

ESA Fringe 2026

Towards a BIOMASS Ice Velocity Product

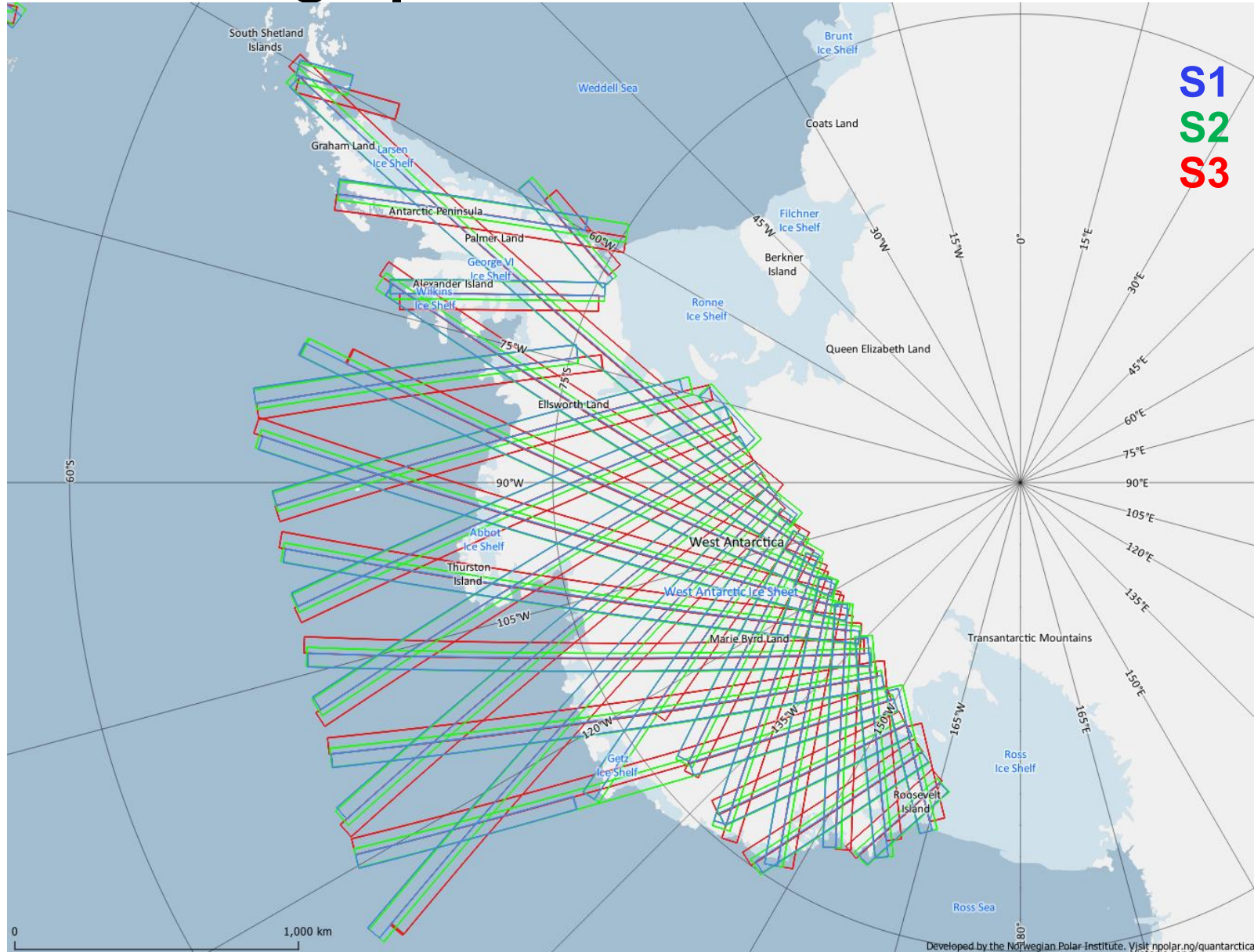
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DTU Space – Technical University of Denmark*

Introduction

- Ice flow mapping is a secondary objective of Biomass
- P-band wavelength advantages
 - Reduced interferometric fringe rate for fast-flowing glaciers
 - Increased temporal coherence (less sensitivity to surface processes like precipitation)
- P-band wavelength problems
 - Ionosphere

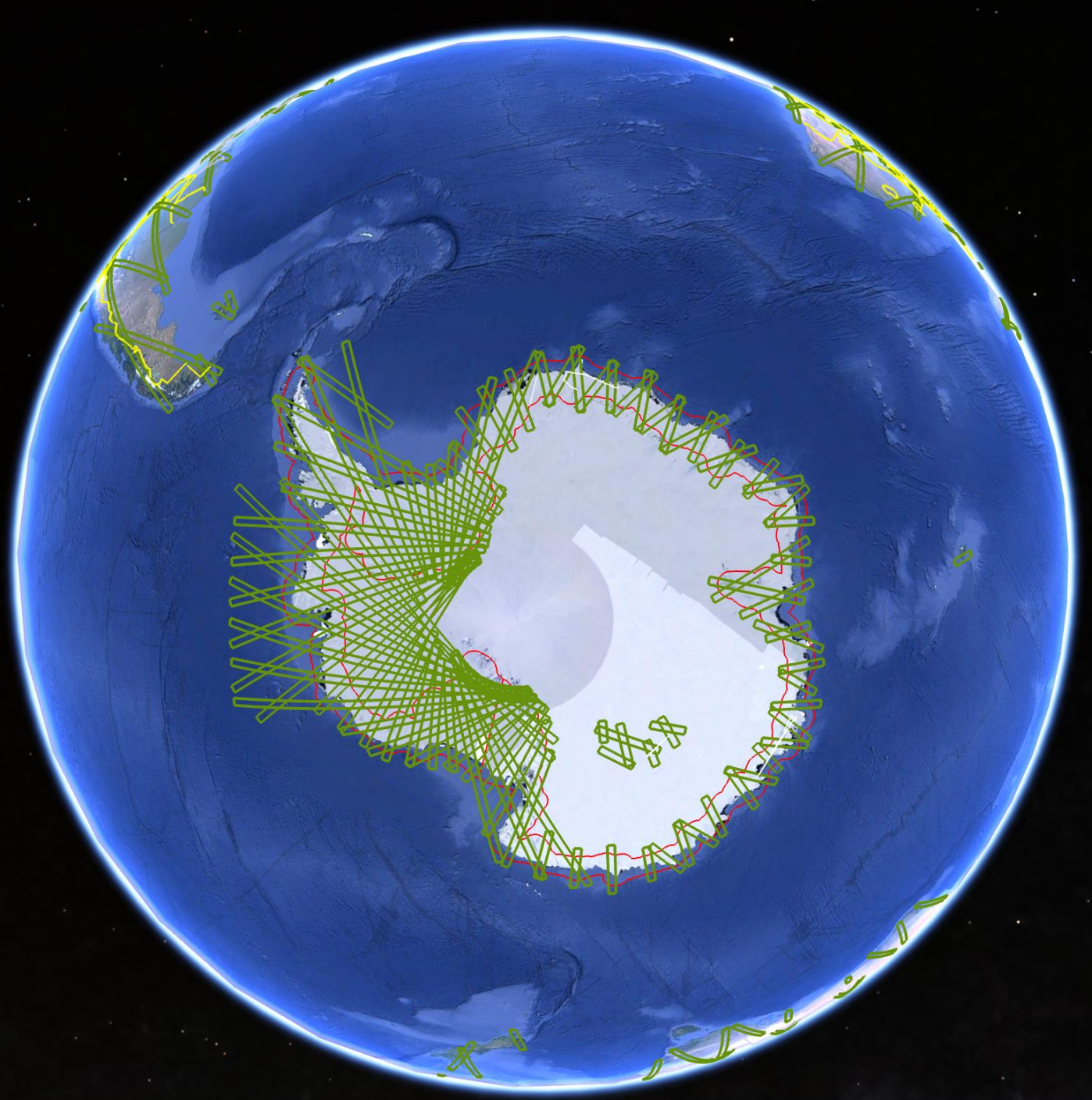
Acquisition plan in Tomographic Phase

- One swath is repeated 7 times with 3-day separation
- After 21, days, next swath is acquired
- After three swaths, BIOMASS is repositioned to acquire new tracks
- “Snapshot” temporal coverage
- InSAR is only feasible way of retrieving velocity
- Asc/Desc InSAR only available in “diamond” intersections

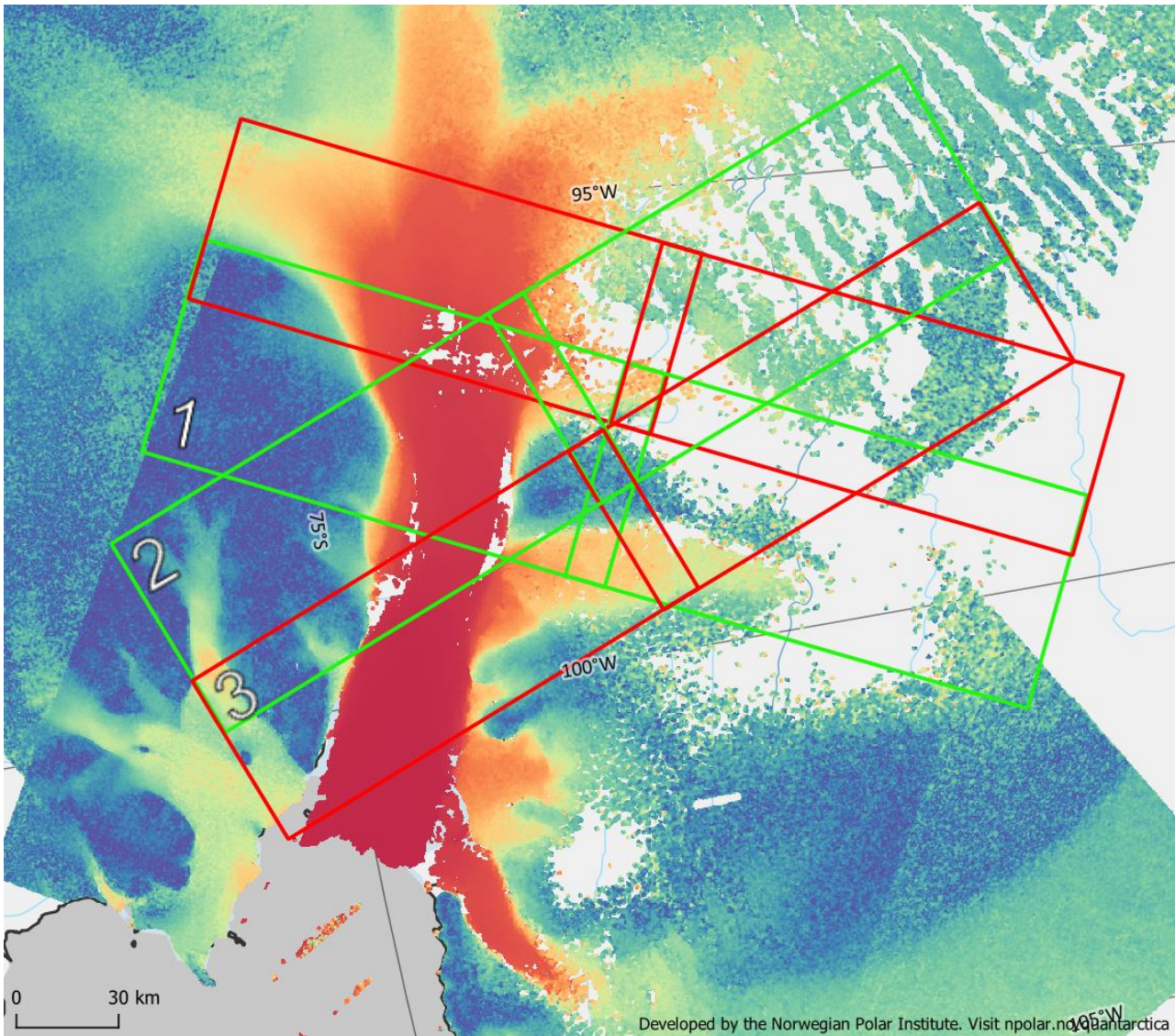


Expanded ice mask

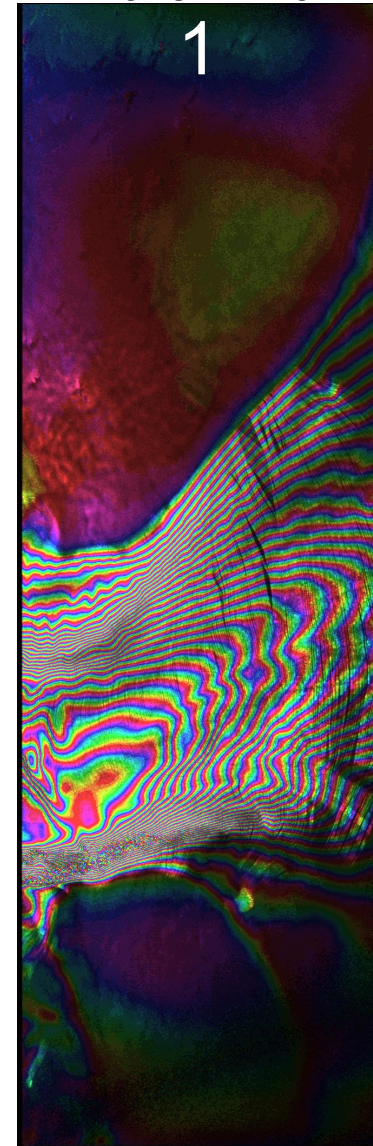
- Improved coverage of coastal areas, and Dome C (calibration site)
- Based on input from Biomass DISC consortium
- Implemented from May 2026 (Tomography Major Cycle 3, Swath 2).



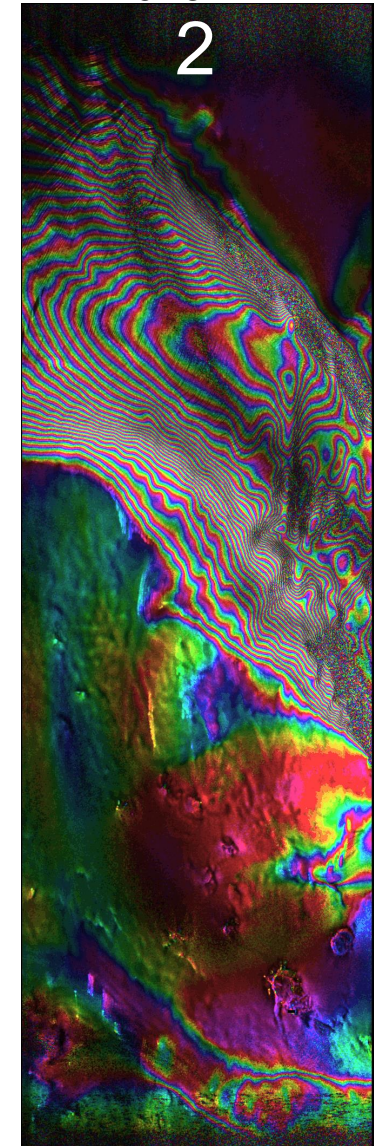
Biomass TMC 1 Interferogram Examples (3-day baseline)



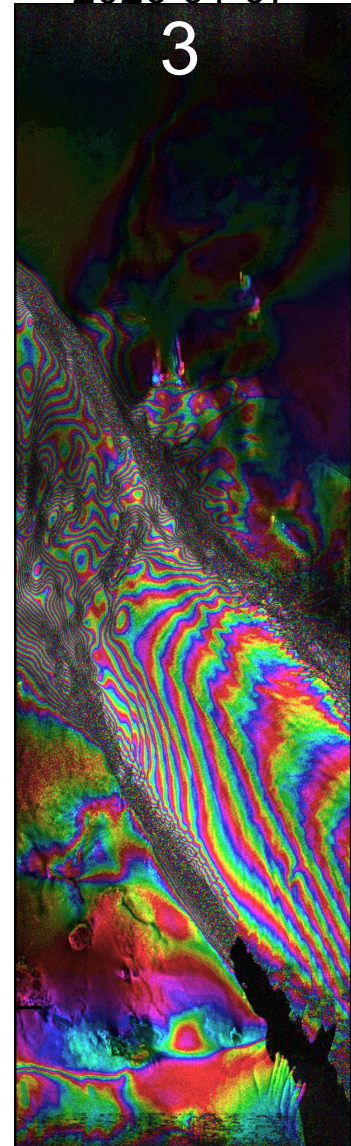
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2025-12-16



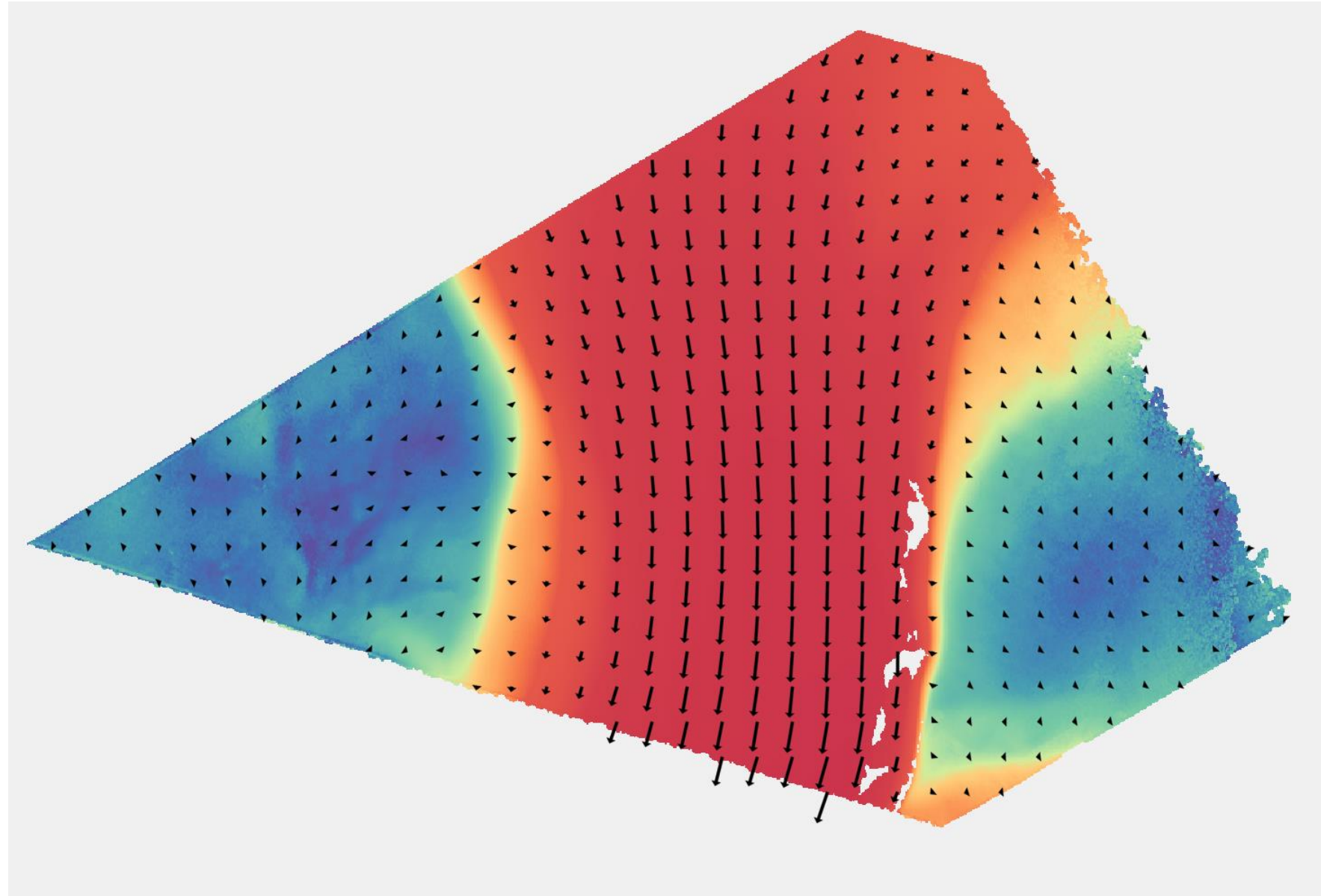
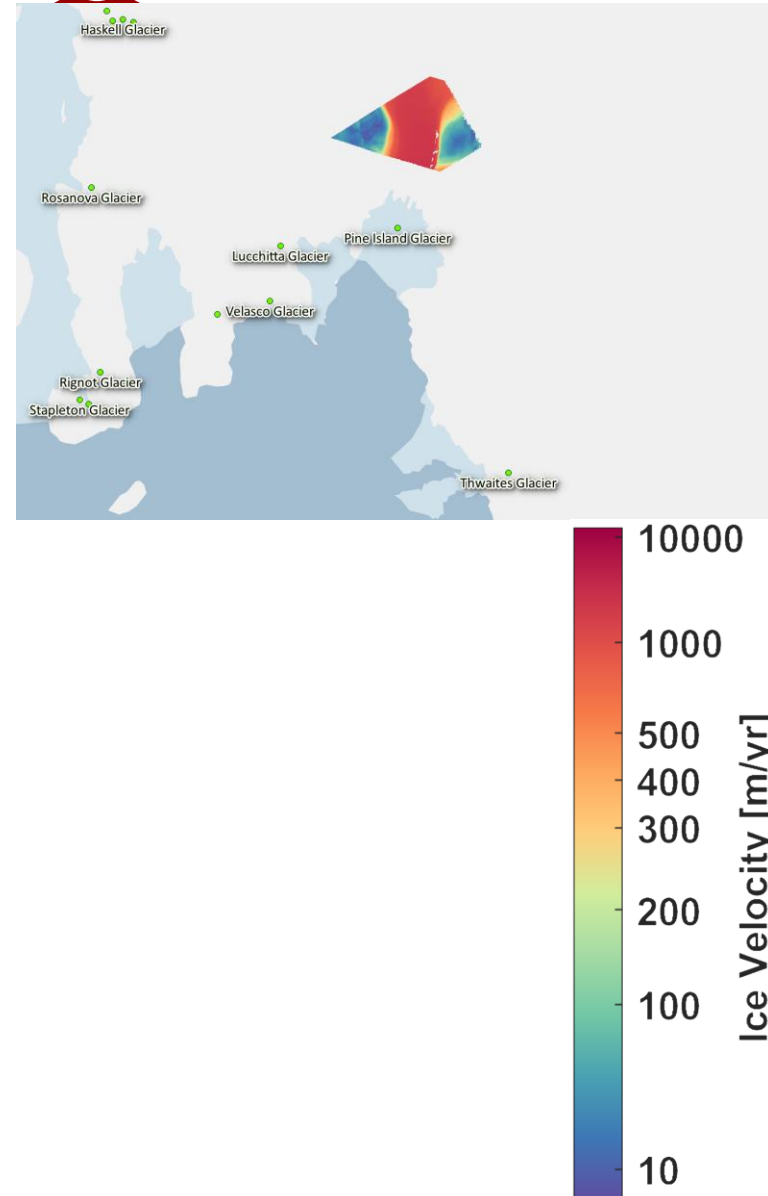
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2026-01-04
2026-01-07

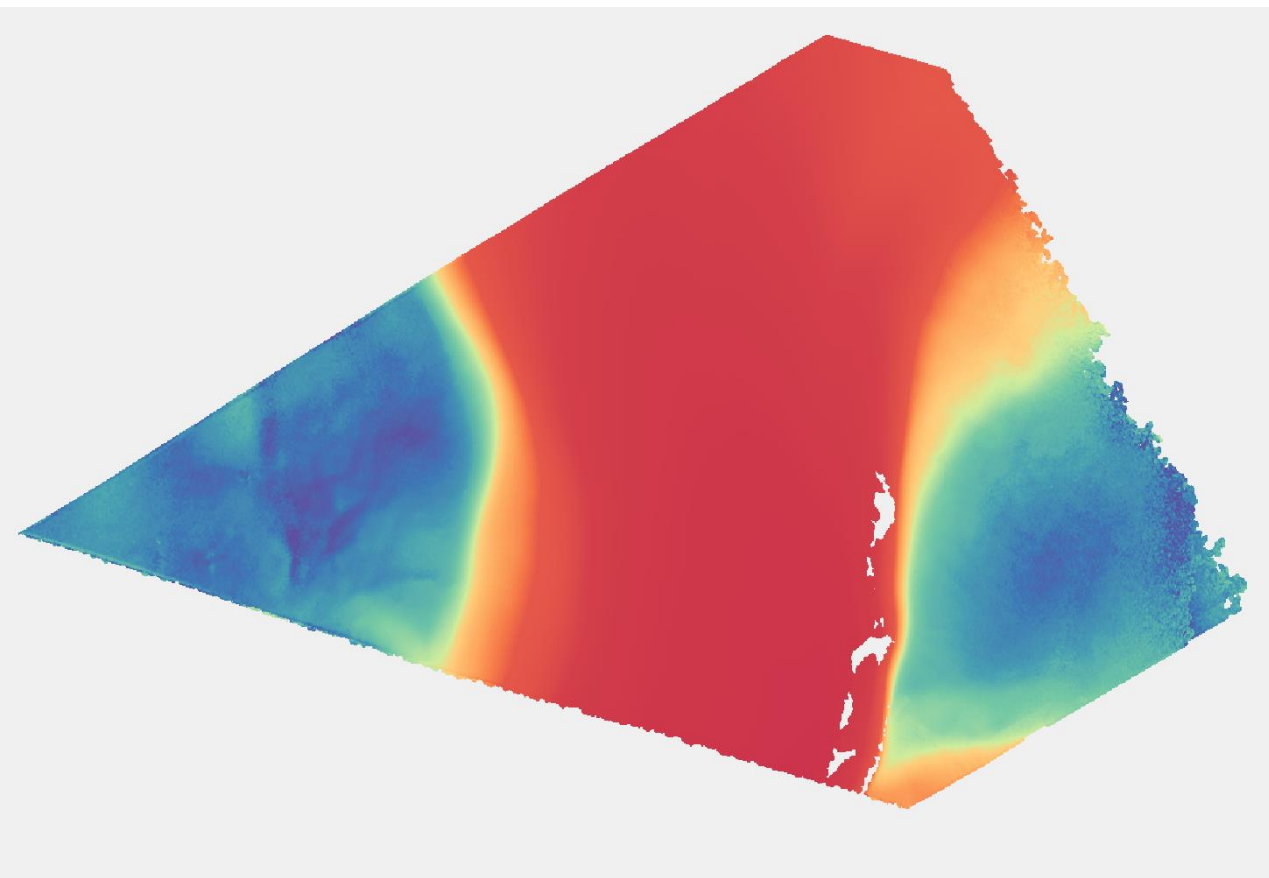


BIOMASS Velocity Map from Asc/Desc InSAR

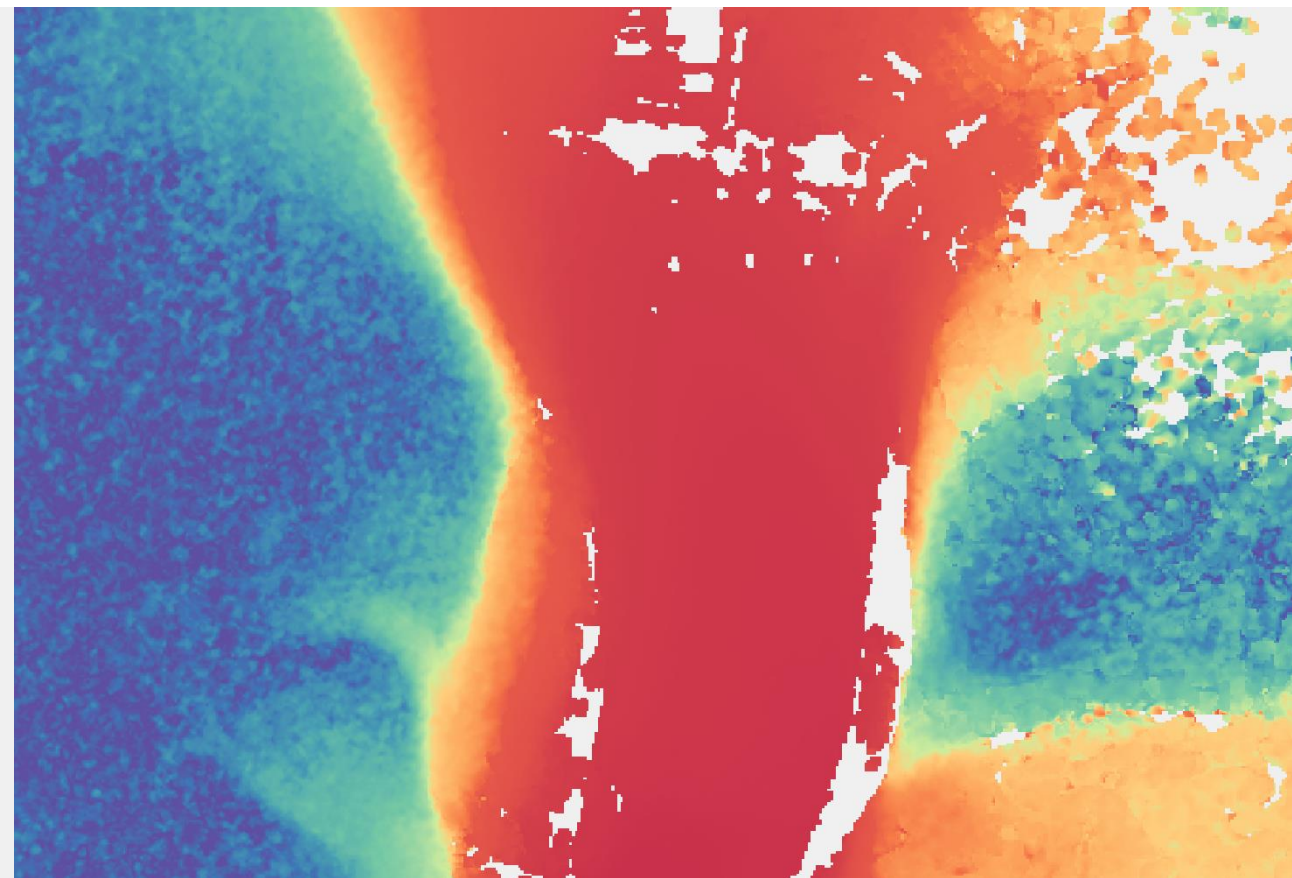


Sentinel-1 / BIOMASS comparison

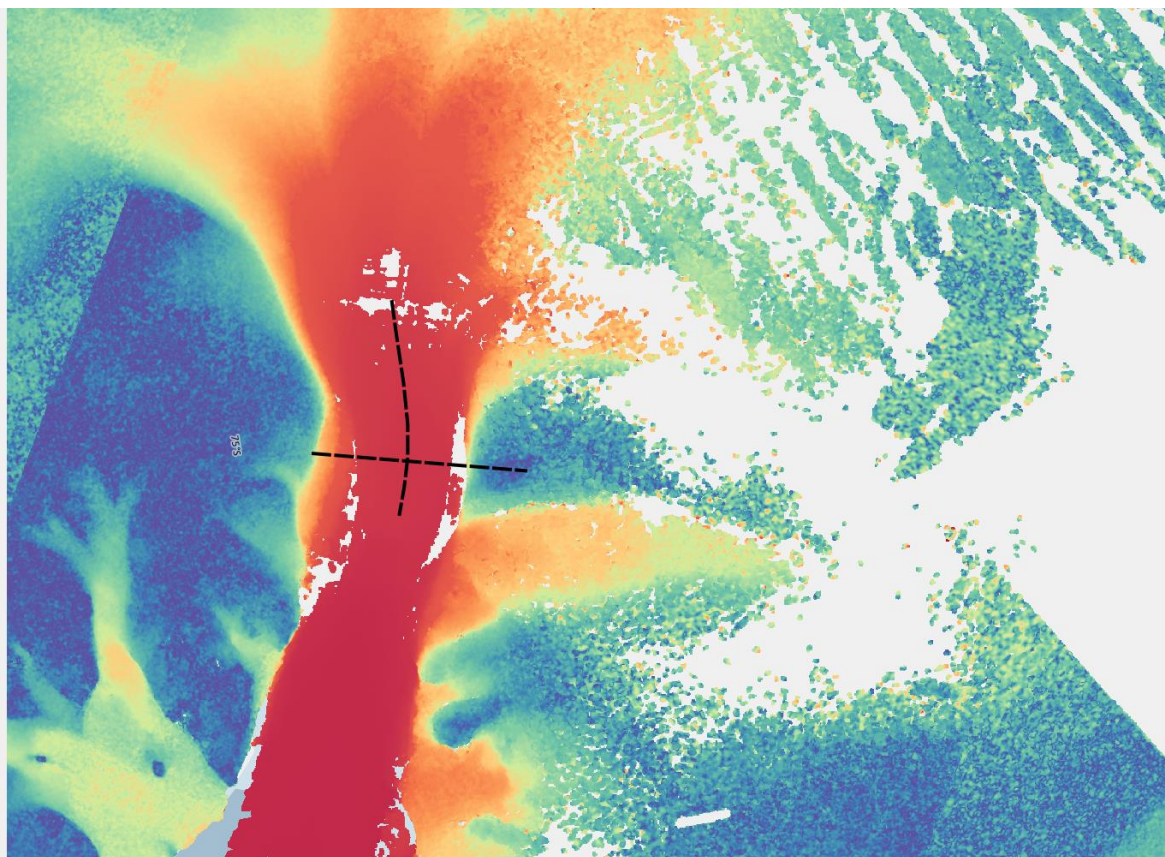
BIOMASS Asc/Desc InSAR



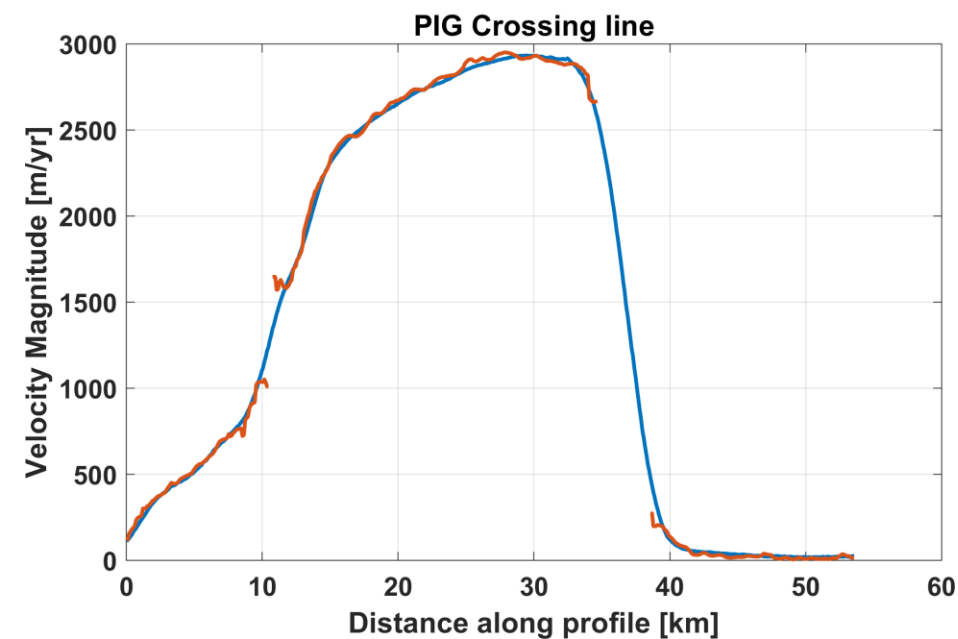
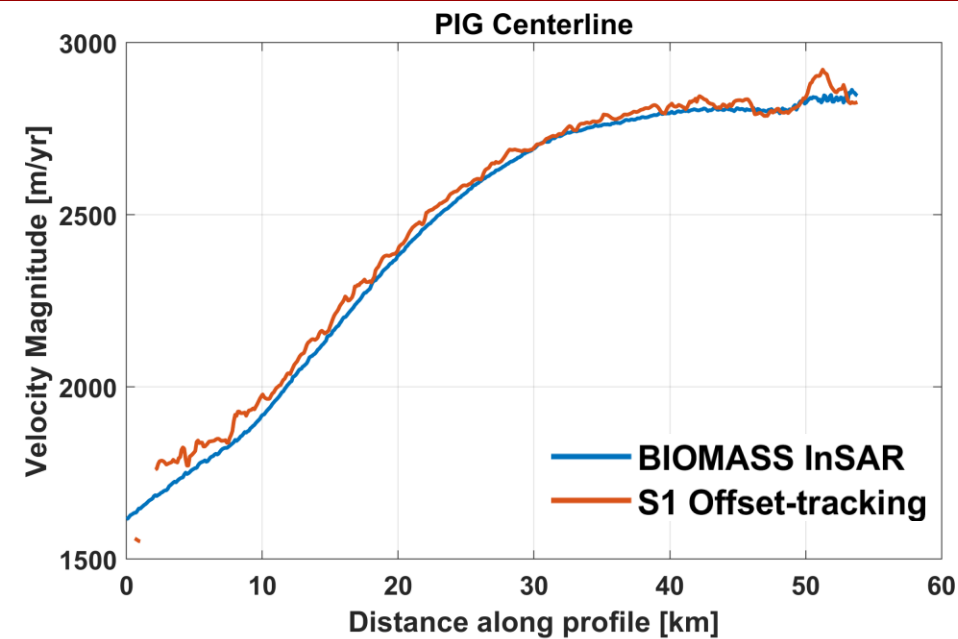
Sentinel-1 6-day Offset-tracking



Velocity Profiles

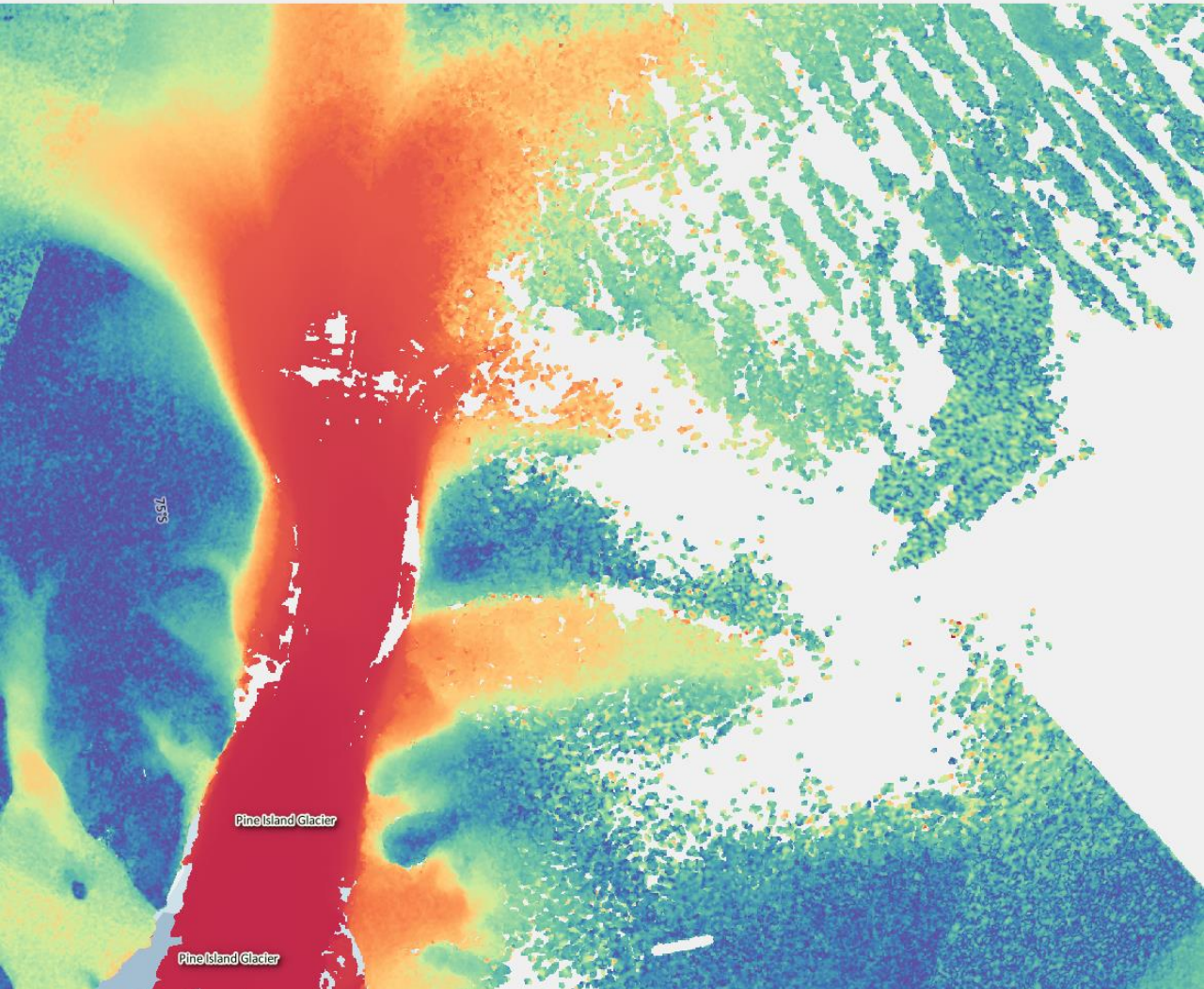


Developed by the Norwegian Polar Institute. Visit npolar.no/quantarctica

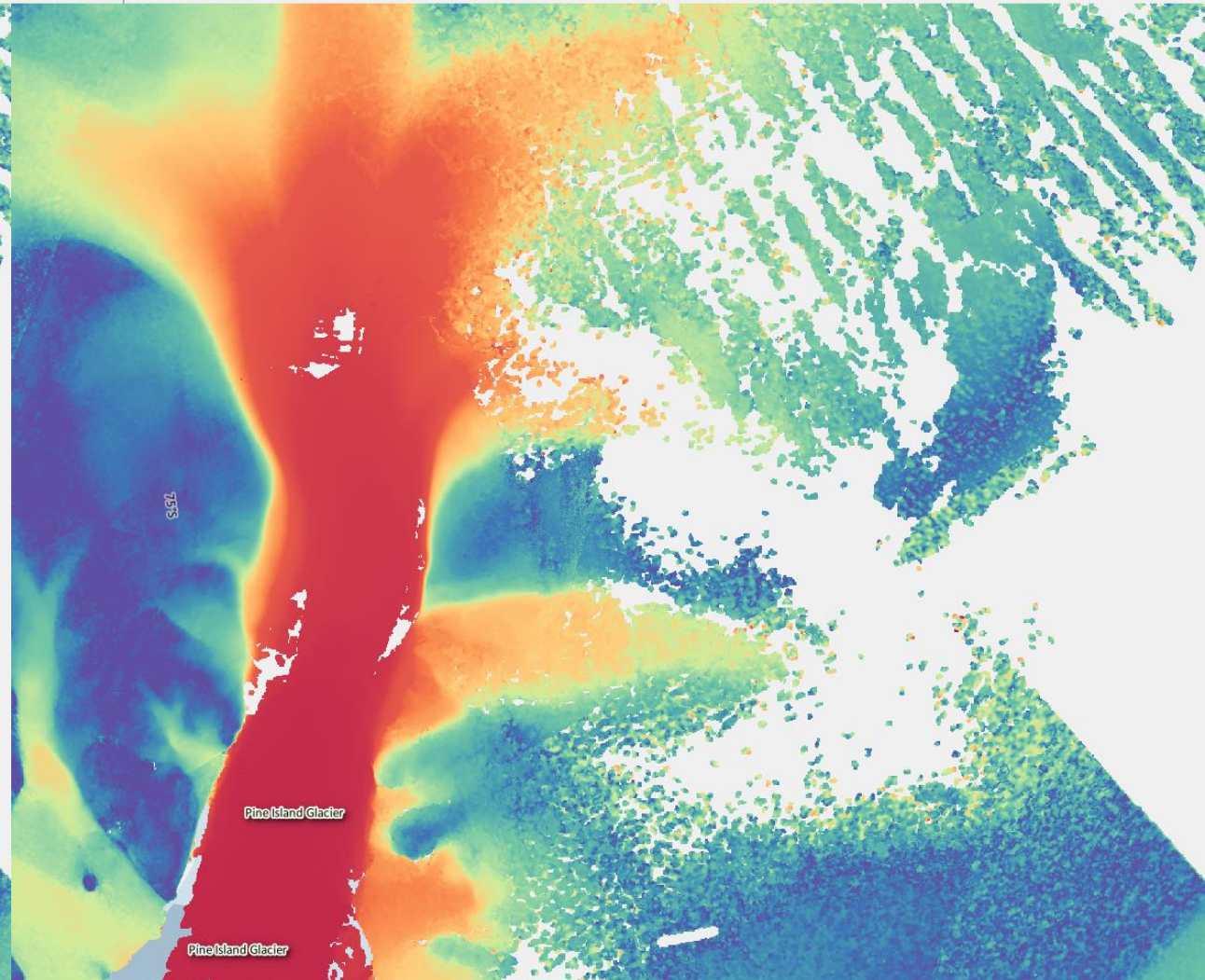


Combining BIOMASS InSAR and Sentinel-1 Offset-tracking

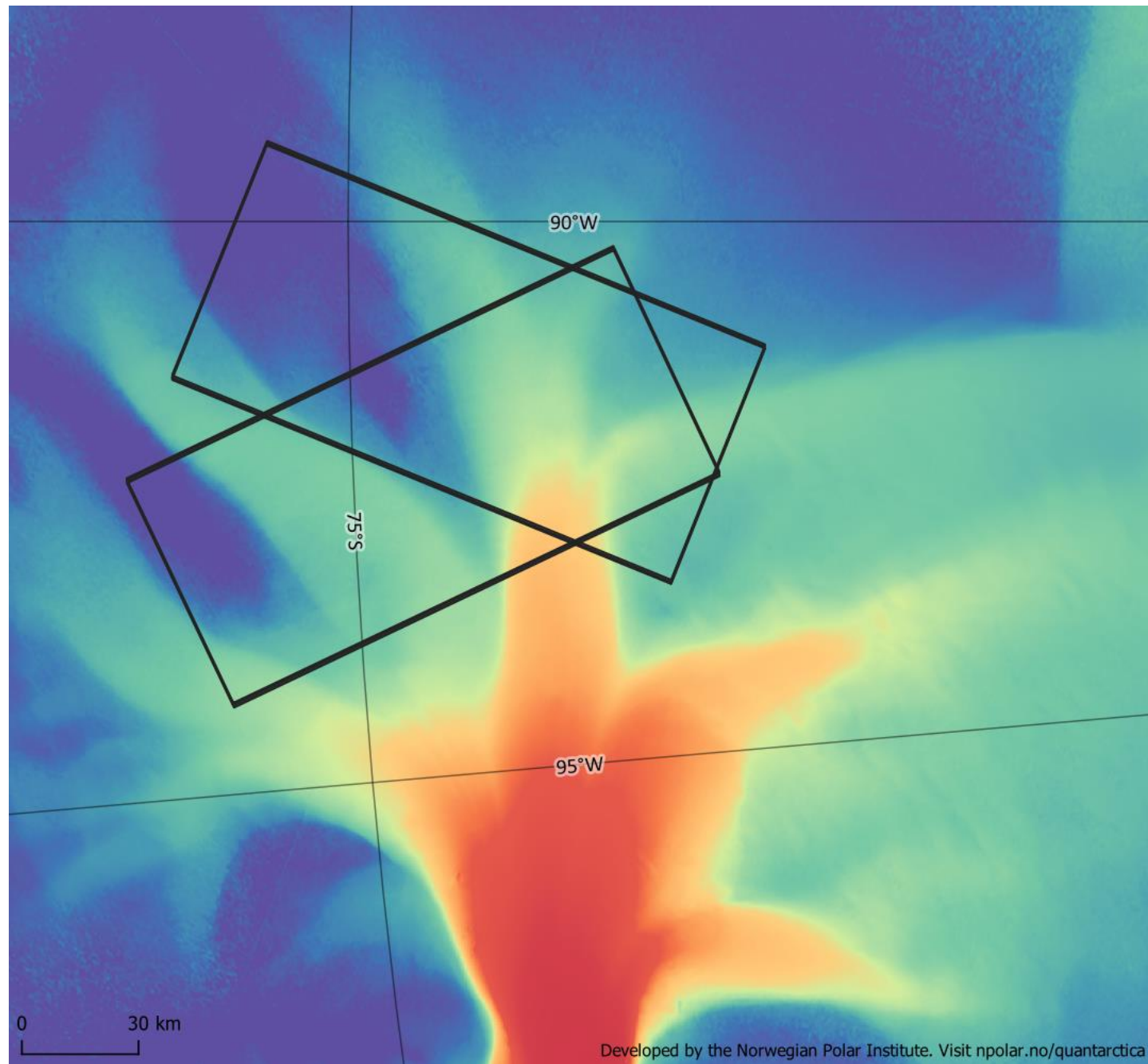
Sentinel-1 only

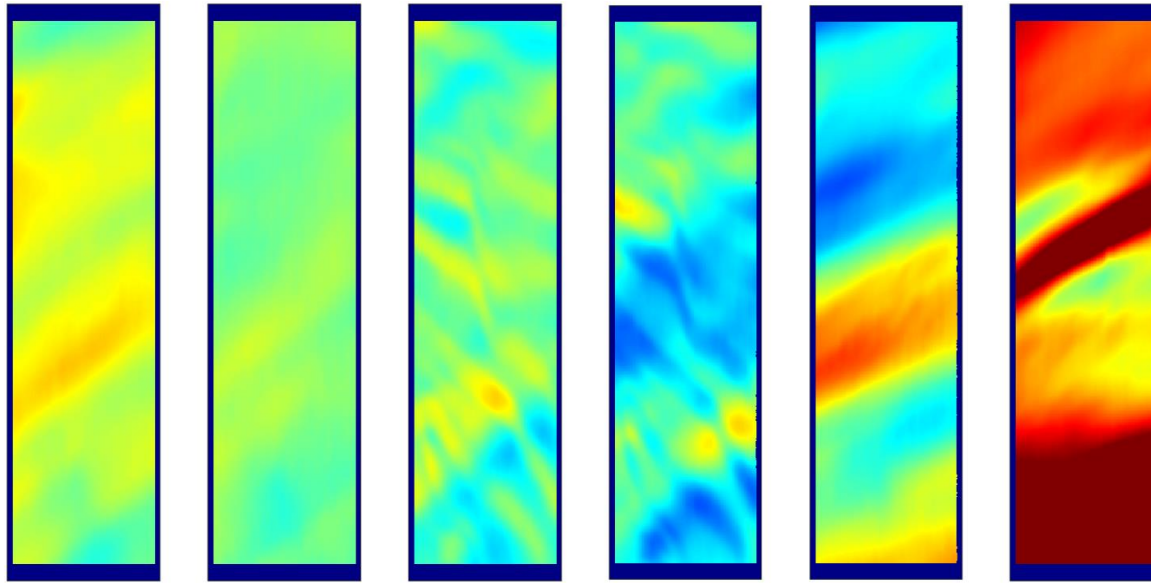


Sentinel-1 and BIOMASS

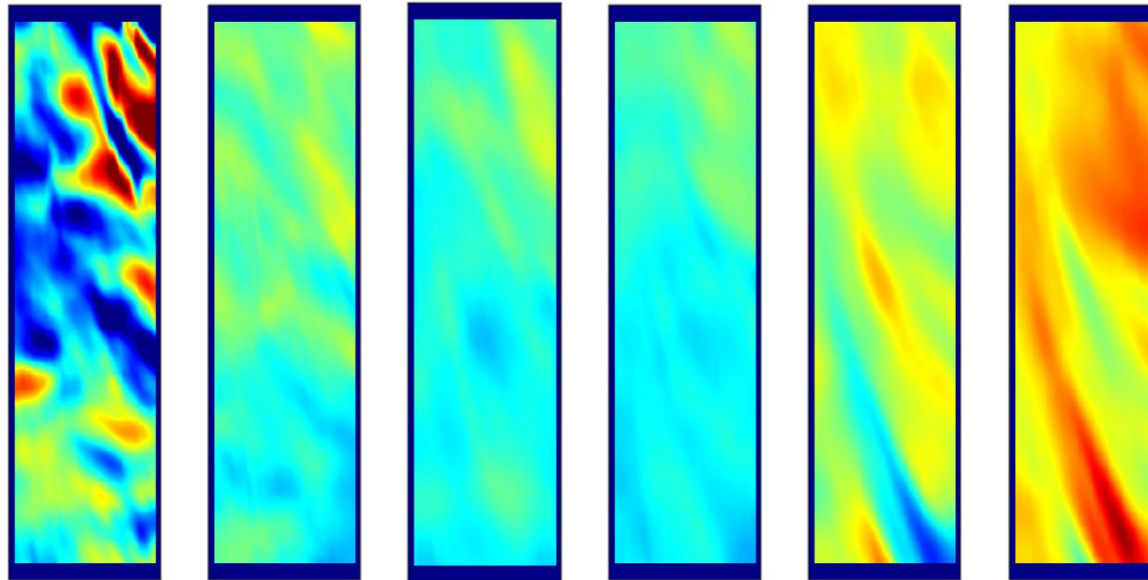


TMC 3 Example (May 2026)

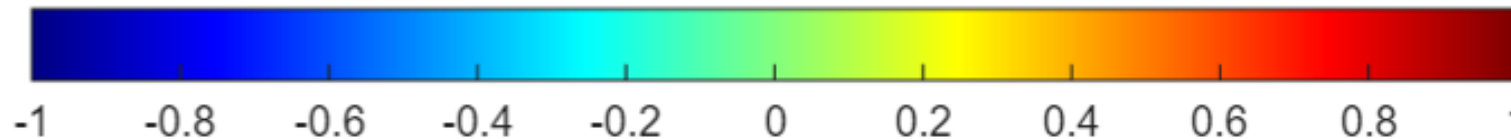


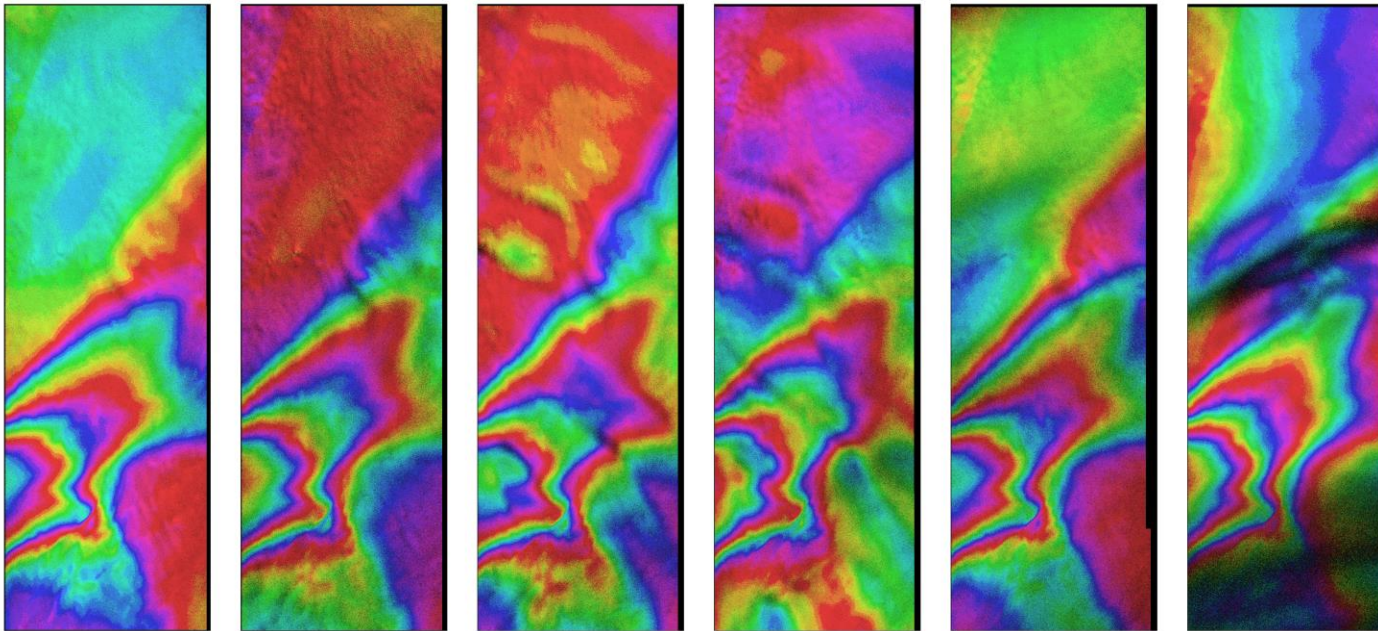


Descending 3-day azimuth shifts

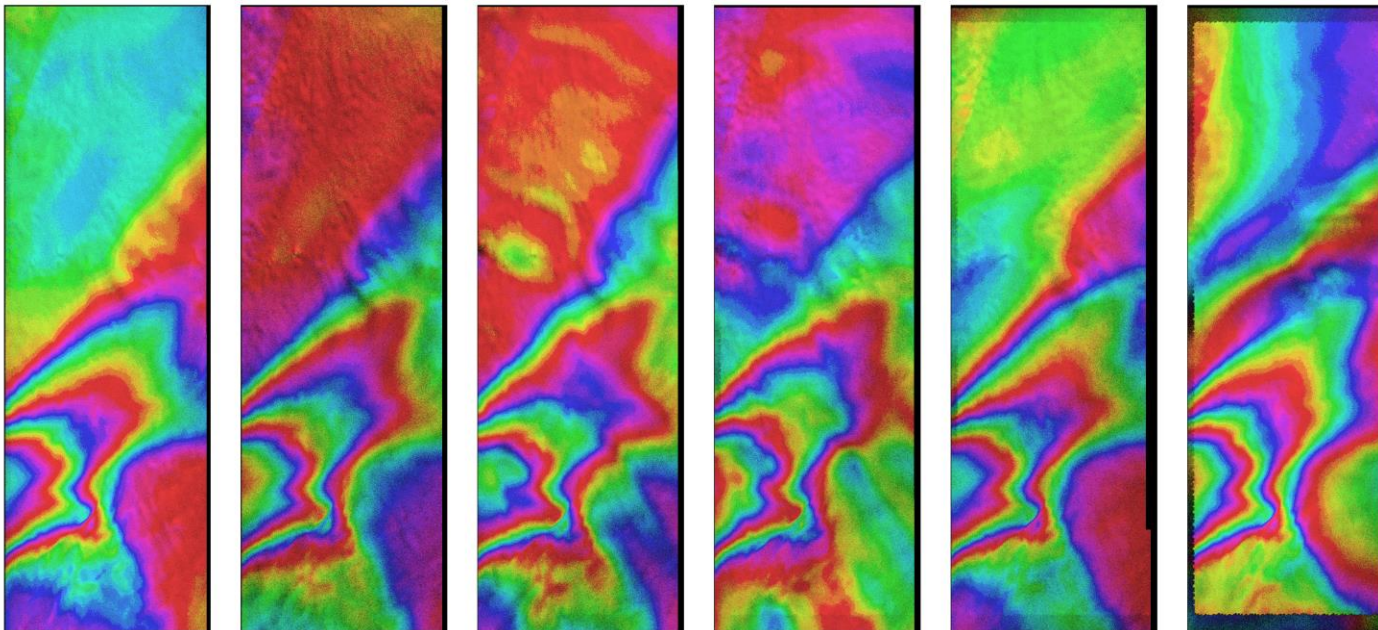


Ascending 3-day azimuth shifts

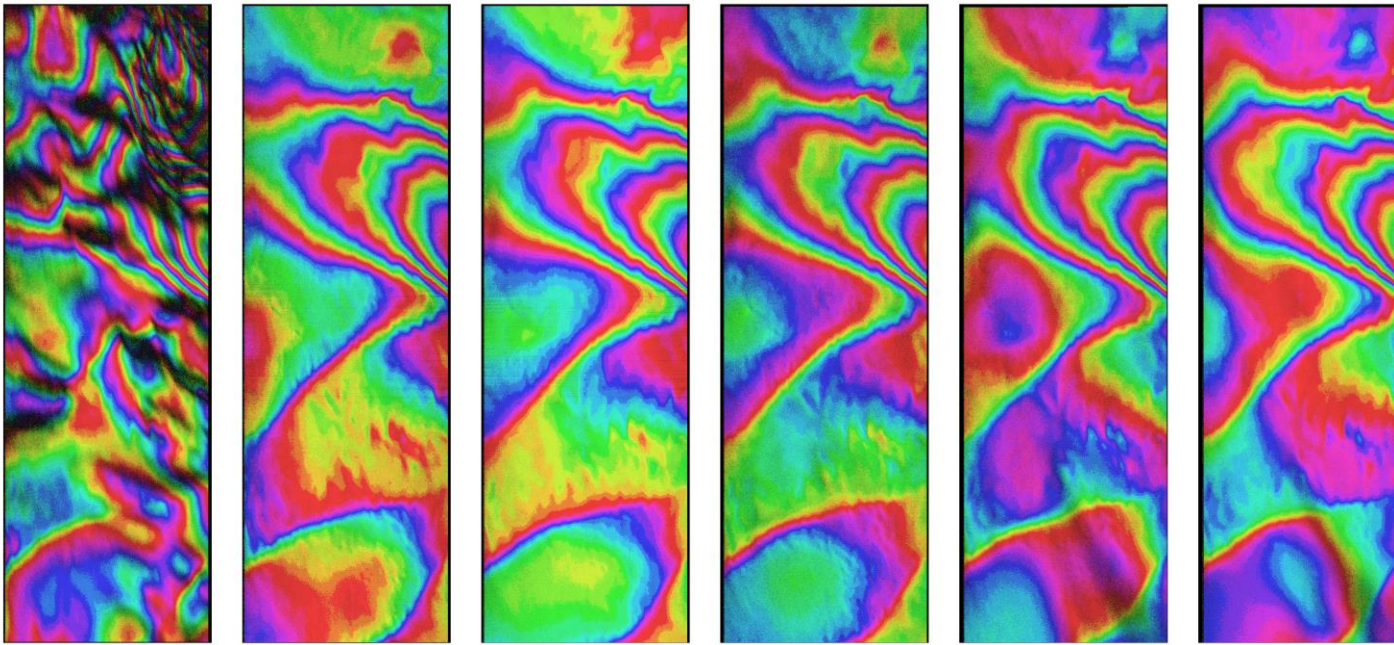




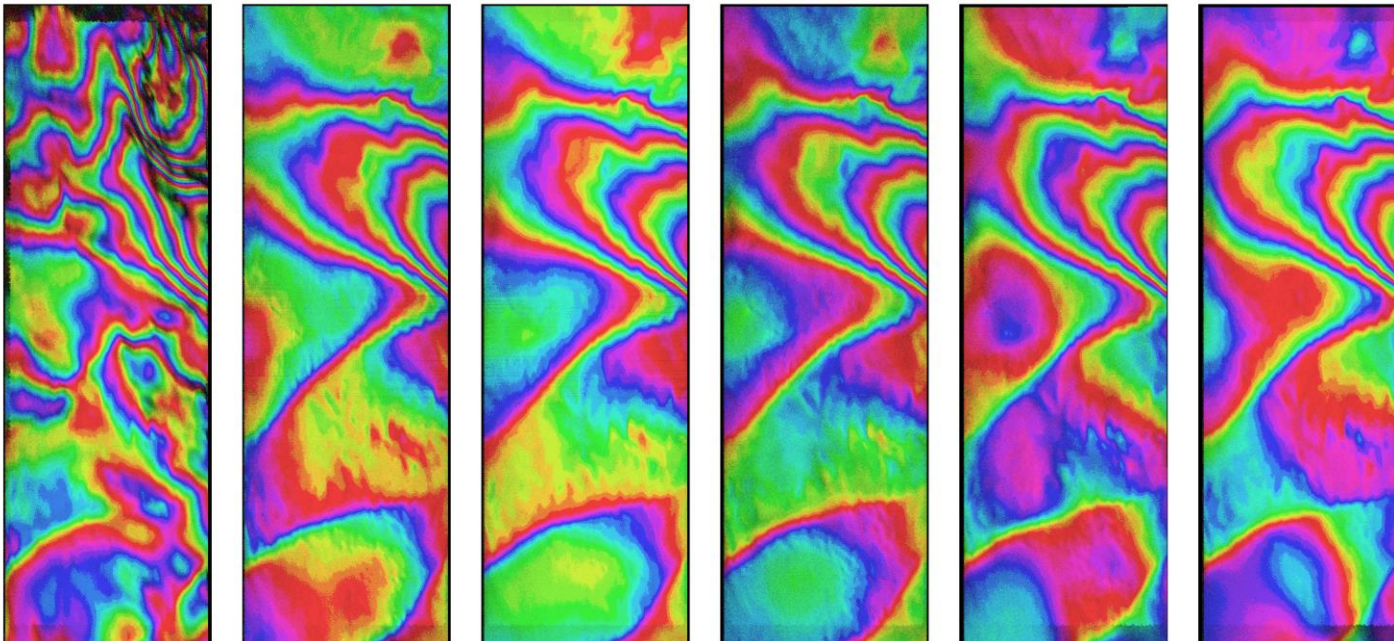
Descending 3-day phase,
Standard coregistration



Descending 3-day phase,
Adaptive coregistration

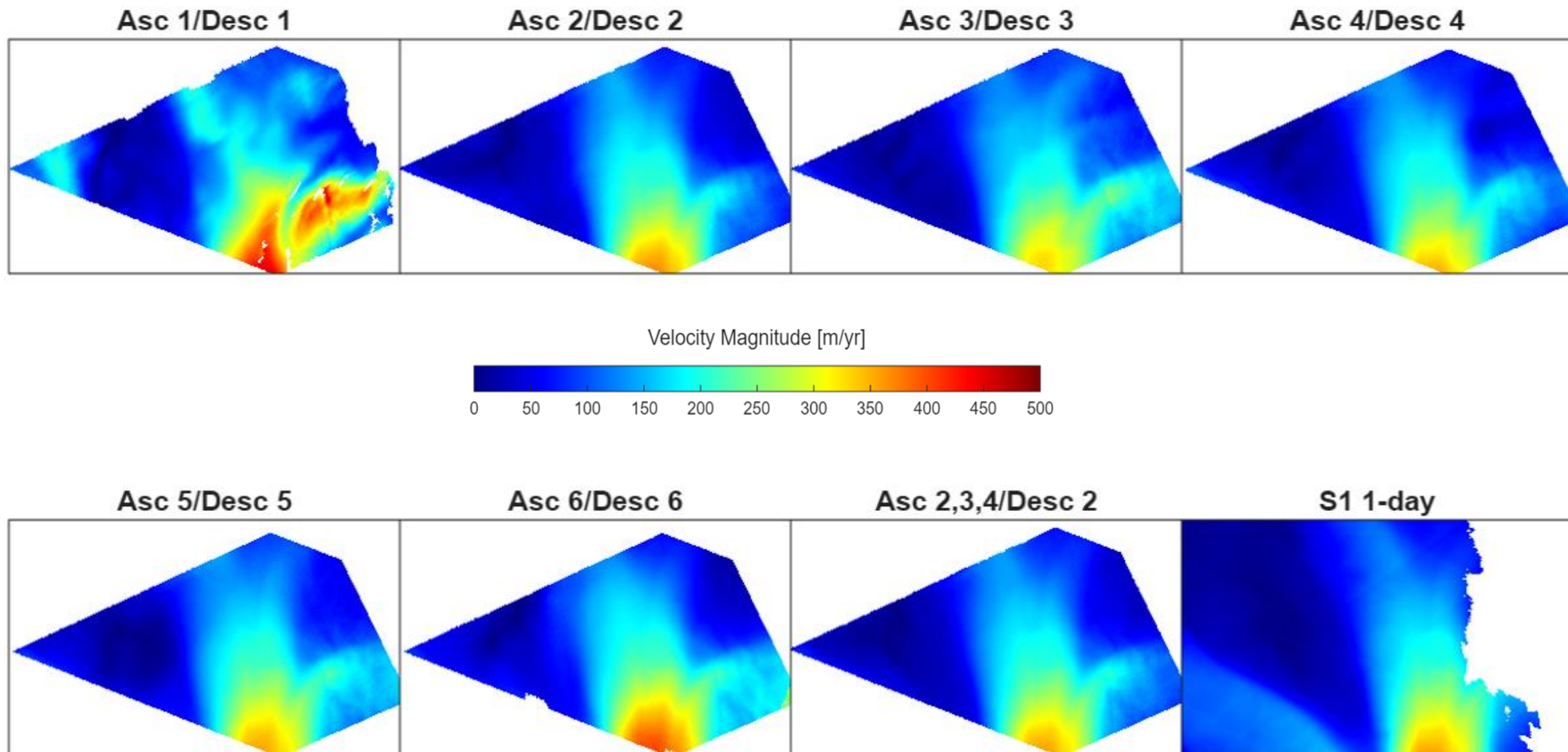


Descending 3-day phase,
Standard coregistration

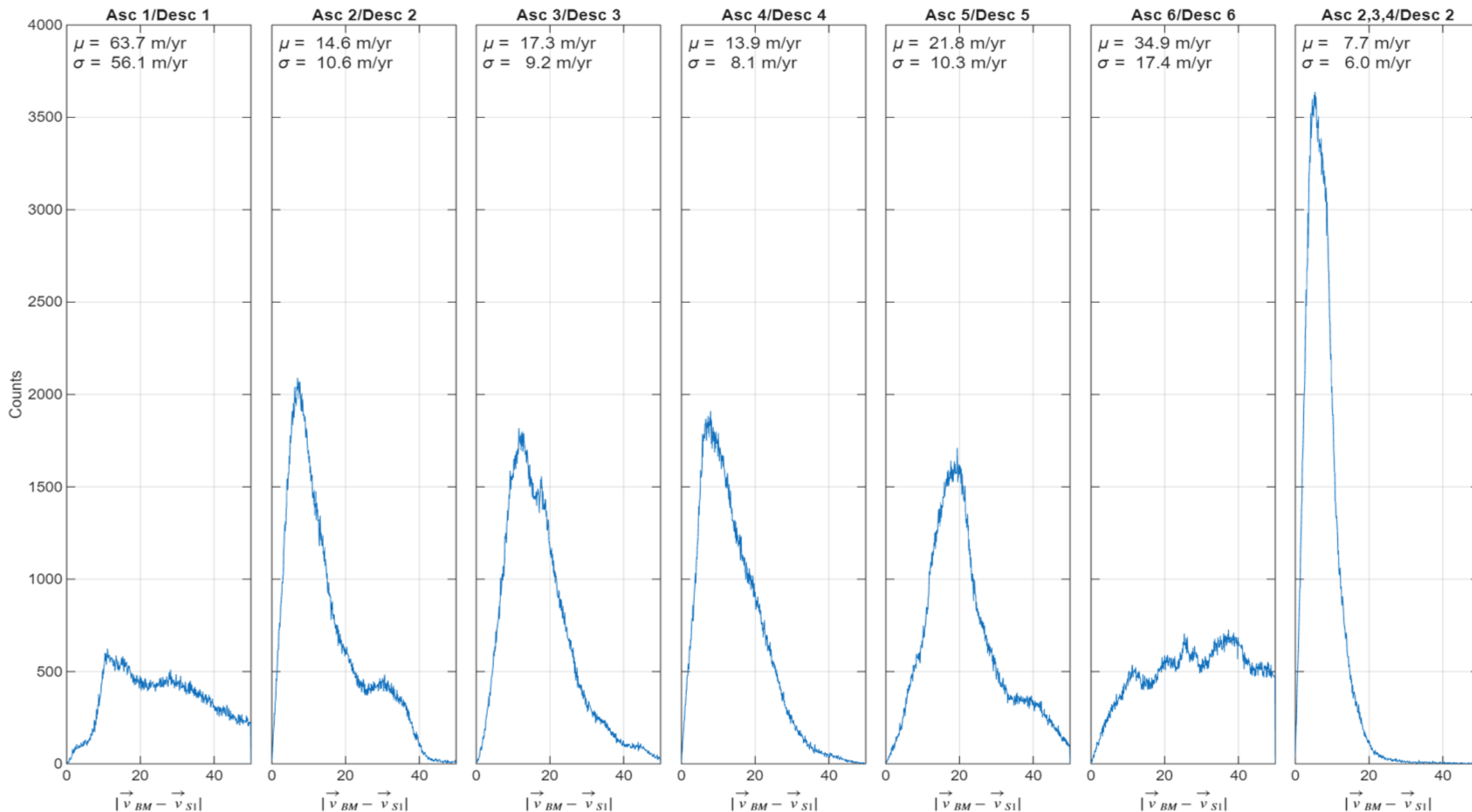


Descending 3-day phase,
Adaptive coregistration

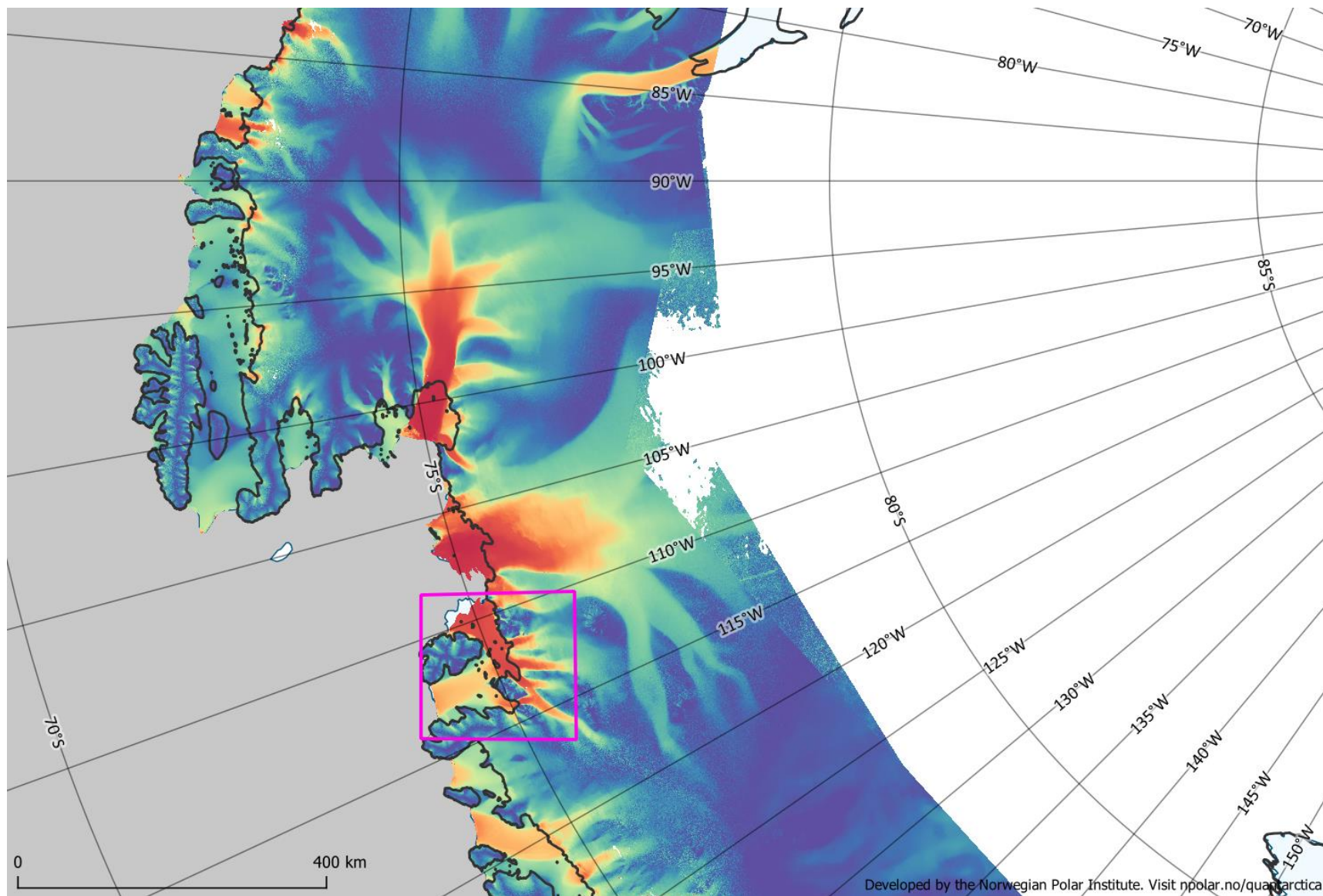
2D Velocity from Asc/Desc



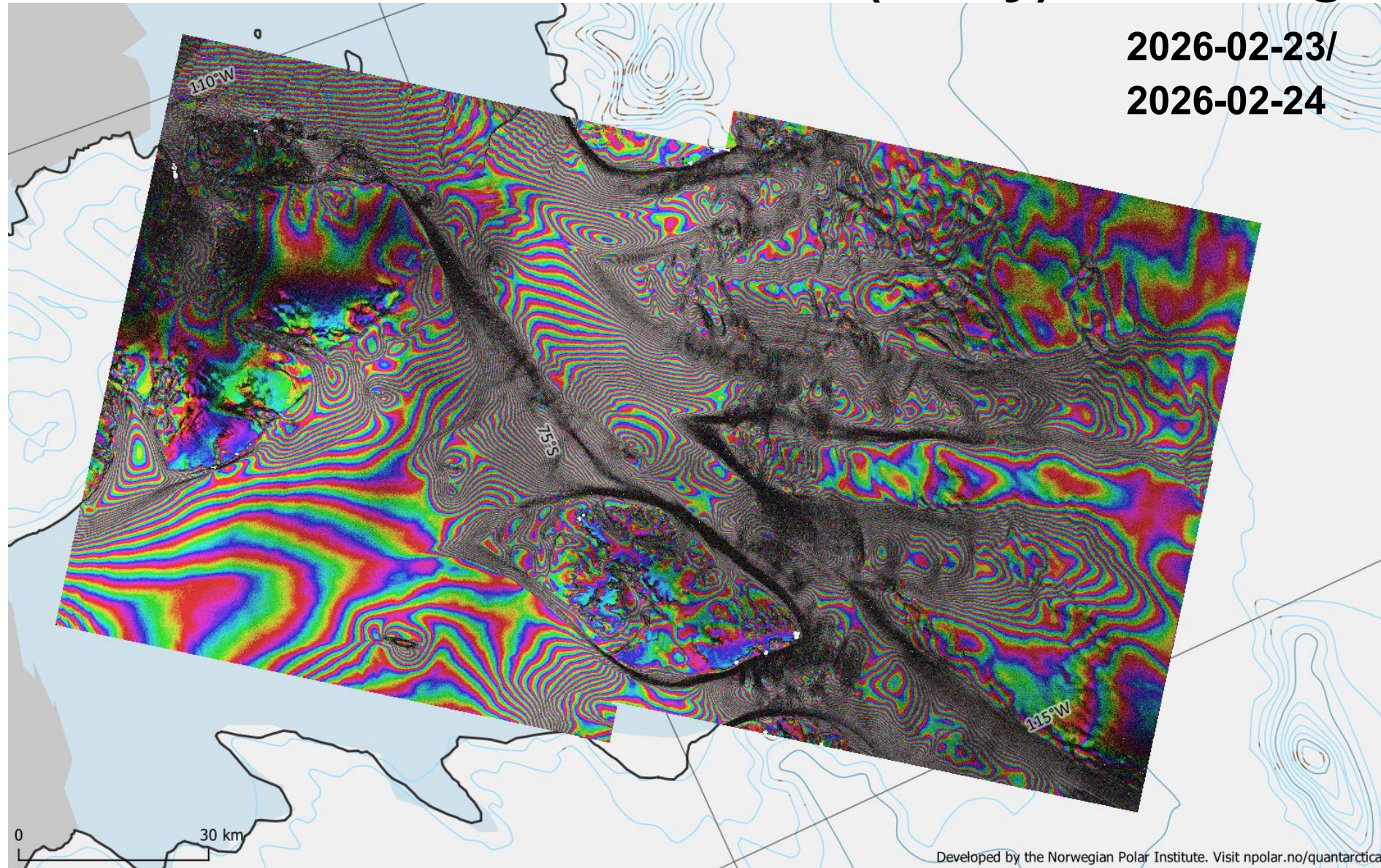
2D Velocity compared to Sentinel-1 1-day



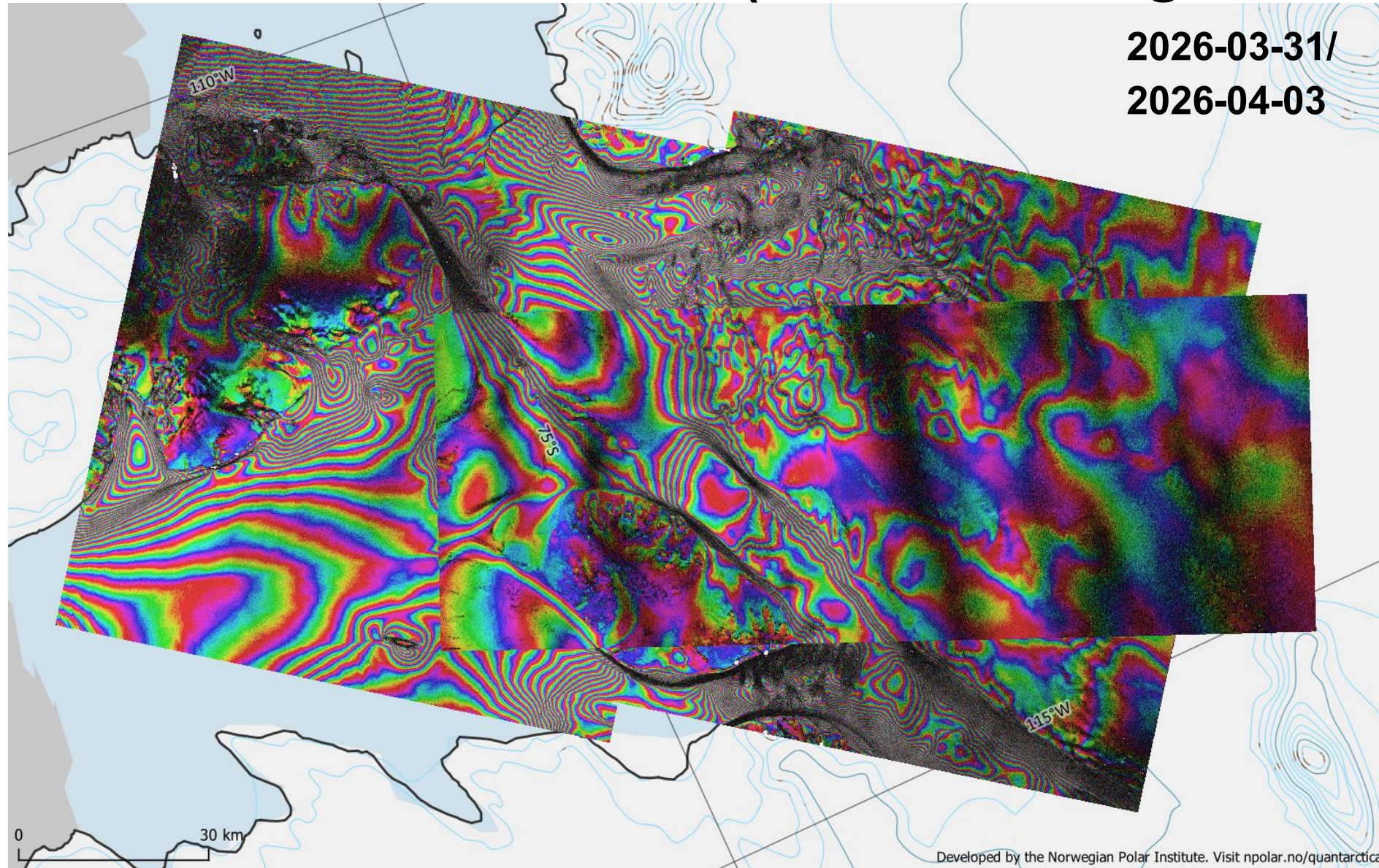
Smith Glacier



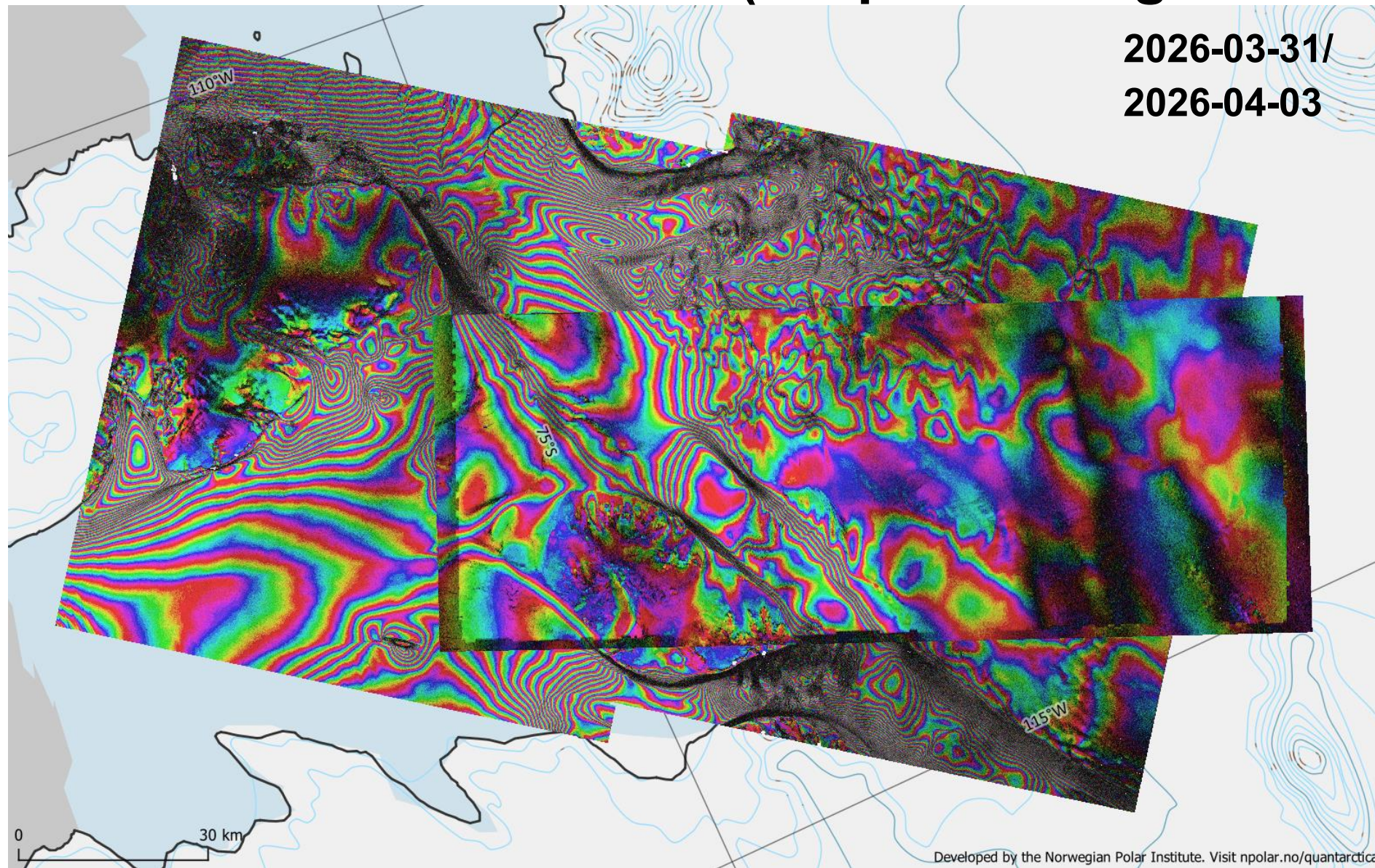
Smith Glacier – Sentinel-1 C/D (1-day) Interferogram



Smith Glacier – BIOMASS (standard coregistration)

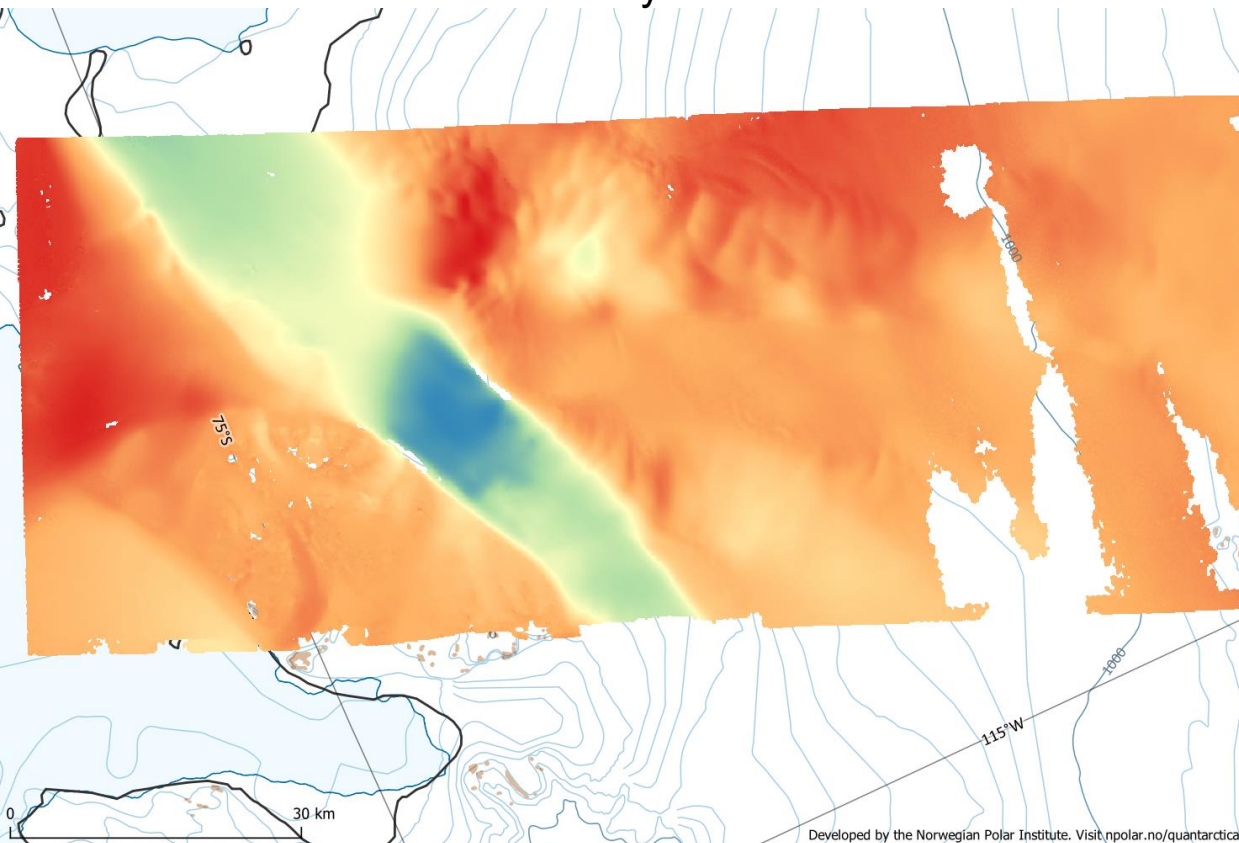


Smith Glacier – BIOMASS (adaptive coregistration)

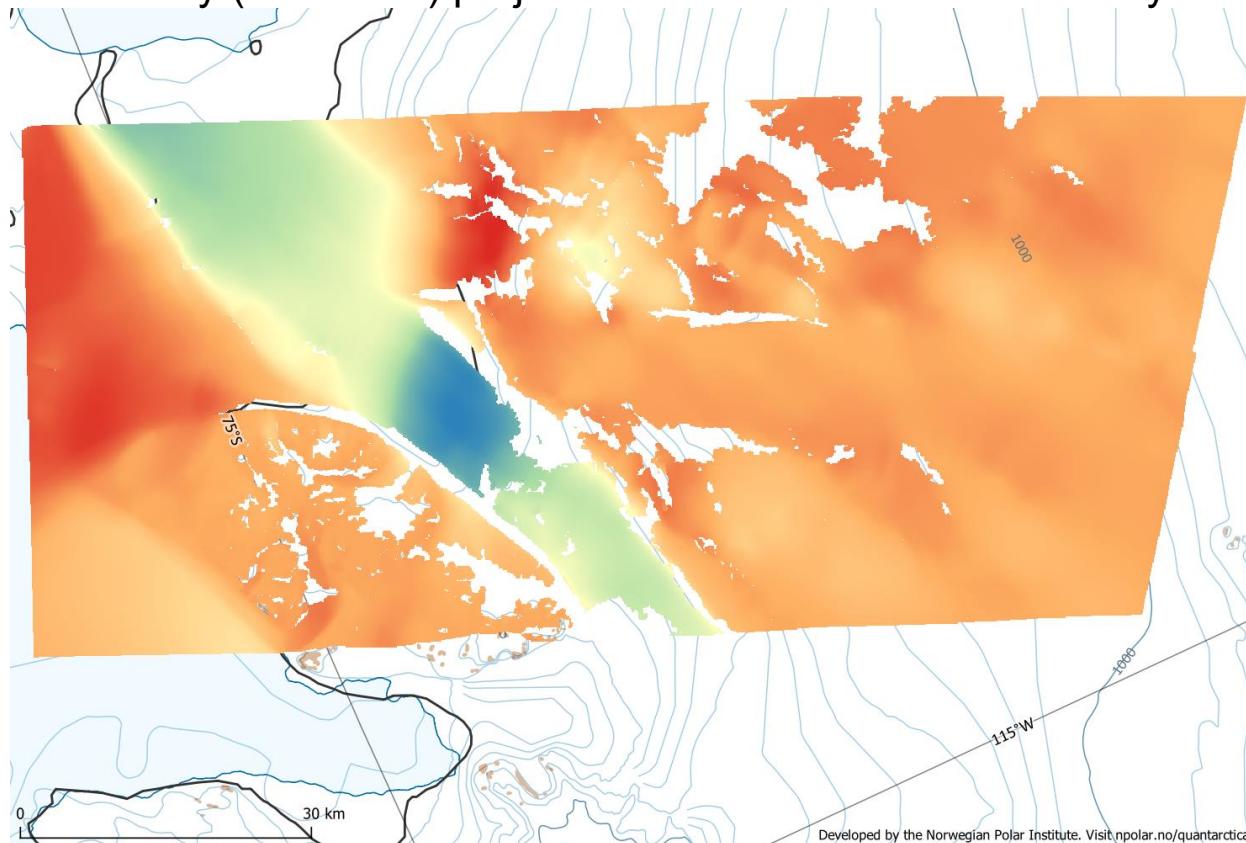


Smith Glacier InSAR-derived velocity

BIOMASS InSAR LoS velocity



S1 velocity (Asc/Desc) projected to BIOMASS LoS Geometry



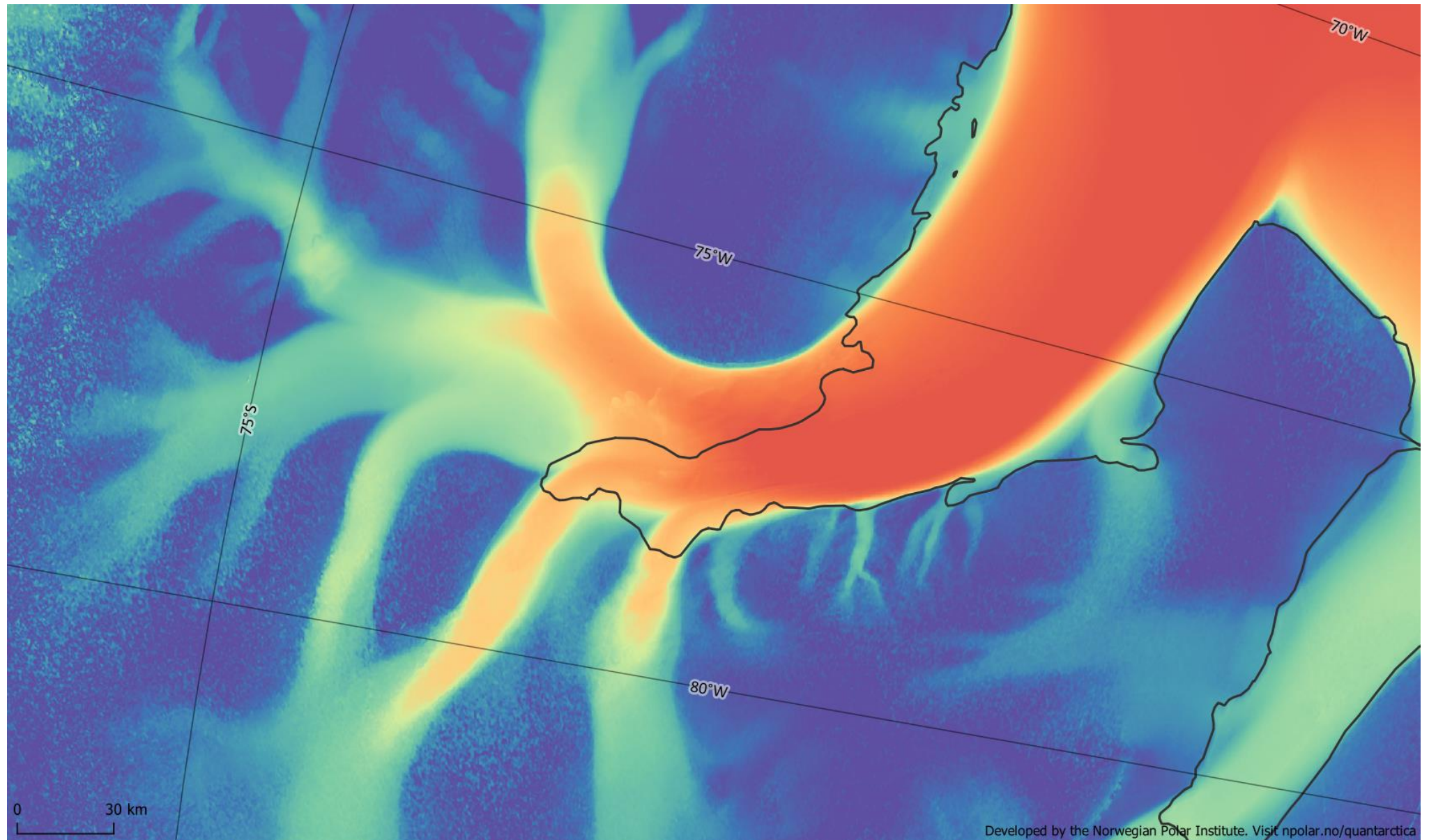
-400 m/yr



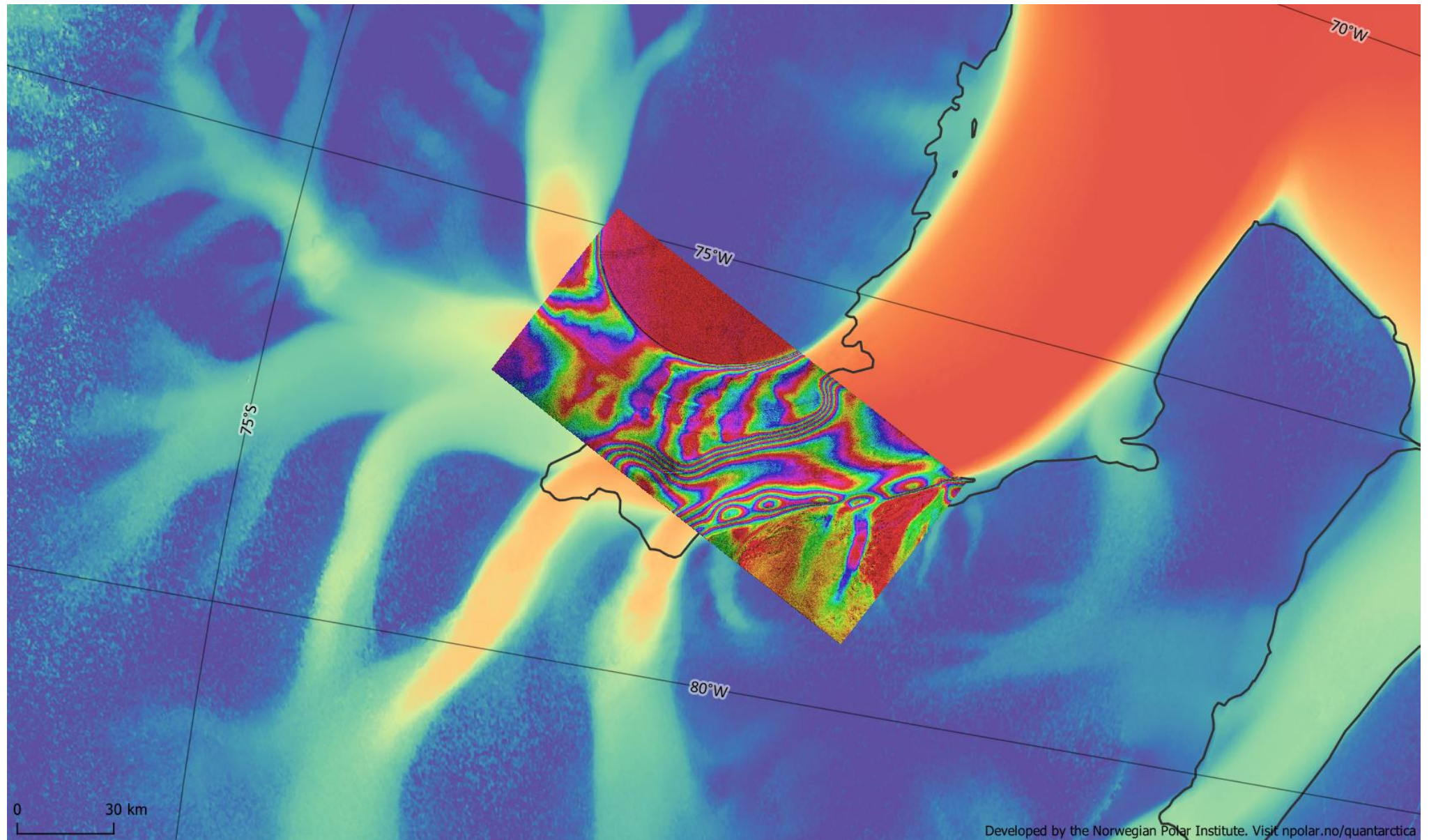
+125 m/yr

LoS Velocity (m/yr)

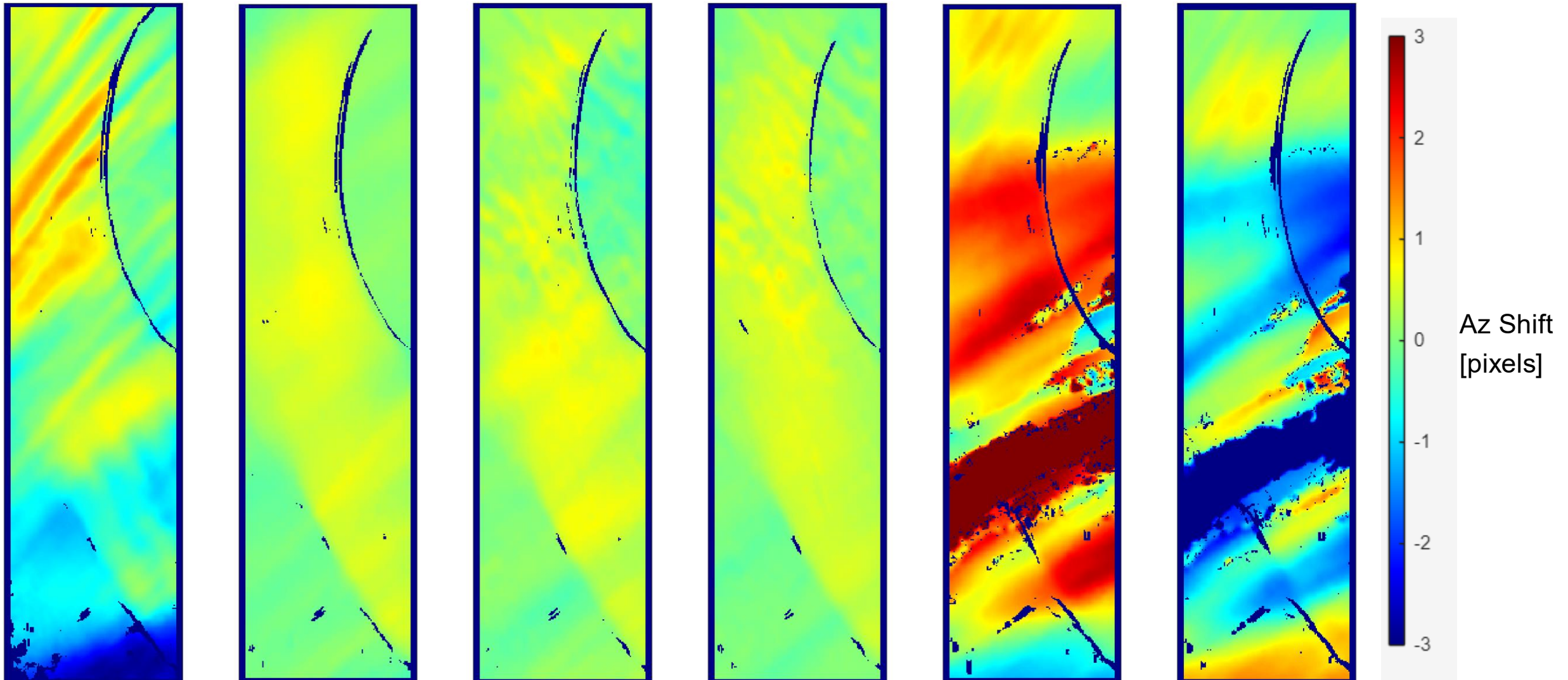
Evans Icestream



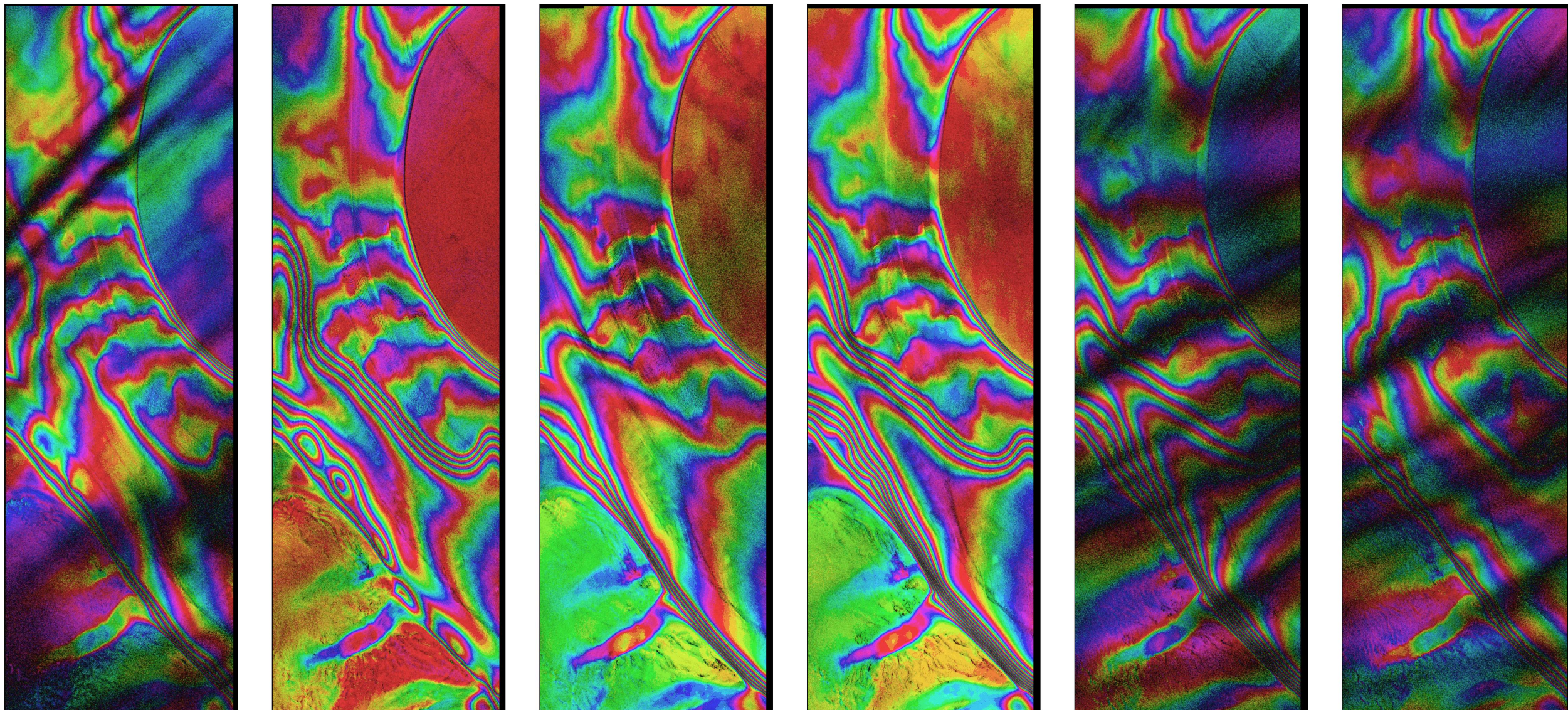
Evans Icestream



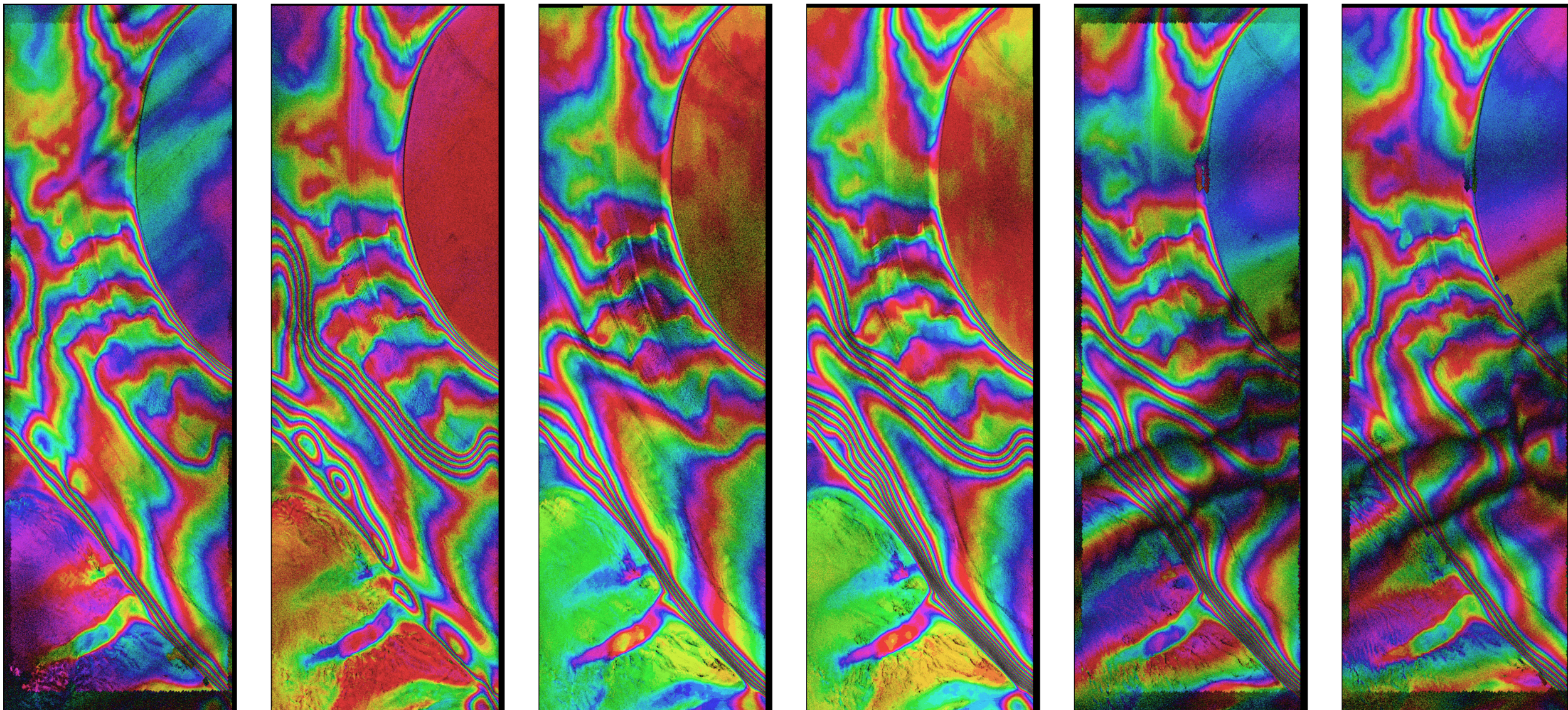
Evans Icestream - Azimuth Shifts



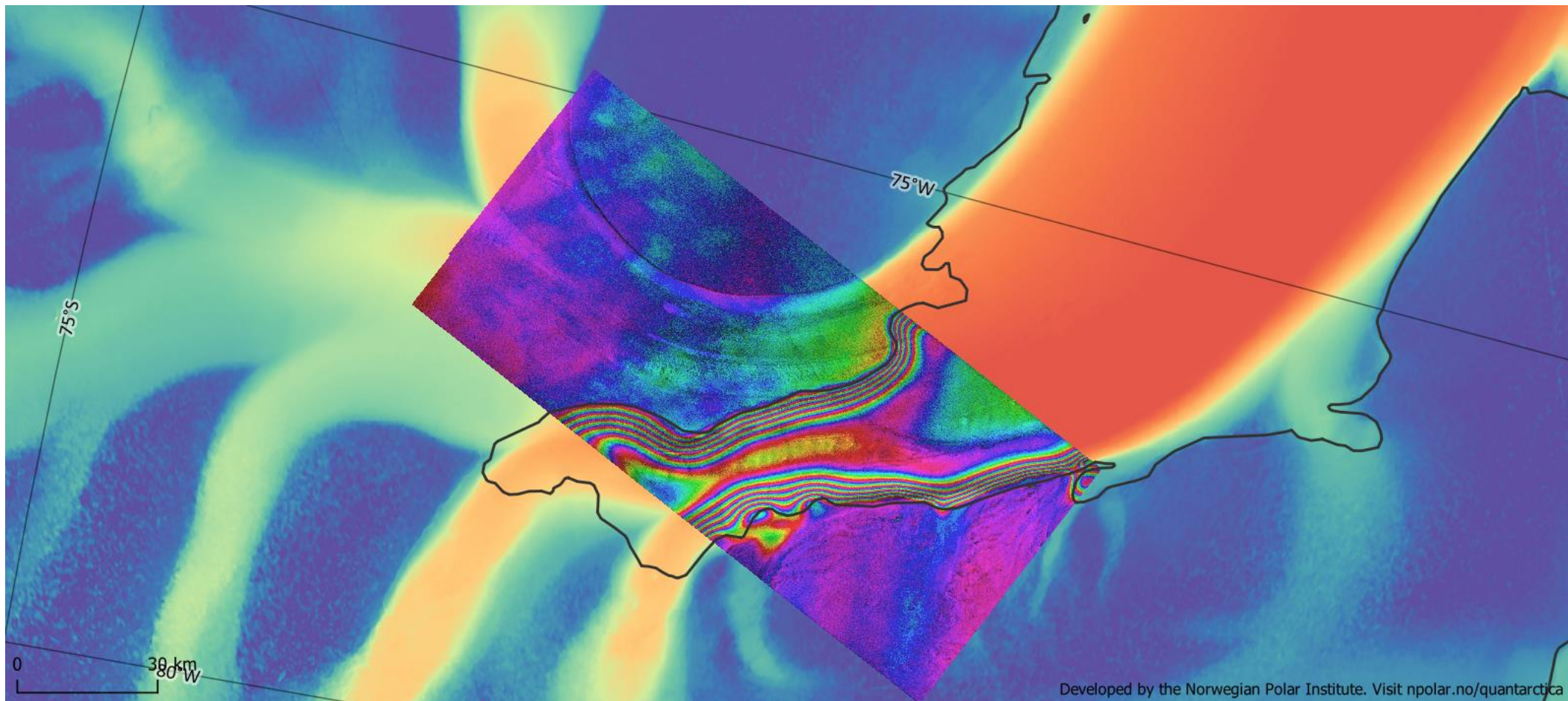
Evans Icestream - Standard Coregistered IFs



Evans Icestream - Adaptive Coregistration

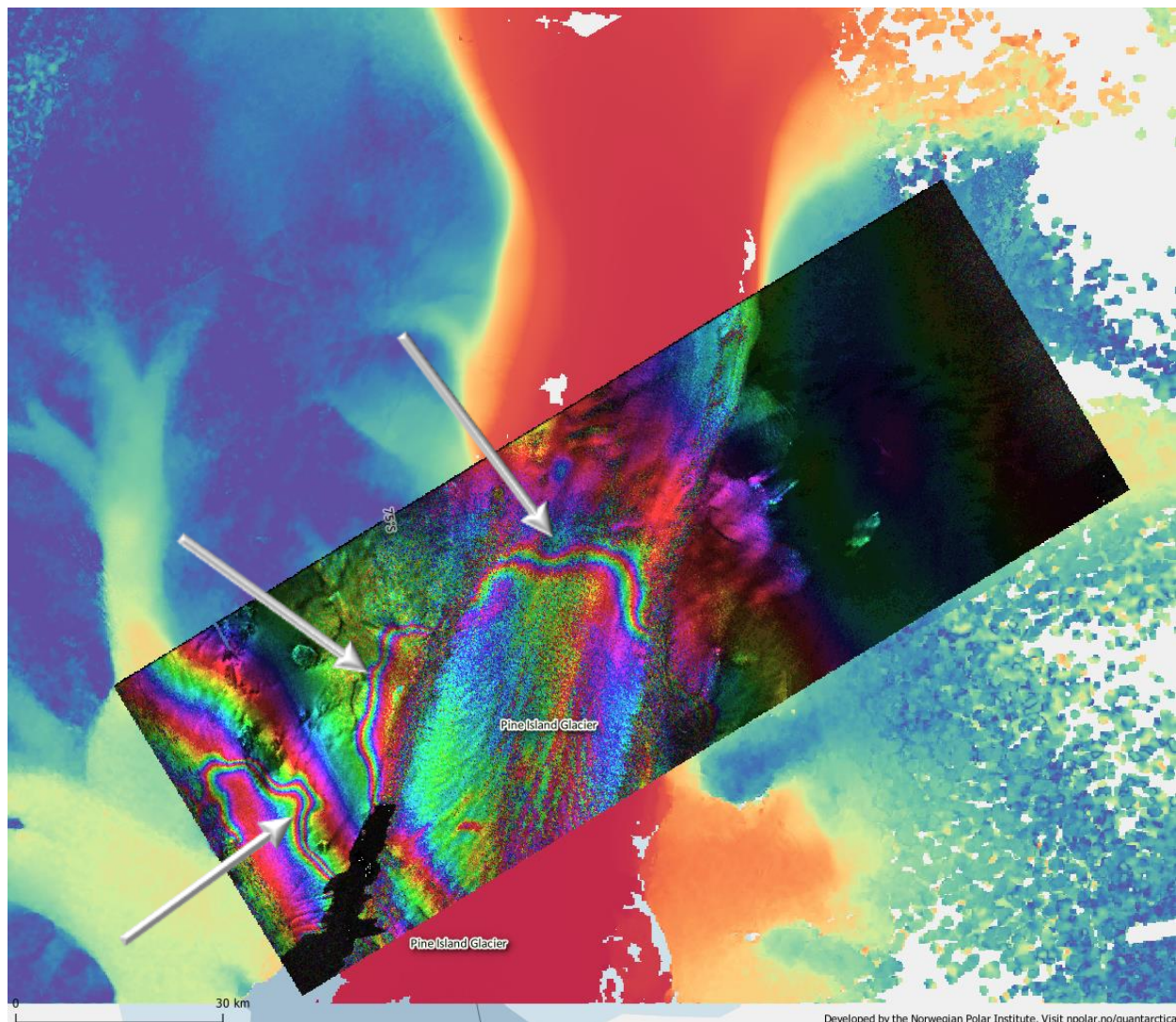


Evans Ice Stream – Double-difference InSAR

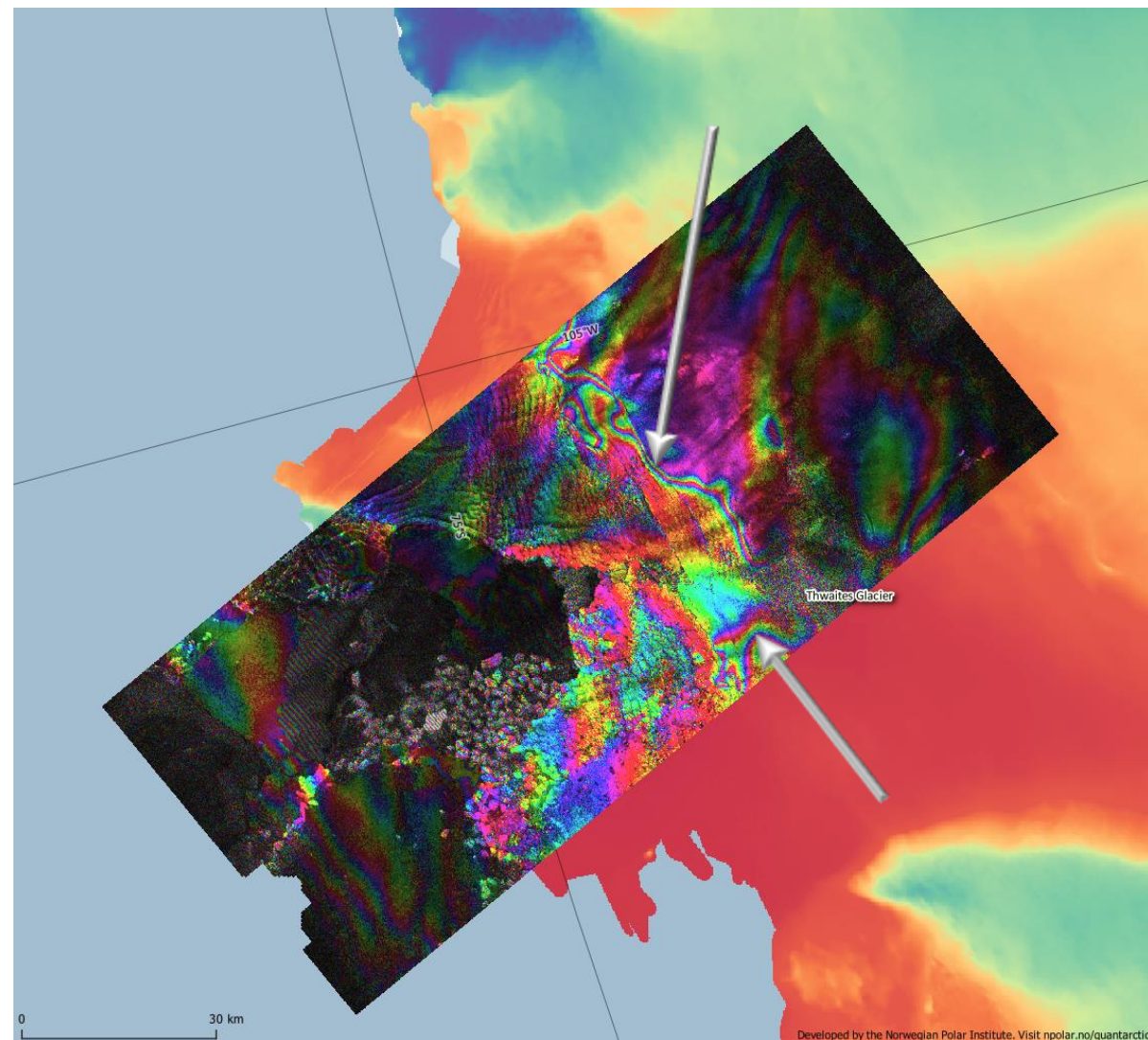


Grounding Lines from BIOMASS Double-difference InSAR

Pine Island Glacier

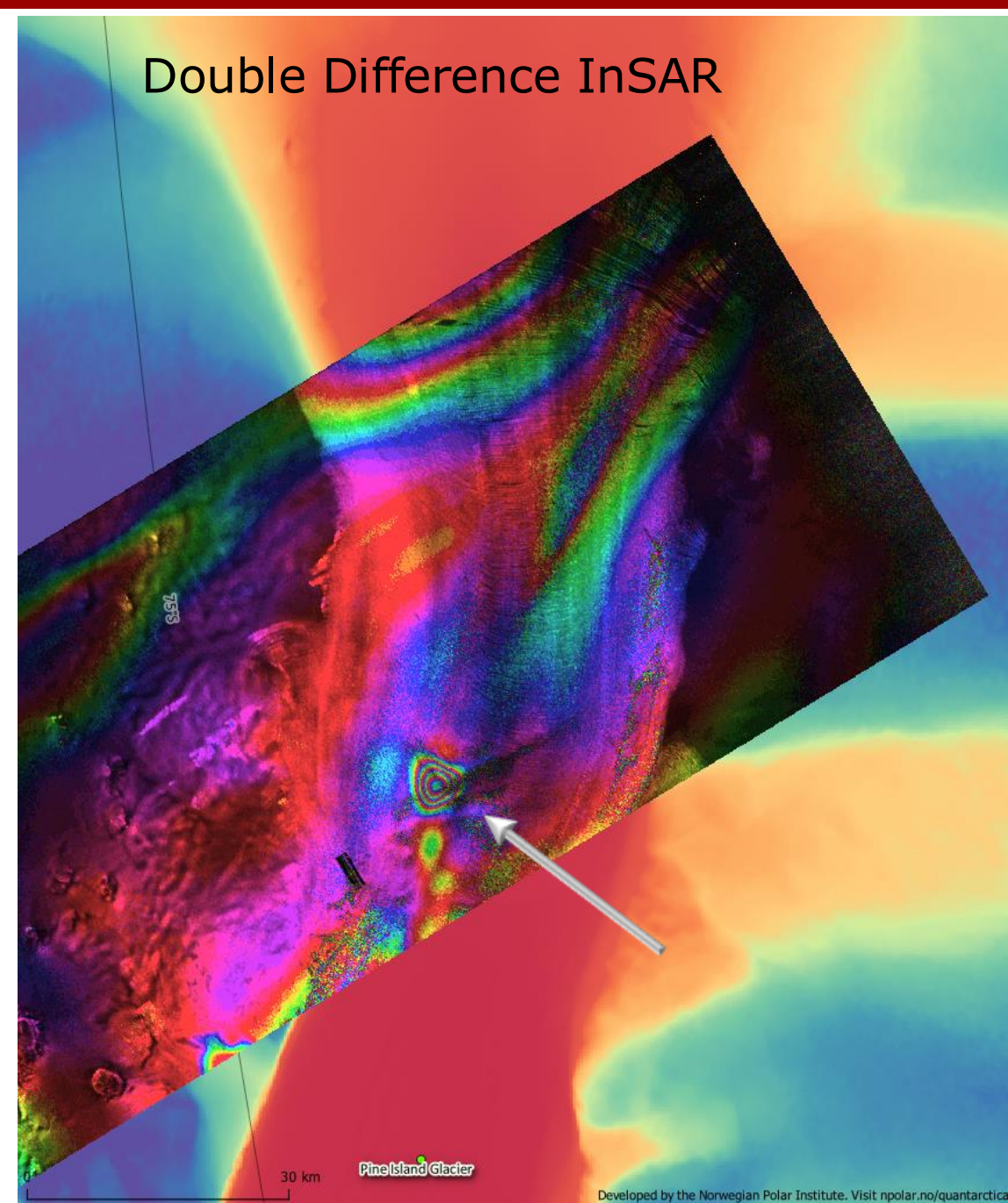


Thwaites Glacier



Vertical Displacements / Subglacial Hydrology

- BIOMASS allows detection of subglacial water propagation even under fast glaciers
- Temporal resolution of 3 days could provide interesting, but short, timeseries



Conclusions and further work

- Promising results for ice flow mapping using BIOMASS InSAR
- Acquisition plan and requirement of crossing orbits limits pure BIOMASS InSAR coverage
- Combination of BIOMASS InSAR and Sentinel-1 6-day repeat offset-tracking shows promise
- Further work needed on ionosphere mitigation
 - Data-driven coregistration, but phase must also be handled
 - Multi-squint ionosphere mitigation should be further examined over fast flowing ice
 - Data selection and combination based on azimuth offset statistics is a possible simple alternative, making use of the 7 repeat acquisitions
- Grounding lines and subglacial hydrology dynamics are other important applications

