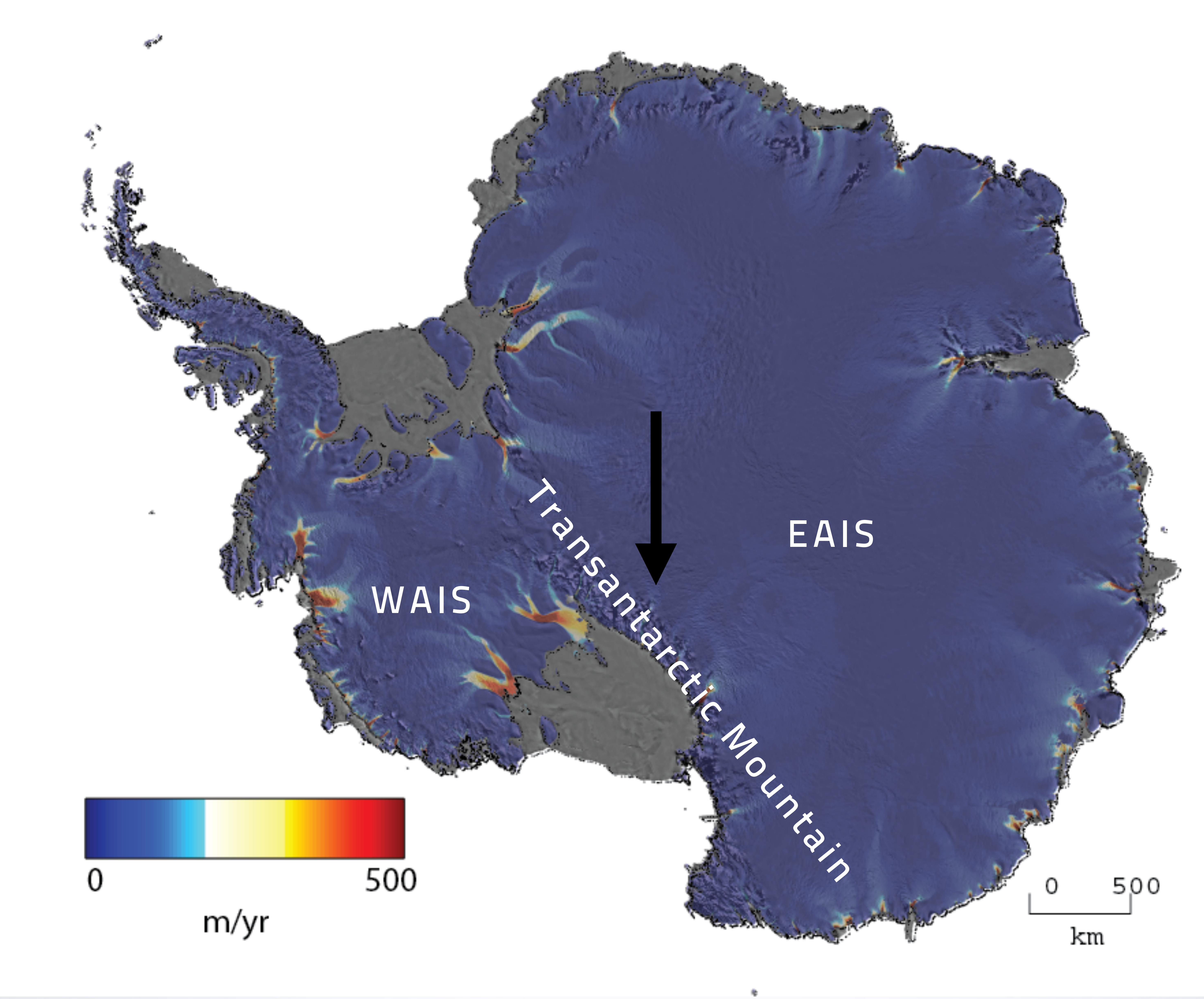
Geophysical Observations of Deformation Near The Grounding Line of Beardmore Glacier

Paul Winberry, Howard Conway, Michelle Koutnik, and Max Stevens

Major Pathway
for Ice Exiting
EAIS via
RIS

Two Field Seasons

2012: Mid-Glacier
2013: Grounding
Zone



Rignot et al 2011
MOA, nsidc

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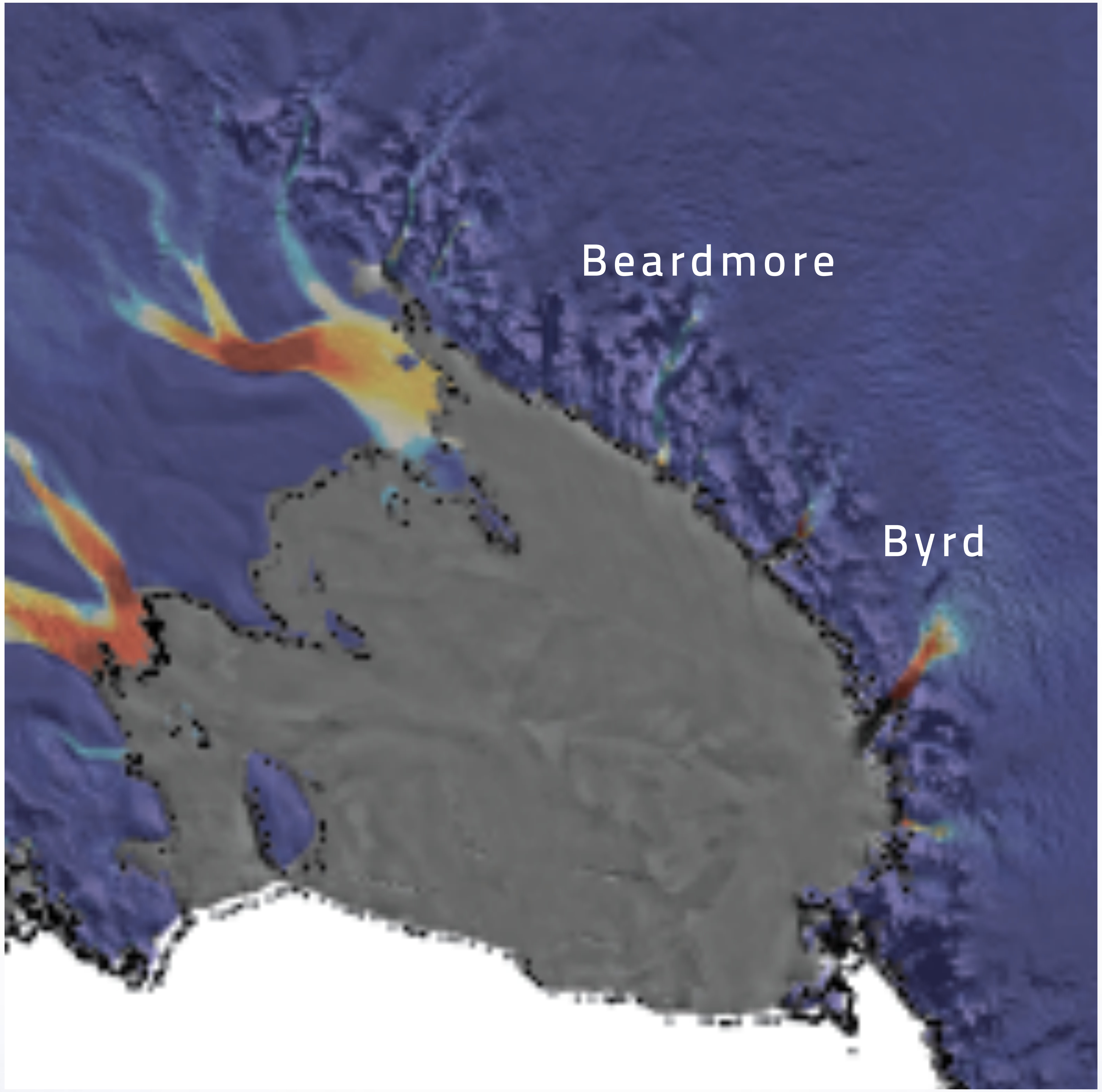

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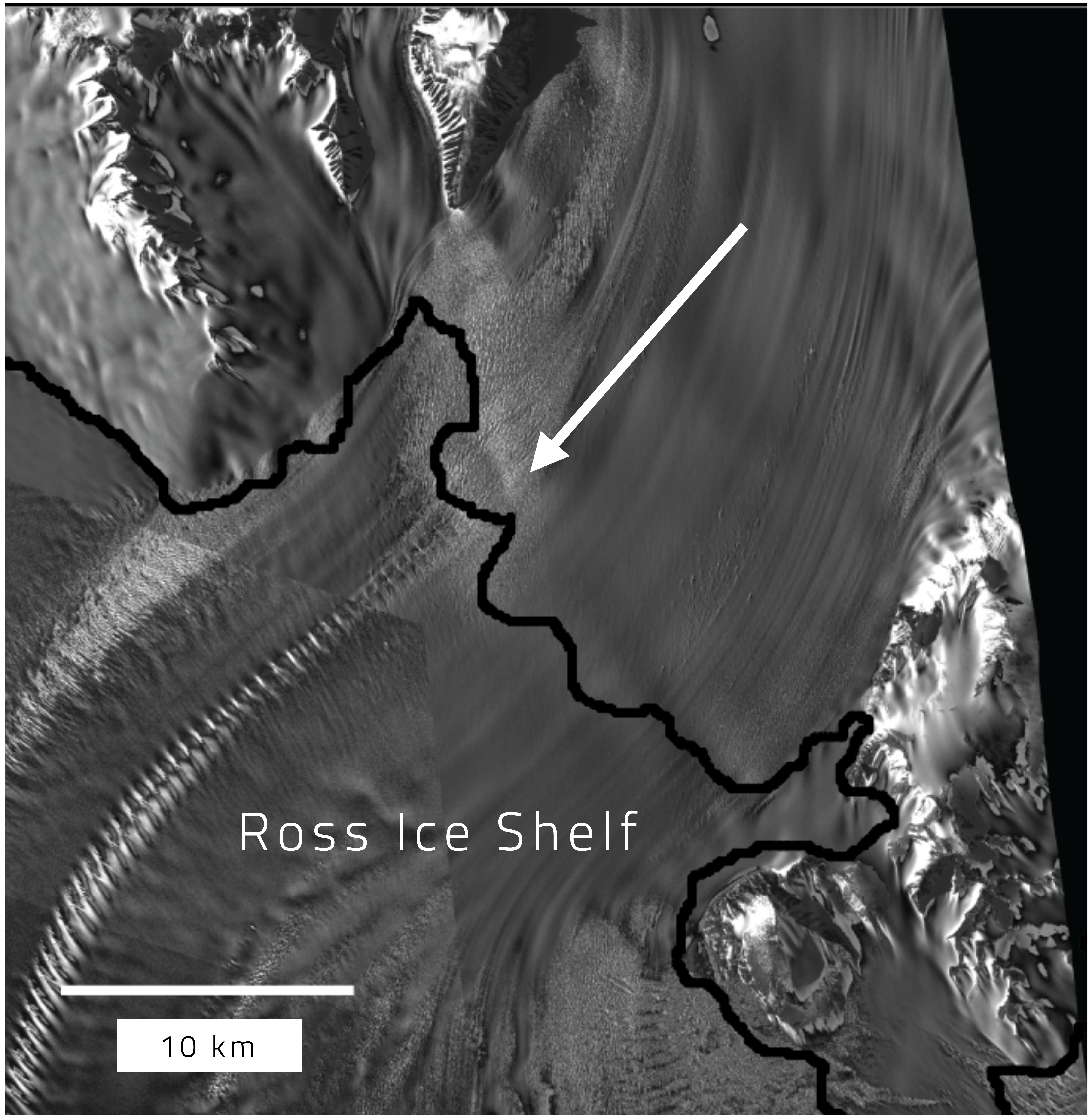
Grounding
Zone



Grounding Zones
Regulate Retreat

Complex Ice-Ocean
Interaction

WorldView from
Polar Geospatial Center

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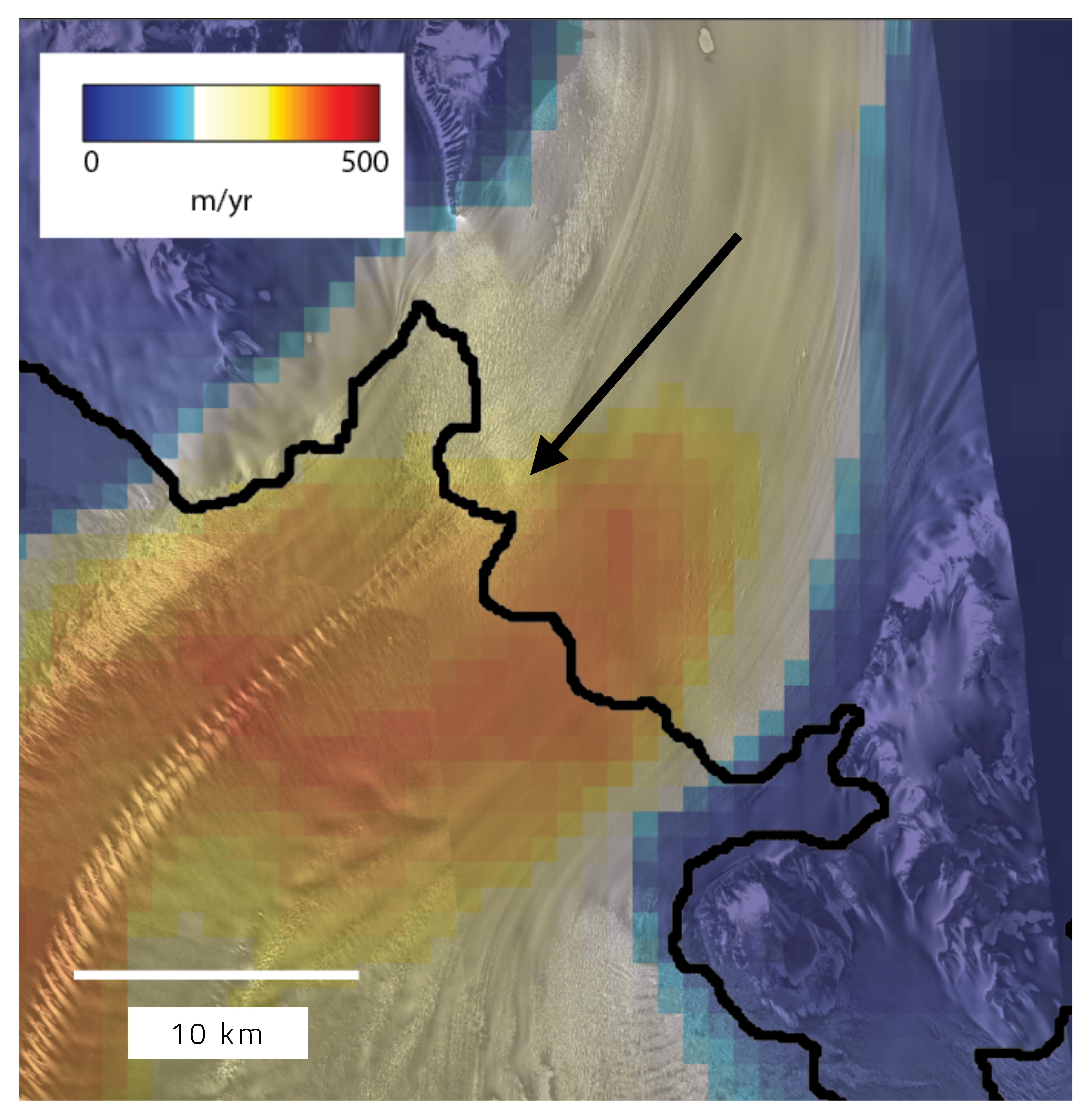
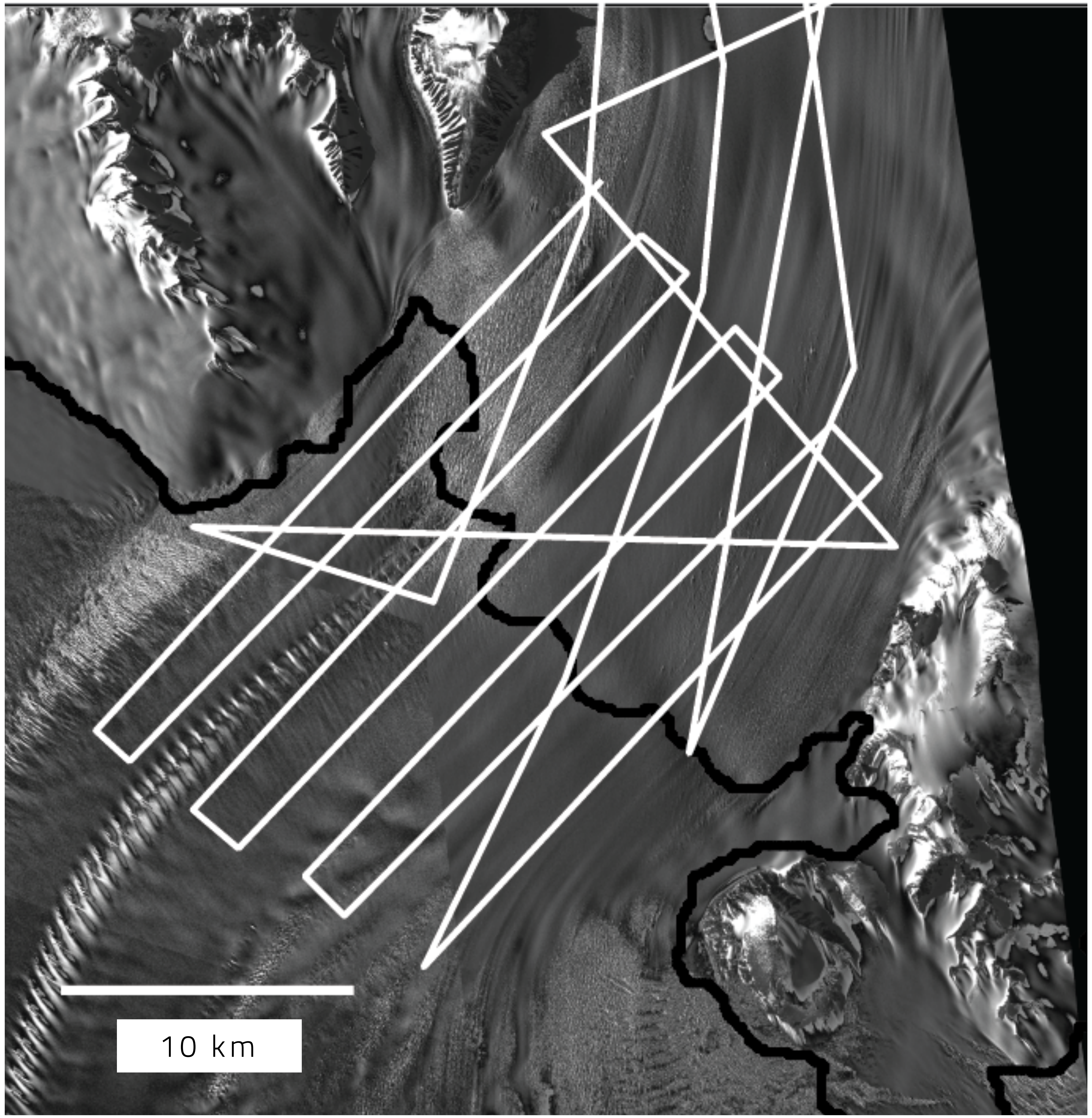
Grounding Zone



Rignot et al 2011

2012 Airborne Radar Survey to Map Ice Thickness



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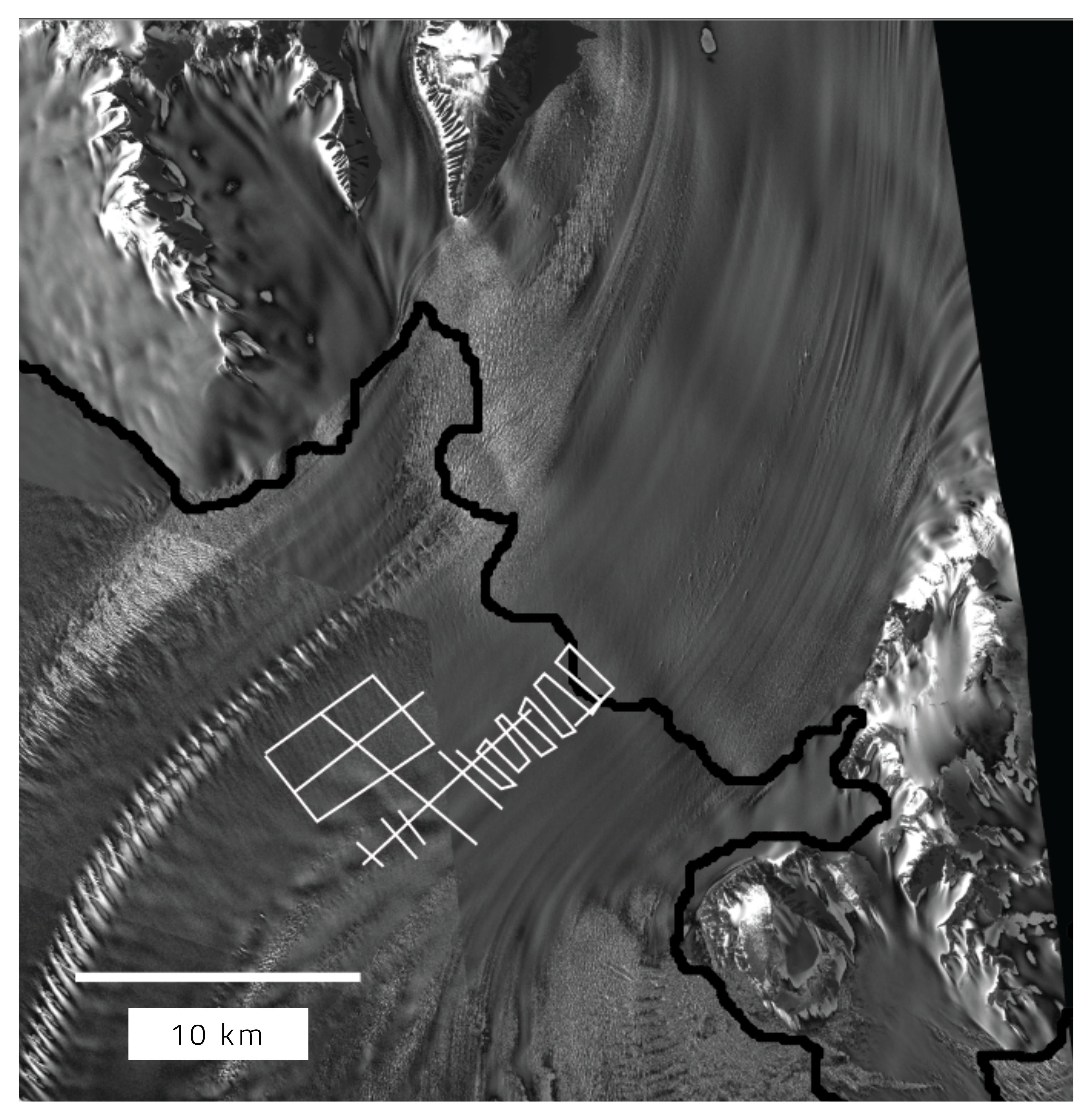
2013 Ground Based
Radar
Survey to Map Ice
Thickness



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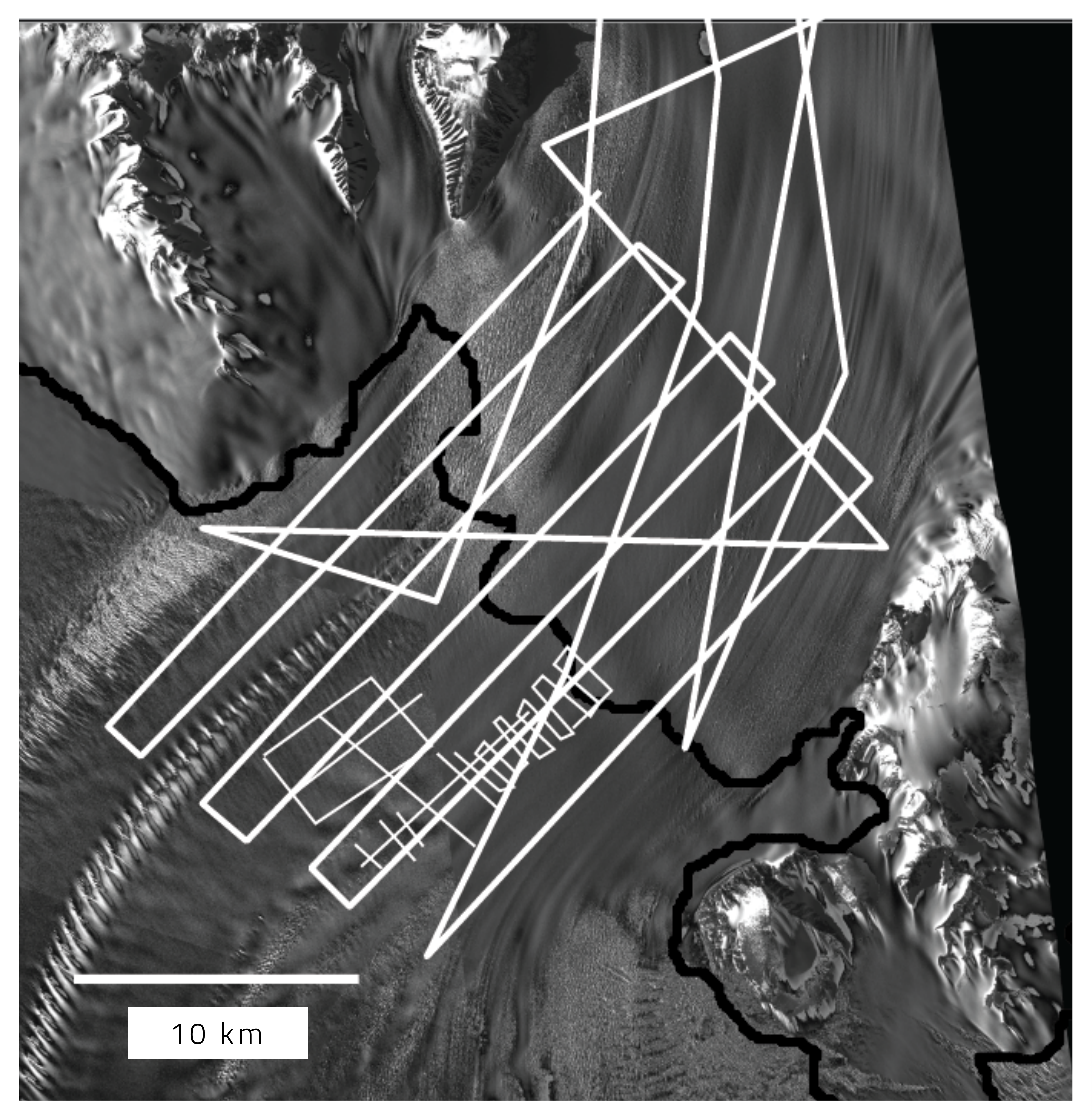
Combined Tracks



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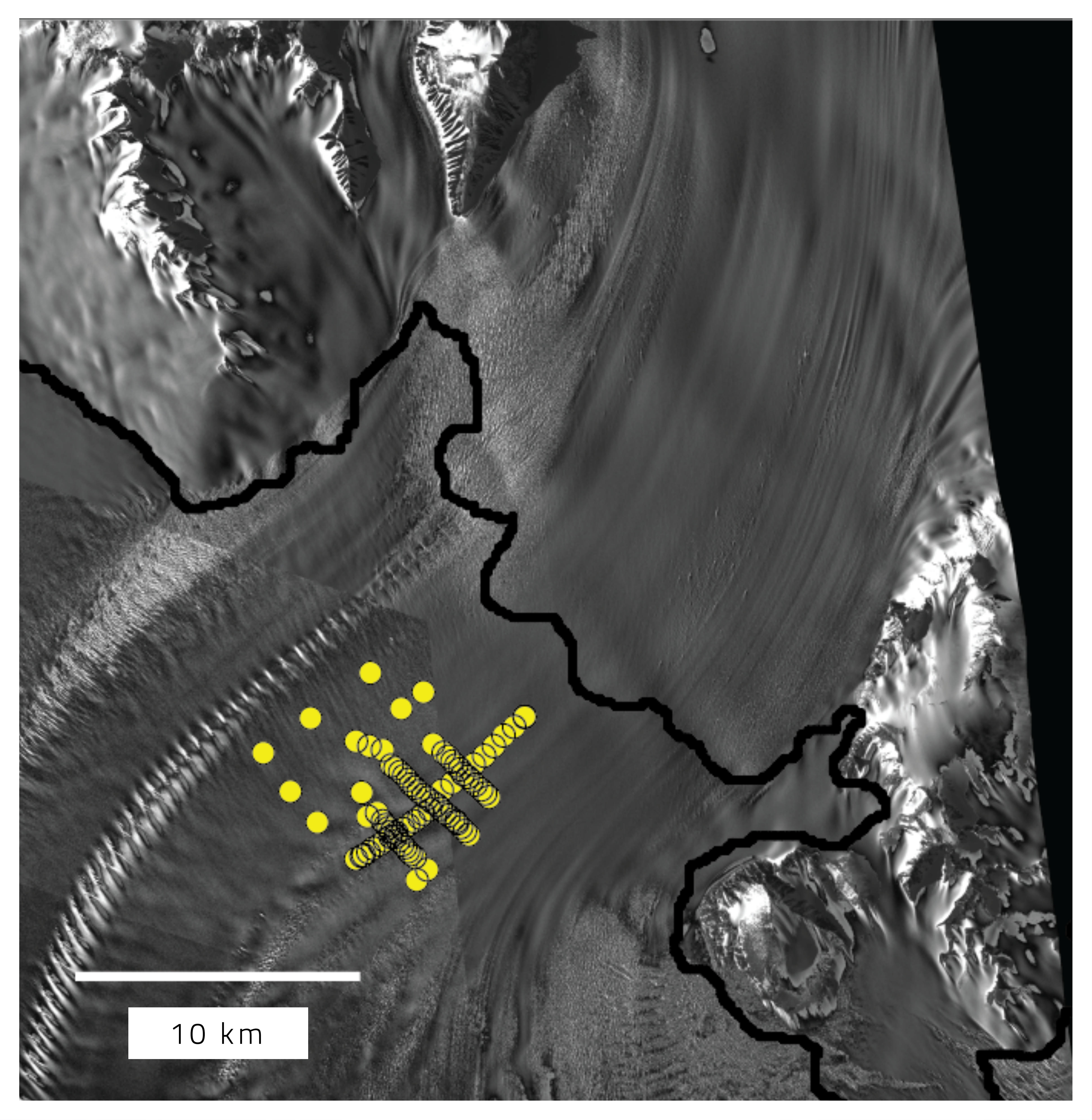
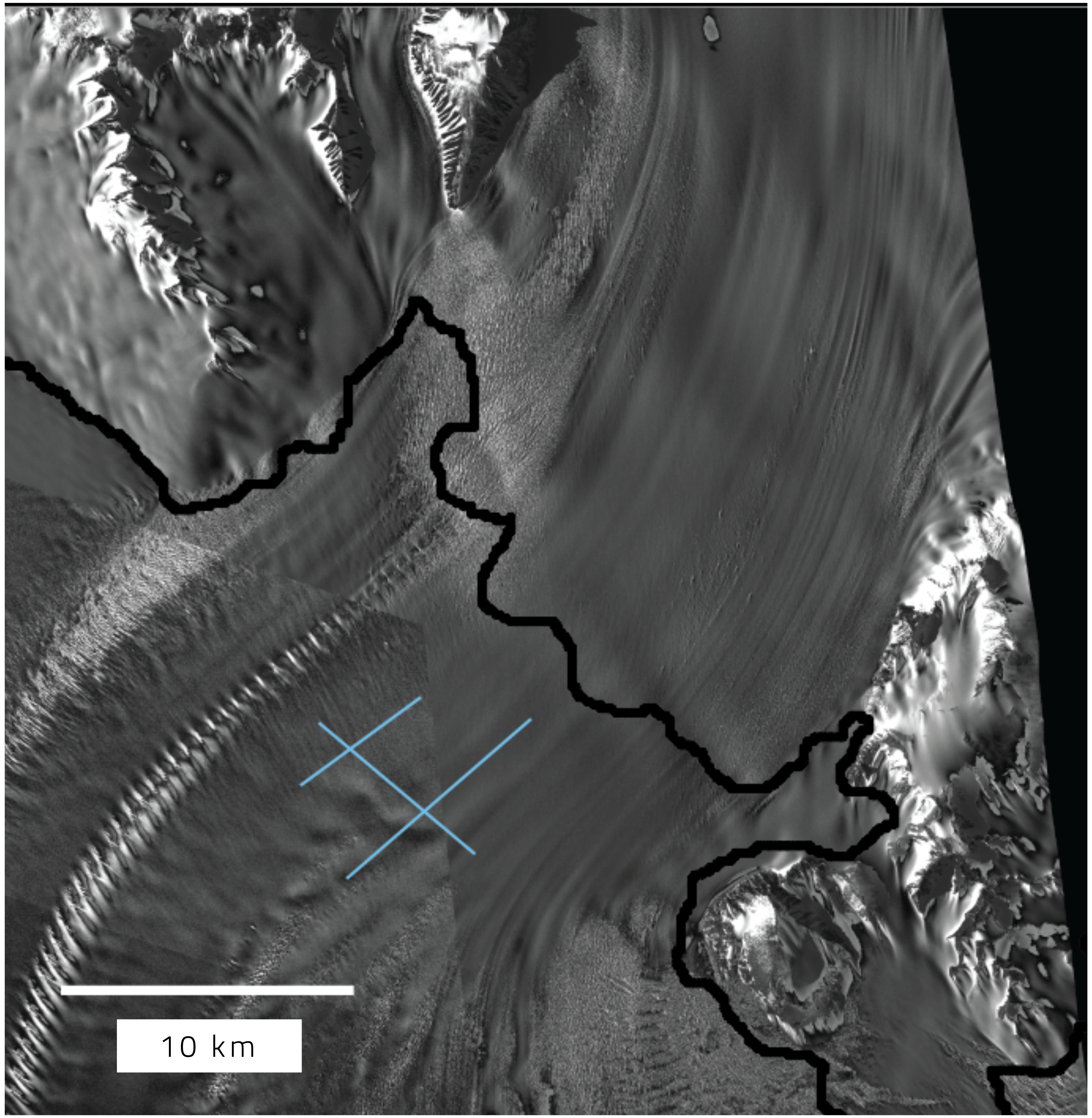
Phase Sensitive
Radar
Survey to Map Ice
Basal Melt
(more ice
deformation)
see Twit at AGU



BAS Supplied



Active Source Seismic to map Water Column Thickness and Subglacial Geology

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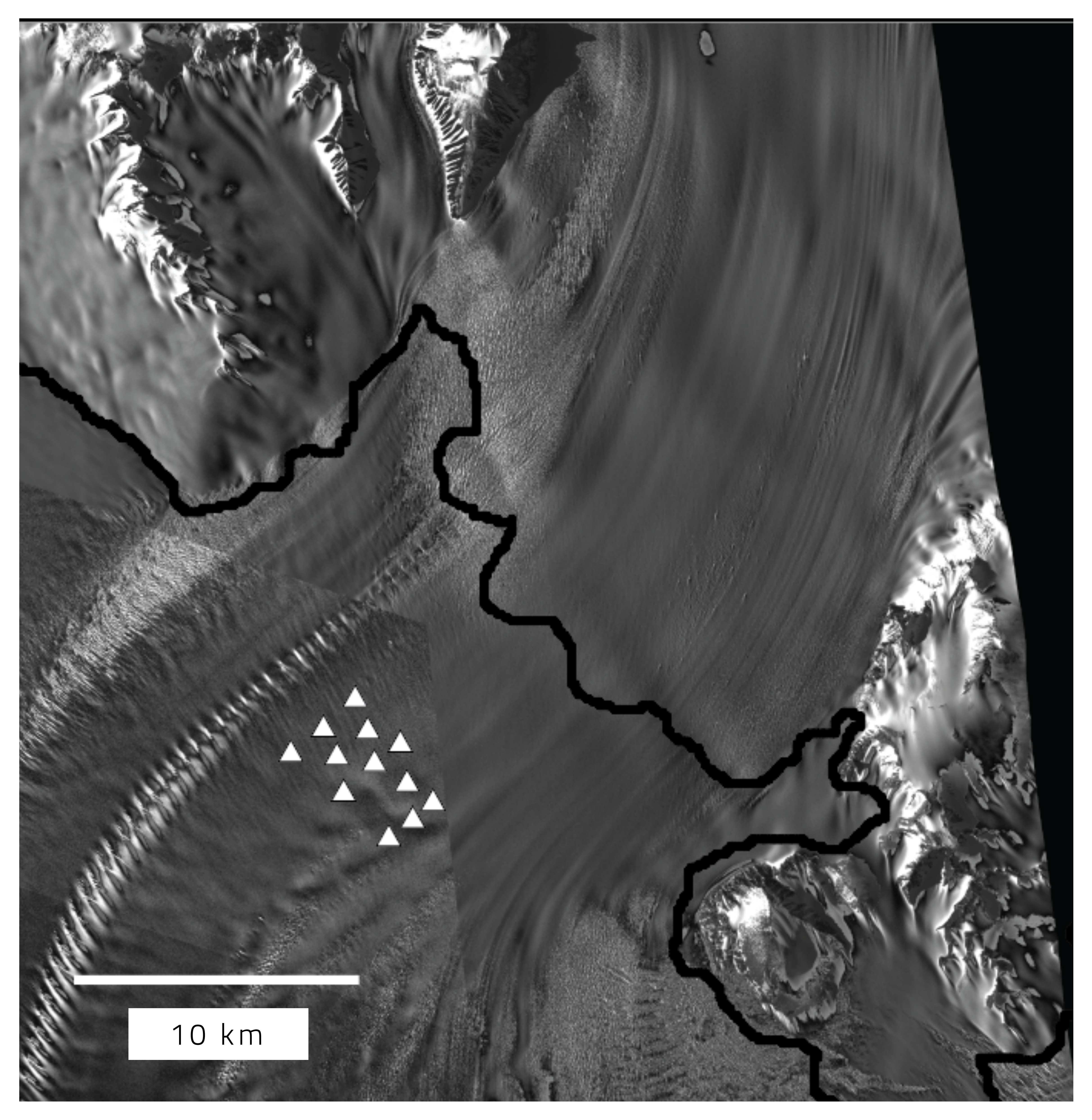
Passive Source Seismic to Monitor Ice Deformation and Motion



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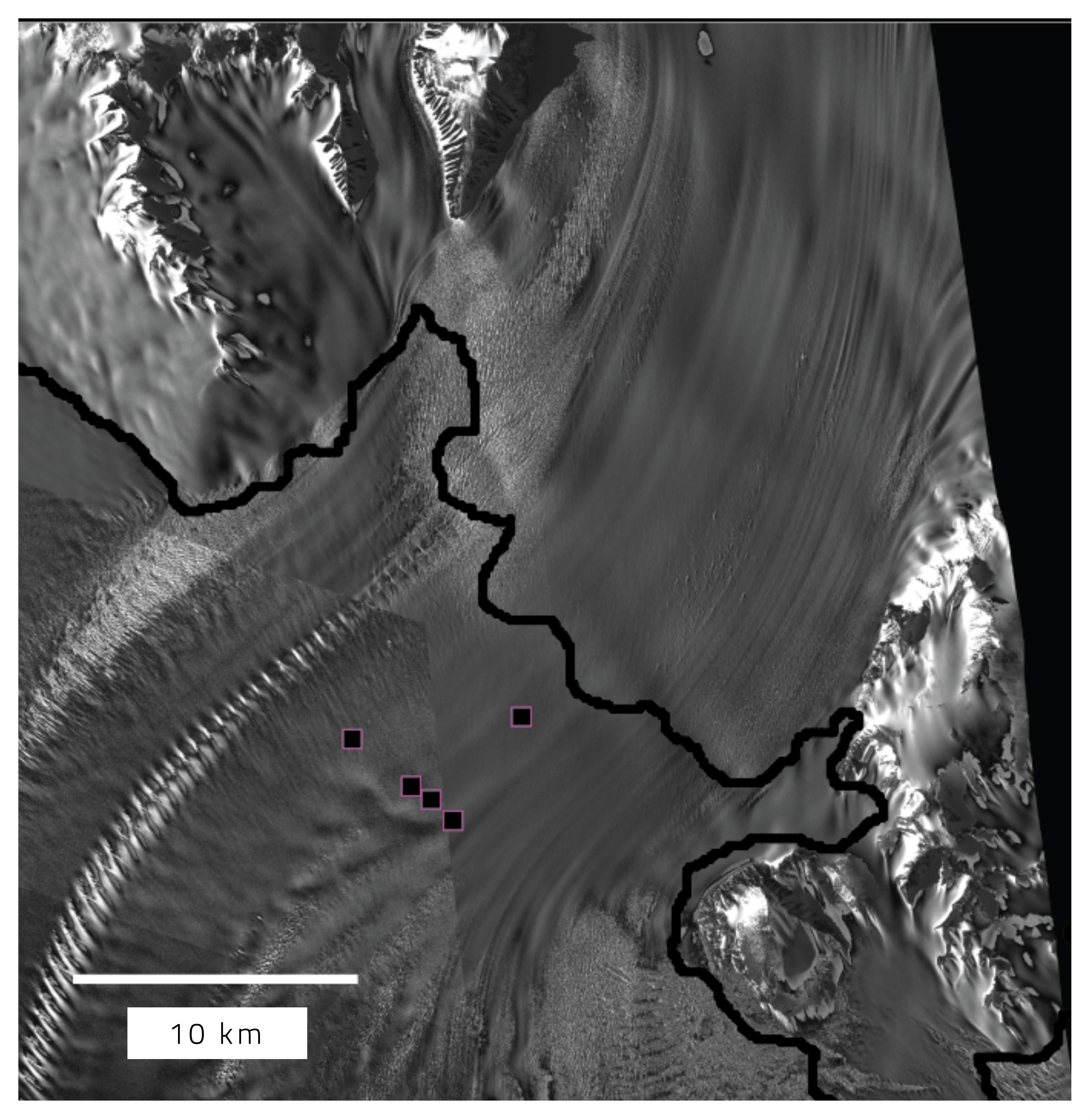
Continuous
GPS to study Tidal
Deformation and
Motion



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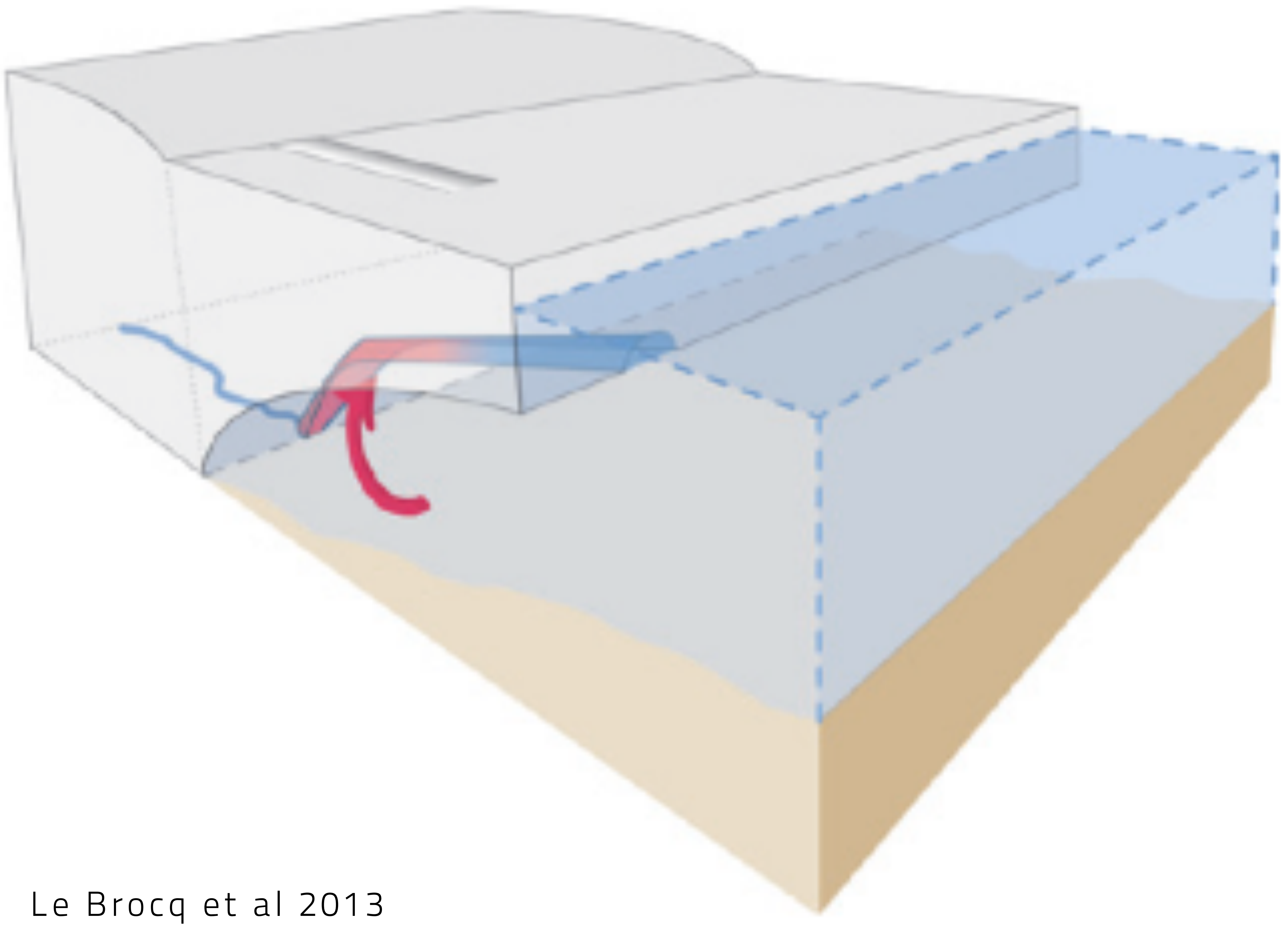
"Large" Channels carved into the bottom of the ice

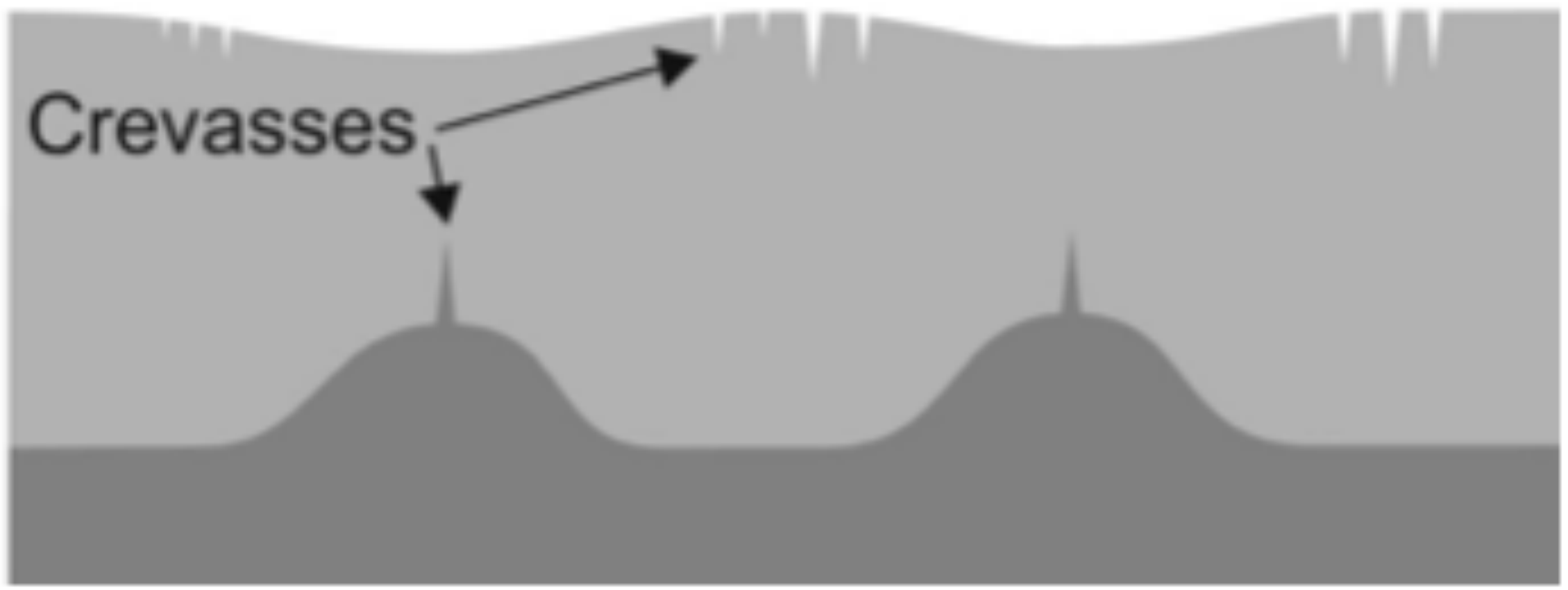
Important for understanding basal melting of ice shelfs

Formation? inherited, subglacial discharge, oceanographic



Le Brocq et al 2013

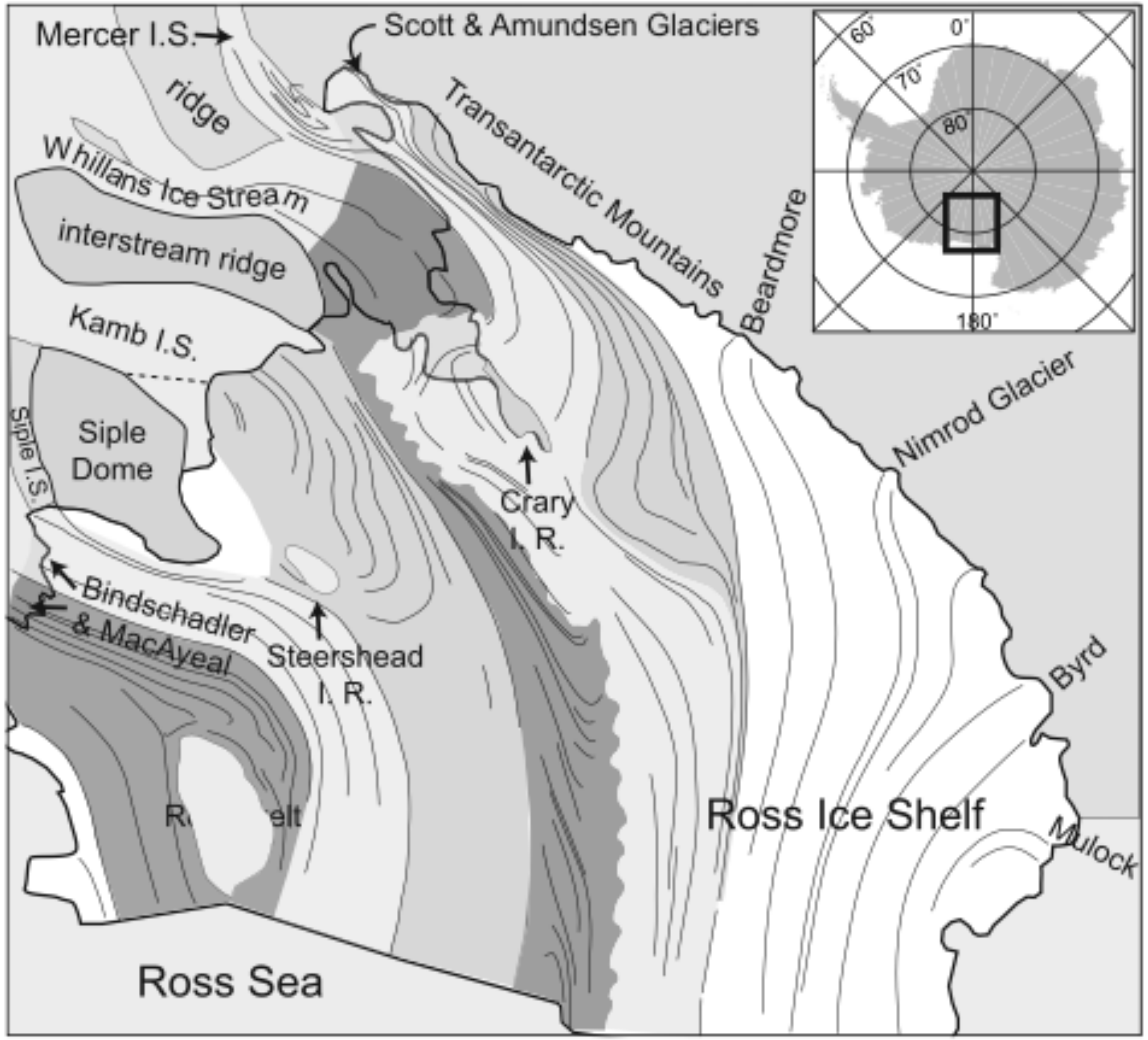
May Weaken Ice Shelfs



Vaughn et al 2012

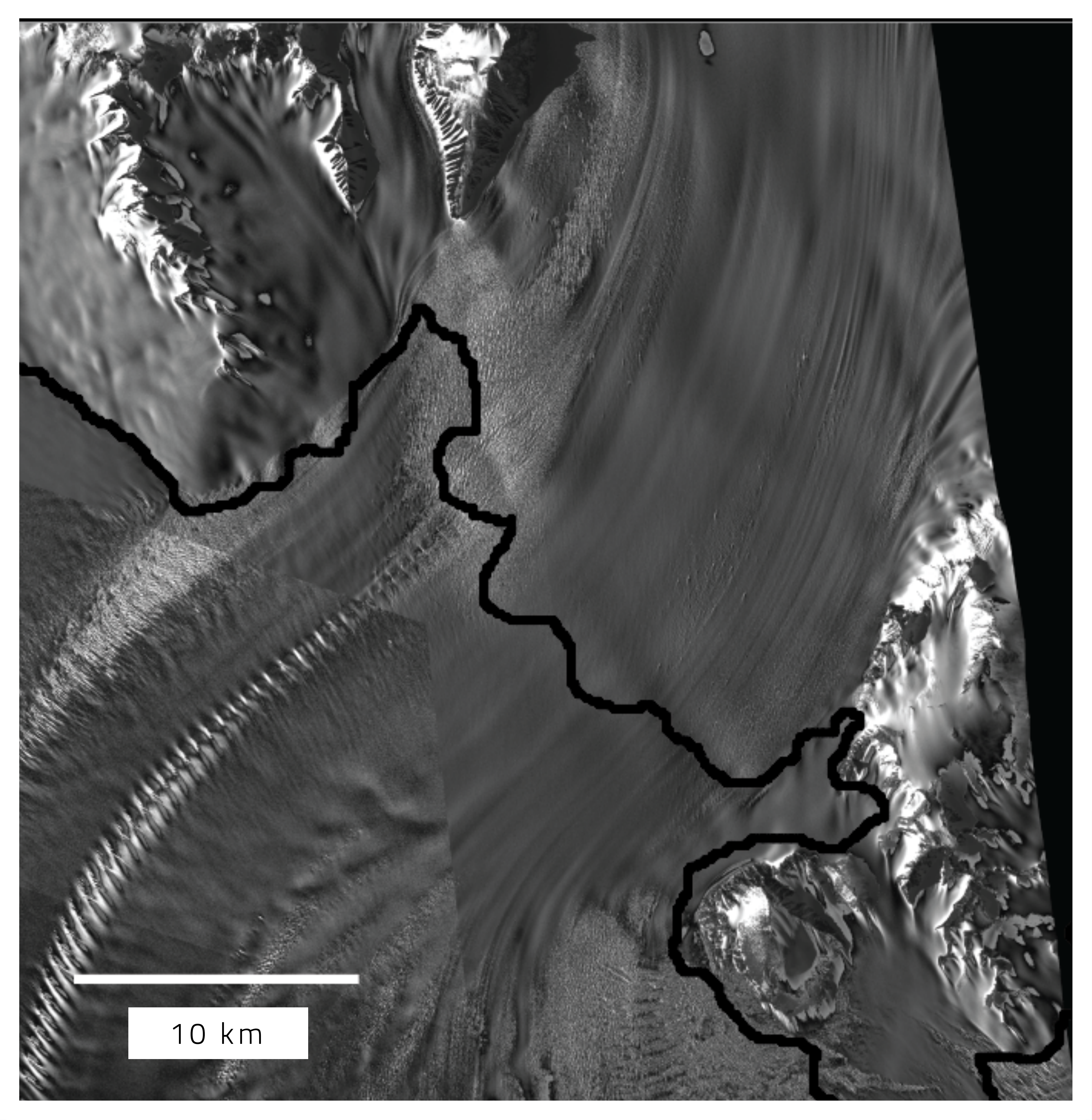
Imperfections created near grounding zones are advocated downstream

Appear to influence calving



Hulbe and Fahnestock 2007

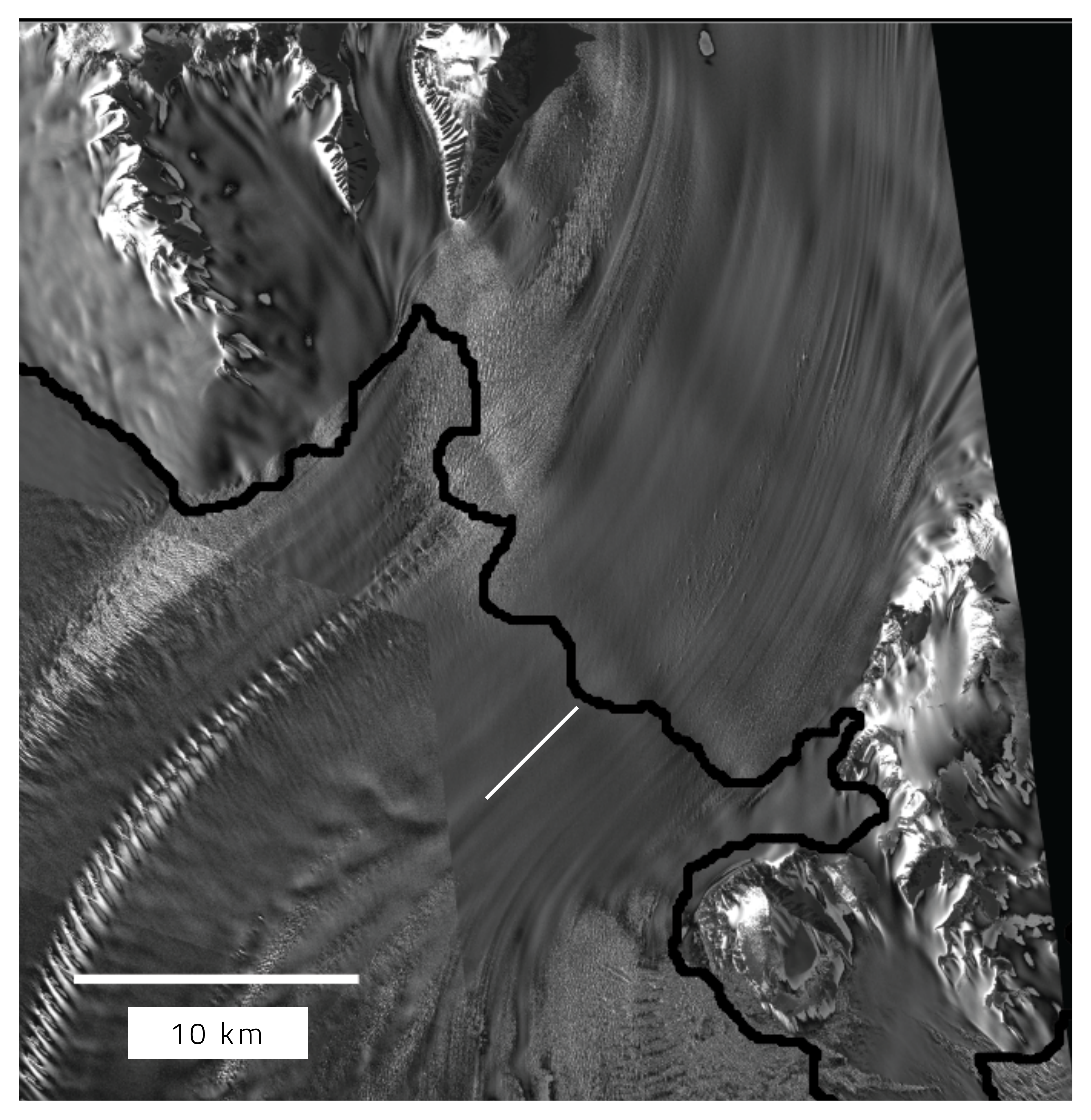
Channels on Beardmore



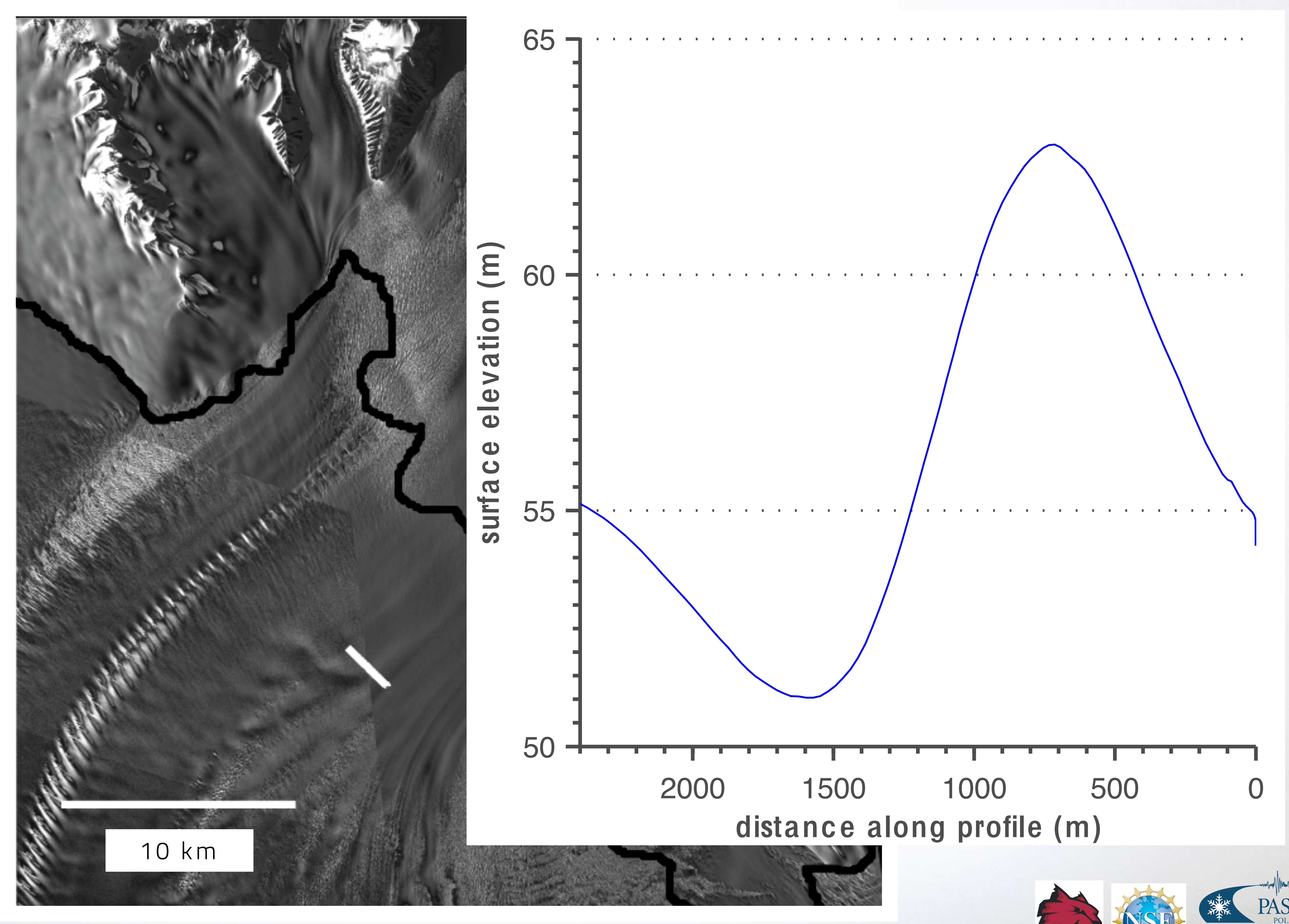
Ridges appear in imagery that appear to be channels

Channels on Beardmore

Ridges appear in imagery that appear to be channels



Surface Elevation
Across
Ridge Trough



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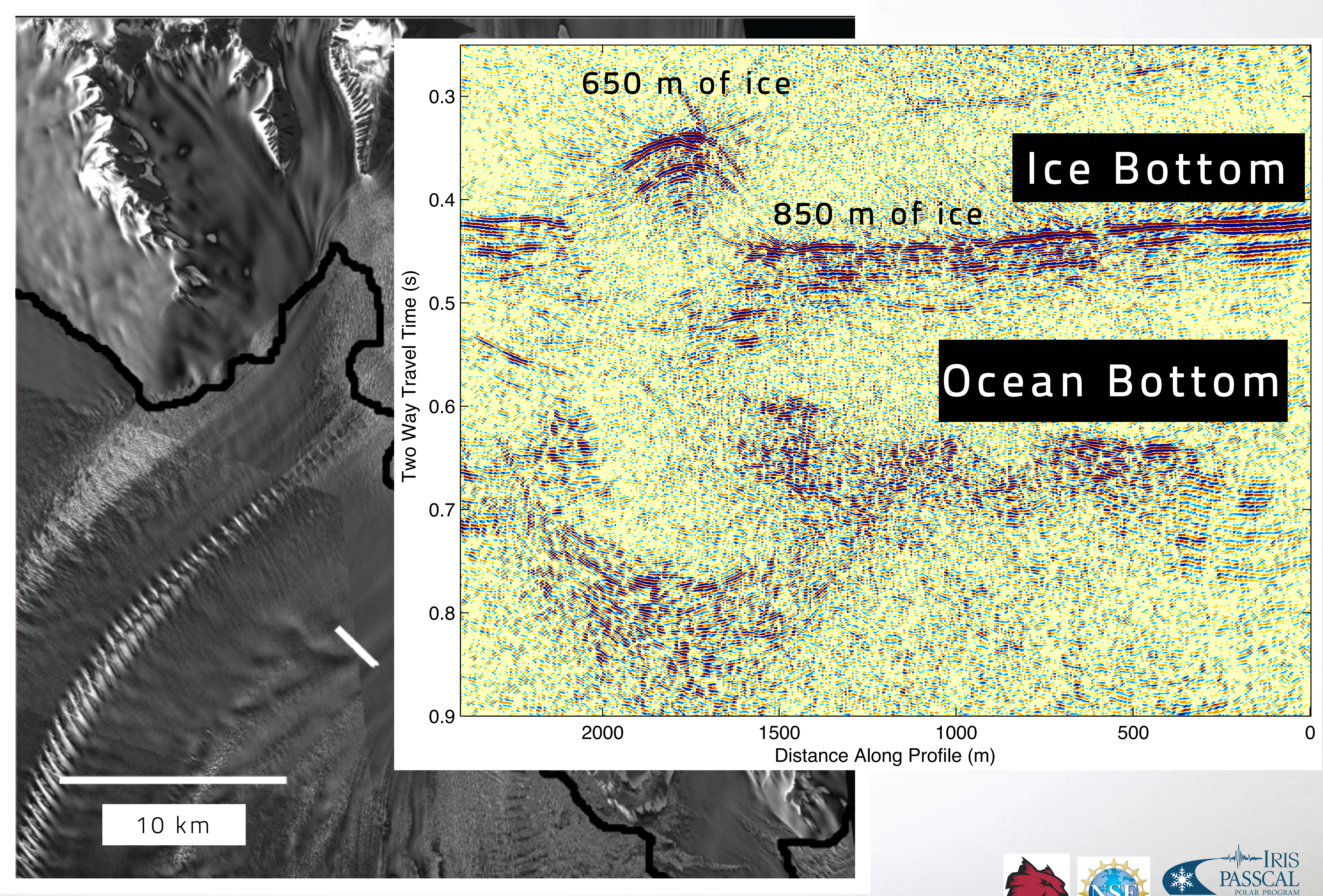
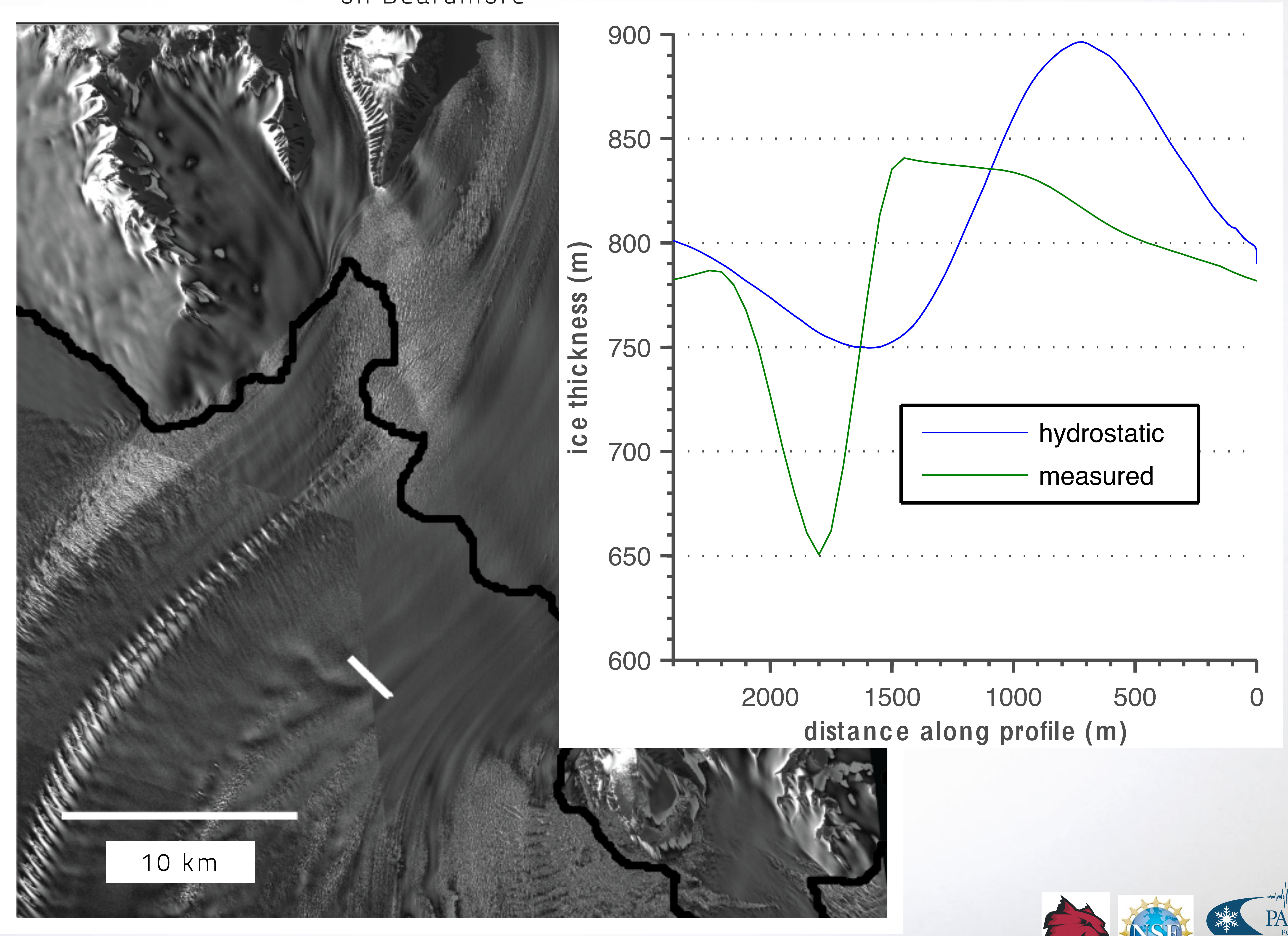
Seismic Reflection Image



Channels on Beardmore

Radar profiles show the channel growing down flow



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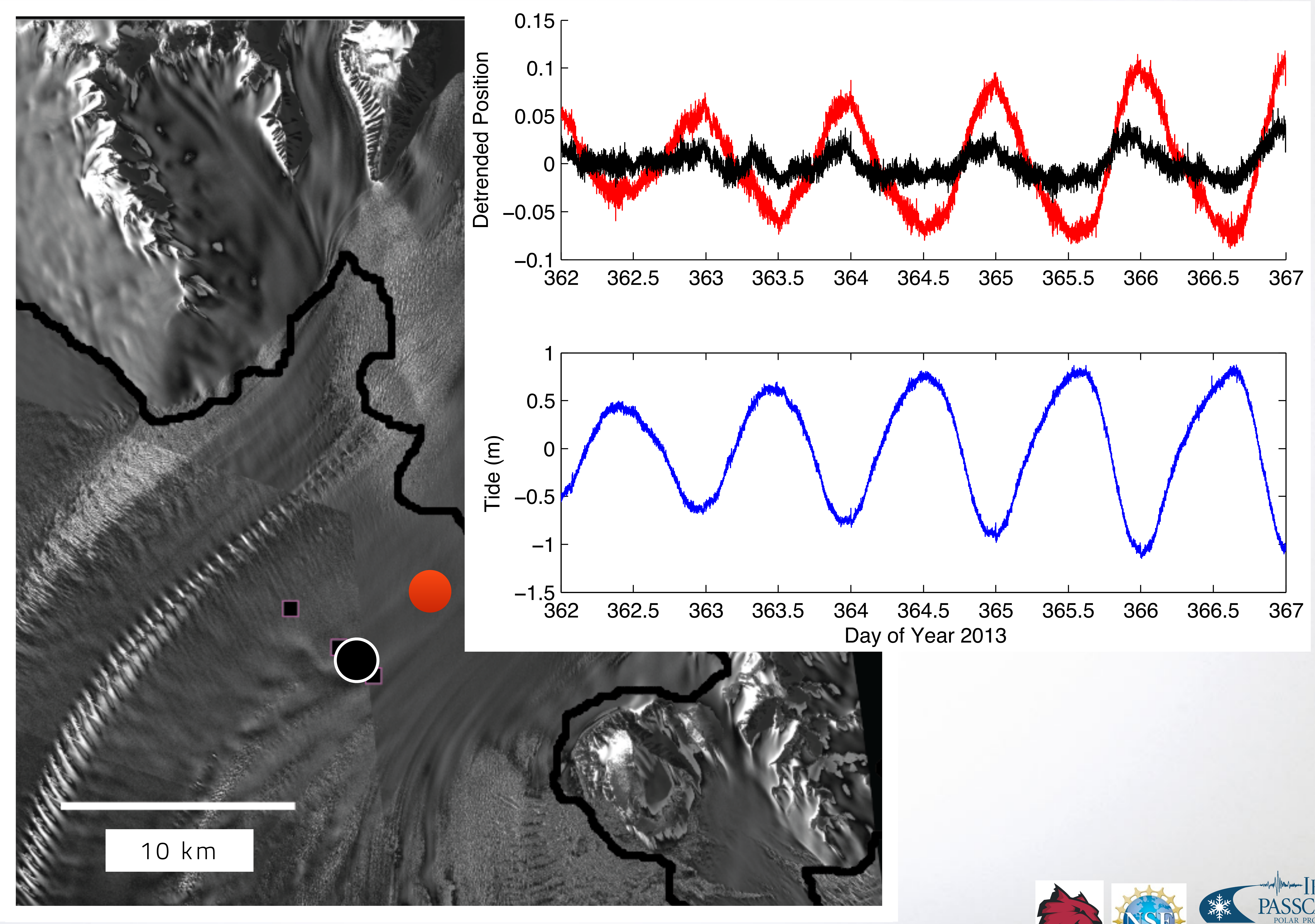
Flow is Modulated by the Tide (see Marsh et al, 2013)

Fast On the Falling Tide (~ 5km from GL)

Minimal ~15 km down flow



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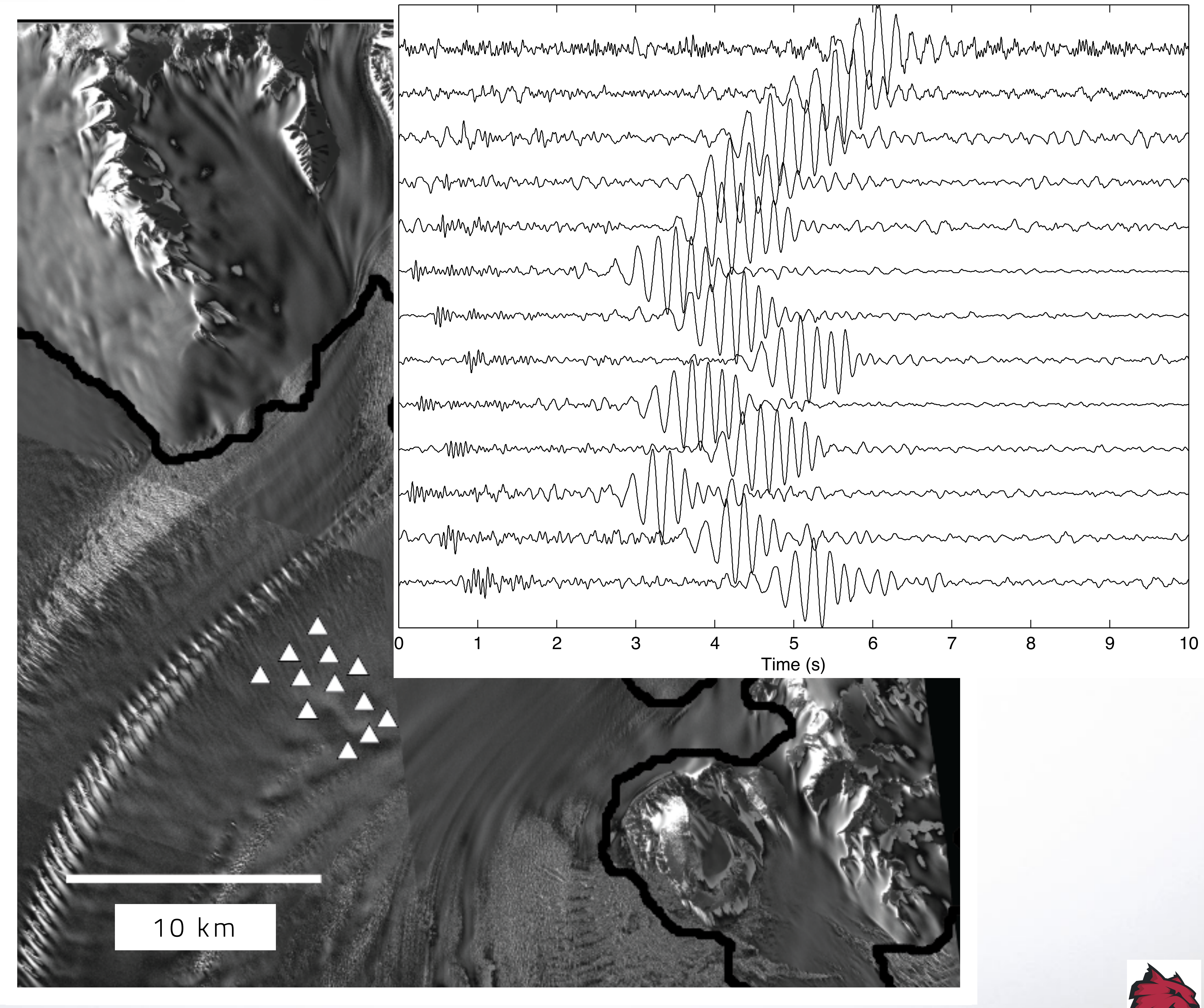
Passive Source Seismic



Passive Source Seismic Record Thousands of Ice Fracturing Events

Can we use to understand the Deformation of the ice shelf? Ala Fricker, Bassis amongst others

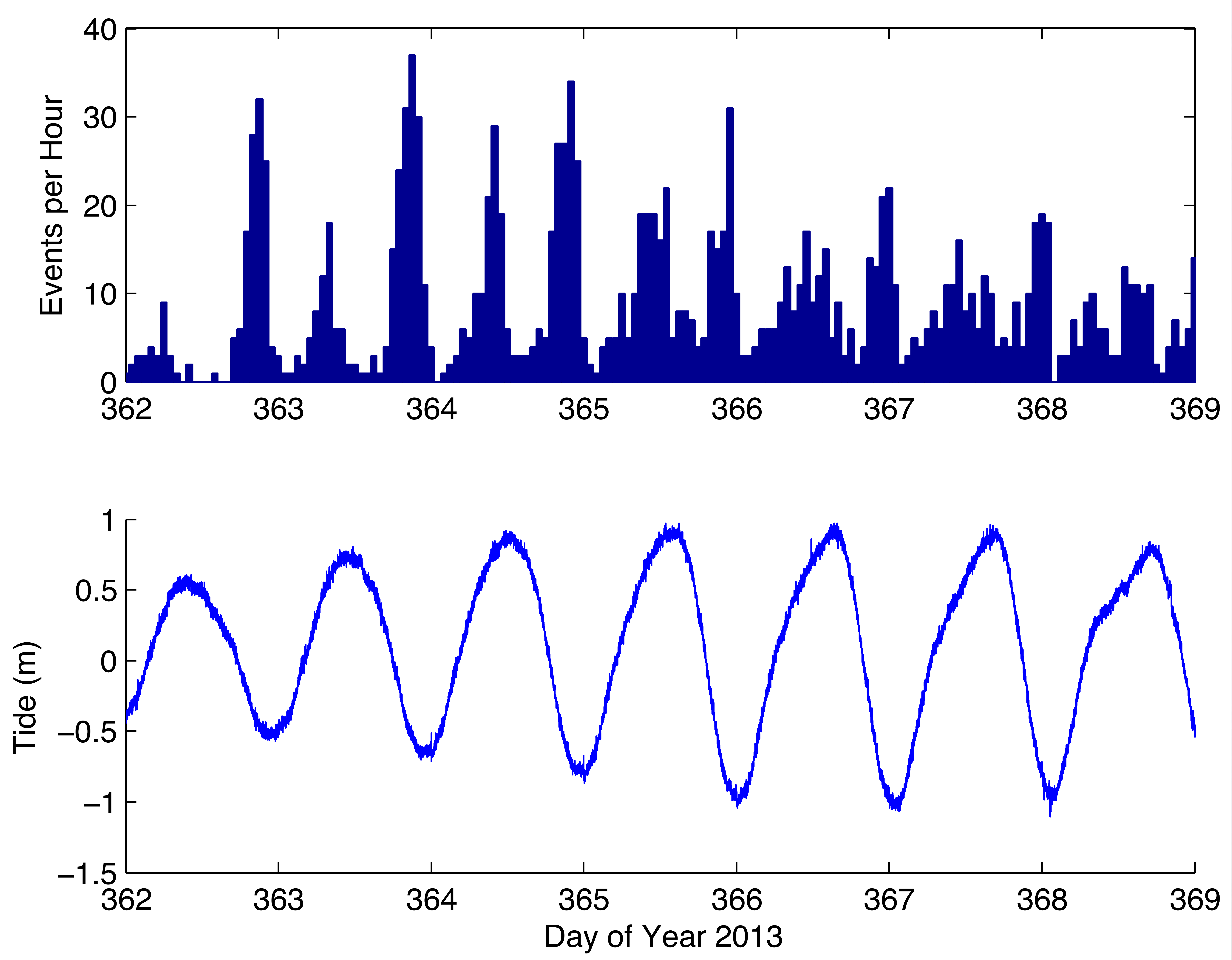
First Thing We
Do Is
Count

Second we plot
versus time

Clear Tidal
Pacing

Falling Tide Peak

Rising Tide Peak



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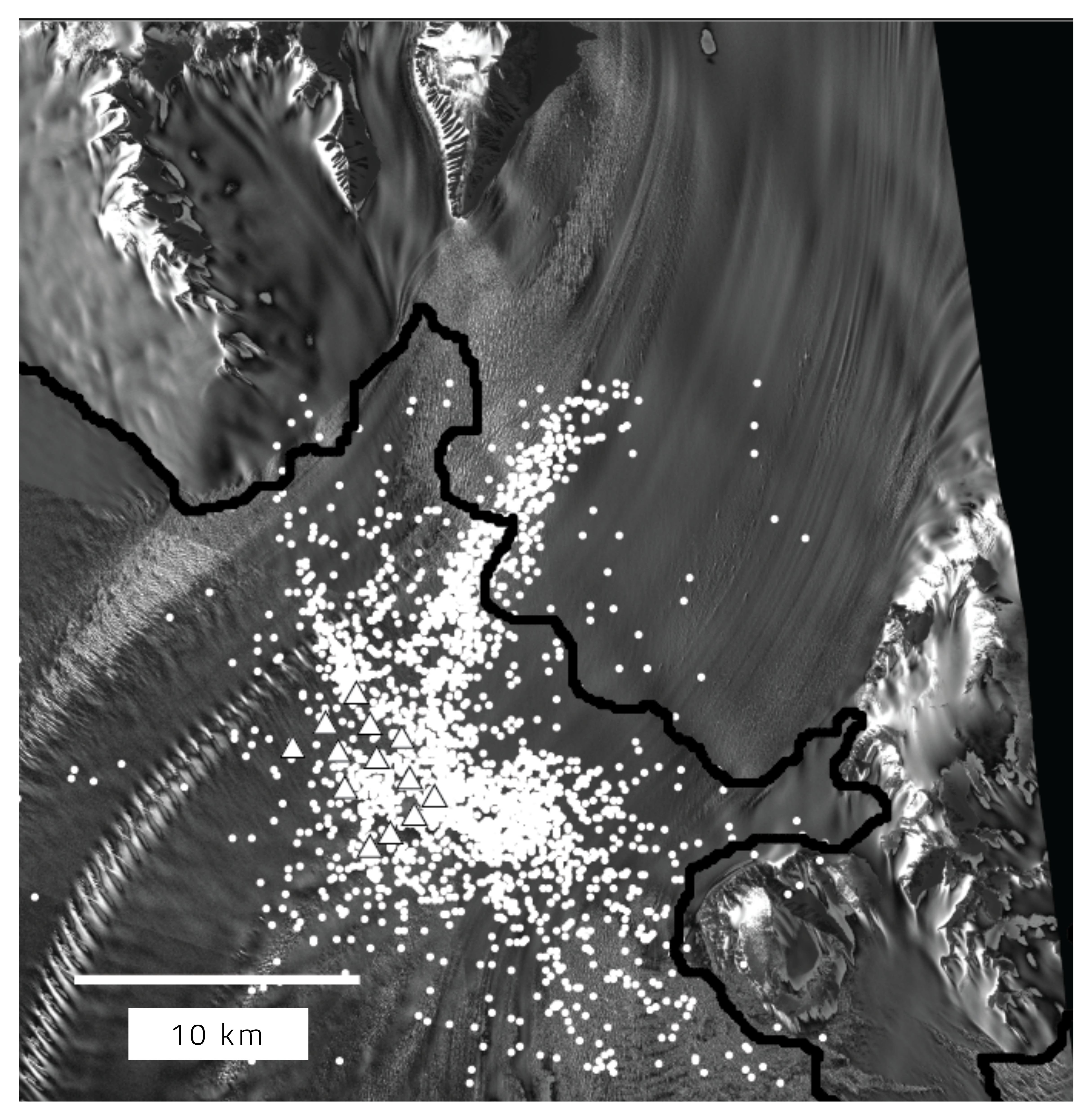
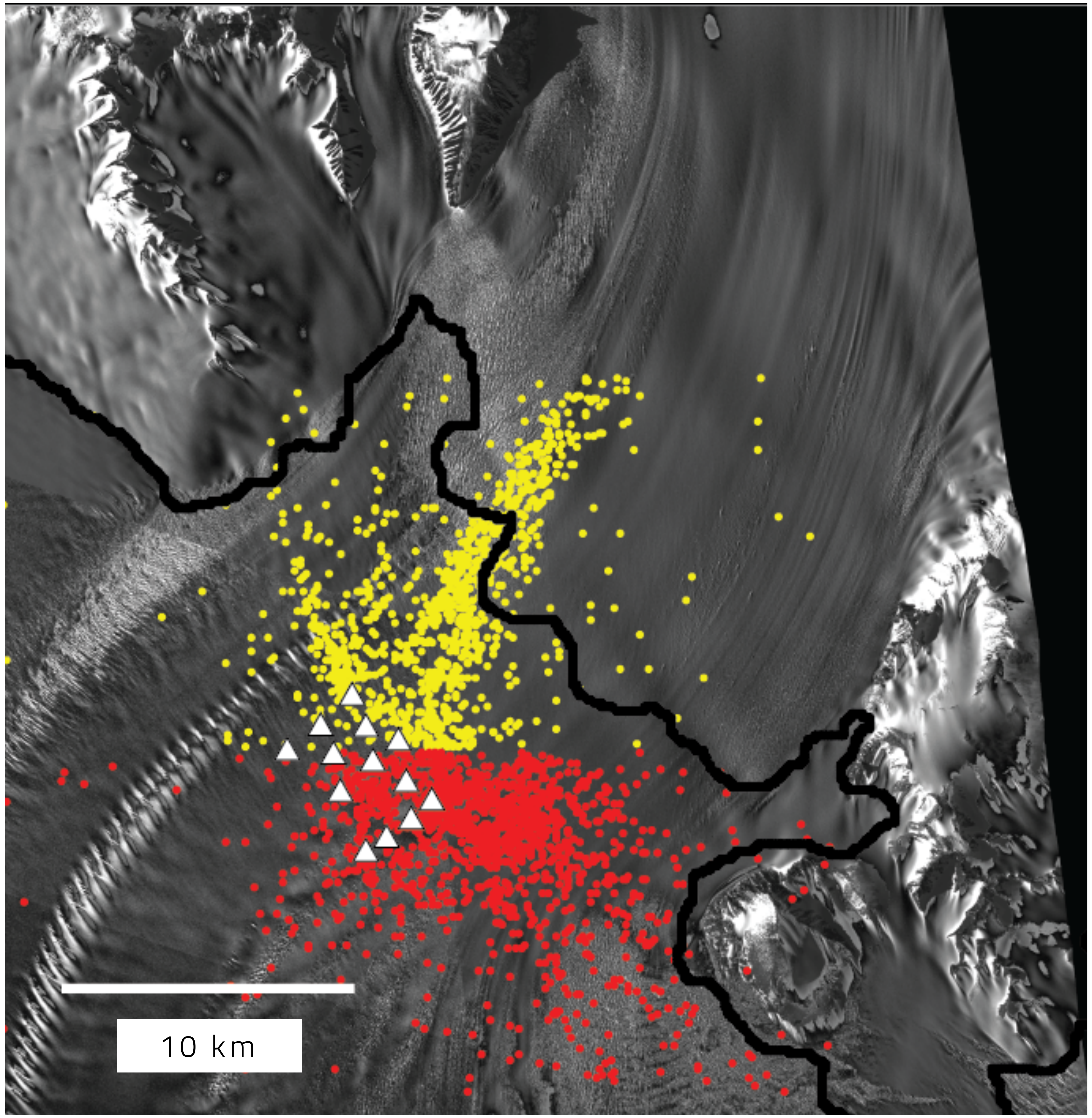
Next Thing we Do is Locate Events



"Two" Clusters



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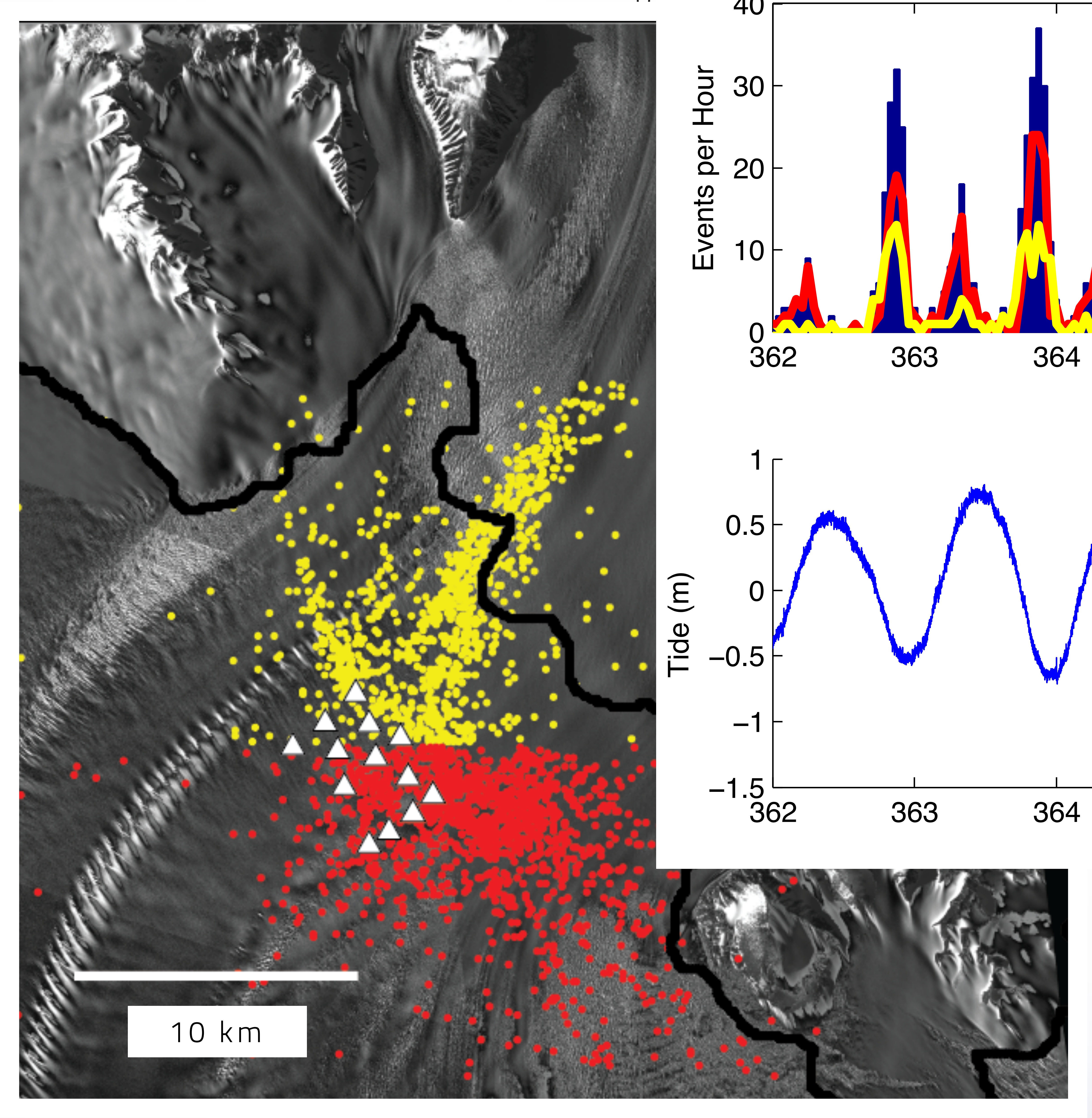
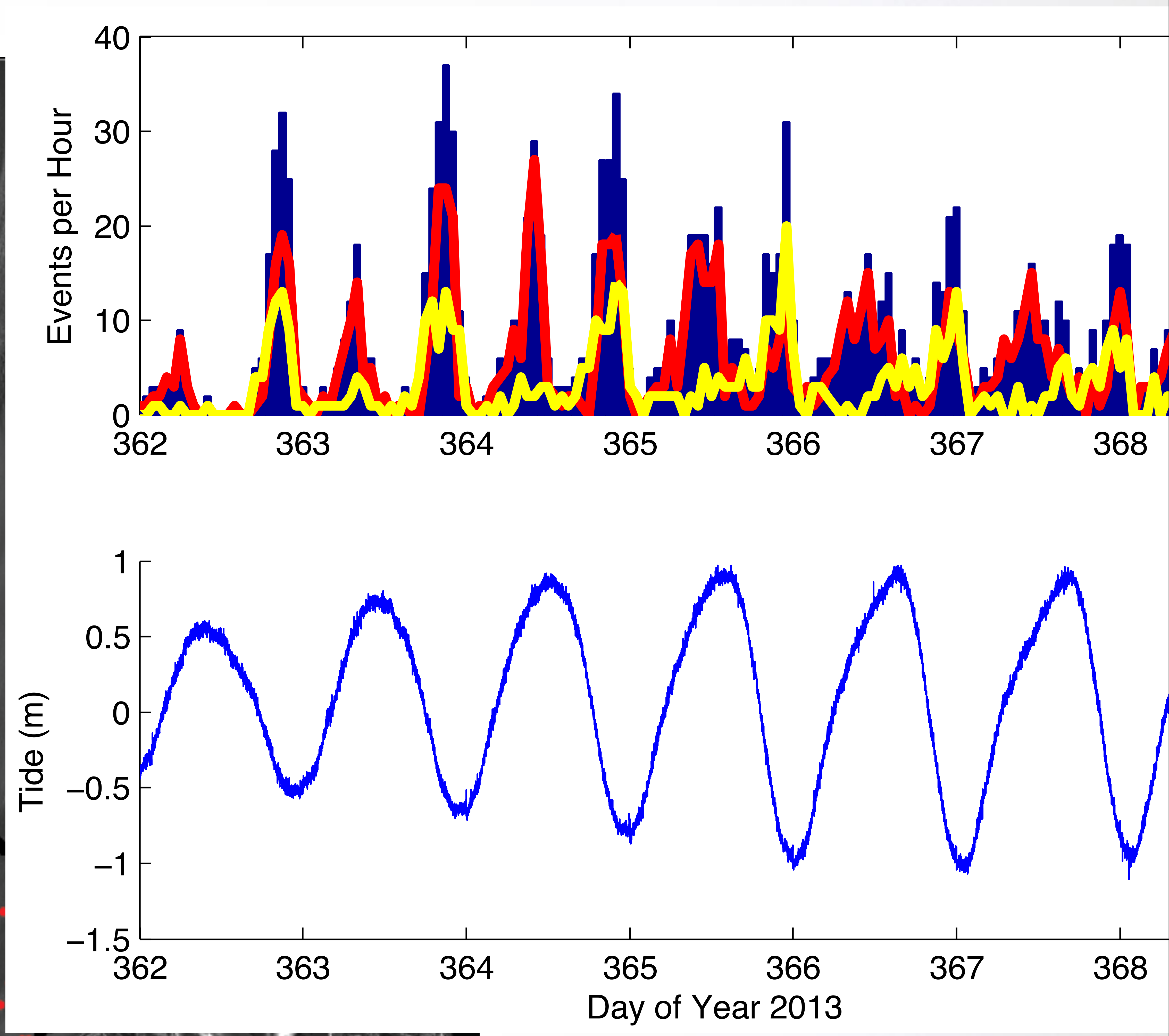
Seismic Activity and Tidal Pacing

Grounding Line Events on Falling Tide
"speed up of ice shelf"

Ice Shelf Events on Rising and Falling Tide





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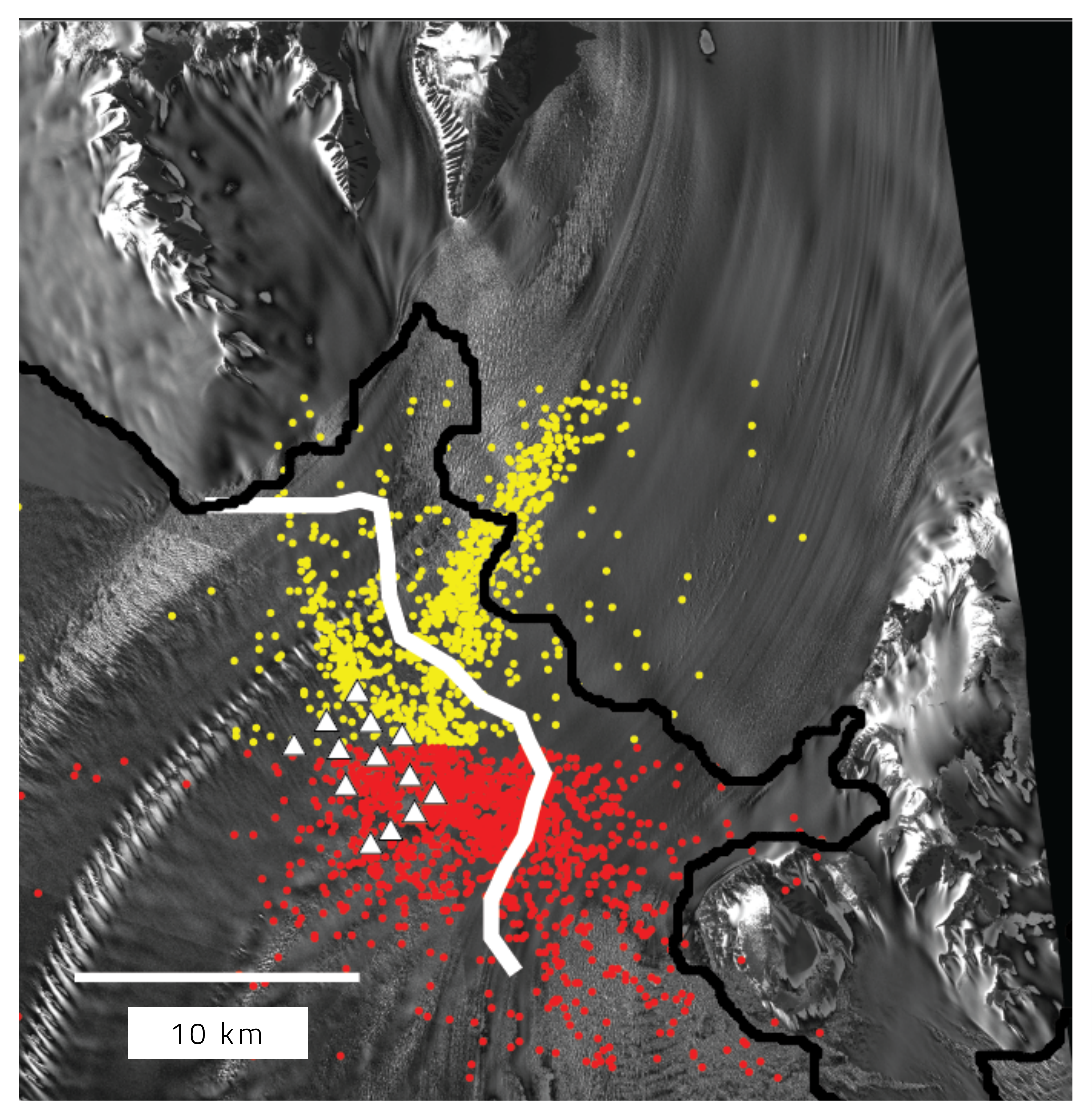
"Far" from
the Grounding
Ice Shelf is still not
Hydrostatic

Limit of Flexure from
Marsh et al, 2014



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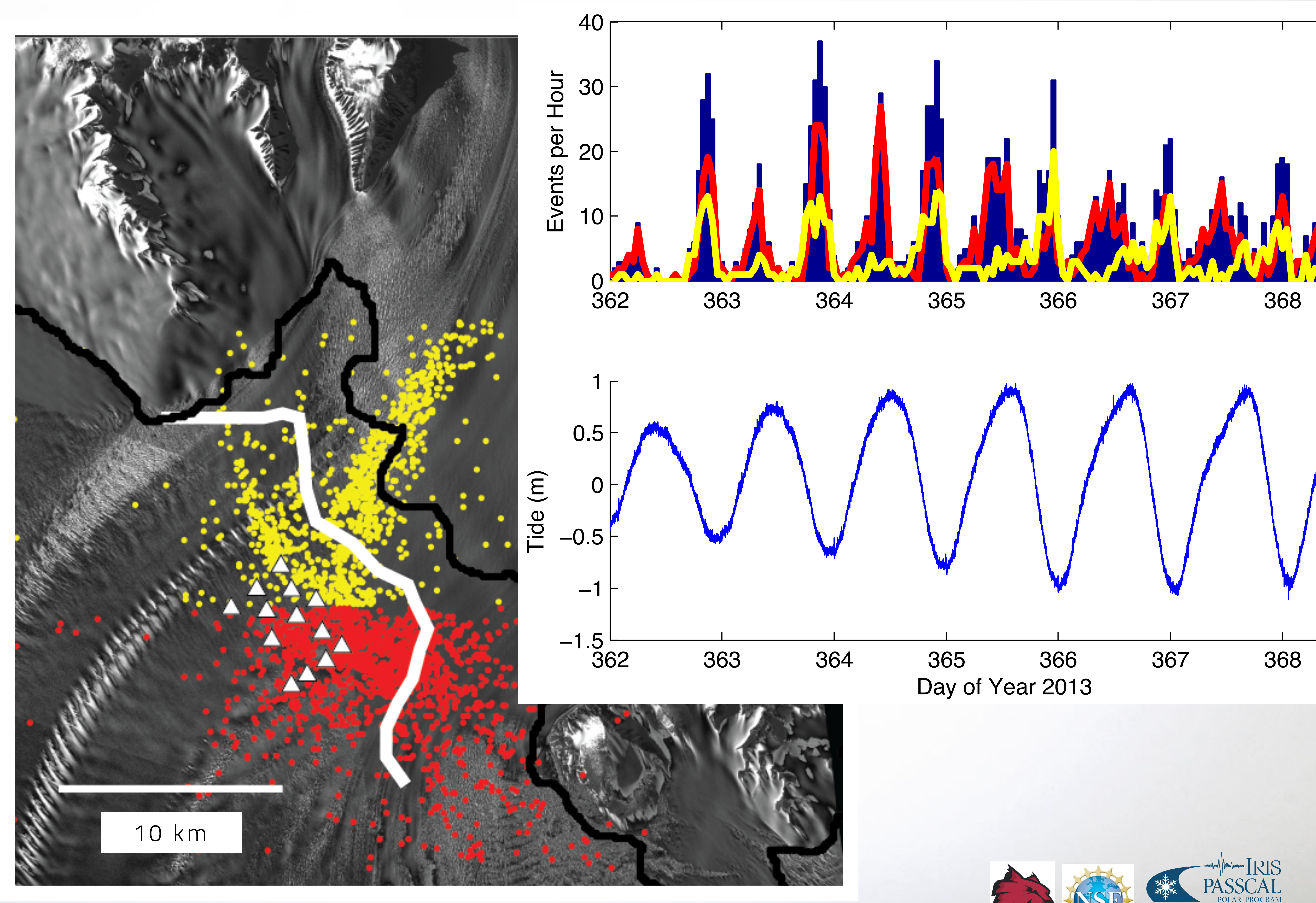

Tidal Flexure
is important
see next talk