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15 - 19 June 2026 | Auditorium Maximum of the Jagiellonian University, Kraków, Poland

FRINGE 2026

Regional-scale assessment of slope instabilities across western and eastern Greenland using Sentinel-1 persistent scatterer interferometry

Tazio Strozzi, Rafael Caduff and Philipp Bernhard
Gamma Remote Sensing, Gümligen, Switzerland

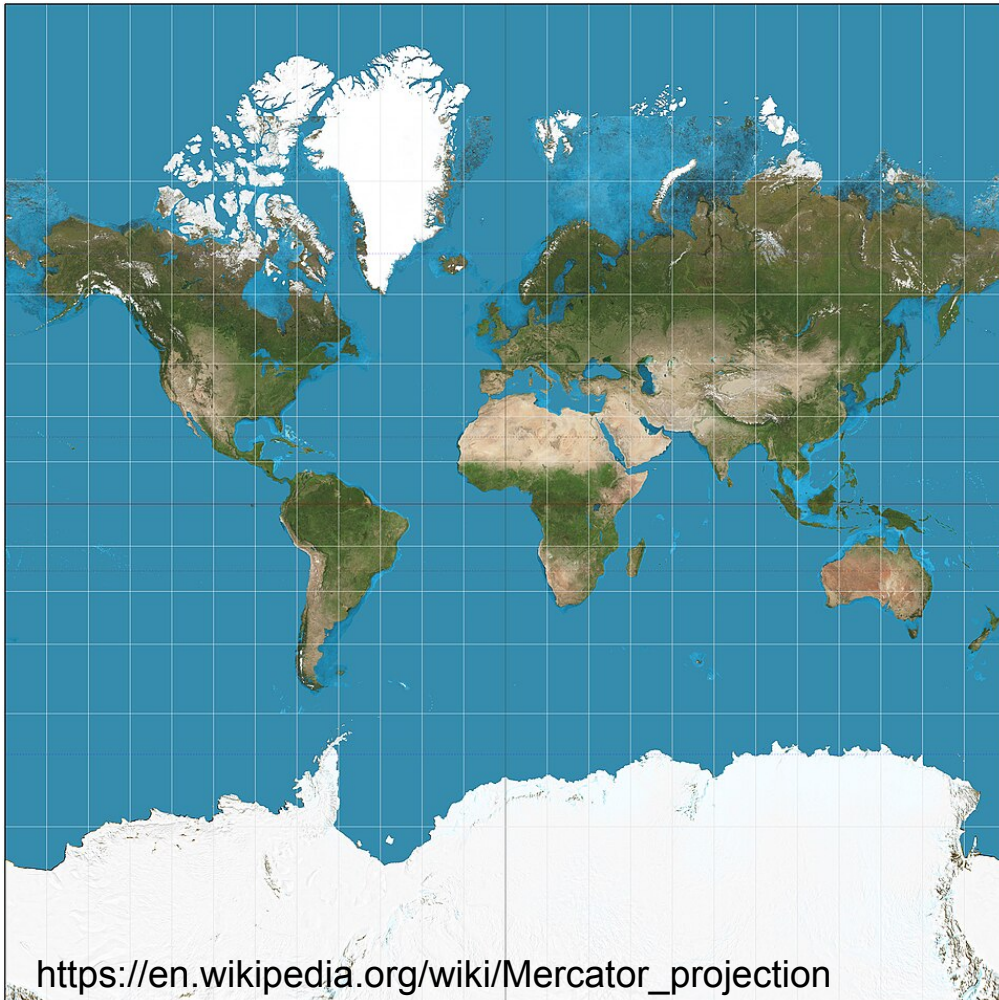
Eva Mätzler and Jonas Petersen
Ministry of Business, Mineral Resources, Energy, Justice and Gender Equality, Government of Greenland

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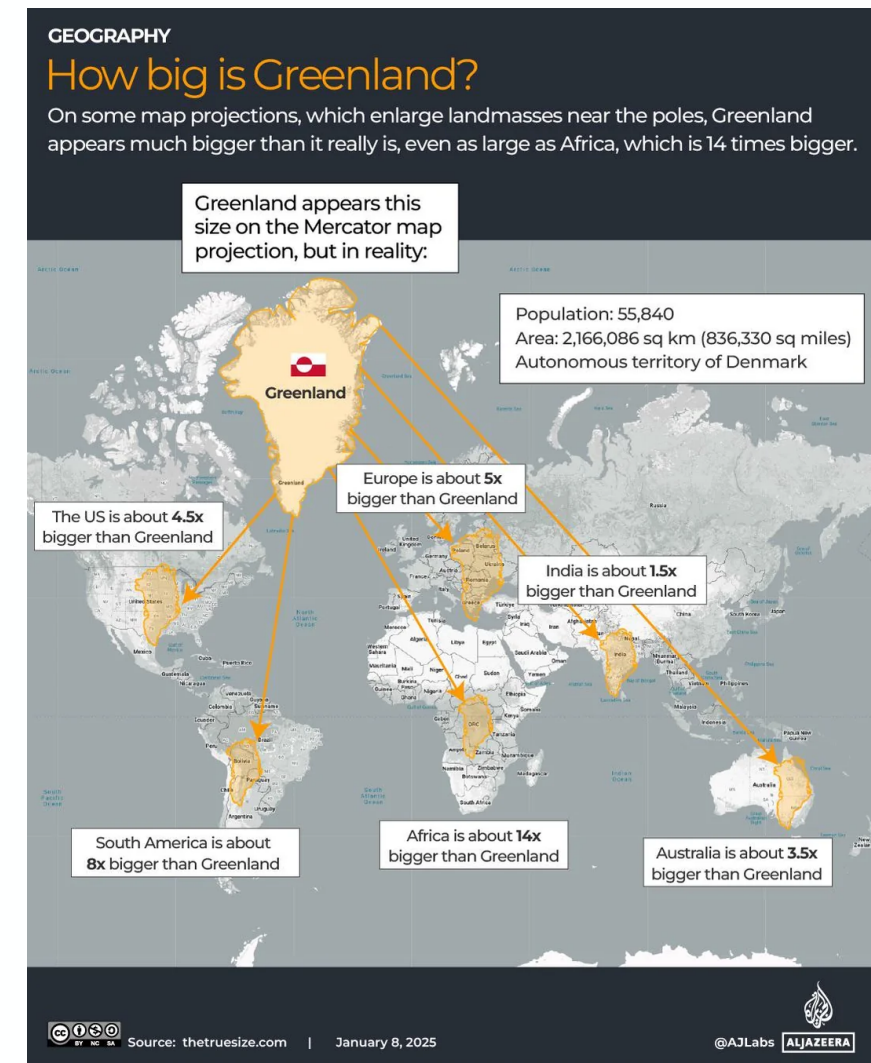


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Mercator (conformal) projection



EGMS : ~ 4.5 million km²



Source: thetruesize.com

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- In some cases, these instabilities could generate tsunamis if large-scale failures were to occur

<https://temblor.net>



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- Evaluate the feasibility of monitoring slope instabilities within multiple fjord systems across western and eastern Greenland using satellite DInSAR
- Identify potentially hazardous sites
- Support the development of an early warning framework for dangerous sites
- A multi-stage analytical approach allows us to
 - establish a regional overview of slope instabilities
 - characterize the current activity levels of the slope instabilities
 - focus on site-specific deformation patterns requiring more sophisticated techniques
 - reconstruct the temporal evolution of slope displacements from 2015 onward
 - implement a DInSAR data portal with near-real-time updating

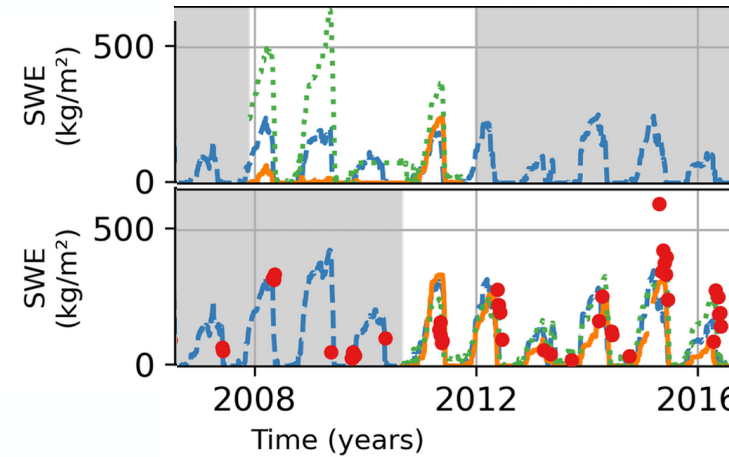
DInSAR challenges



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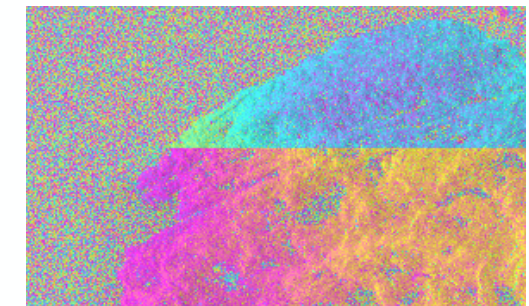
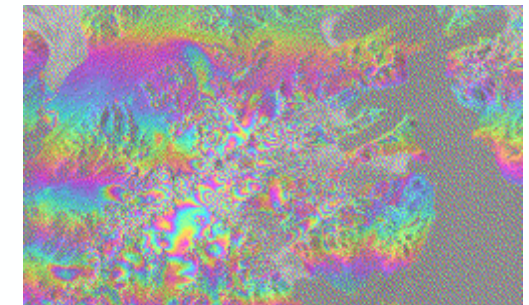
- While 80-85% of the island is covered by a permanent ice sheet, the ice-free coastal zones experience extensive winter snow cover lasting several months
- The terrain is predominantly mountainous and rocky, characterized by a narrow, rugged coastline incised by deep fjords and flanked by towering mountains and tidewater glaciers (layover/shadow, poor line-of-sight sensitivity, disconnected islands)
- Ionospheric effects are more severe in polar regions compared to mid-latitudes



van der Schot et al., 2024

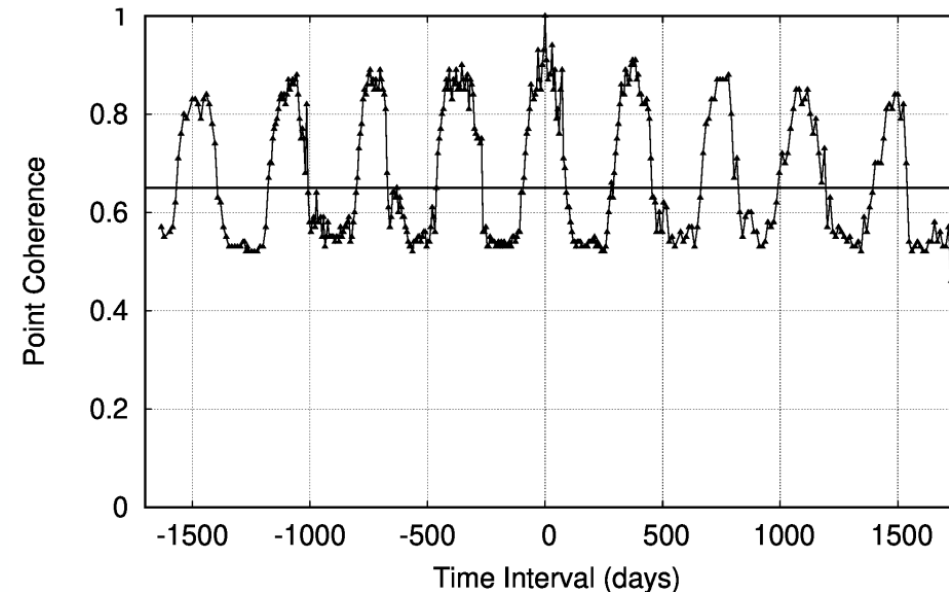
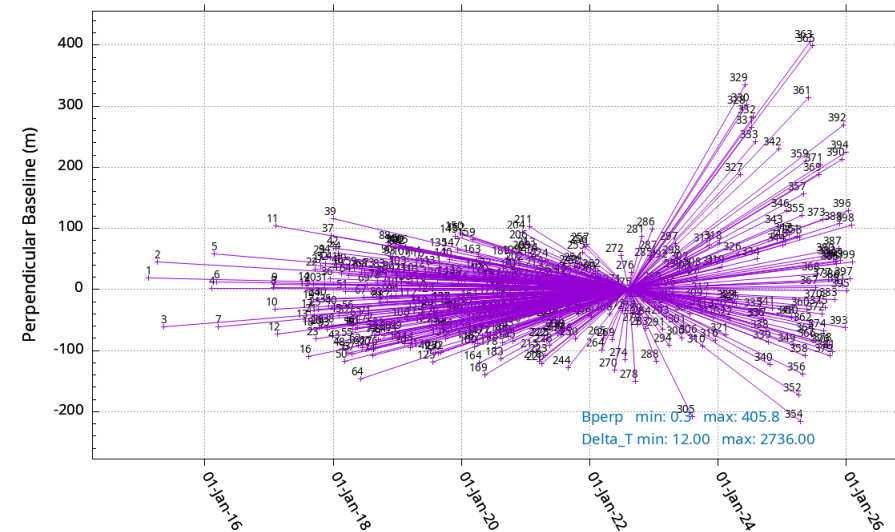


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- Map of Greenland showing the locations of Ilulissat and Nuuk. The map includes a scale bar from 0 to 300 km and labels for various towns and regions. Ilulissat is marked with a black dot in the north, and Nuuk is marked with a black dot in the south. The map also shows the coastline, major rivers, and surrounding waters.

- Sentinel-1 acquisitions are available at regular intervals of 6 days (2017-2021 and 2025-onward) and 12 days (2015-2016 and 2022-2024)
- We identified a well-defined snow-free period extending from approximately May/June through October/November, characterized by reduced out-of-season snow cover precipitation and consistent height coverage throughout. Therefore, a simple coherence threshold allows for the selection of snow-free acquisitions



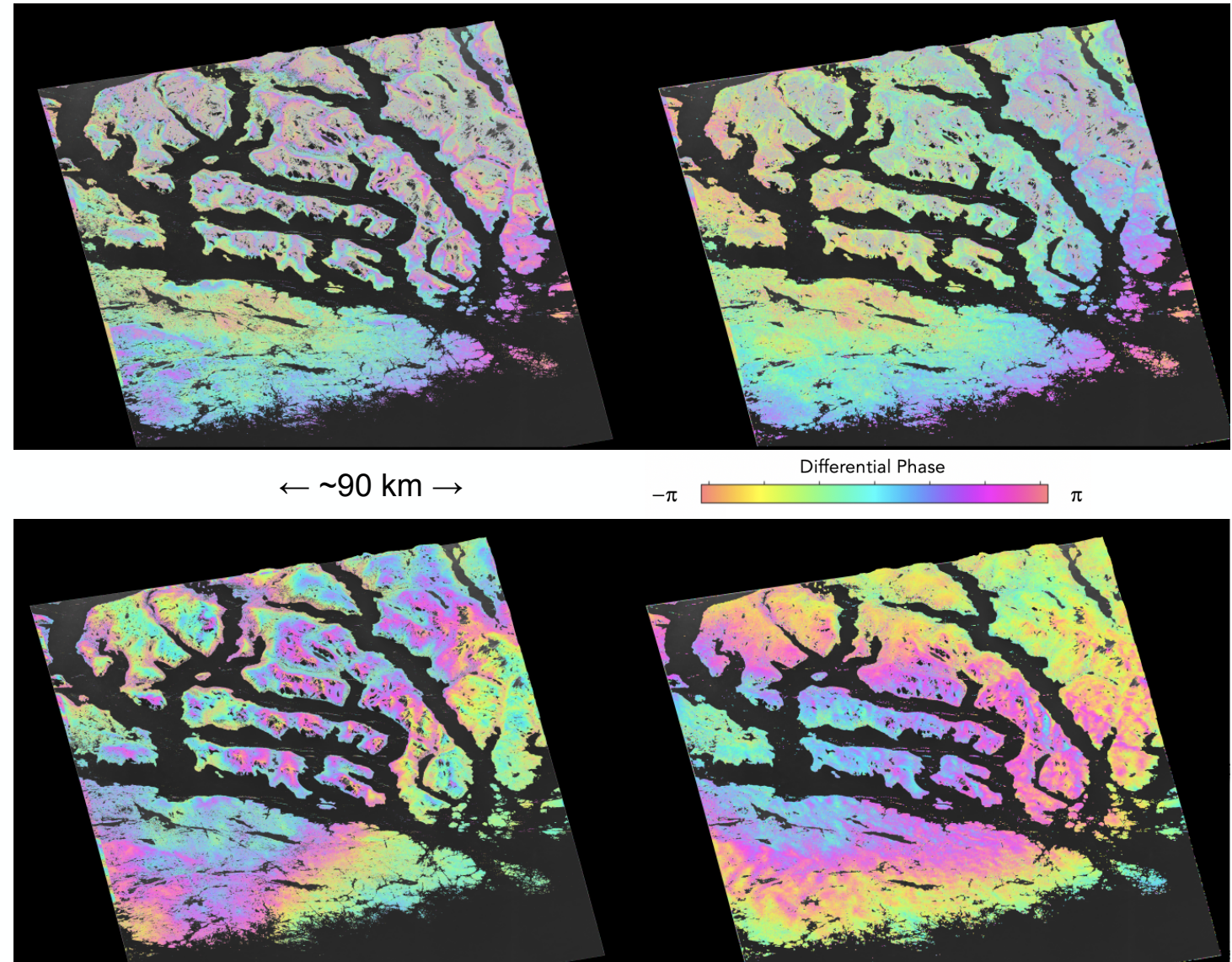
PSI processing

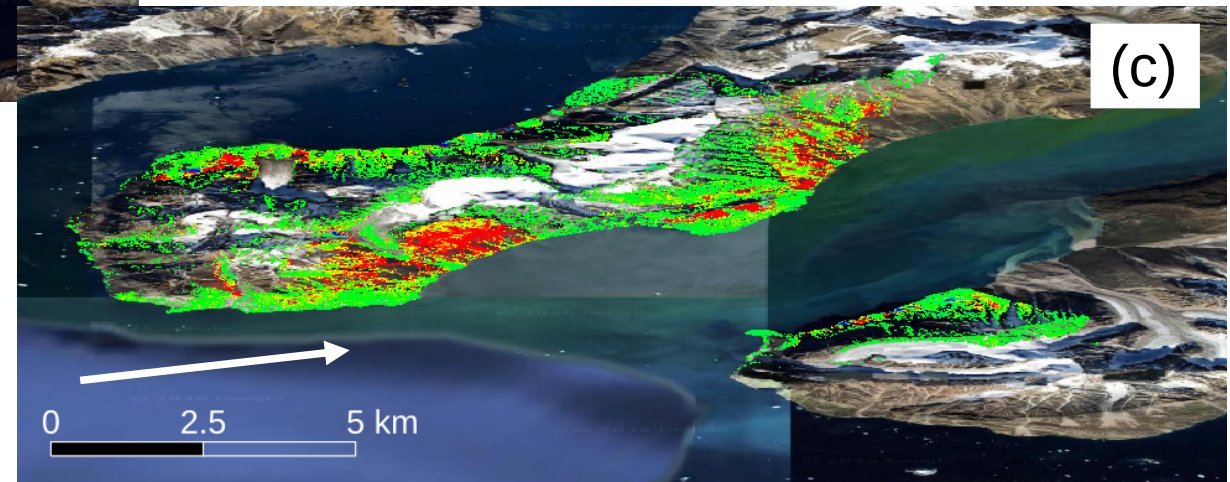
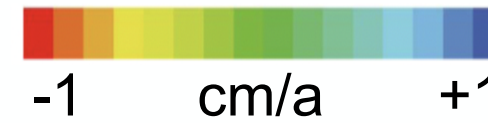


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- Tropospheric effects are primarily limited to a height-dependent component, which can be estimated and removed using a phase-to-height relationship, while turbulence is notably restricted due to the dry, cold air
- Ionospheric effects are generally small for Sentinel-1 data on a local scale and can be effectively removed using large-scale filters





PSI results



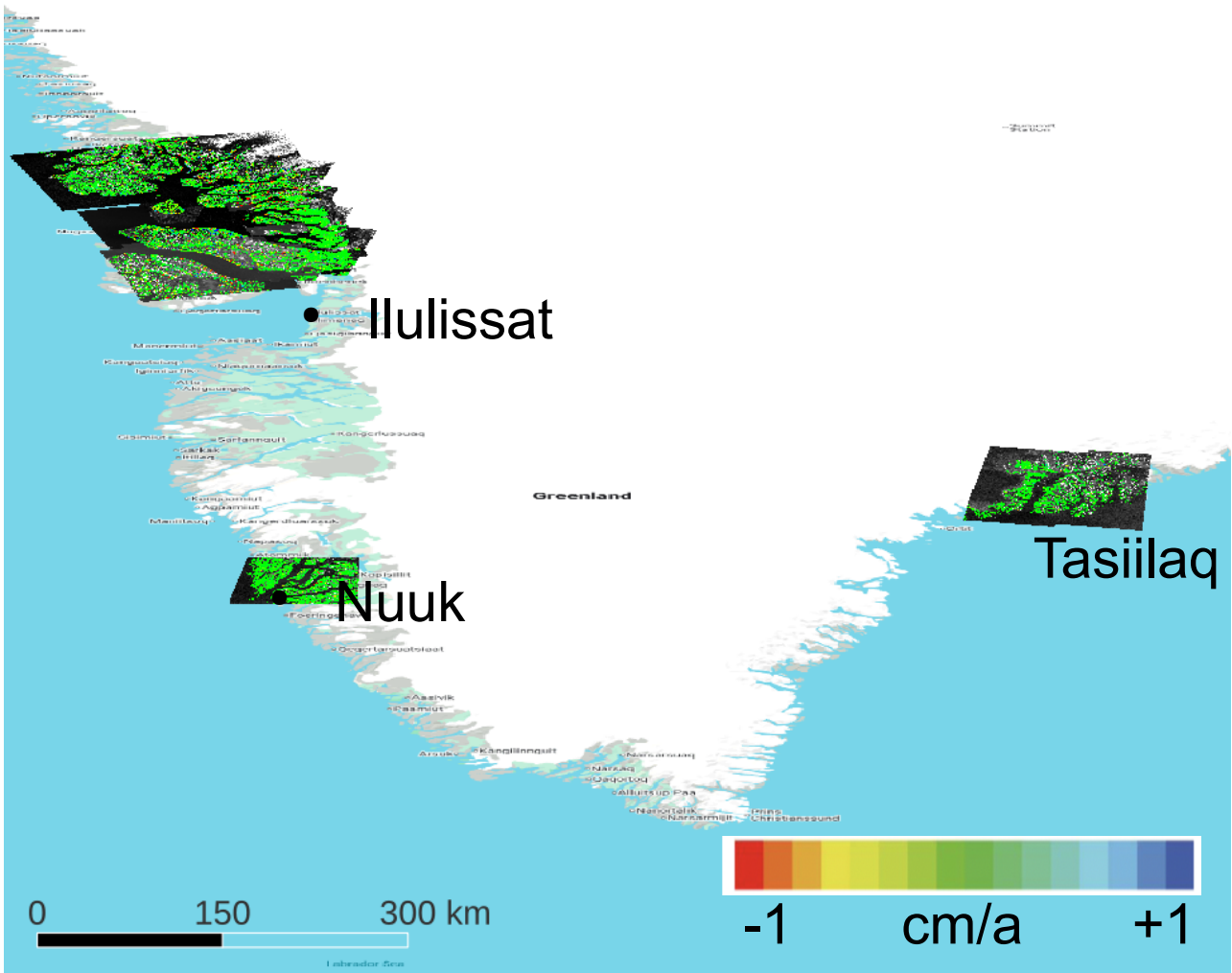
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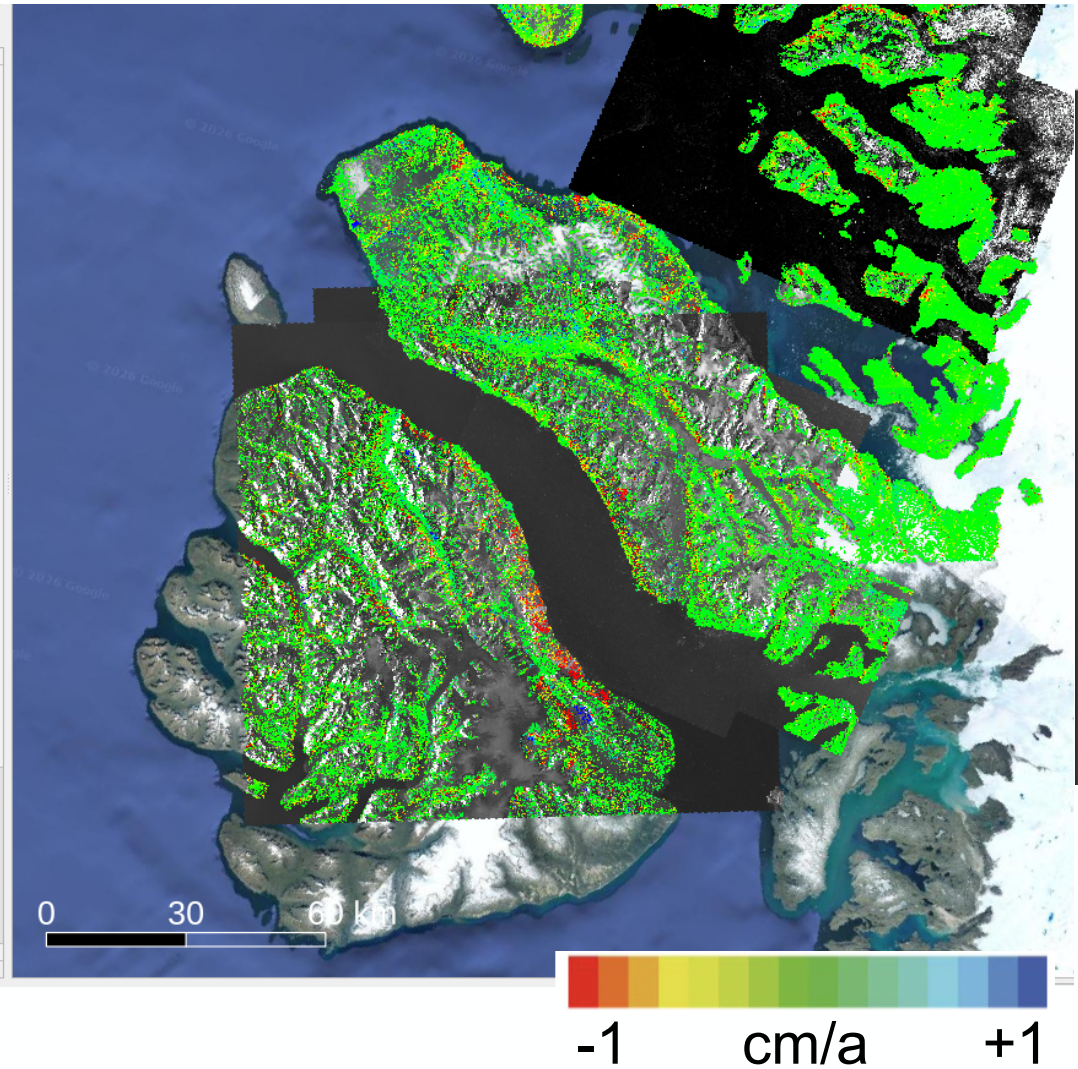


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Map of unstable slopes and registered mass movements

Legend

Potential_unstable

Tsunami potential



0



1

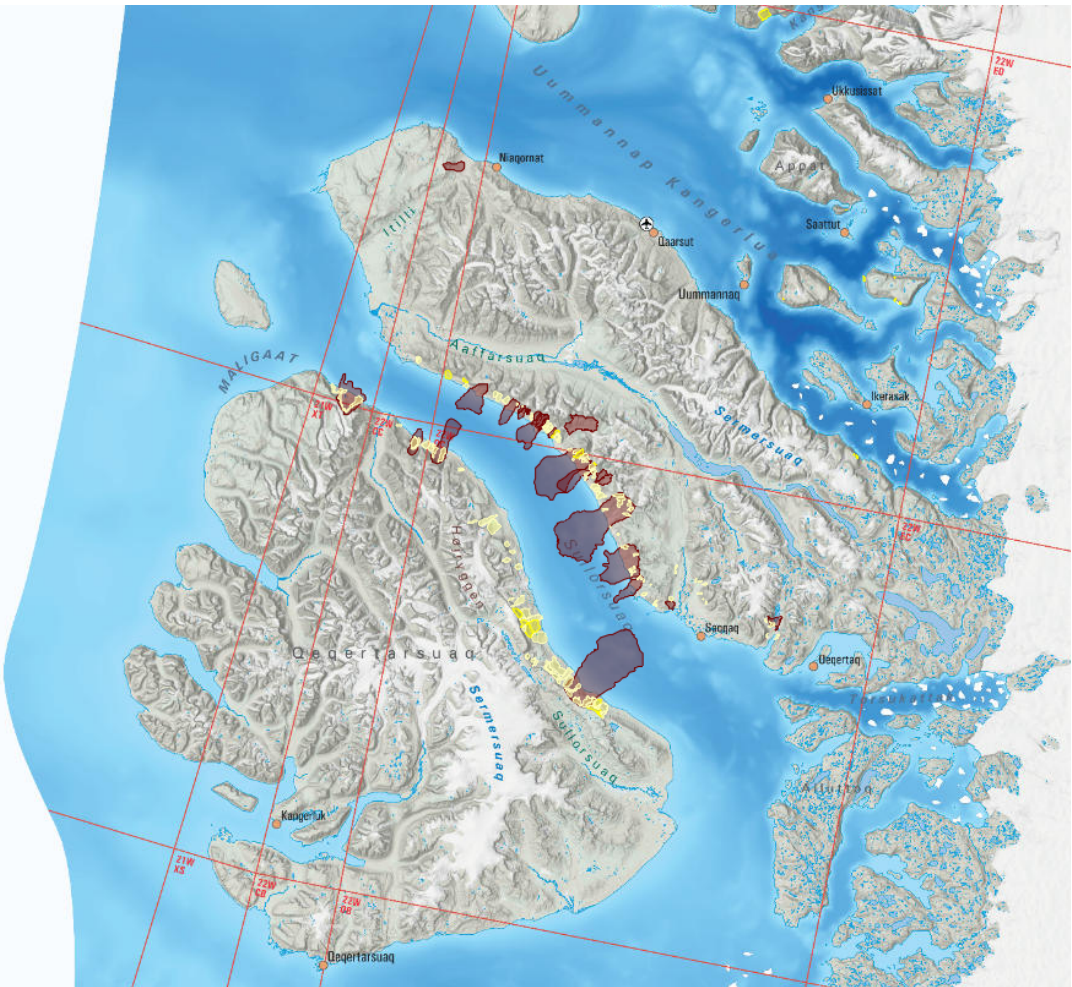


2

Registrered_events



Registrered_events



PSI results



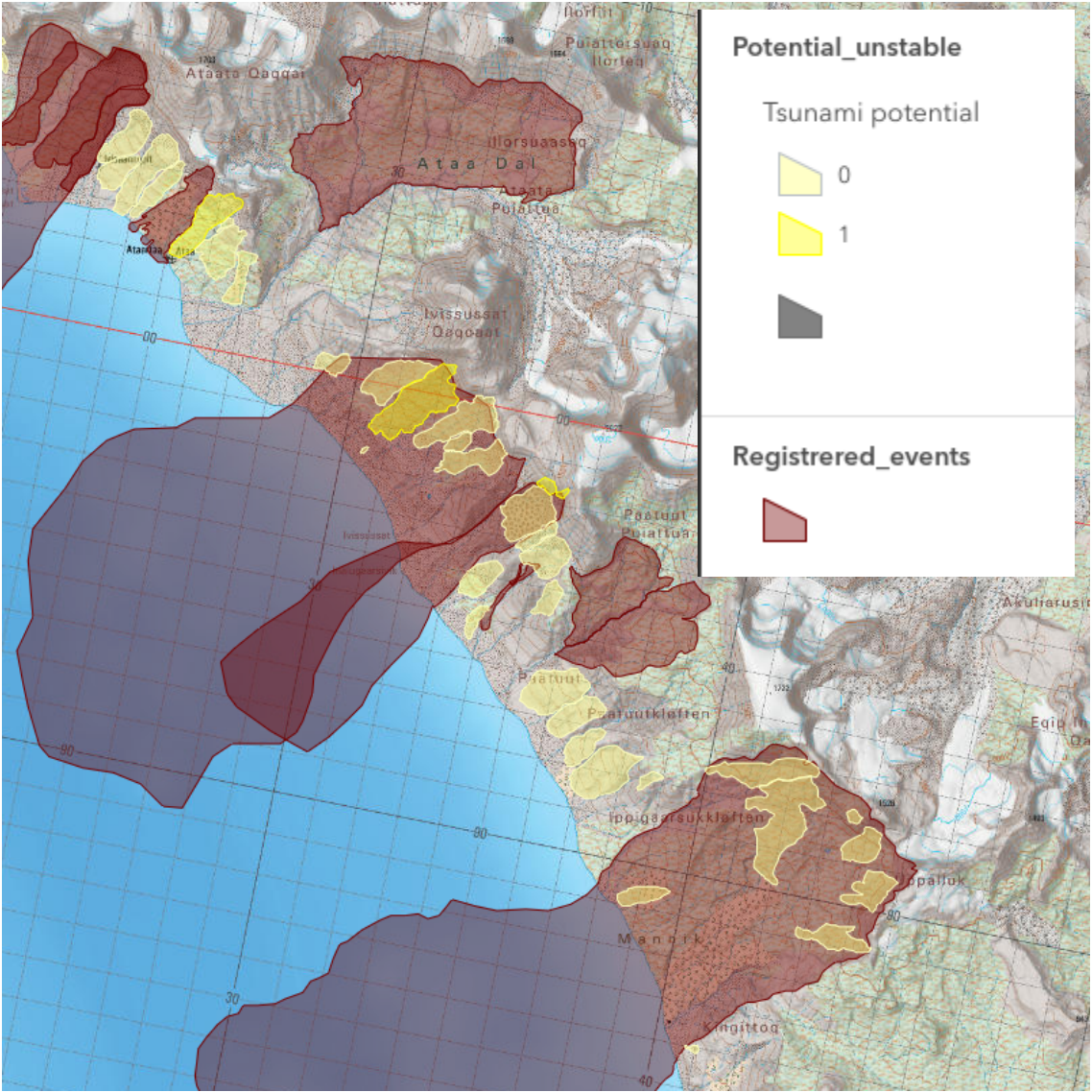
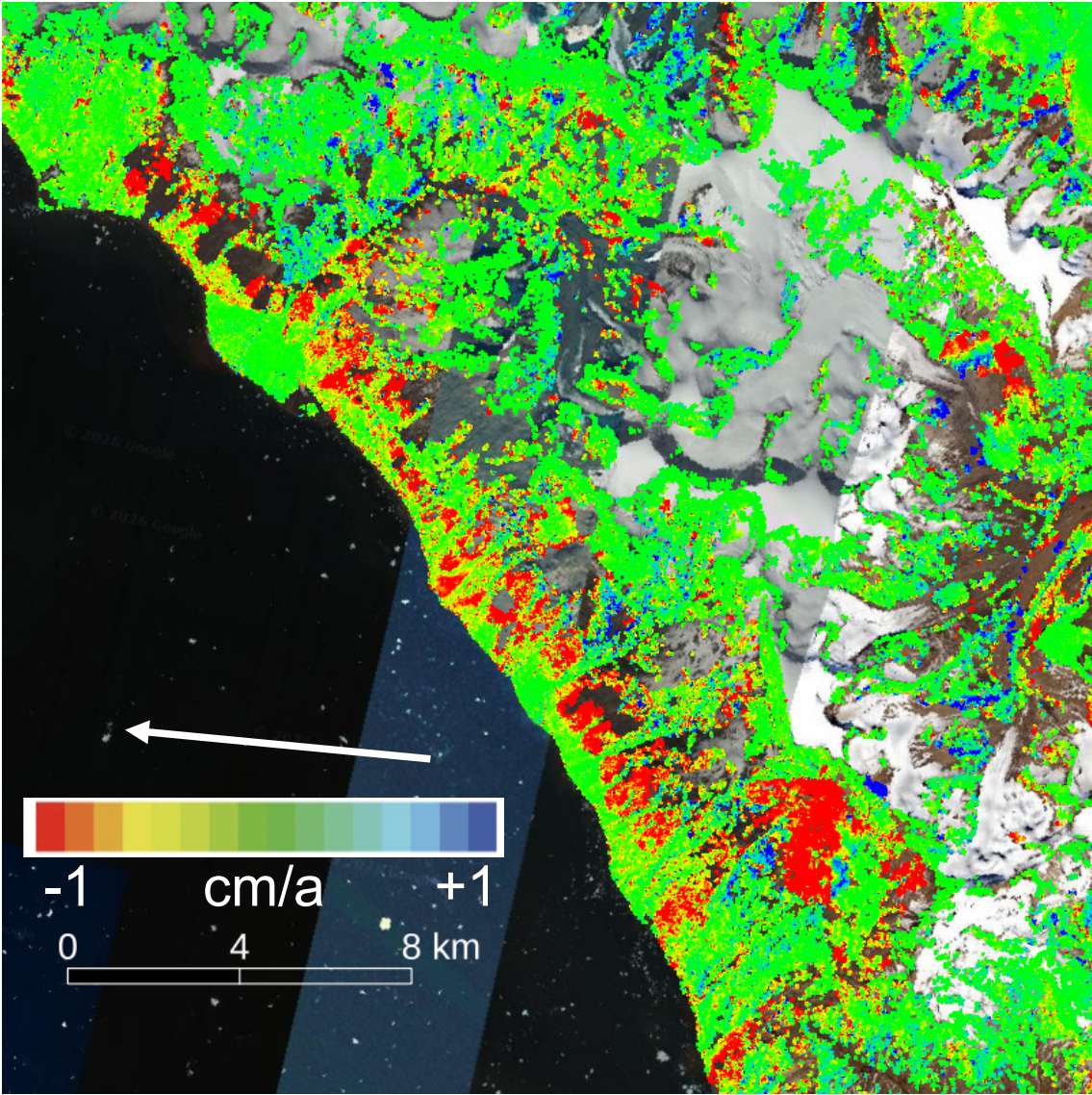
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Kigarsima



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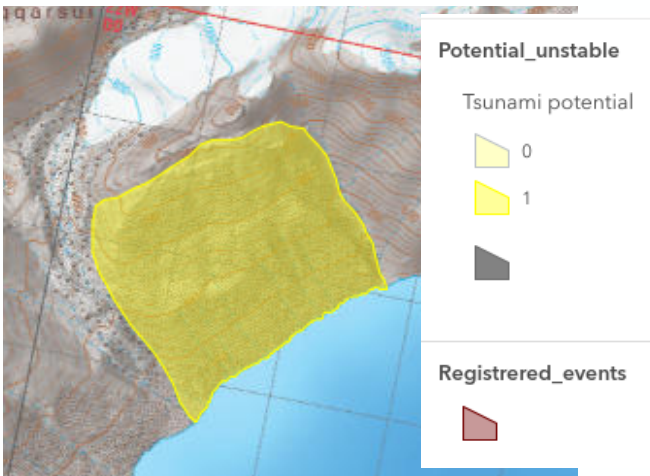
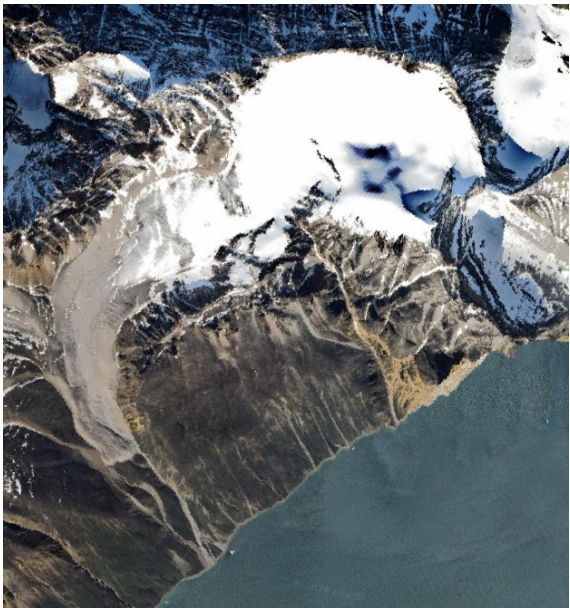
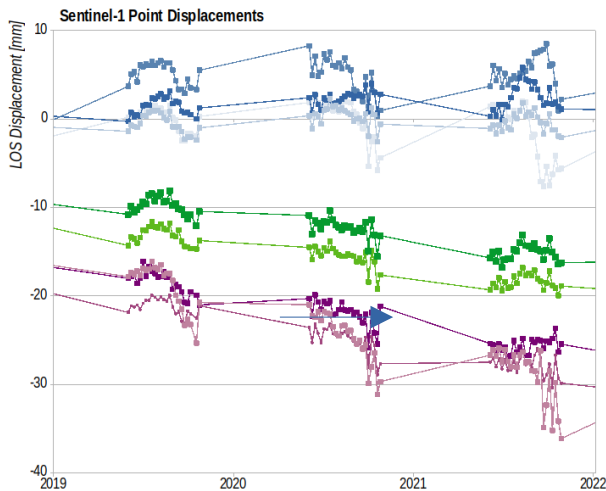
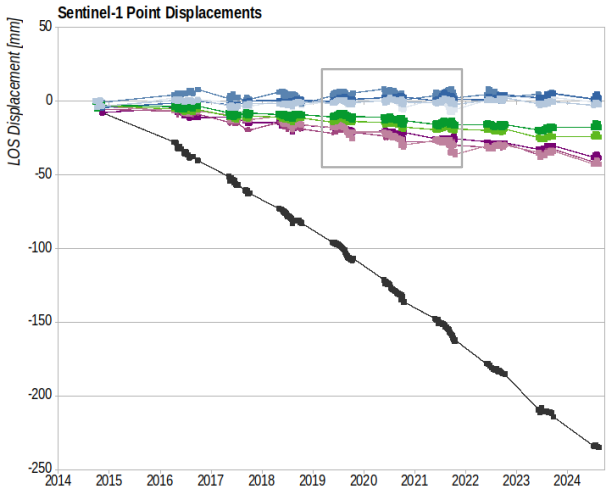
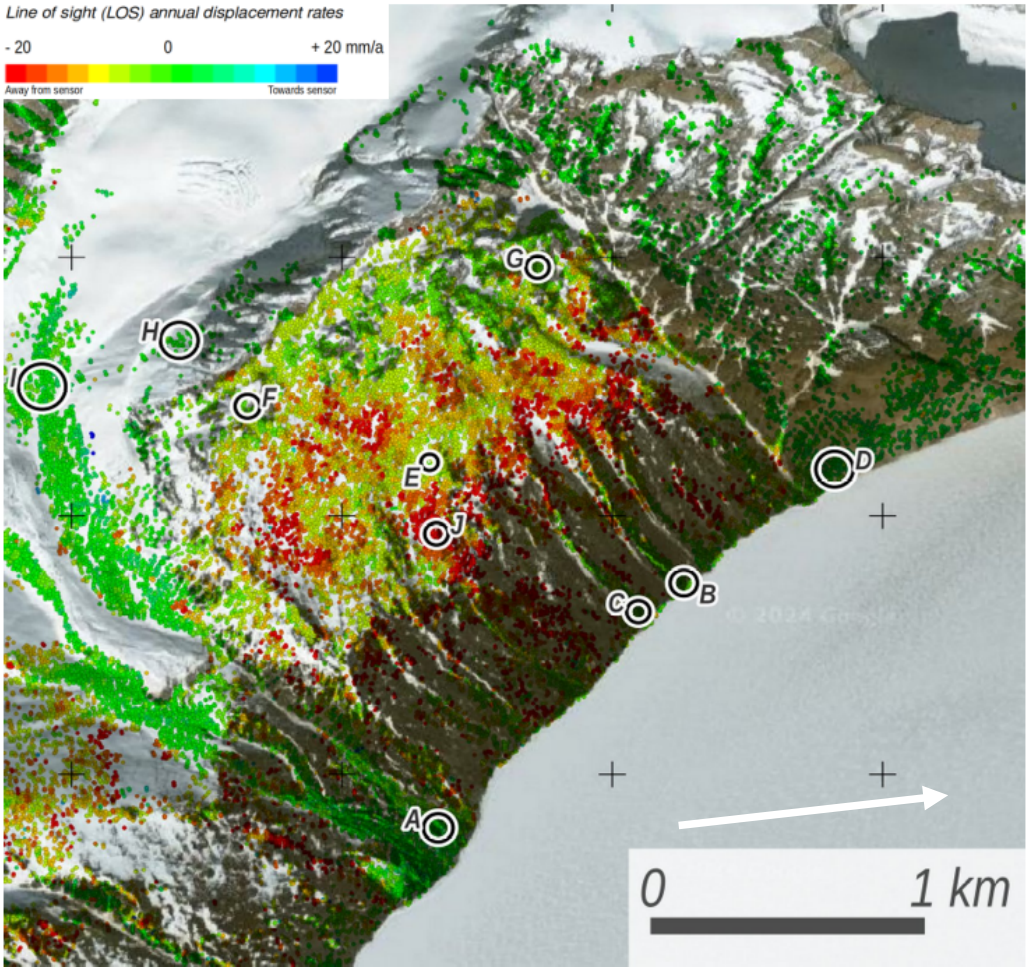


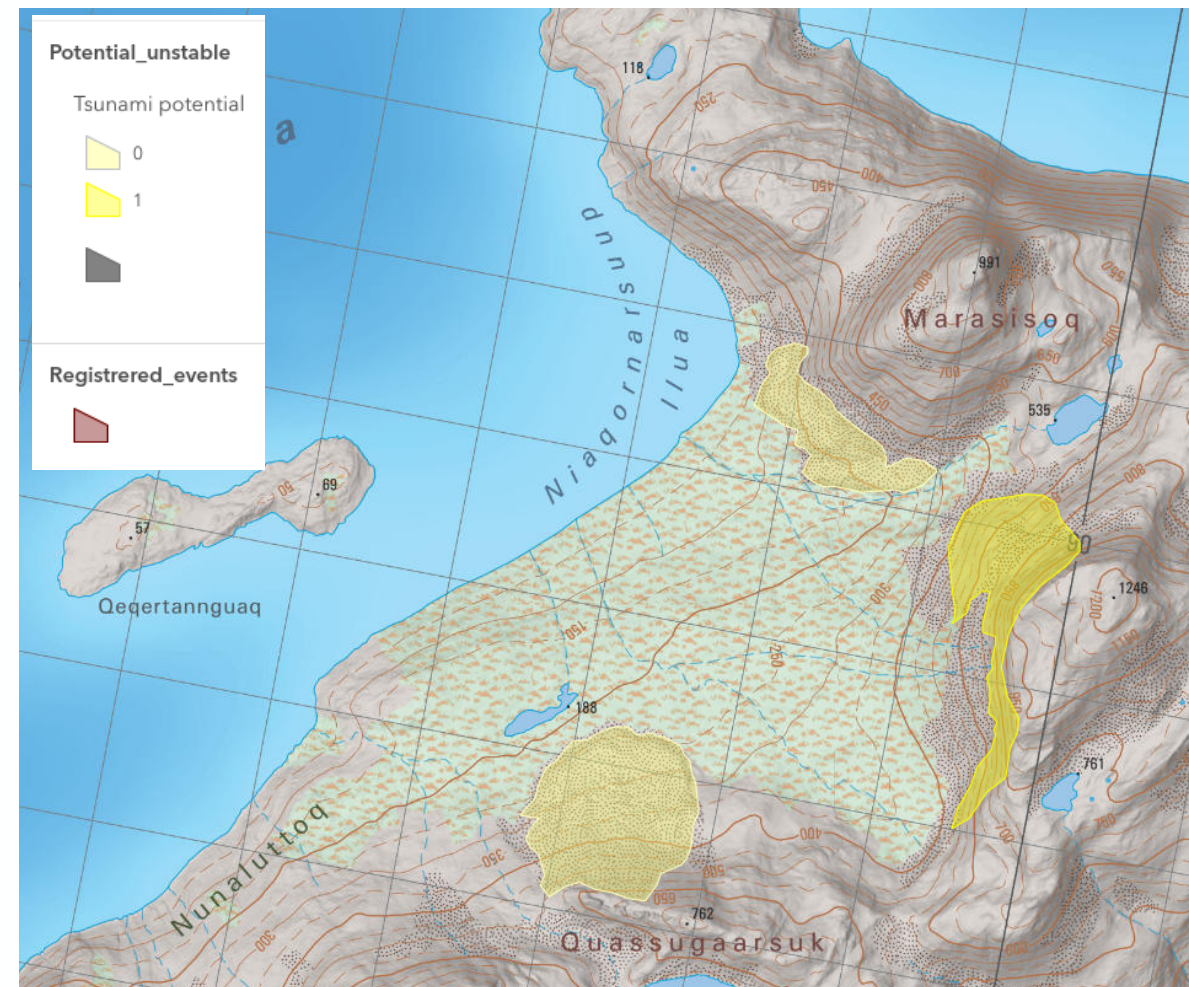
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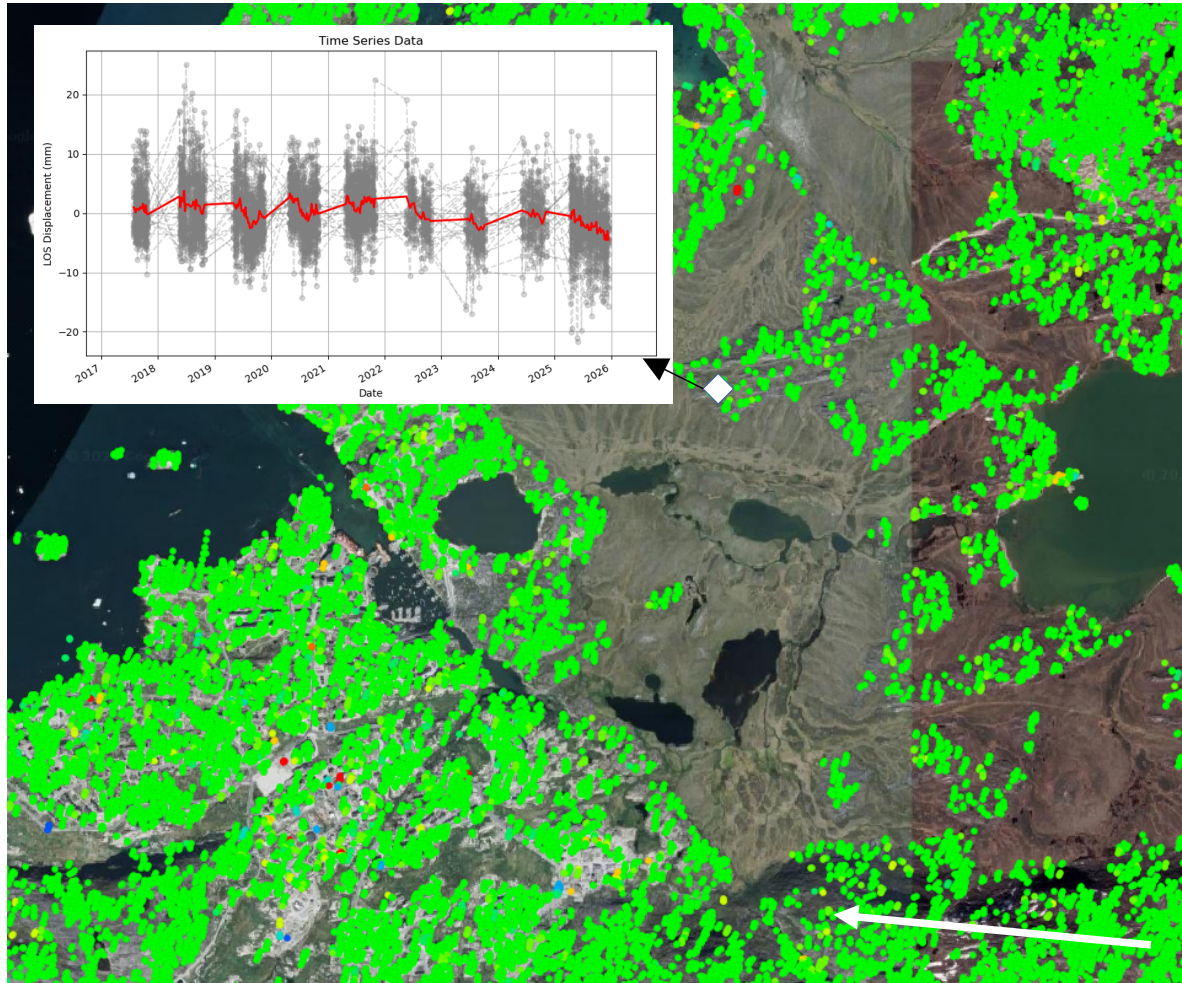
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Line of sight (LOS) annual displacement rates
- 20 0 + 20 mm/a
Away from sensor Towards sensor

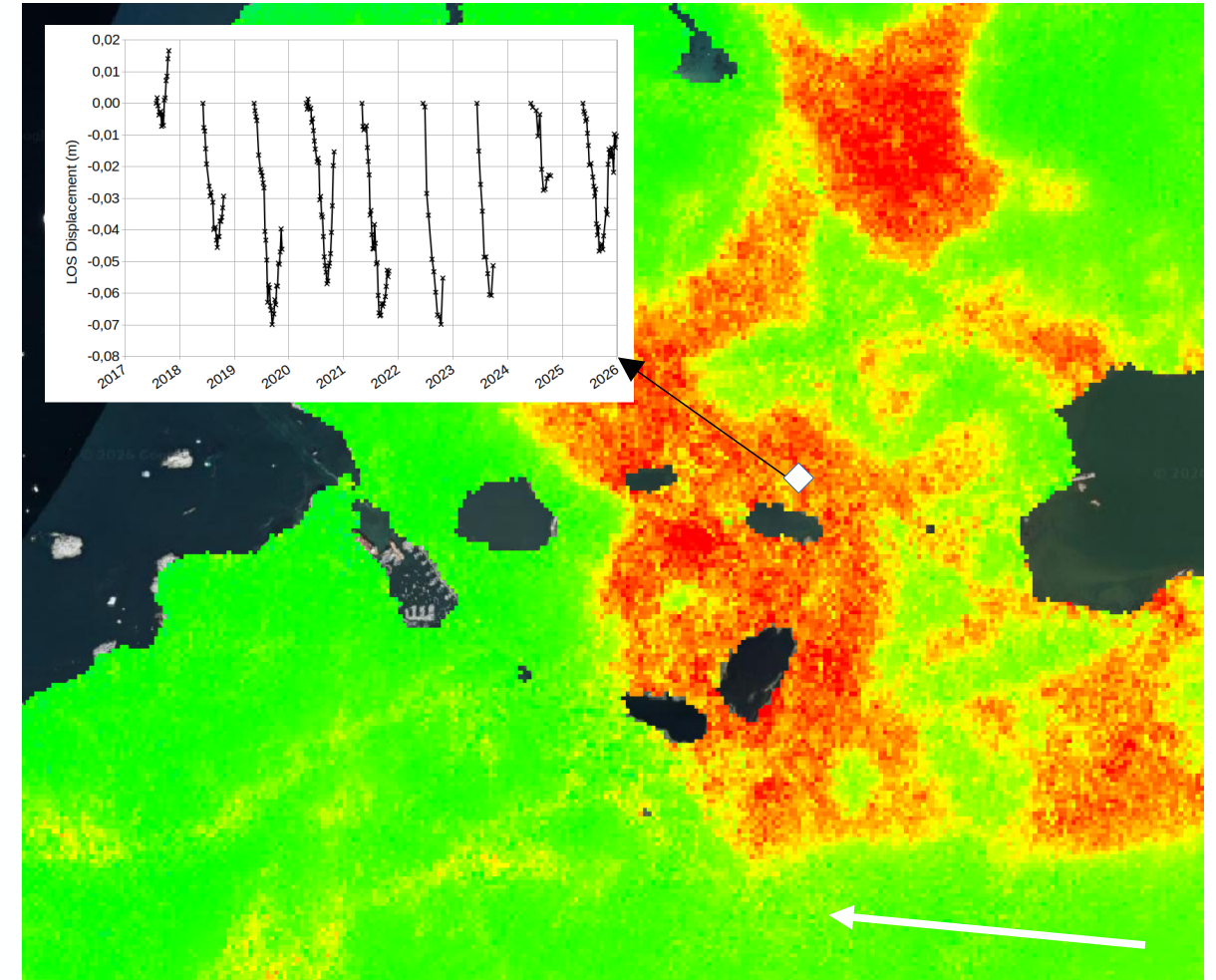


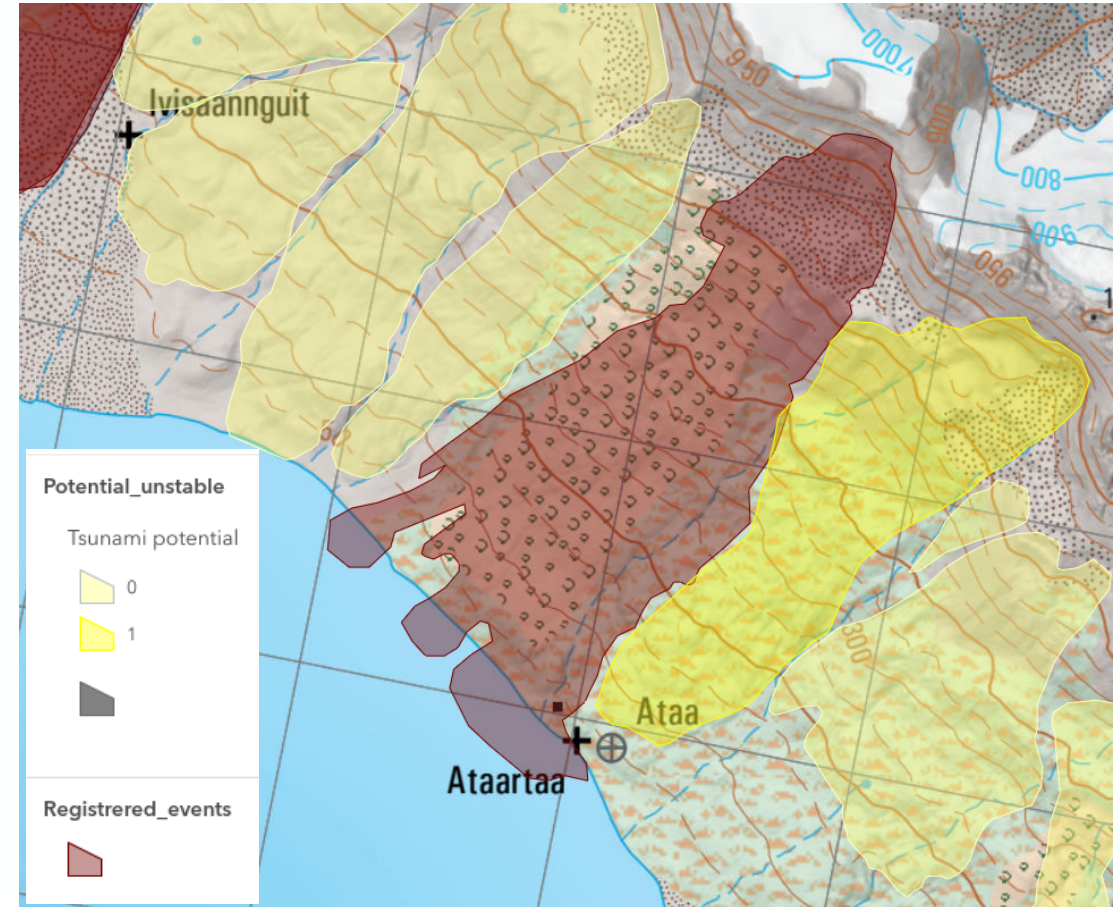
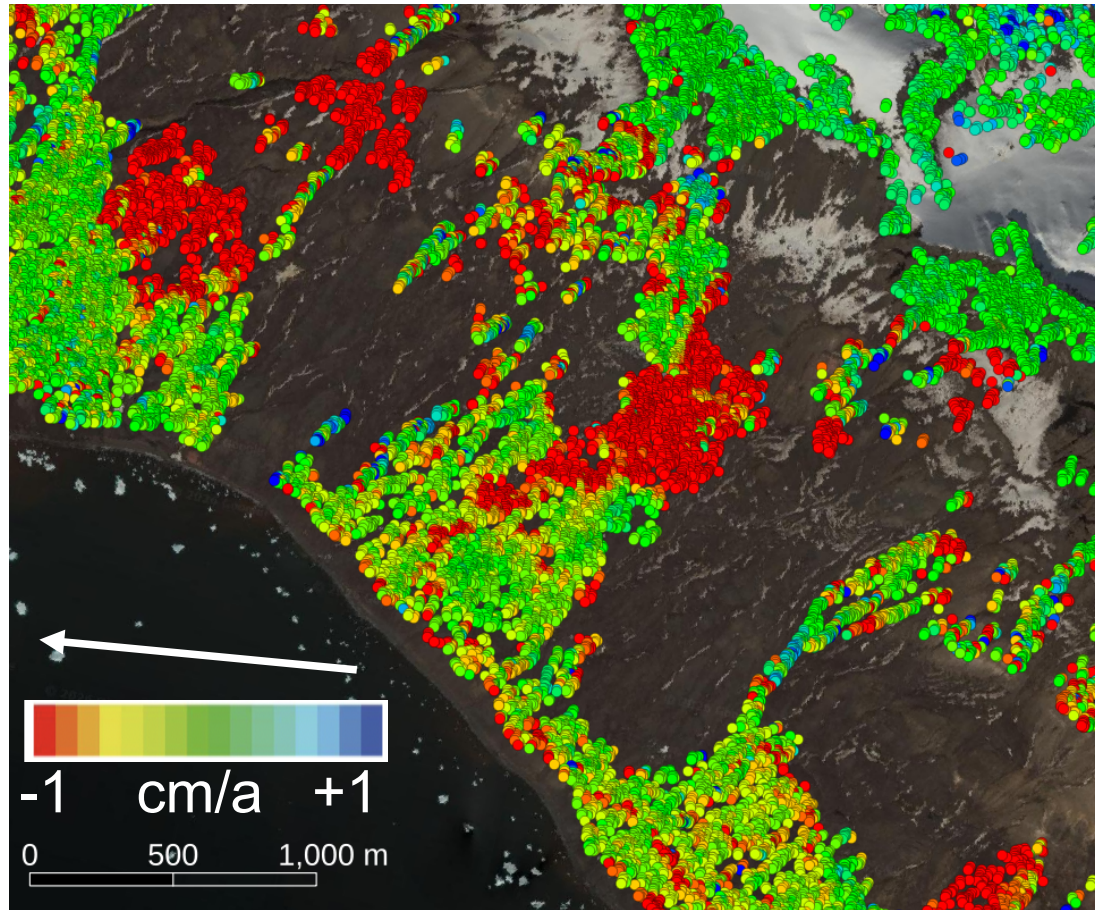


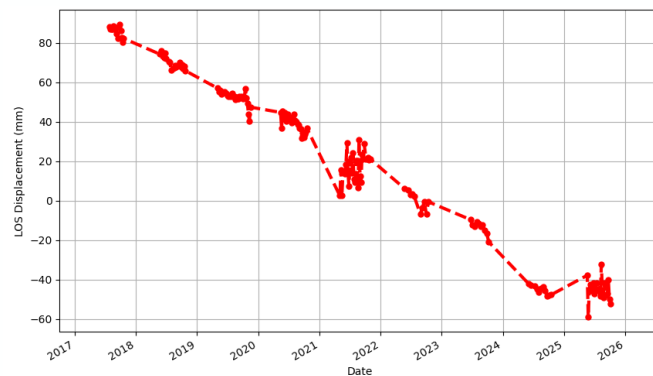
PSI : mean annual def. rate



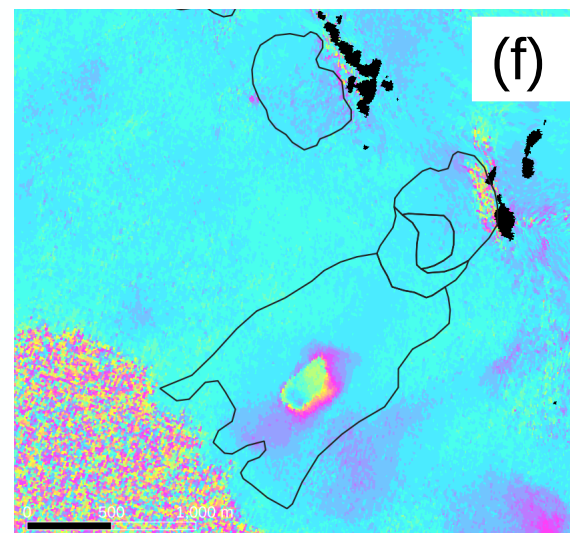
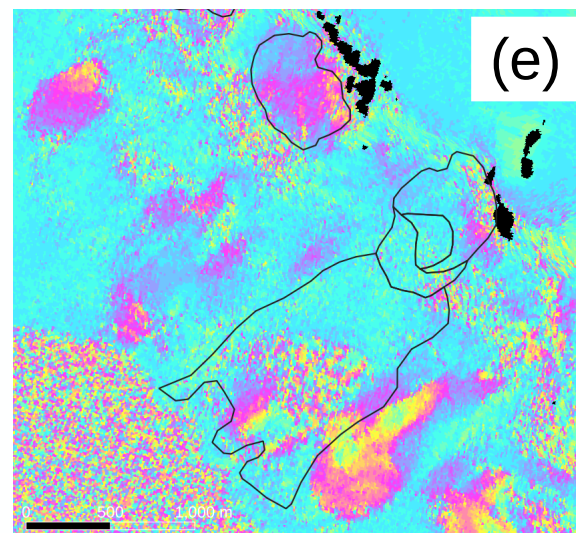
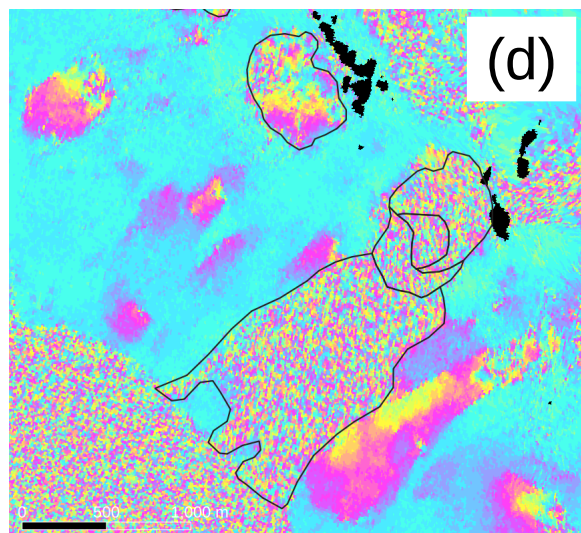
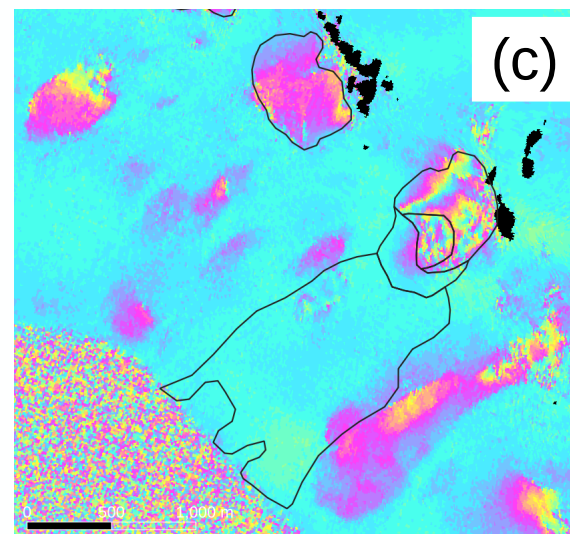
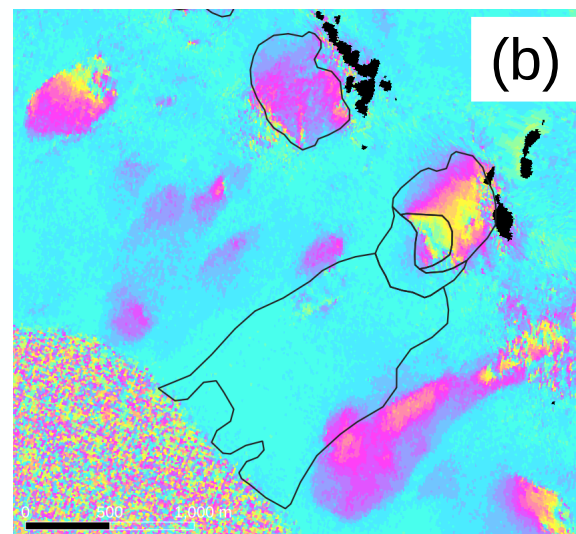
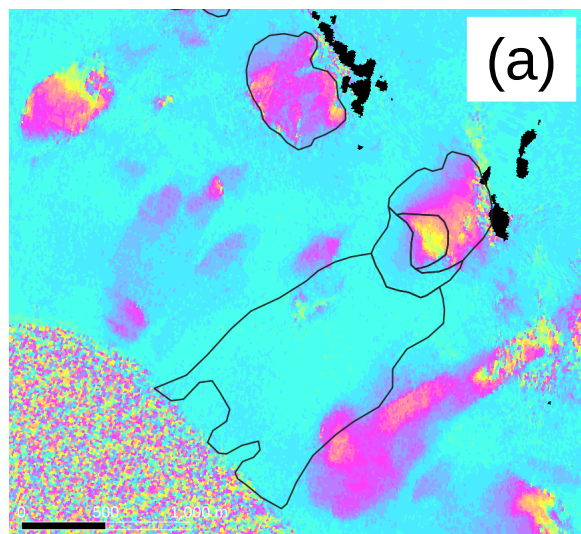
SBAS: mean seasonal def. rate



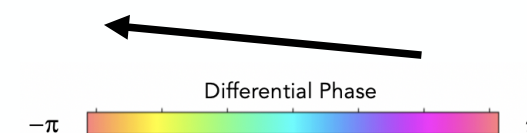




23



- (a) 20180823_20180829
6 days
- (b) 20190818_20190824
6 days
- (c) 20200818_20200824
6 days
- (d) 20210608_20210614
6 days
- (e) 20260407_20260413
6 days
- (f) 20260425_20260426
1 day



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- Recommendation: highlight the benefit of 1 day interferograms

Thank you



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