

On the Need of Daily Repeat InSAR Data in Antarctica and Greenland

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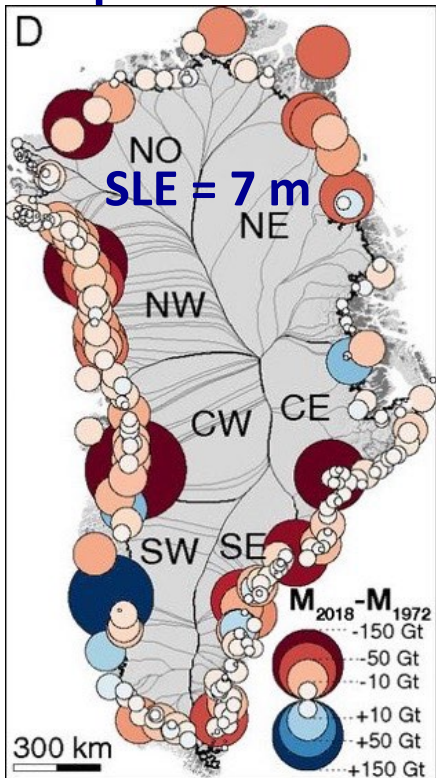
This work was carried out at UCI, under a contracts with the National Aeronautics and Space Administration (NASA) as part of the CSDA and MEaSURES programs. We thank ICEYE for providing InSAR time series data over several test sites. Some ICEYE data used was purchased through the NASA CSDA program.

Space Science Week – CESAS, Apr 1-4 2025



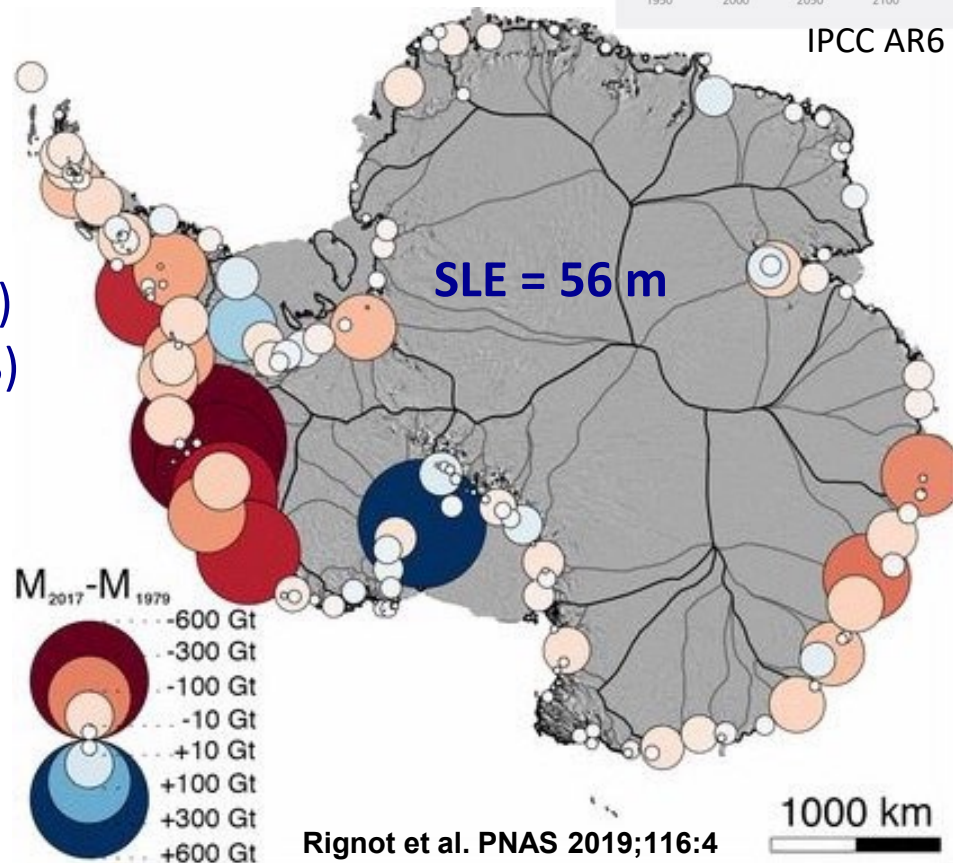
Mass changes of Ice Sheets

Impact on coastlines around the world!

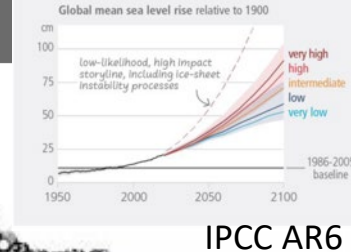


Mass change
of major basins:
Antarctica (1979-2017)
Greenland (1972-2018)
(blue:gain, red:loss);
circle proportional
to the absolute
mass balance.

Mouginot et al. PNAS 2019;116:19



Rignot et al. PNAS 2019;116:4





Ice Sheet Information Requirements and Synthetic Aperture RADAR

- Surface Elevation & Elevation Change
- Ice Velocity
- Grounding Line Location
- Calving Front Location
- Bed Elevation*

SAR interferometry is an important source of information

* SAR derived ice velocity is input for mass conservation method

Antarctic Peninsula: Sentinel-1 time series

UCI

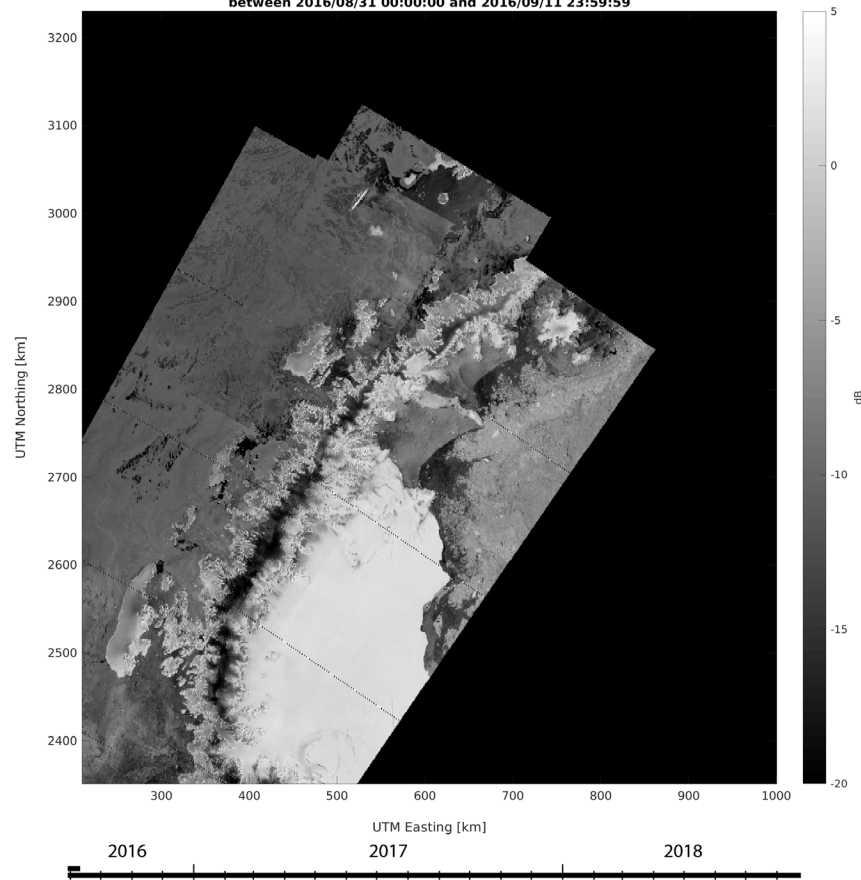
University of California, Irvine

Collaboration with D. Small, U Zürich

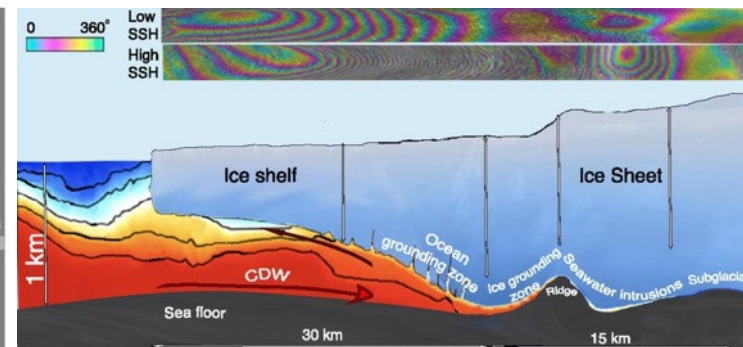
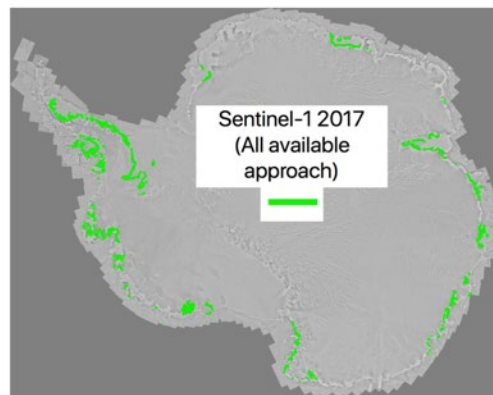
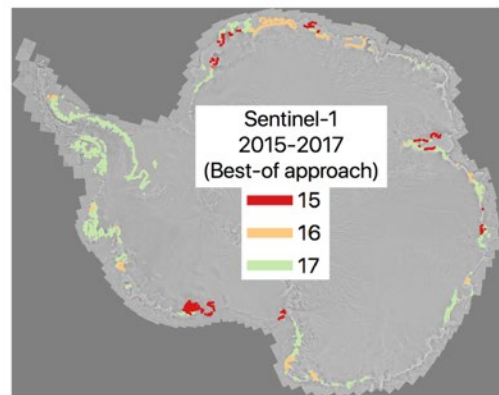
Composite backscatter from 12 scenes
between 2016/08/31 00:00:00 and 2016/09/11 23:59:59



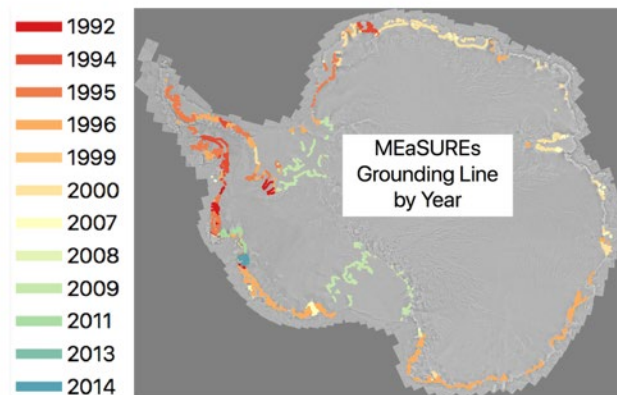
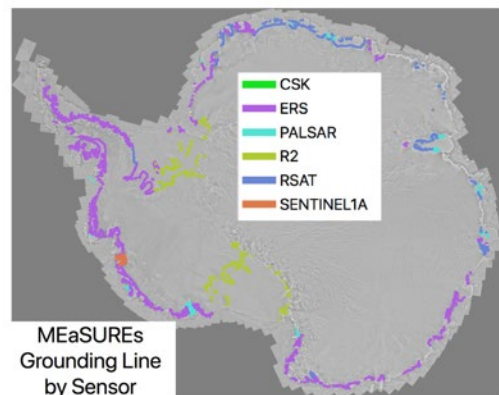
University of Zurich



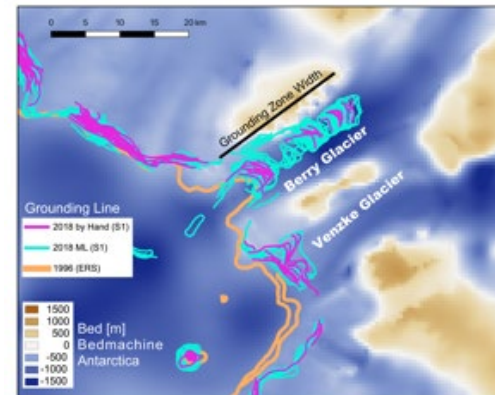
Grounding Line & Ice Grounding Zone



Rignot et al. PNAS 2024; 121:22



0 1,000 2,000 km



<http://nsidc.org/data/NSIDC-0498/>

<http://nsidc.org/data/NSIDC-0778>

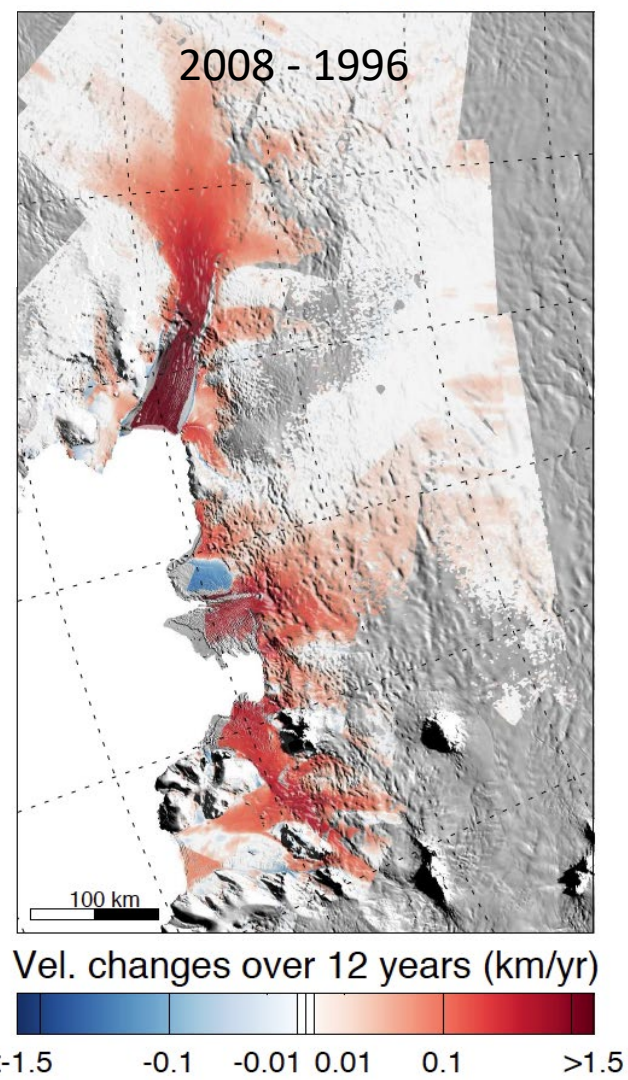
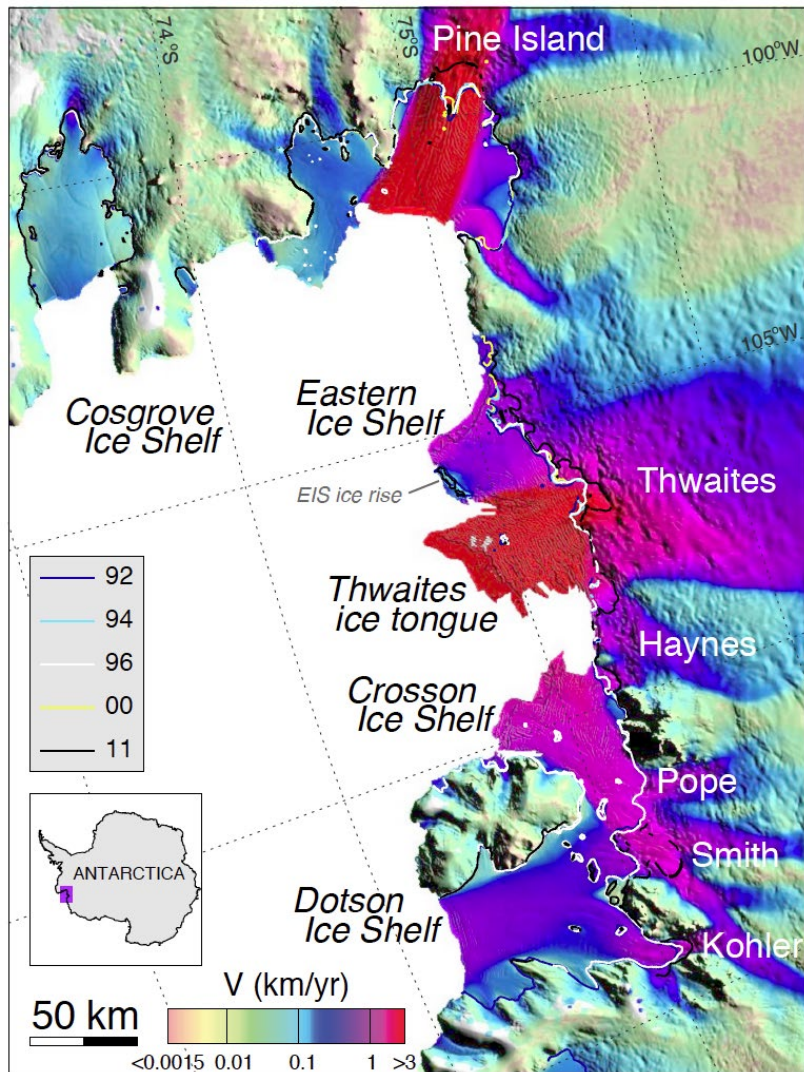
Amundsen Sea Embayment

**Grounding line
retreat!**
By 2011,
measurements
only from ERS
1- and 3-day
repeat campaigns.

Rignot et al. 2014

Glacier speedup!
Long revisit caused
decorrelation.

Mouginot et al. 2014

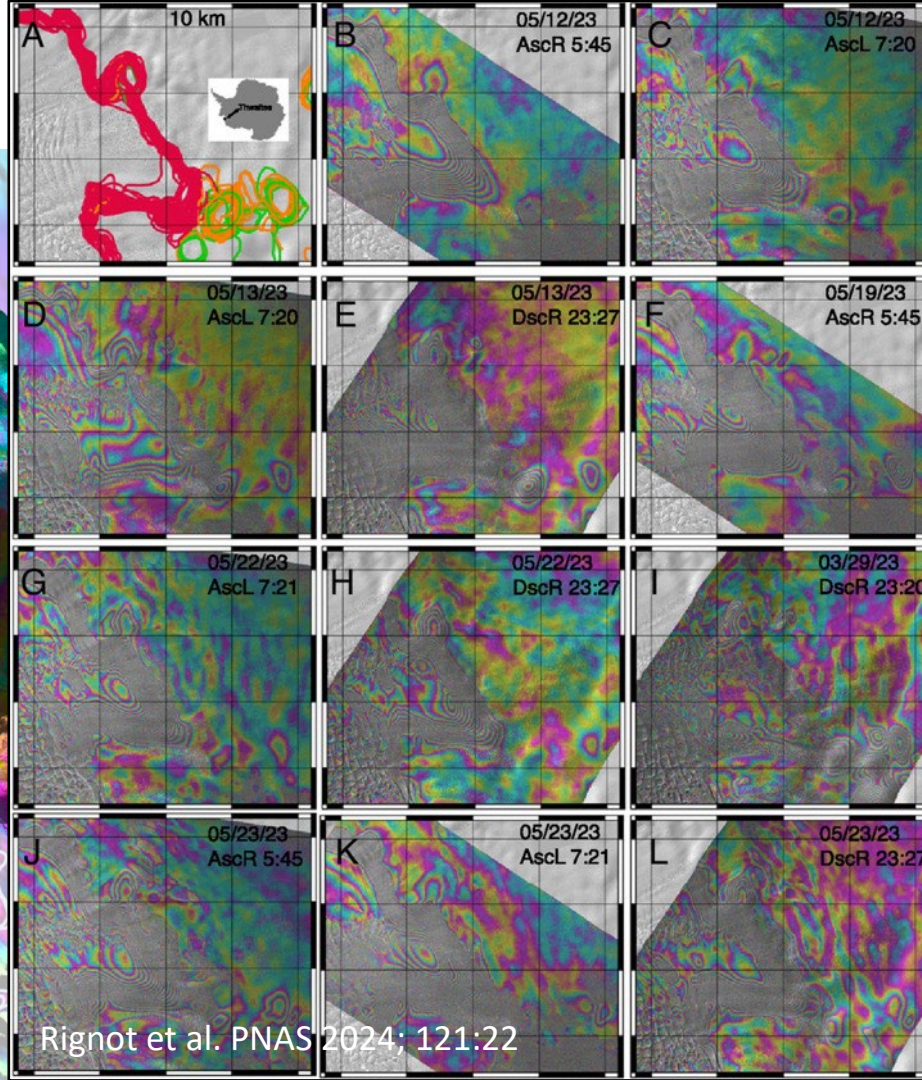


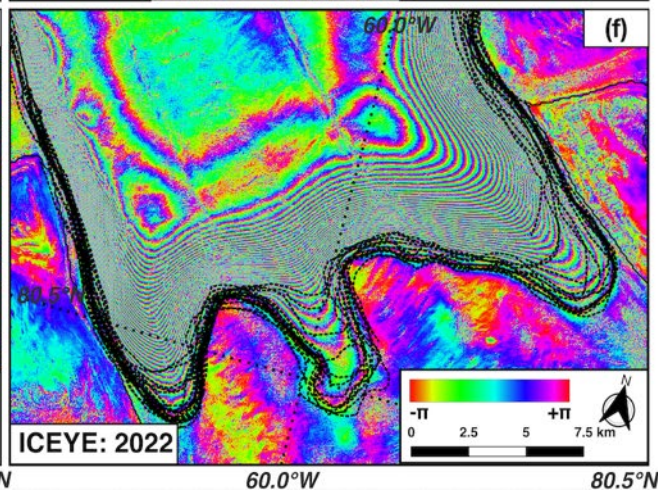
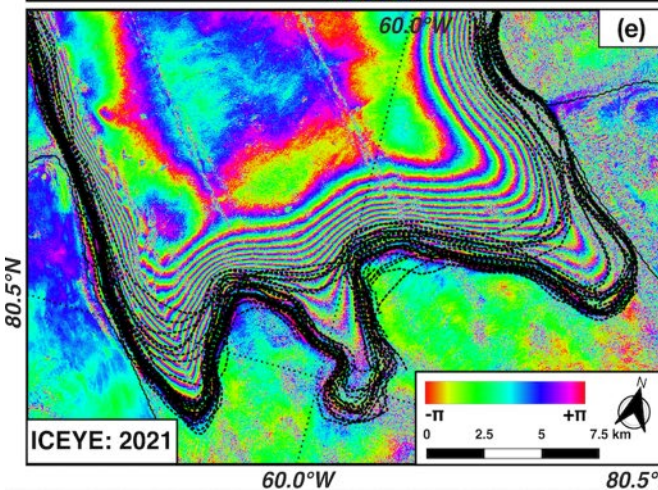
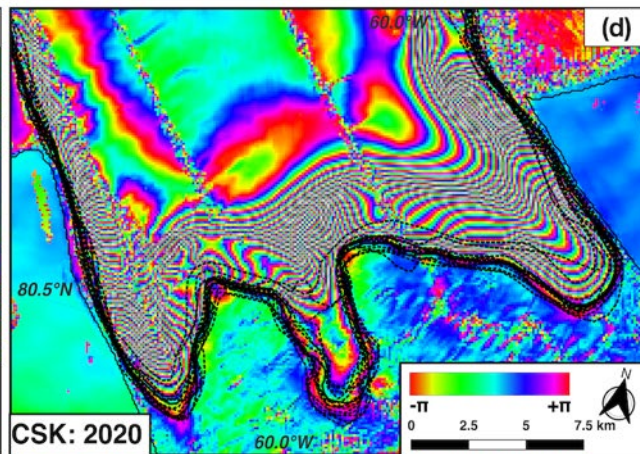
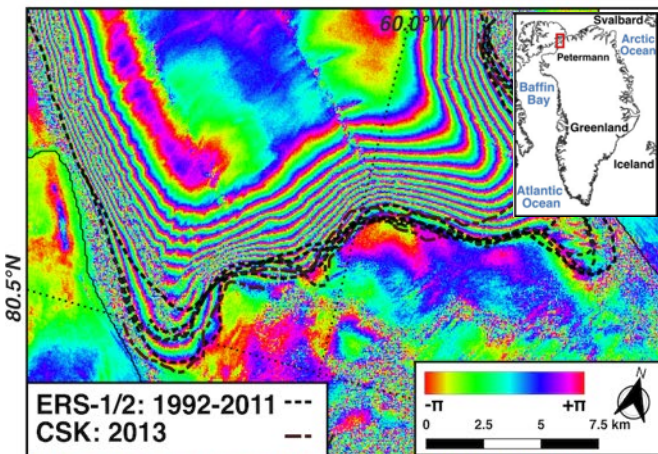
ICEYE

- Commercial X-band constellation
- 1-day repeat pass capability.

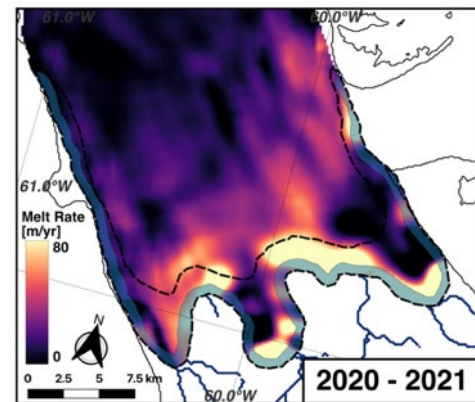
Recommendation:
Augment the program of record **in areas of rapid change.**

NASA CSDA program ensures the data become part of the program of record.

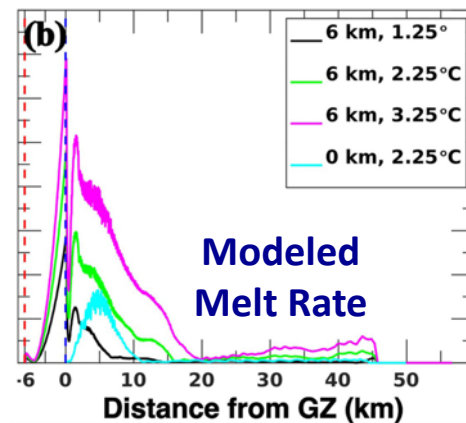




Subglacial Melt Rate for Petermann Glacier



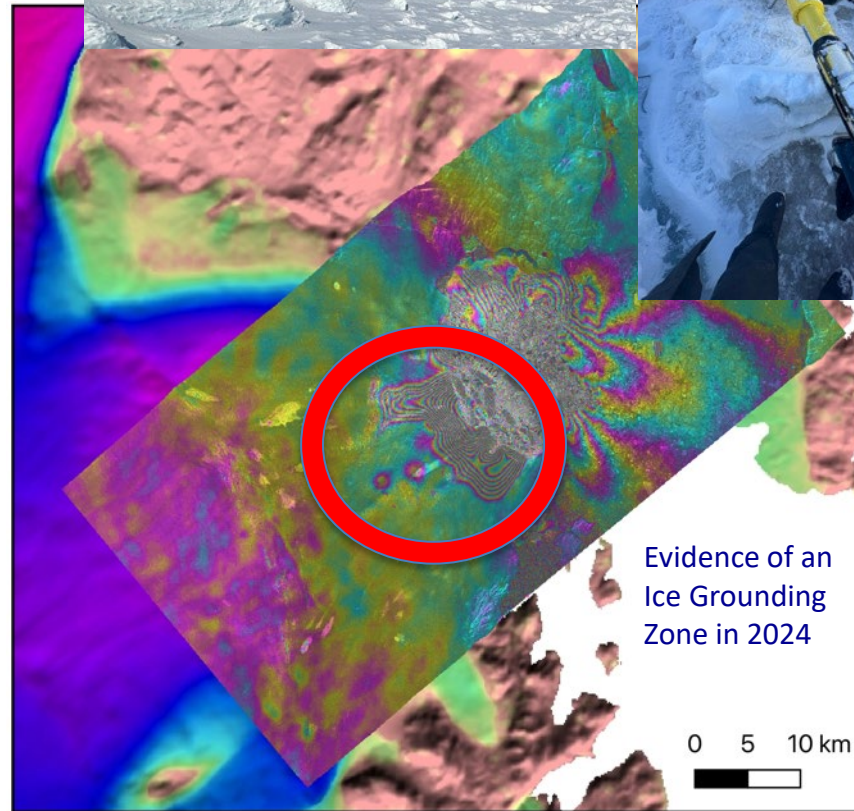
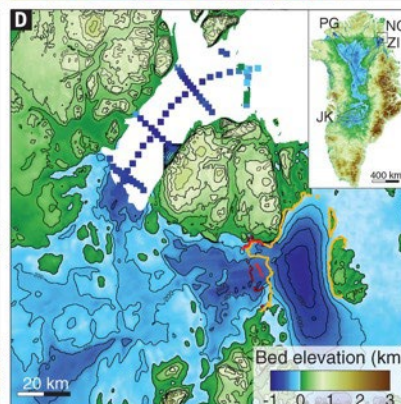
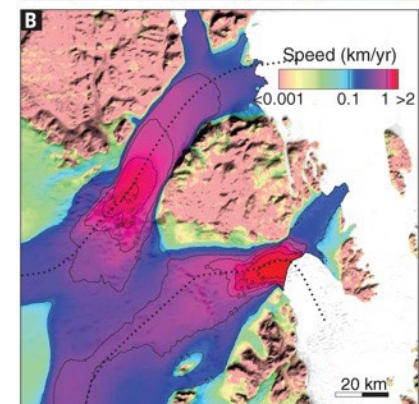
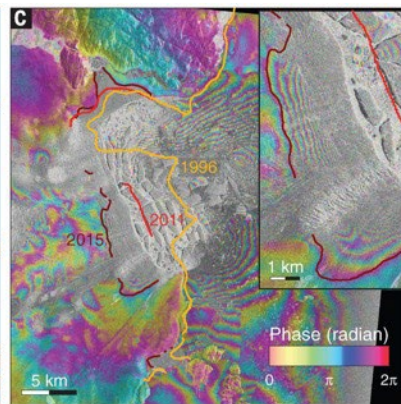
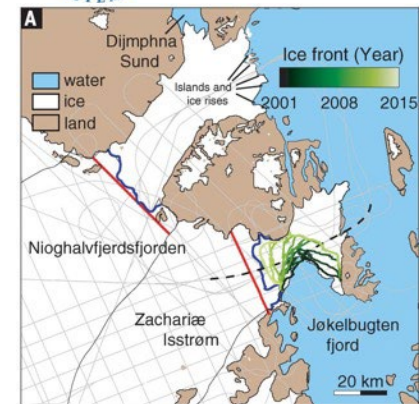
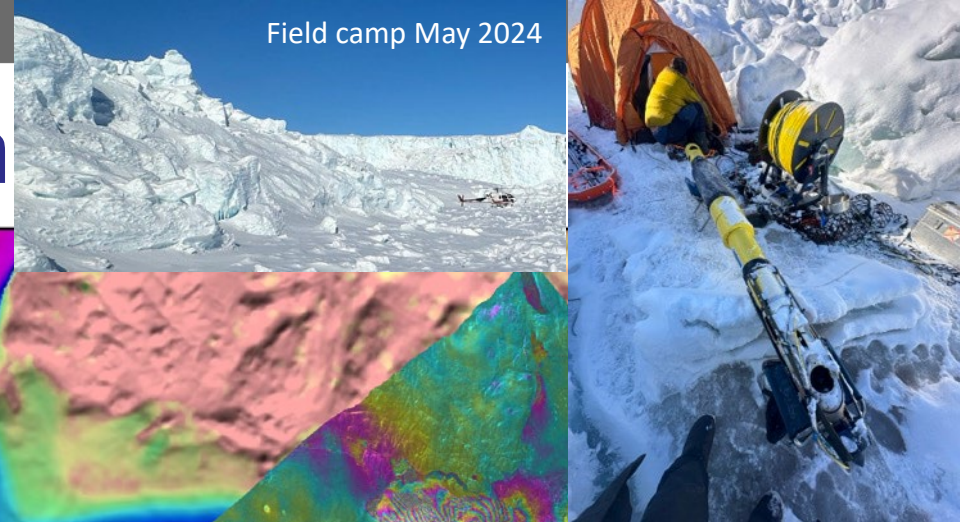
Ciraci et al. PNAS 2023; 120:20



Gadi et al. GRL 2023; no. 24

Zacharie Isstrom

Field camp May 2024

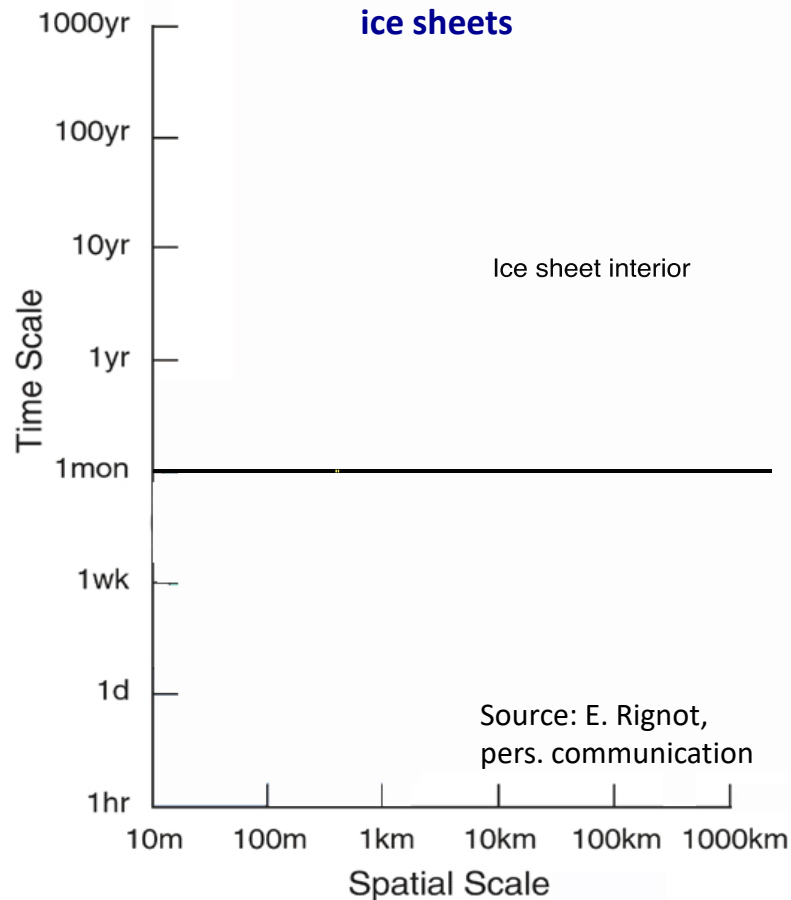


Evidence of an
Ice Grounding
Zone in 2024

Mouginot *et al.* 2015

ICEYE double difference interferogram (3/31, 4/1, 4/2 2024)

Temporal and spatial scales of phenomena driving changes in glaciers and ice sheets



A Virtual Constellation

- The concept of a *virtual constellation* is working for ice sheet science.
- Constellation information exceeds that of any single mission.
- Coordination remains important.
- Commercial data add the capability of frequent (daily) repeat.
- NASA's **open data policy** allows easy access, this is not the case for all agencies.

The **NASA CSDA** program is a key element to

- add commercial data to the *program of record*.
- increase access to the data (within applicable user license).





Thank you!

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ESDR record

Ice Velocities:

<https://nsidc.org/data/NSIDC-0754>

<https://nsidc.org/data/NSIDC-0484>

<https://nsidc.org/data/NSIDC-0720>

<https://nsidc.org/data/NSIDC-0545>

<https://nsidc.org/data/NSIDC-0525>

<https://nsidc.org/data/NSIDC-0761>

Grounding Line:

<https://nsidc.org/data/NSIDC-0498>

Grounding Zone:

<https://nsidc.org/data/NSIDC-0778>

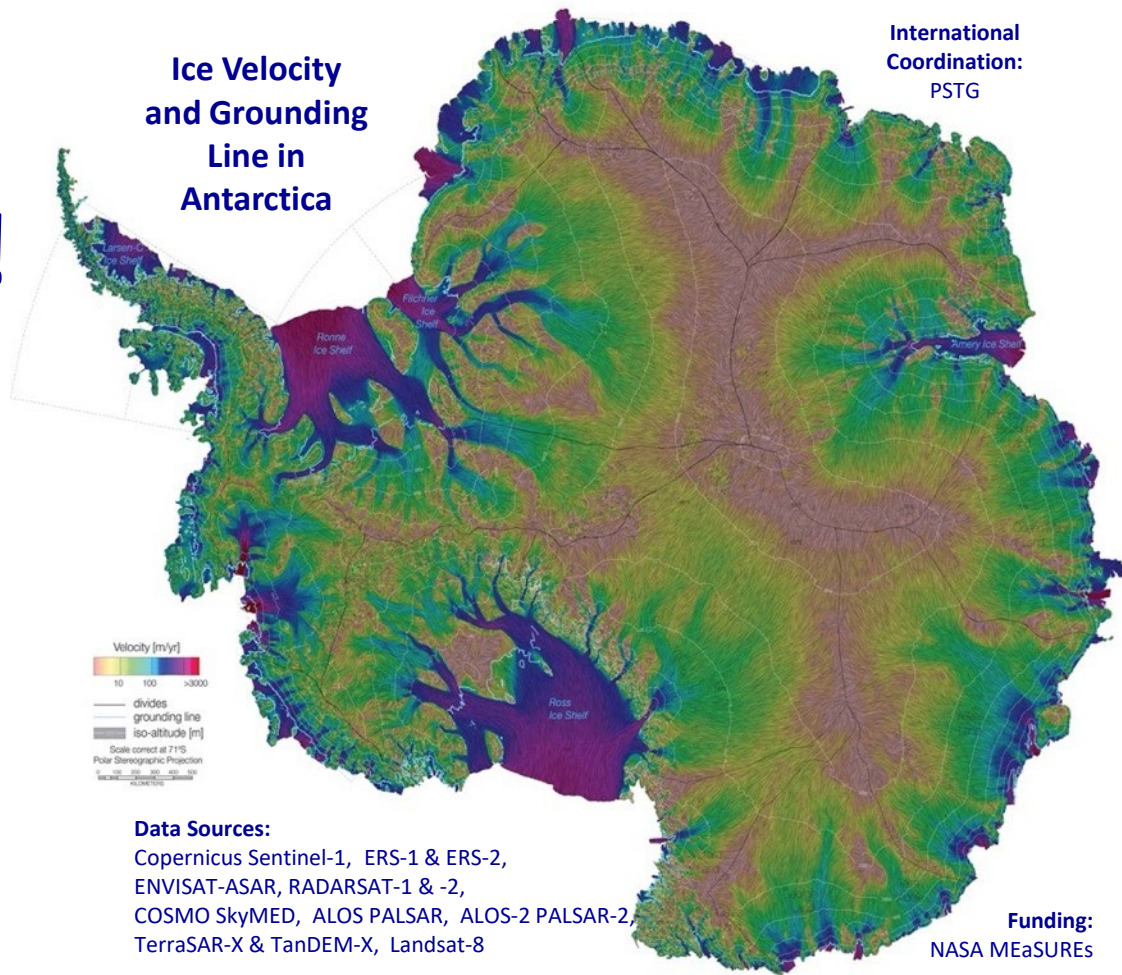
Boundaries:

<https://nsidc.org/data/NSIDC-0709>

Bedmachine Antarctica:

<https://nsidc.org/data/NSIDC-0756>

Ice Velocity and Grounding Line in Antarctica



Data Sources:

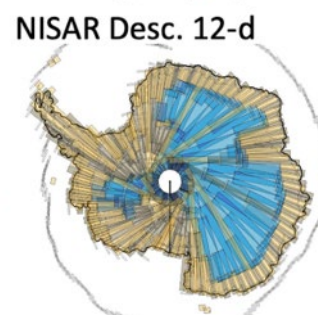
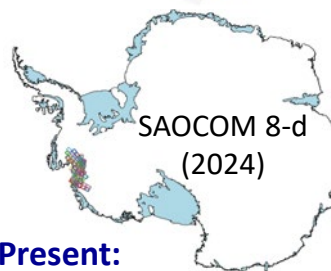
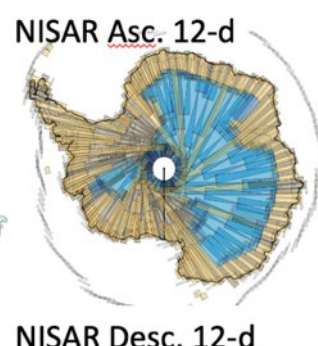
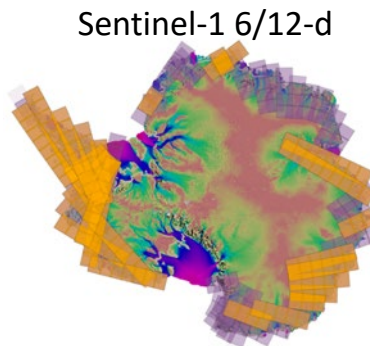
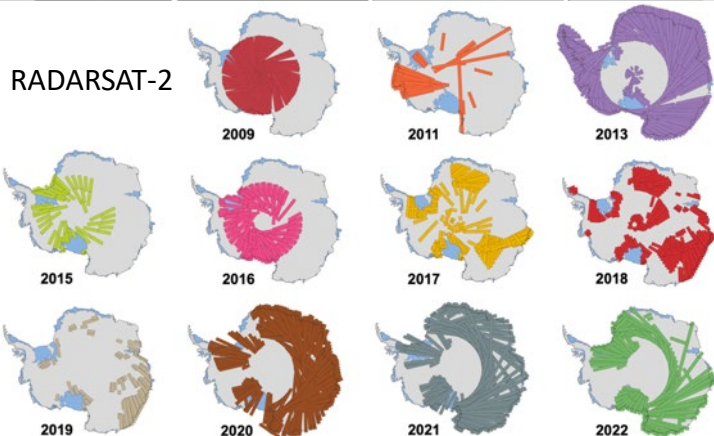
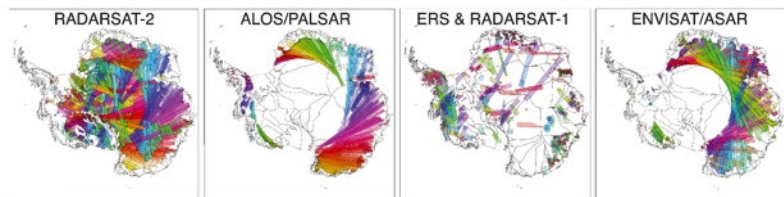
Copernicus Sentinel-1, ERS-1 & ERS-2,
ENVISAT-ASAR, RADARSAT-1 & -2,
COSMO SkyMED, ALOS PALSAR, ALOS-2 PALSAR-2,
TerraSAR-X & TanDEM-X, Landsat-8

International
Coordination:
PSTG



Funding:
NASA MEaSUREs

SAR Coverage of Antarctica – Coordination is key



Present:

- Sentinel-1: Long-term commitment to coastal coverage, much in 6-day repeat (2 satellites)
- RCM: Focus on fast glaciers for grounding line measurements with 4-day repeat data.
- ALOS-2: Restriction in access to Stripmap data → Focus on fast glaciers where C-band decorrelates.
- SAOCOM: Coverage of Amundsen Sea Embayment