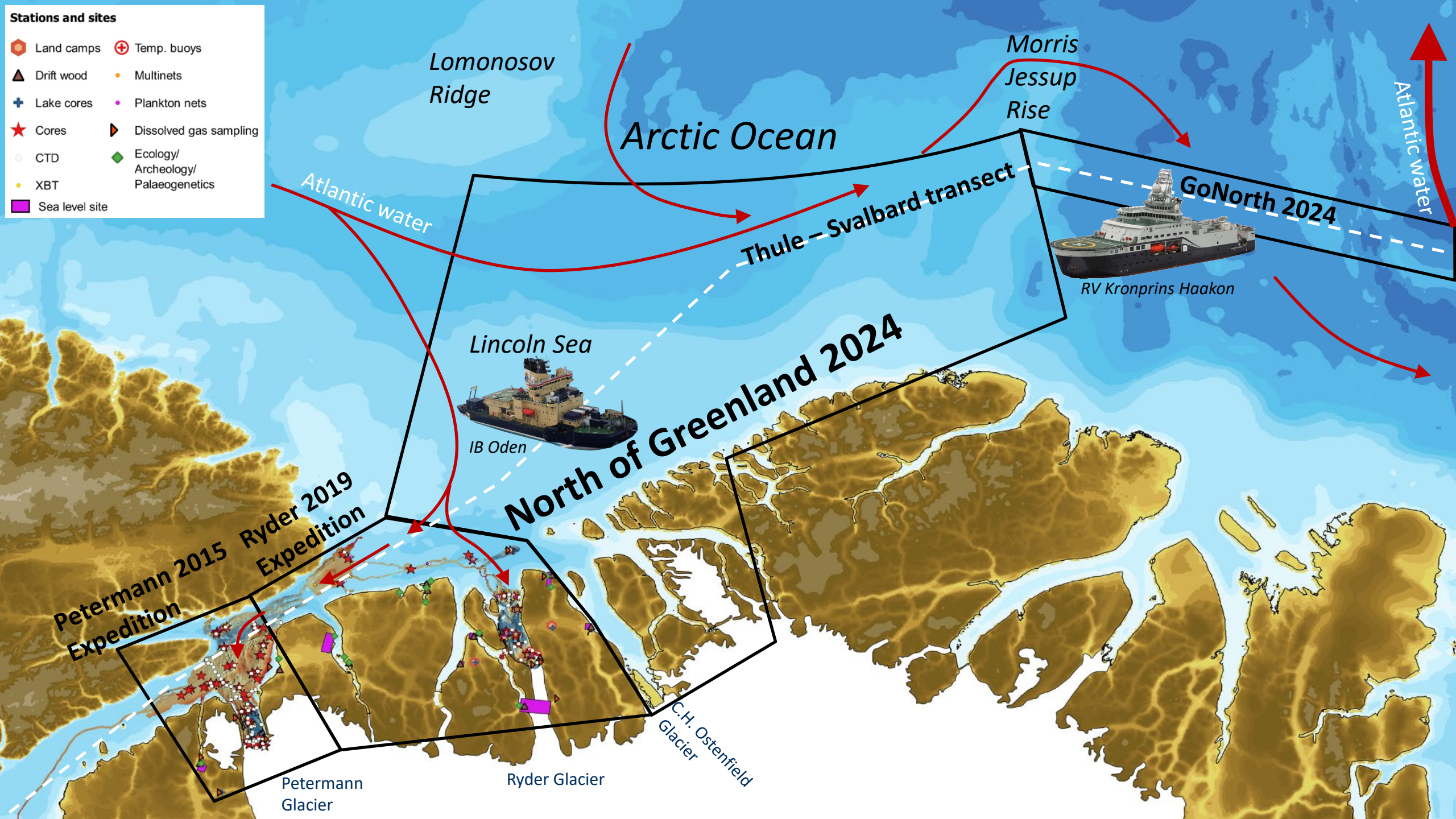
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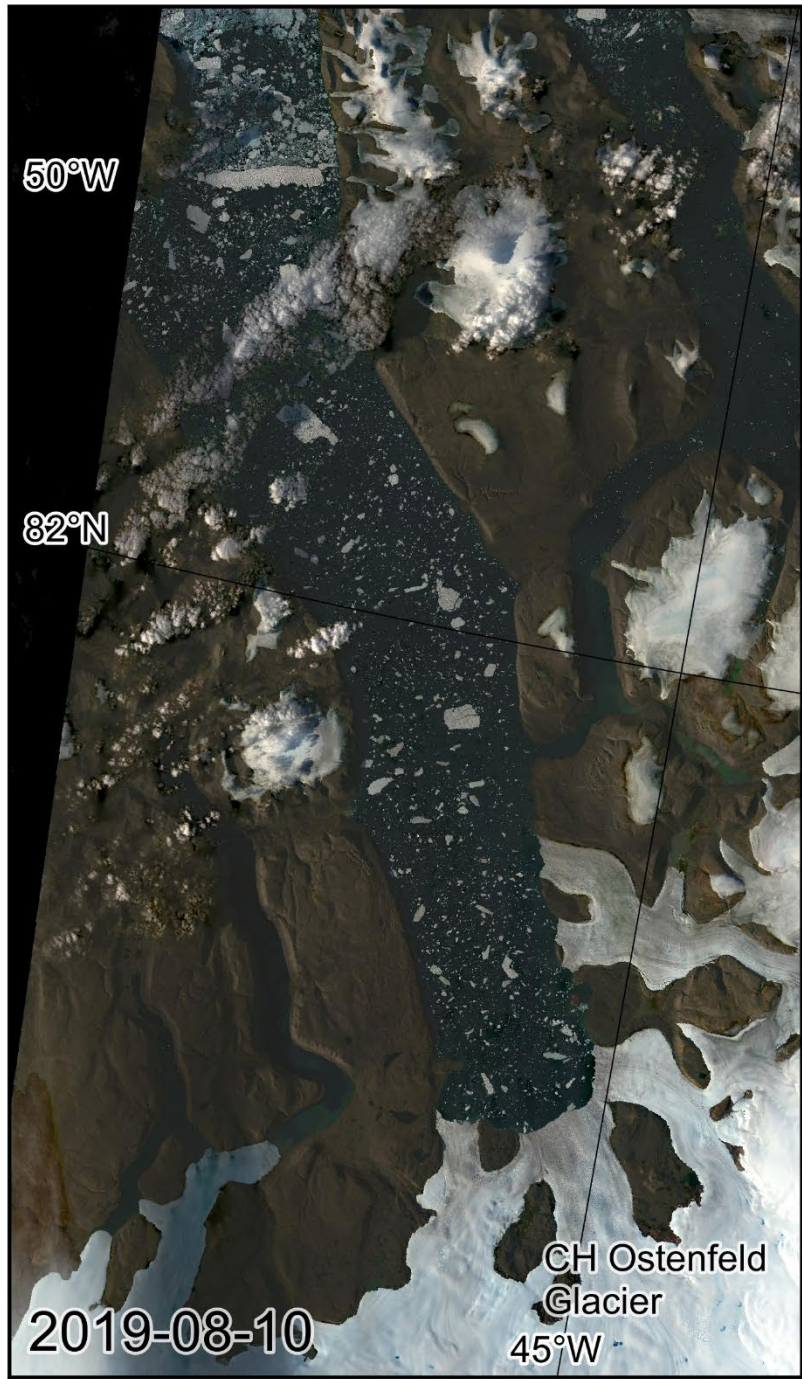
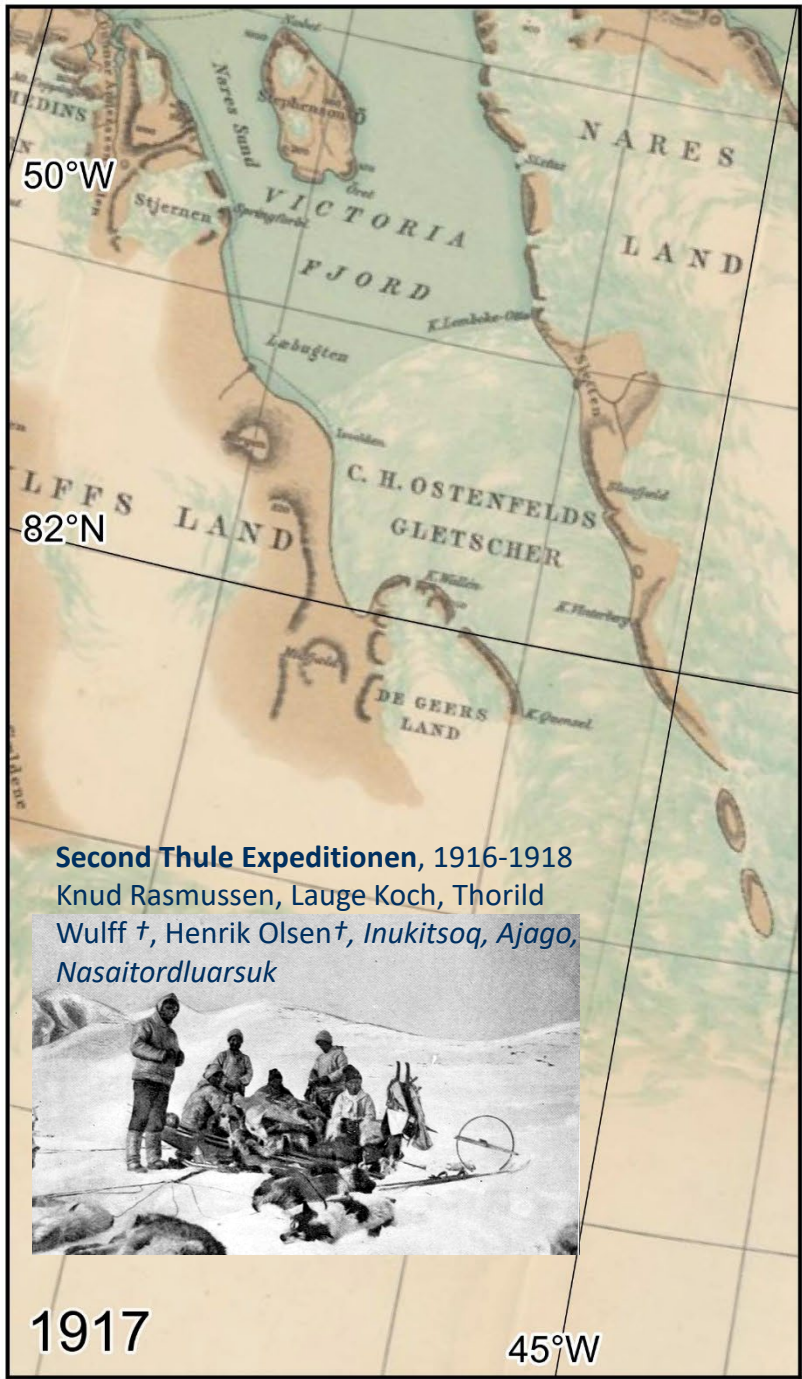
North of Greenland Expedition 2024



Stations and sites

 Land camps	 Temp. buoys
 Drift wood	 Multinets
 Lake cores	 Plankton nets
 Cores	 Dissolved gas sampling
 CTD	 Ecology/ Archeology/ Palaeogenetics
 XBT	
 Sea level site	







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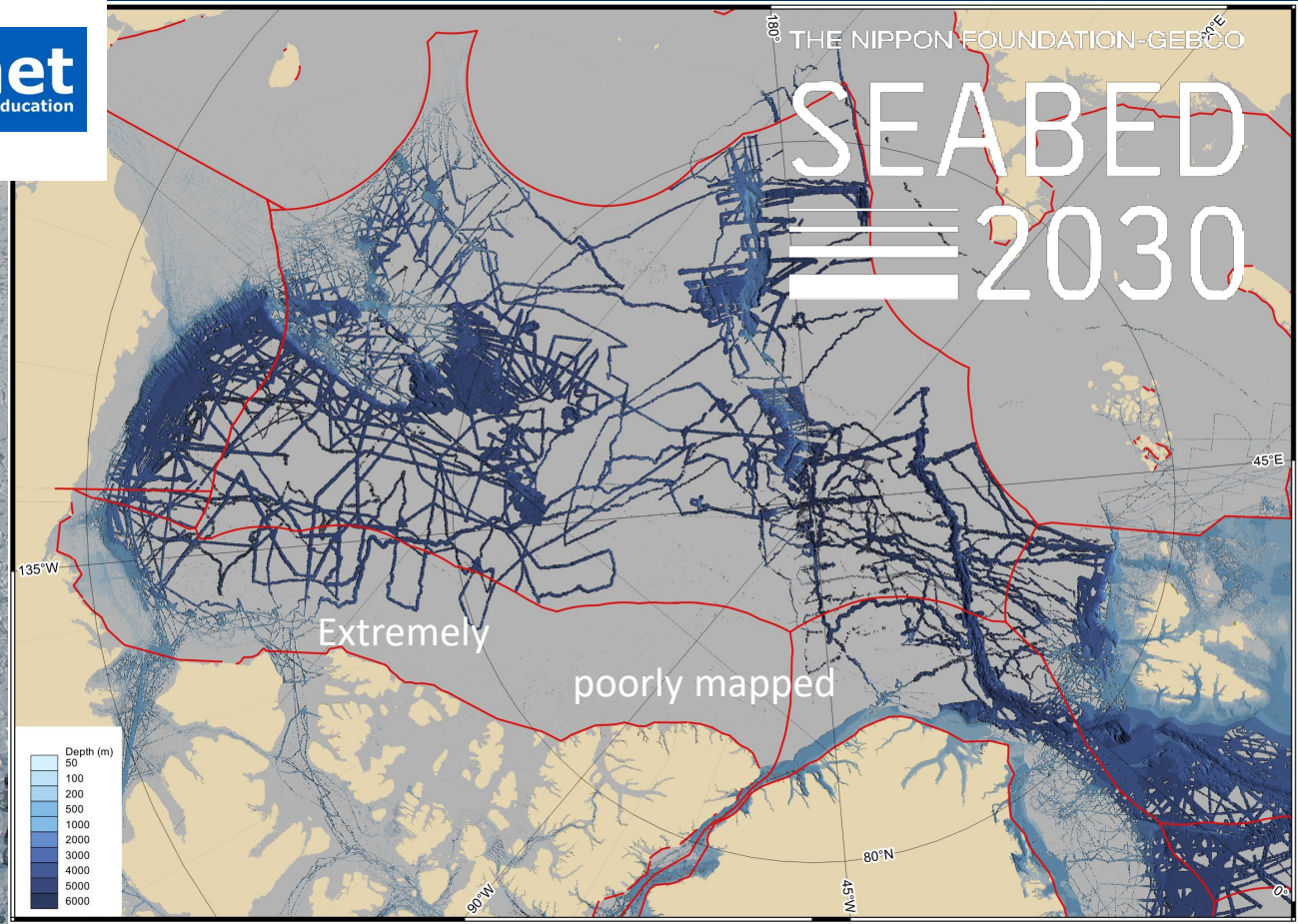
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Desktop study

Martin Jakobsson
Department of Geological Sciences





Thanks/Tack!

