

12/28/23-02/15/24
RV ARAON ANA14B



2 x 150 m ice core recovery supported by South Korean icebreaker RV ARAON

RAICA Canisteo Peninsula 2023-2024 West Antarctica

Korea Polar Research Institute | KBS

Peter Neff, Yeongcheol Han, Won Sang Lee, Vikram Goel, Julia Andreasen, Chaewon Chang, Etienne Gros, Songyi Kim, Jangil Moon, Kenichi Matsuoka, TJ Young, & RV ARAON ANA14B scientists & crew

Sep 15, 2025

9th International Symposium on Ice Drilling Technology

Dr. Peter D Neff

Assistant Professor

University of Minnesota - Twin Cities



U.S. ICE DRILLING PROGRAM

12/28/23-02/15/24
RV ARAON ANA14B



Korea Polar Research Institute | KBS



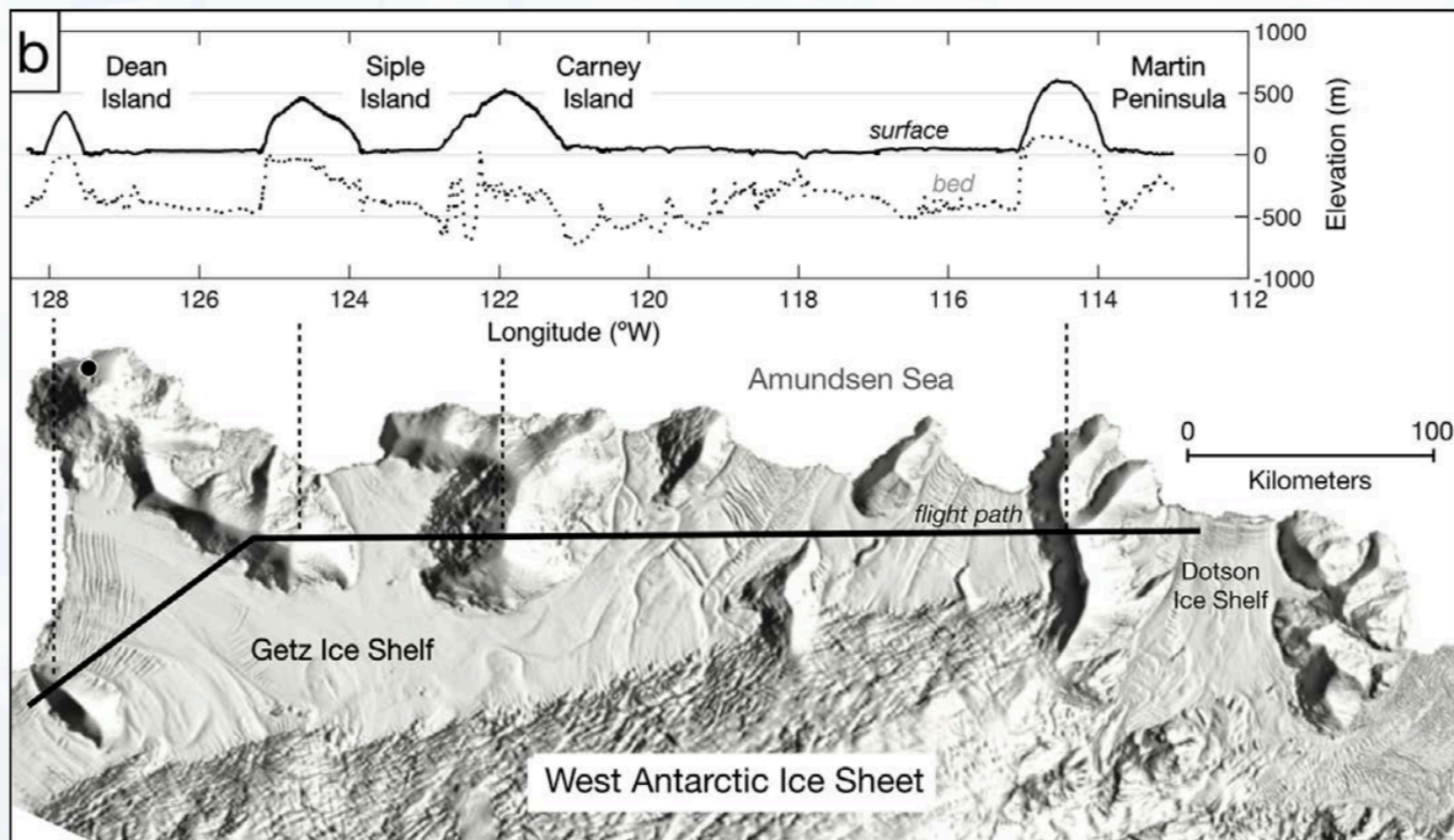
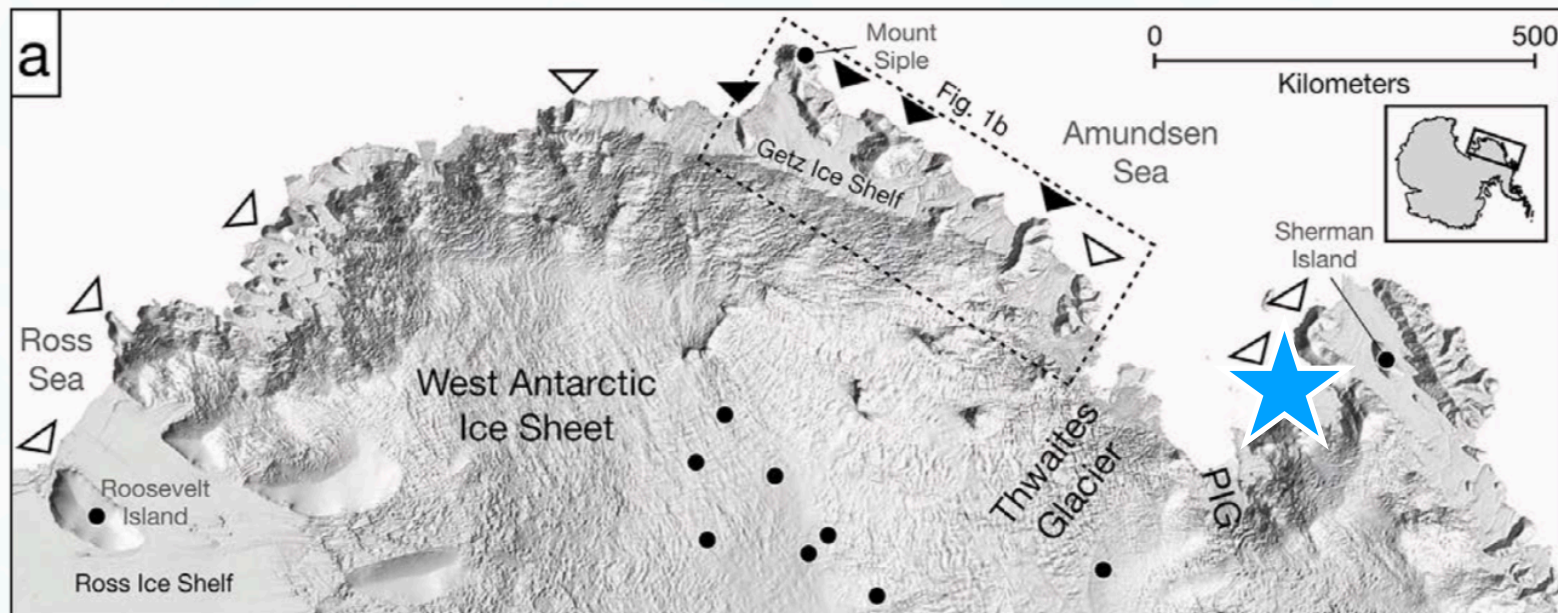
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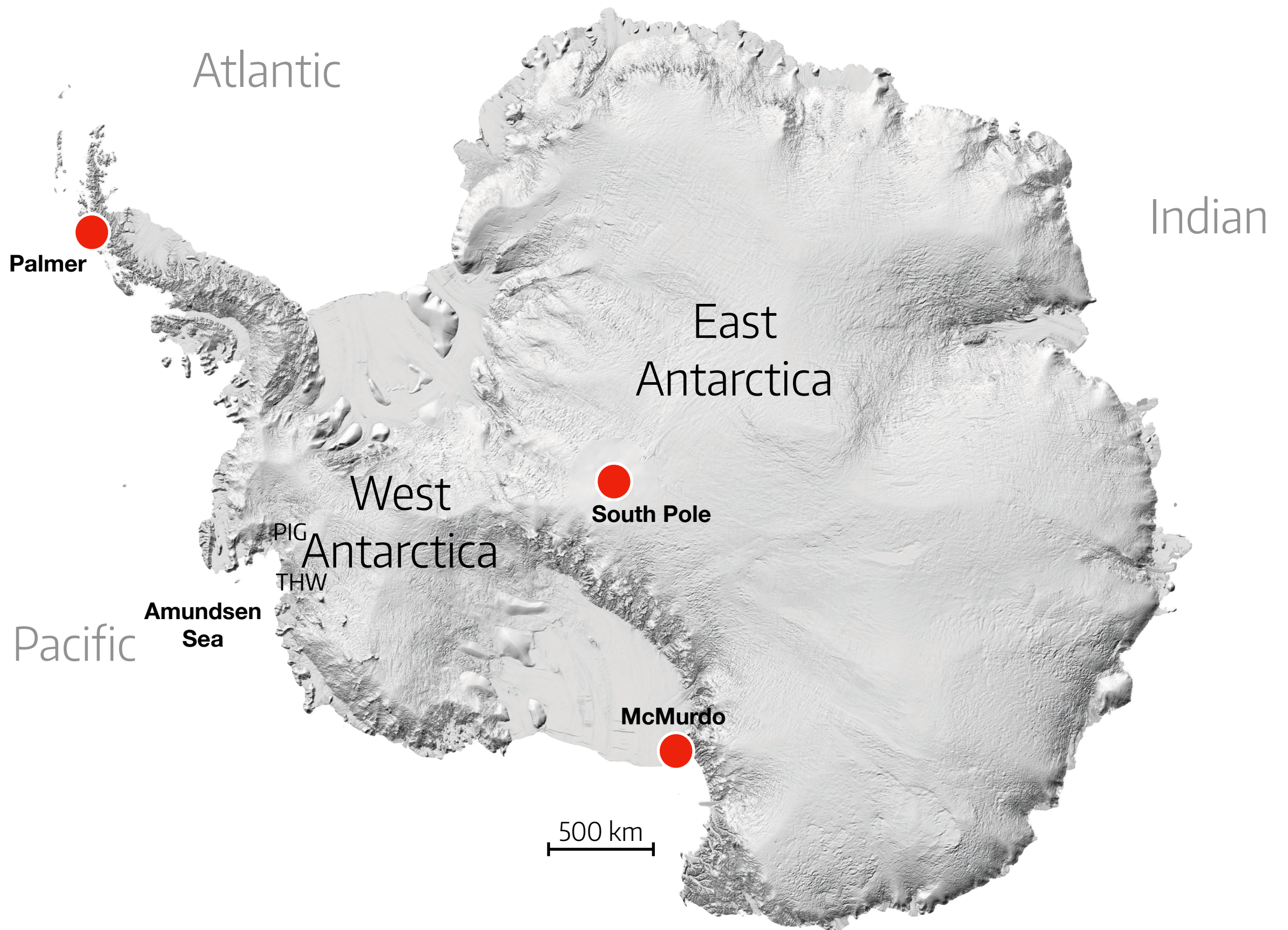
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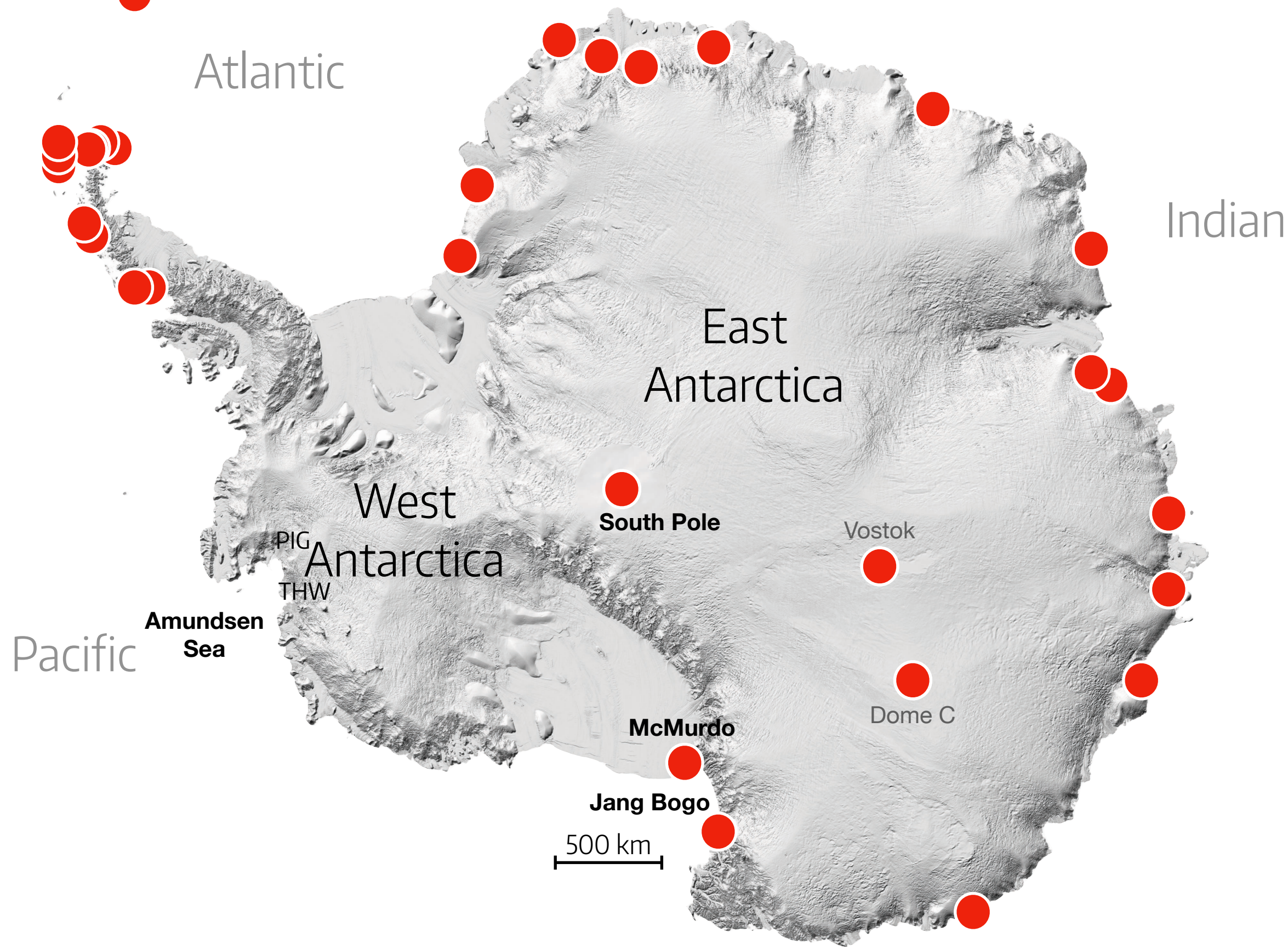
Amundsen Sea Coastal Ice Rises: Future Sites for Marine-Focused Ice Core Records



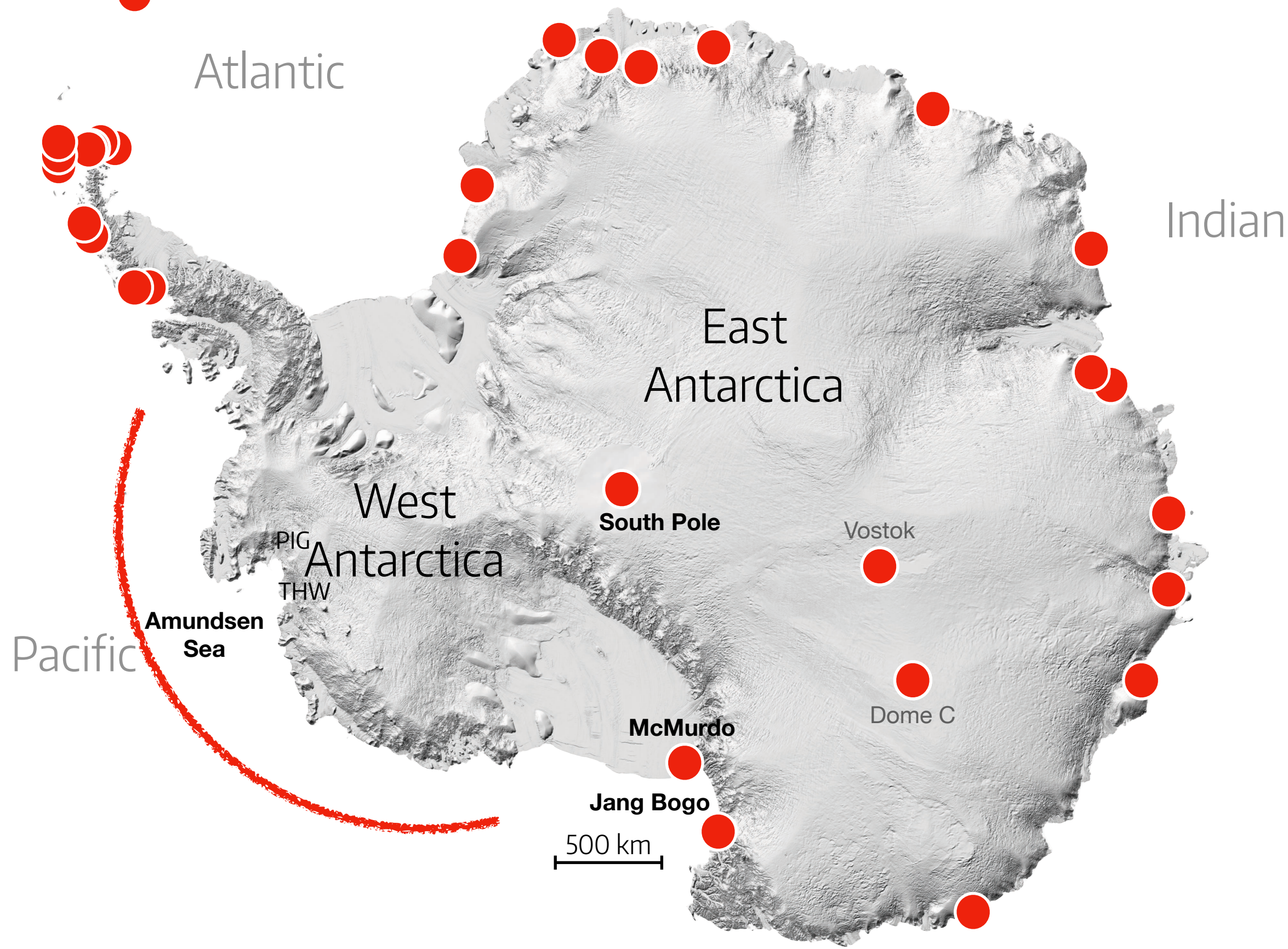
Neff, *Oceanography*
2020



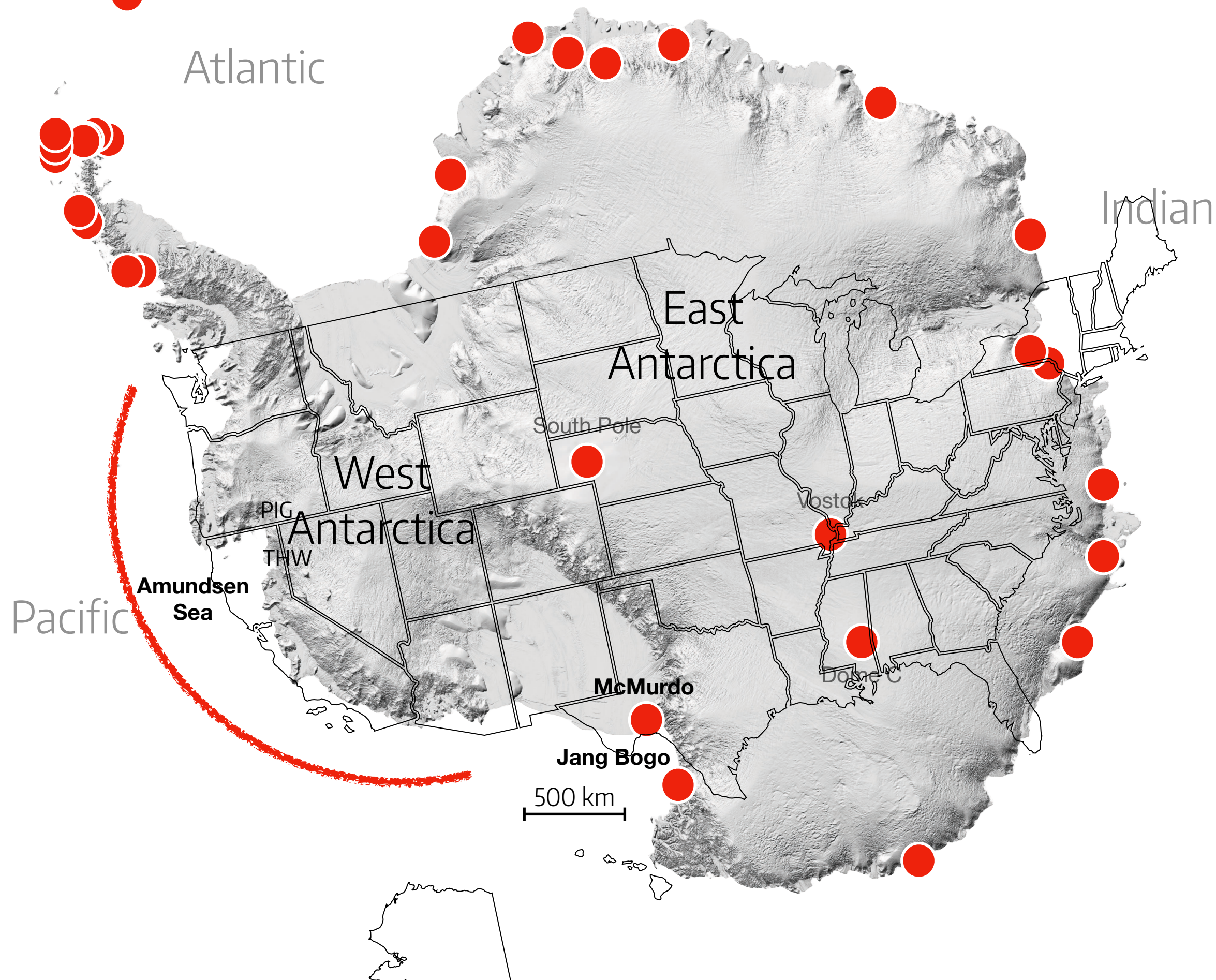
Permanent Research Stations



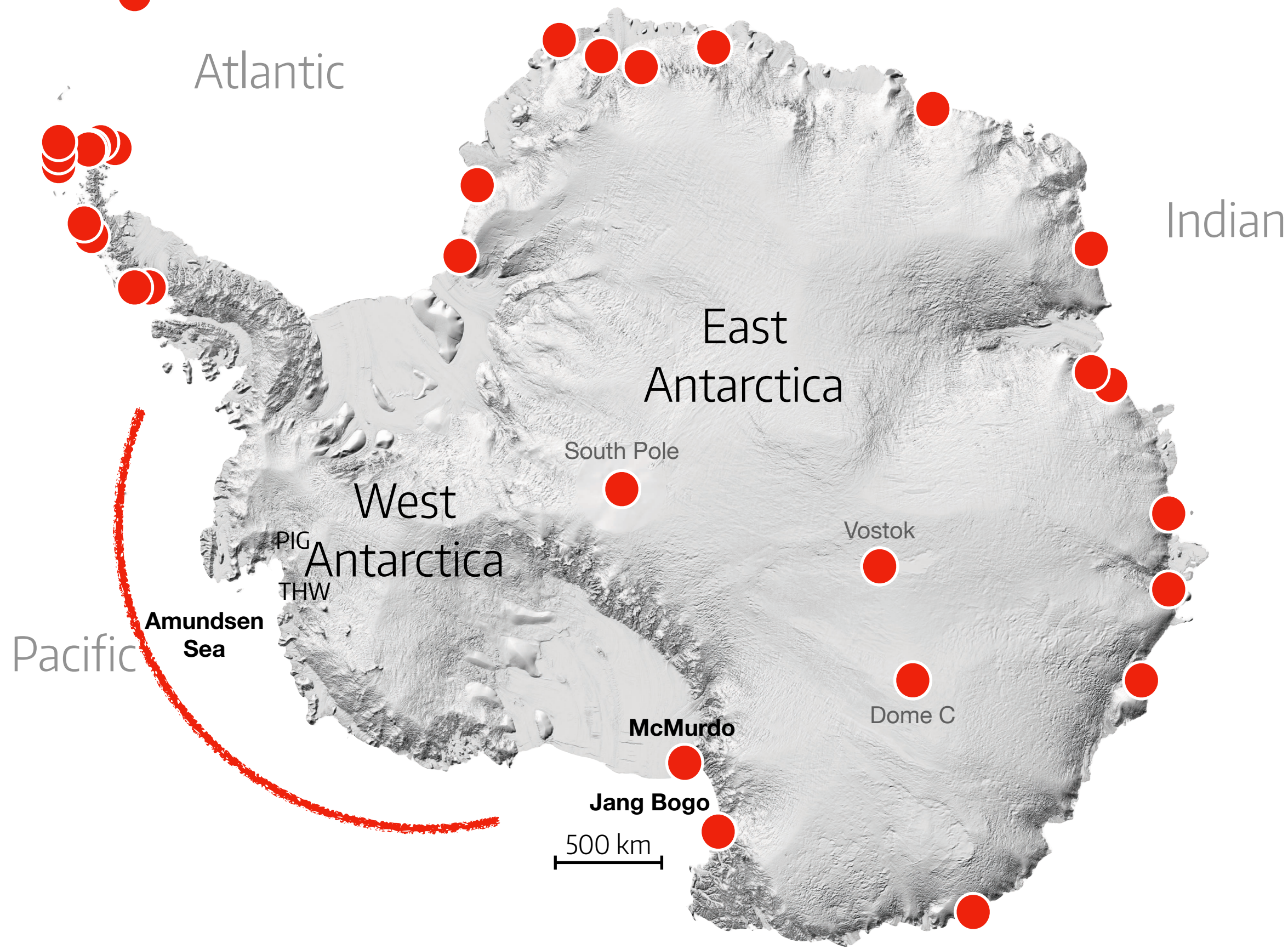
Permanent Research Stations



Permanent Research Stations

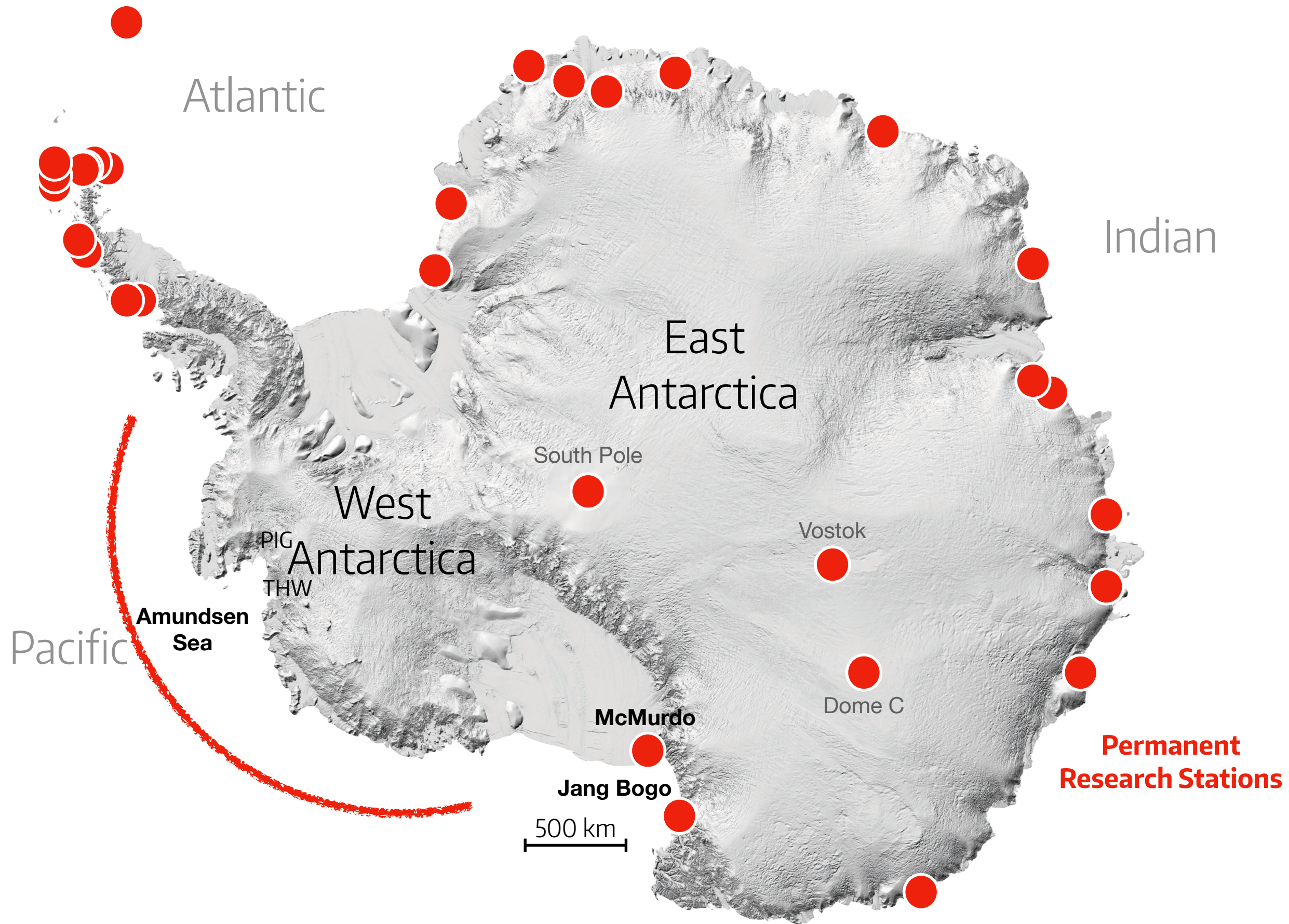


Permanent Research Stations

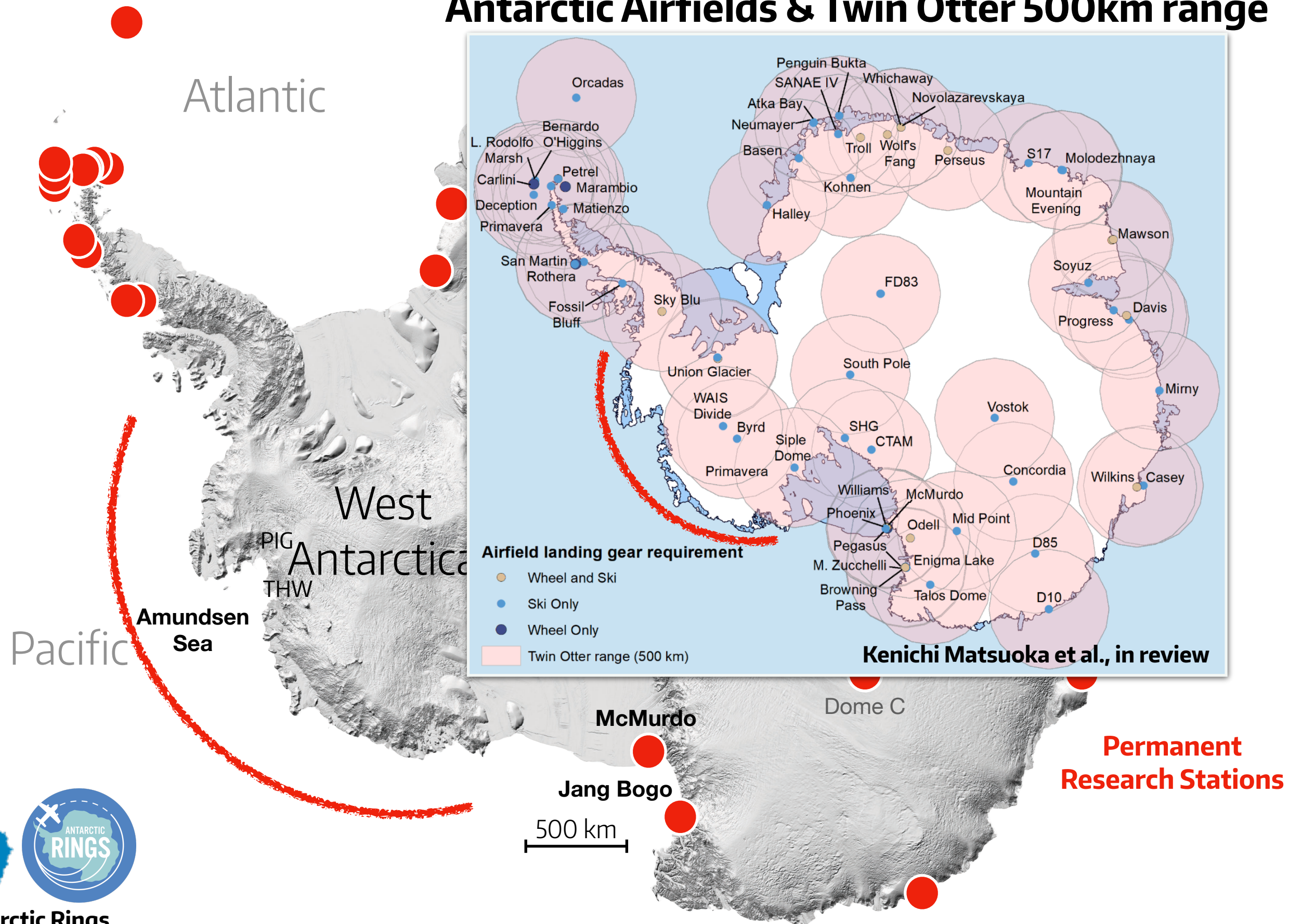


Ice Thickness Change





Antarctic Airfields & Twin Otter 500km range

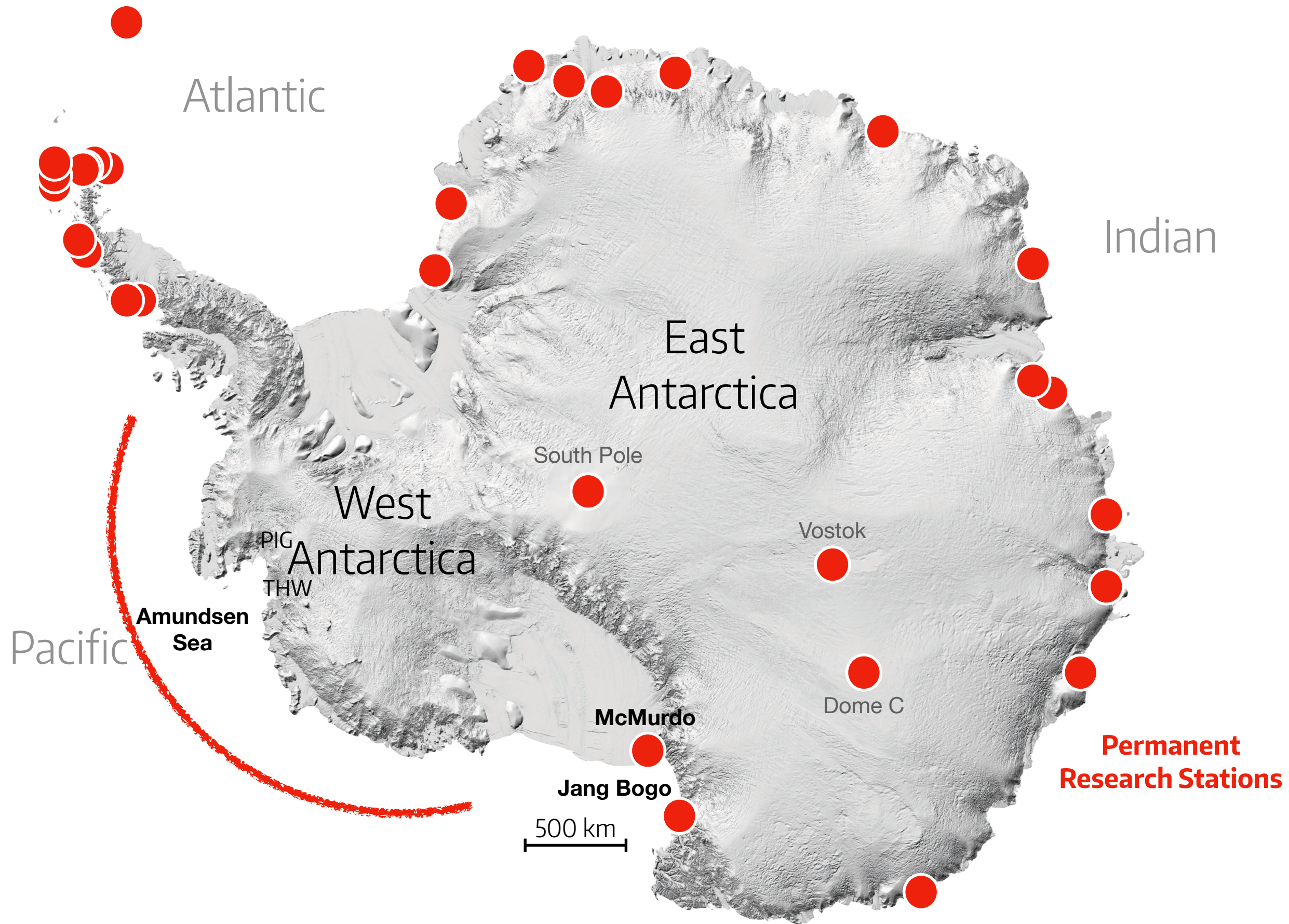


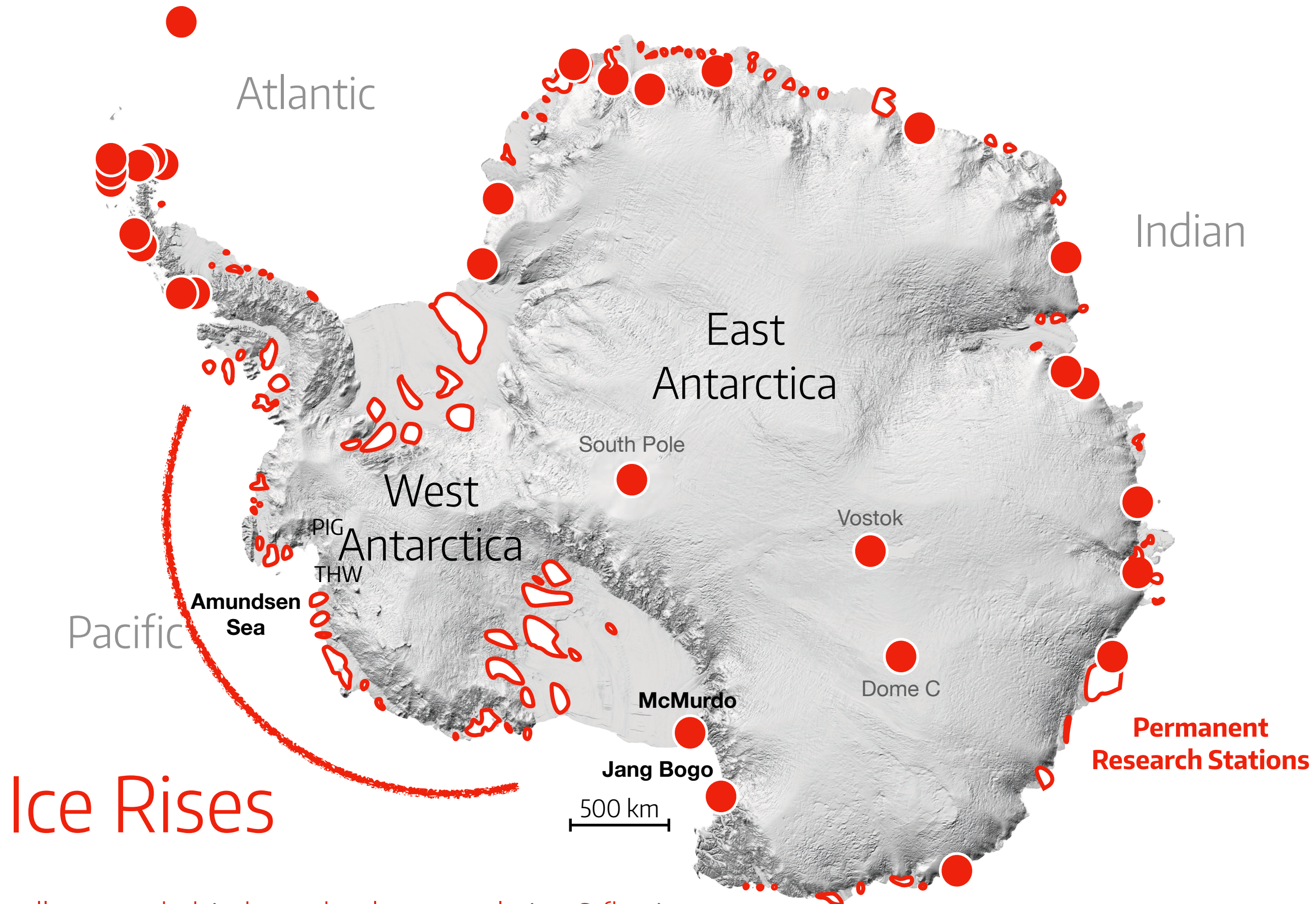
SCAR Antarctic Rings

Kenichi Matsuoka et al. (in review) Towards an improved understanding of the Antarctic coastal zone and its contribution to future global sea level.

Reviews of Geophysics.

ESS Open Archive . July 13, 2025



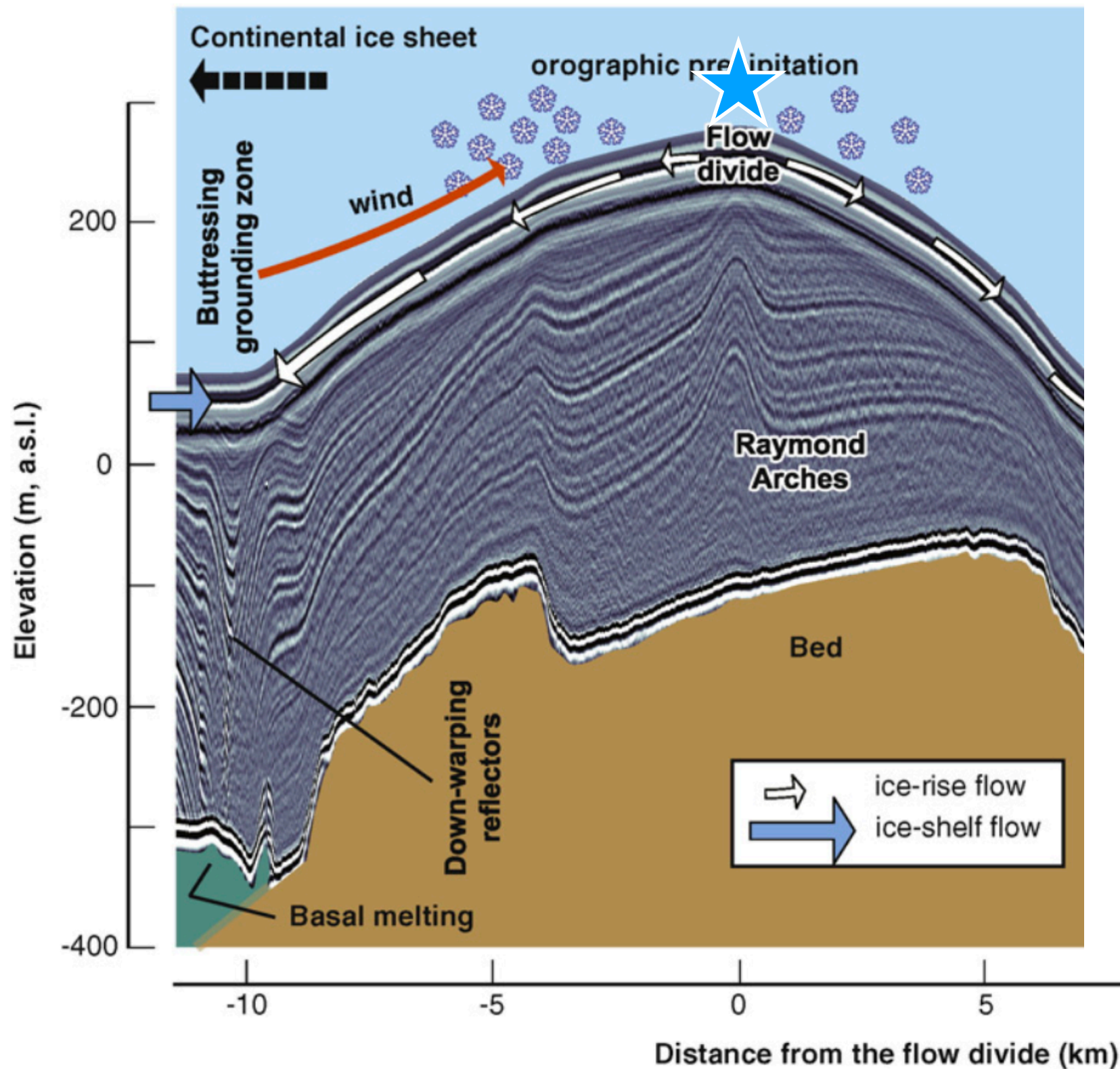


Ice Rises

Locally-grounded, independently accumulating & flowing ice within or at the margin of Antarctic ice shelves



Ice core scientists & glaciologists love **ice rises**



Simplest ice flow case in complex coastal regions

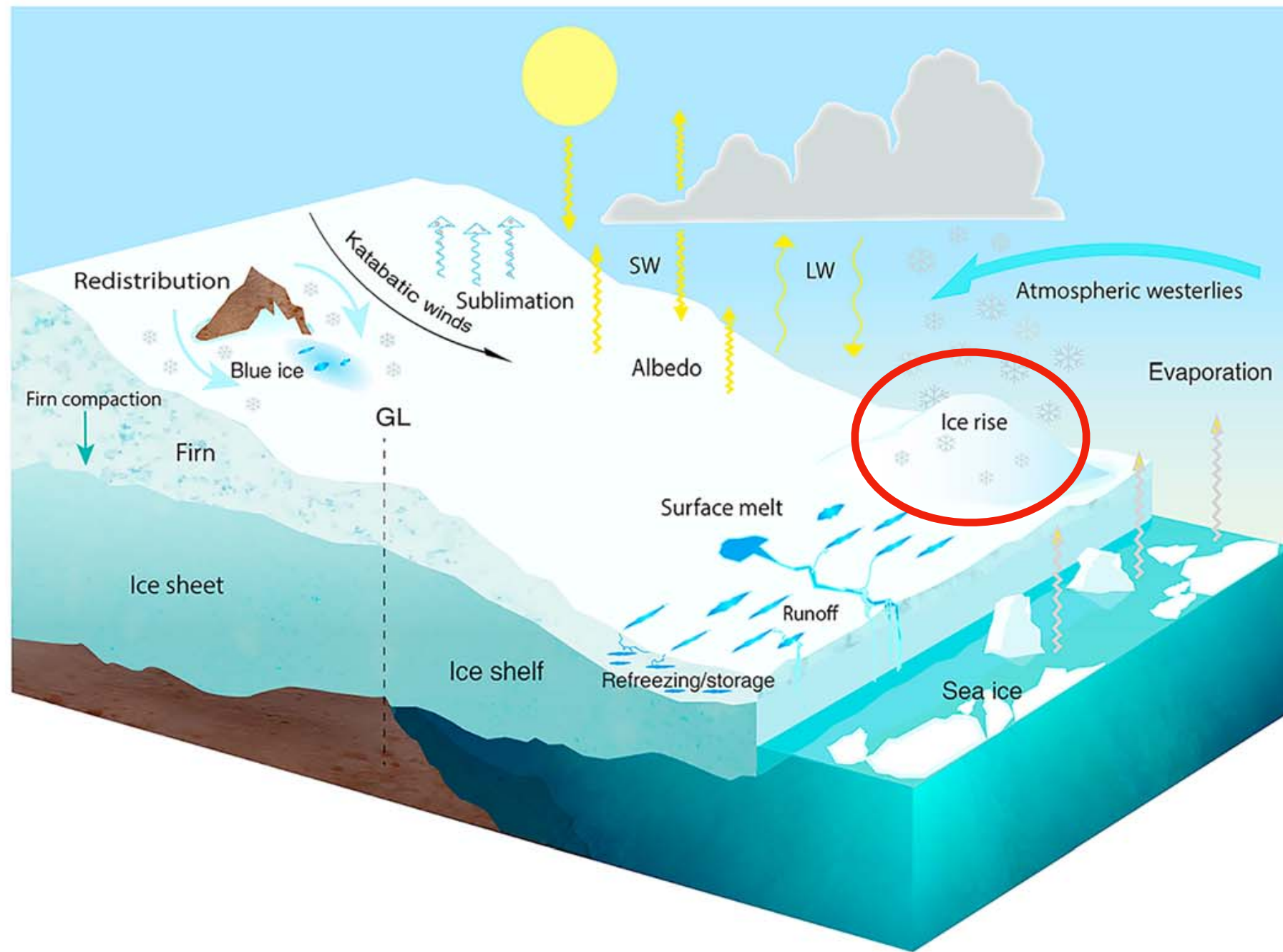
No crevassing

Elevated above melt-prone ice shelves

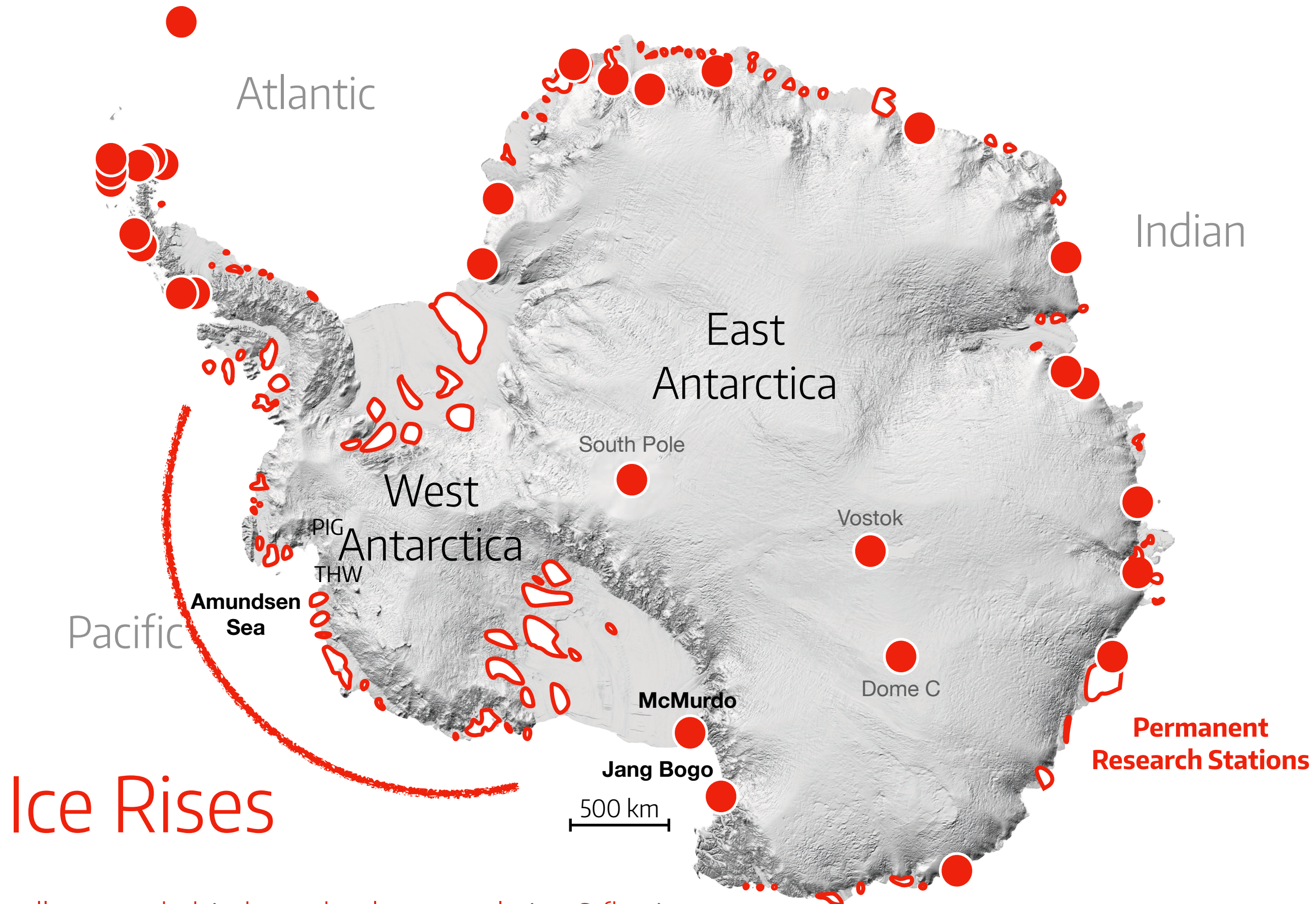
Thick ice for possible millennial reconstruction

Ice rise divide structure brings old ice nearer to surface

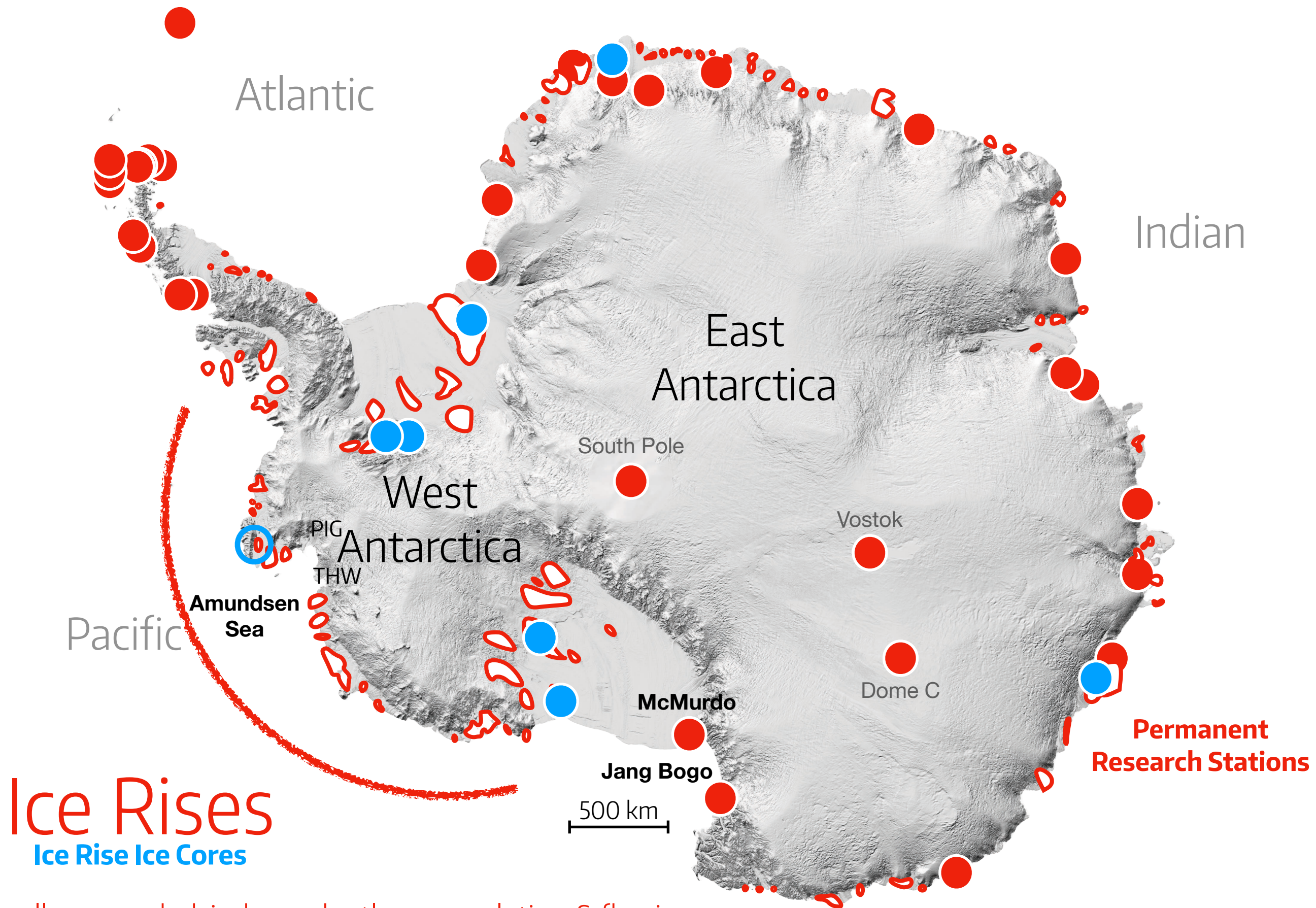
Ice rises are ideally located in the mix of coastal processes affecting ice sheet mass balance



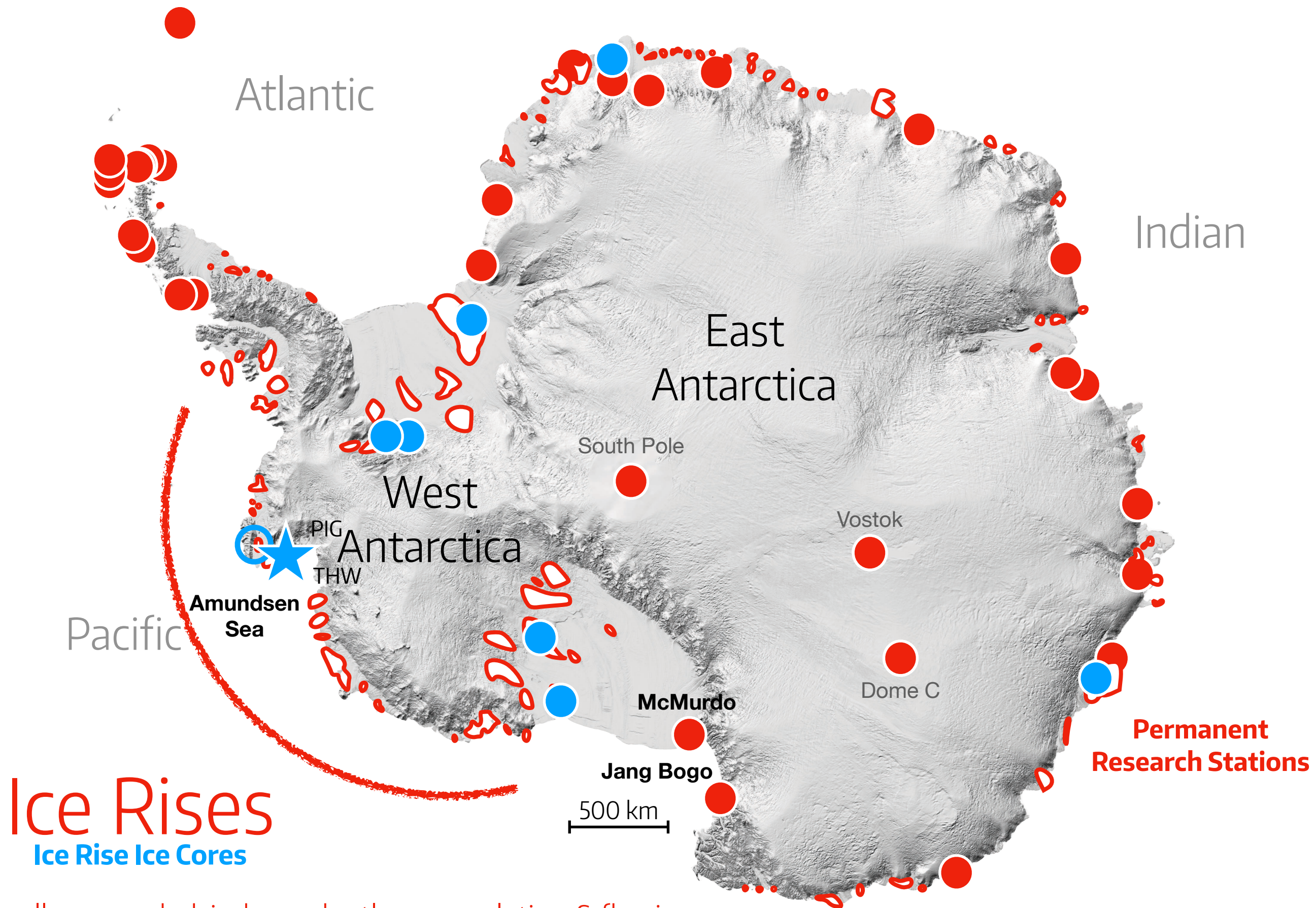
Especially proximal to **ice-ocean-atmosphere** processes driving WAIS ice loss



Locally-grounded, independently accumulating & flowing ice within or at the margin of Antarctic ice shelves

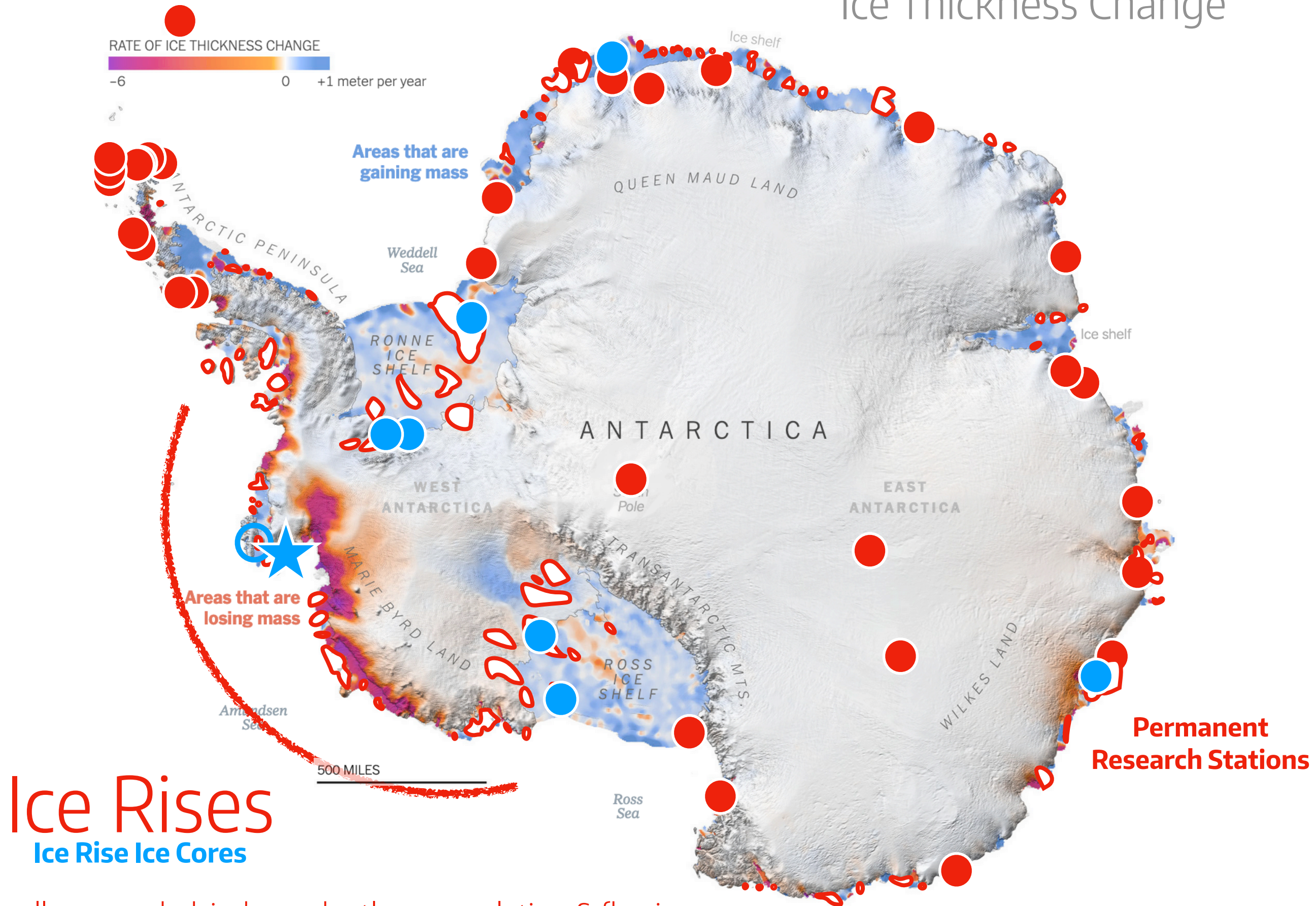


Locally-grounded, independently accumulating & flowing ice within or at the margin of Antarctic ice shelves



Locally-grounded, independently accumulating & flowing ice within or at the margin of Antarctic ice shelves

Ice Thickness Change



Ice Rises

Ice Rise Ice Cores

Locally-grounded, independently accumulating & flowing ice within or at the margin of Antarctic ice shelves

Smith et al., 2020
NASA ICESat and ICESat-2
New York Times visualization

50 km



2021-12-05

Amundsen
Sea

PIG

**Thwaites
Glacier**

West Antarctic Ice Sheet

50 km



2021-12-05

Amundsen
Sea

Abbot

KP

Cosgrove

CP

Getz

MP

Dotson

BP

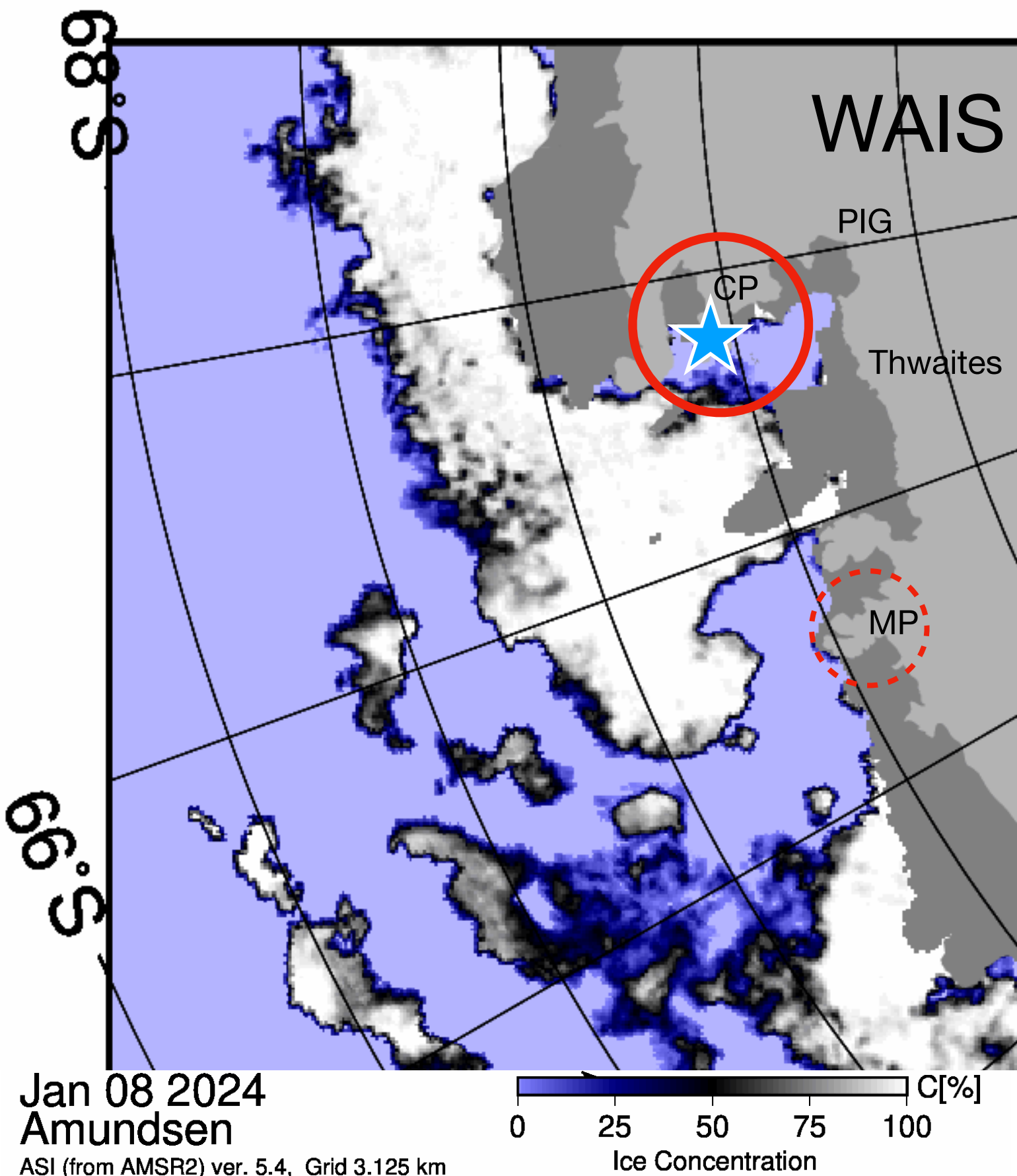
Crosson

PIG

Thwaites
Glacier

West Antarctic Ice Sheet

MP - Martin Pen
BP - Bear Pen
CP - Canisteo Pen
KP - King Pen



**10 day sail from
Lyttelton, New Zealand**

**Sea ice conditions
dictate Canisteo Pen.
as primary site**

**RV ARAON able to
remain near
(< 8 hr response)**

**Ship completes Pine
Island Bay science while
ice coring underway**



Canisteo Peninsula (73.7°S, 102.3°W)

atmosphere
ice
ocean

Canisteo Peninsula

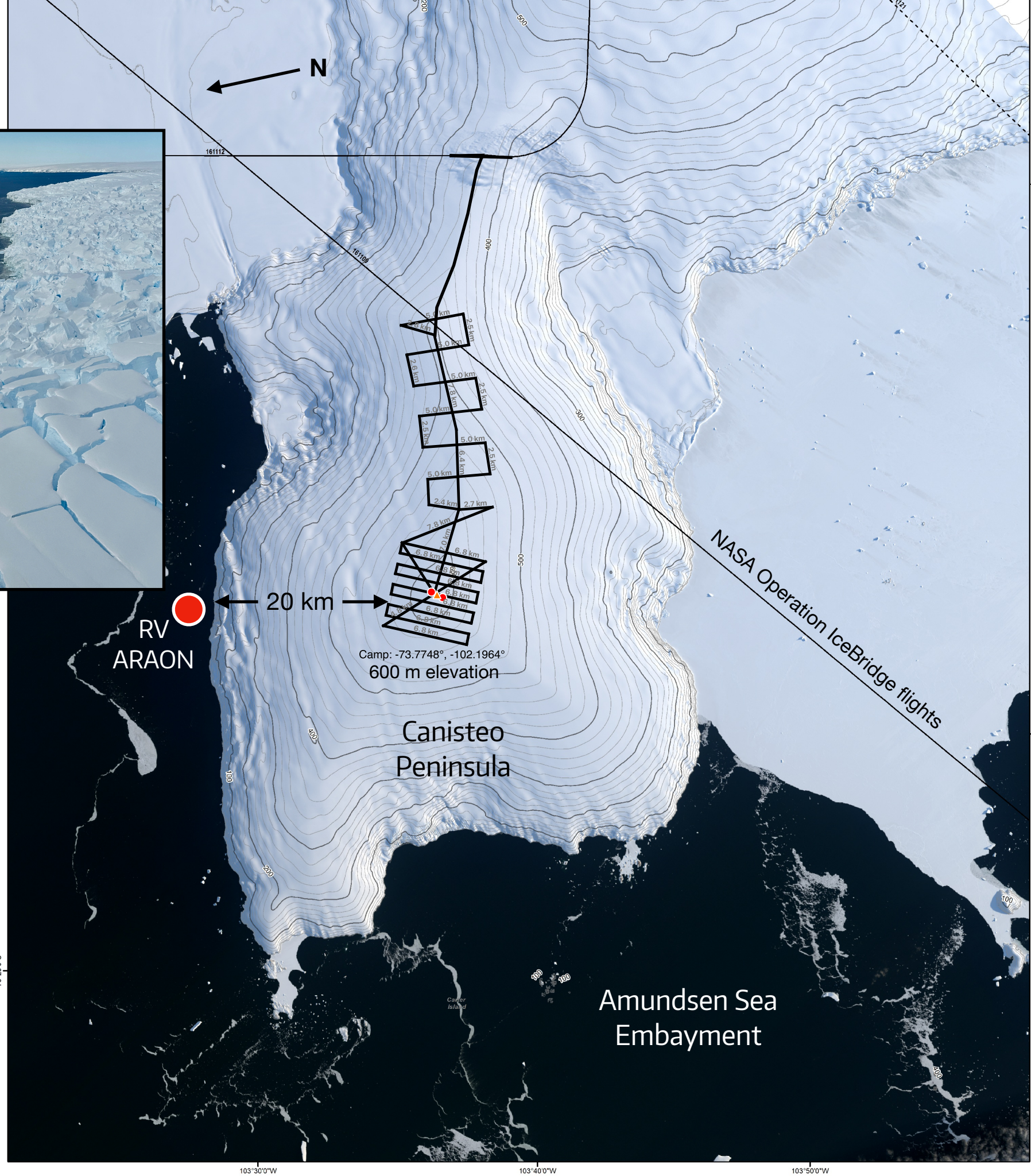


~7500 kg equipment IN

7500 kg equip.
5600 kg ice OUT

12-17 flights in & out
Two AS350 helicopters

Ship onsite ~36 hours



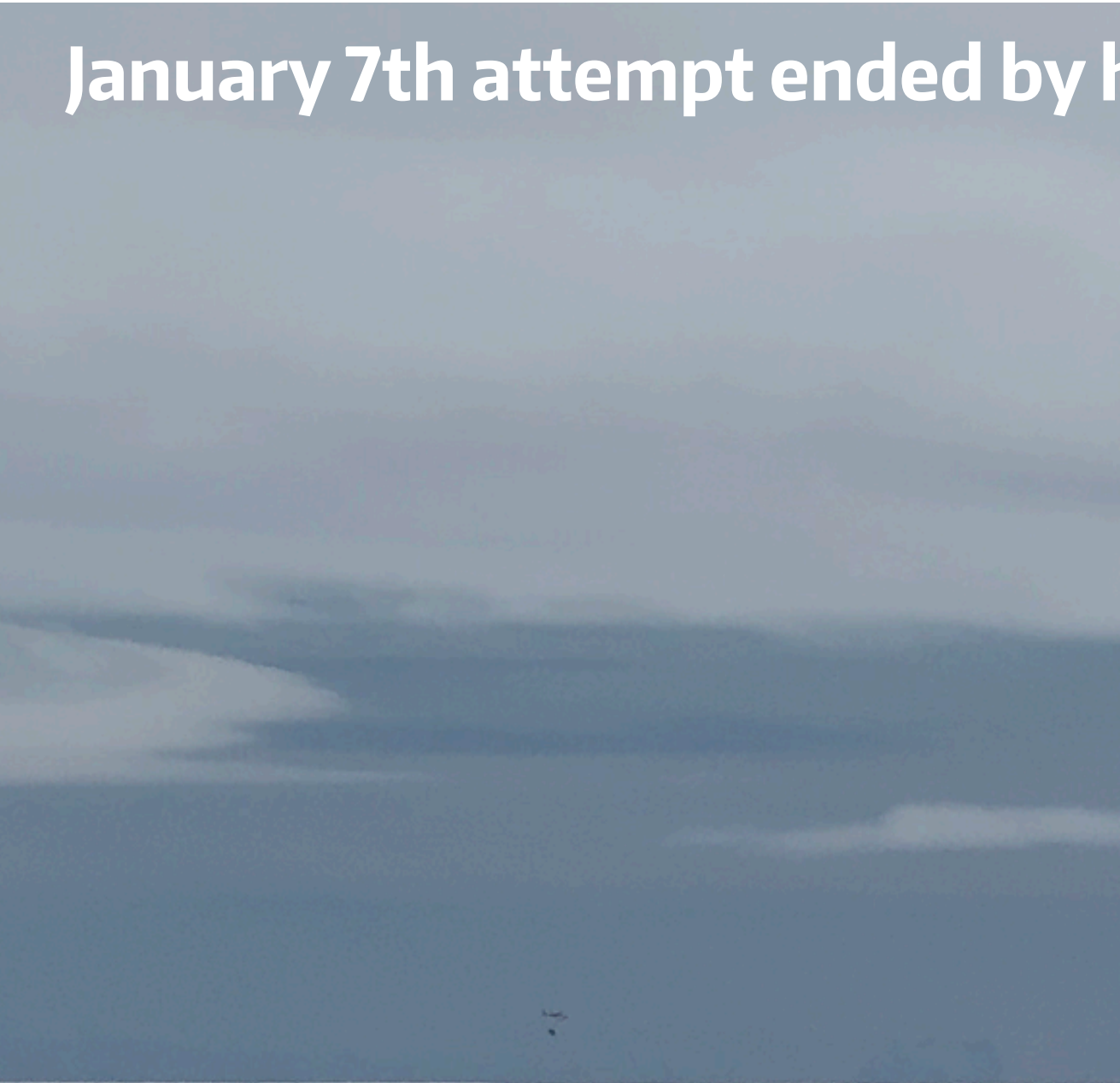
Canisteo Peninsula - Camp Put-In

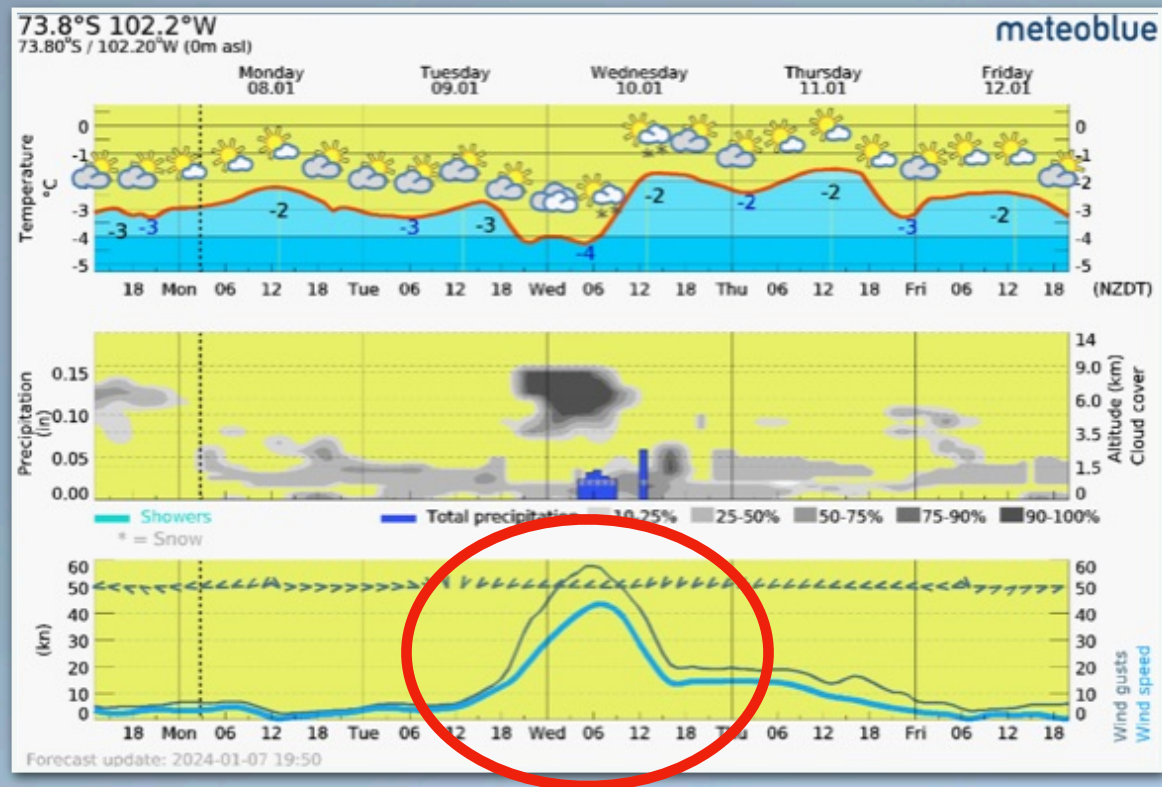
January 7th attempt ended by high cloud, poor ground reference



Canisteo Peninsula - Camp Put-In

January 7th attempt ended by high cloud, poor ground reference





January 7th concern as weather window is poor & narrowing

Snow/wind storm forecast in 36 hours...



Canisteo Peninsula - Camp Put-In

January 8th put-in, 4 hours 8:00 - 12:00z



S. Kim

V. Goel

Canisteo Peninsula - Weathering 36 hr storm

January 8, 23:00

-

January 10, 10:00



**Two tents crushed,
no equipment lost**



Mountain Hardwear Space Station performs poorly in strong wind & snow

Canisteo Peninsula - Weathering 36 hr storm



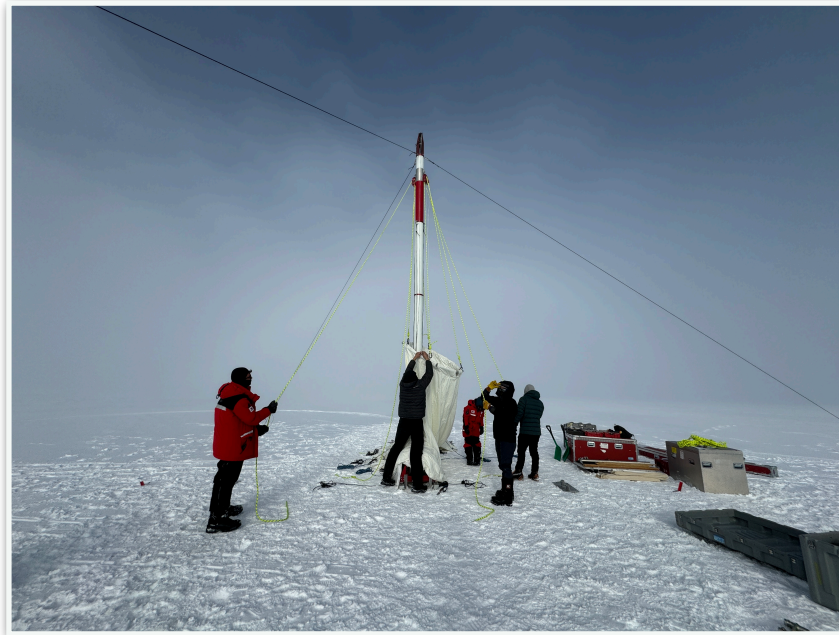
Primary US drilling challenge was generator electronics after snowstorm

Silly mistake, problem progressed to disconnecting auto throttle, controlling manually



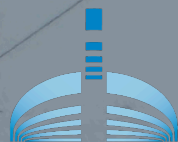
Starlink + YouTube troubleshooting 👍

Canisteo Peninsula - US Ice Drilling Program Foro 400 drill



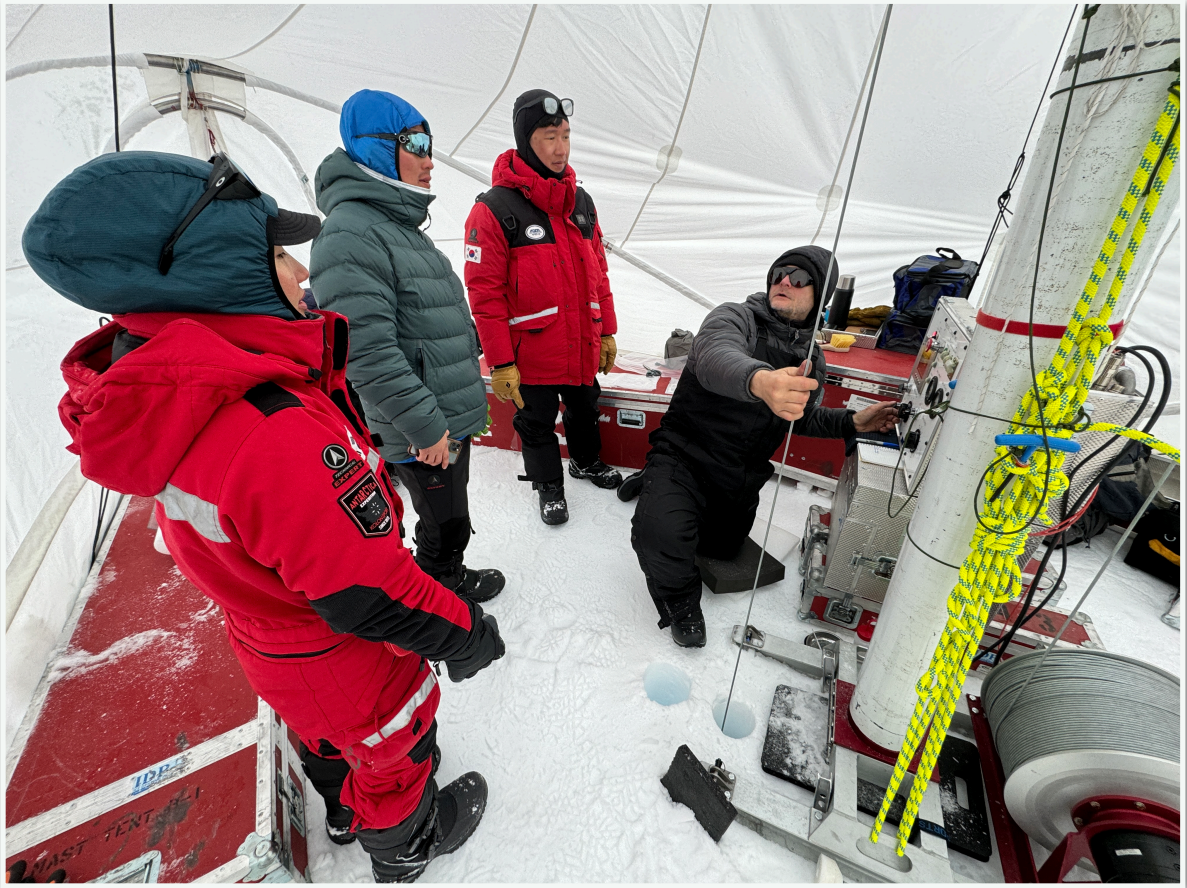
Etienne Gros, US-IDP contract driller

Do our guy lines indicate stress after the storm?

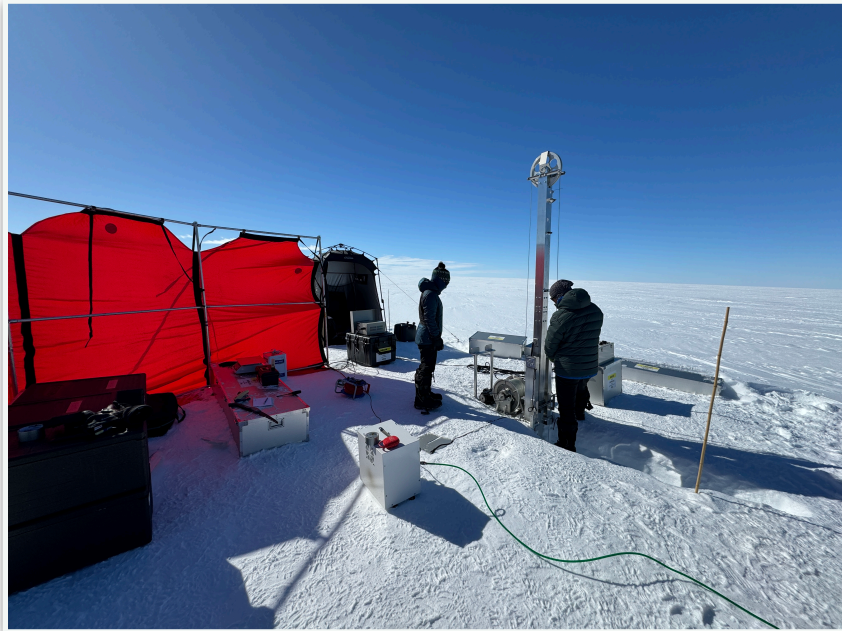


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Canisteo Peninsula - US Ice Drilling Program Foro 400 drill



Canisteo Peninsula - KOPRI Geotech (Japan) drill



Drilling generally progressed with limited drama,
just drill, eat, sleep for one week



Canisteo Peninsula

13 days on site

7 days drilling

2 x **150 m** ice cores



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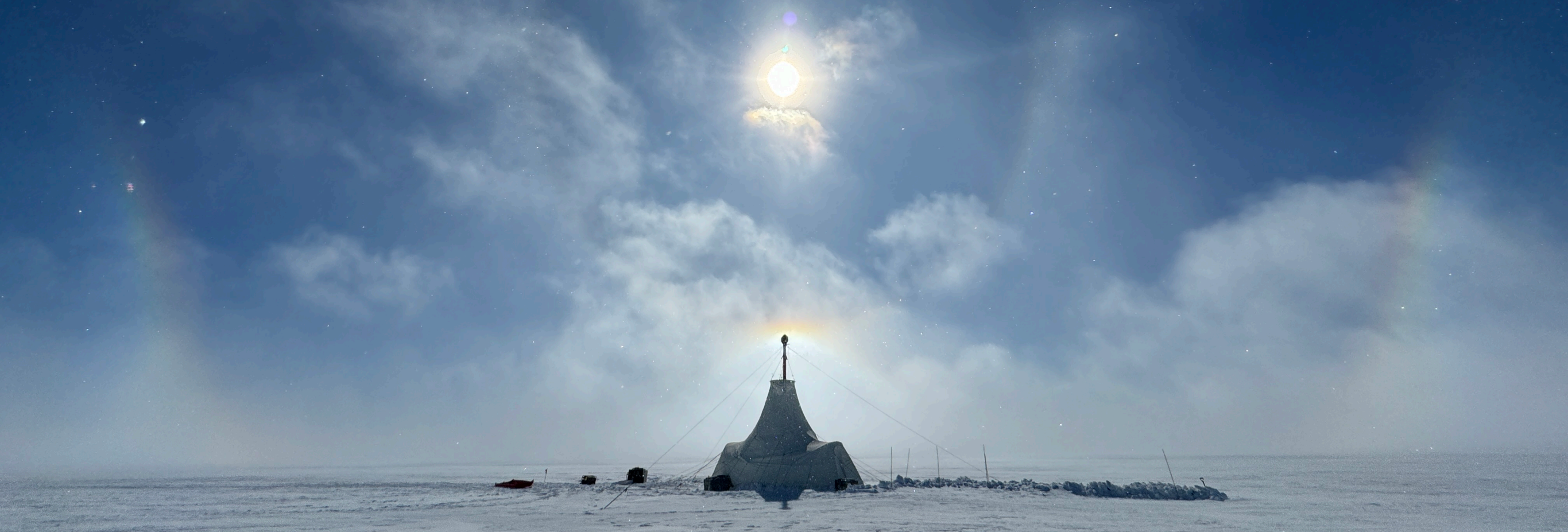
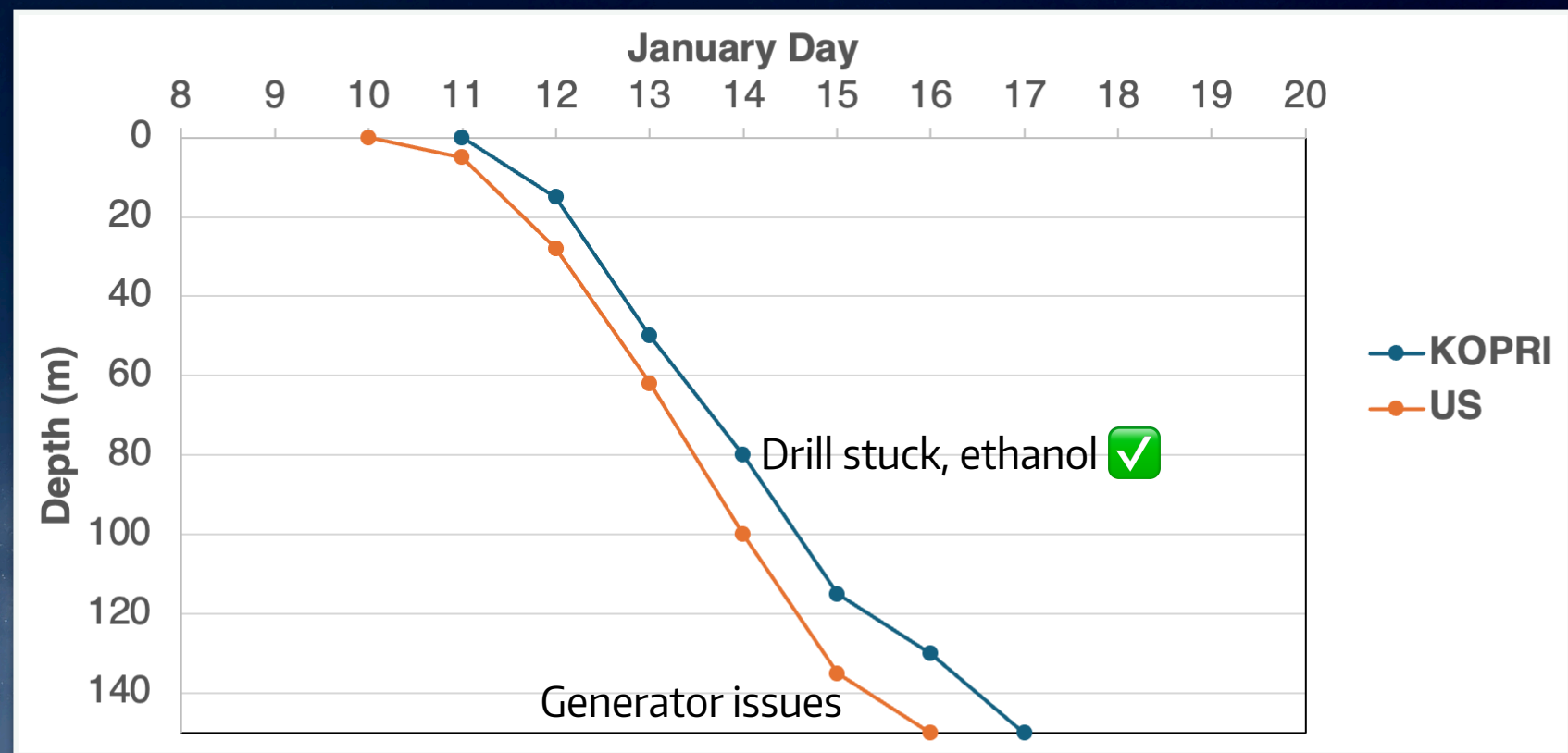
U.S. ICE DRILLING PROGRAM

Canisteo Peninsula

13 days on site

7 days drilling

2 x 150 m ice cores





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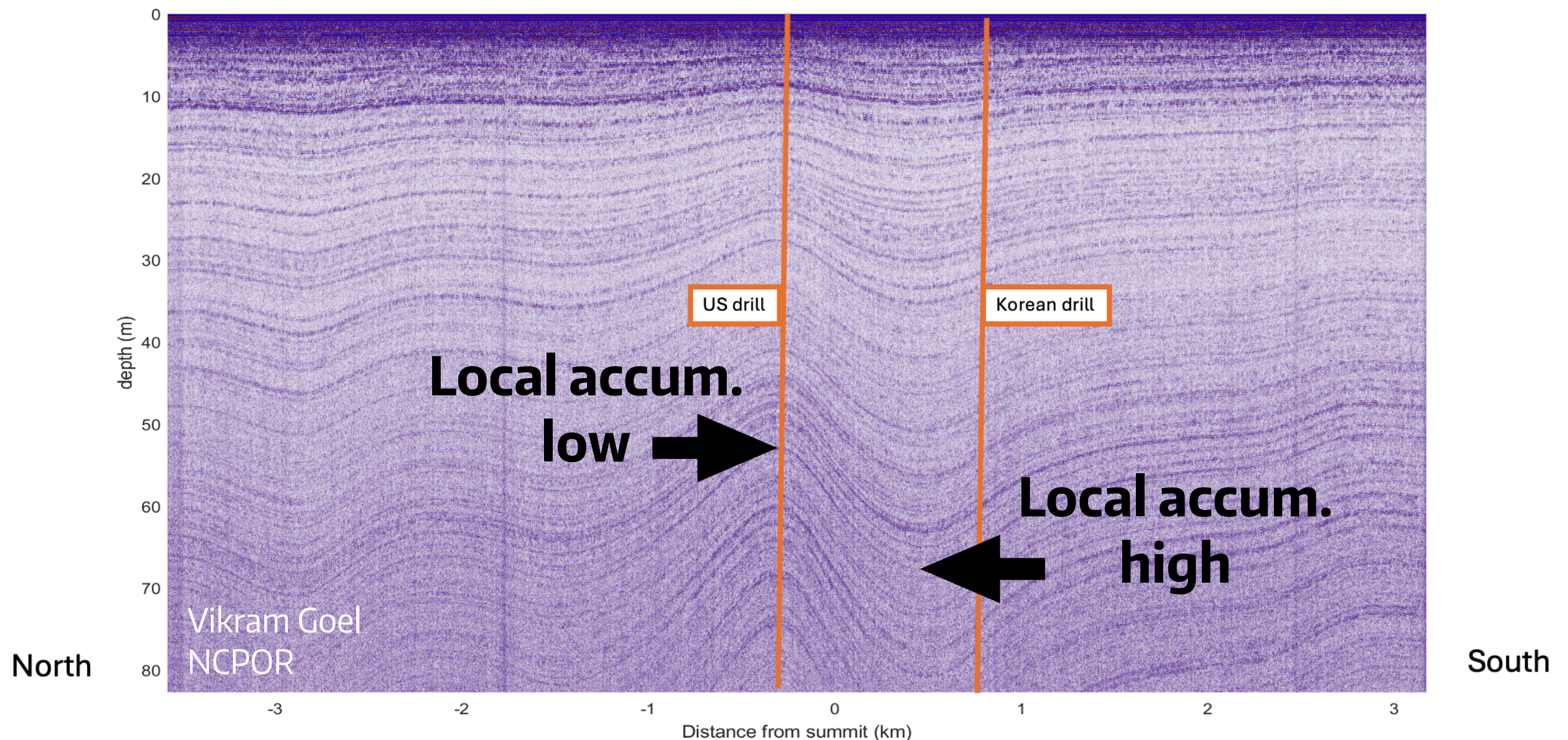
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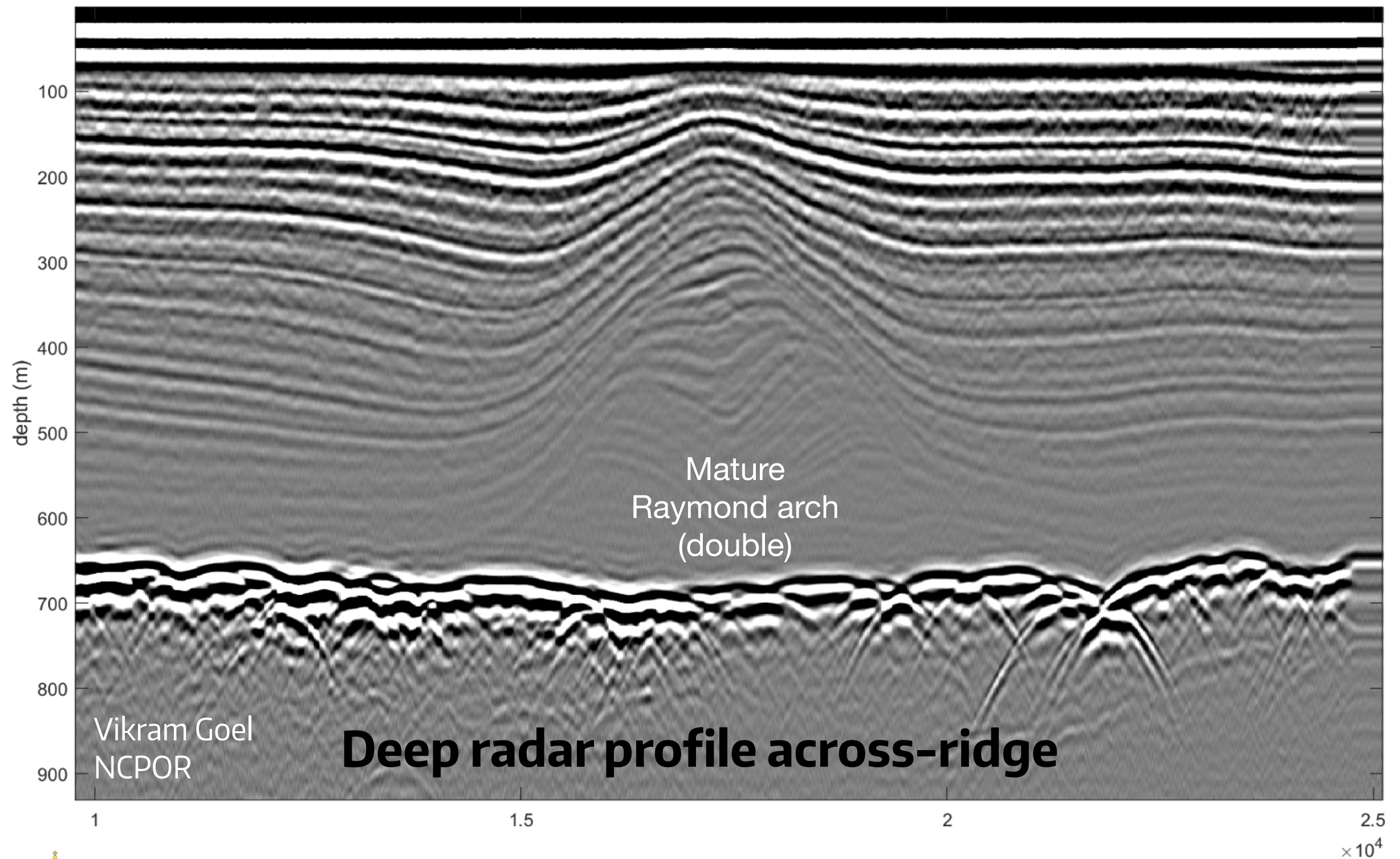
U.S. ICE DRILLING PROGRAM

Two cores drilled for maximum sample volume, replication, & sampling local high/low snow accumulation

Shallow-radar profile across the ridge



Ice thickness ~650 m, 2nd repeat ice thickness & 1st regional surface mass balance survey (iSTAR, Pritchard et al., unpublished)







Canisteo Peninsula - Camp Take-Out

January 20th pull-out, 5.5 hours 10:00 - 15:30z



Canisteo Peninsula - Camp Take-Out

January 20th pull-out, 5.5 hours 10:00 - 15:30z



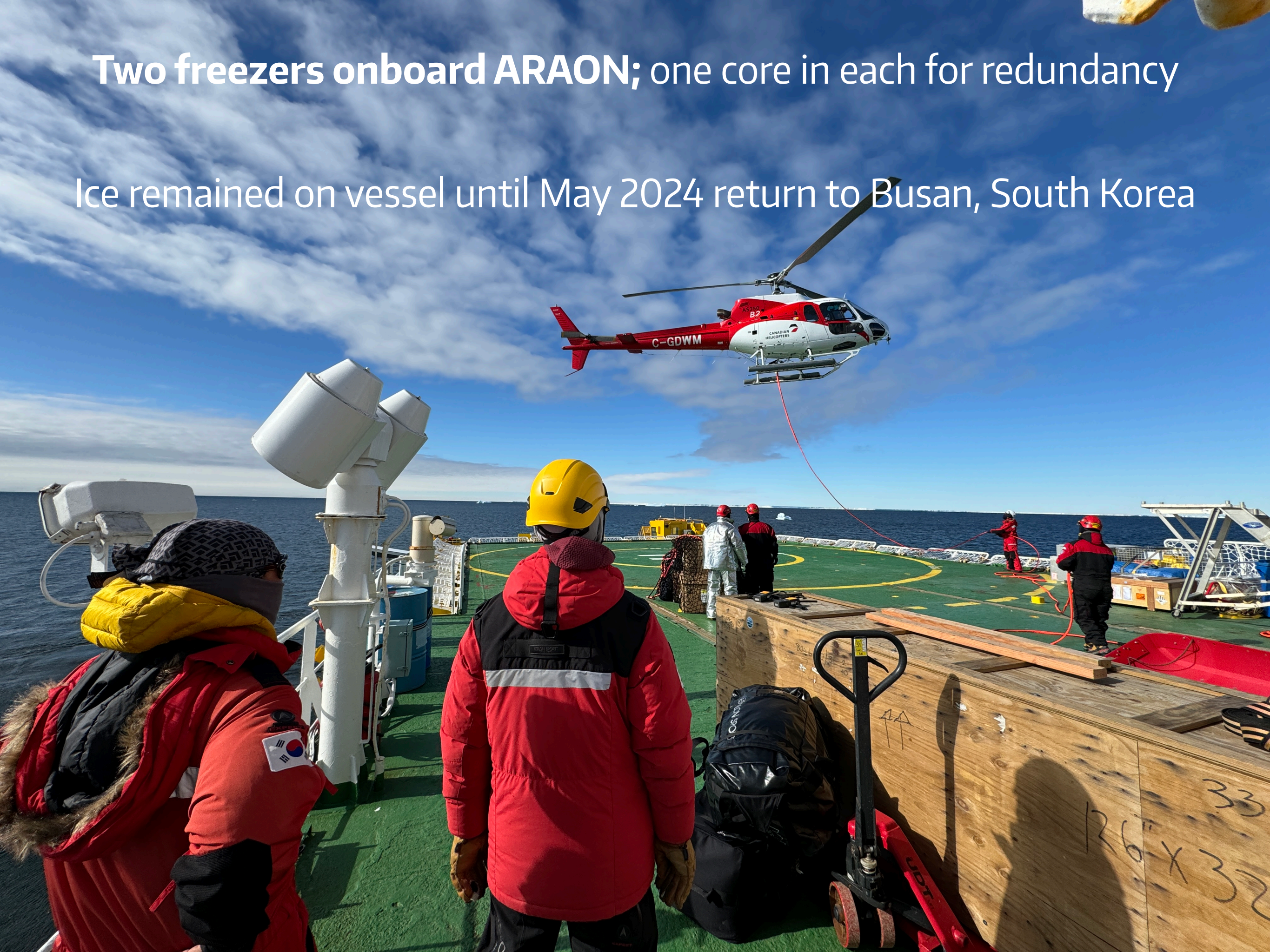
D. O'Rourke

Why helicopters are an essential tool for coastal Antarctic glaciology & oceanography...



Two freezers onboard ARAON; one core in each for redundancy

Ice remained on vessel until May 2024 return to Busan, South Korea





Major Lessons

~2 days of dedicated ship time to support 8 person ice core & geophysics camp for ~2 weeks. Retro 300m of ice.

~Weekly synoptic weather cycle is a challenge in a 3-4 week science cruise window. Storms can last much longer than 2 days

Coastal cloud can limit aviation & is a primary danger for helicopters in Antarctica

**20 km from hub to camp beats 2,300 km
(distance from McMurdo)**



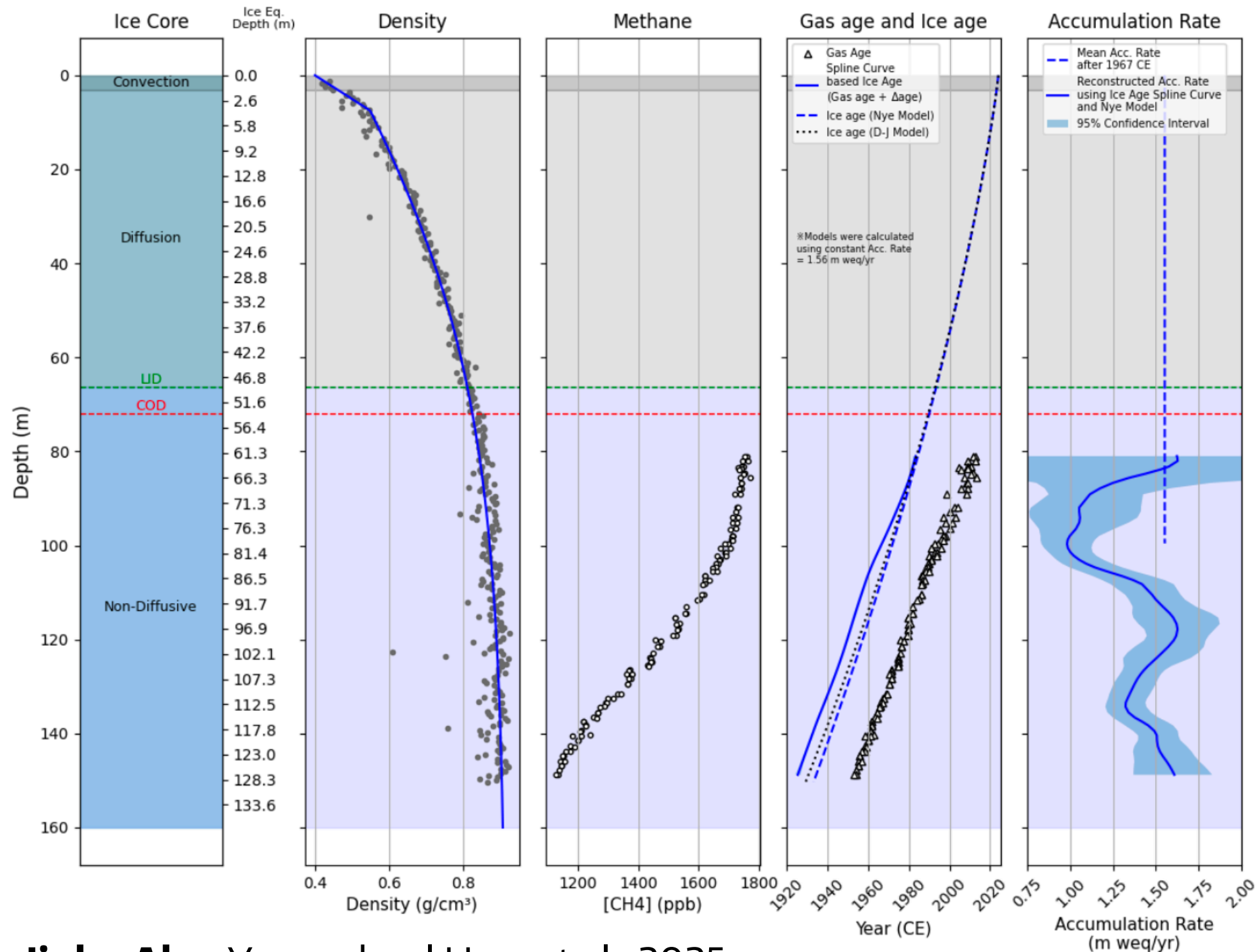
Canisteo Peninsula - Preliminary Data

KOPRI core (CPSW)

1.56 m/yr ice-equivalent snow accumulation

Ice age 1967 CE @ 100m, **~1920 CE @ 150m**

Methane well-preserved, 28 yr Δ age



Hyeongi Lee, Jinho Ahn, Yeongcheol Han, et al., 2025

RAICA

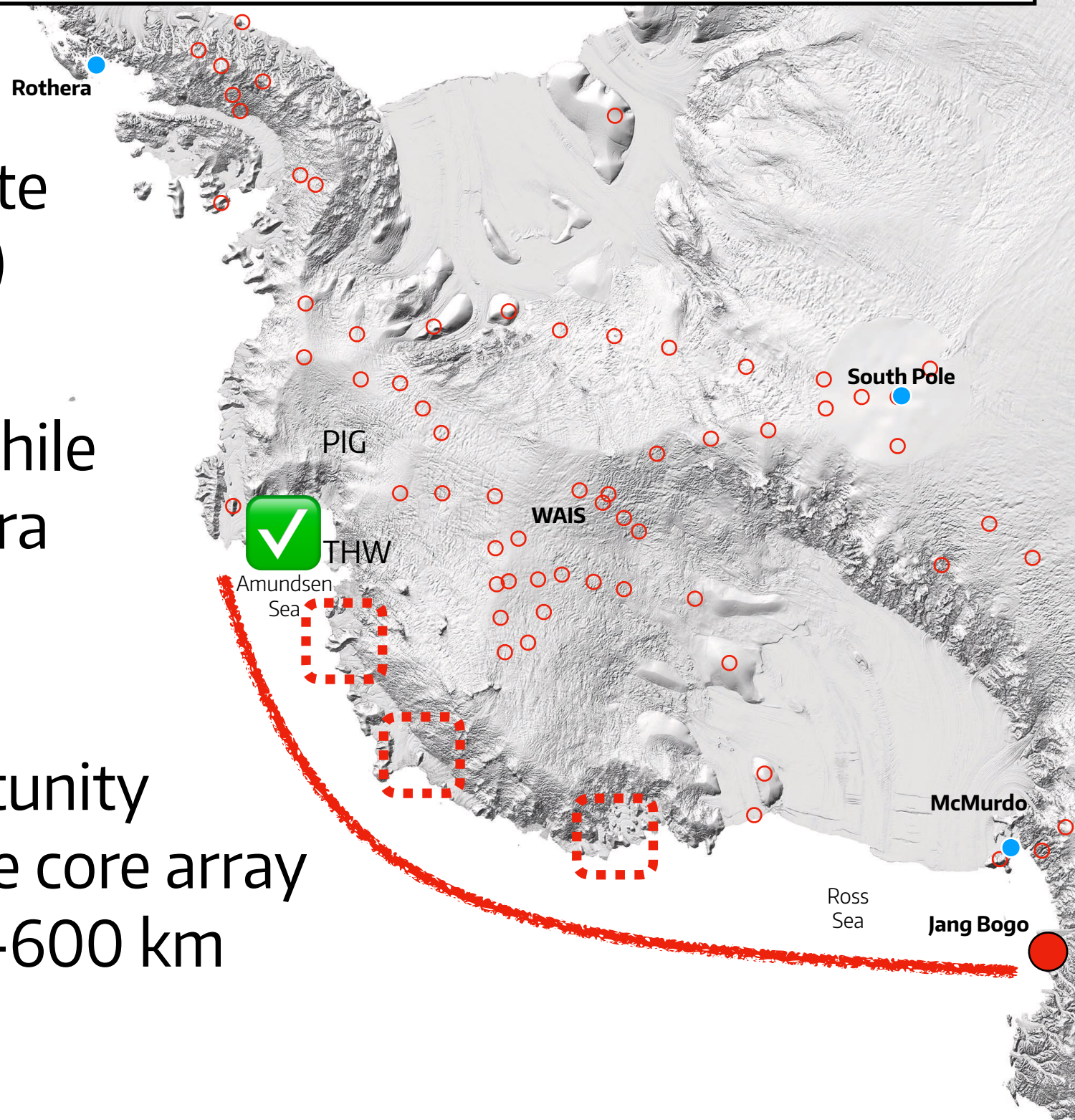
The Ross-Amundsen Ice Core Array

Closing the coastal gap in the WAIS ice core array

Minimum 150 m cores to document 20th century climate (snow accumulation >1 m/yr)

Collect new coastal cores while maintaining the 2000s-era WAIS ice core array

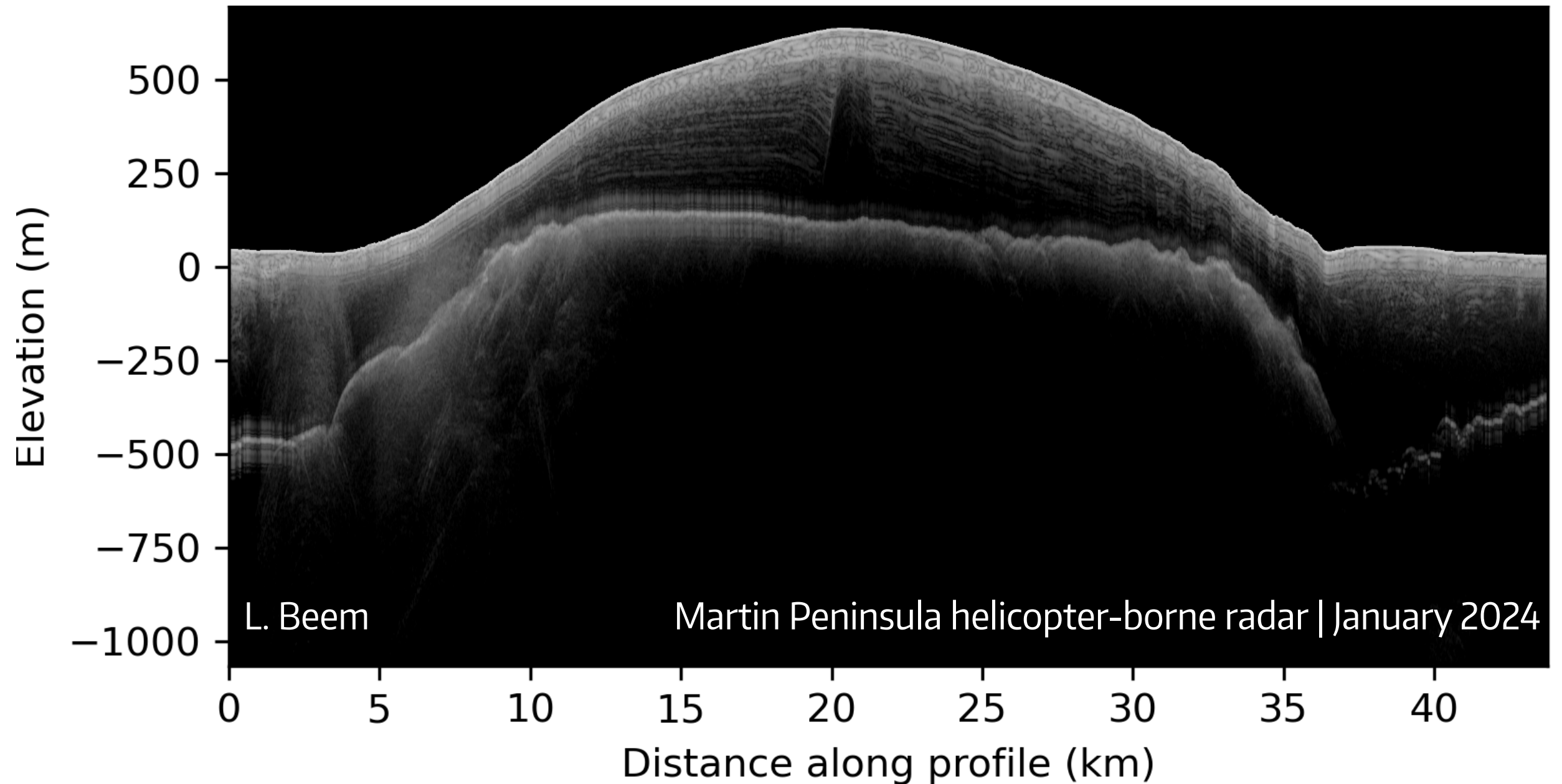
Ice rises provide opportunity to construct a WAIS coastal ice core array with an ice core every 400-600 km



U.S. ICE DRILLING PROGRAM

RAICA

Closing the coastal gap in the
WAIS ice core array



**WAIS coast is a target-rich environment for ice rise ice
cores to fill a critical gap in our international
Antarctic ice core array**

South Korea a world leader in ambitious multi-disciplinary tasking of RV ARAON, especially use of helicopters for coastal Antarctic glaciology. The United States currently DOES NOT have a viable vessel for such necessary work for the foreseeable future.





RAICA: The Ross-Amundsen Ice Core Array Canisteo Peninsula



Endless gratitude

to Yeongcheol Han, Won Sang Lee, and Sukyoung Yun
for their leadership & support on the voyage

