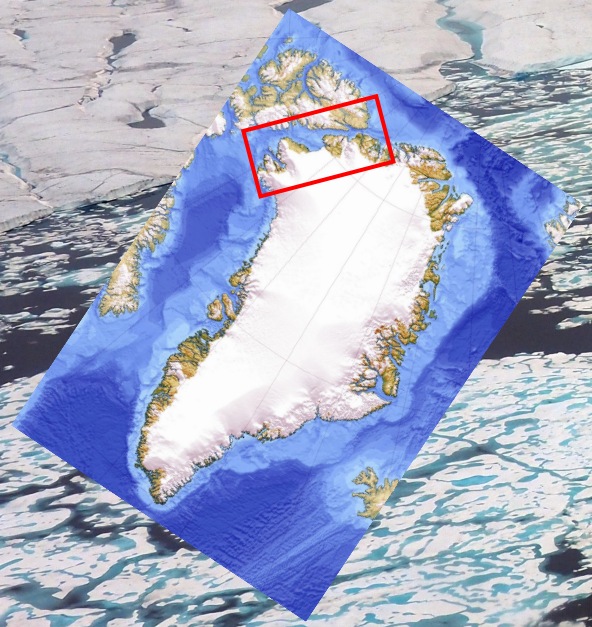
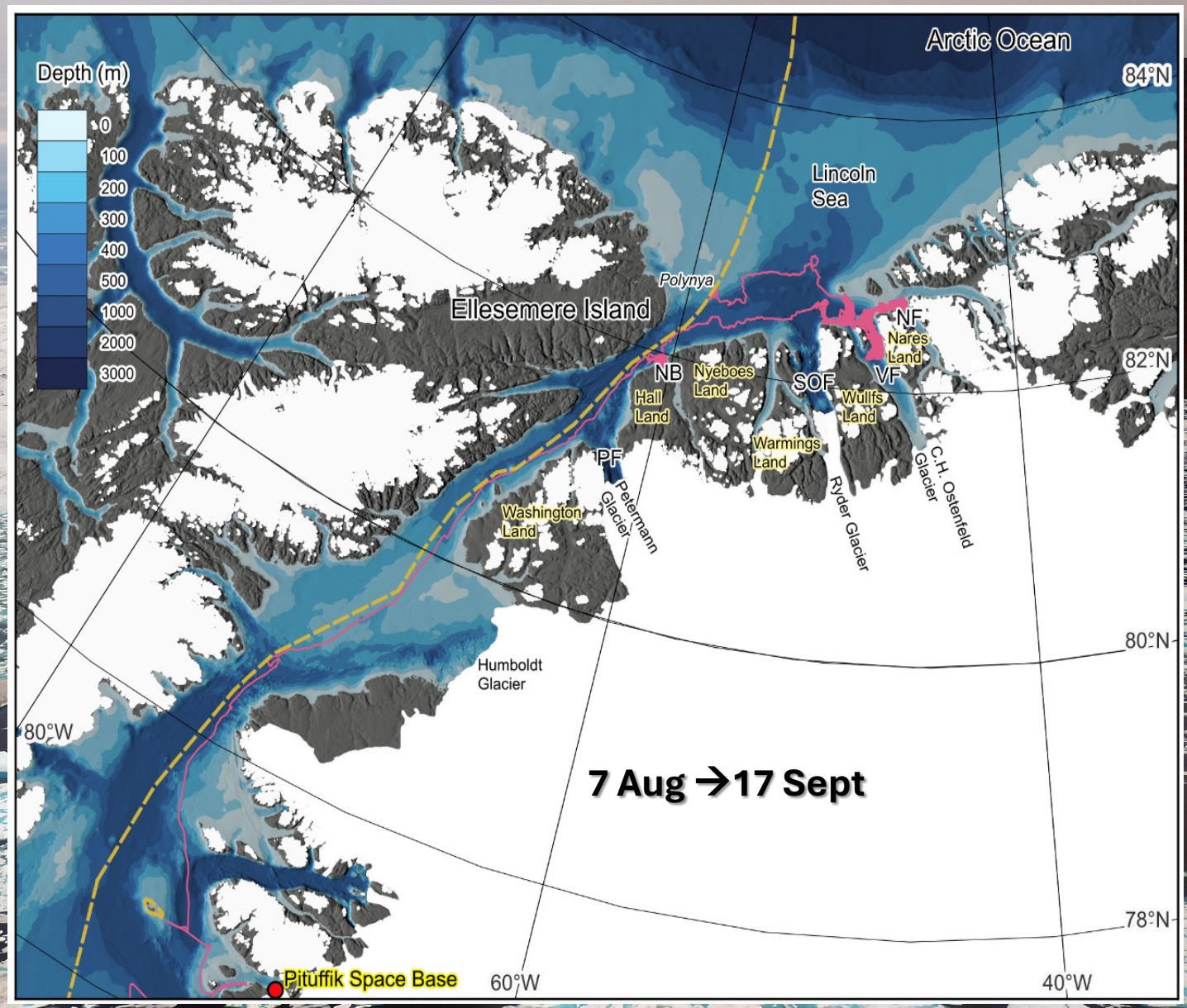
Mapping in Support of GEOEO24

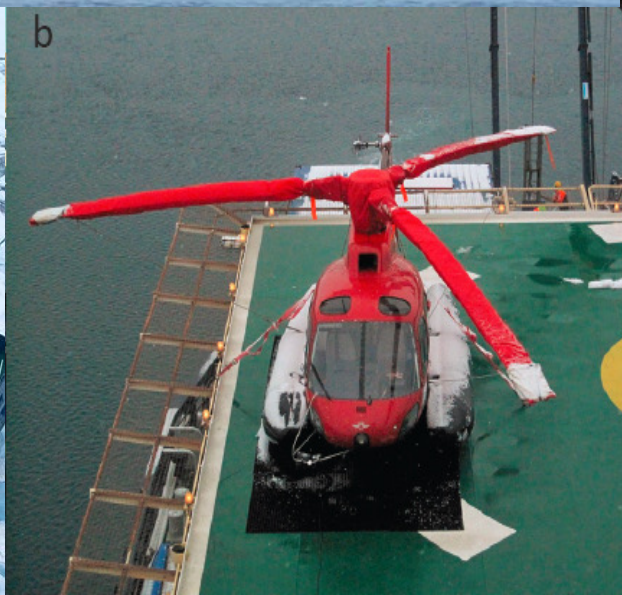


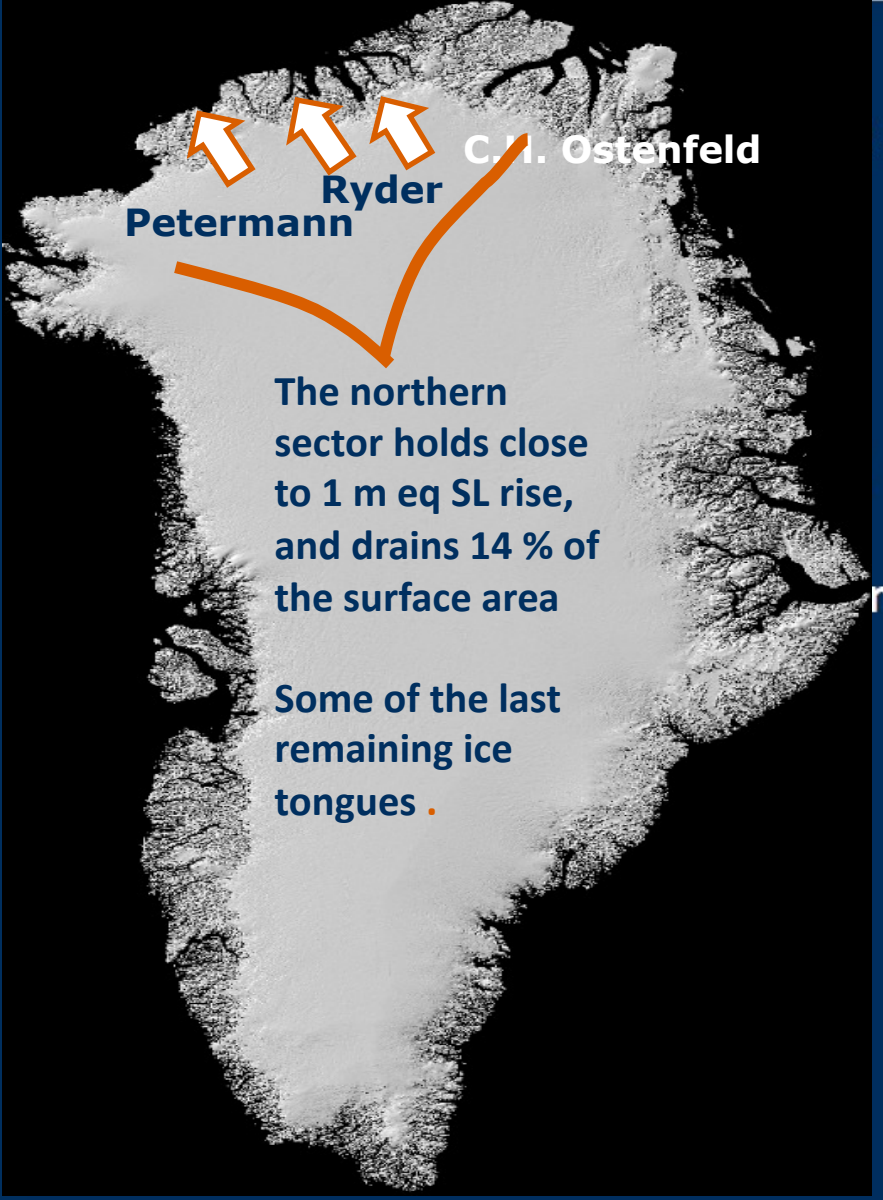


NORTH OF GREENLAND 2024 EXPEDITION
GEOEO • ODEN

- Length: 107.75 meters
- Beam: 31.20 meters
- Ice breaking capability: 1.9 meters of level ice at 3 knots
- Draught: 8.50 meters
- Air draught: 42.50 meters
- Displacement: 13,000 tons
- Top speed in open water: 16 knots
- Cruising speed: 11 knots
- Total power: 24,500 horsepower
- Main engines: 4x8 cylinder Sulzer ZA 40S
- Main propellers: 2 CPP
- Summer deadweight capacity: 4,906 tons

- Crew: ~22
- Science Party ~40
- SPRS ~ 12



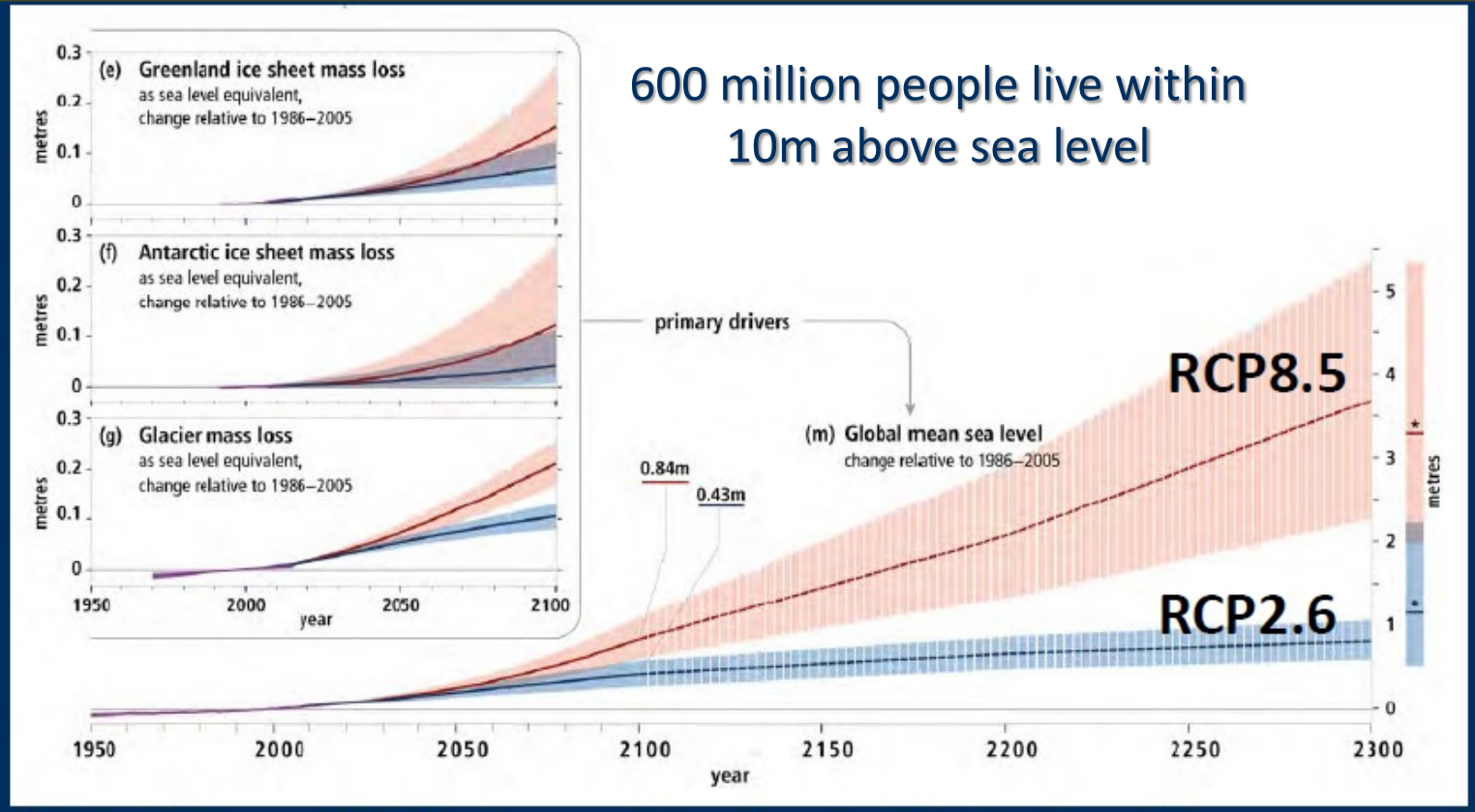


The northern sector holds close to 1 m eq SL rise, and drains 14 % of the surface area

Some of the last remaining ice tongues .

Greenland now largest contributor to global sea level rise -~.77mm/yr

600 million people live within 10m above sea level

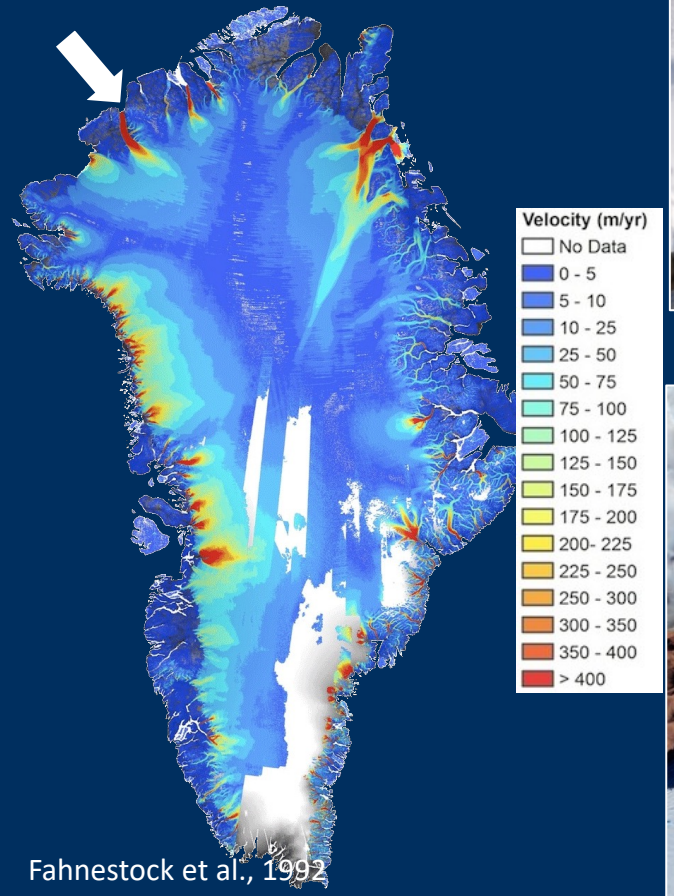


IPCC Special Report 2019: "The Ocean and Cryosphere in a Changing Climate"

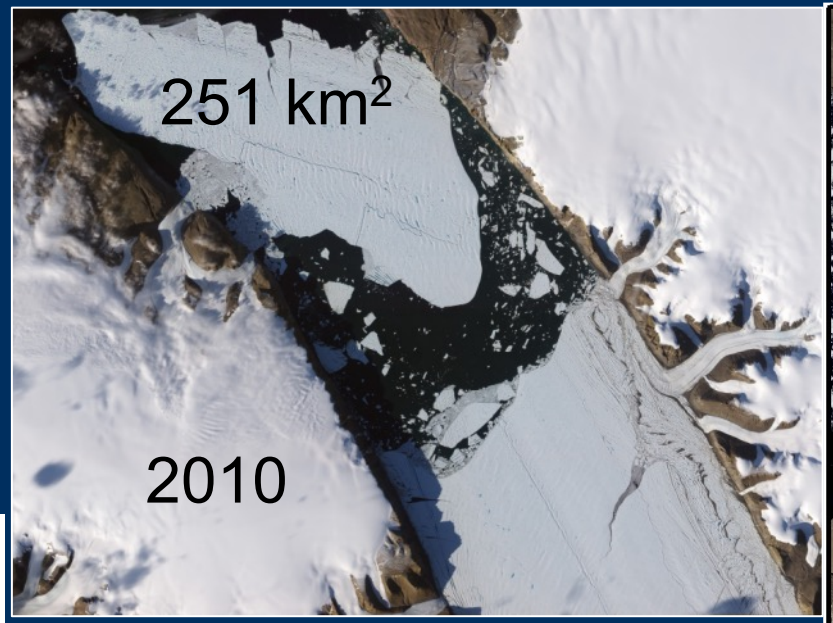
Greenland Ice Sheet = ~ 7.4 m of global SLR

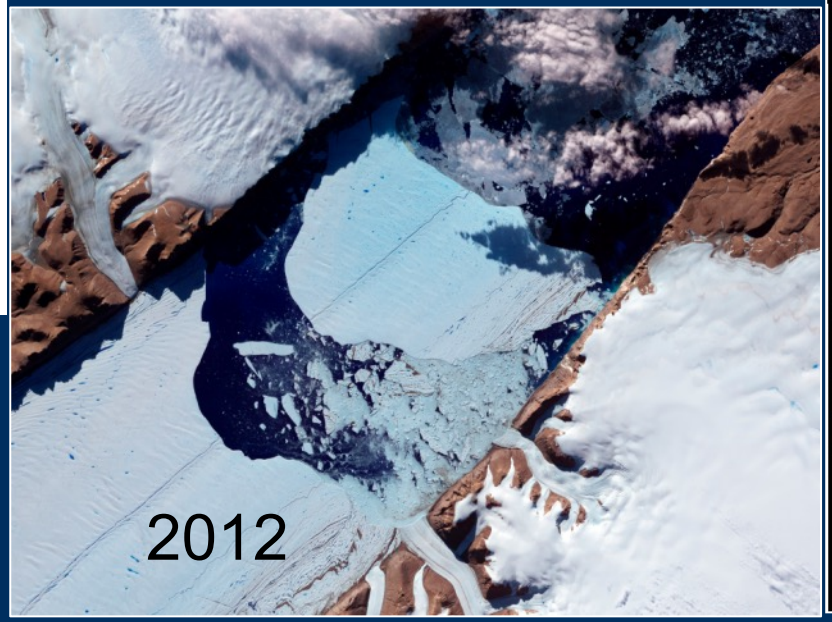
Peterman Glacier

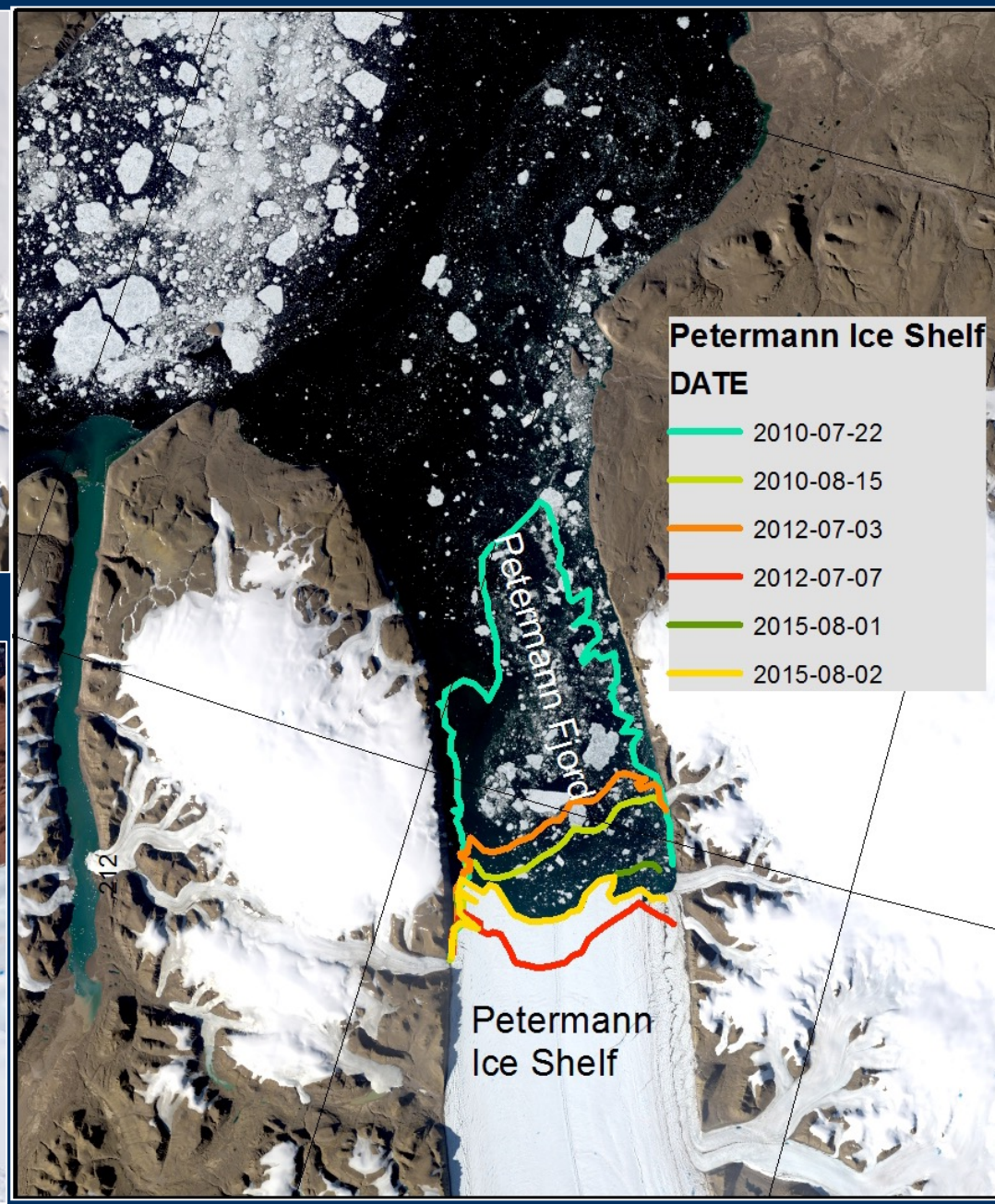
Has a floating ice tongue



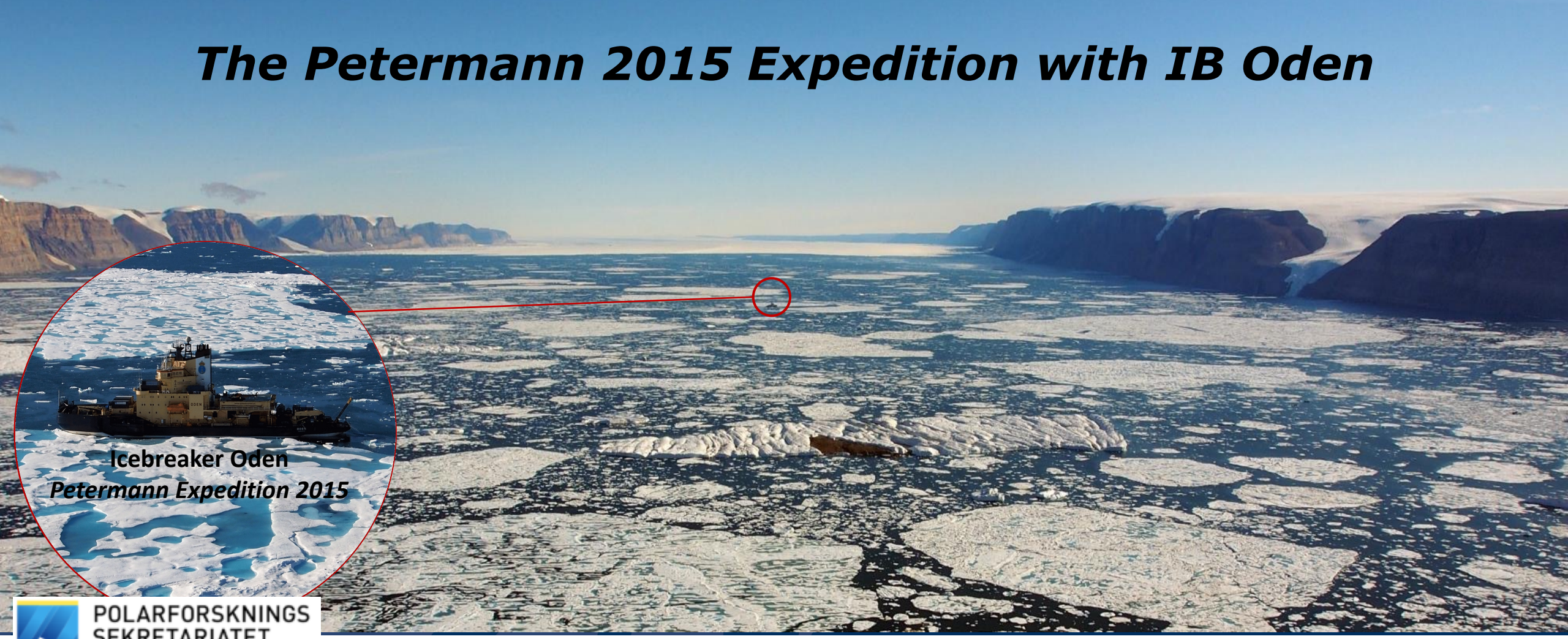
Fahnestock et al., 1992







The Petermann 2015 Expedition with IB Oden



POLARFORSKNINGS SEKRETARIATET
SWEDISH POLAR RESEARCH SECRETARIAT

Bolin Centre for Climate Research | Stockholm University

CCOM JHC

OSU Oregon State University

British Antarctic Survey

SOLIDUM PETIT IN PROFUNDIS · UNIVERSITAS ARHUSIENSIS

GEUS

INSTAAR

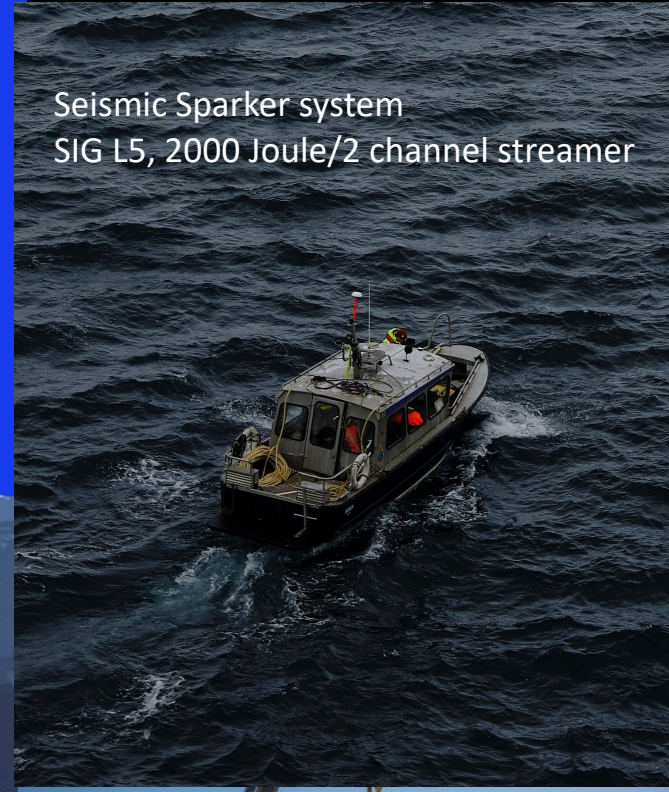
IB Oden echo sounders

ADCP, 75 kHz

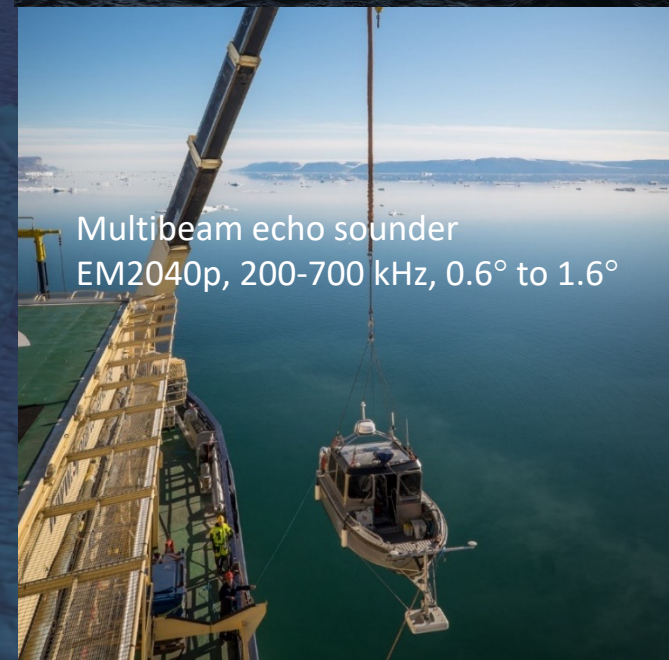
Split beam
EK 80, 18/38/70 kHz

Sub-bottom profiler
SBP 120, 2-7 kHz, 3°x3°

Multibeam echo sounder
EM 122, 12 kHz, 1°x1°

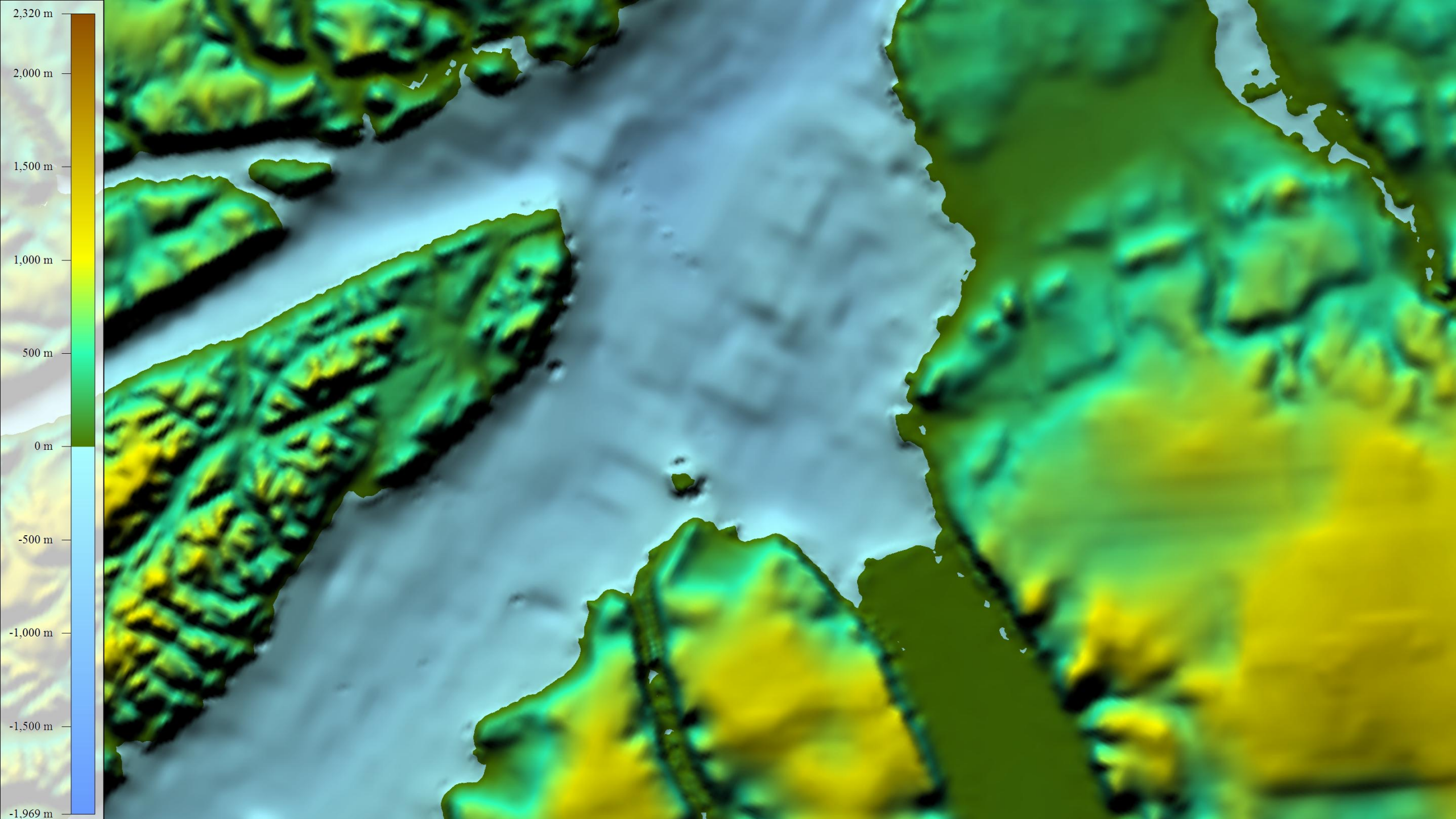


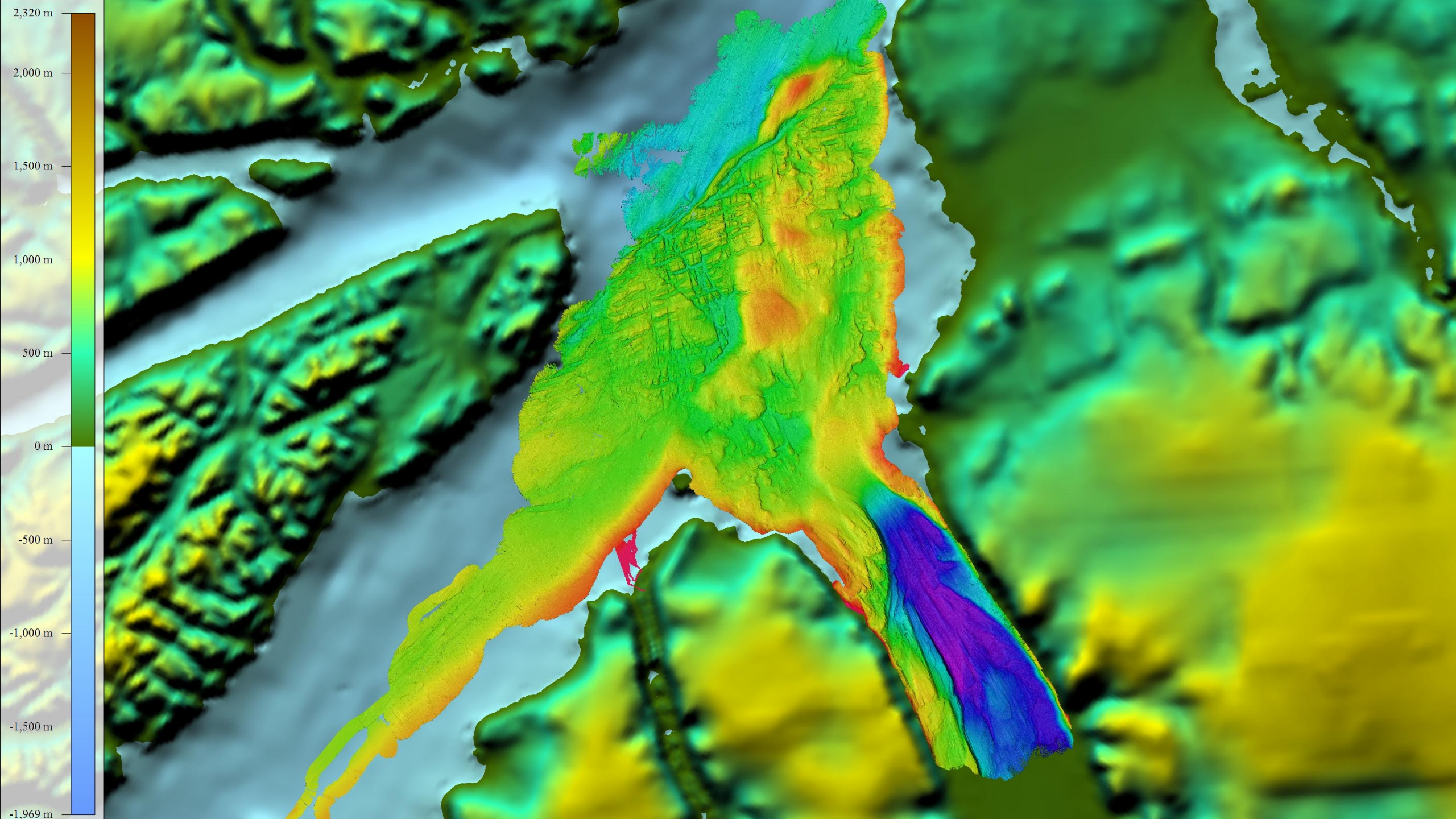
Seismic Sparker system
SIG L5, 2000 Joule/2 channel streamer

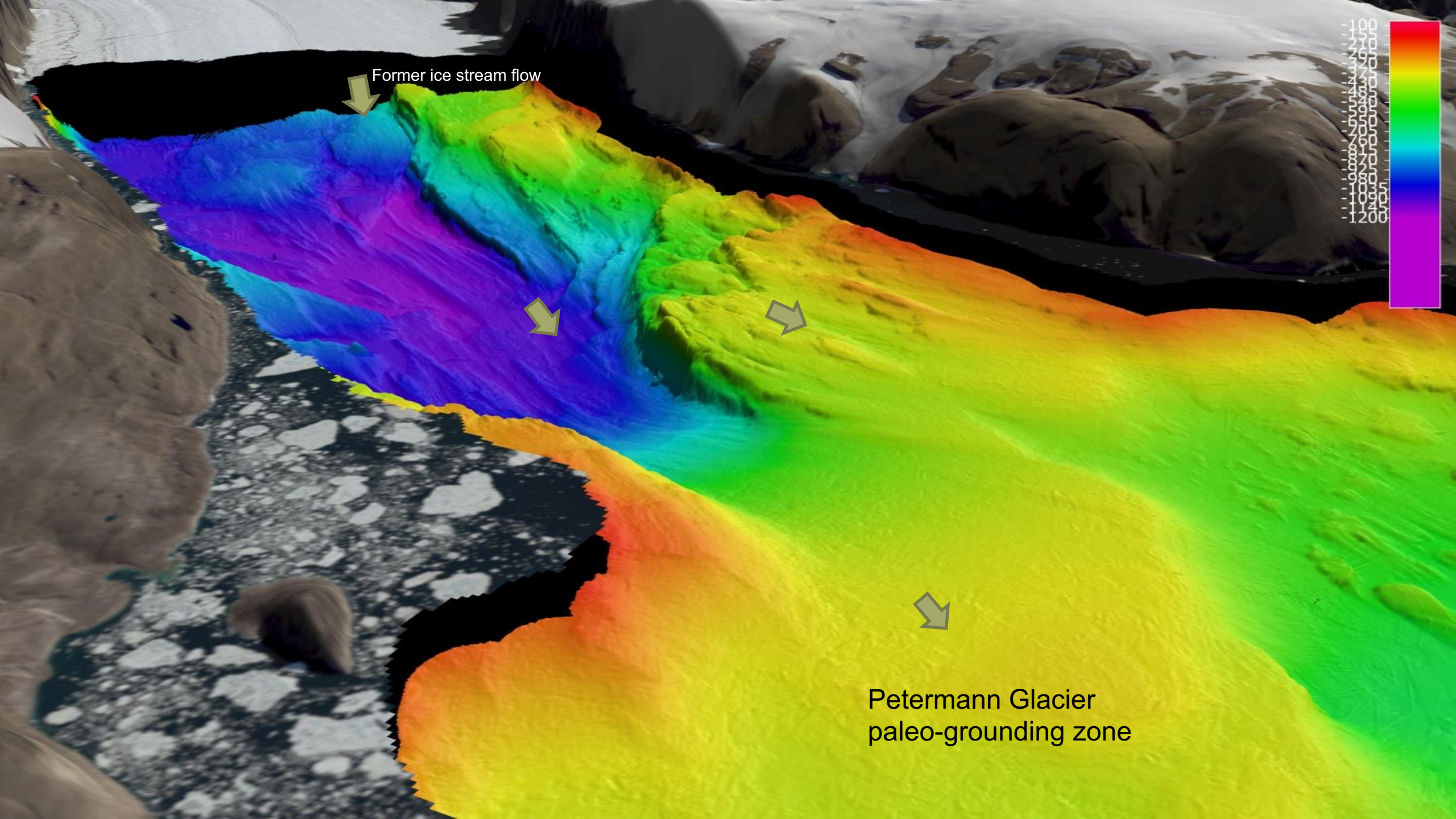


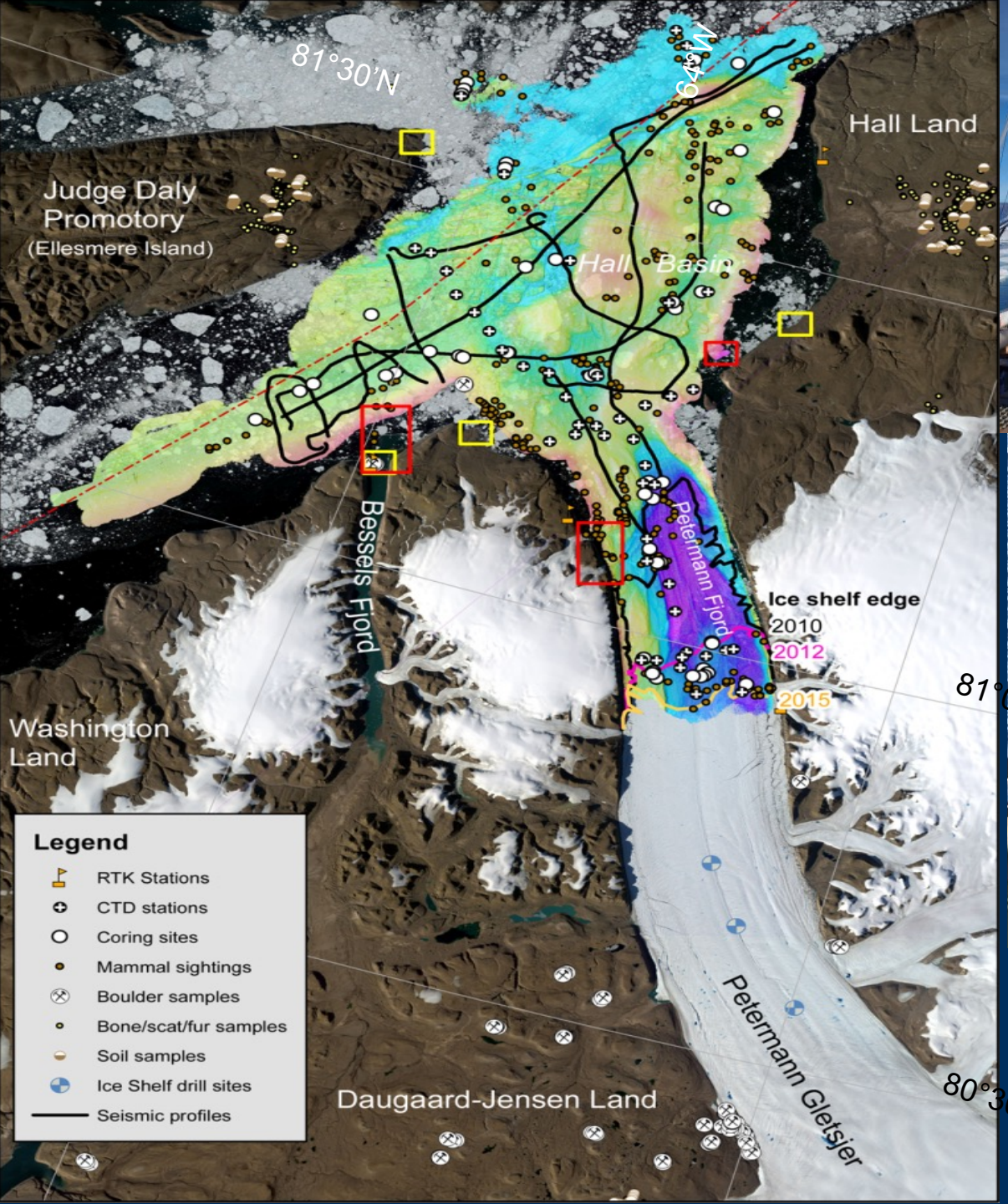
Multibeam echo sounder
EM2040p, 200-700 kHz, 0.6° to 1.6°

Vetenskapsrådet
Knut och Alice Wallenbergs Stiftelse
POLARFORSKNINGS SEKRETARIATET
SWEDISH POLAR RESEARCH SECRETARIAT
SJÖFARTSVERKET
Stockholm University


2,320 m
2,000 m
1,500 m
1,000 m
500 m
0 m
-500 m
-1,000 m
-1,500 m
-1,969 m


2,320 m
2,000 m
1,500 m
1,000 m
500 m
0 m
-500 m
-1,000 m
-1,500 m
-1,969 m


Former ice stream flow
Petermann Glacier
paleo-grounding zone



Stockholm University

Petermann Fjord

Ice stability zones

GSW: Ground Zone Wedge

GZW

nature COMMUNICATIONS

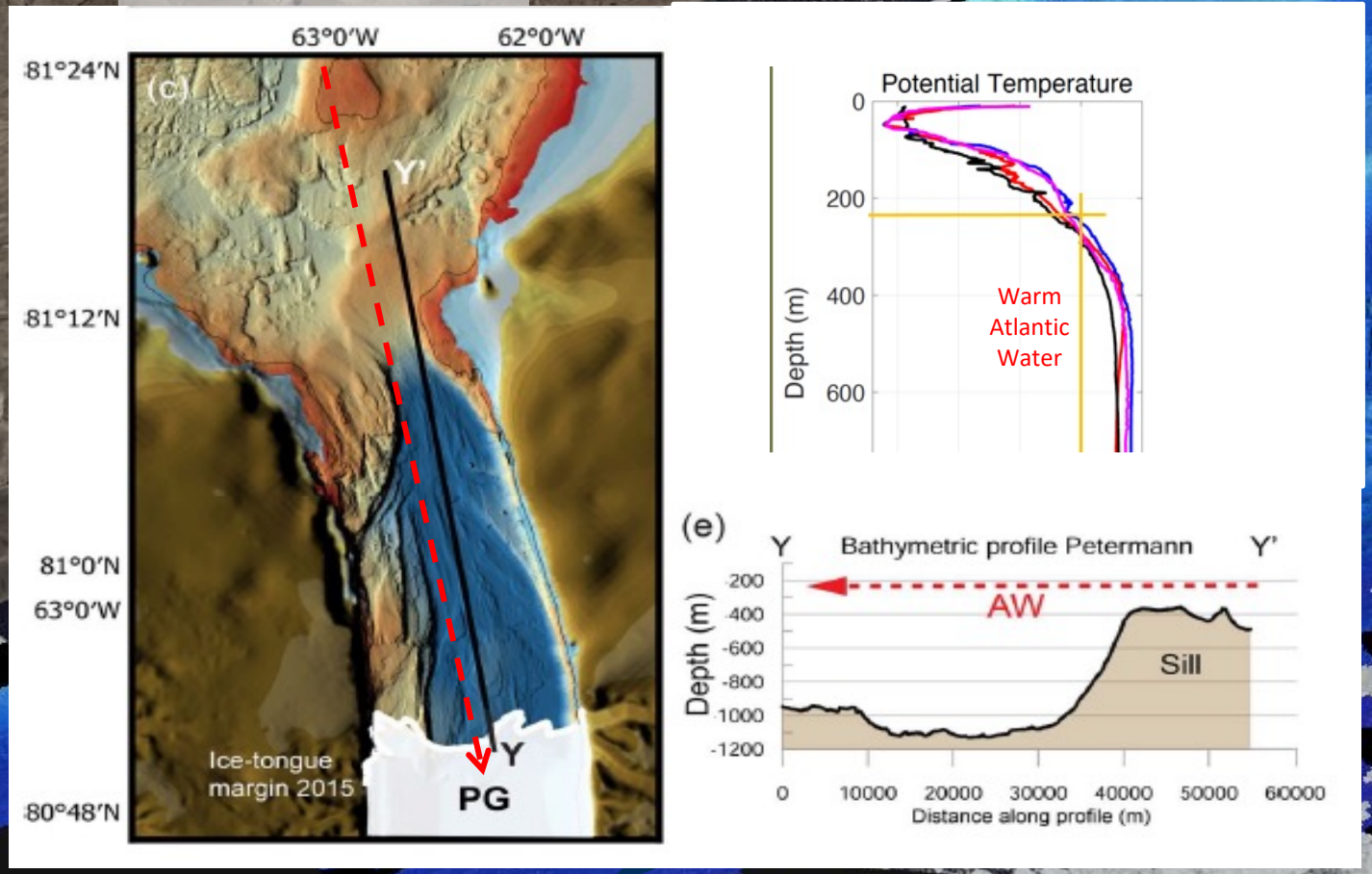
ARTICLE

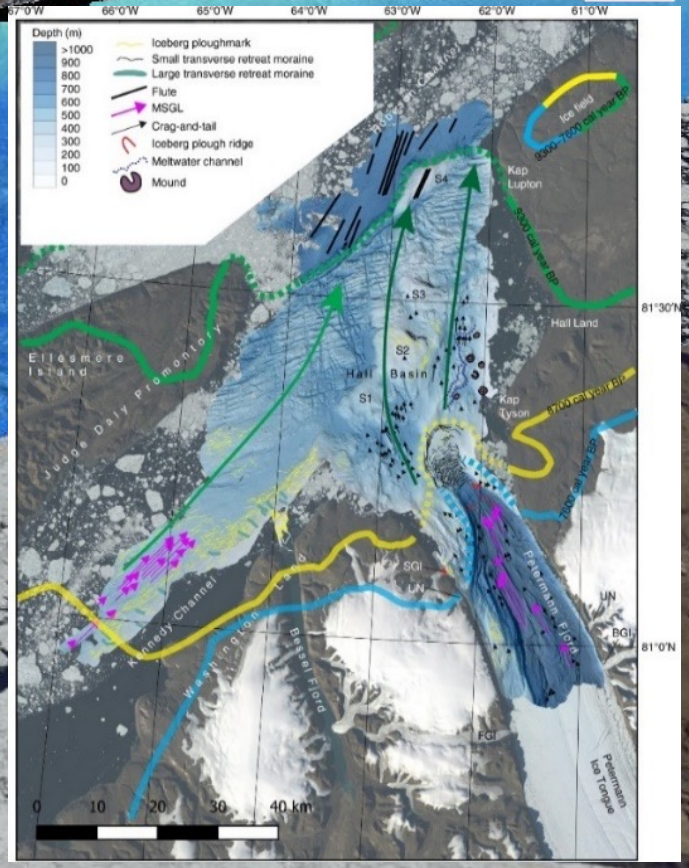
DOI: 10.1038/s41467-018-04573-2 OPEN

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

Martin Jakobsson[1,2], Kelly A. Hogan[3], Larry A. Mayer[4], Alan Mix[5], Anne Jennings[6], Joe Stoner[5], Björn Eriksson[1,2], Kevin Jerram[4], Rezwan Mohammad[1,2], Christof Pearce[7], Brendan Reilly[5] & Christian Stranne[1,2]

Sill: 443 m (Threshold for warm water inflow)



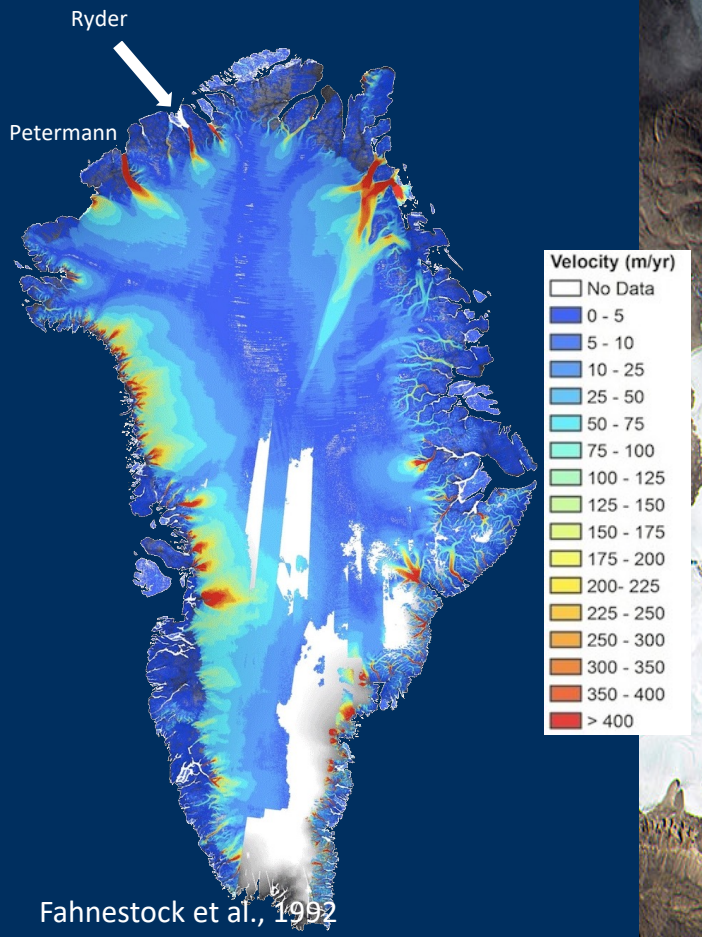


Ryder Glacier

Has a floating ice tongue

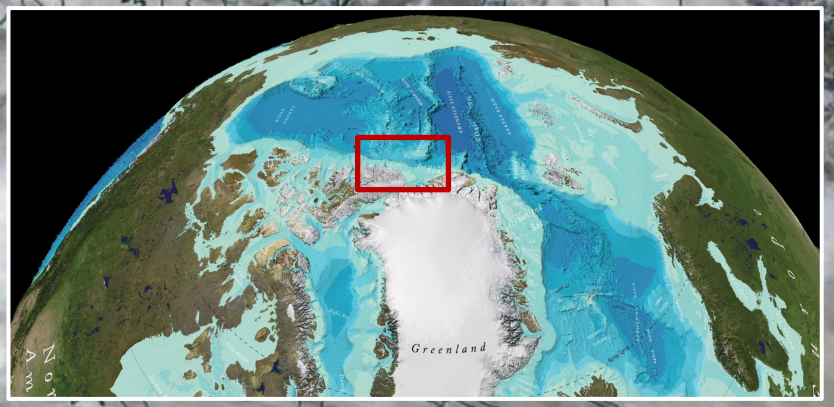
Is a surge type glacier

Was first surveyed by Lauge Koch in 1917



Fahnestock et al., 1992

NORTHERN GREENLAND
RYDER 2019 EXPEDITION
ICEBREAKER ODEN



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

Lincoln Sea

Stephensons Ö

Henriks Ö

Ryder Glacier

C.H. Ostendfeld Glacier

Petermann Glacier

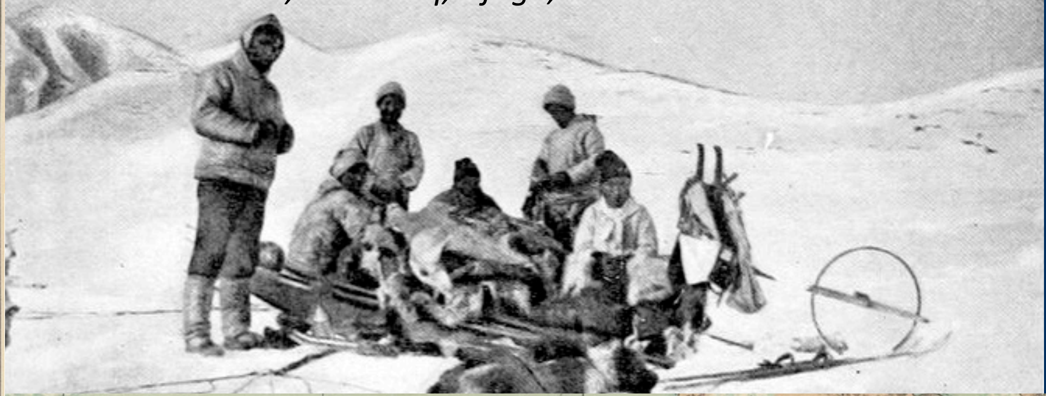
Humboldt Glacier

Nares Strait

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

MODIS: 23 August, 2019

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



Ryder 2019 Expedition

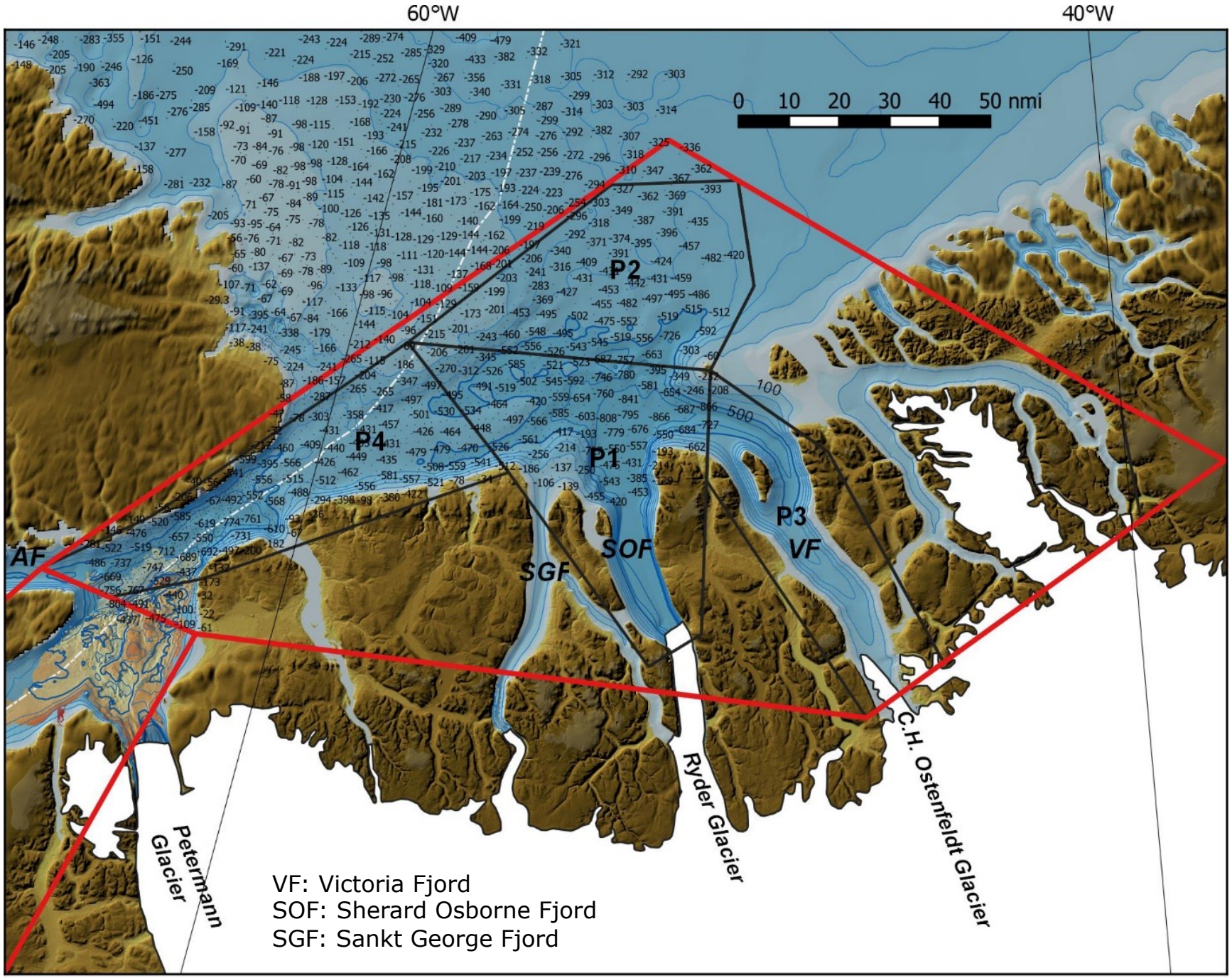
NORTHERN GREENLAND
RYDER 2019 EXPEDITION
ICEBREAKER ODEN

Co-Chief Scientists
Martin Jakobsson, Stockholm University, Sweden
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

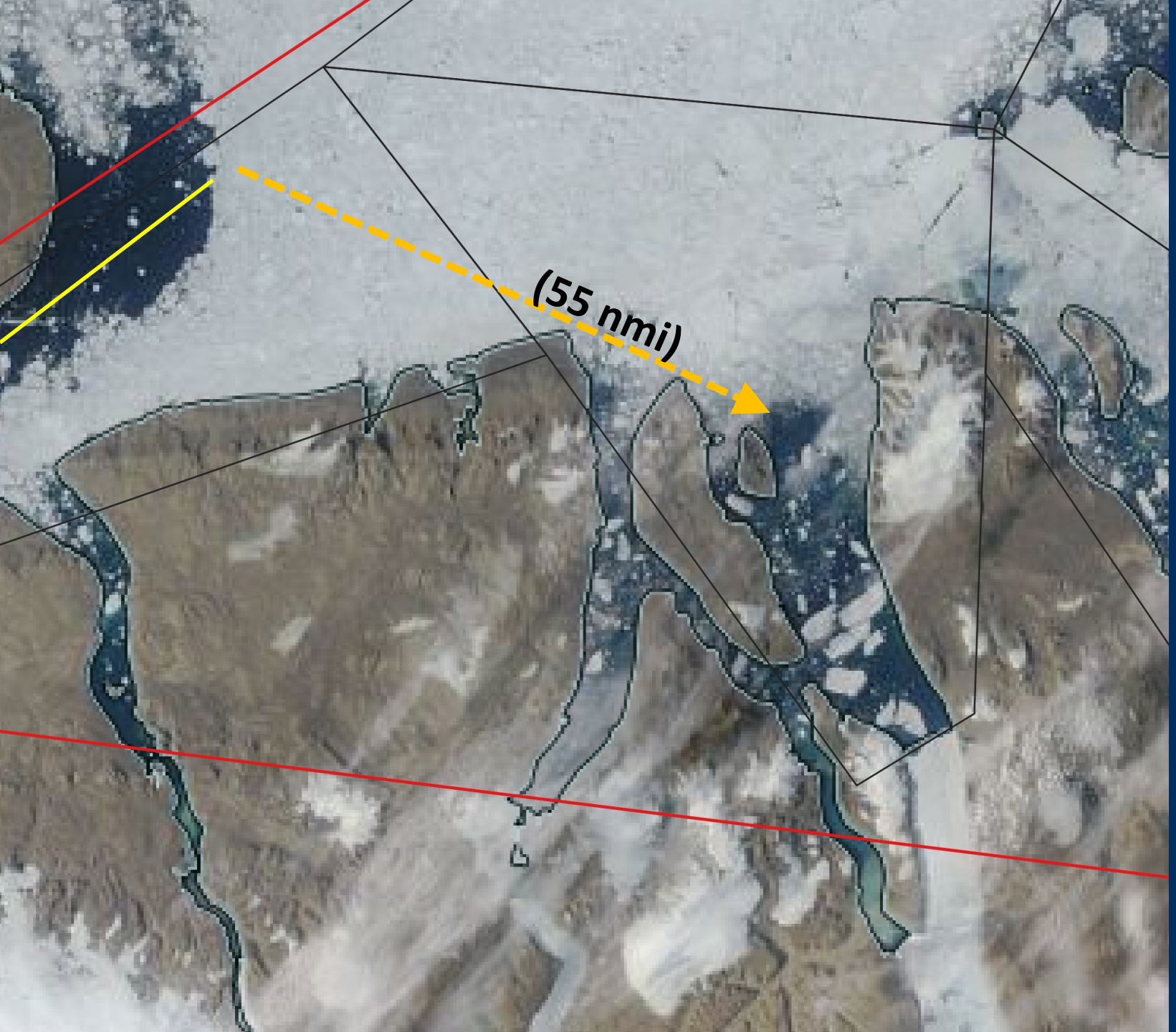
Bolin Centre for Climate Research
Stockholm University
University of New Hampshire
CCOM JHC
OSU Oregon State University
Solidum petit in profundis Universitas Arhusiensis
University of Gothenburg
MEMORIAL UNIVERSITY
USGS science for a changing world
USARC United States Arctic Research Commission
An independent agency that advises the President and Congress on domestic and international Arctic research through recommendations and reports
POLARFORSKNINGS SEKRETARIATET
SWEDISH POLAR RESEARCH SECRETARIAT



NORTHERN GREENLAND
RYDER 2019 EXPEDITION
ICEBREAKER ODEN

Completely **uncharted waters and sea ice conditions are big challenges!**

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

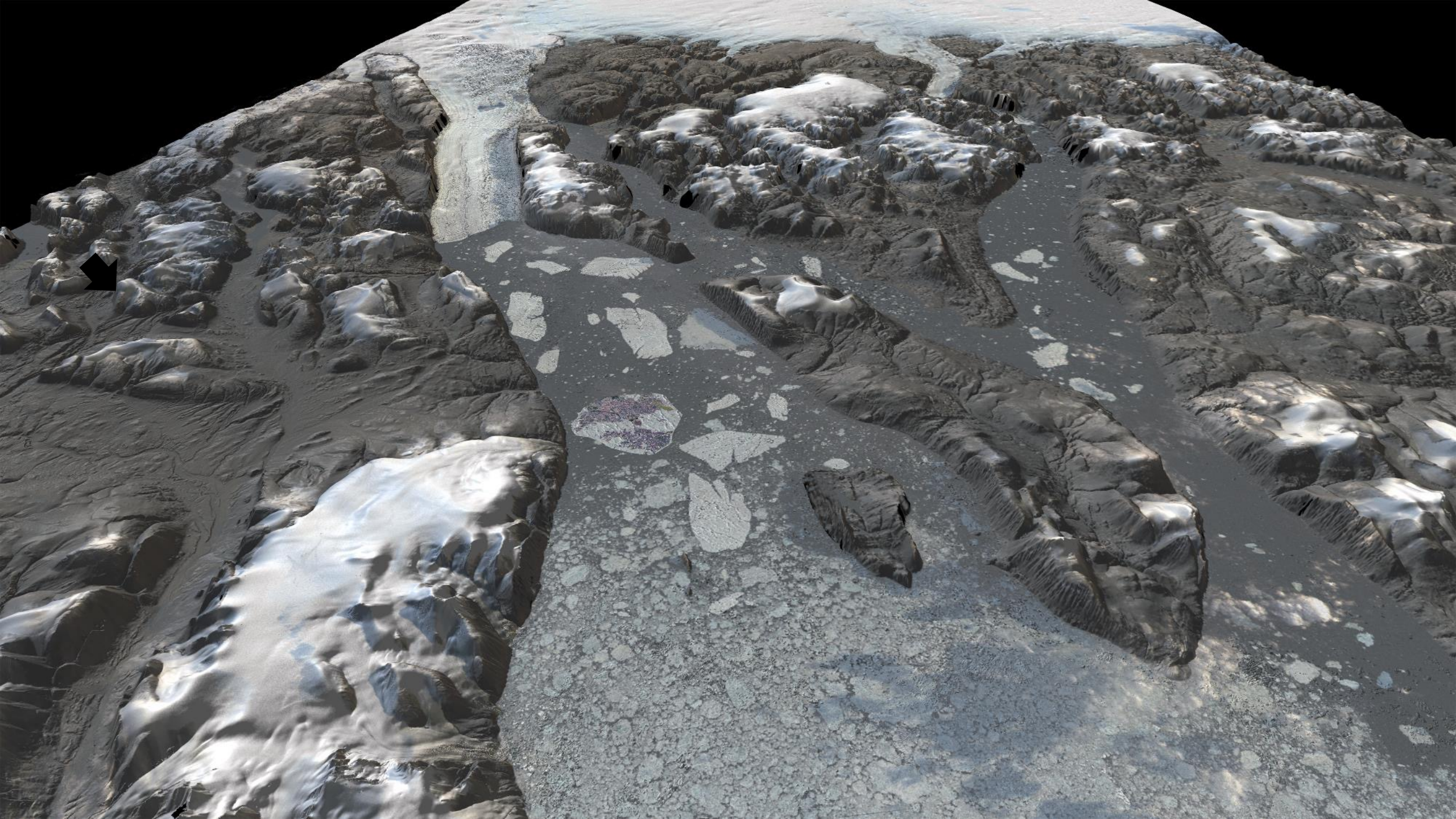


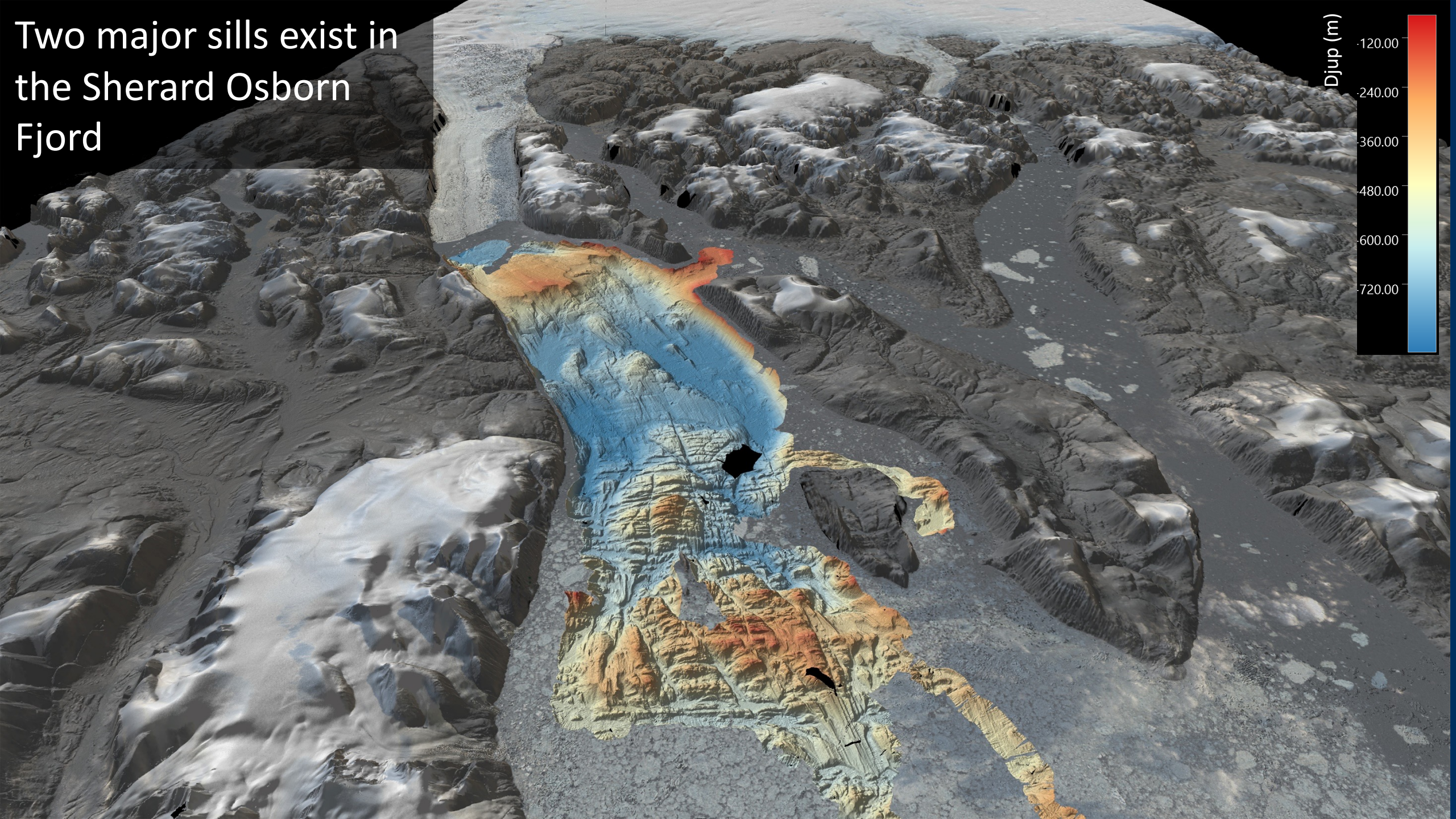
NORTHERN GREENLAND
RYDER 2019 EXPEDITION
ICEBREAKER ODEN

Helo recon multiples times per day

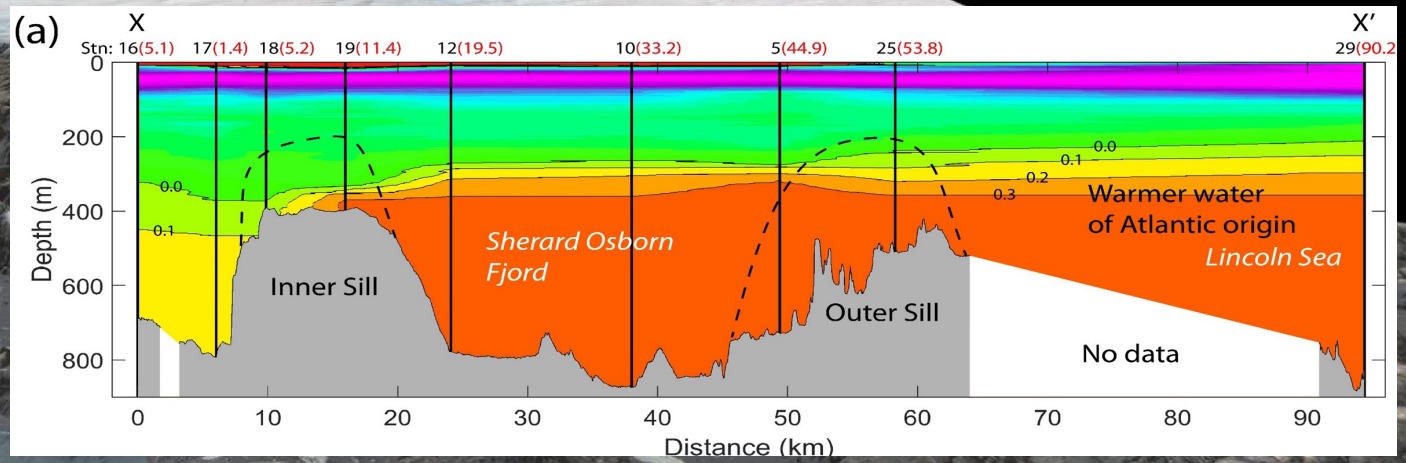
About 3 days to get to entrance

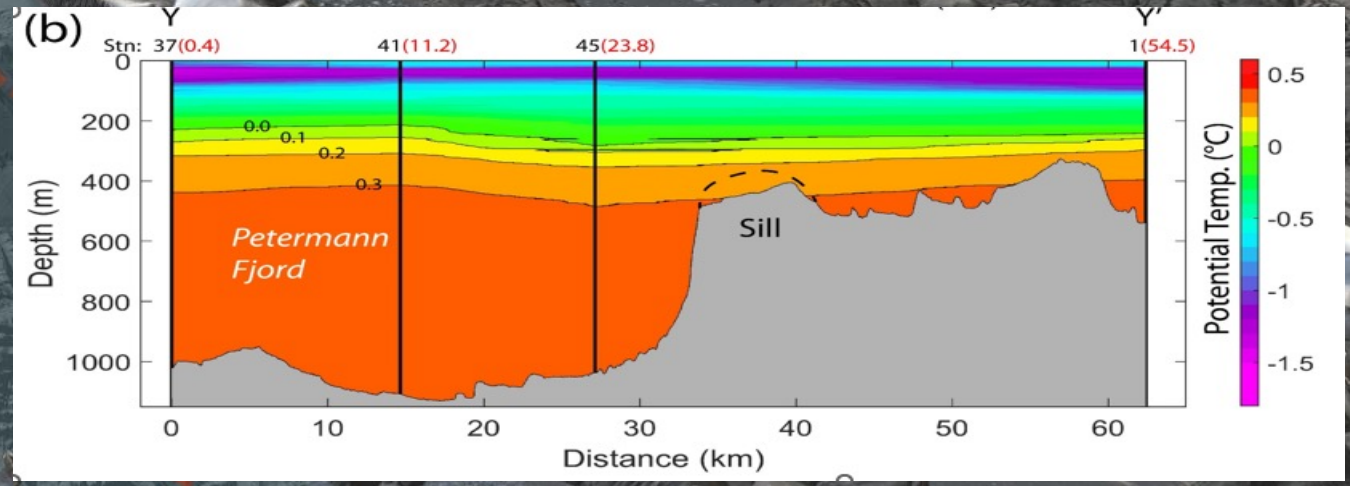
Stockholm University




Two major sills exist in the Sherard Osborn Fjord
Djup (m)
-120.00
-240.00
-360.00
-480.00
-600.00
-720.00

Temperature measurements show the shielding effect of the sill





50°W

82°N

NARES

VICTORIA

FJORD

LAND

C. H. OSTENFELDS

GLETSCHER

DE GEERS

LAND

Second Thule Expedition 1916-1918

Knud Rasmussen, Lauge Koch, Thorild Wulff †, Henrik Olsen†, *Inukitsoq, Ajago, Nasaitordluarsuk*

1917

45°W

50°W

82°N

Ice tongue

CH Ostenfeld Glacier

2002-07-31

45°W

50°W

82°N

CH Ostenfeld Glacier

2019-08-10

45°W

Participants and collaborative partners

North of Greenland 2024 Expedition…..

Swedish Military Herc Flight to Pituffik 5 Aug 2024

GEOEO Mapping Program:

WP Remotely Operated Mapping

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

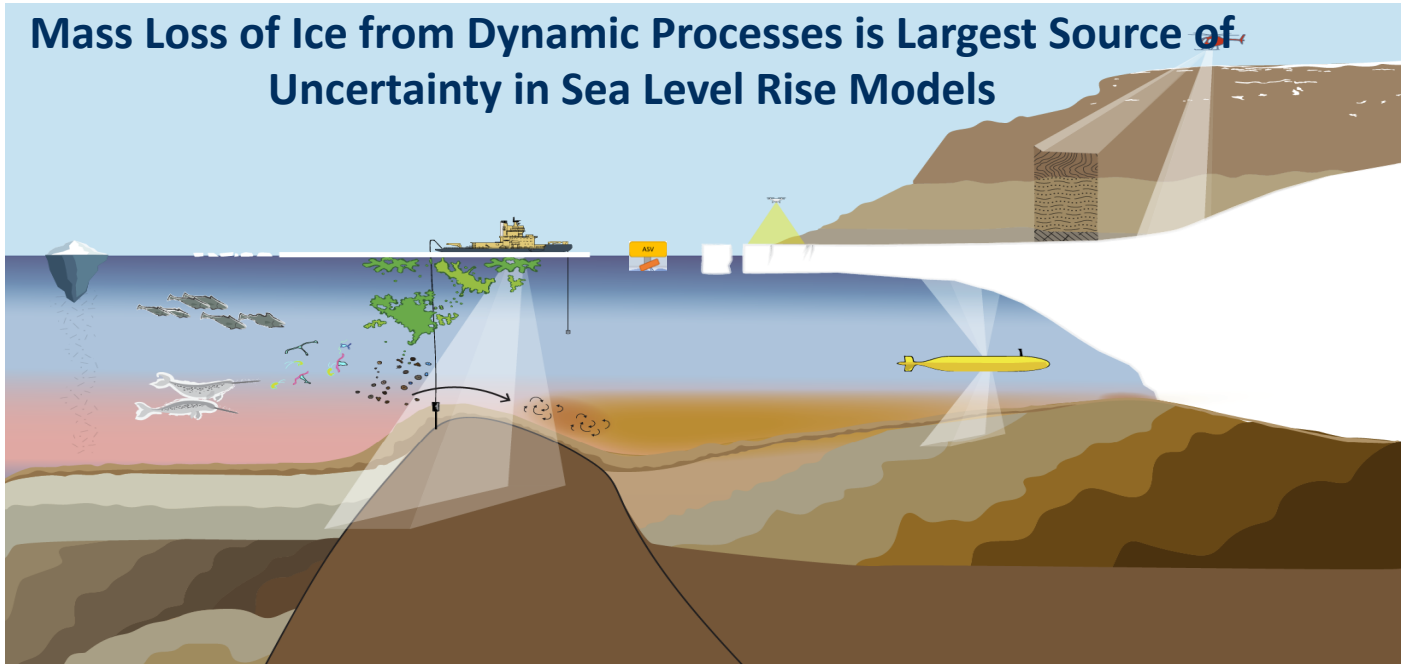
Ship length: 6.4 m
Multibeam:
KM EM2040, 1°x1°, 200-400 kHz
(Depth range: 0.5-550 m)

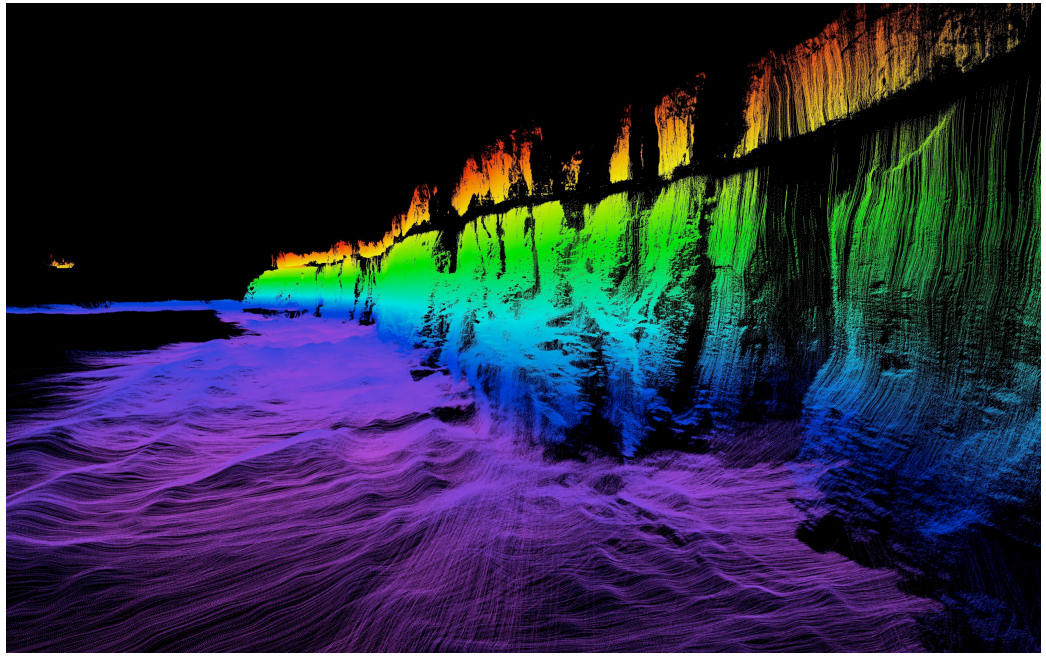
Sub-bottom profiler:
EA 600, 15 kHz

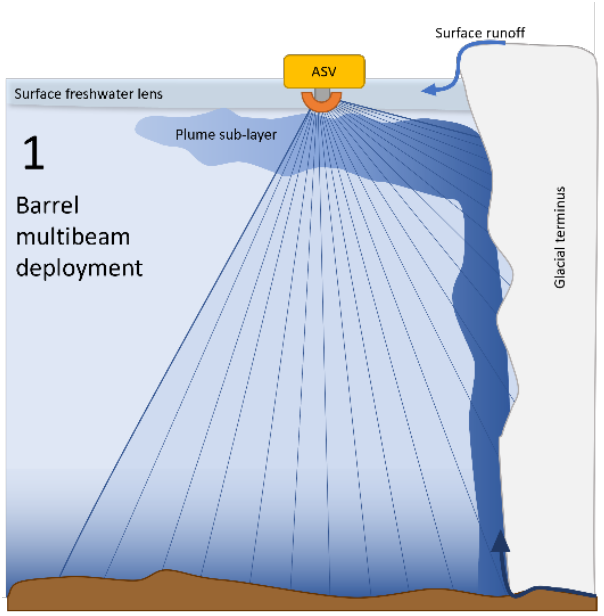
The EchoBoat ASV

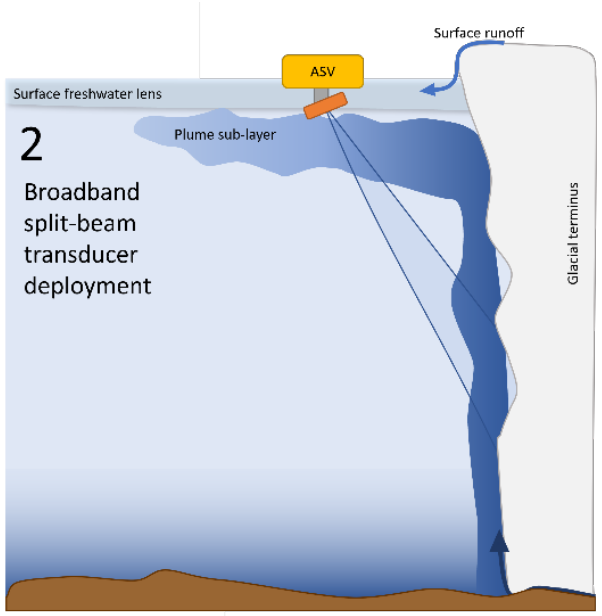
Vessel length: 1.7 m
Weight: 30 kg
Range and endurance: 2 km, 7-8 hours
Multibeam/motion sensor: Norbit iWBMS 200 – 400 kHz with integrated /Applanix SurfMaster
200 kHz EK-80 WBAT-Mini
Forward and sidelooking cameras

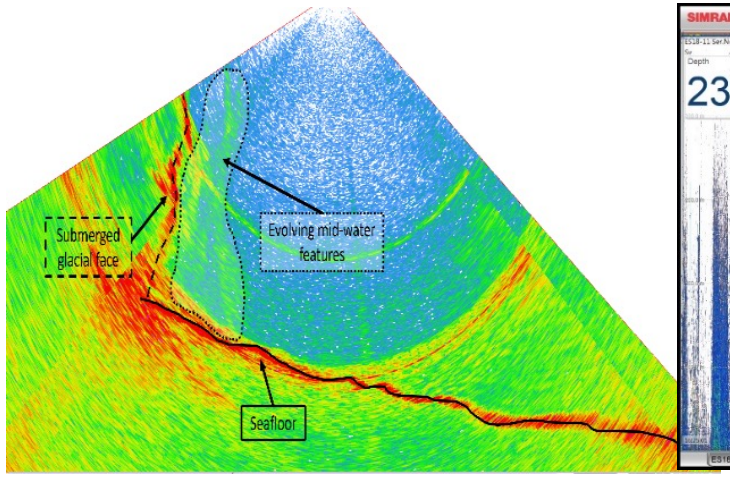
Mass Loss of Ice from Dynamic Processes is Largest Source of Uncertainty in Sea Level Rise Models



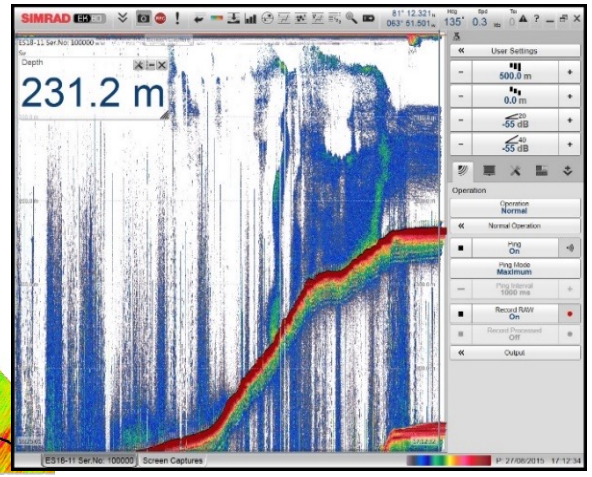






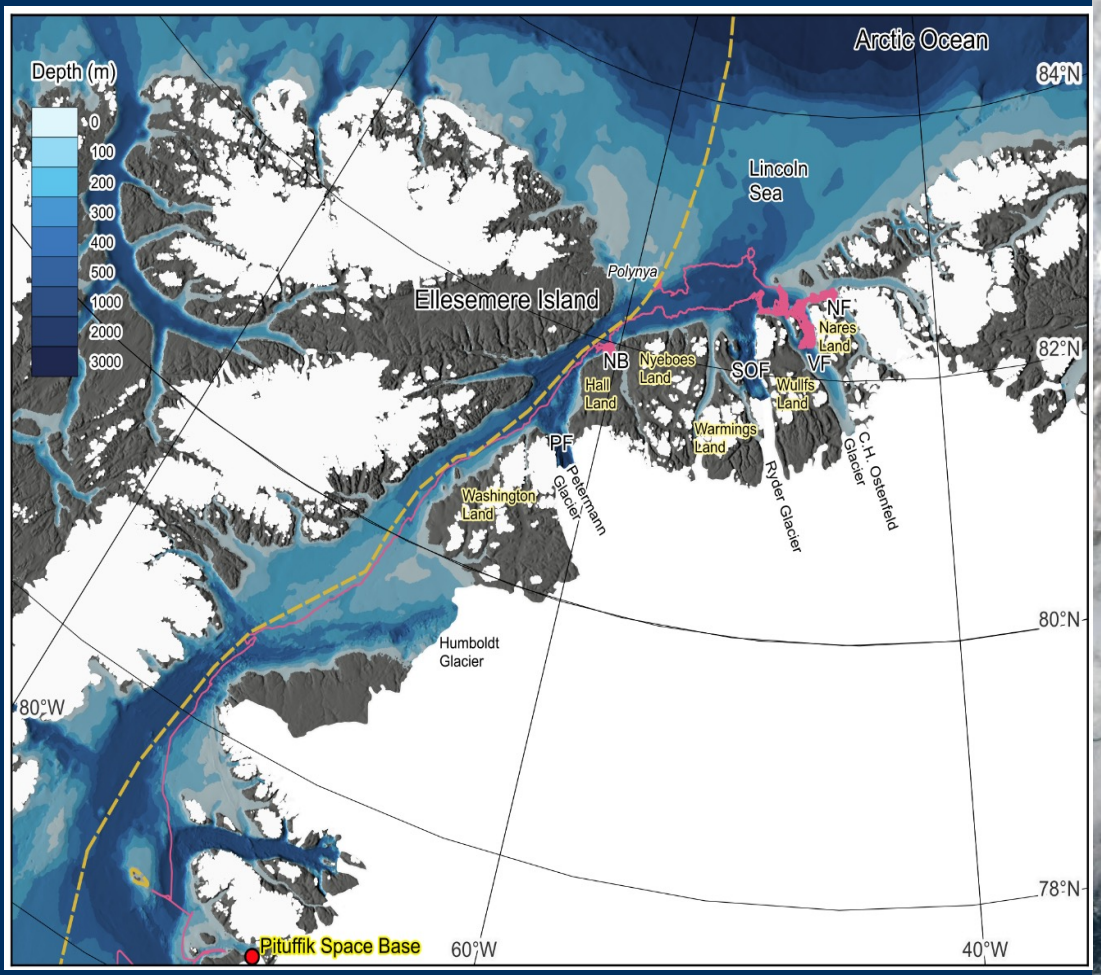


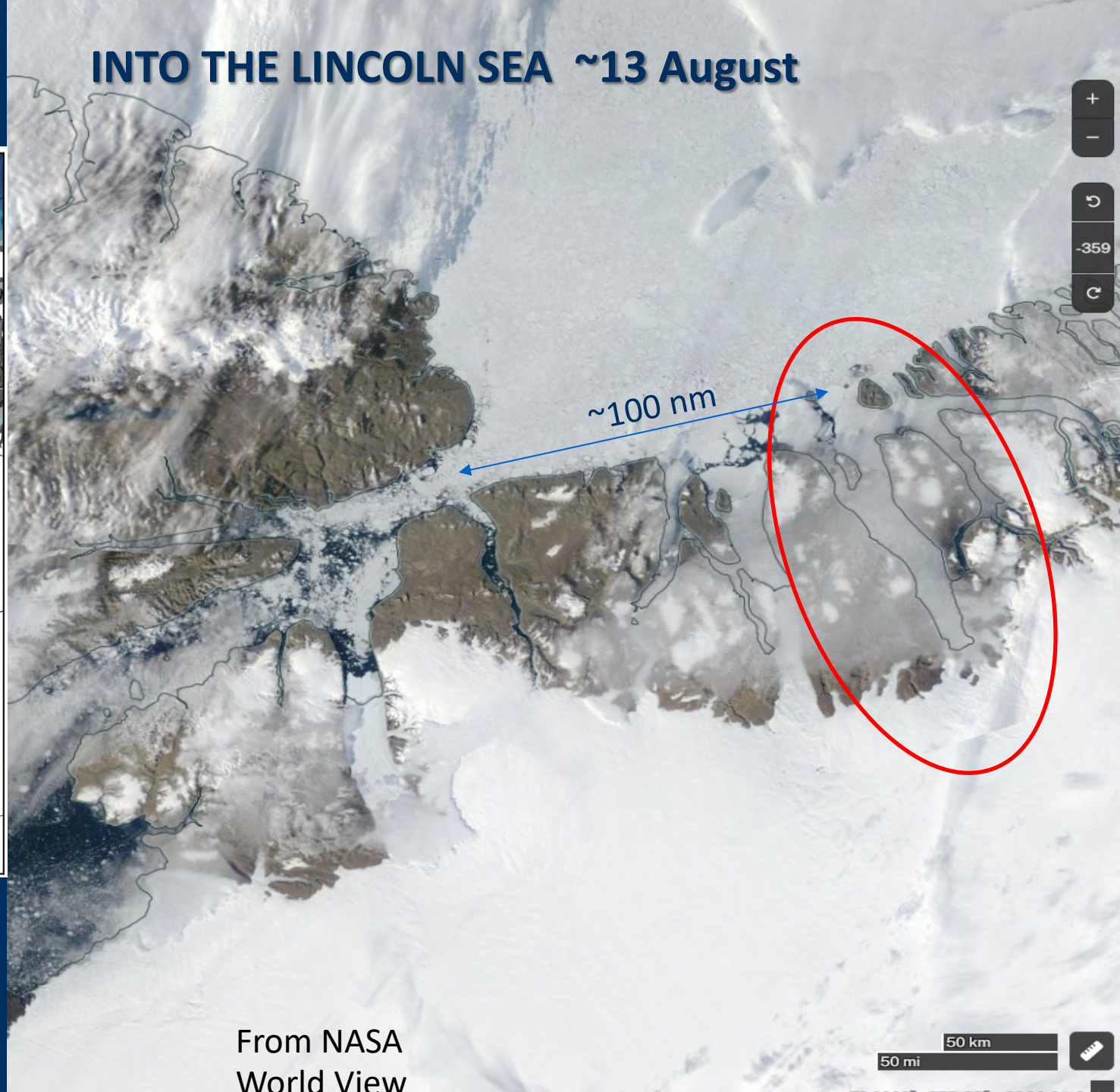
MBES



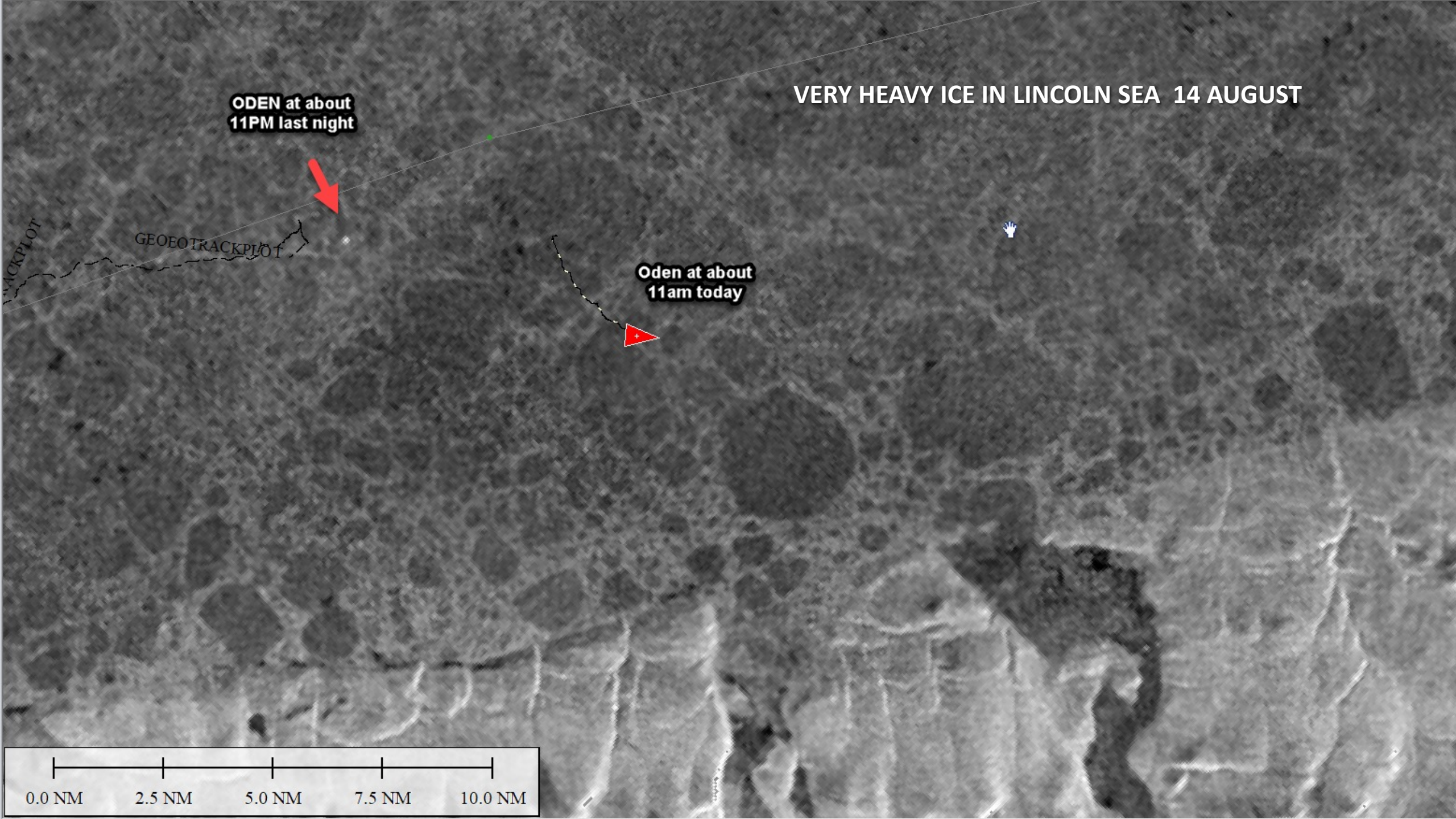
EK80

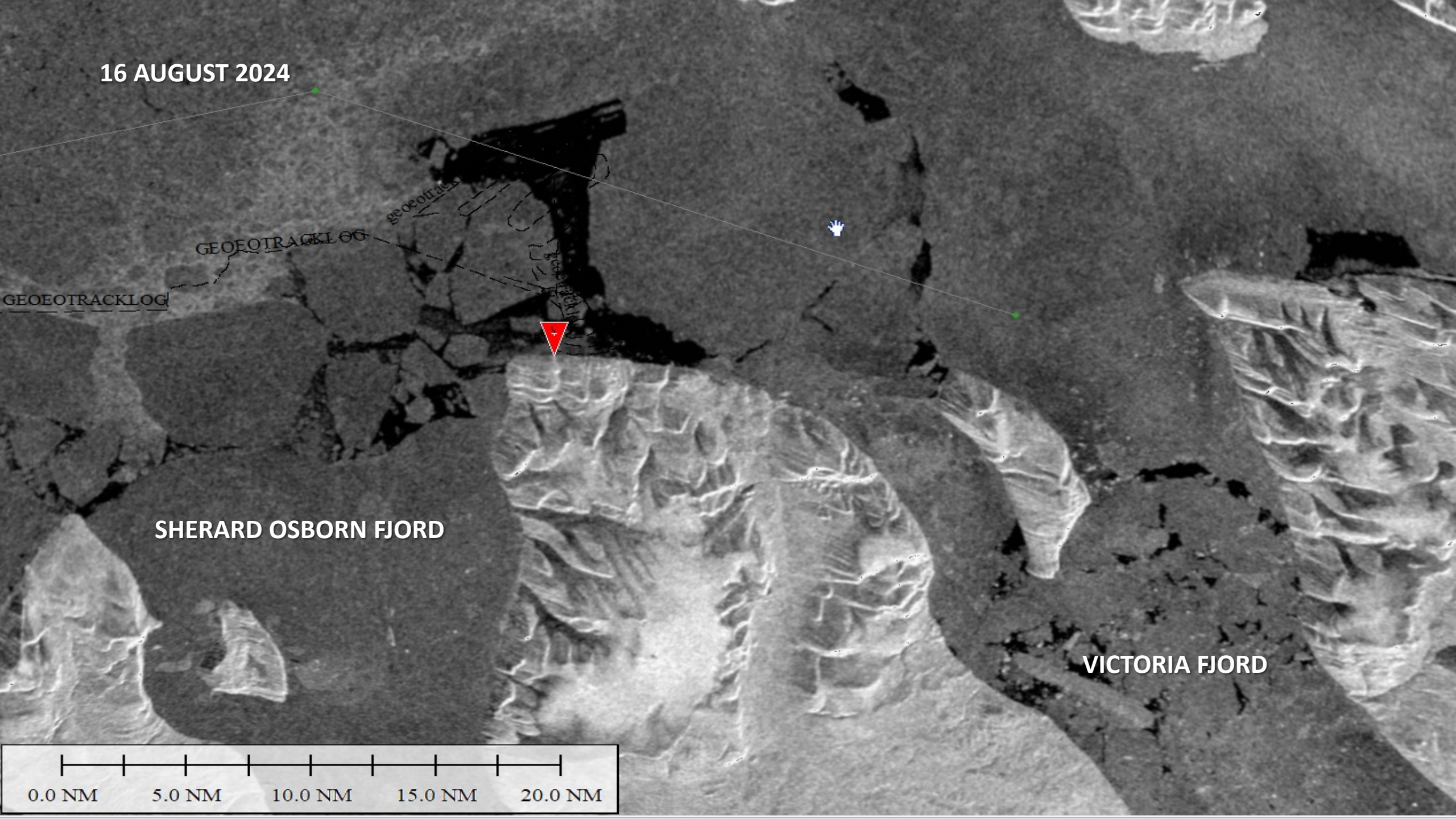
INTO THE LINCOLN SEA ~13 August



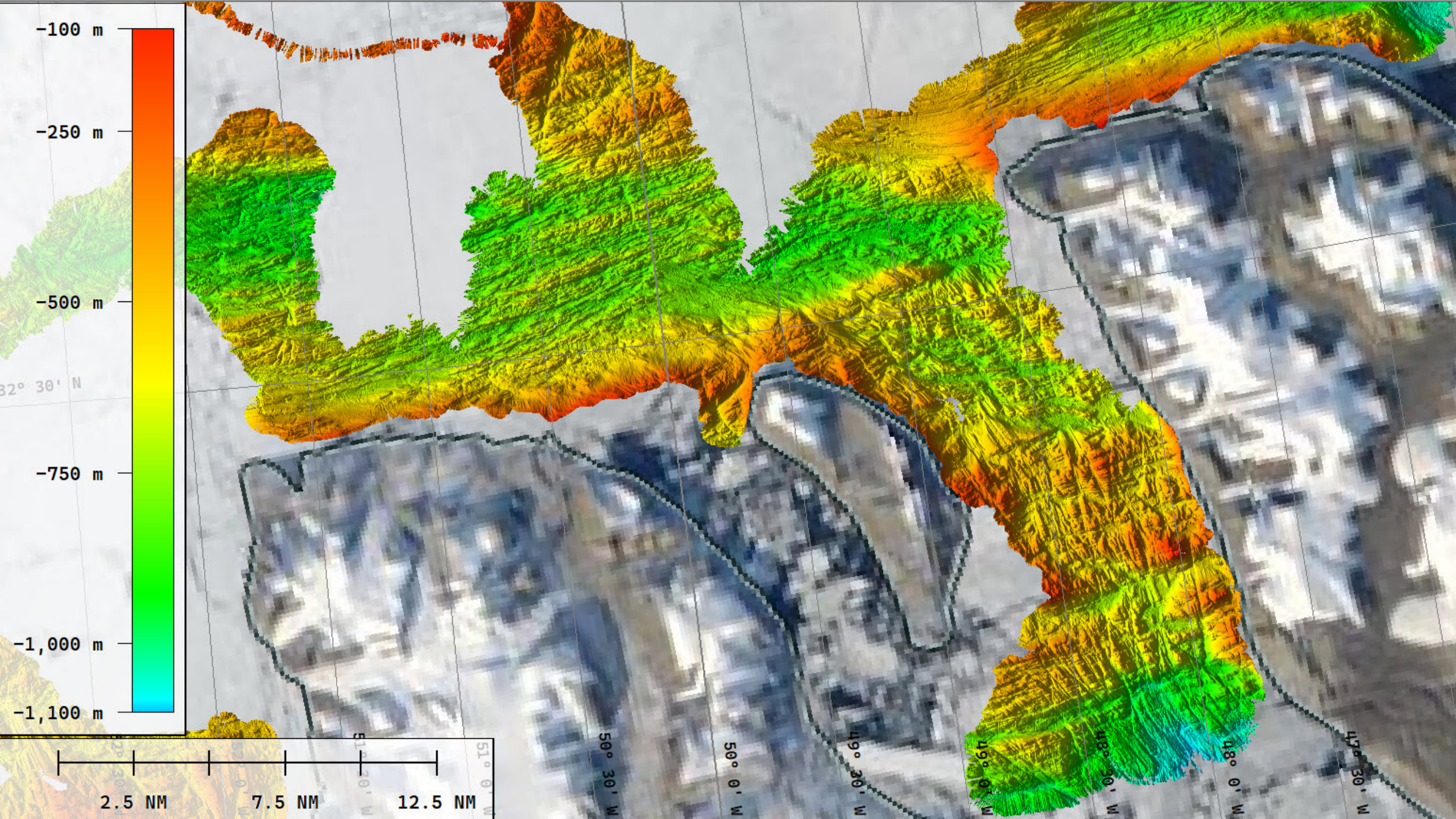


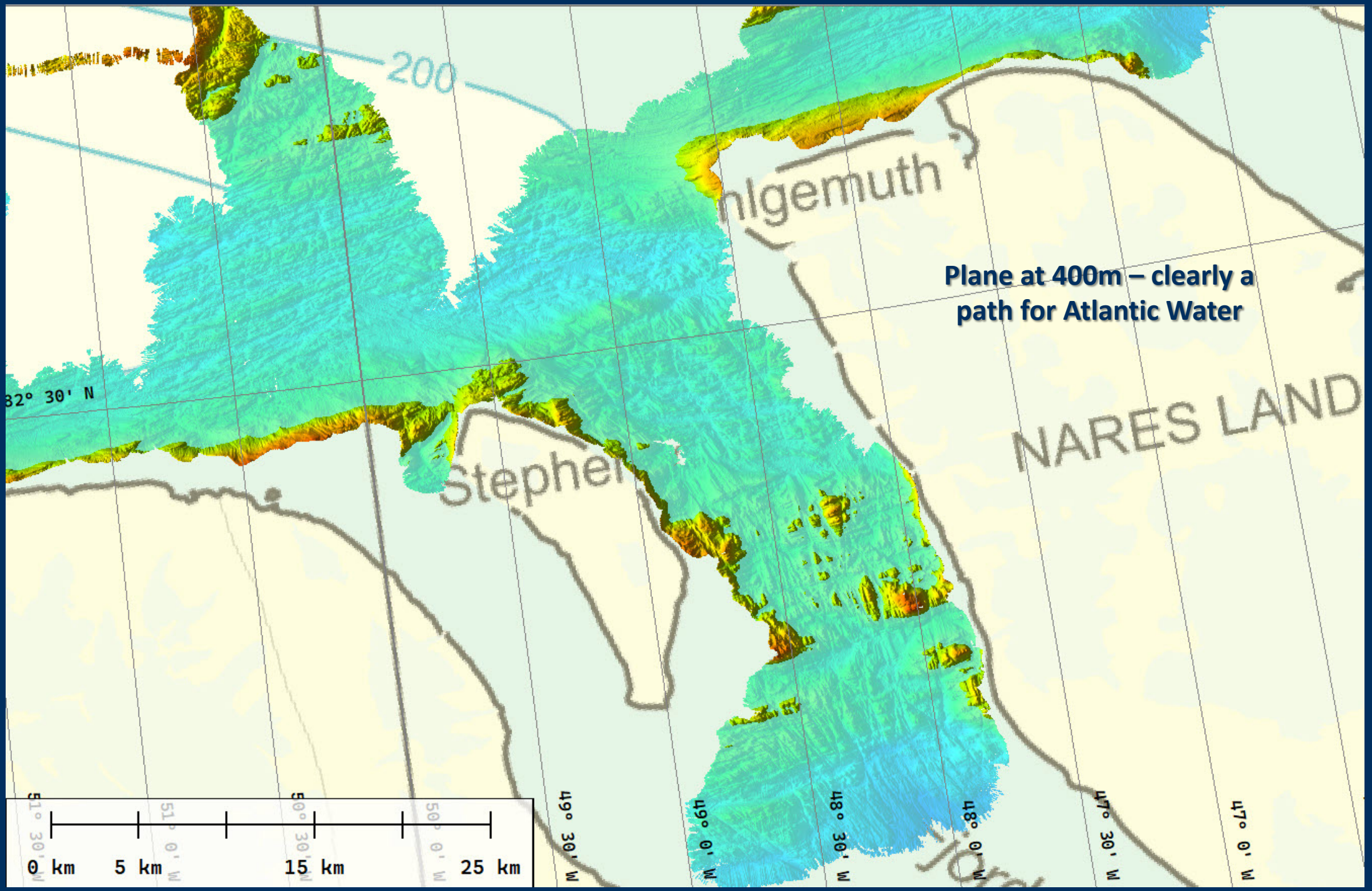
From NASA World View

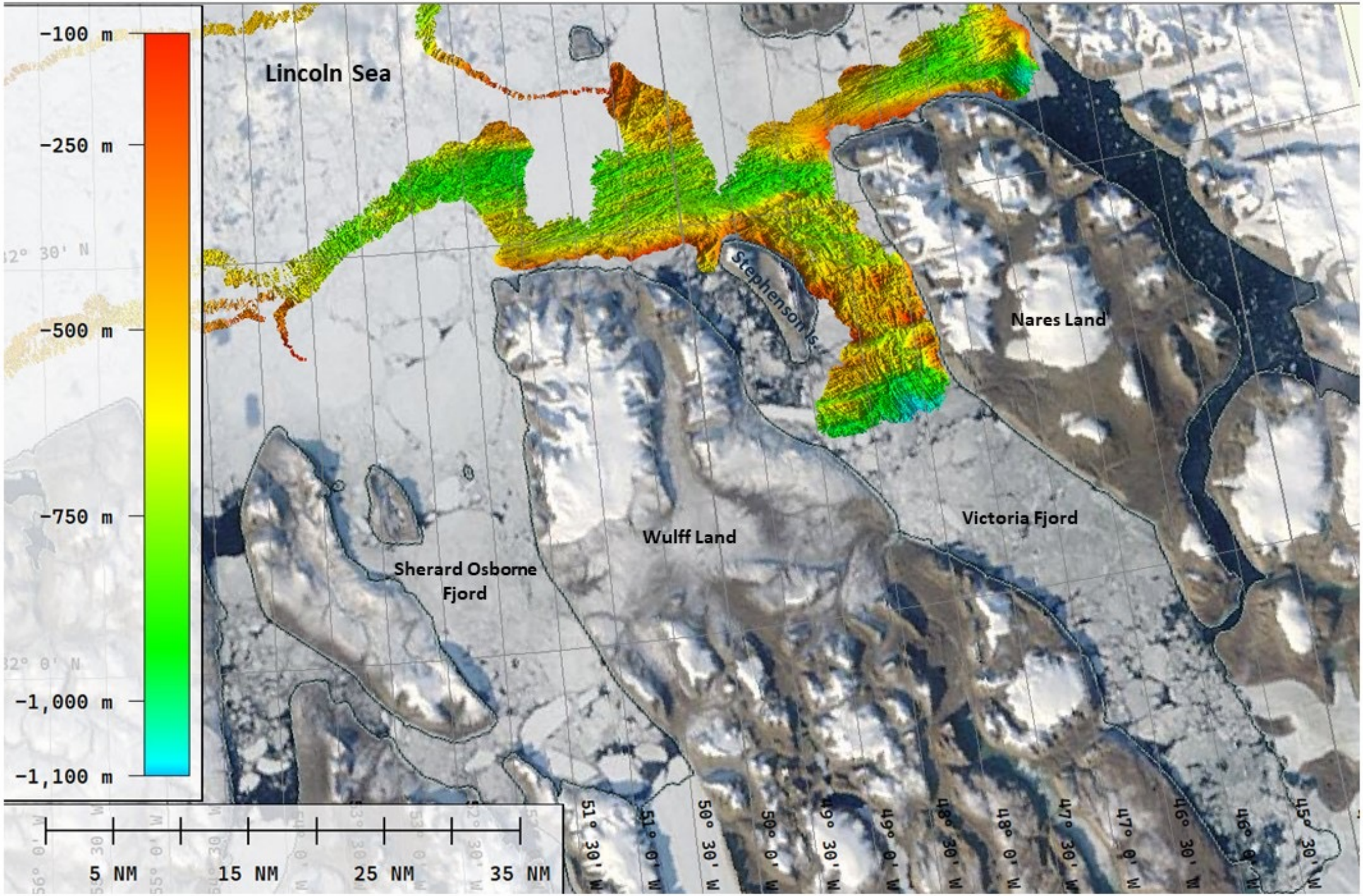

VERY HEAVY ICE IN LINCOLN SEA 14 AUGUST
ODEN at about
11PM last night
GEOEOTRACKPLOT
Oden at about
11am today
0.0 NM
2.5 NM
5.0 NM
7.5 NM
10.0 NM


16 AUGUST 2024
GEOEOTRACKLOG
GEOEOTRACKLOG
SHERARD OSBORN FJORD
VICTORIA FJORD
0.0 NM
5.0 NM
10.0 NM
15.0 NM
20.0 NM

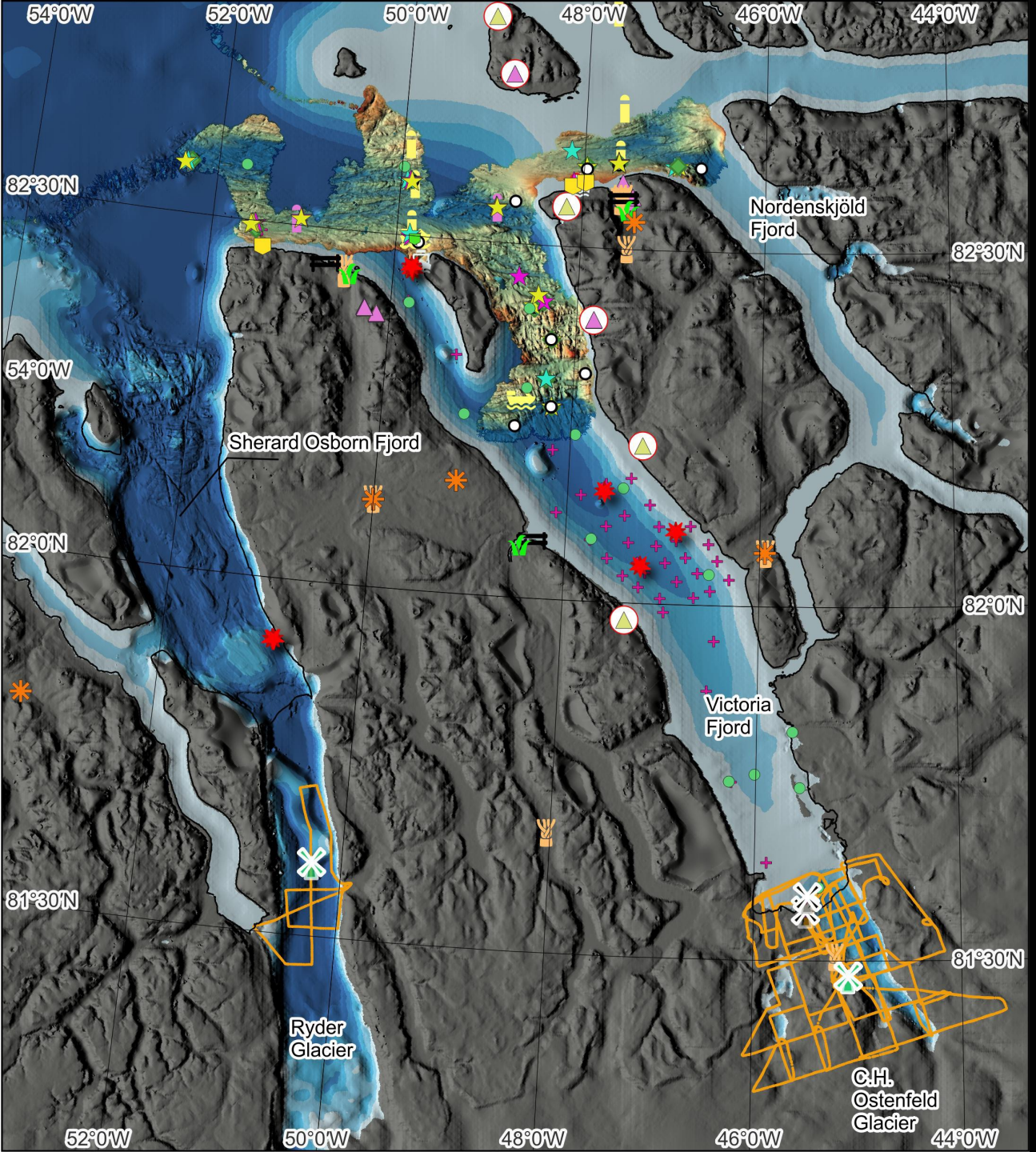

19 AUGUST – FINALLY ENTERED VICTORIA FJORD


-100 m
-250 m
-500 m
-750 m
-1,000 m
-1,100 m
2.5 NM
7.5 NM
12.5 NM
50° 30' W
50° 0' W
49° 30' W
49° 0' W
48° 30' W
48° 0' W
47° 30' W


200
hlgemuth
Stephen
NARES LAND
82° 30' N
Plane at 400m – clearly a path for Atlantic Water
0 km
5 km
15 km
25 km
51° 30' W
51° 0' W
50° 30' W
50° 0' W
49° 30' W
49° 0' W
48° 30' W
48° 0' W
47° 30' W
47° 0' W


-100 m
-250 m
-500 m
-750 m
-1,000 m
-1,100 m
Lincoln Sea
Stephenson Is.
Nares Land
Victoria Fjord
Wulff Land
Sherard Osborne Fjord
5 NM
15 NM
25 NM
35 NM


A wall of icebergs in lower 2/3 of fjord

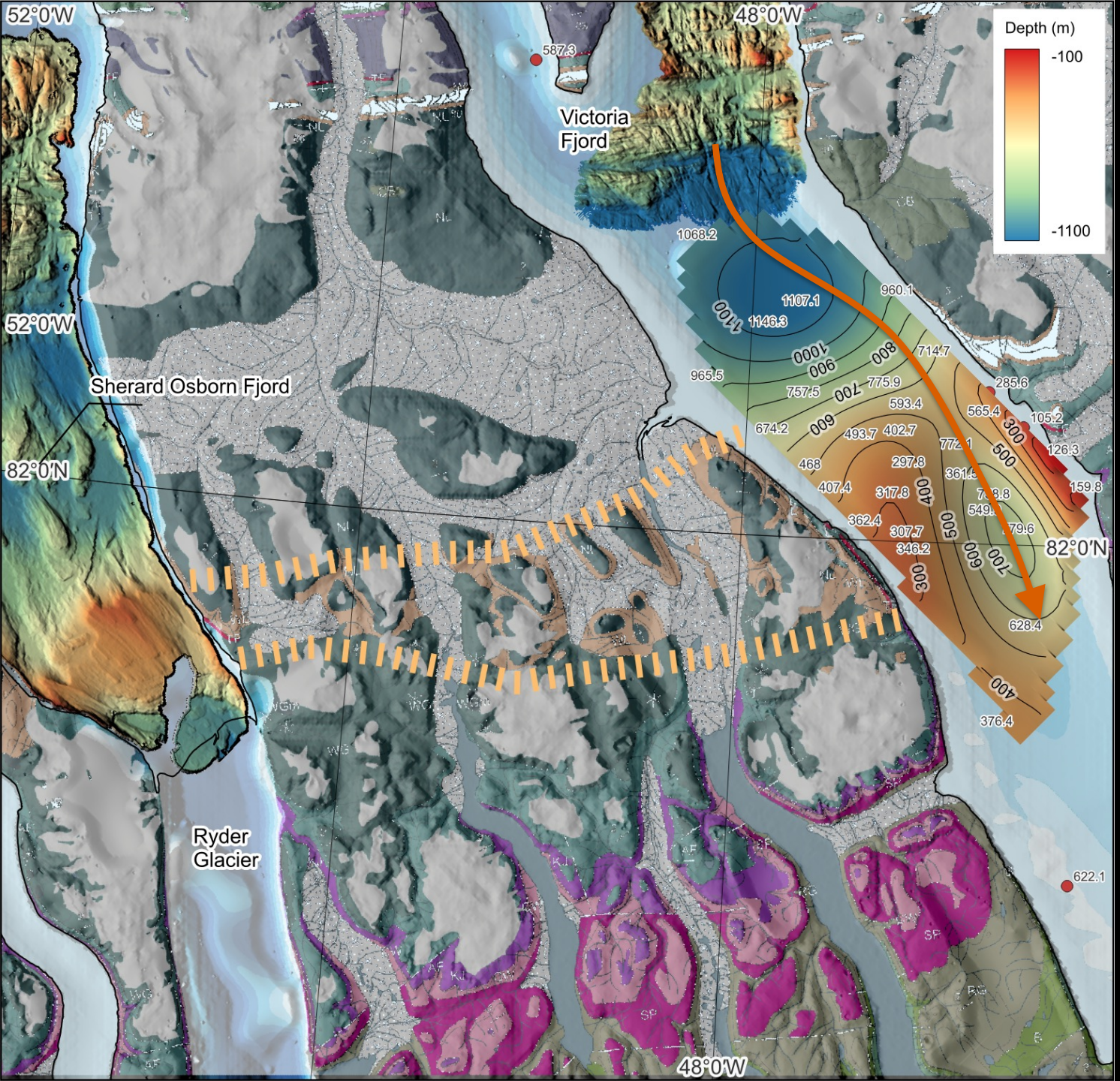


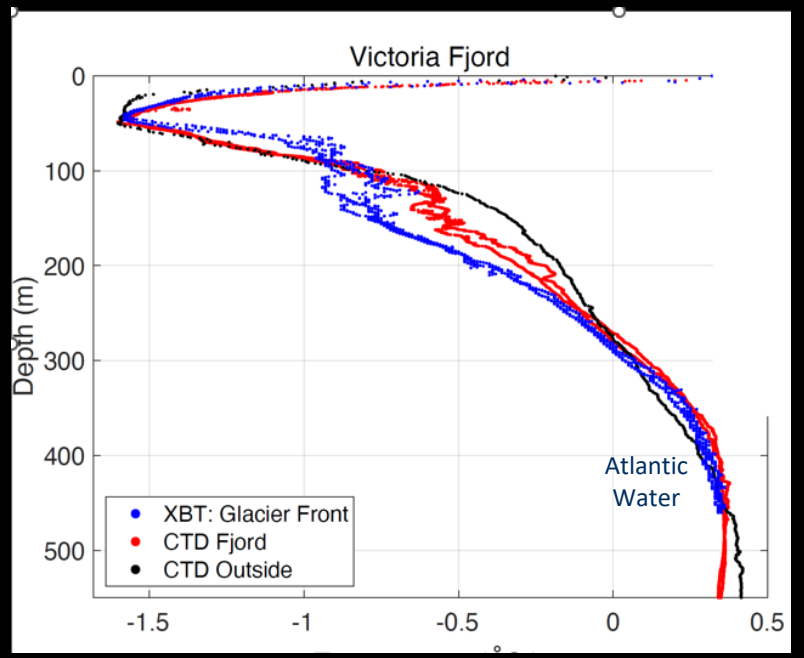
- Depths from helicopter
- Bongo net
- CTD
- SVP
- Gravity core
- Multi core
- Piston core
- XBT
- XBT-heli
- Lake core
- Time Lapse Cameras
- Lotus buoys
- Drone survey
- Radio-echosounding, heli
- Driftwood
- Shrubs
- Seismometer
- Geology Field Station
- Rock Samples
- RV Skidbladner
- Echoboat
- Kuninganna
- LoLo
- Ice station adjacent-Oden
- Ice station-Heli
- near-surface sampling
- DNA samplelocations

First ship ever to Victoria Fjord, but not only that!

NORTH OF GREENLAND 2024 EXPEDITION · ODEN · GEOTEO

Work Package cross-collaboration





NORTH OF GREENLAND 2024 EXPEDITION
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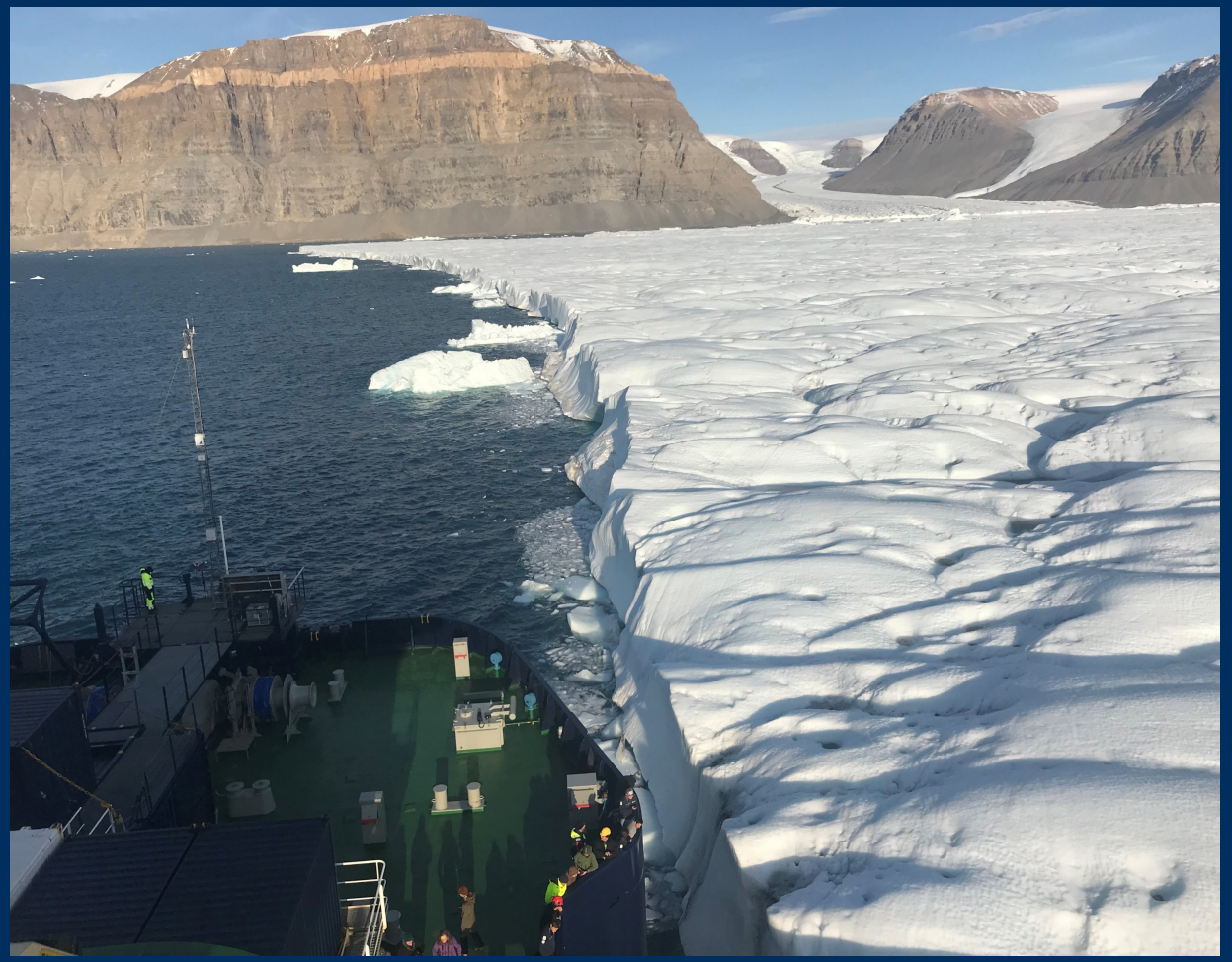
WHAT WE EXPECTED THE ICE FRONT TO LOOK LIKE:

Petermann Fjord (Petermann Glacier) Ice Front

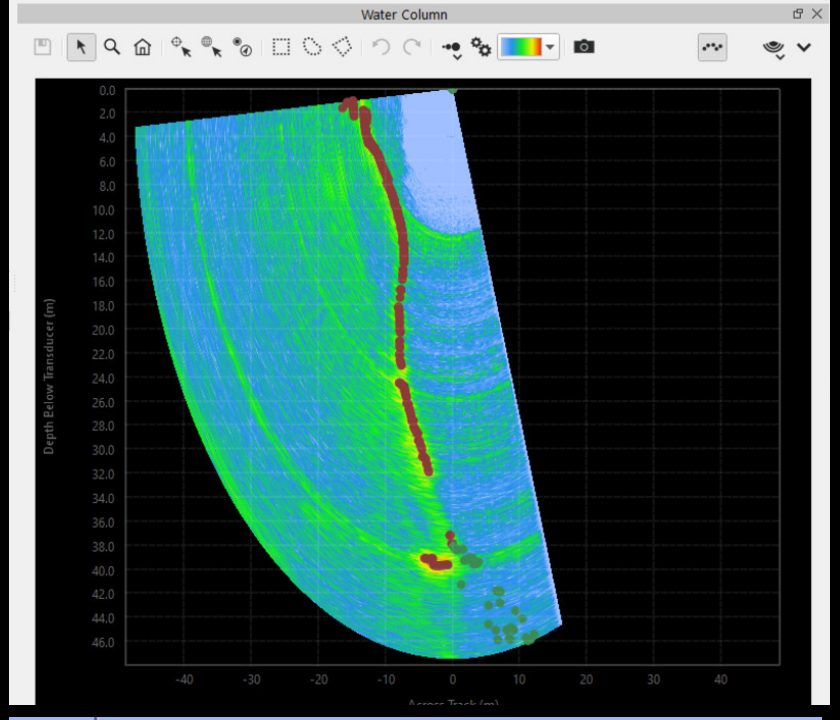
Sherard Osborn Fjord (Ryder Glacier)Ice Front

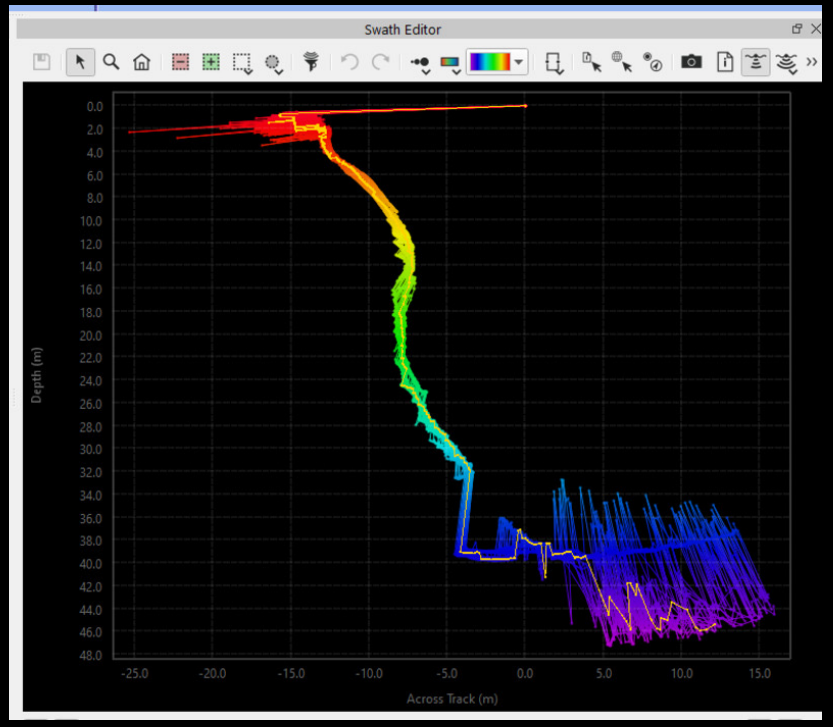


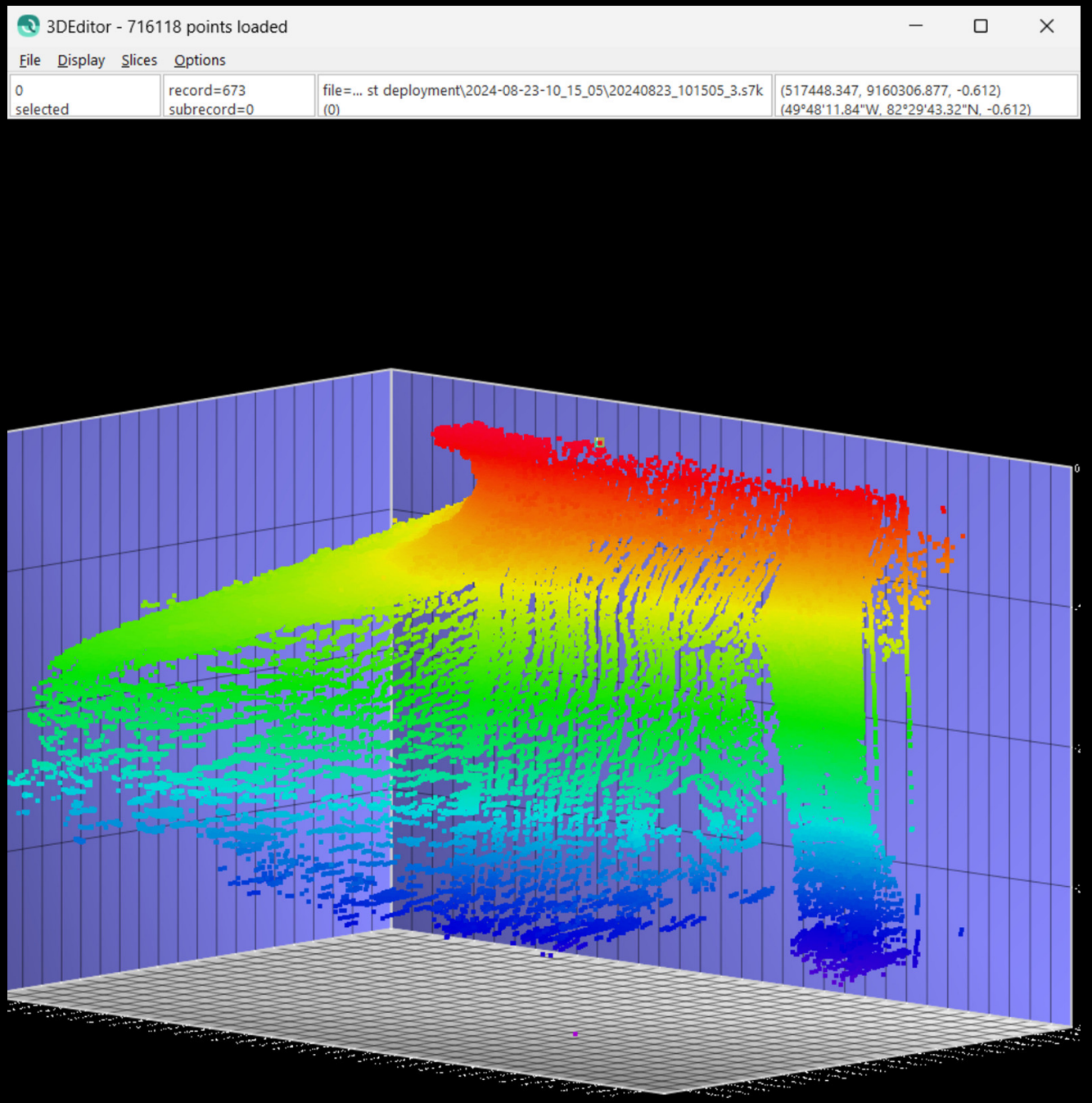

ECHOBOAT-160
AML

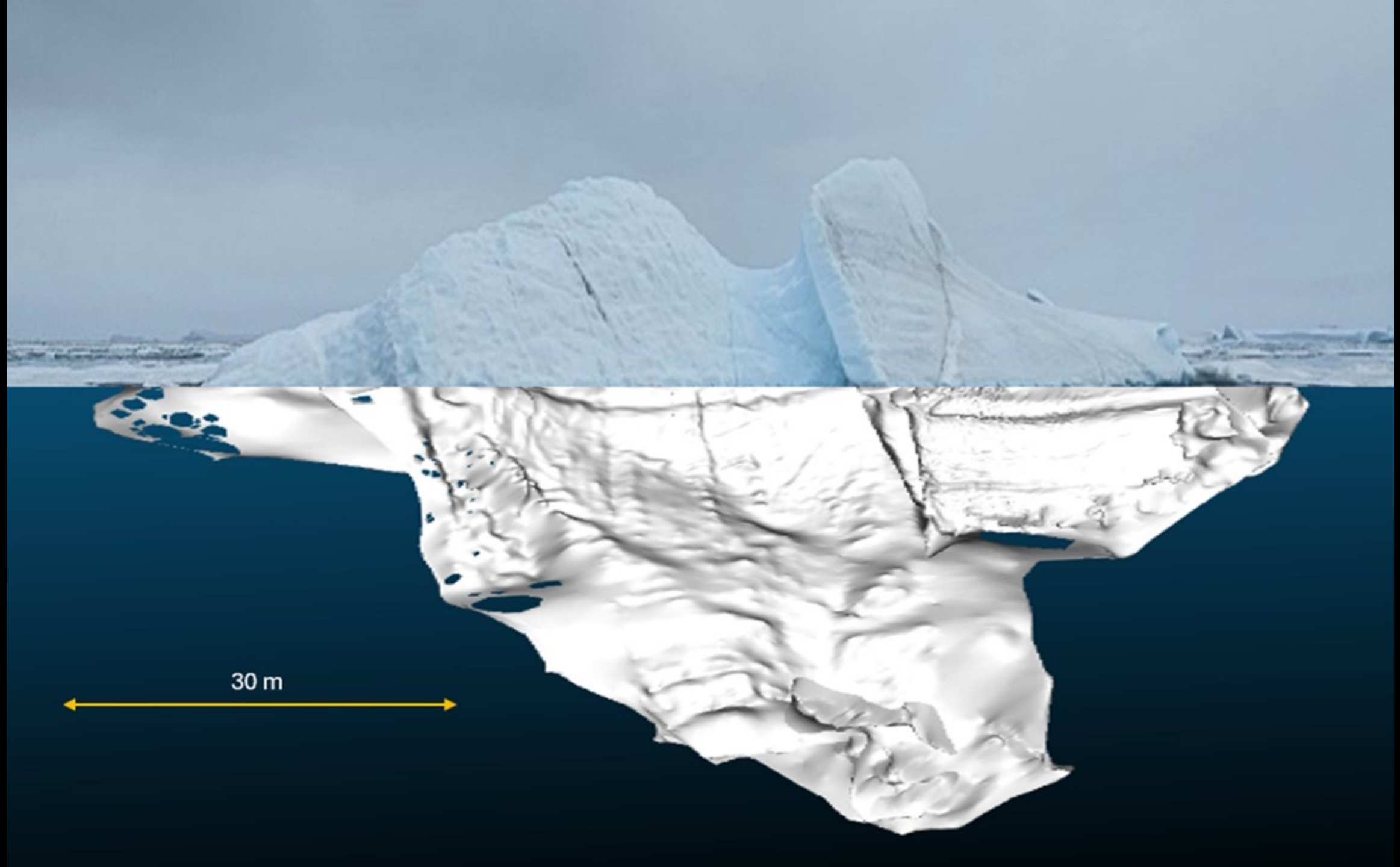

ECHOBOAT-160

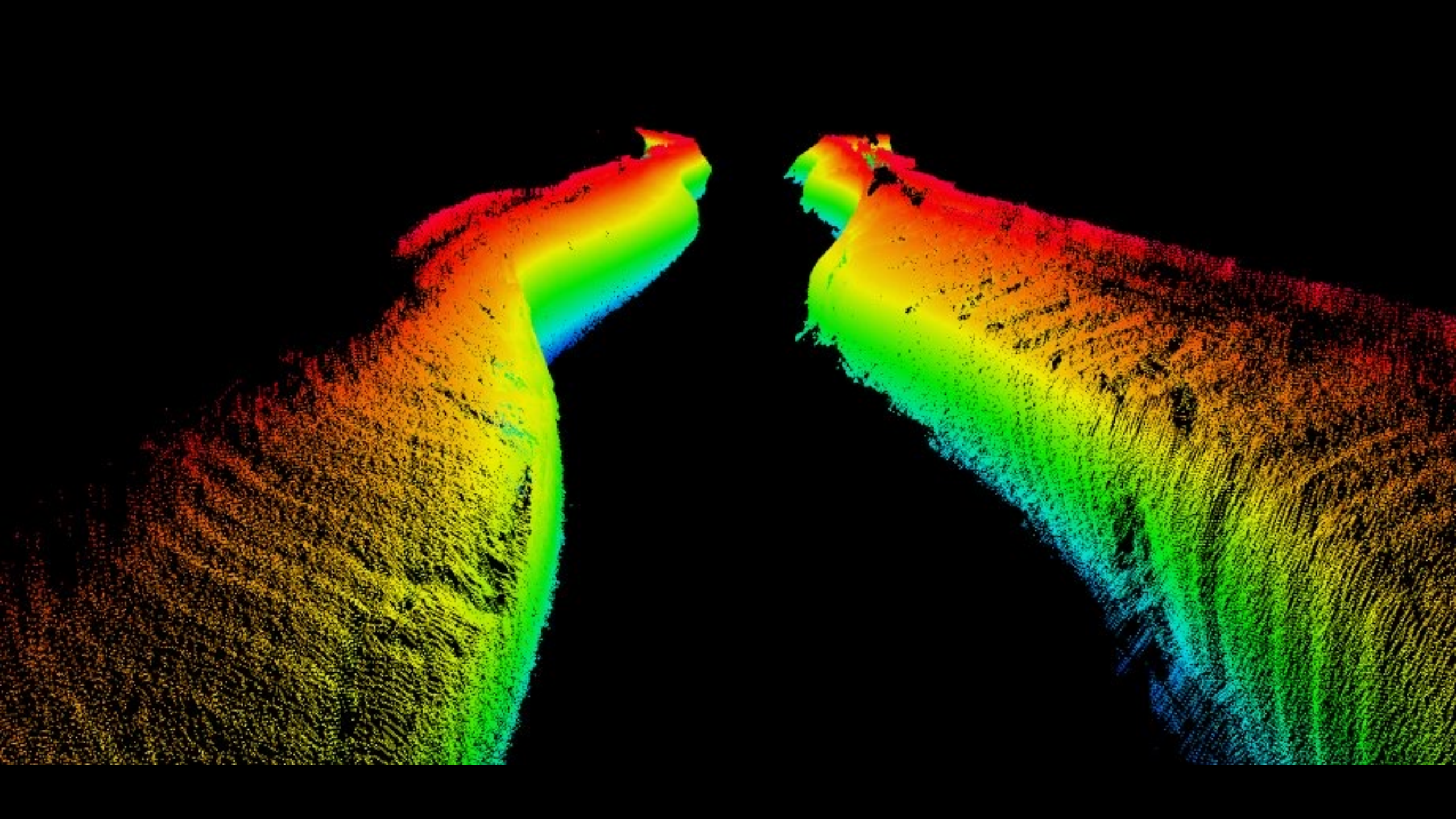

ODEN
HARKILA

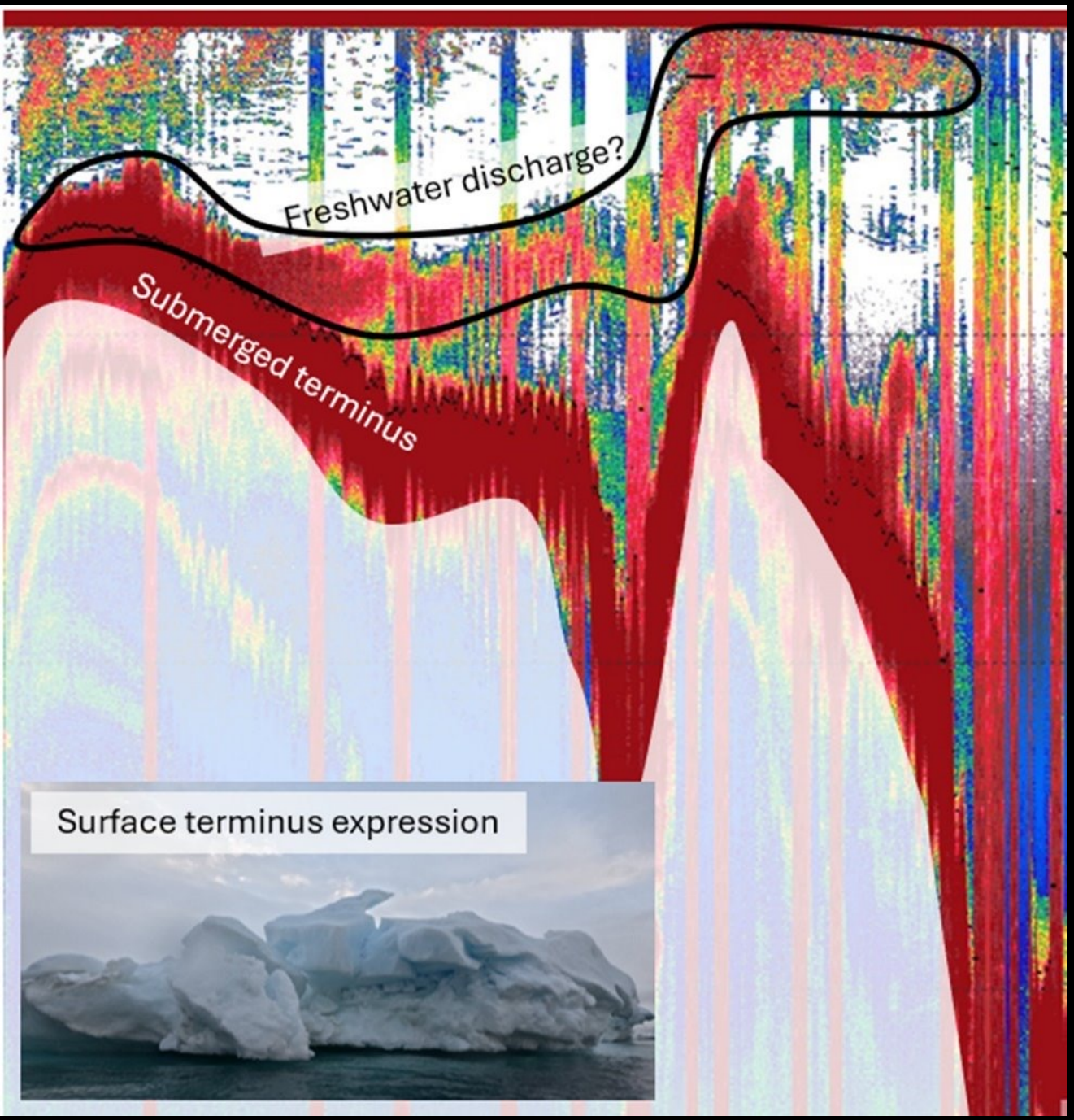

Water Column
Depth Below Transducer (m)
Across Track (m)

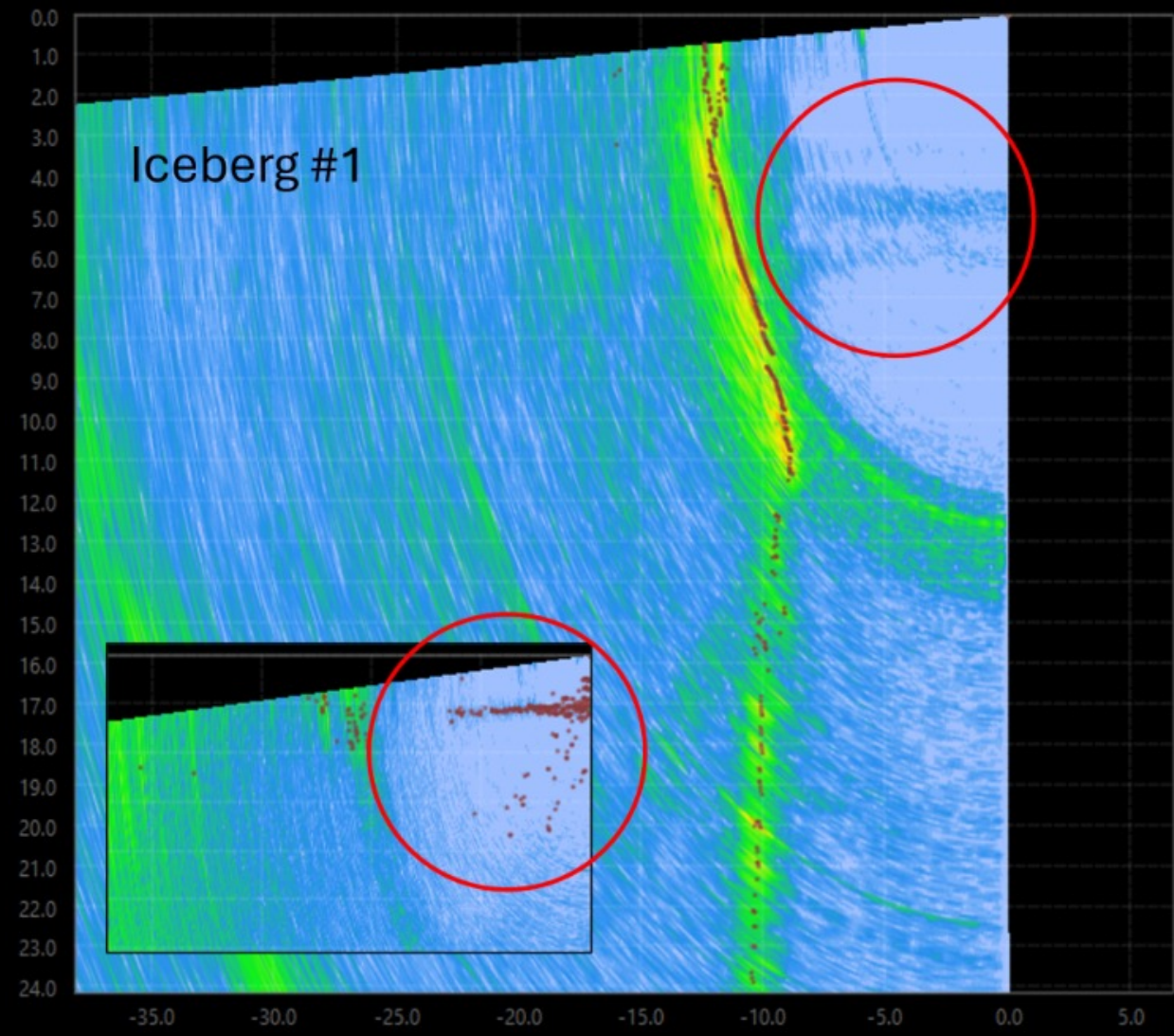

Swath Editor
Depth (m)
Across Track (m)


3DEditor - 716118 points loaded
File
Display
Slices
Options
0
selected
record=673
subrecord=0
file=... st deployment\2024-08-23-10_15_05\20240823_101505_3.s7k
(0)
(517448.347, 9160306.877, -0.612)
(49°48'11.84"W, 82°29'43.32"N, -0.612)


30 m




Freshwater discharge?
Submerged terminus
Surface terminus expression


Iceberg #1
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
11.0
12.0
13.0
14.0
15.0
16.0
17.0
18.0
19.0
20.0
21.0
22.0
23.0
24.0
-35.0
-30.0
-25.0
-20.0
-15.0
-10.0
-5.0
0.0
5.0


Picture: Björn Eriksson

Picture: Felicity Holmes

Picture: Adam Andersson

~50 Narwhals in Hans Bugt – furthest north observation of narwhals in Greenland

Video: Love Dalén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