Detection of subsurface meltwater in East Antarctica using SAR Interferometry

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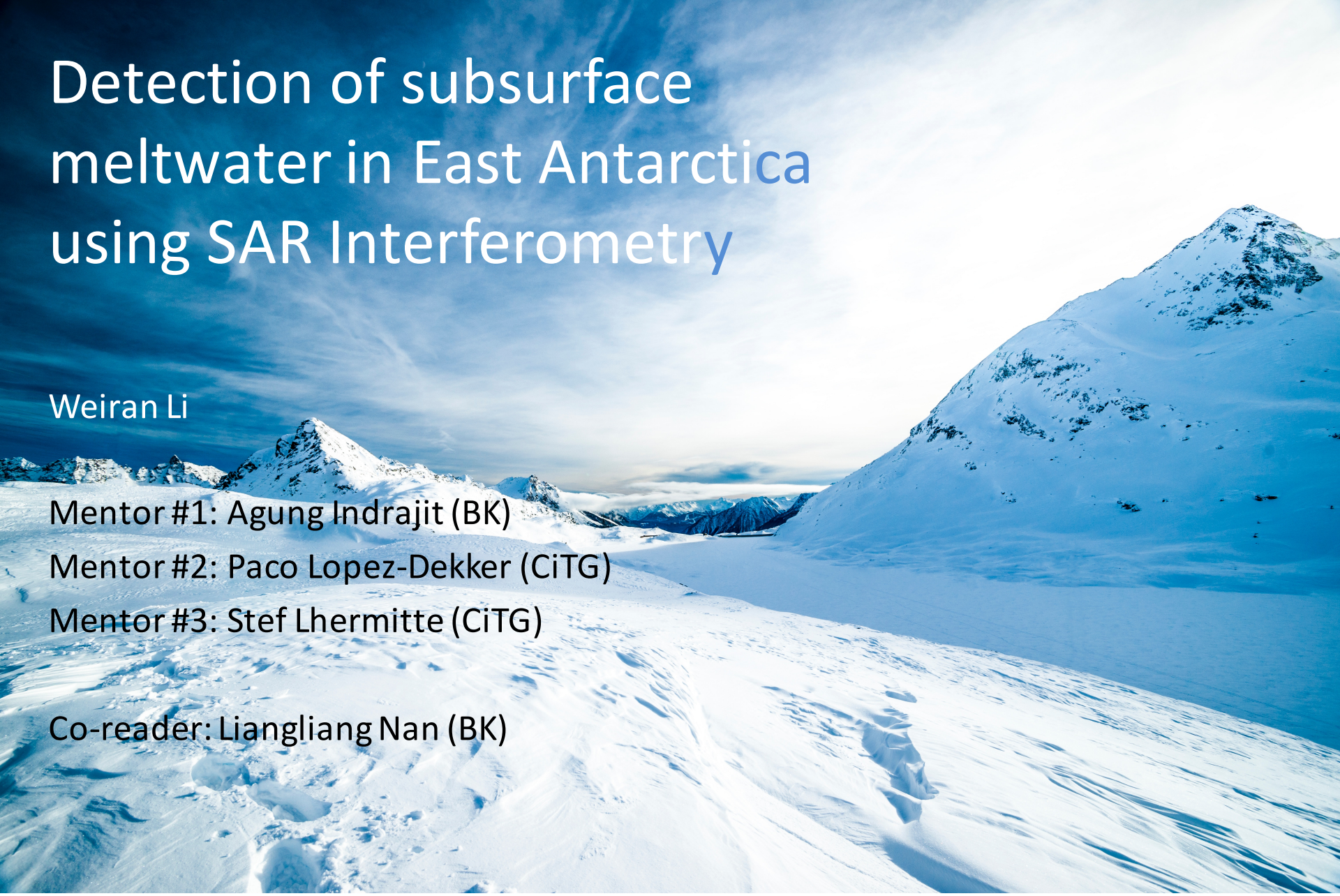
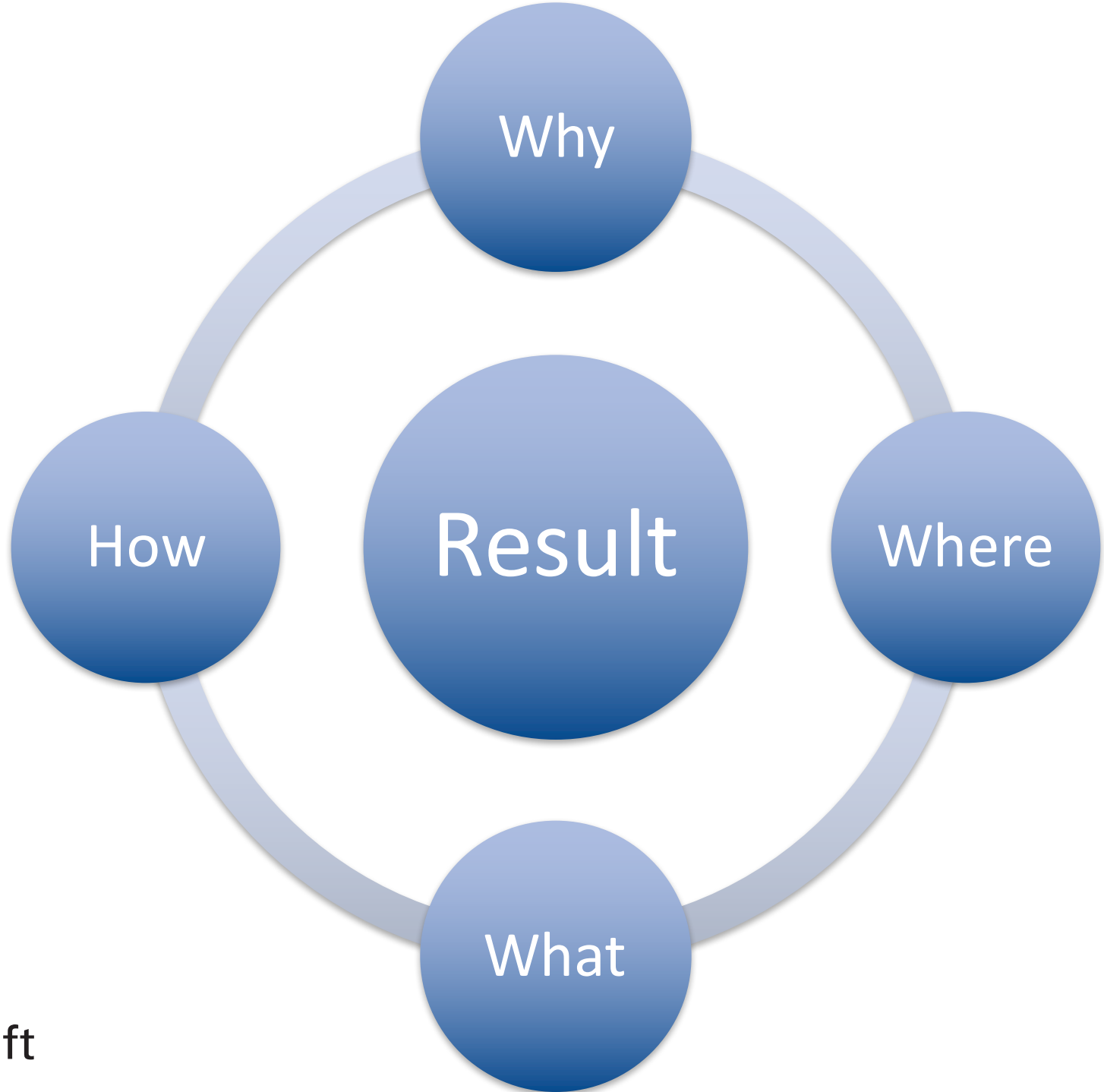
Co-reader: Liangliang Nan (BK)



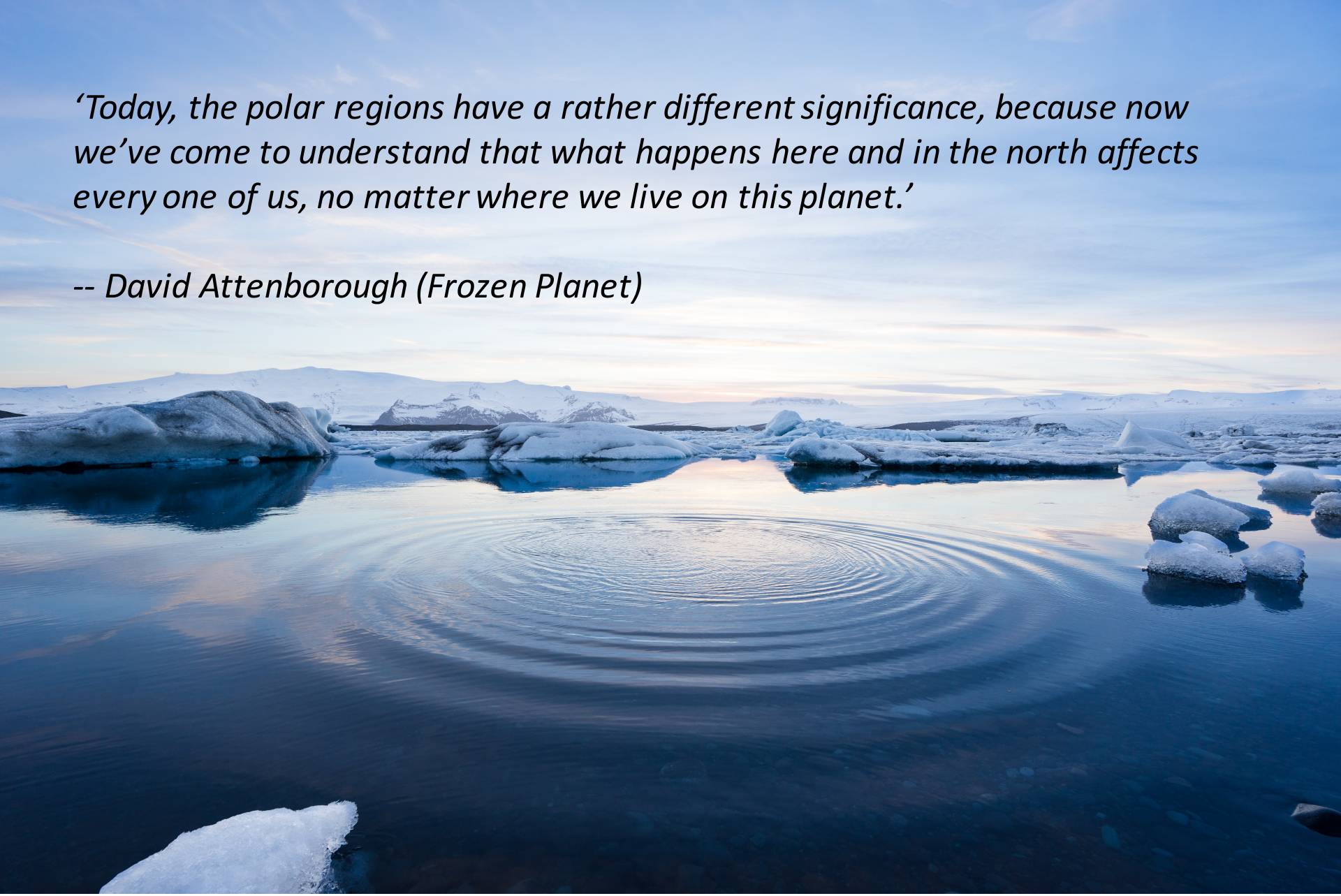
TU Delft

Photo by Alberto Restifo on Unsplash


Why
How
Result
Where
What

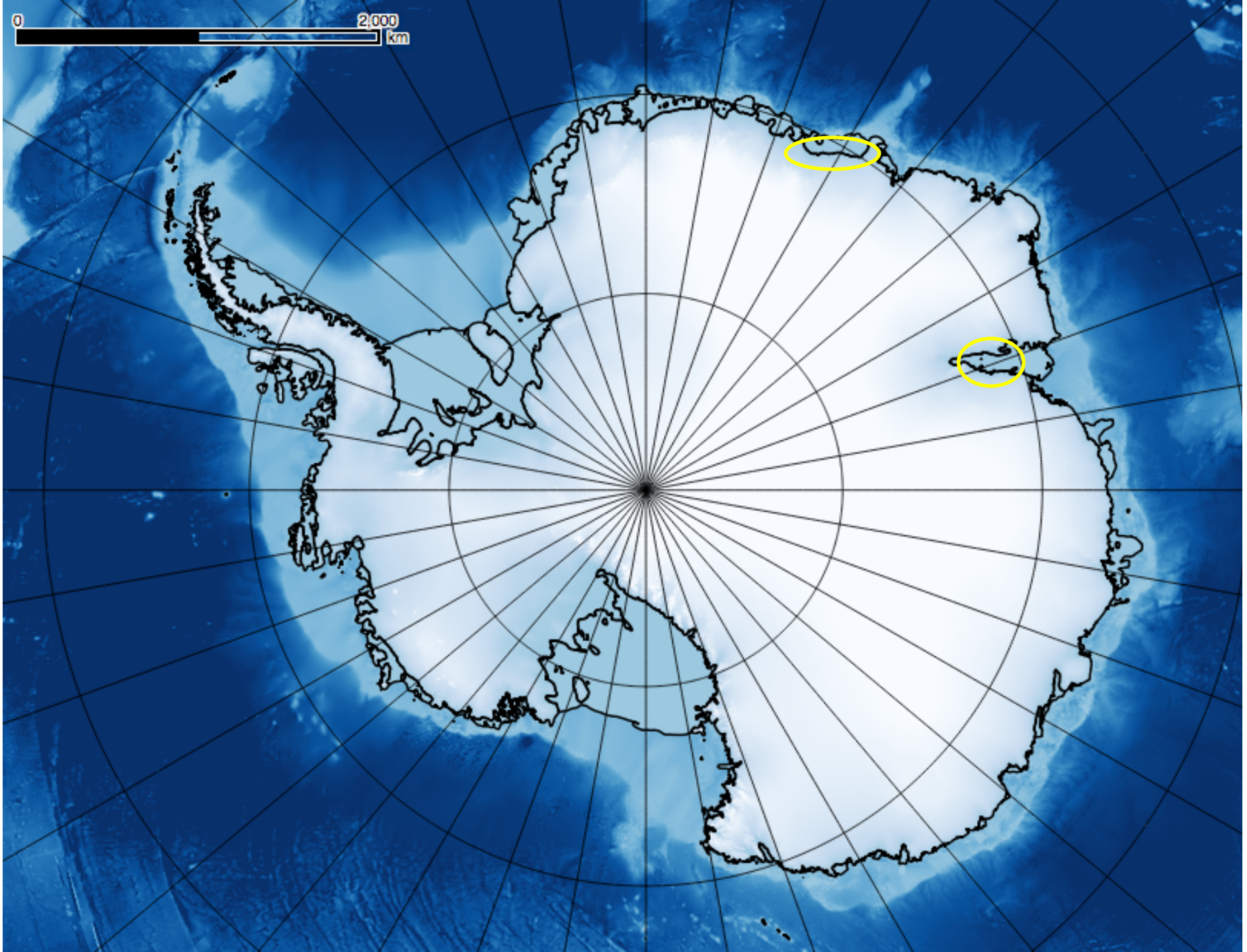
'Today, the polar regions have a rather different significance, because now we've come to understand that what happens here and in the north affects every one of us, no matter where we live on this planet.'

-- David Attenborough (Frozen Planet)

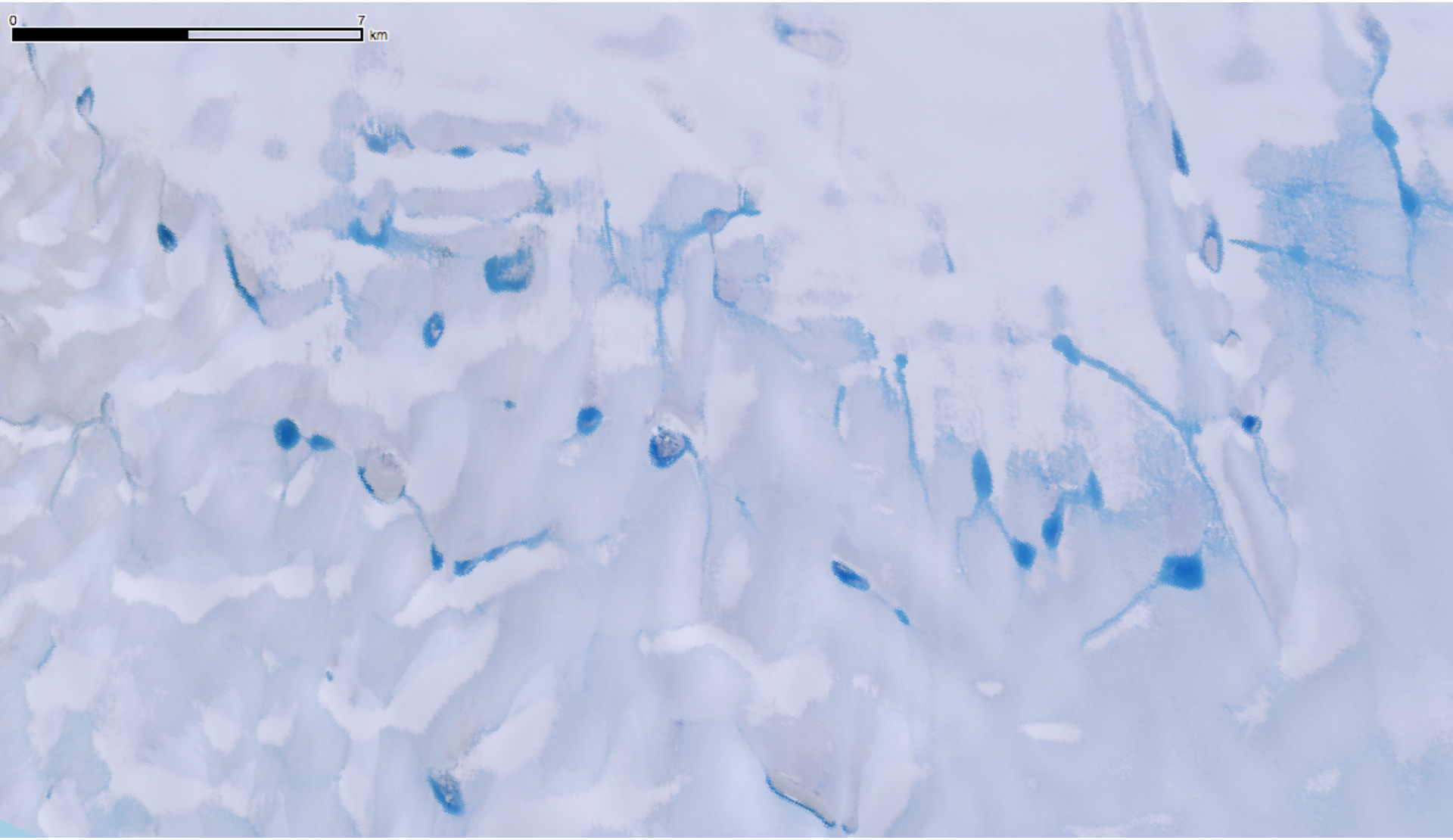


TU Delft

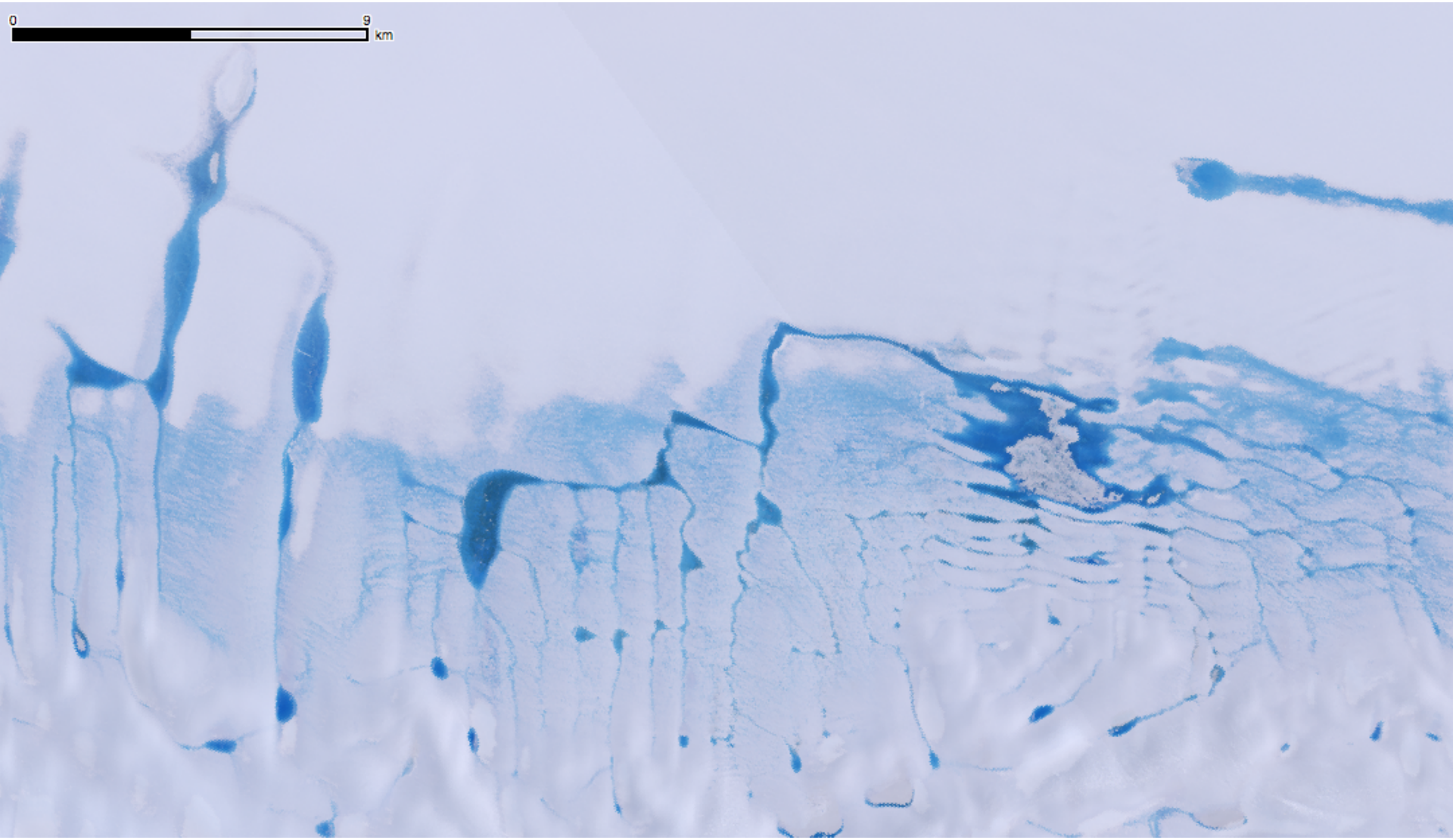
Photo by Jeremy Goldberg on Unsplash


0
2,000
km

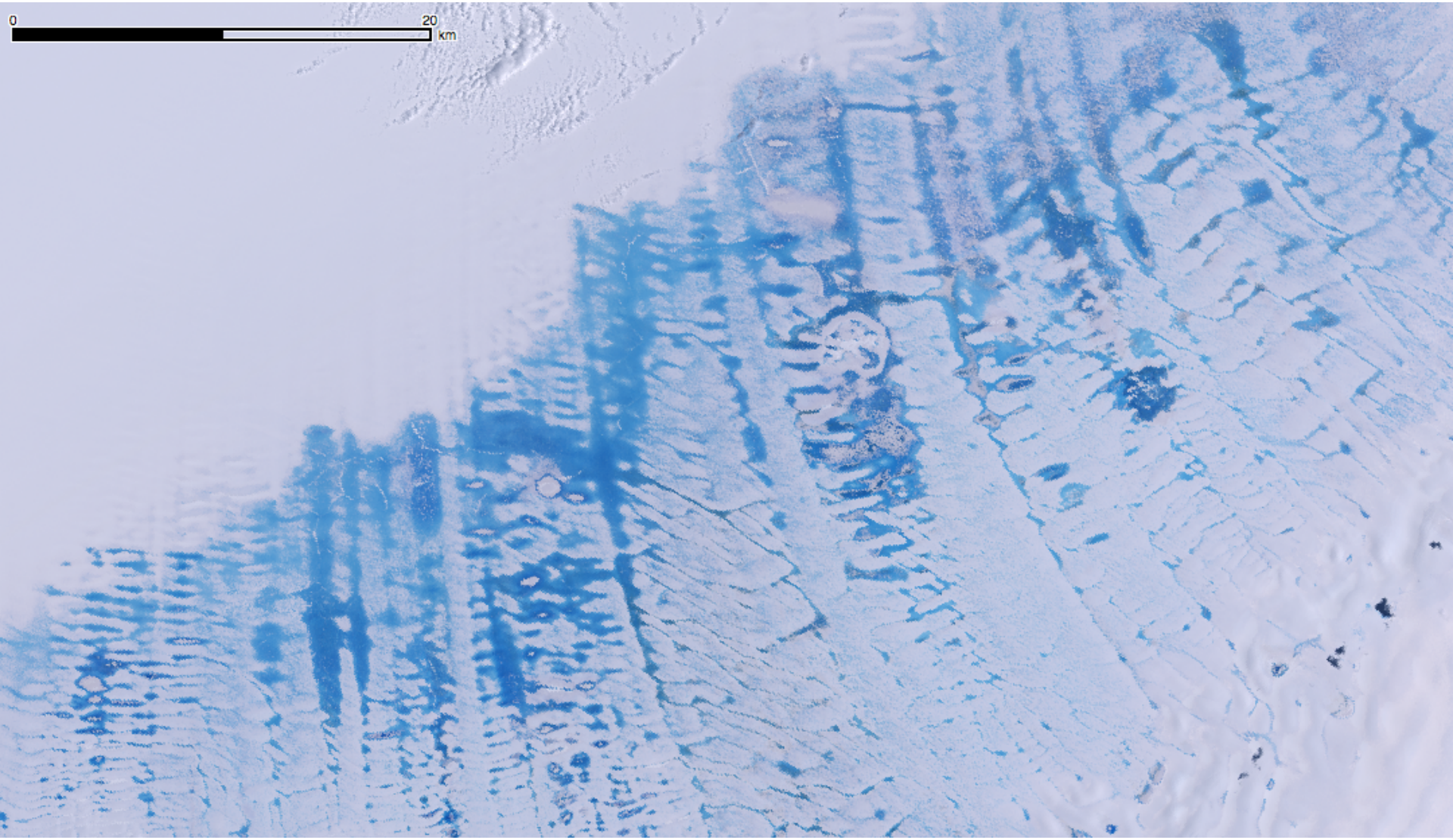
Landsat 8 image on January 9, 2018



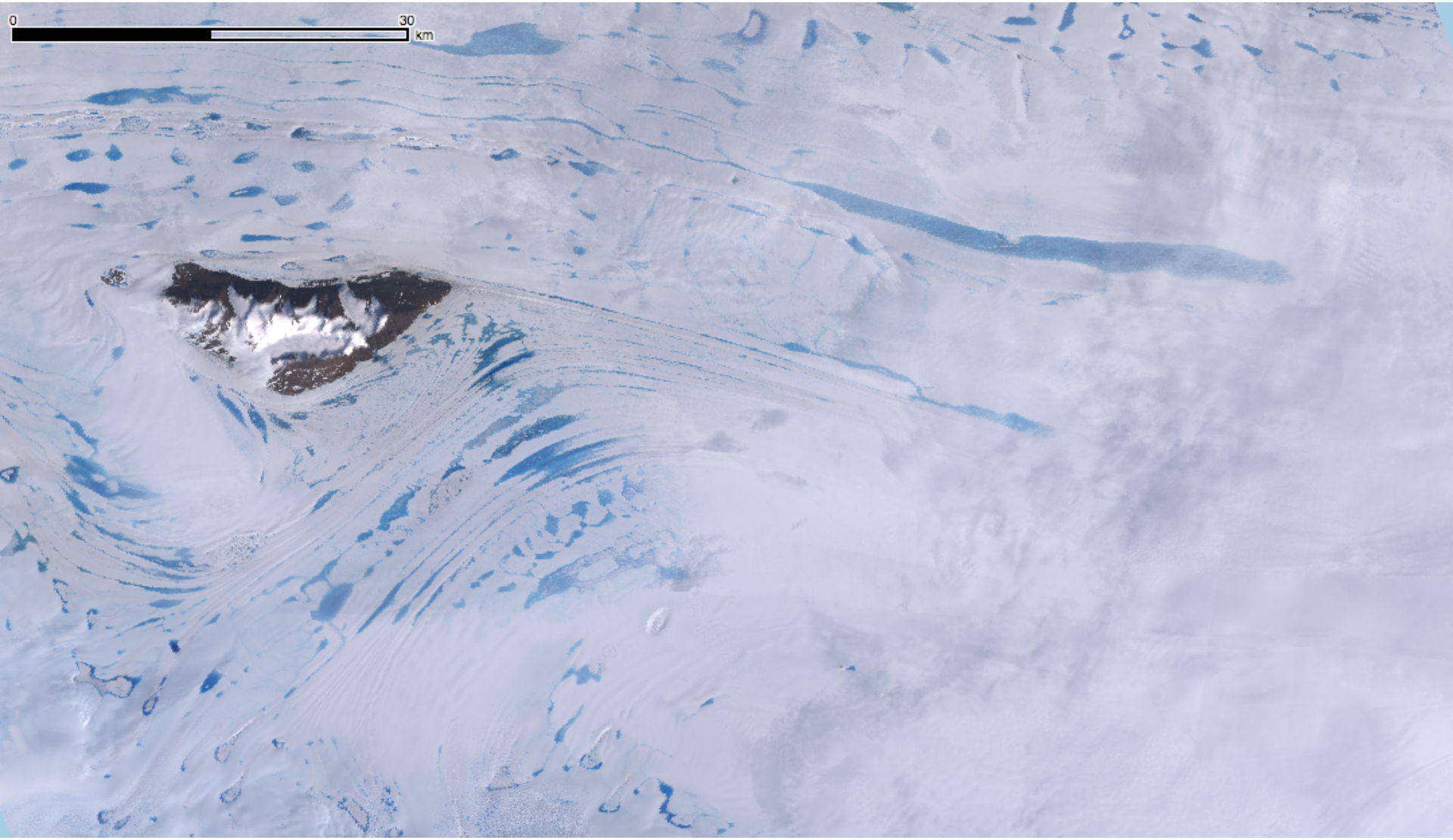
Landsat 8 image on January 11, 2018



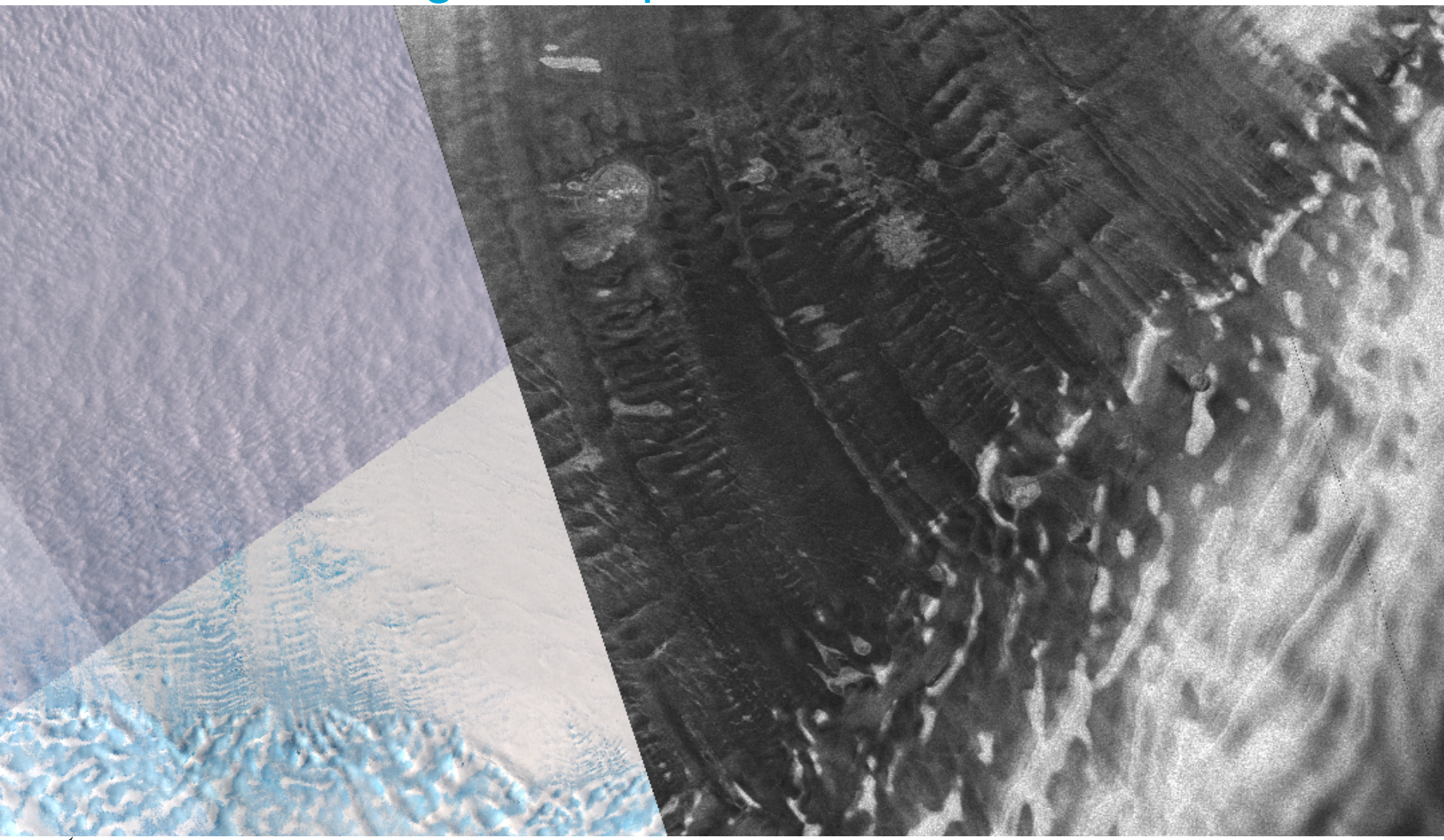
Landsat 8 image on January 11, 2018



Landsat 8 image on January 27, 2017

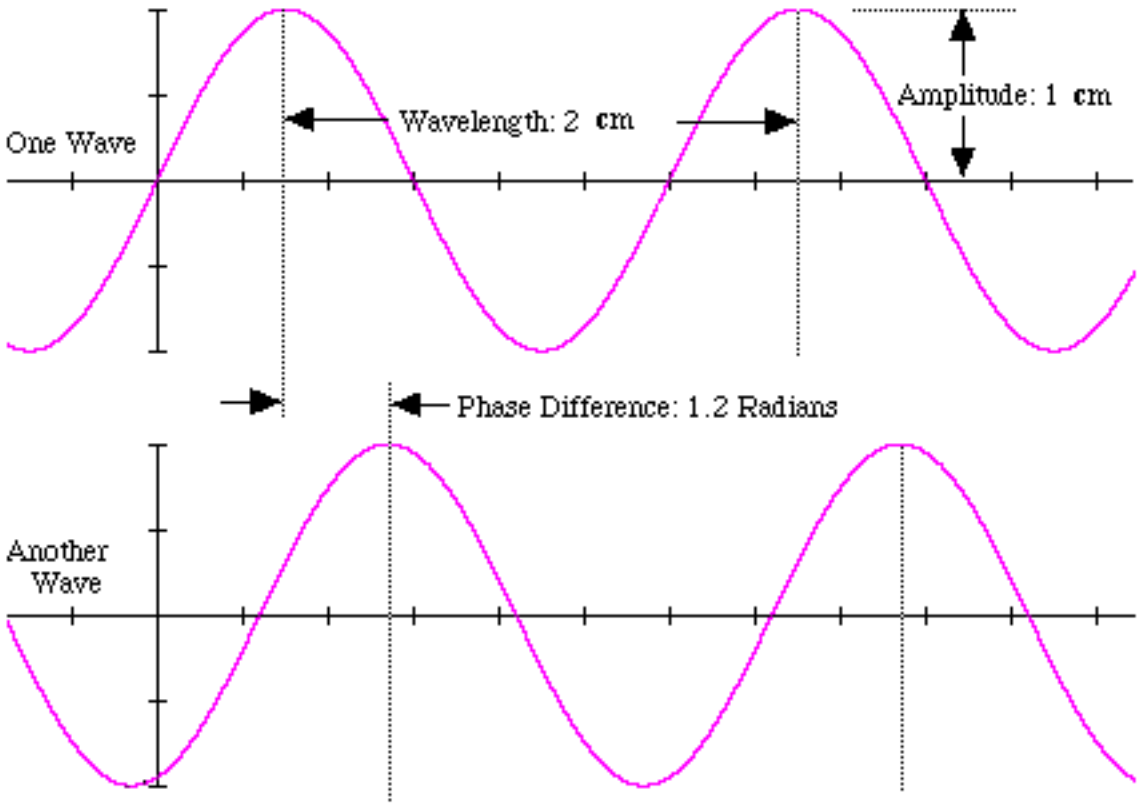


Remote sensing techniques



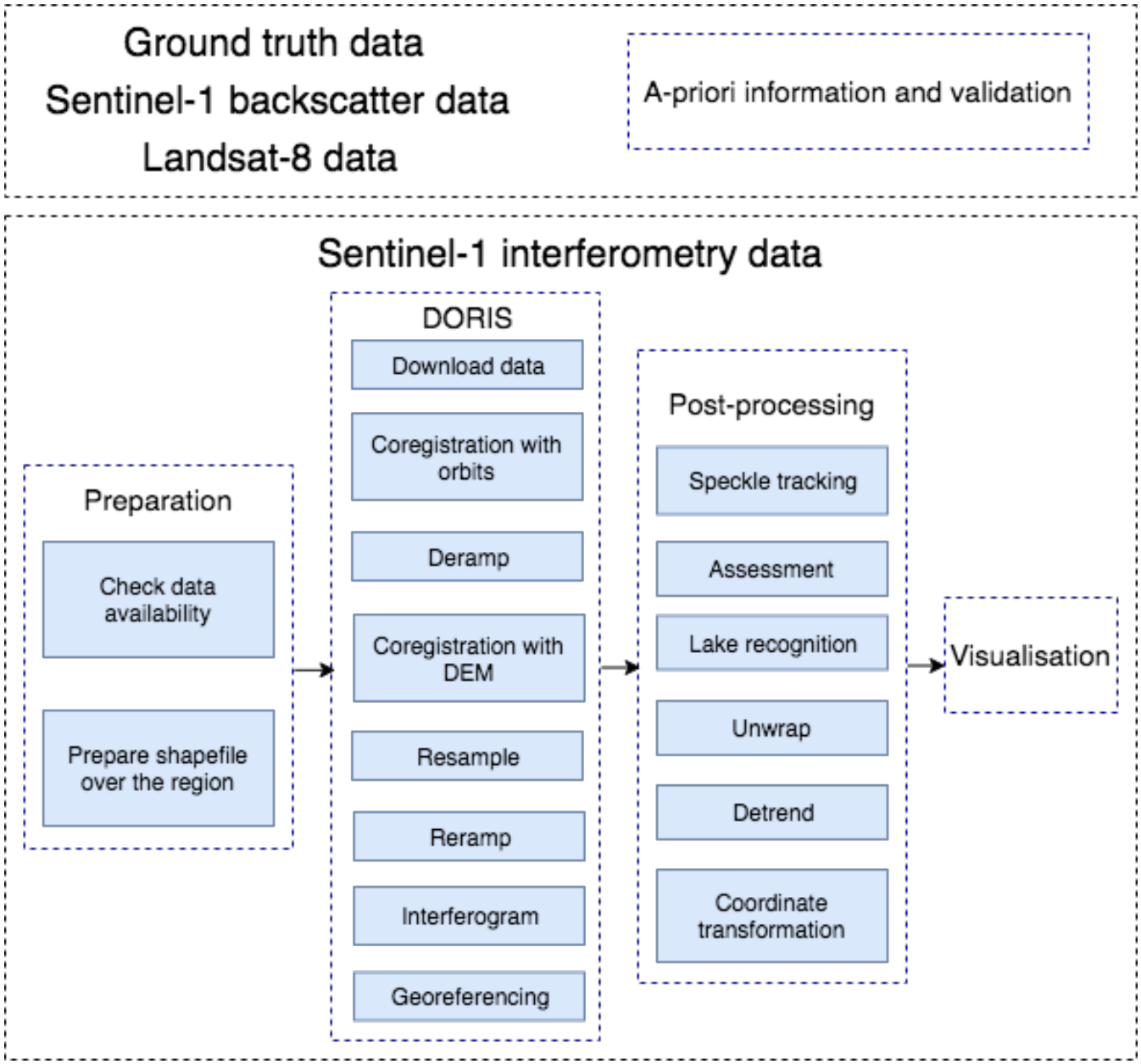
InSAR

- Added information: phase

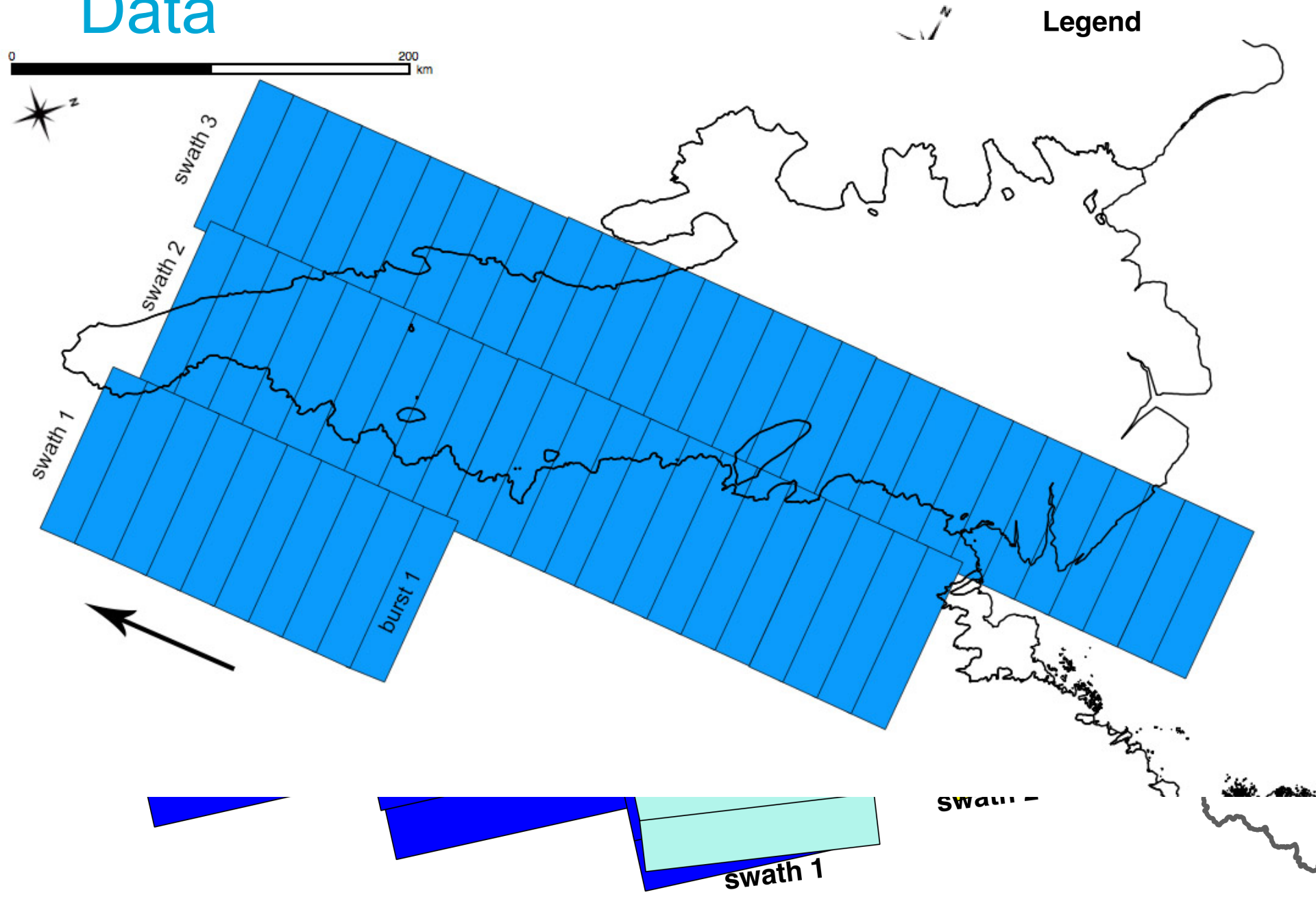


Credit: ESA https://earth.esa.int/handbooks/asar/CNTR1-1-5.html

Methods

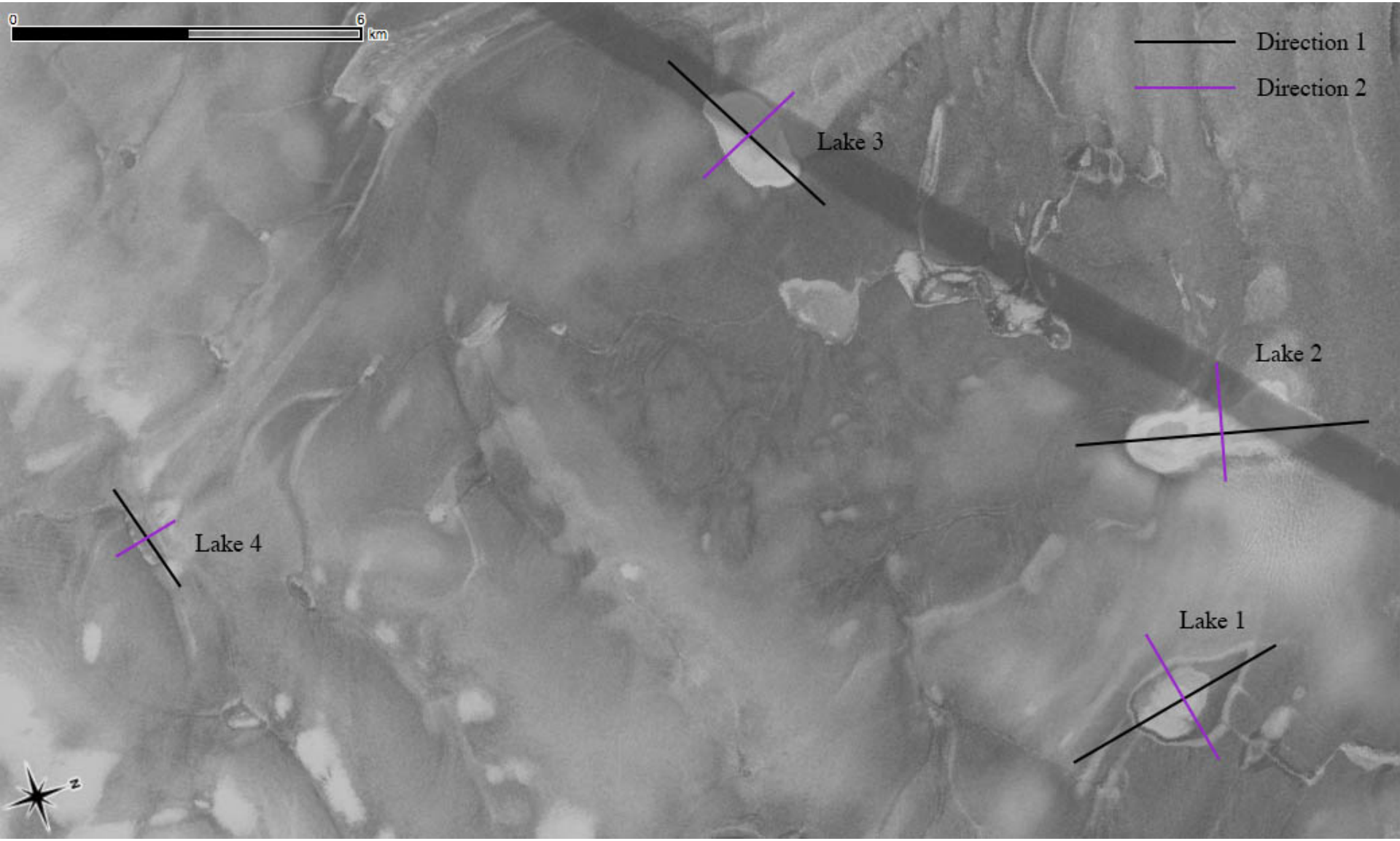

Ground truth data
Sentinel-1 backscatter data
Landsat-8 data
A-priori information and validation
Sentinel-1 interferometry data
Preparation
Check data availability
Prepare shapefile over the region
DORIS
Download data
Coregistration with orbits
Deramp
Coregistration with DEM
Resample
Reramp
Interferogram
Georeferencing
Post-processing
Speckle tracking
Assessment
Lake recognition
Unwrap
Detrend
Coordinate transformation
Visualisation

Data

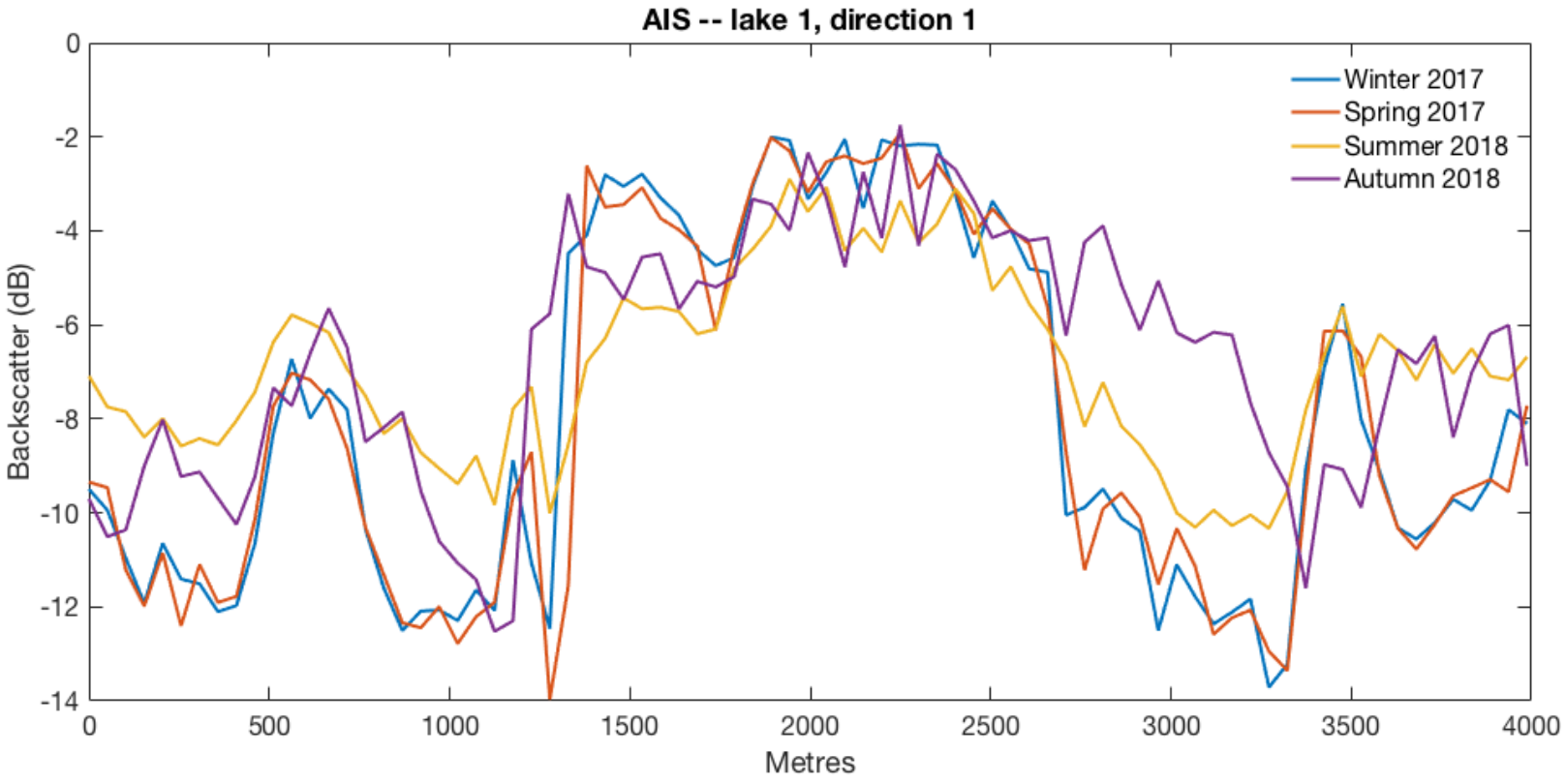


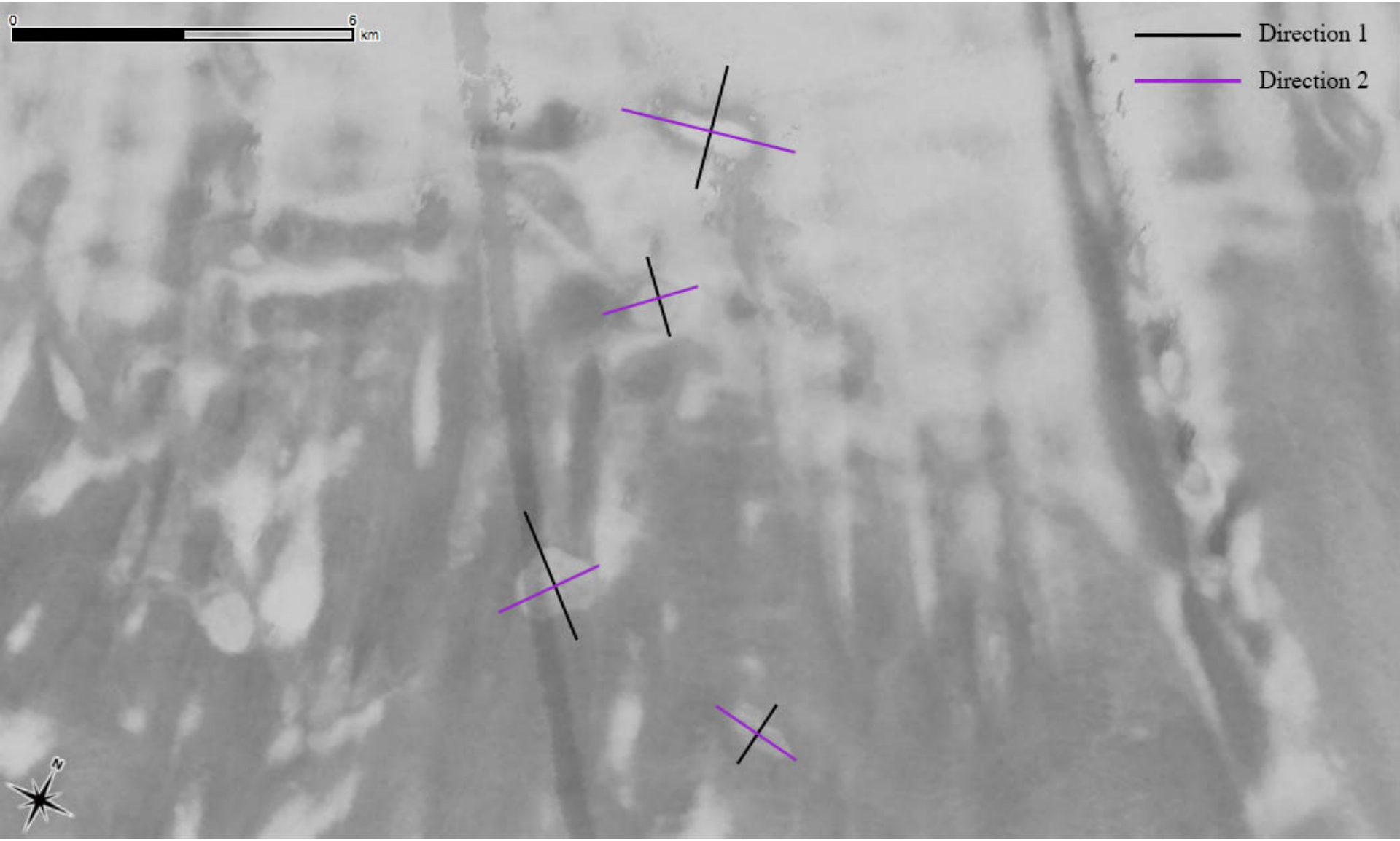
Data

- Information and validation: Sentinel-1 Ground Range Detected (GRD) & Landsat 8
- InSAR computation: Sentinel-1 Single Look Complex (SLC)
- InSAR products: amplitude, coherence, interferogram

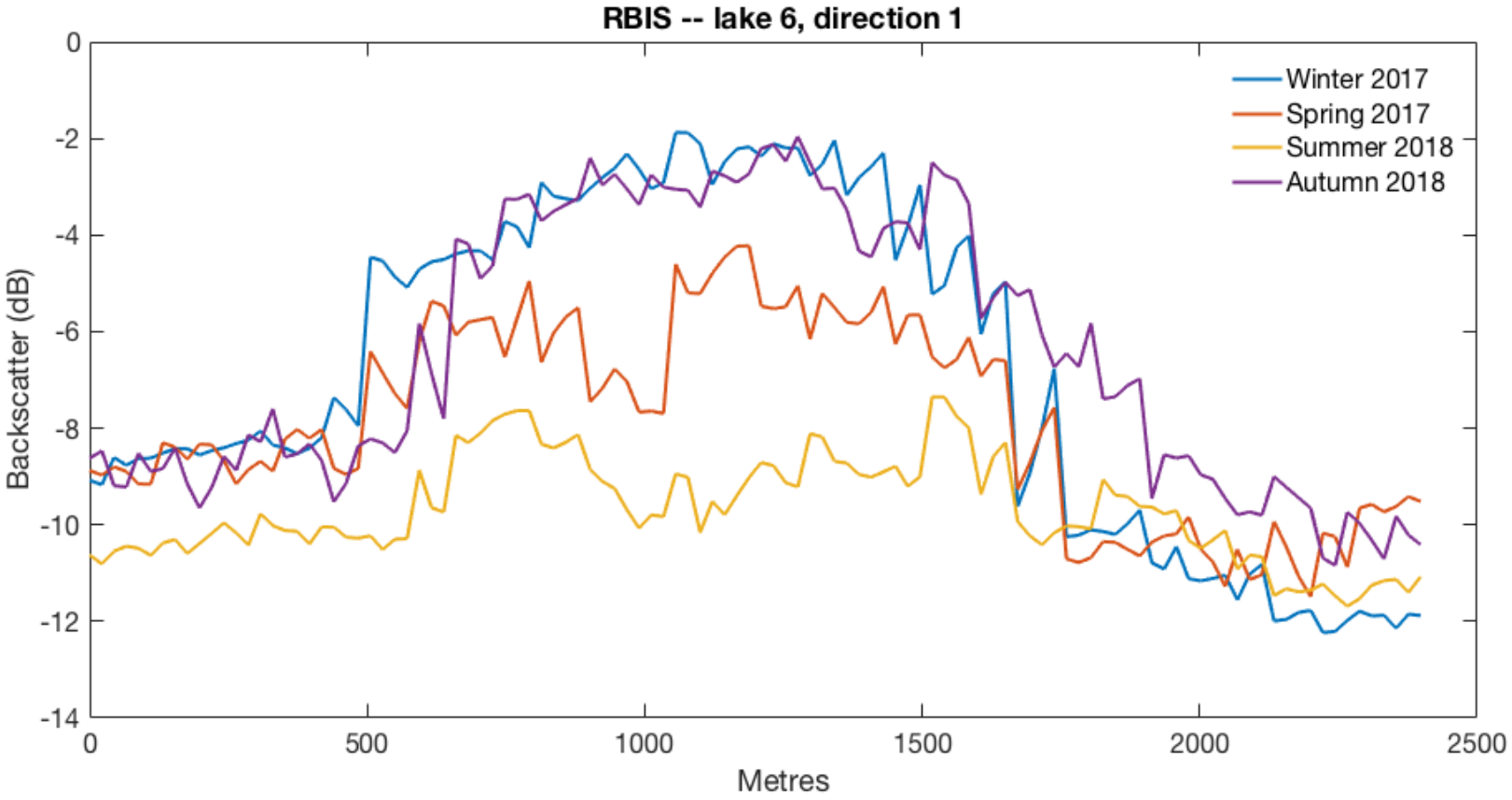

0
6
km
Direction 1
Direction 2
Lake 3
Lake 2
Lake 4
Lake 1
N

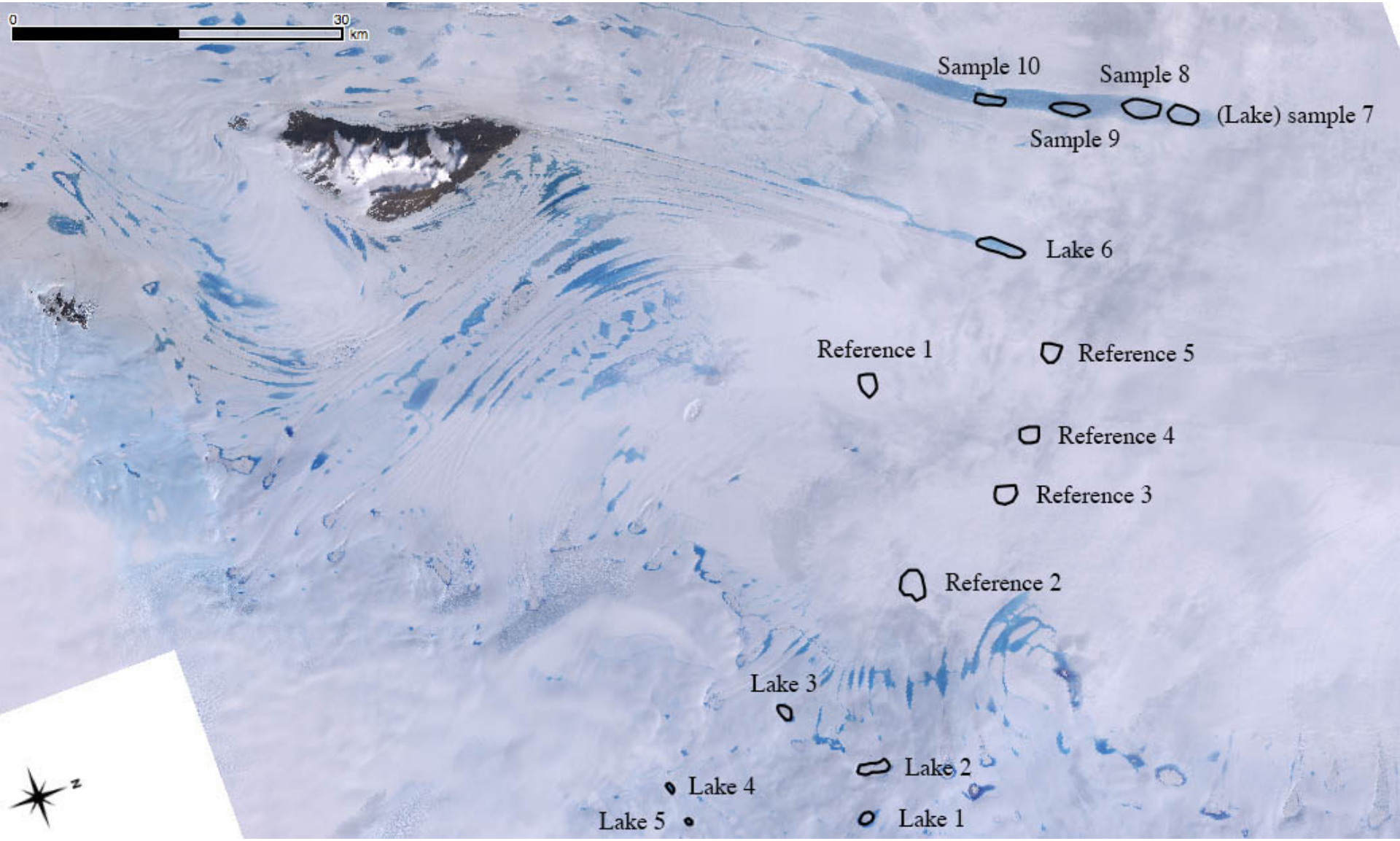
GRD information



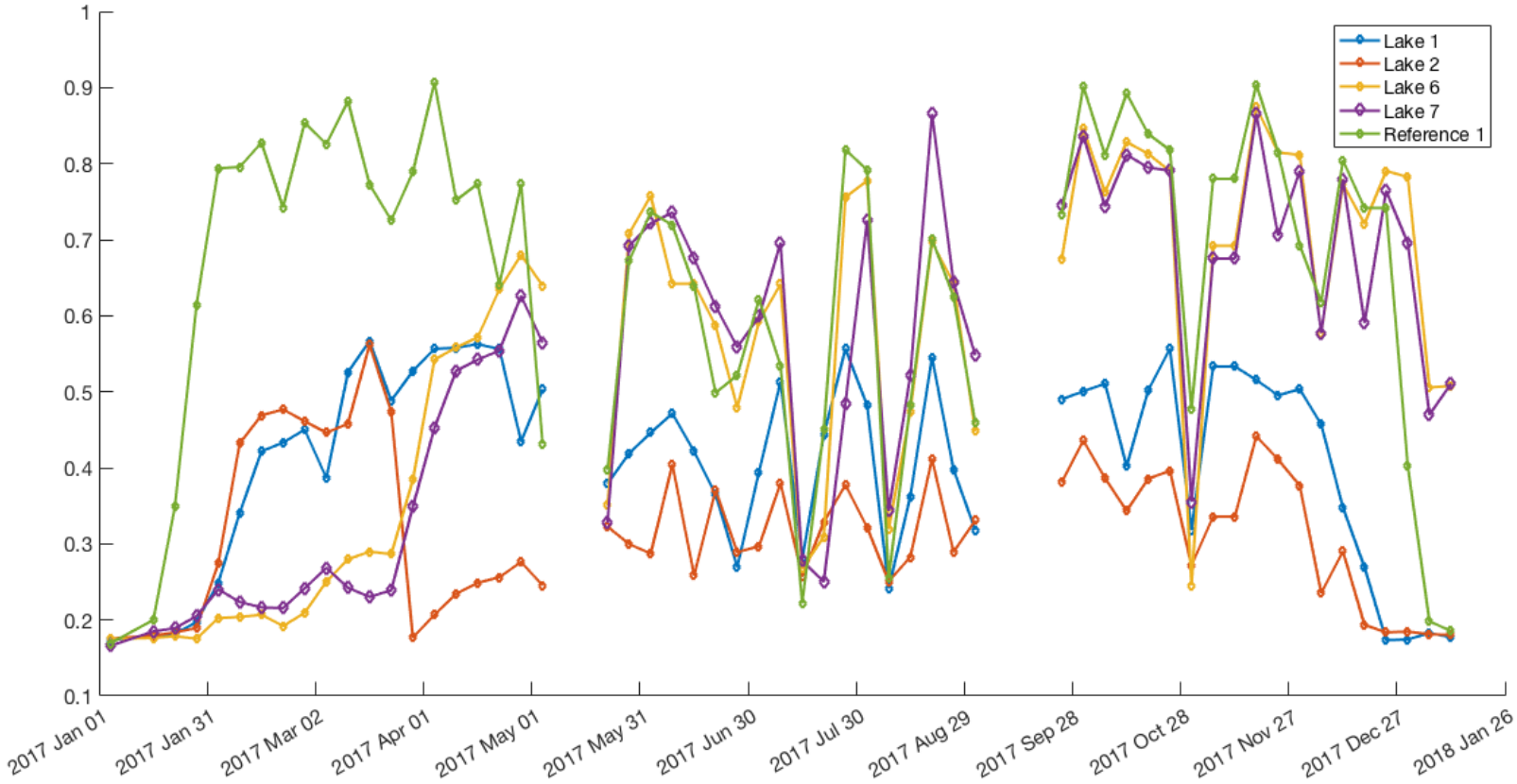

0
6
km
Direction 1
Direction 2
N

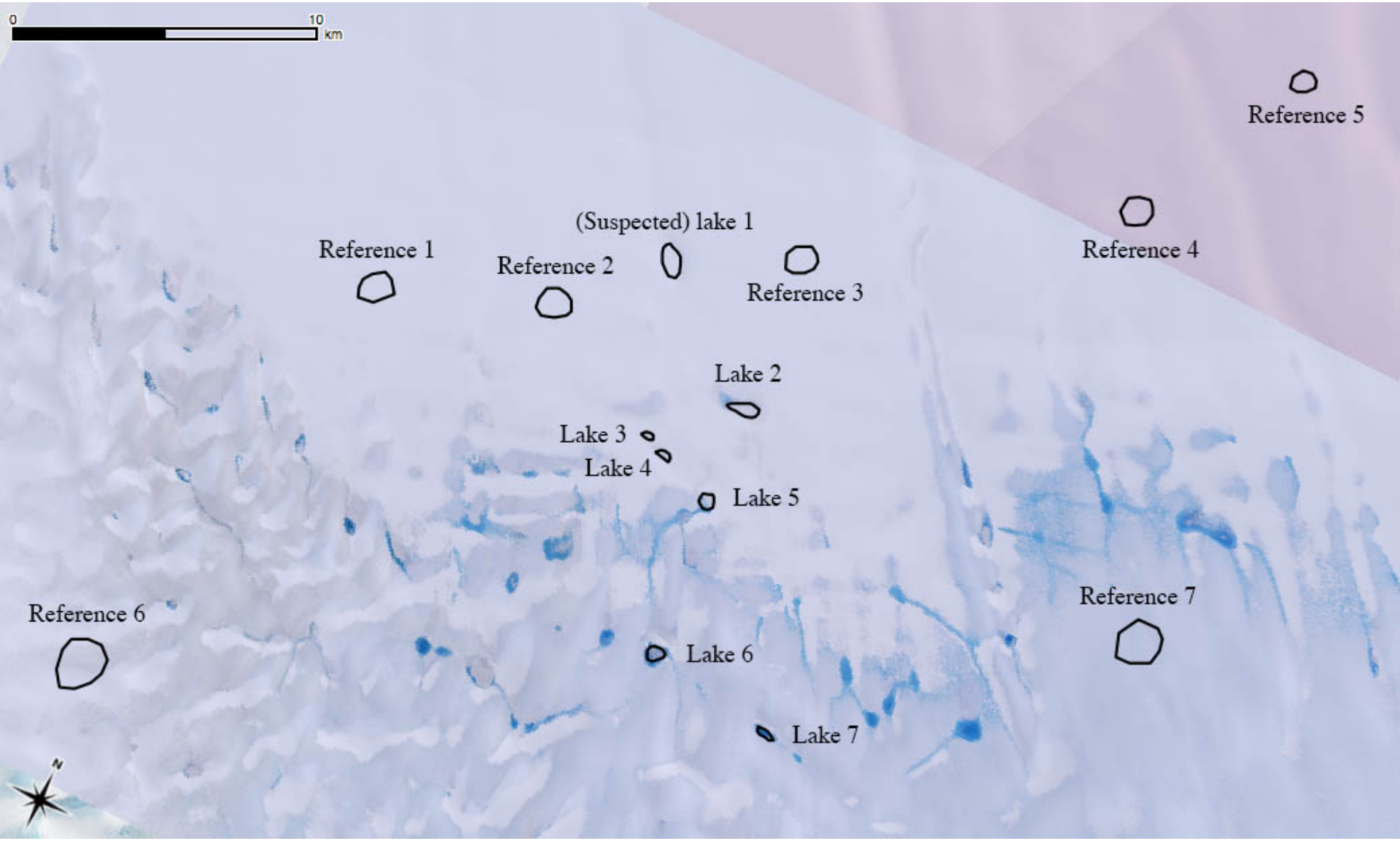
GRD information



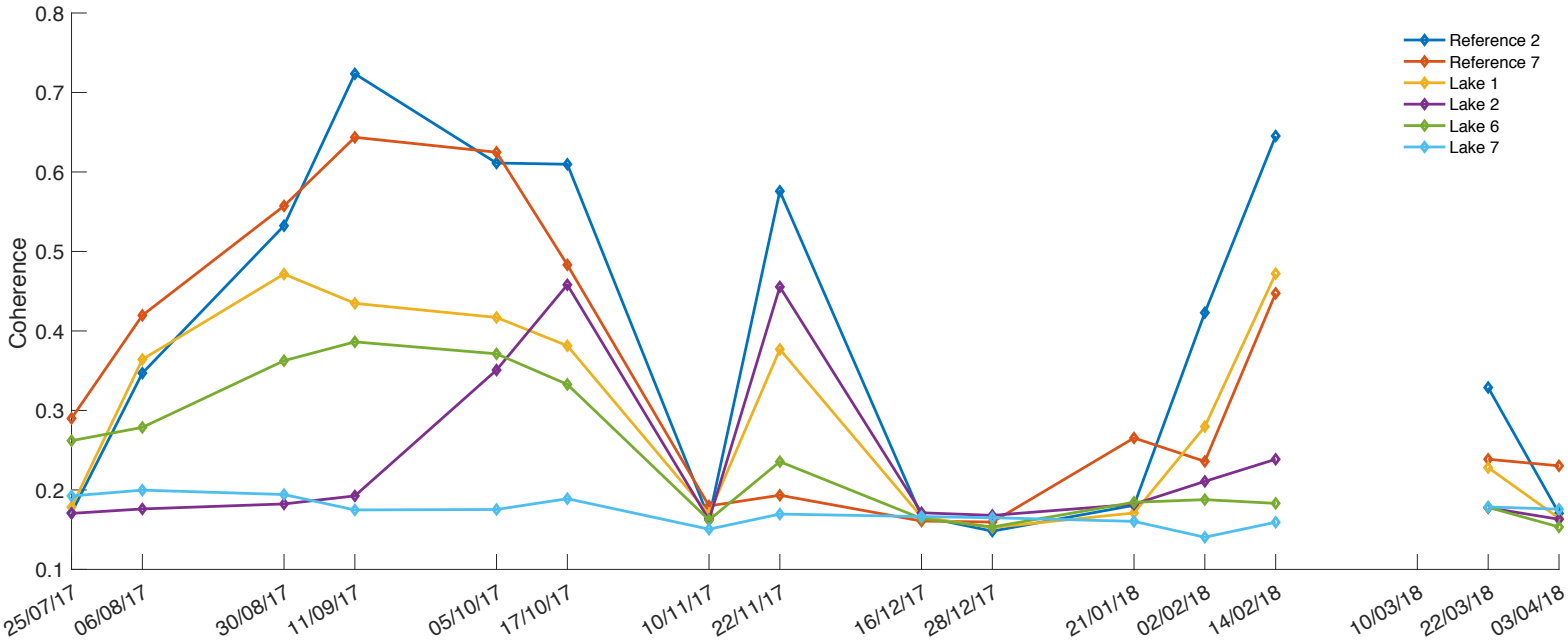

0
30
km
Sample 10
Sample 8
(Lake) sample 7
Sample 9
Lake 6
Reference 1
Reference 5
Reference 4
Reference 3
Reference 2
Lake 3
Lake 2
Lake 4
Lake 5
Lake 1

Coherence information



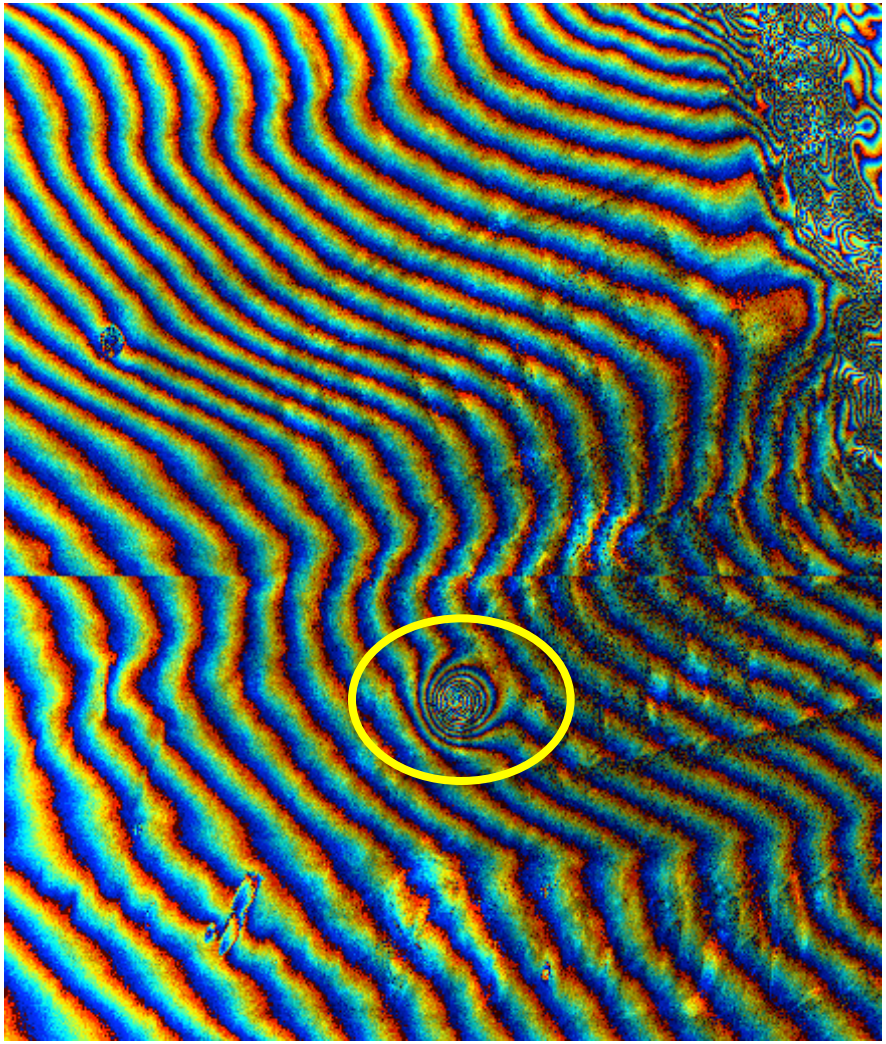

0
10
km
Reference 5
(Suspected) lake 1
Reference 1
Reference 2
Reference 3
Reference 4
Lake 2
Lake 3
Lake 4
Lake 5
Reference 6
Reference 7
Lake 6
Lake 7
N

Coherence information

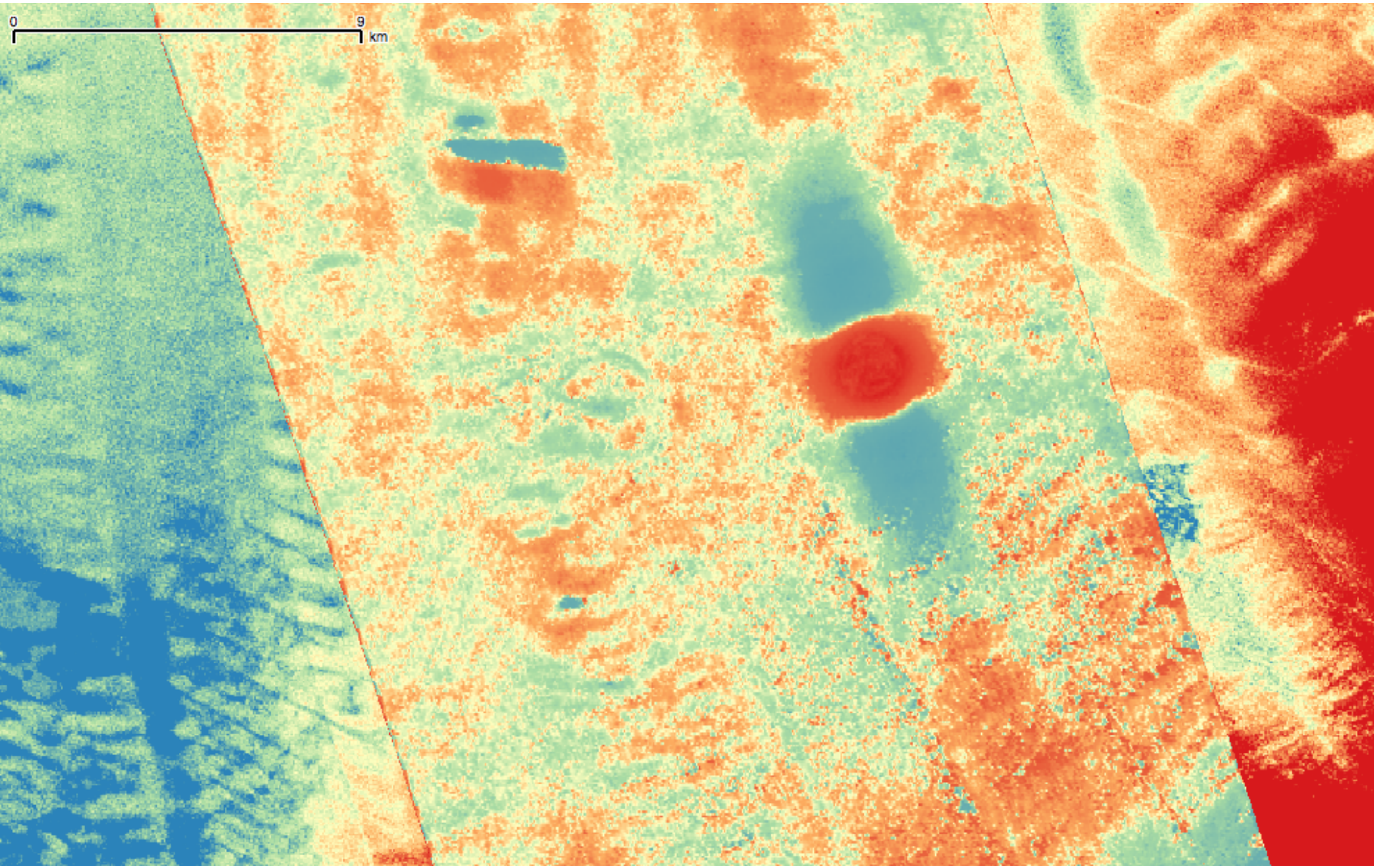


R: amplitude in Oct.
G: coherence in Oct.
B: amplitude in Dec.

Interferogram information



What's this?

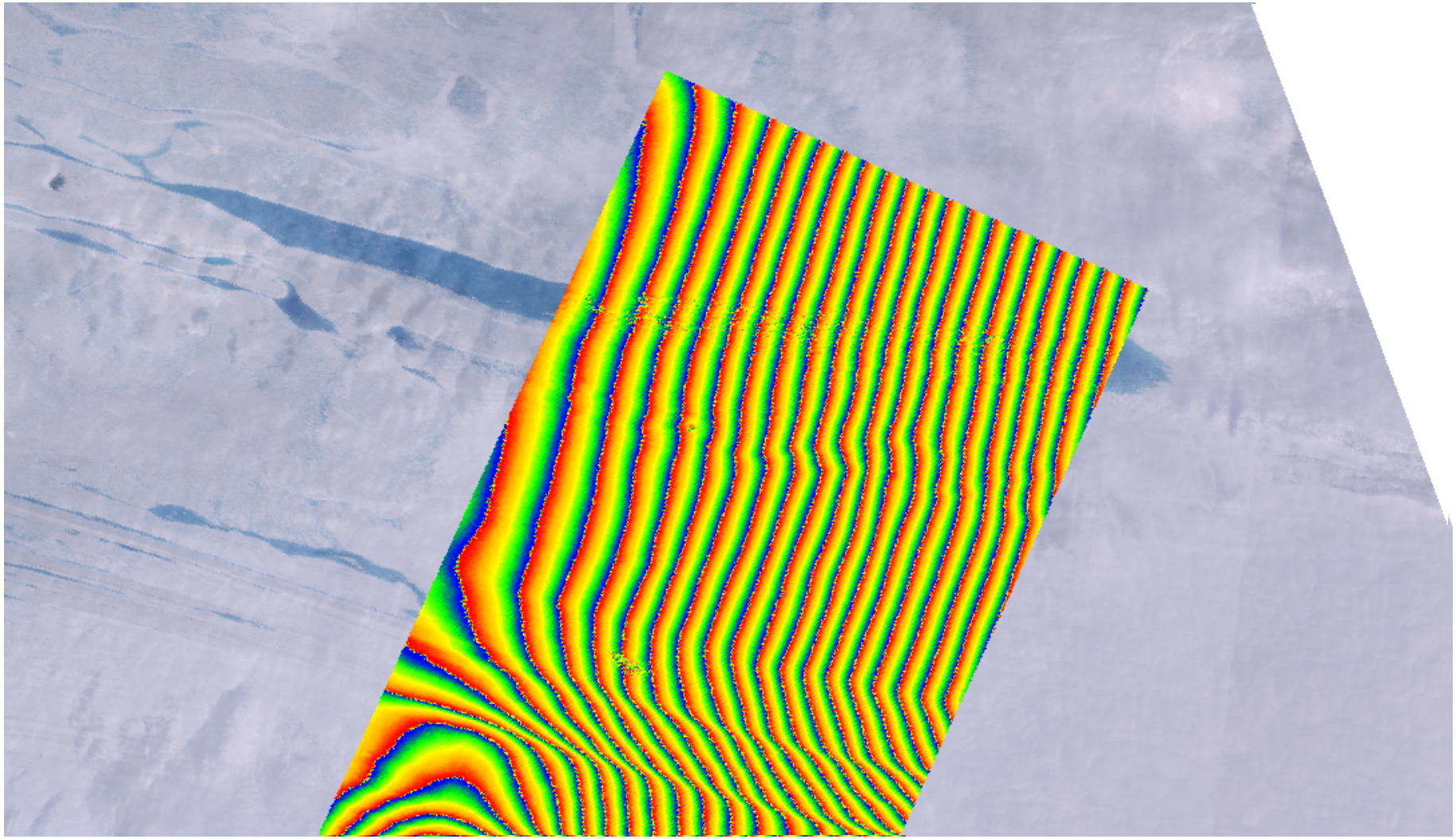


Uplift: approximately 10cm

Validation

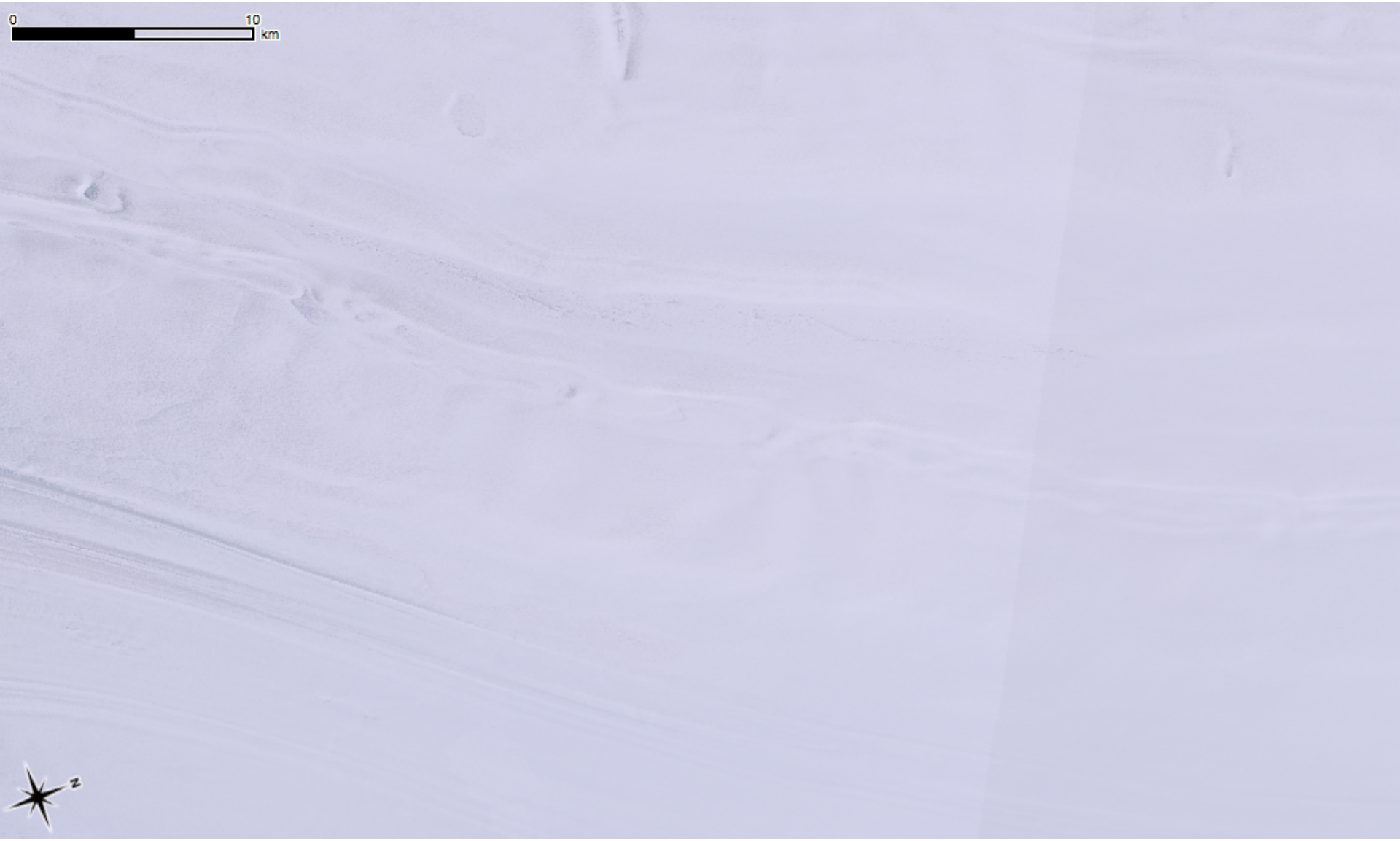
December 19, 2017

Interferogram information



Amplitude 28/03/2017

Interferogram between 22/03/2017 and 28/03/2017


0
10
km
N

Conclusion

- InSAR is indeed capable of detecting subsurface meltwater, including dynamic behaviours, under the condition of:
  - Frequent revisit time
  - Sufficient coherence
- We need more knowledge of how the actual meltwater features influence the backscatters and coherence.

TU Delft

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