

Ryder 2019 Expedition

Co-Chief Scientists

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Larry Mayer, University of New Hampshire, USA

Participating organizations:

Stockholm University, Sweden

University of New Hampshire, USA

University of Gothenburg, USA

Oregon State University, USA

Memorial University of Newfoundland, Canada

Natural History Museum, Sweden

University of Copenhagen, Denmark

Lund University, Sweden

Aarhus University, Denmark

US Geological Survey, USA

USARC, USA

Logistical support:

Swedish Polar Research Secretariat

Oden Crew

NORTHERN GREENLAND

RYDER 2019 EXPEDITION



The Petermann 2015 Expedition with IB Oden



Icebreaker Oden
Petermann Expedition 2015

 POLARFORSKNINGS
SEKRETARIATET
SWEDISH POLAR RESEARCH SECRETARIAT



Bolin Centre for
Climate Research



British
Antarctic
Survey

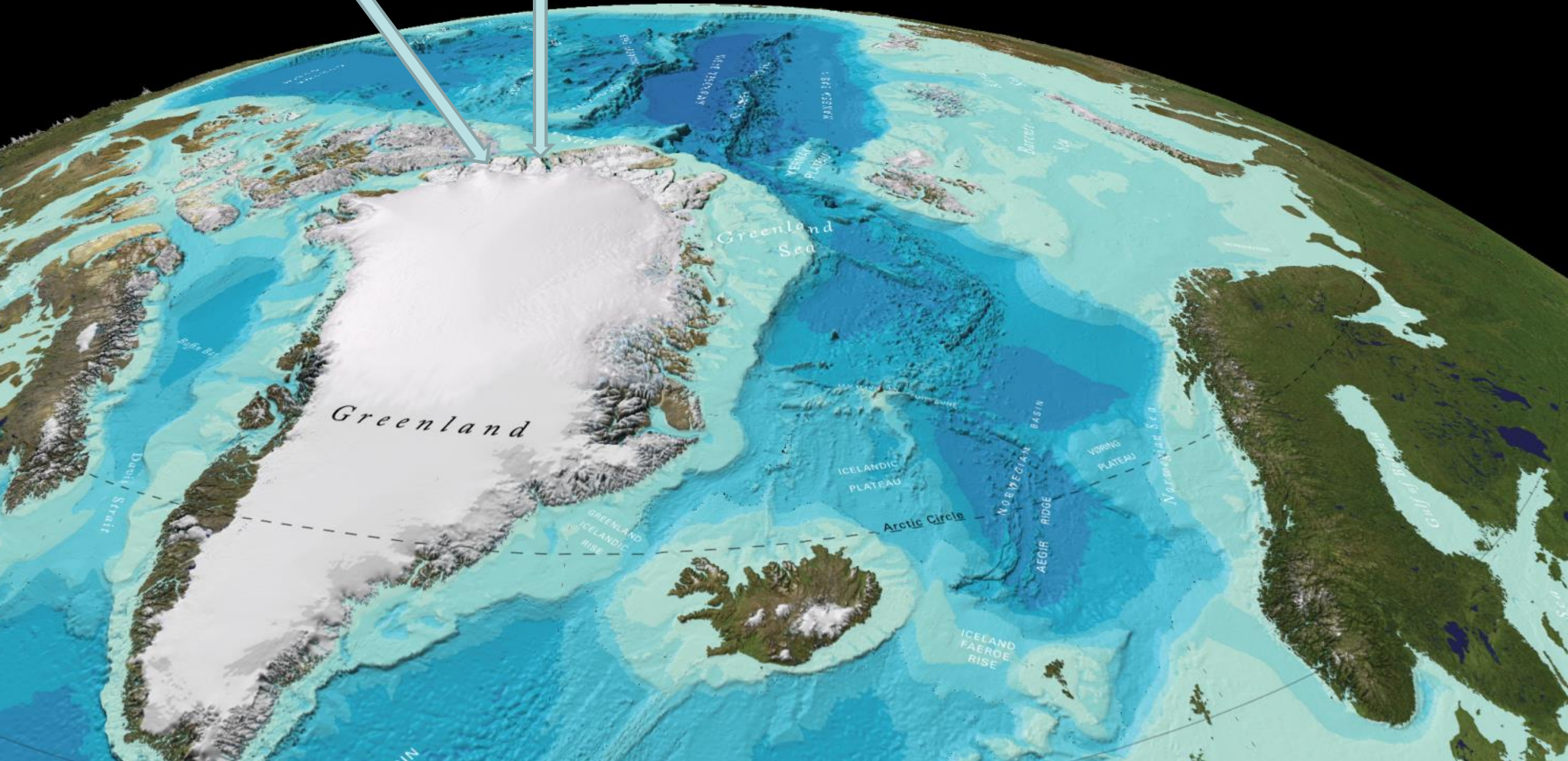


GEUS



**Petermann Glacier
2015**

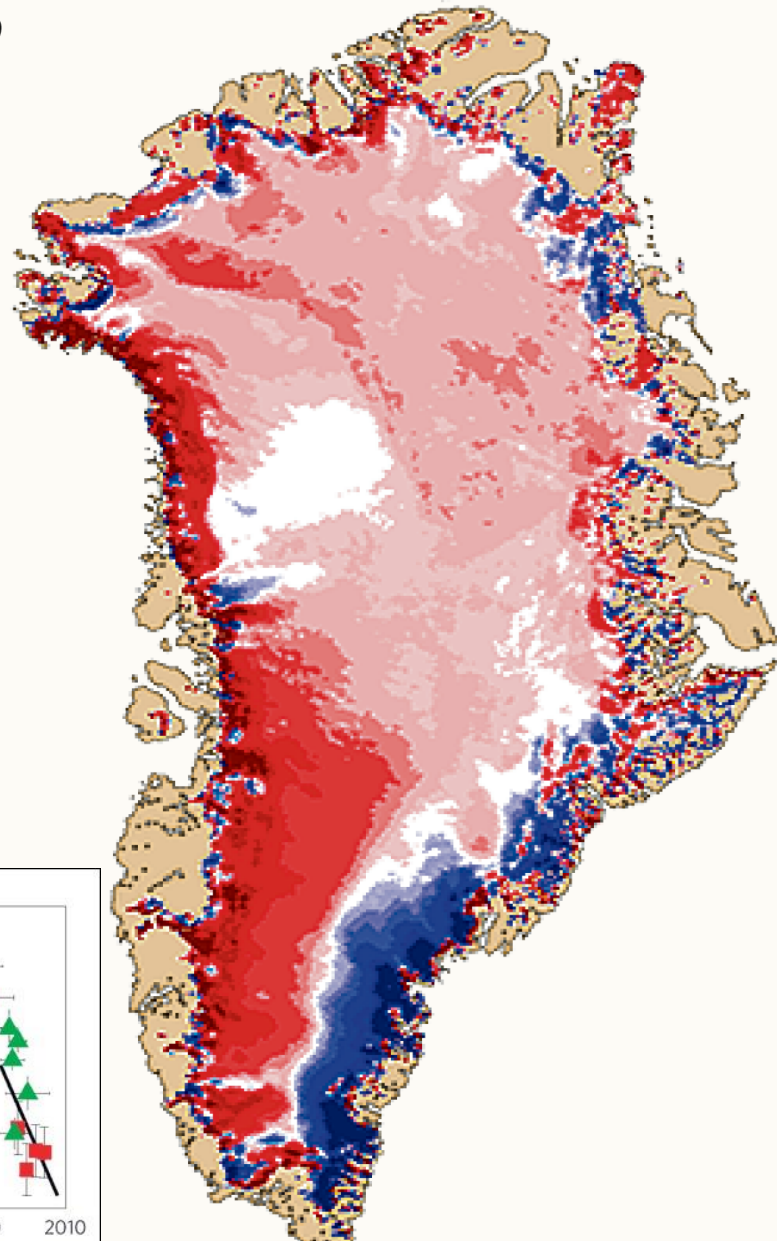
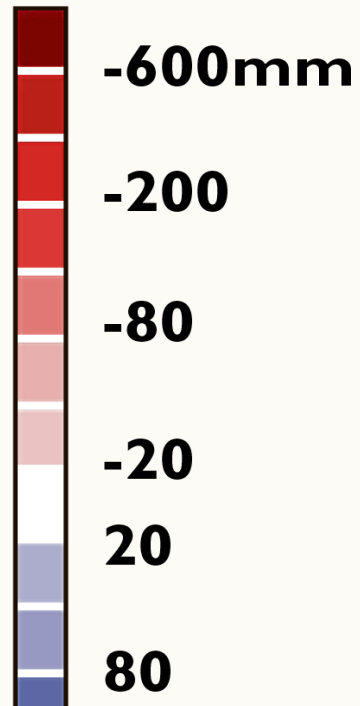
**Ryder Glacier
2019**



Accumulated change since September 1, 2018

July 29, 2019

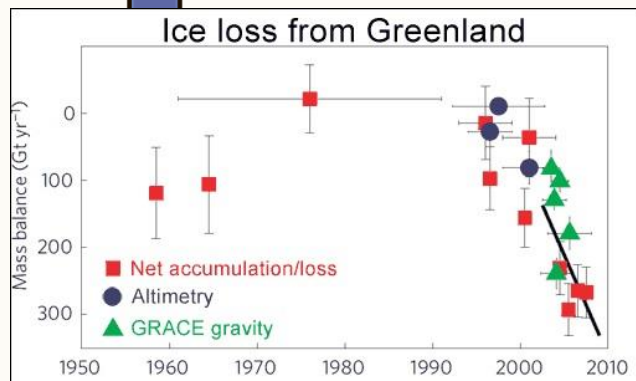
Mass loss



What is the history of the
Greenland Ice Sheet?

What are processes of rapid
acceleration of melting (and
impacts on sea level)? (GIS
represents >7m of SL rise)

What is happening to the
floating ice shelves?







The Nippon Foundation-GEBCO Seabed 2030

Vision: *100% of the World Ocean floor mapped by 2030*

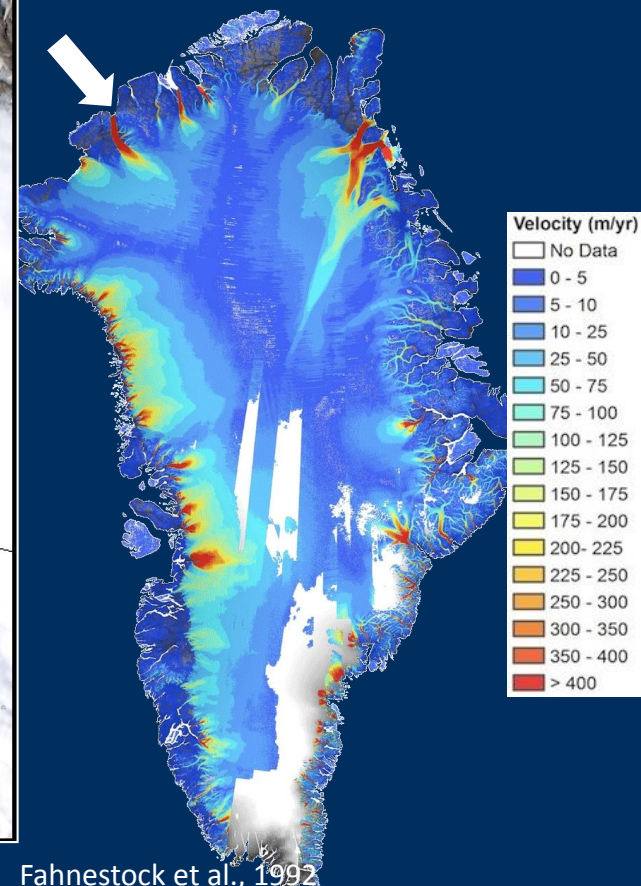
Mission: *Produce the definitive map of the World Ocean floor by 2030 to empower the world to make policy decisions, use the ocean sustainability and undertake scientific research based on detailed bathymetric information of the Earth's seabed.*



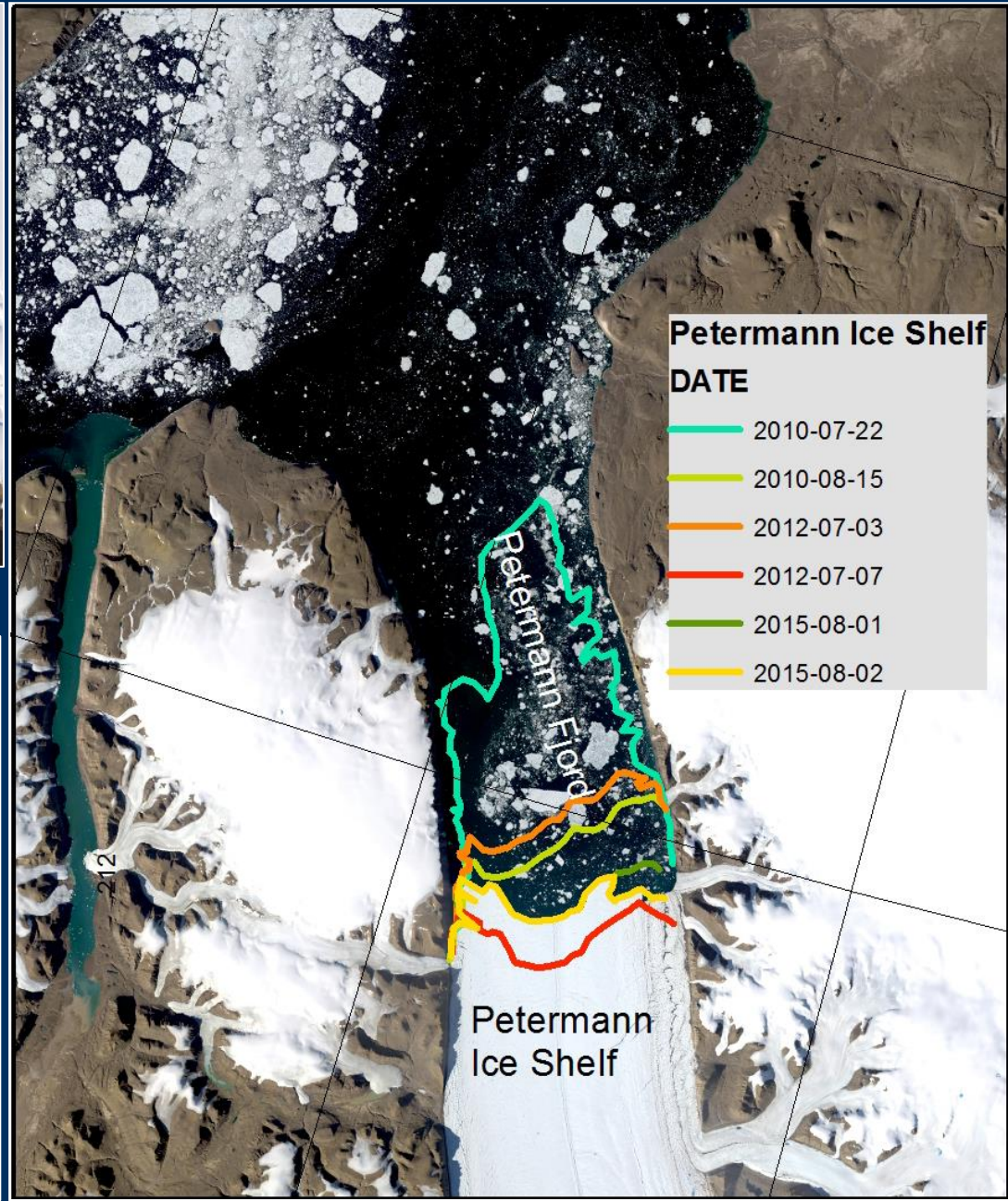
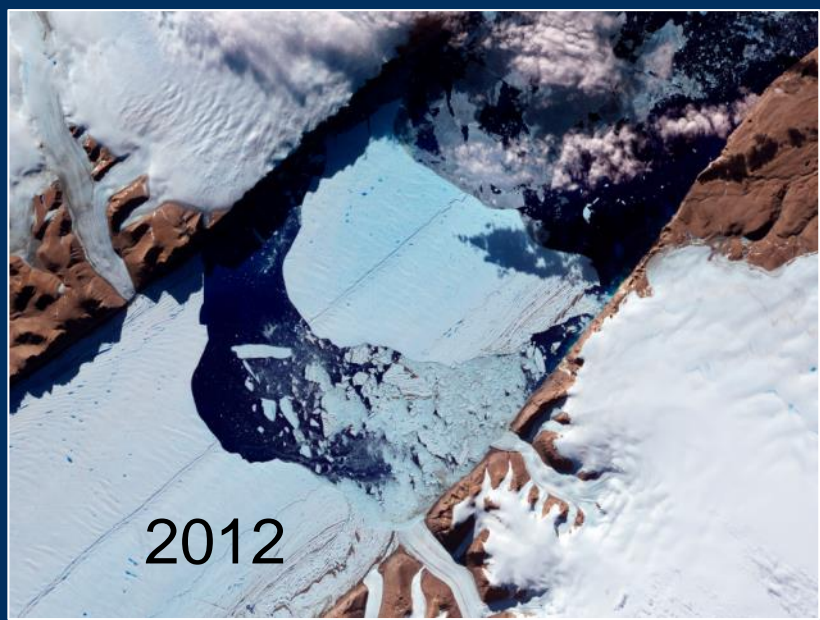
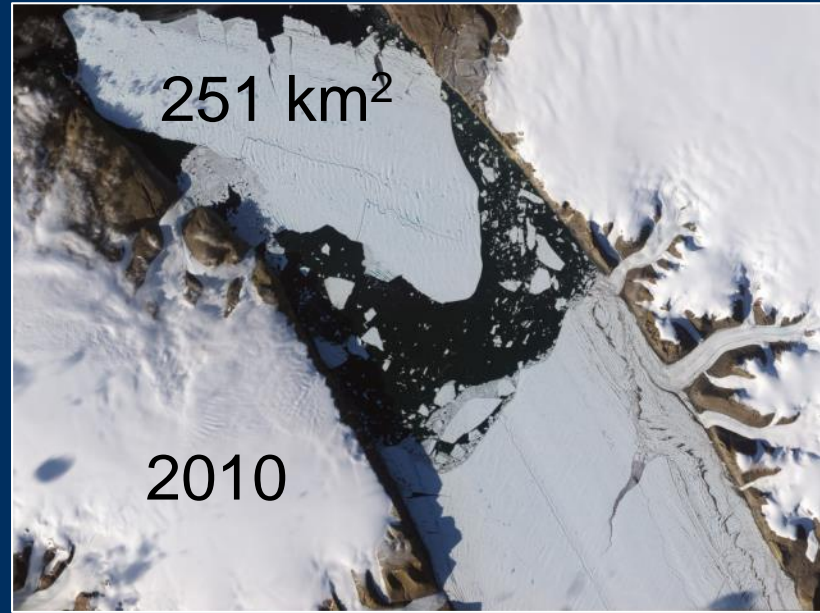


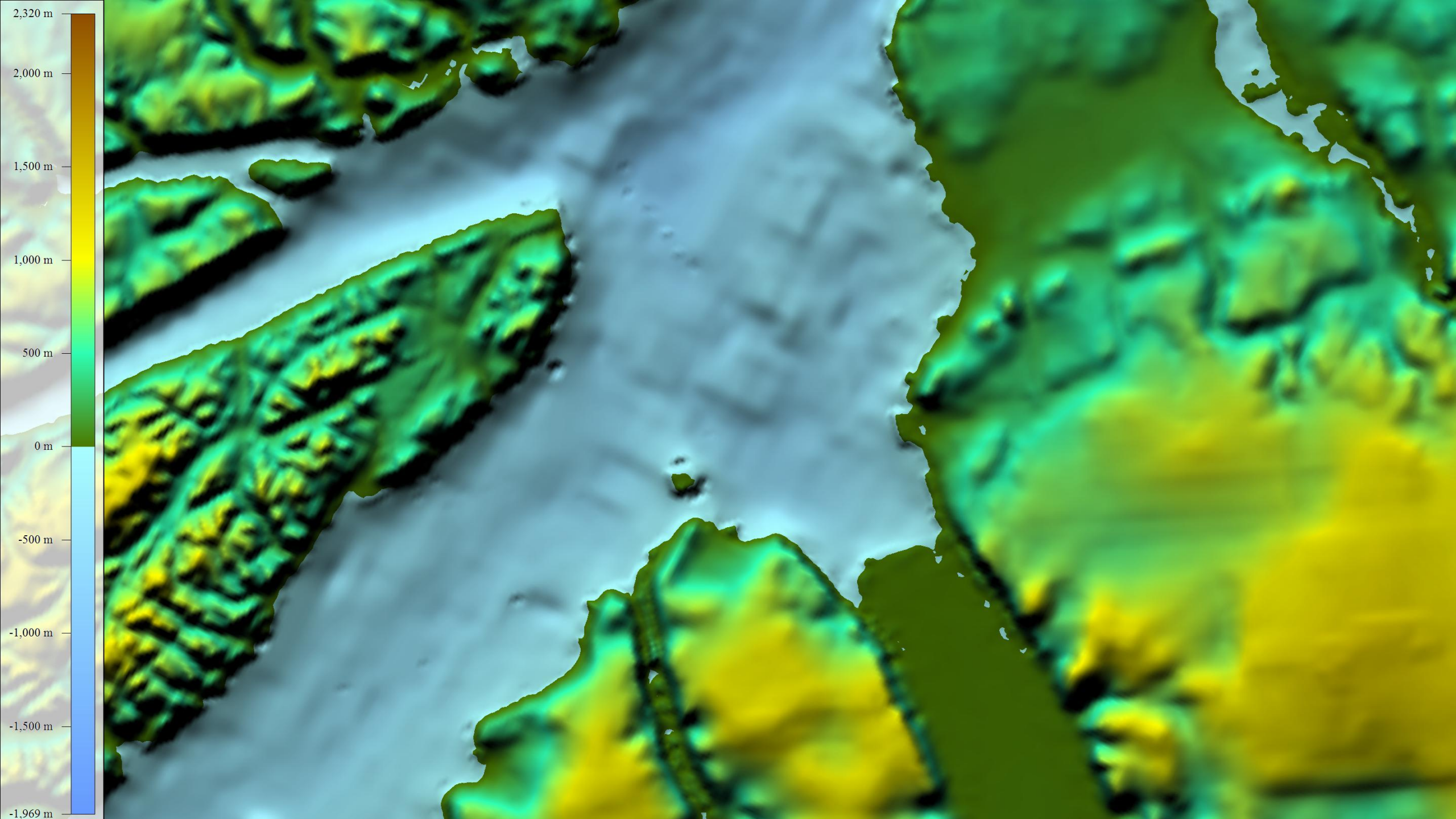
Peterman Glacier

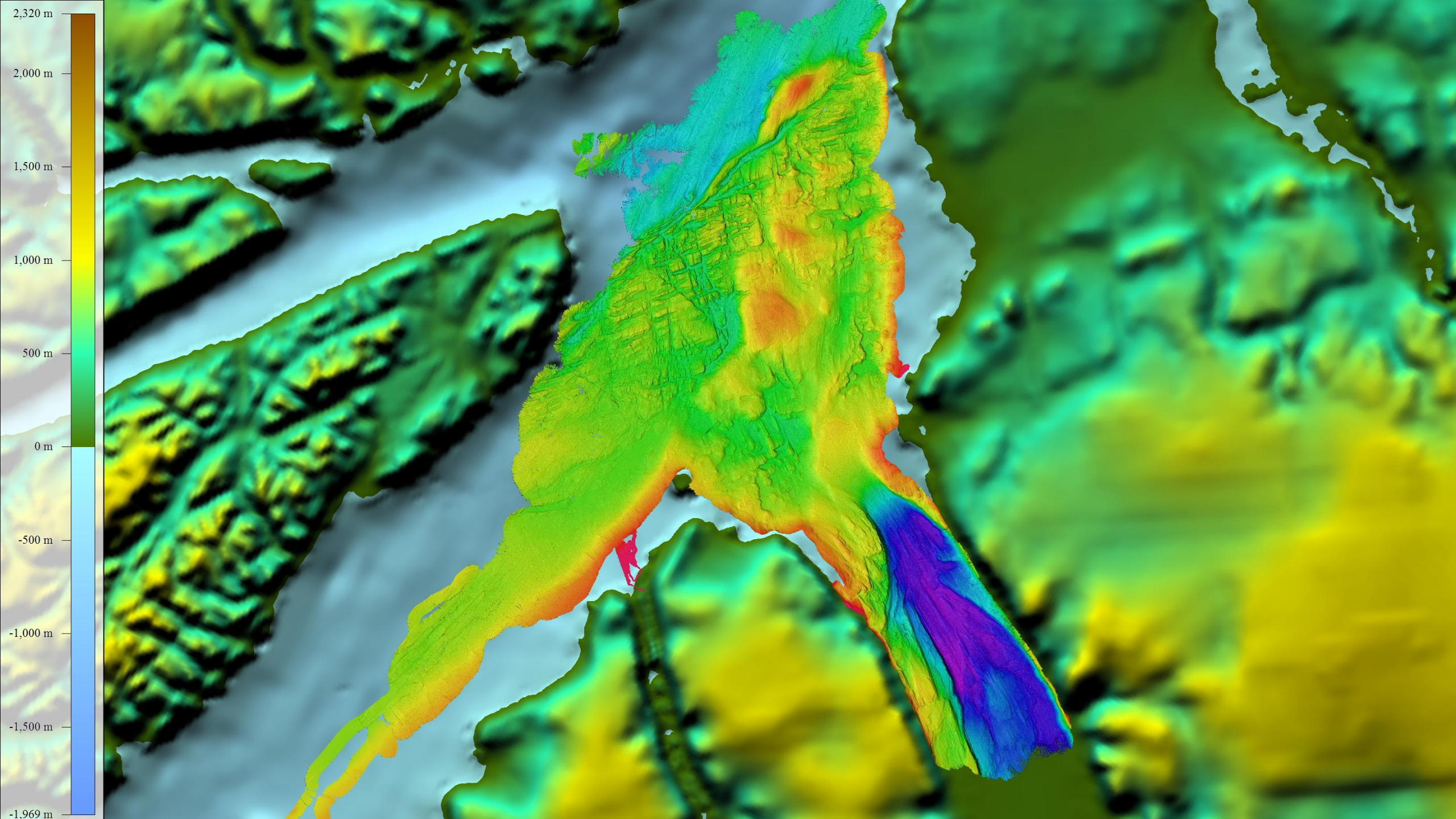
Has a floating ice tongue

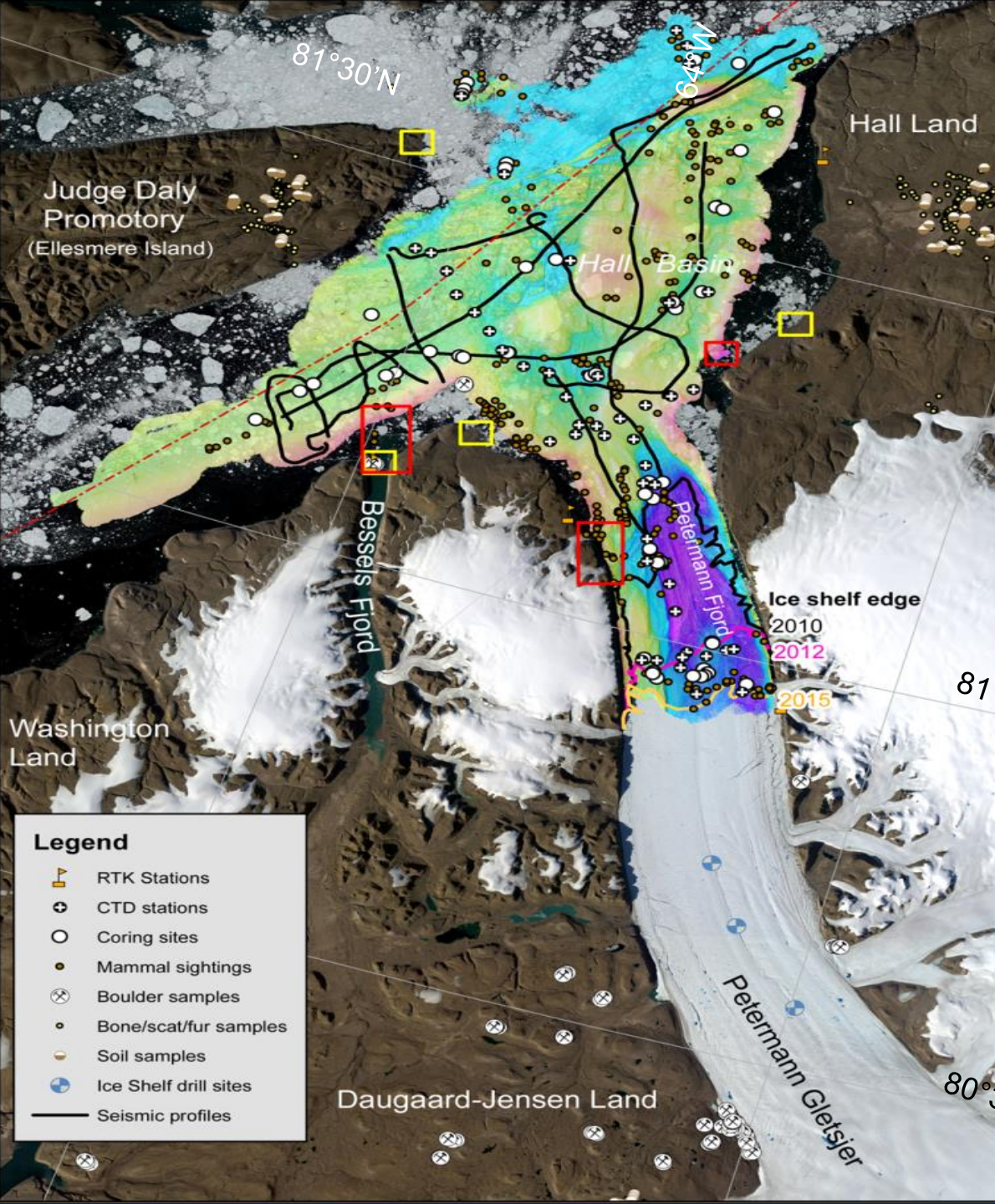


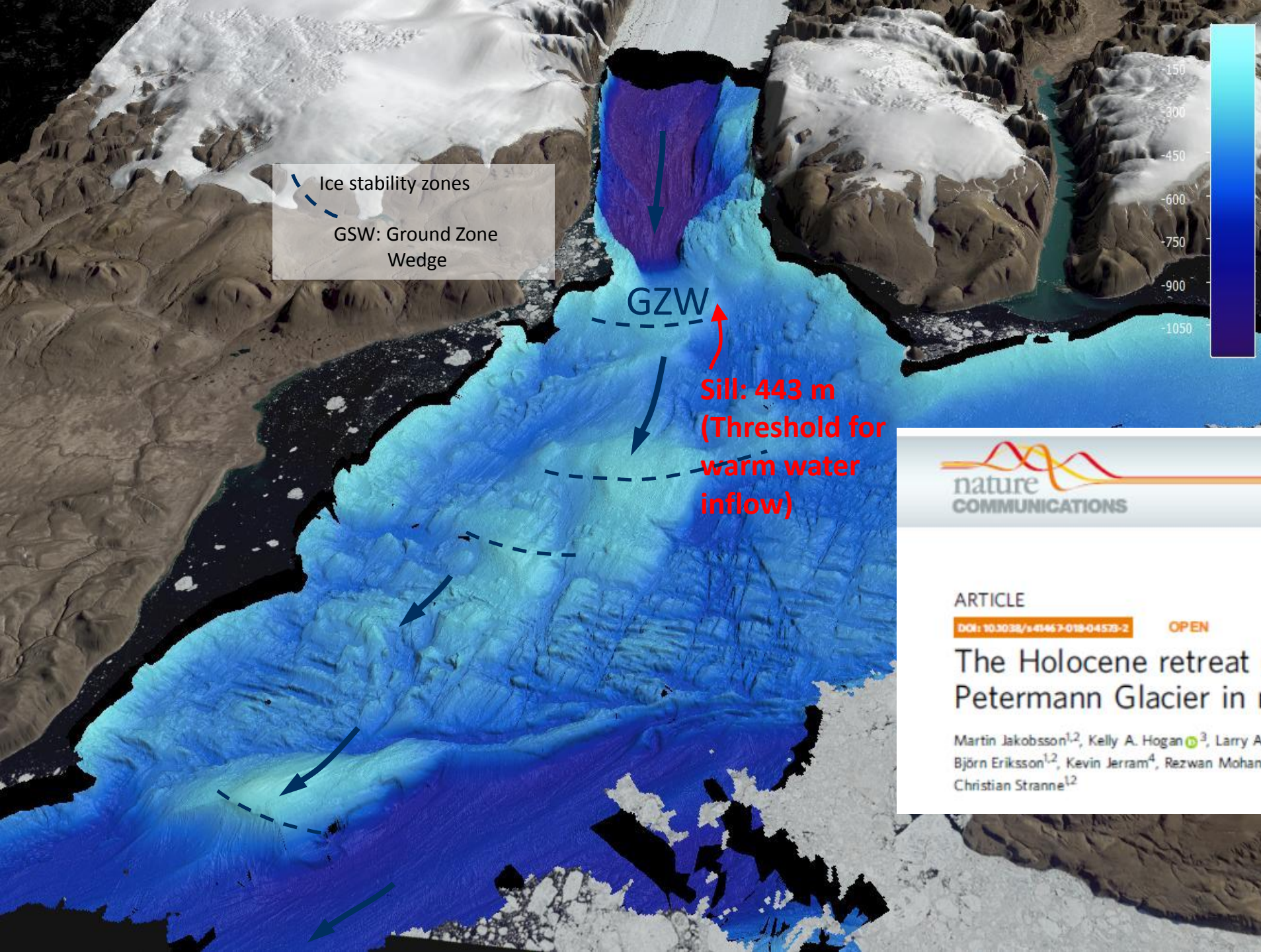
Fahnestock et al., 1992











ARTICLE

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OPEN

The Holocene retreat dynamics and stability of Petermann Glacier in northwest Greenland

Martin Jakobsson^{1,2}, Kelly A. Hogan³, Larry A. Mayer⁴, Alan Mix⁵, Anne Jennings⁶, Joe Stoner⁵, Björn Eriksson^{1,2}, Kevin Jerram⁴, Rezwan Mohammad^{1,2}, Christof Pearce⁷, Brendan Reilly⁵ & Christian Stranne^{1,2}

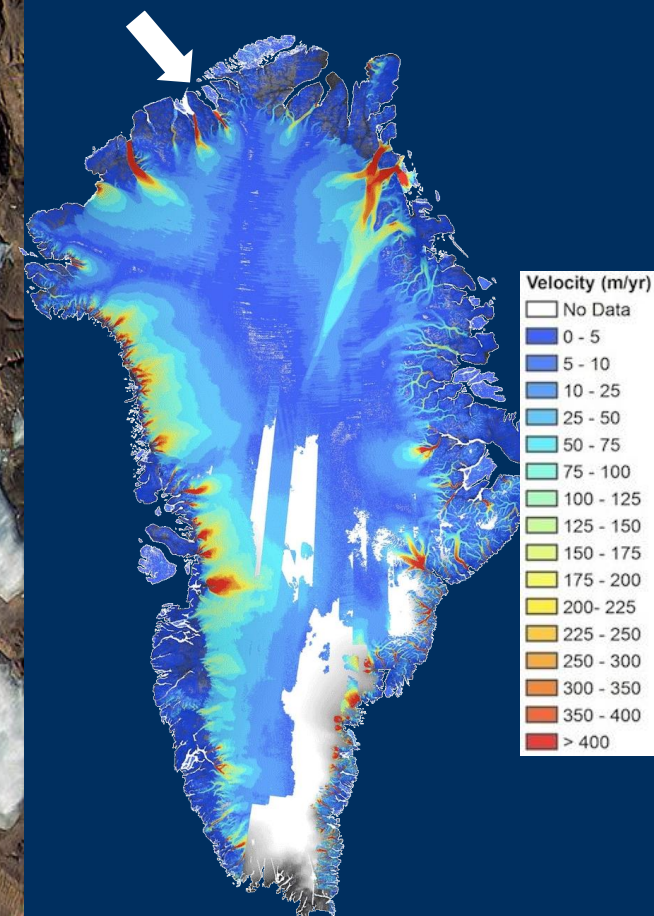


Ryder Glacier

Has a floating ice tongue

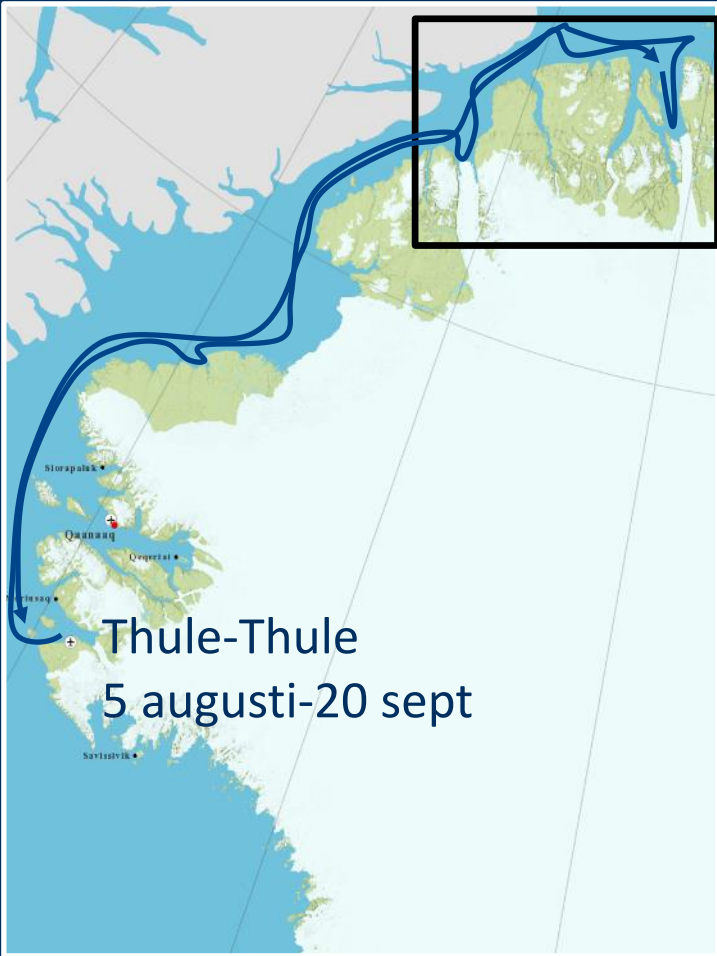
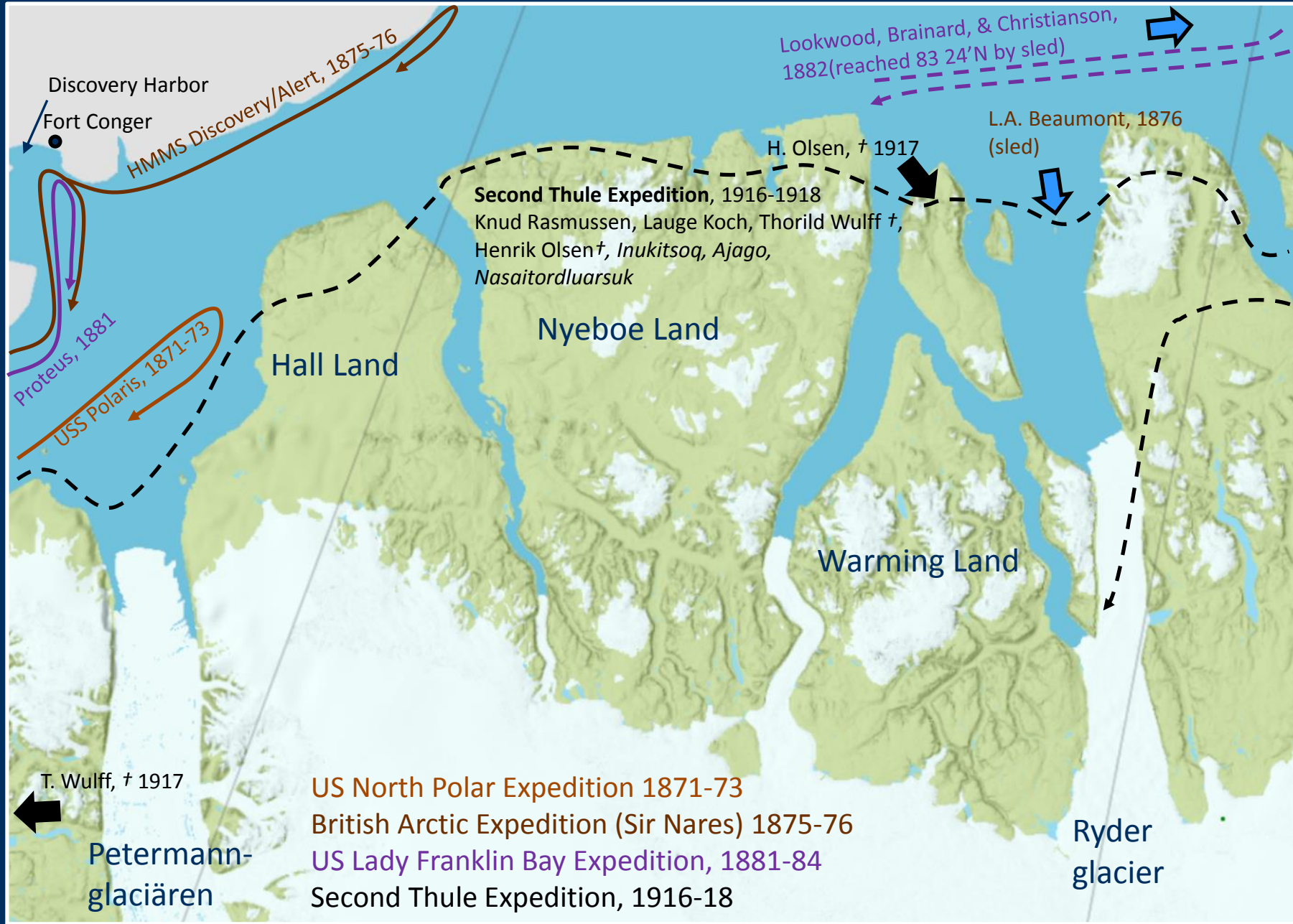
Is a surge type glacier

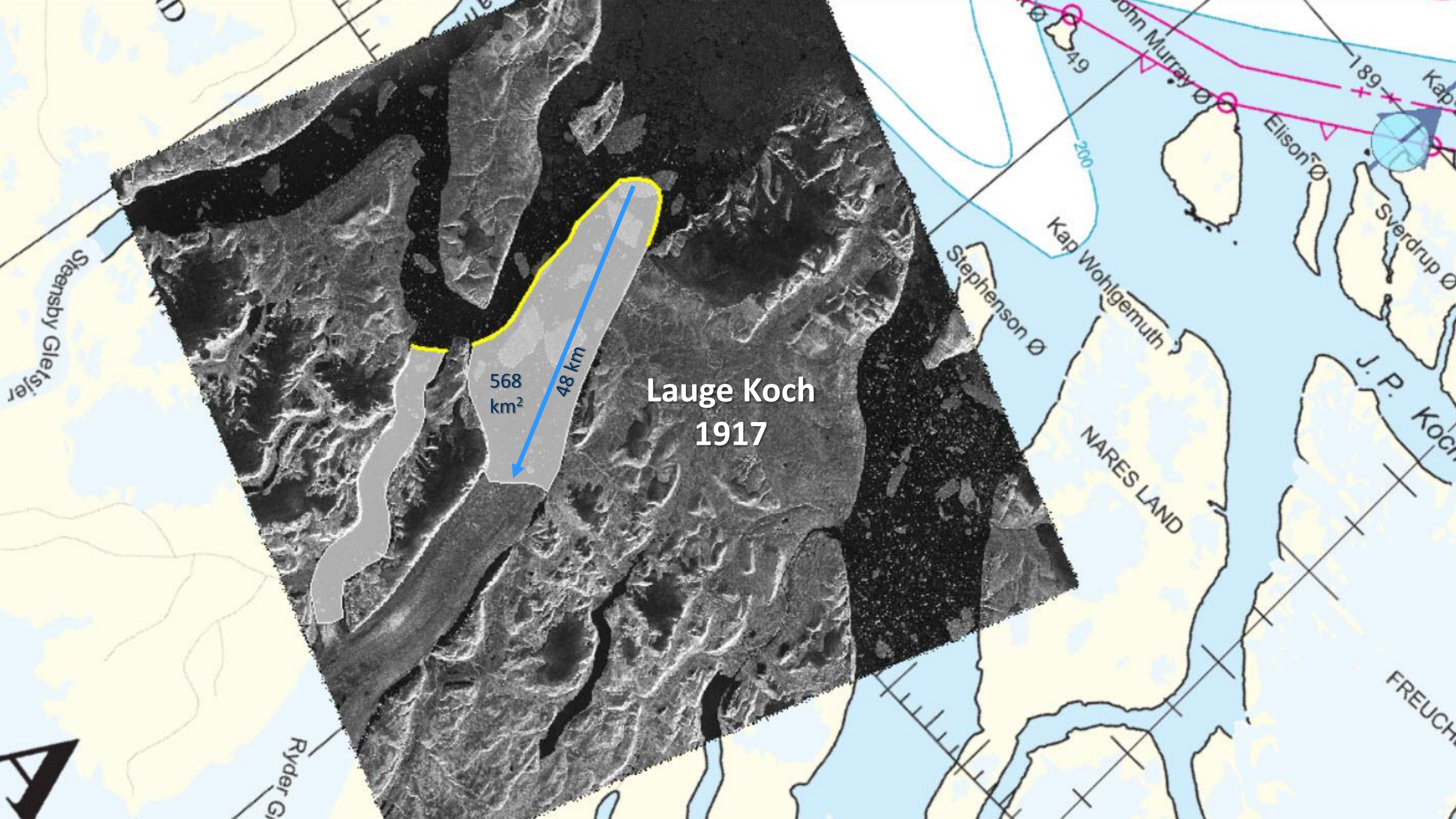
Net advance ($\sim 43\text{m/yr}$)
over last 70 years



Fahnestock et al., 1992

Ryder 2019 Expedition





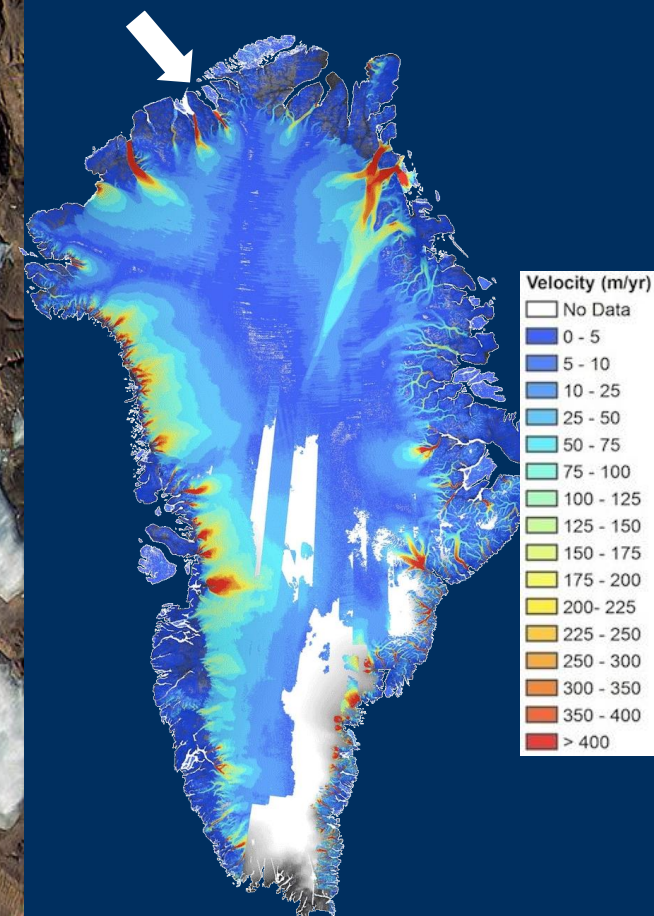


Ryder Glacier

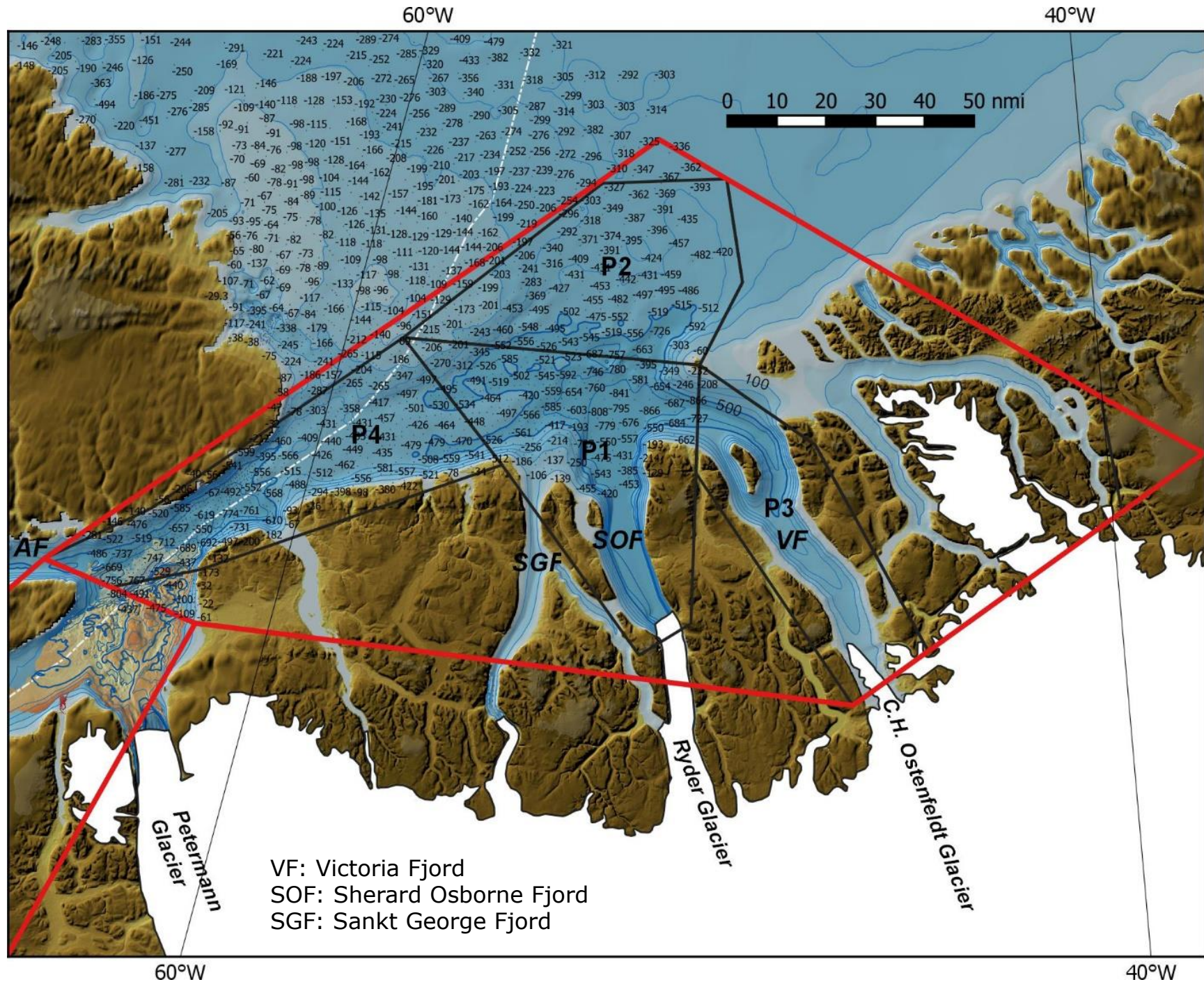
Has a floating ice tongue

Is a surge type glacier

Net advance ($\sim 43\text{m/yr}$)
over last 70 years



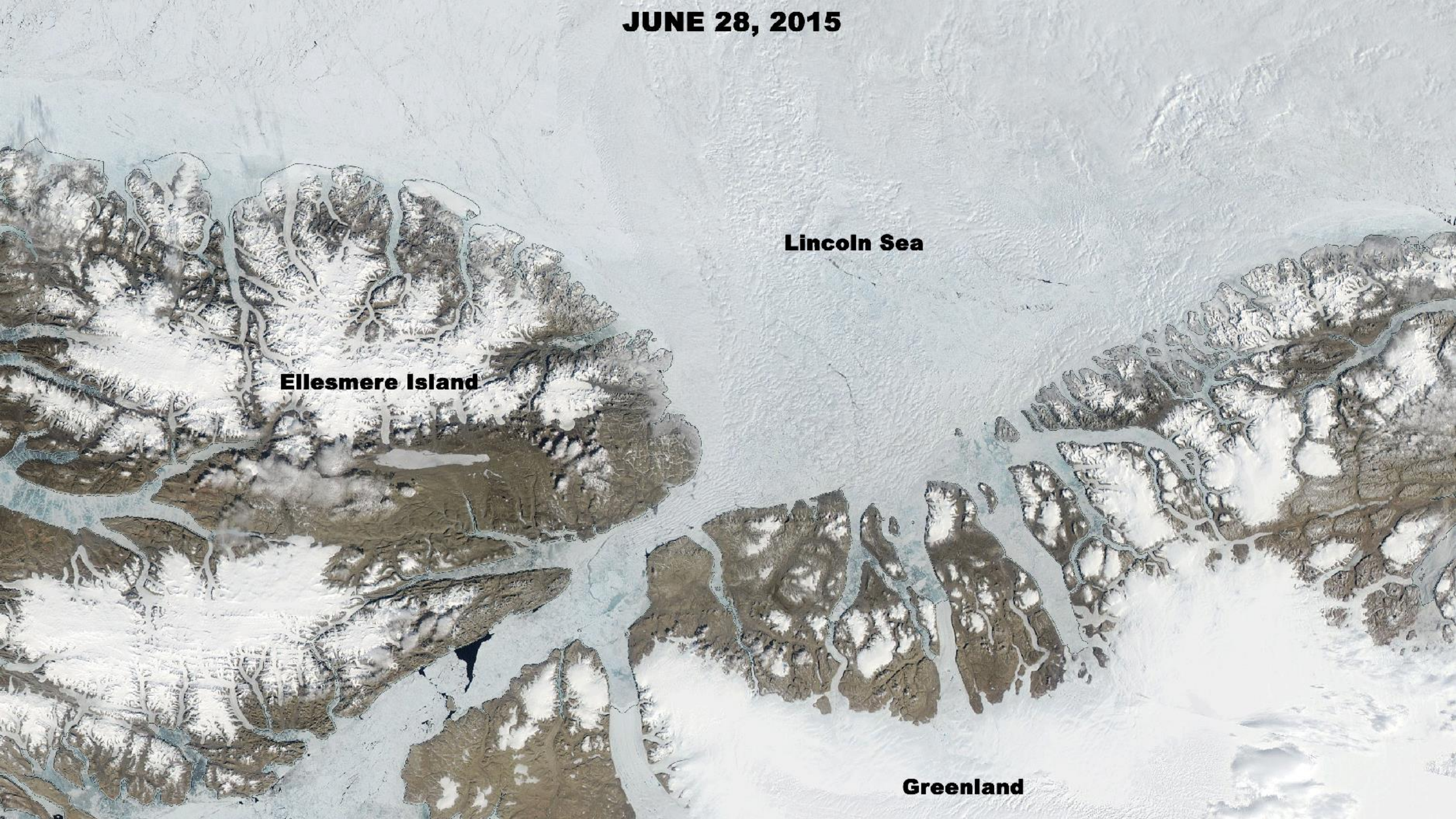
Fahnestock et al., 1992



Completely uncharted waters and sea ice conditions are big challenges!

Is there a sill?
Can we establish the retreat dynamics?

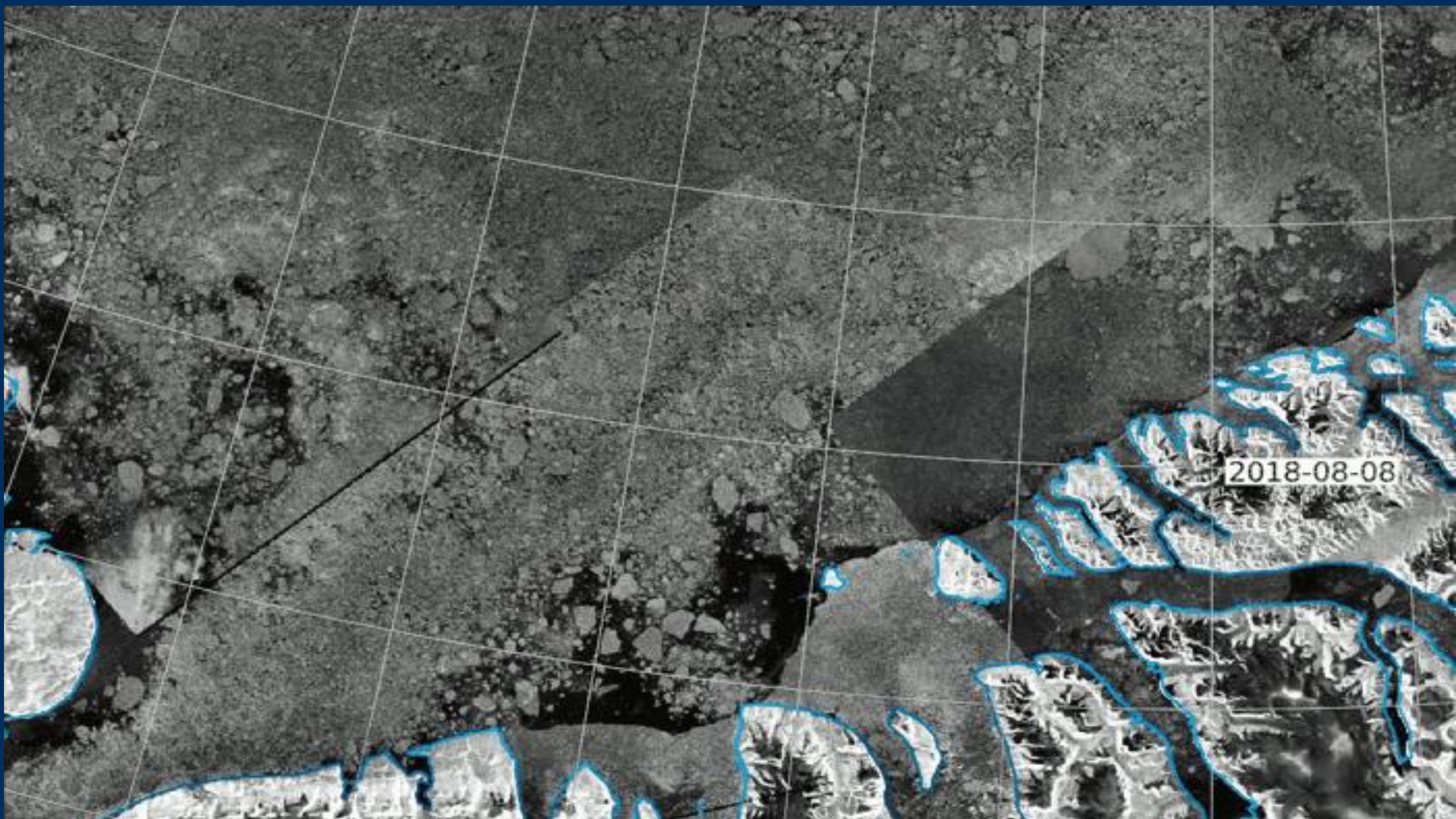
JUNE 28, 2015



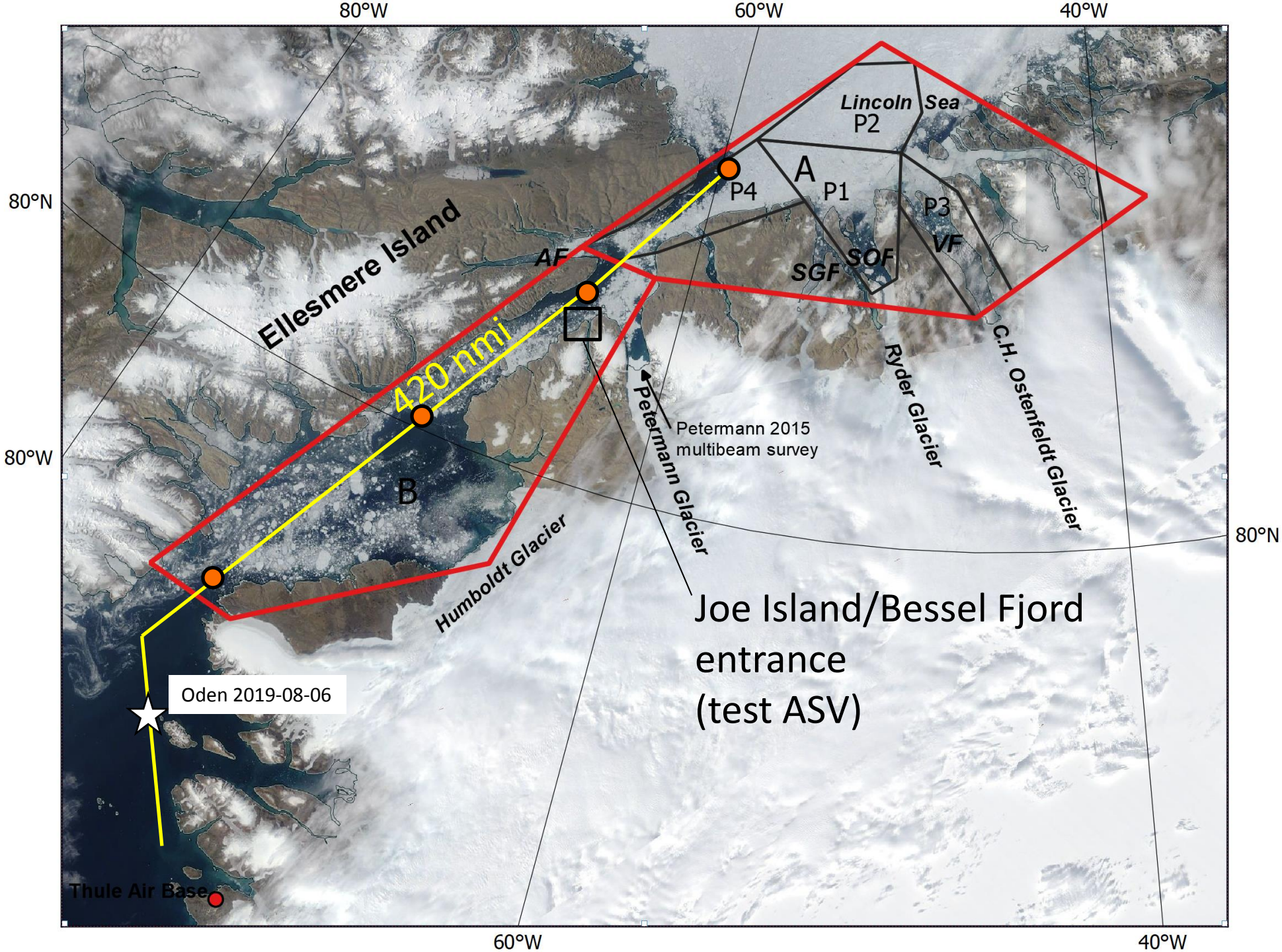
Lincoln Sea

Ellesmere Island

Greenland

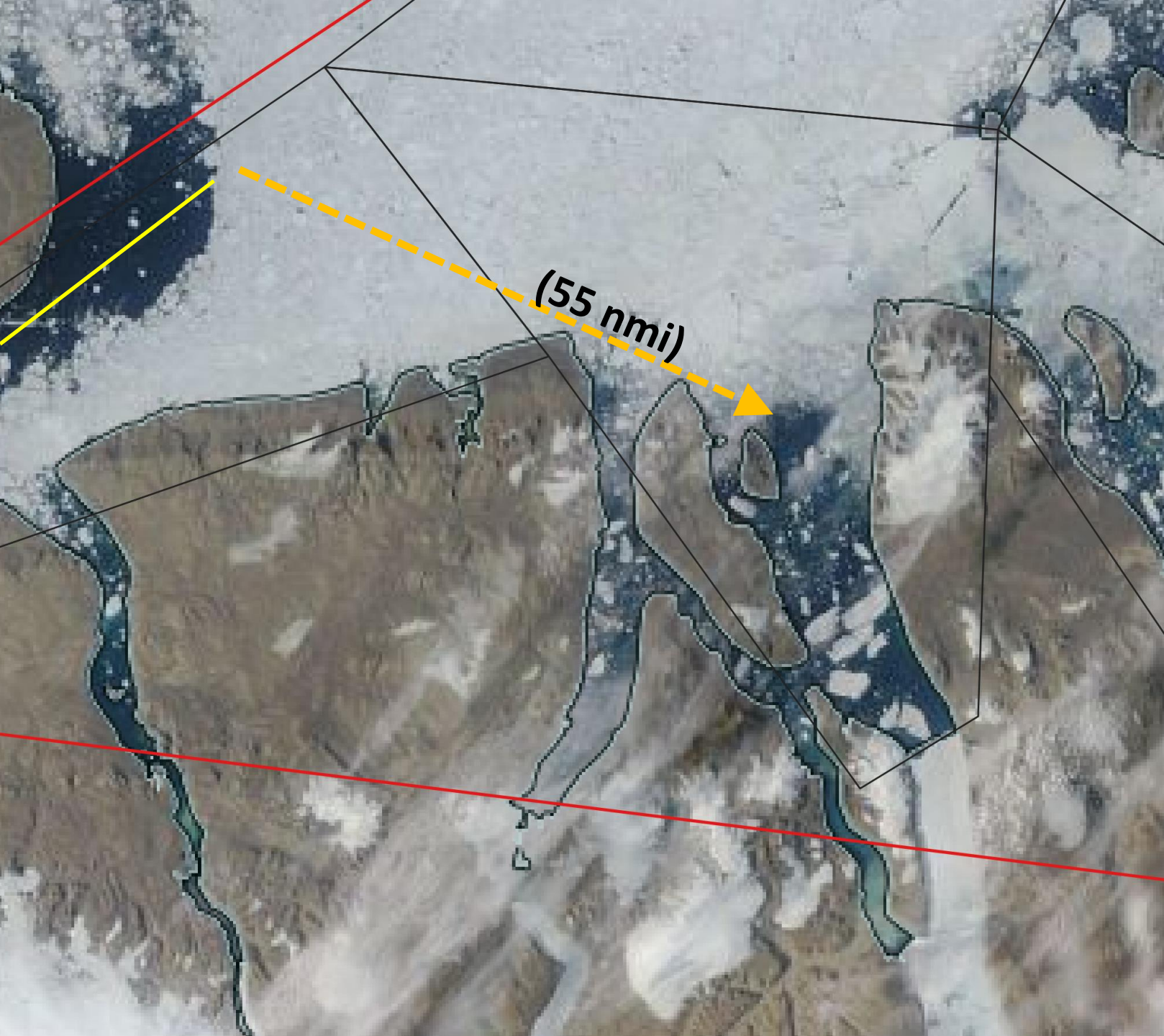


2018-08-08



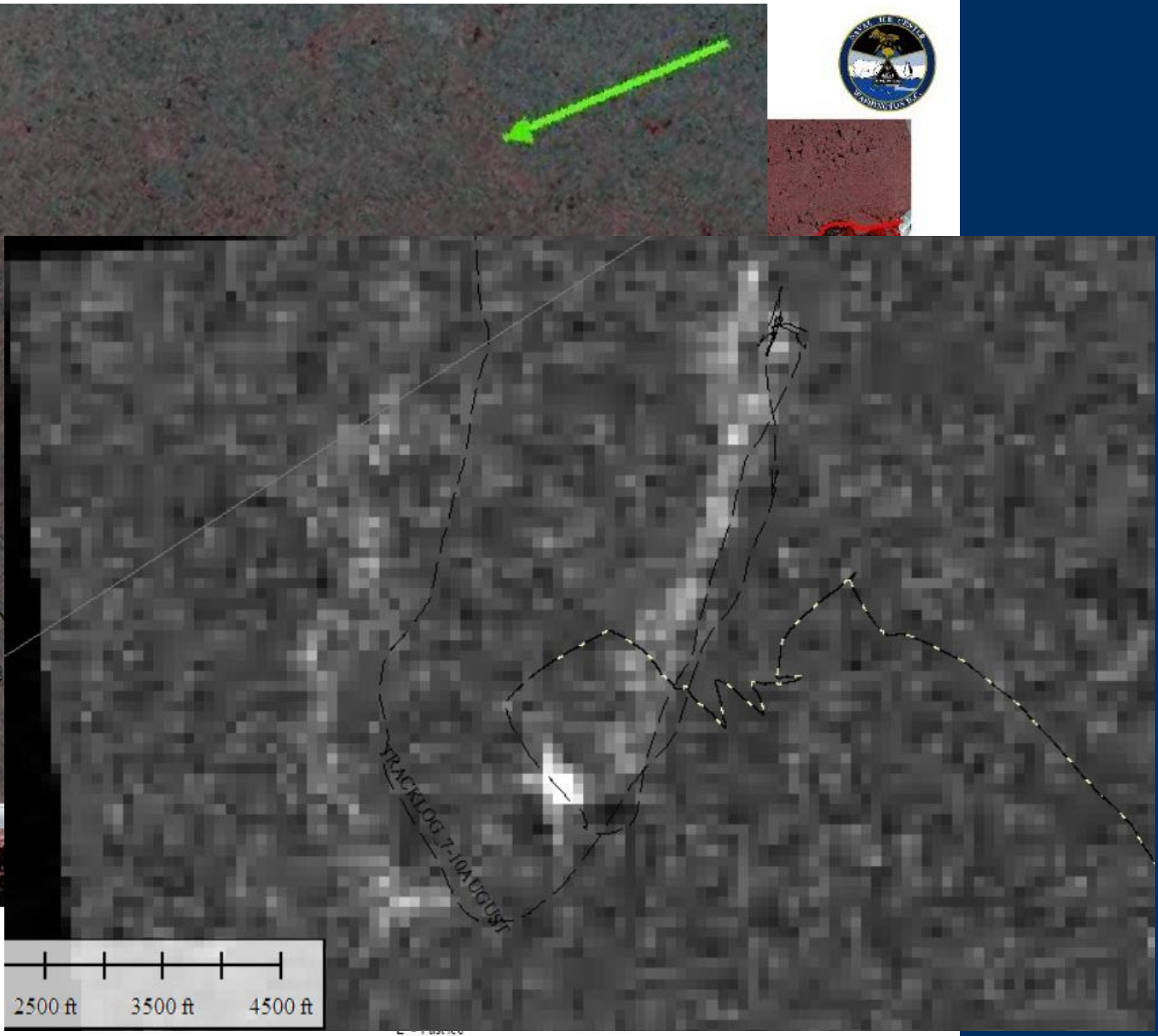
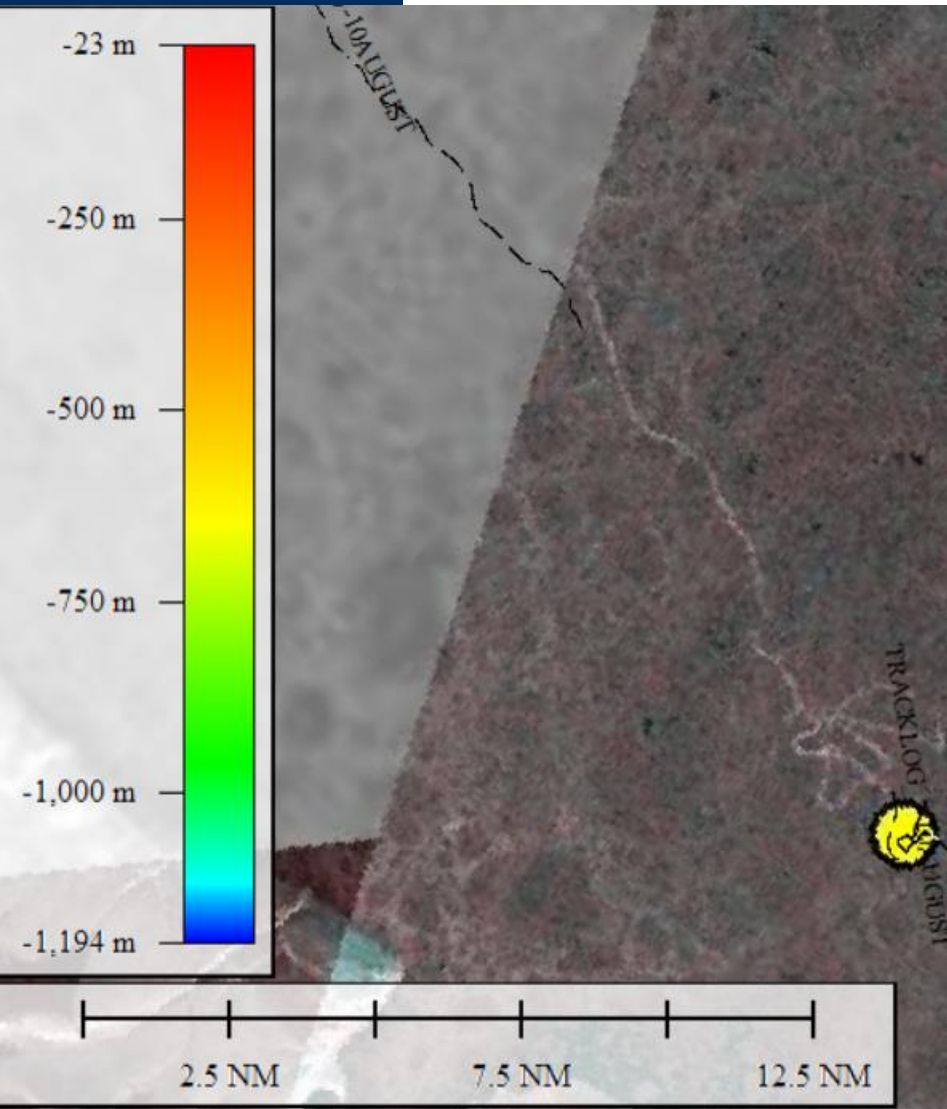
Transit to P4
~ 3 days
6-7 knots + station
time

(had taken us 7 days
to get to Petermann
in 2015)



Helo recon
multiples times
per day

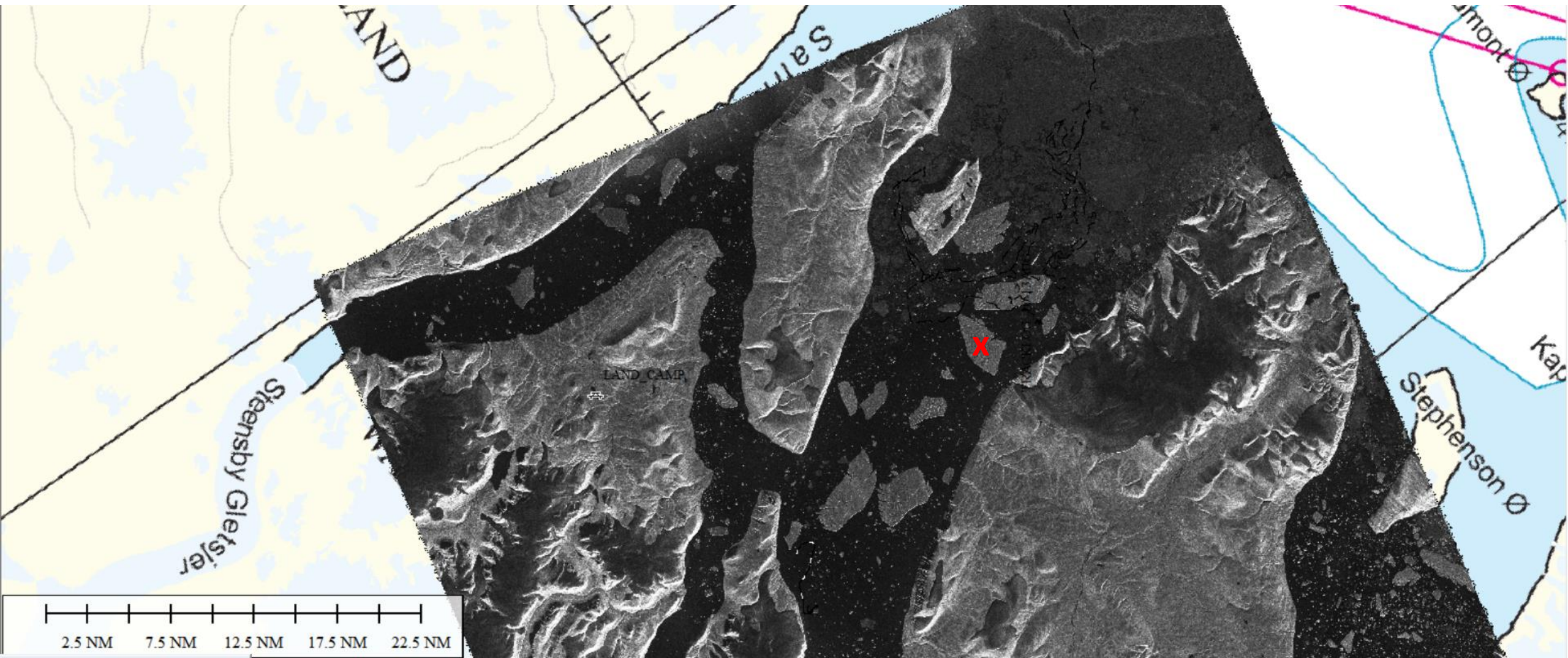
About 3 days to
get to entrance



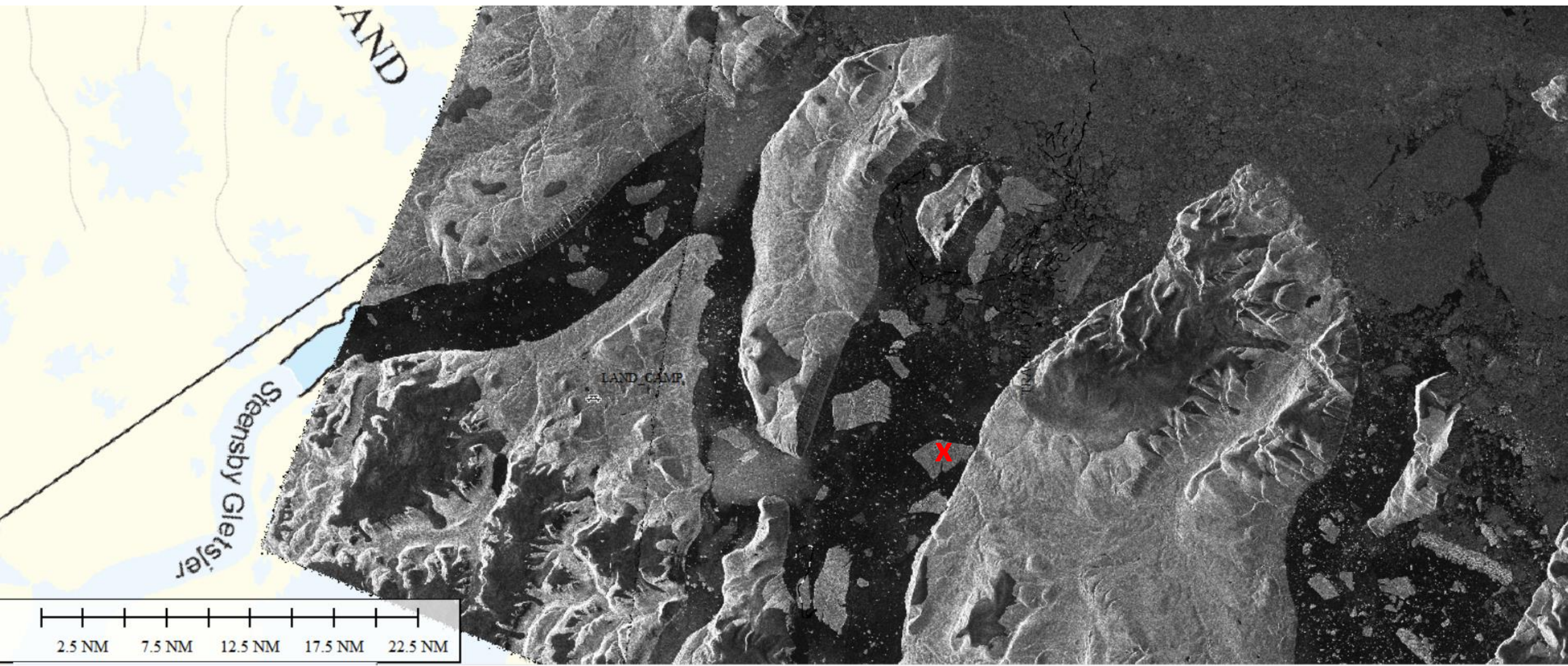
IB Oden 1300Z 10 AUG



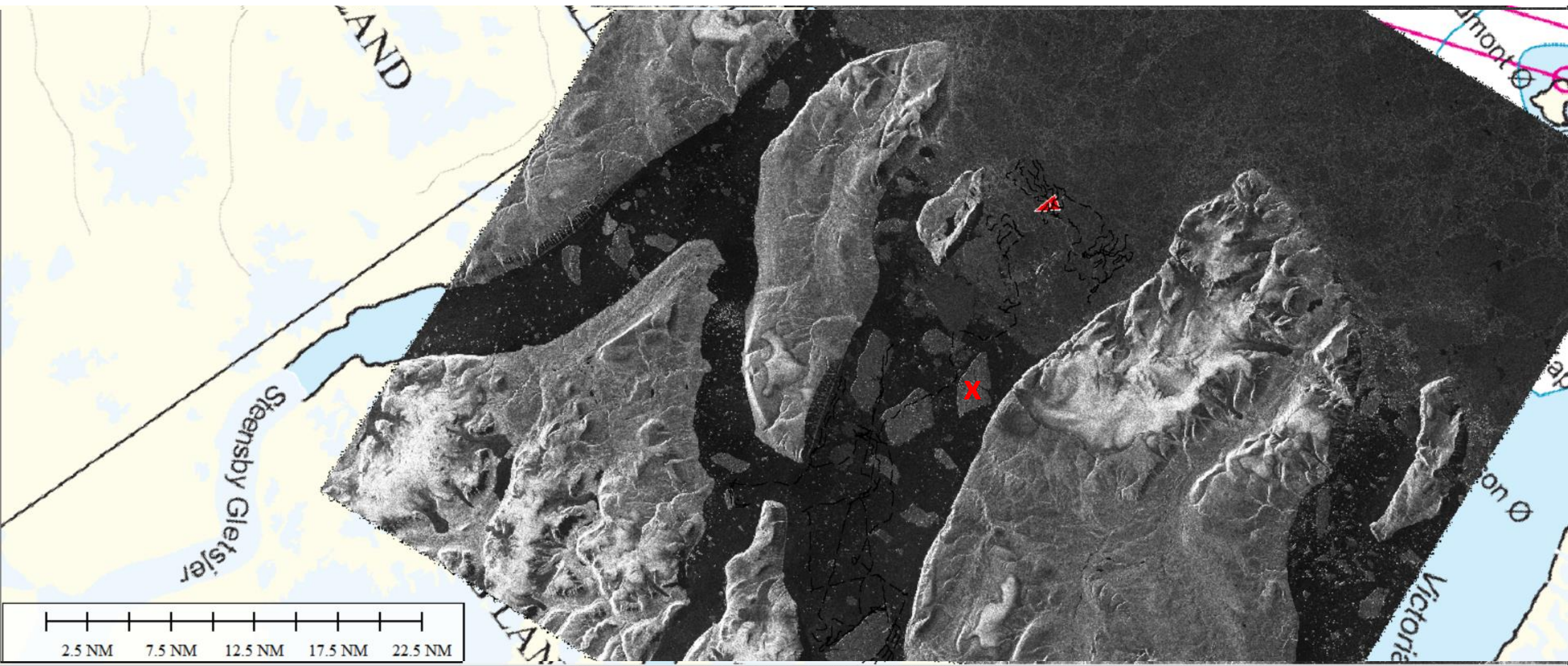
09 August 2019



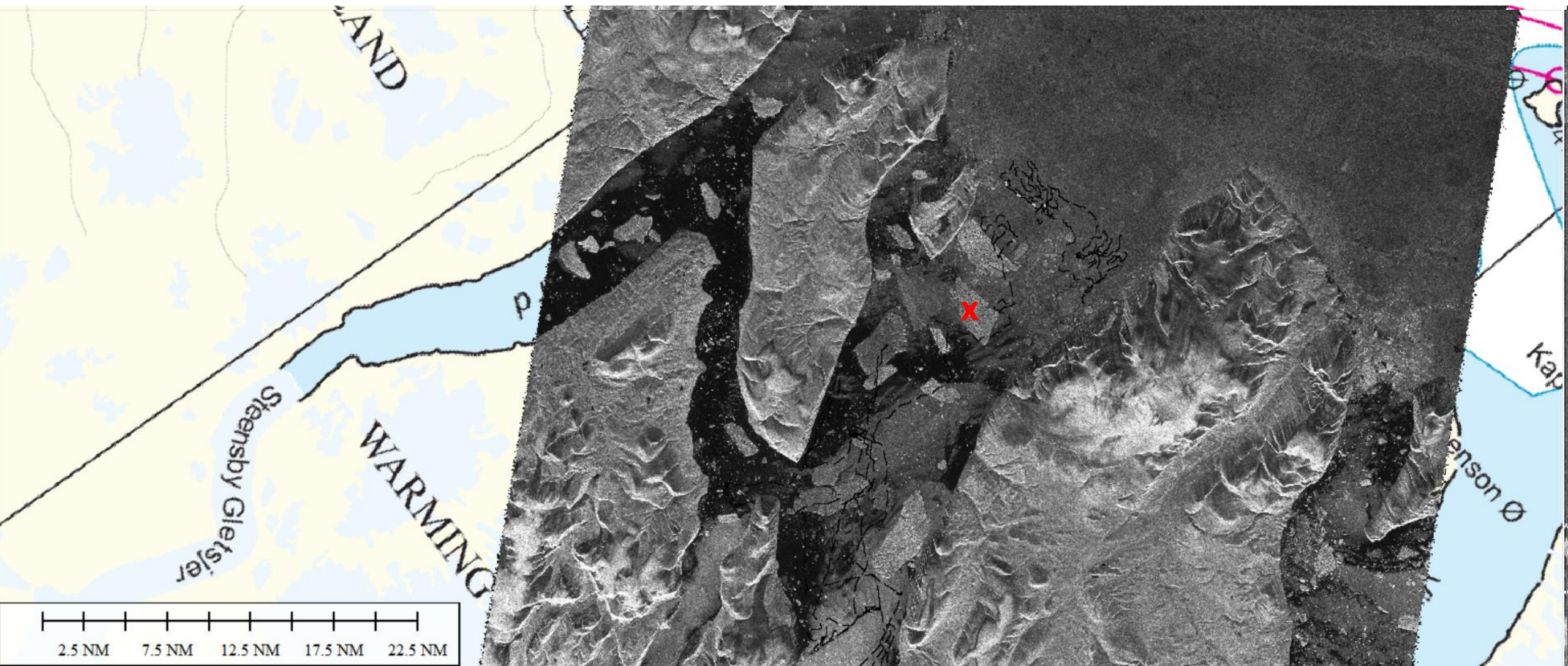
16 August 2019



23 August 2019



25 August 2019



WP Geophysical Mapping (Brian Calder)
WP Water Column Imaging (Christian
Stranne/Liz Weidner)

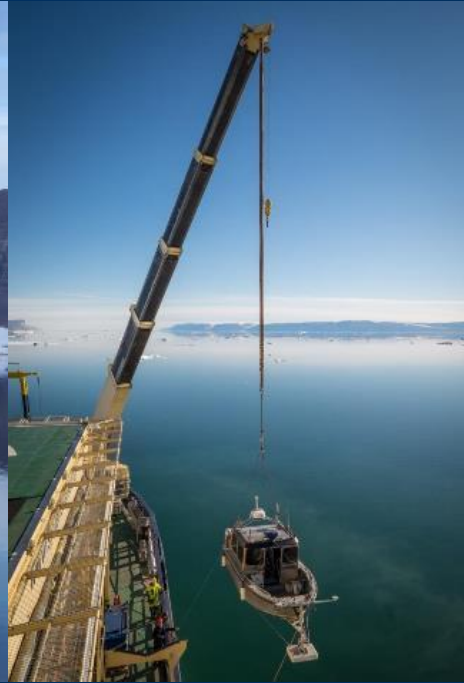


IB Oden

Ship length: 109 m
Multibeam:
KM EM122, 1°x1°, 12 kHz
(Depth range: 20-11000 m)

Sub-bottom profiler:
KM SBP120, 3°x3°, 2-7 kHz

Midwater split beam:
KM EK60, 18 kHz



RV Skidbladner

Ship length: 6.4 m
Multibeam:
KM EM2040, 1°x1°, 200-400 kHz
(Depth range: 0.5-550 m)

Sub-bottom profiler:
EA 600, 15 kHz

WP Remotely Operated Mapping (Sam Reed)



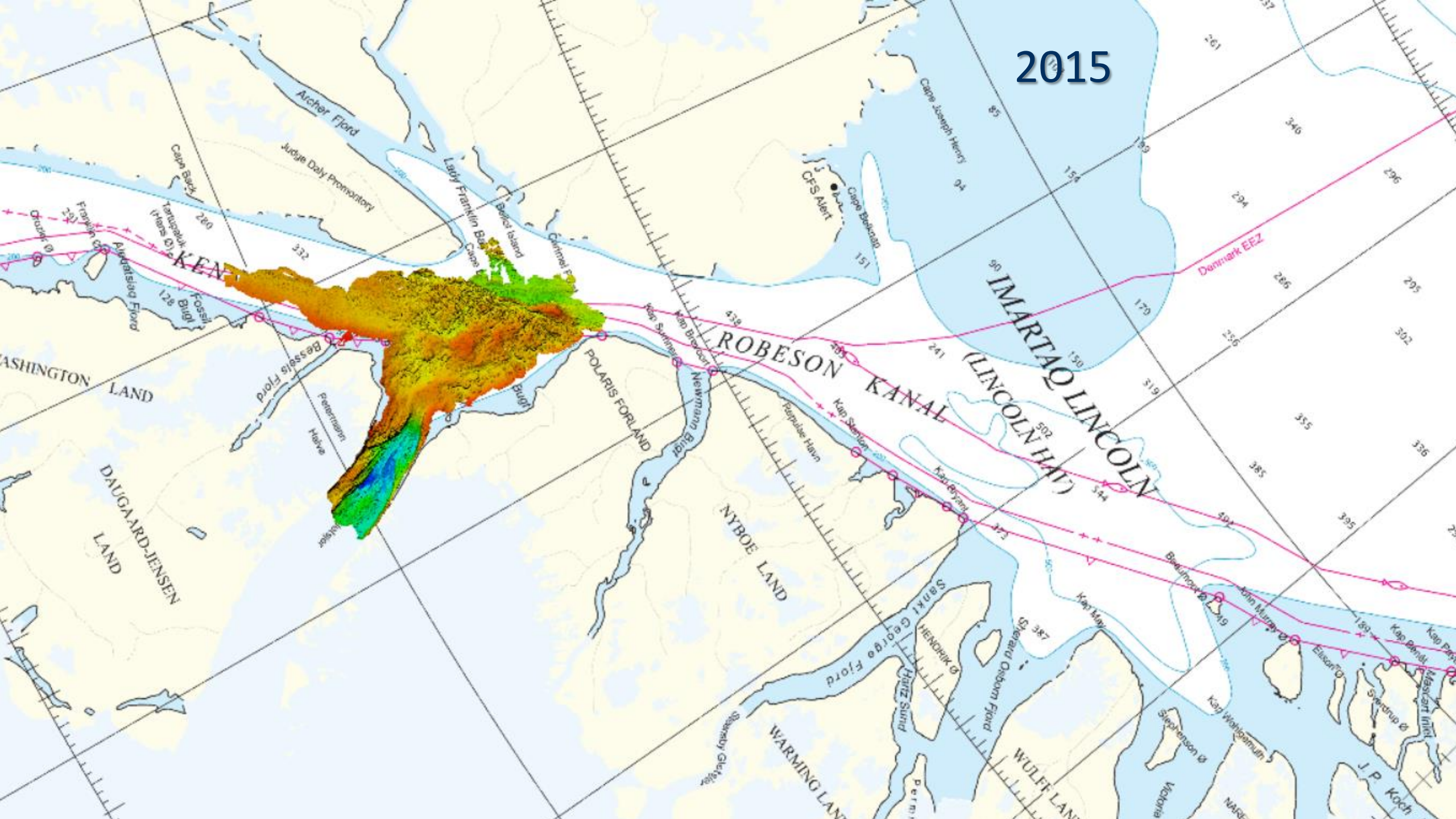
The EchoBoat ASV

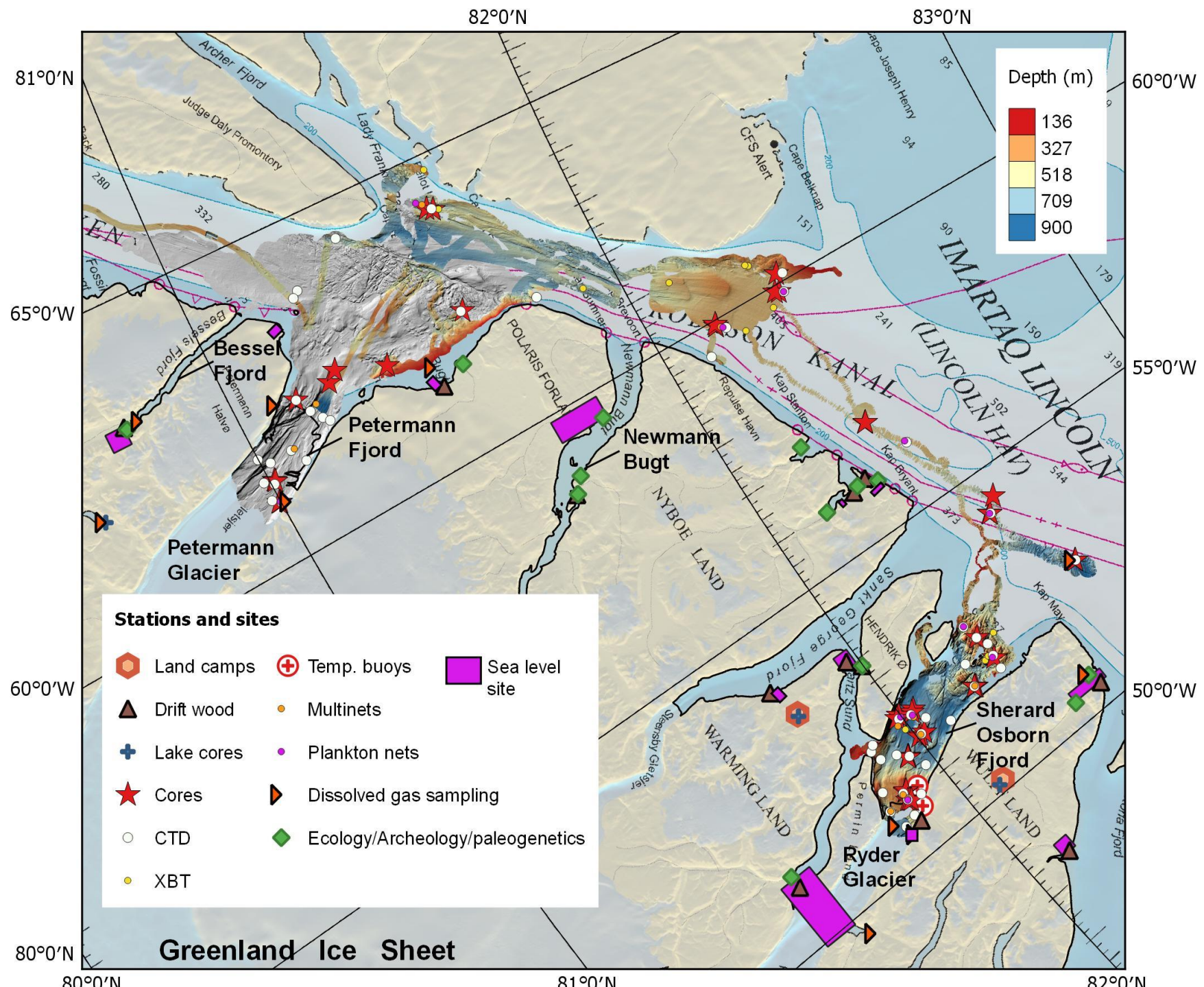
Vessel length: 1.7 m
Weight: 30 kg
Range and endurance: 2 km, 7-8 hours
Multibeam/motion sensor: PicoMBES120-SF with integrated
Applanix SurfMaster (depth range: 240 m with reduced swath)

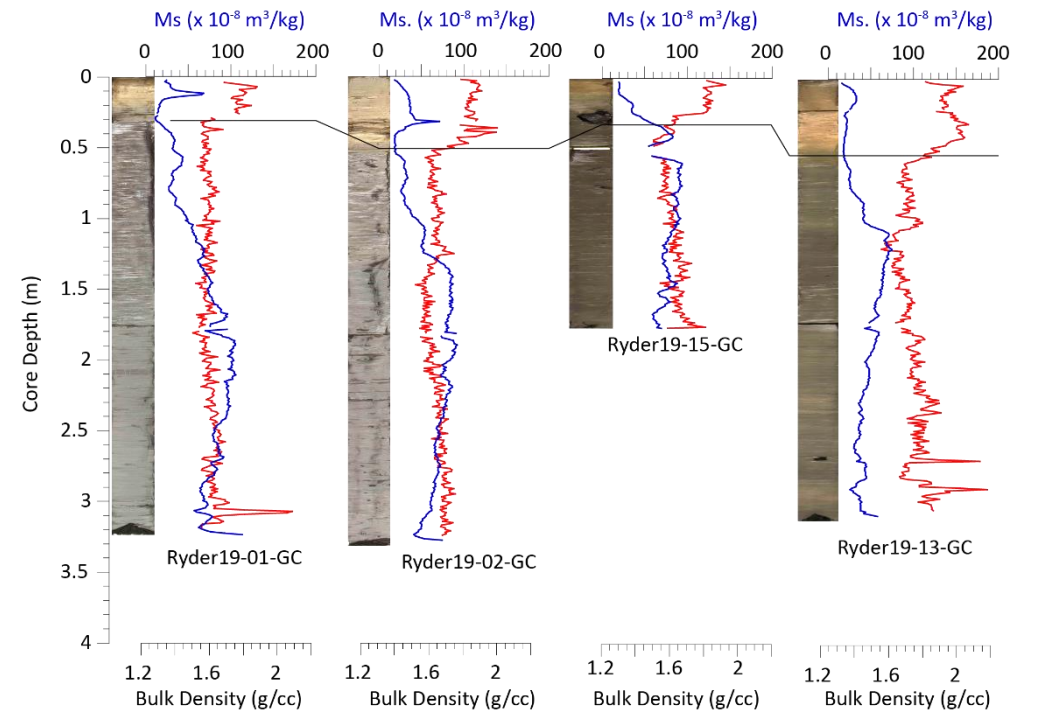
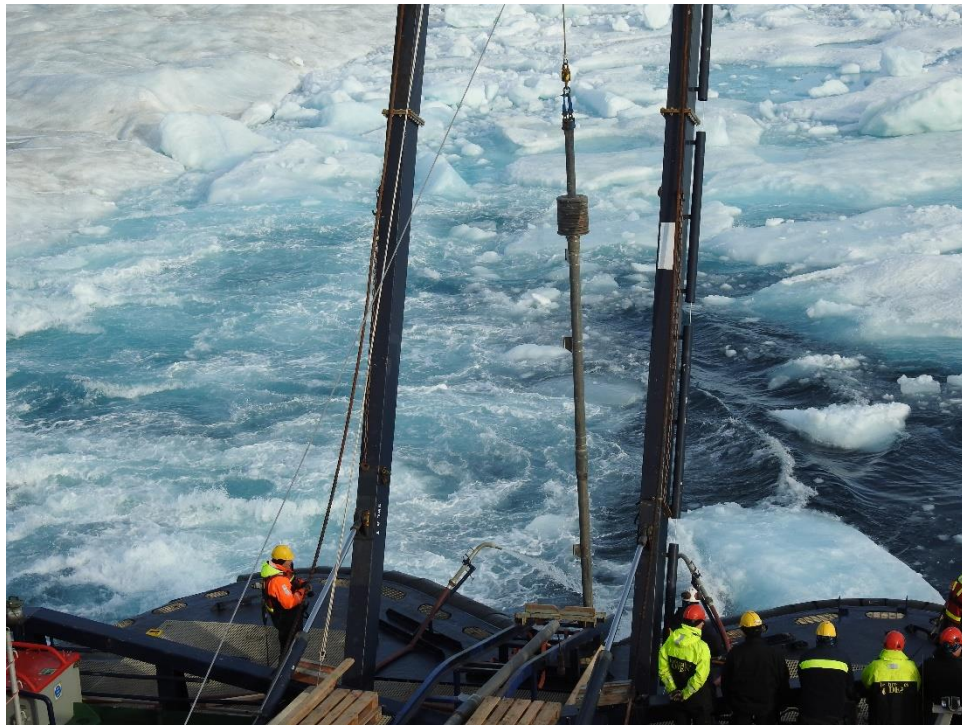


(KM=Kongsberg Maritime)

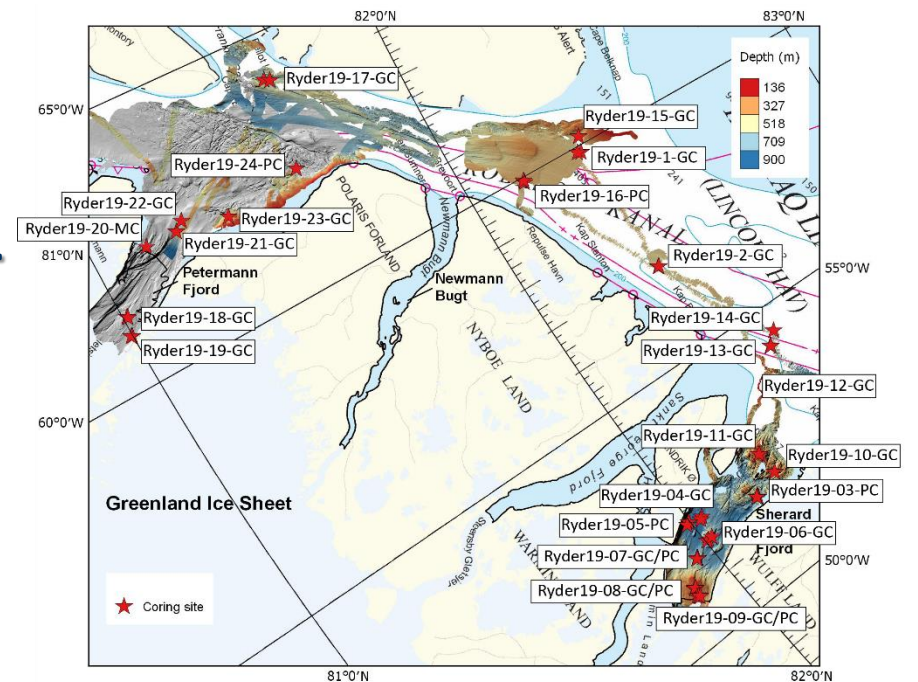
2015





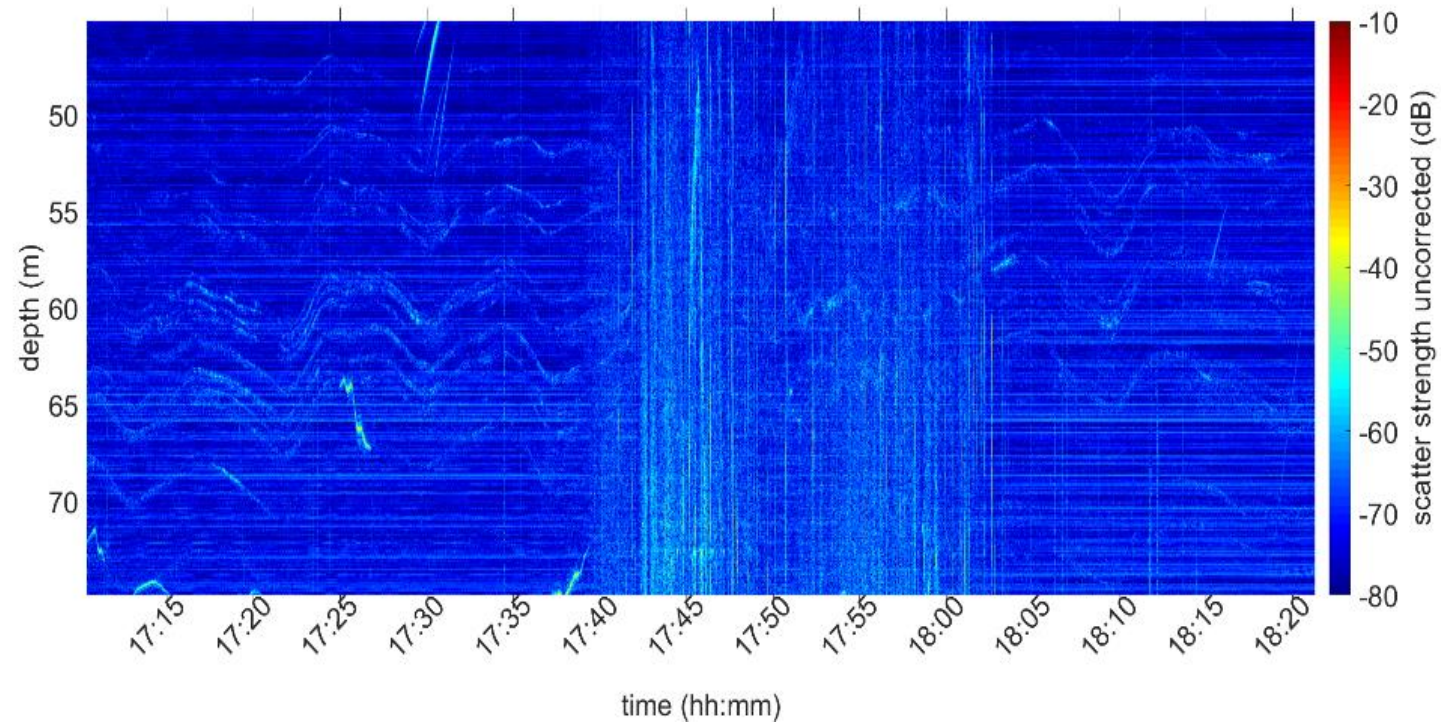
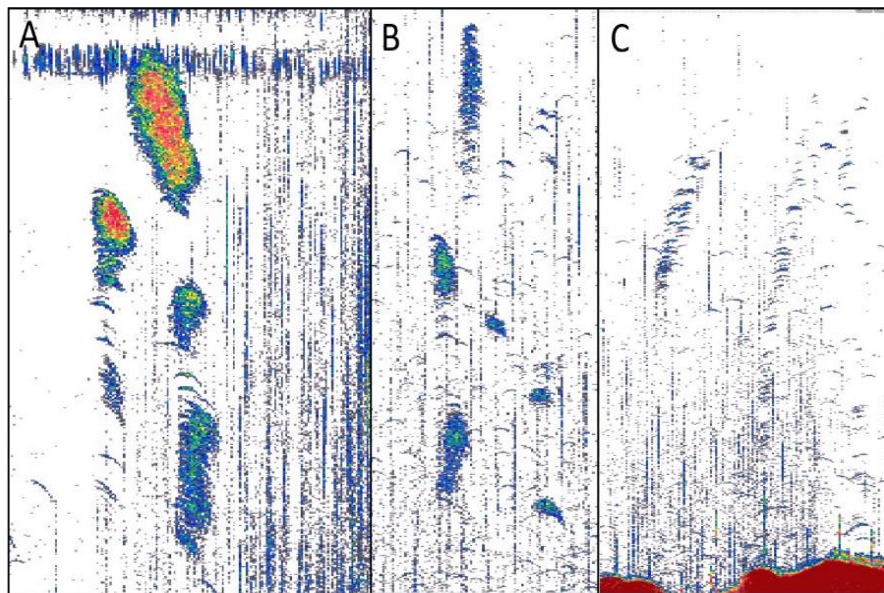
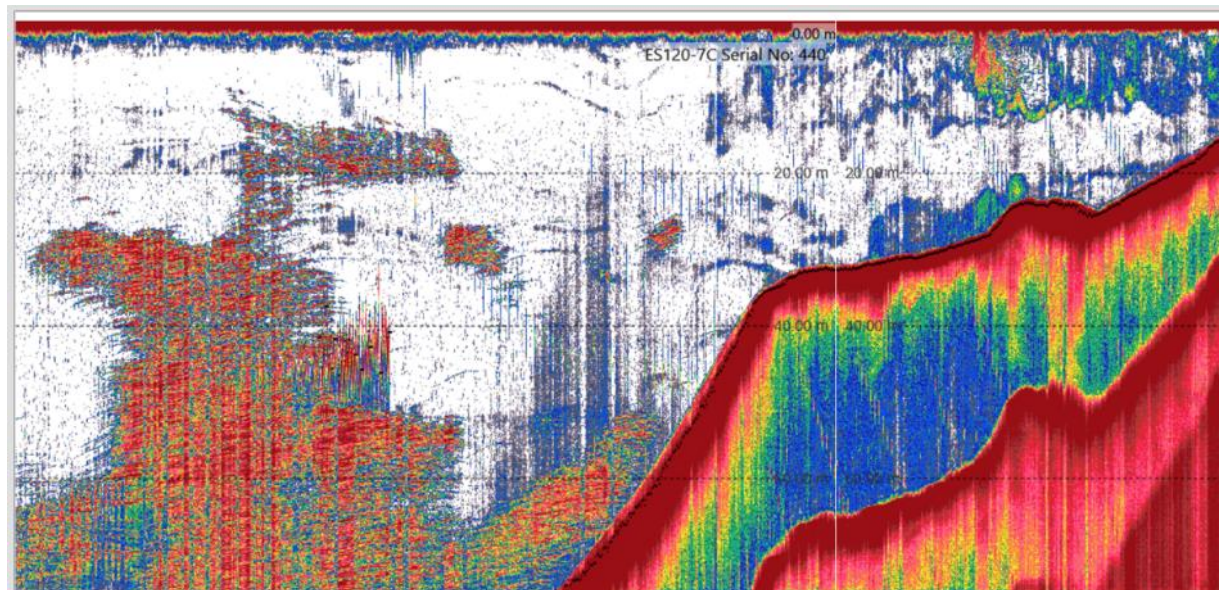


CORING: Piston, Gravity, Multi- corer



Broadband Acoustic Mapping of Water Column

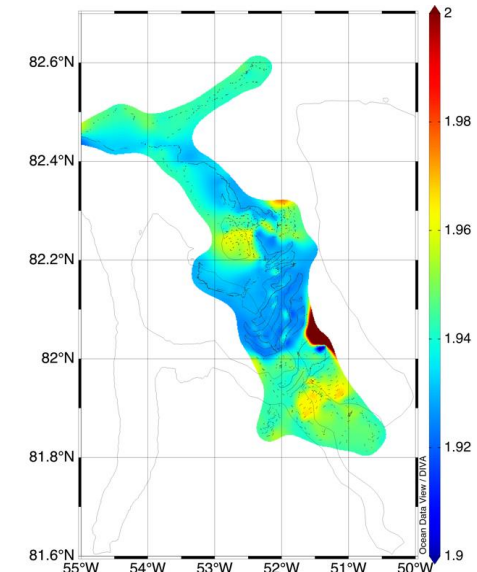
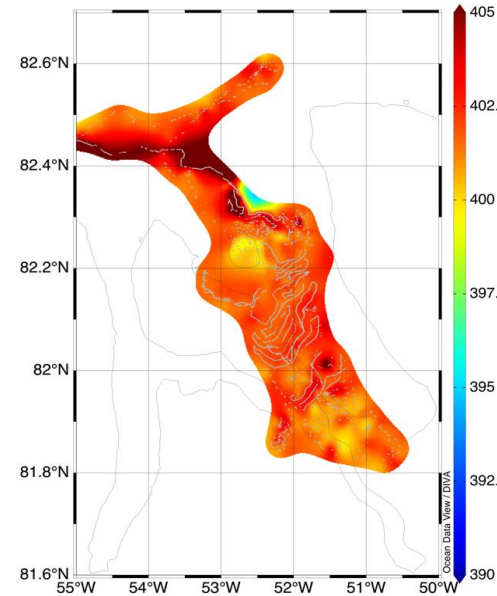
Fish – Gas – Physical Oceanography



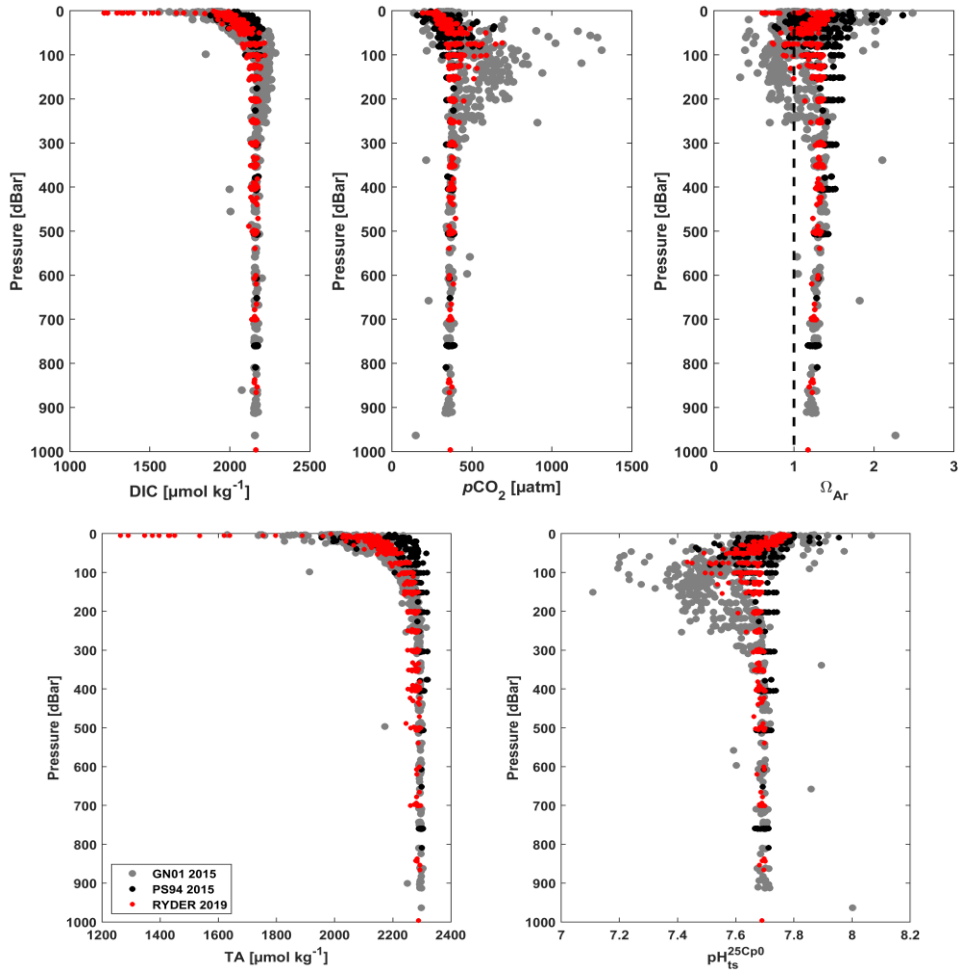
Biological Sampling: Multinet, Plankton Net



Atmospheric Chemistry – CO₂ and Methane

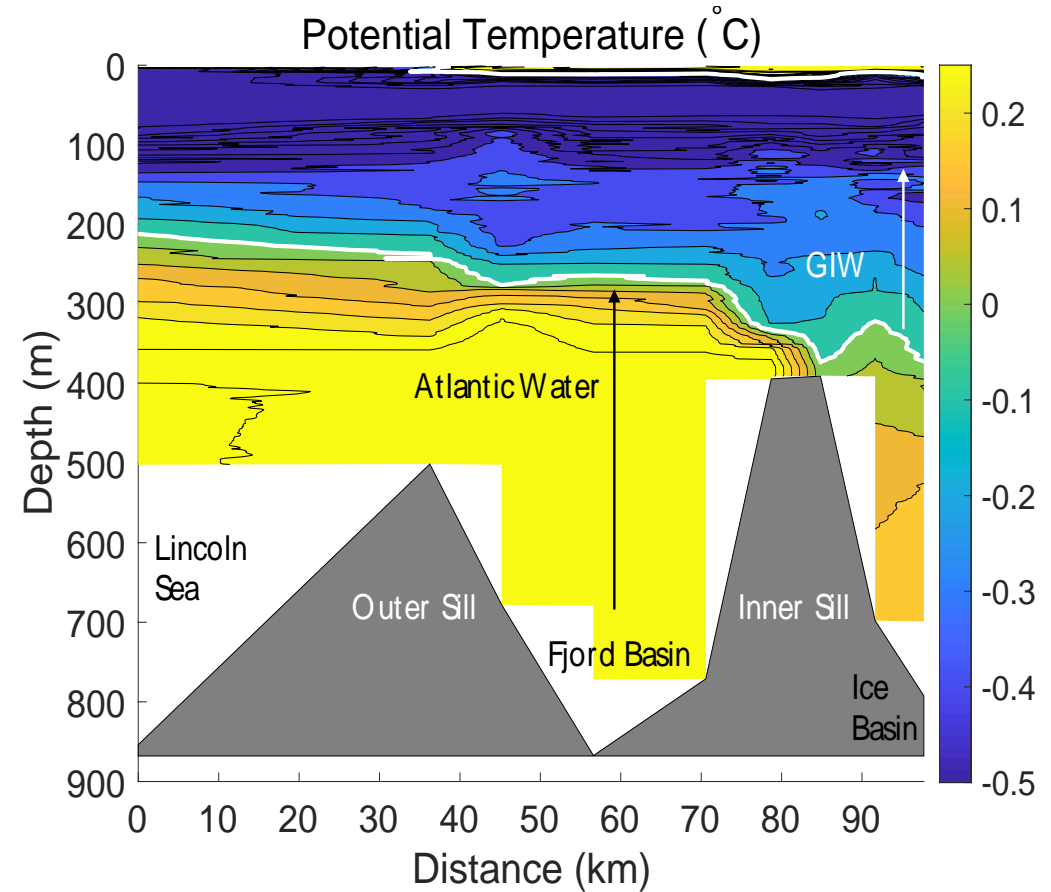


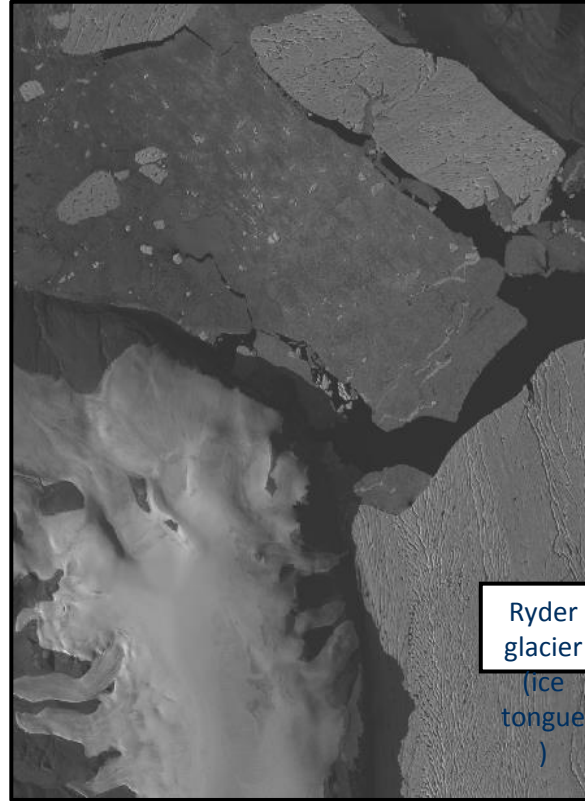
Ocean Chemistry: DIC, pH, Alkalinity



CTD – Physical Oceanography Tracing warm Atlantic waters into the fjords

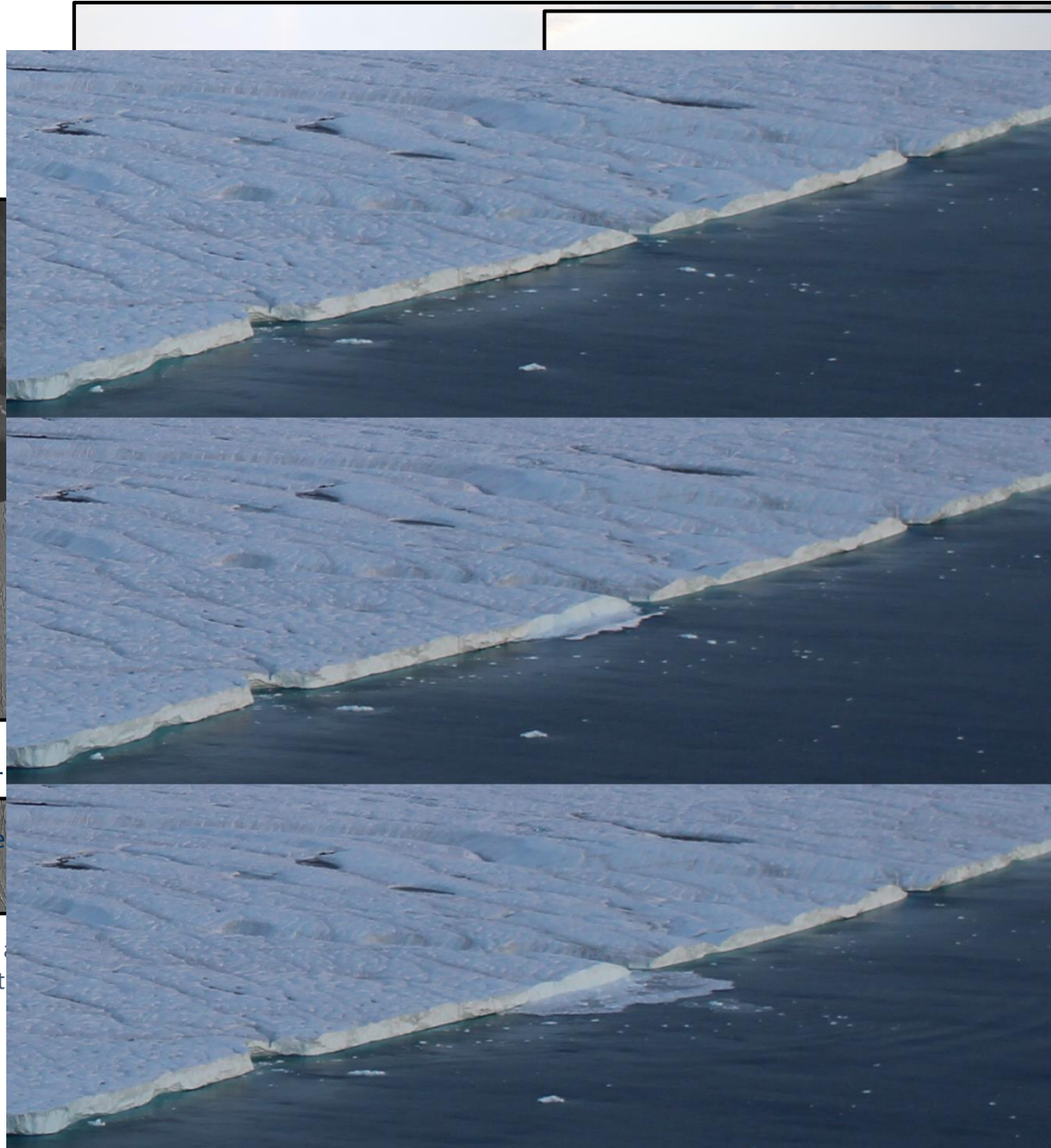
Temperature in Sherard Osborne Fjord





Ryder glacier
(ice tongue)

GLAC-Fig01.jpg: Landsat image of Ryder Glacier from July 14, 2019, showing the location of the t



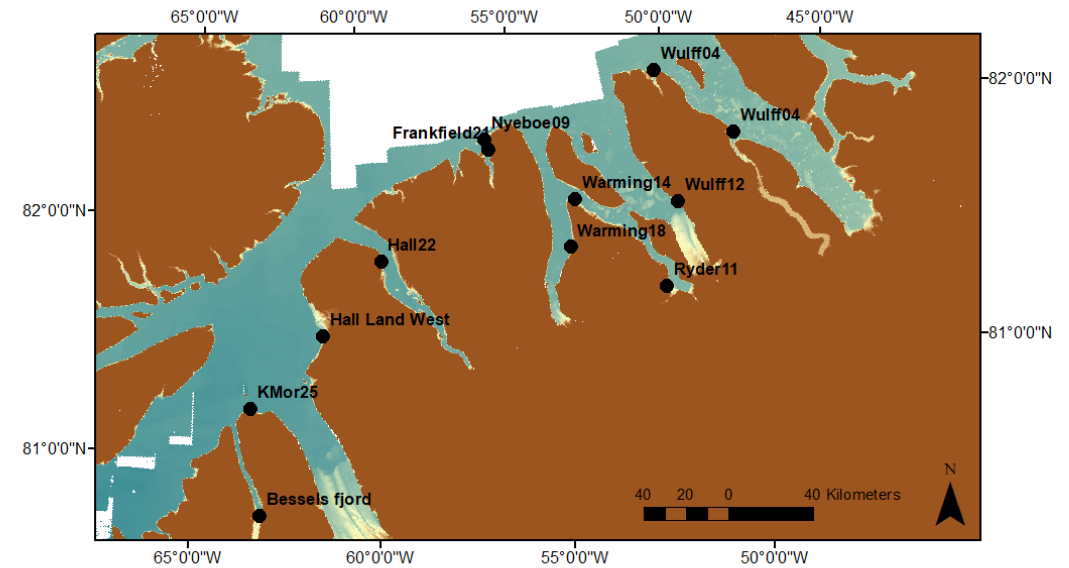
Direct Imaging of Calving Events



Land Teams: Sea Level through Clams....



Ryder_19 - Overview



Legend

- Sample Locations



“Dead Wood” Team – Driftwood

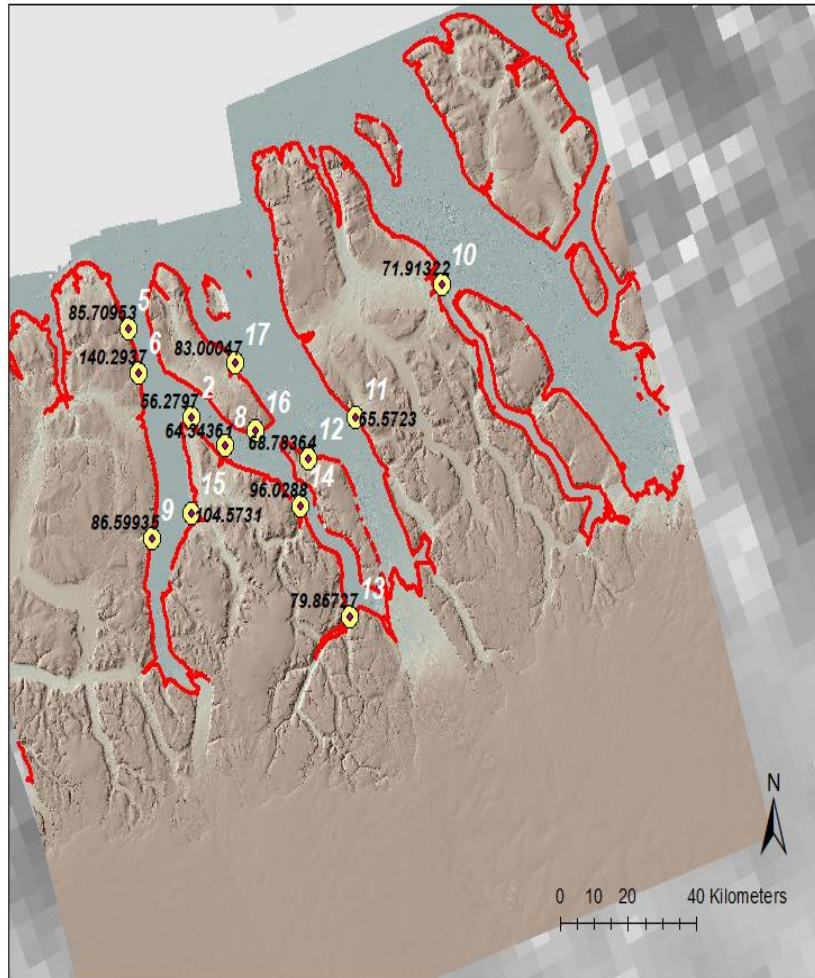


Figure 7. Driftwood. Clockwise from top left corner: Drifting wood (Hendrik Ø); The root end of a tree (Wulff Land); Whole log (cut) on the present beach (Warming Land); Partly buried driftwood at ca 15 m a.s.l. (Frankenfield Bugt)

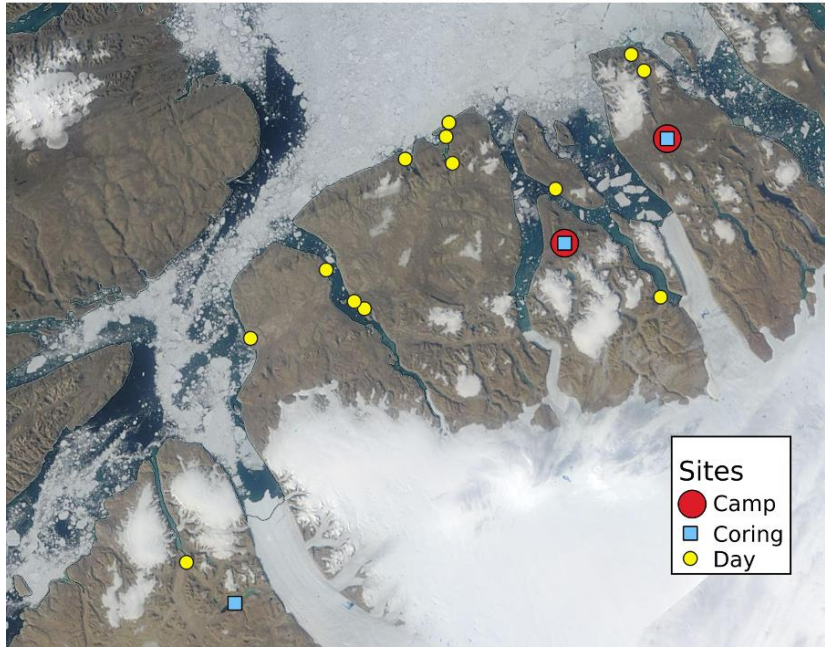


Figure 8. A driftwood disc prepared for measurement. This sample, collected on Hendrik Ø, grew between 1851 and 1955 along the Yenisei River in Russia.

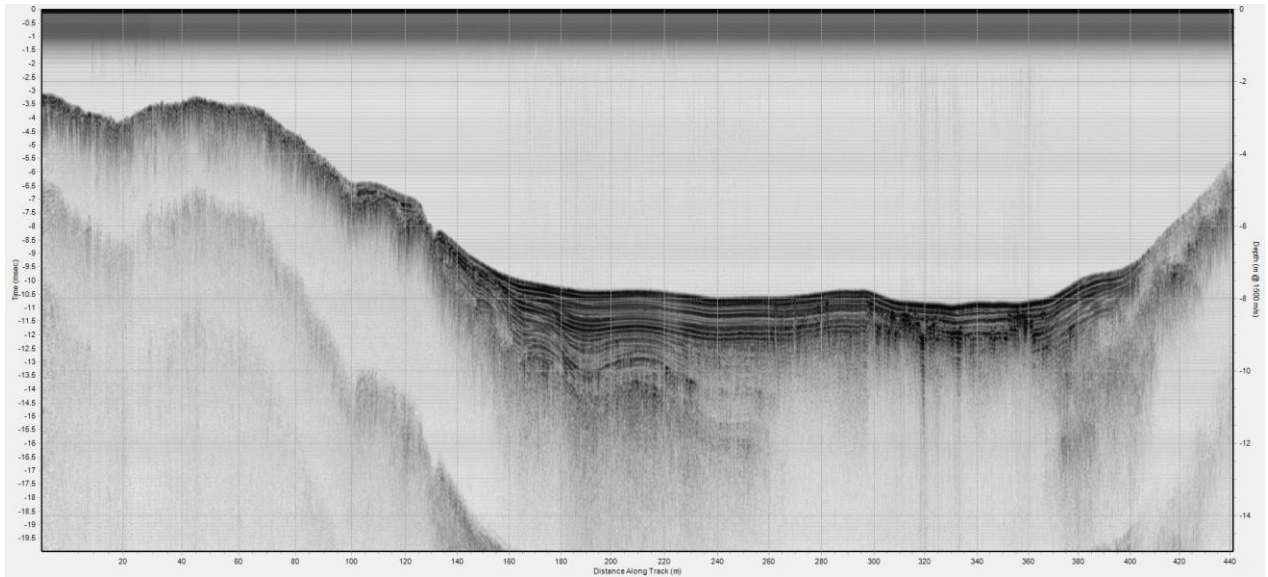
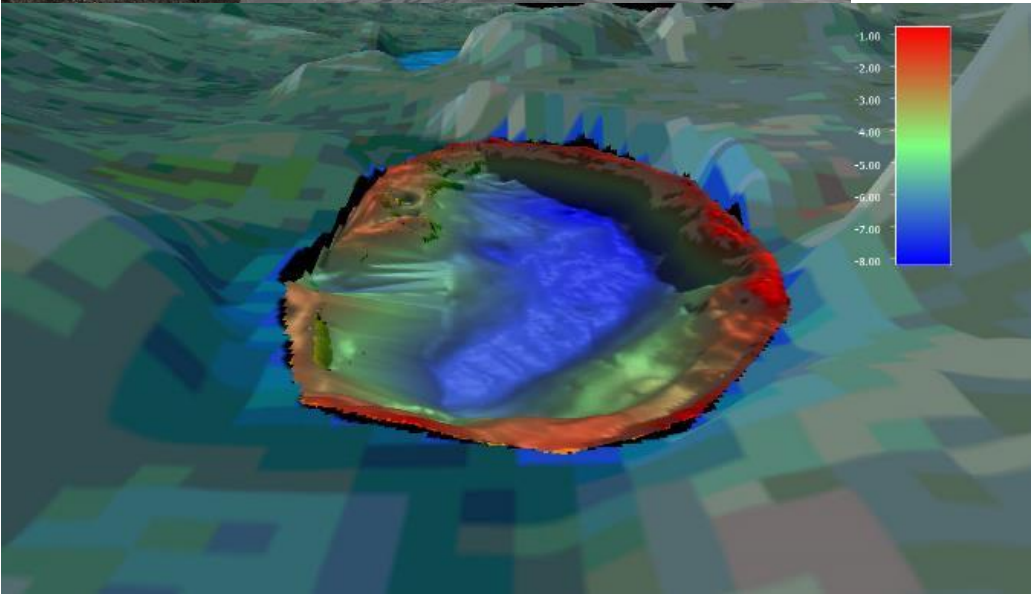
Archeology Team: Independence People 4000 yrs BP – Thule People 800 yrs BP



Lake Teams – DNA, Ecology, Paleoclimate

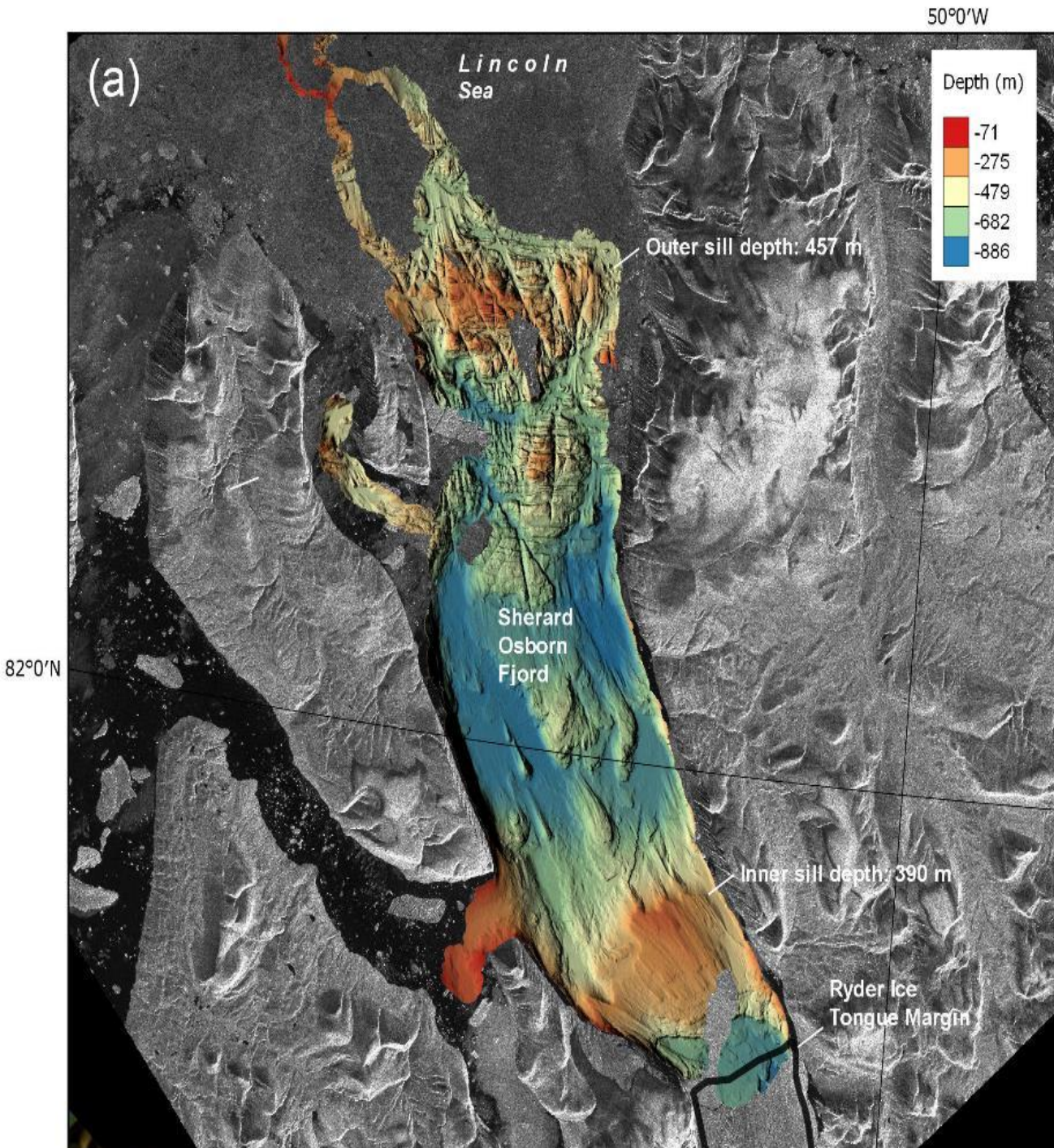


Lake Teams – Mapping and Subbottom Profiling in the Lakes

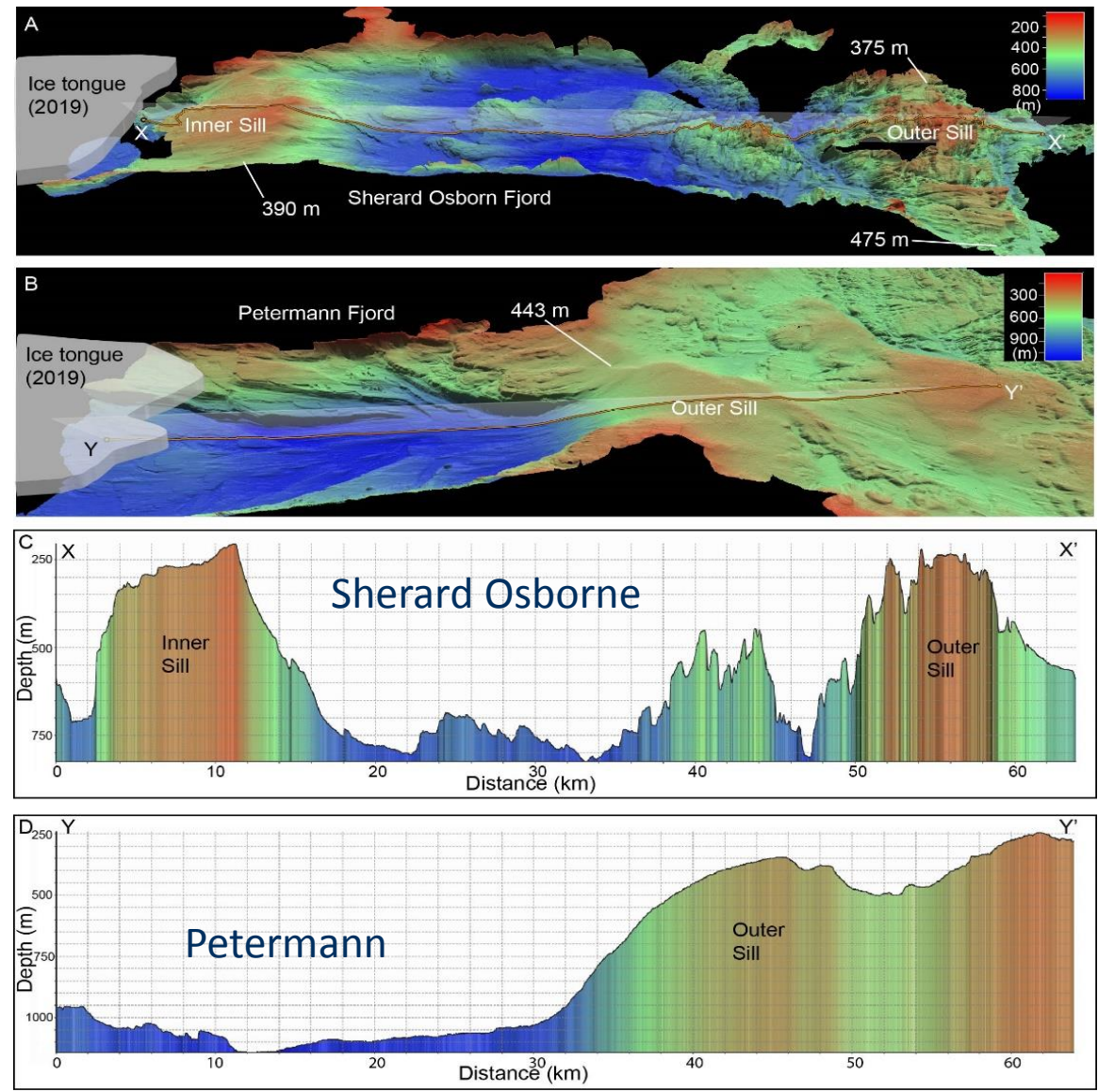


Mapping old shorelines and Helo-clamming!!!

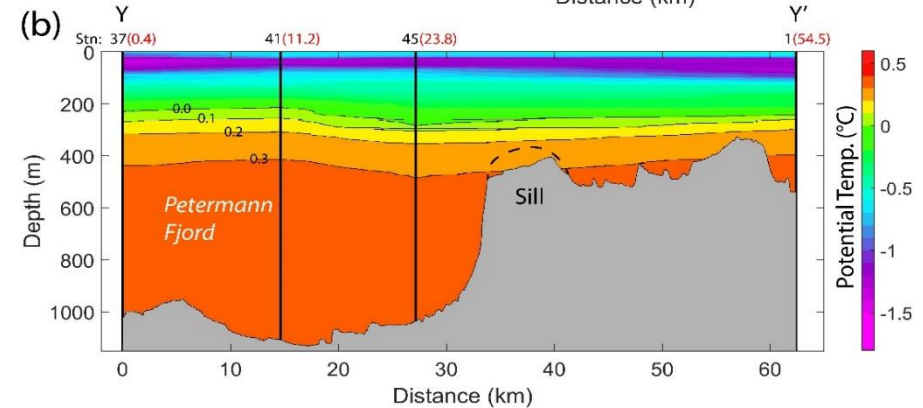
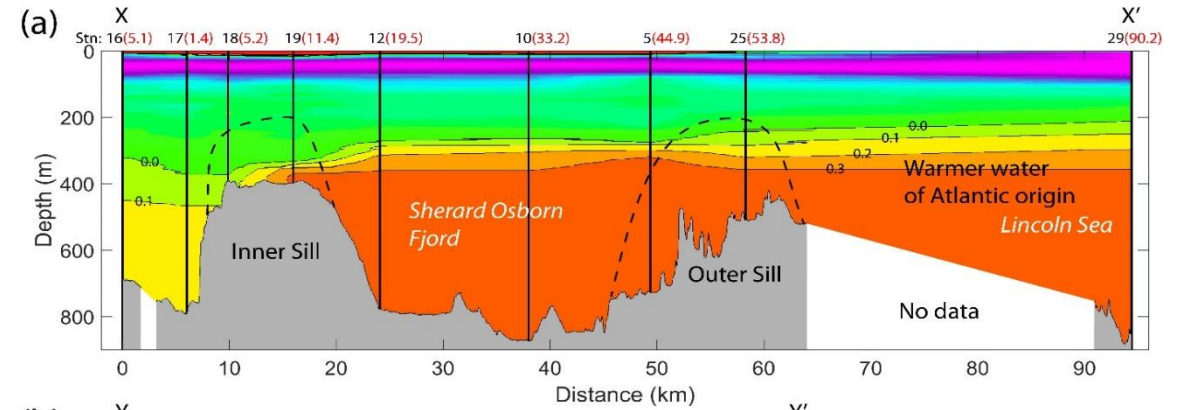
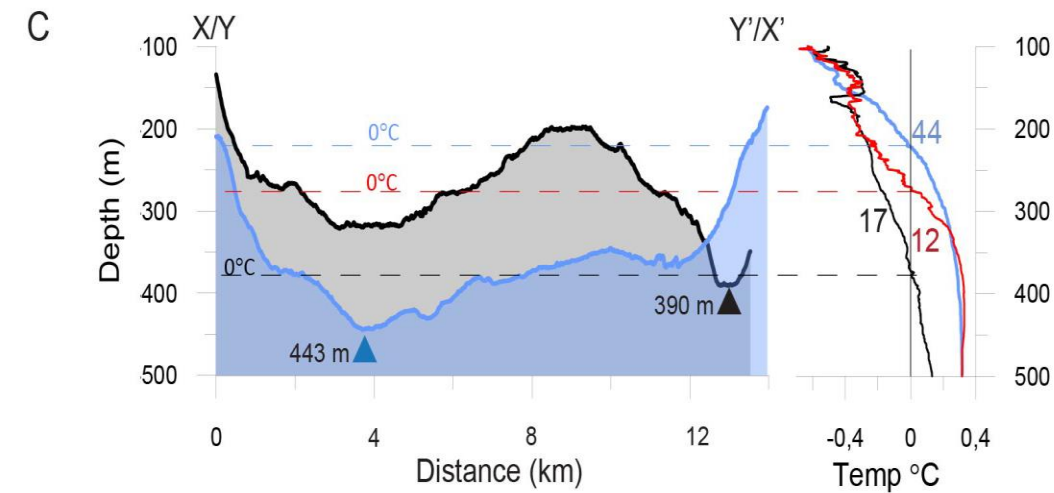
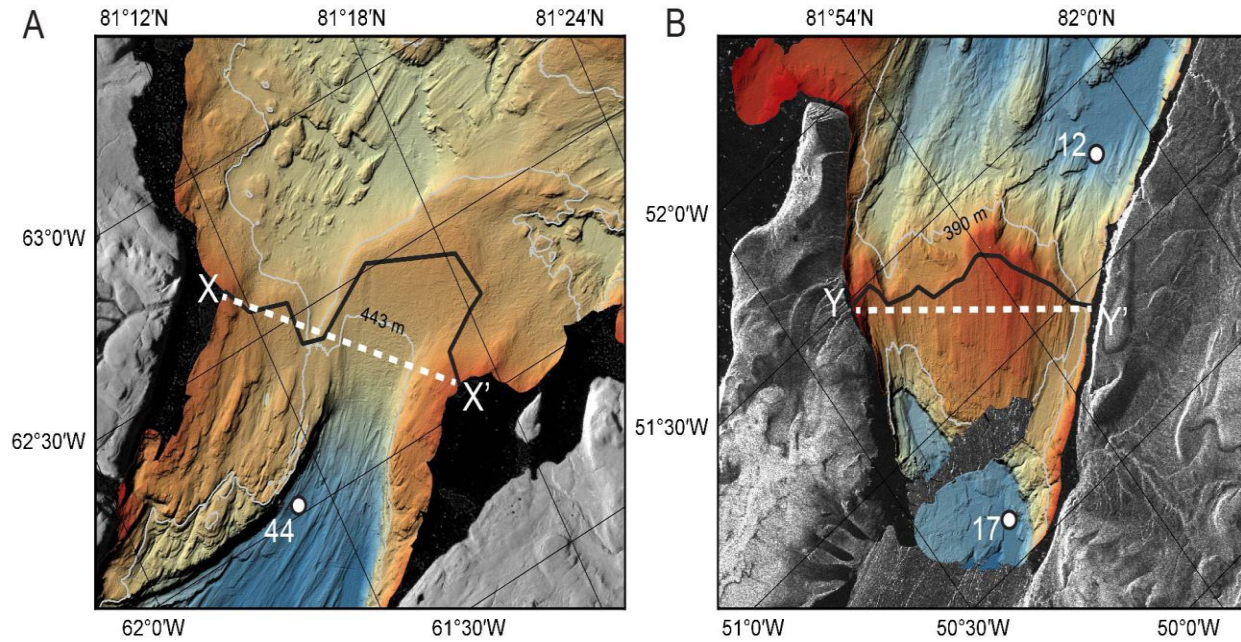


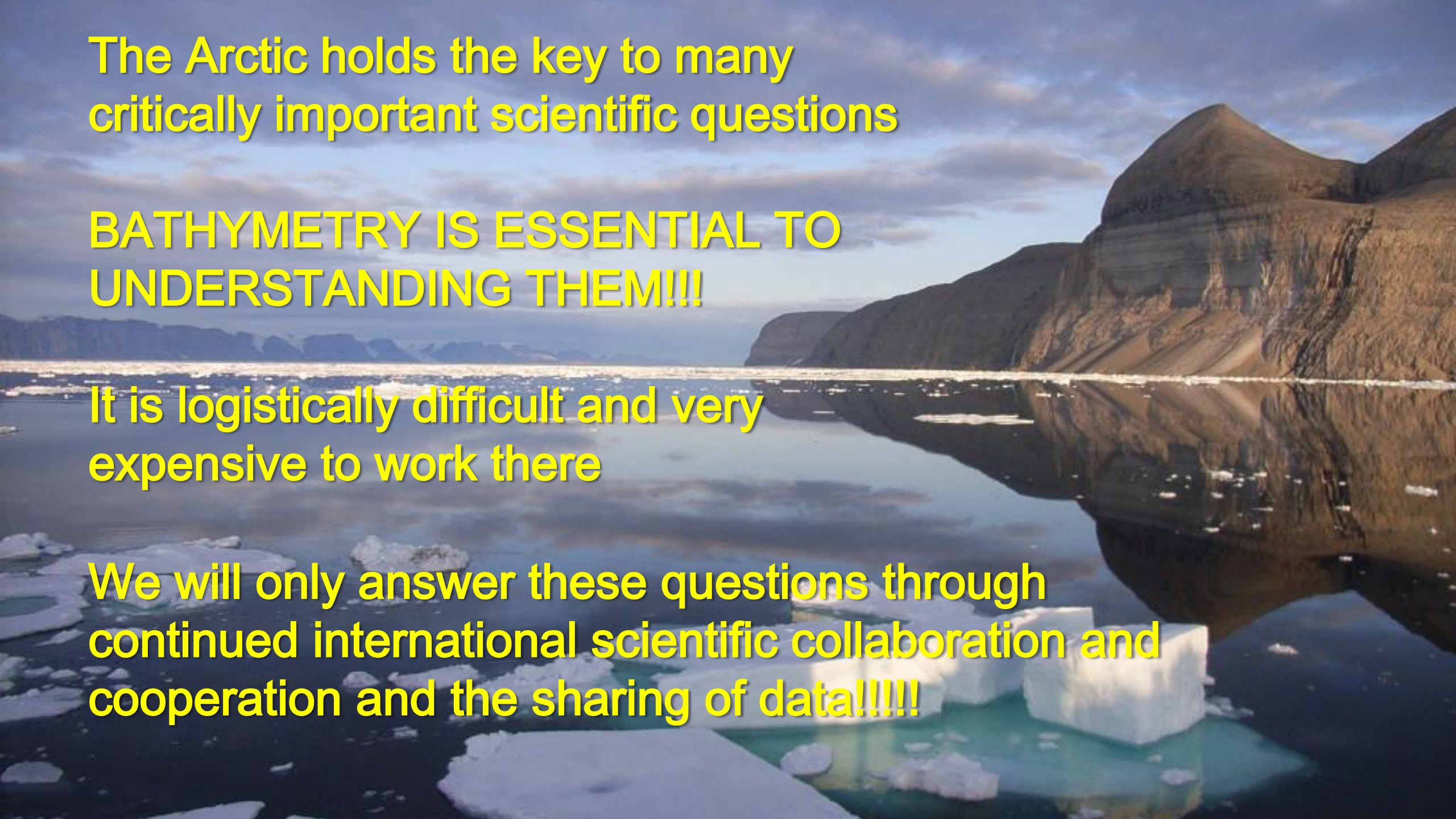


Near-complete mapping of Sherard-Osborne Fjord



Near-complete mapping of Sherard-Osborne Fjord Inner sill – preventing warm Atlantic Water from interacting with ice sheet



A scenic view of an Arctic coastline. In the foreground, several large, white icebergs float in the dark blue water. The middle ground shows a calm sea reflecting the sky and the surrounding landscape. In the background, there are dark, rugged mountains under a sky with soft, wispy clouds. The overall lighting suggests a late afternoon or early morning setting.

The Arctic holds the key to many critically important scientific questions

BATHYMETRY IS ESSENTIAL TO UNDERSTANDING THEM!!!

It is logistically difficult and very expensive to work there

We will only answer these questions through continued international scientific collaboration and cooperation and the sharing of data!!!!