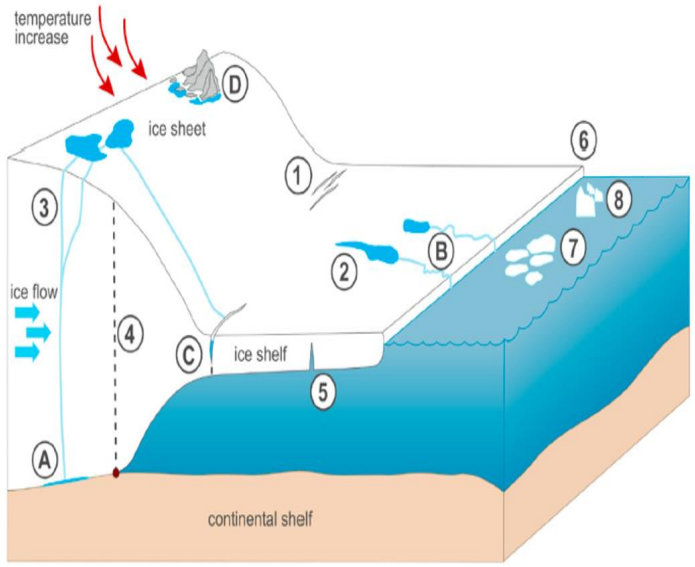
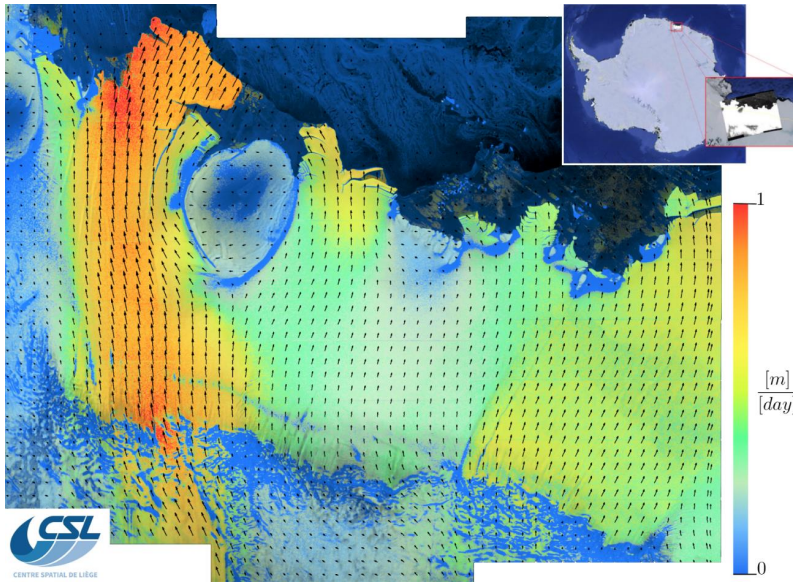
Quentin GLAUDE
Ph.D Student

Coherence Tracking and its Adaptation to TOPSAR Acquisition Mode - Study case over Antarctic Ice Shelves

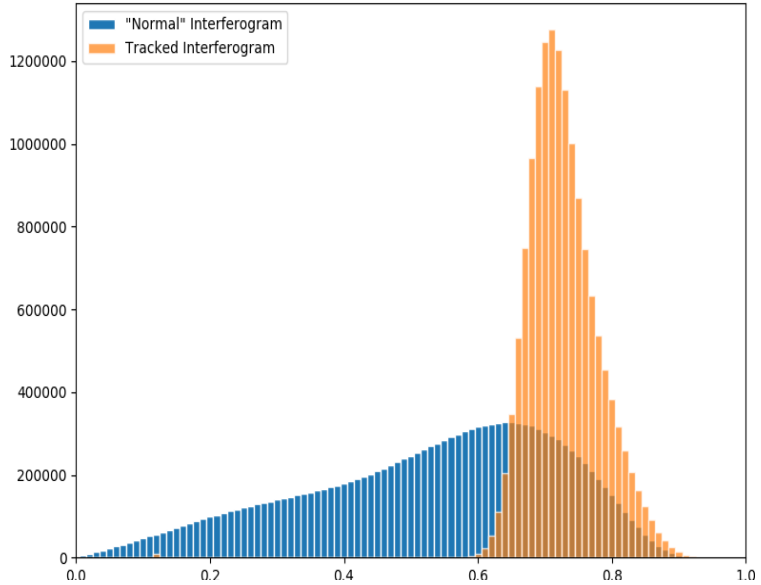
Ice Shelves



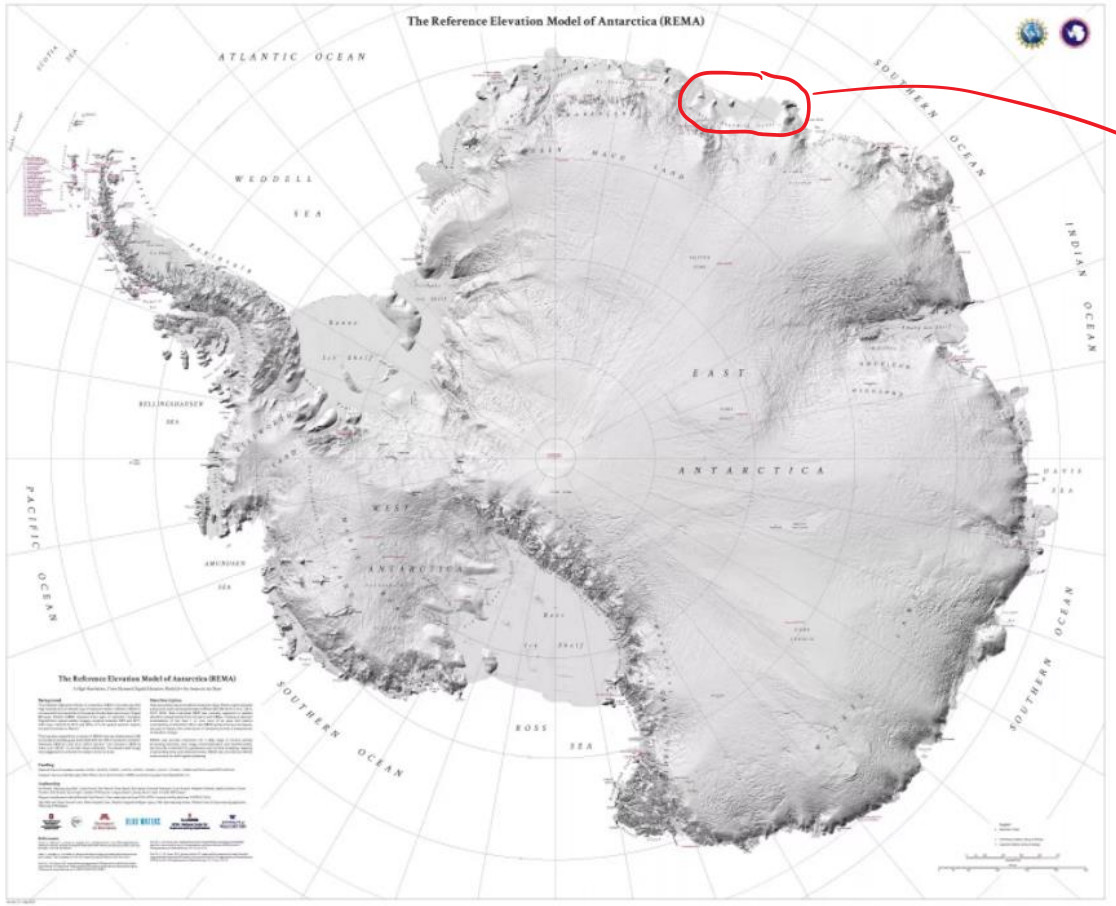


Bidimensional Results

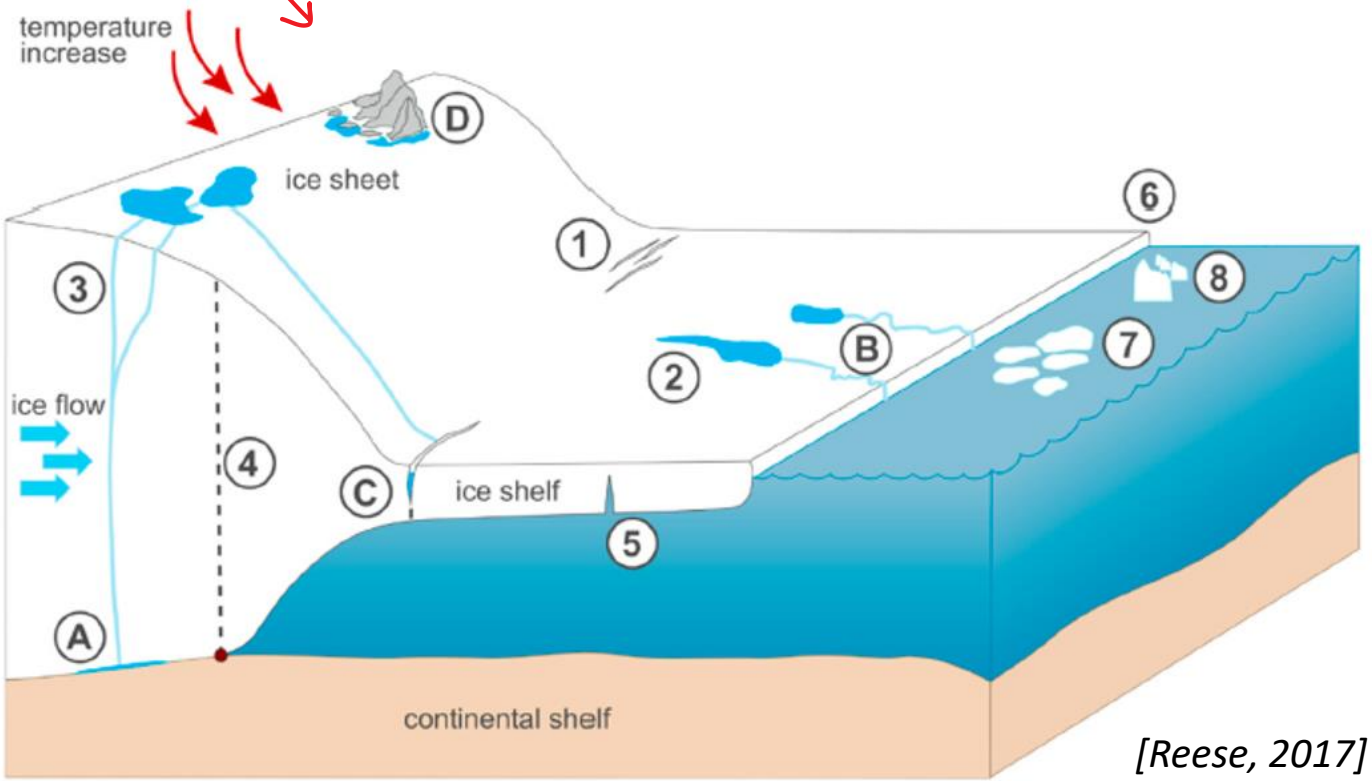
InSAR Improvements



Antarctica is the largest ice sheet on Earth. Ice-shelves are the extending parts of this ice-sheet, which are floating on the boundaries of Antarctica

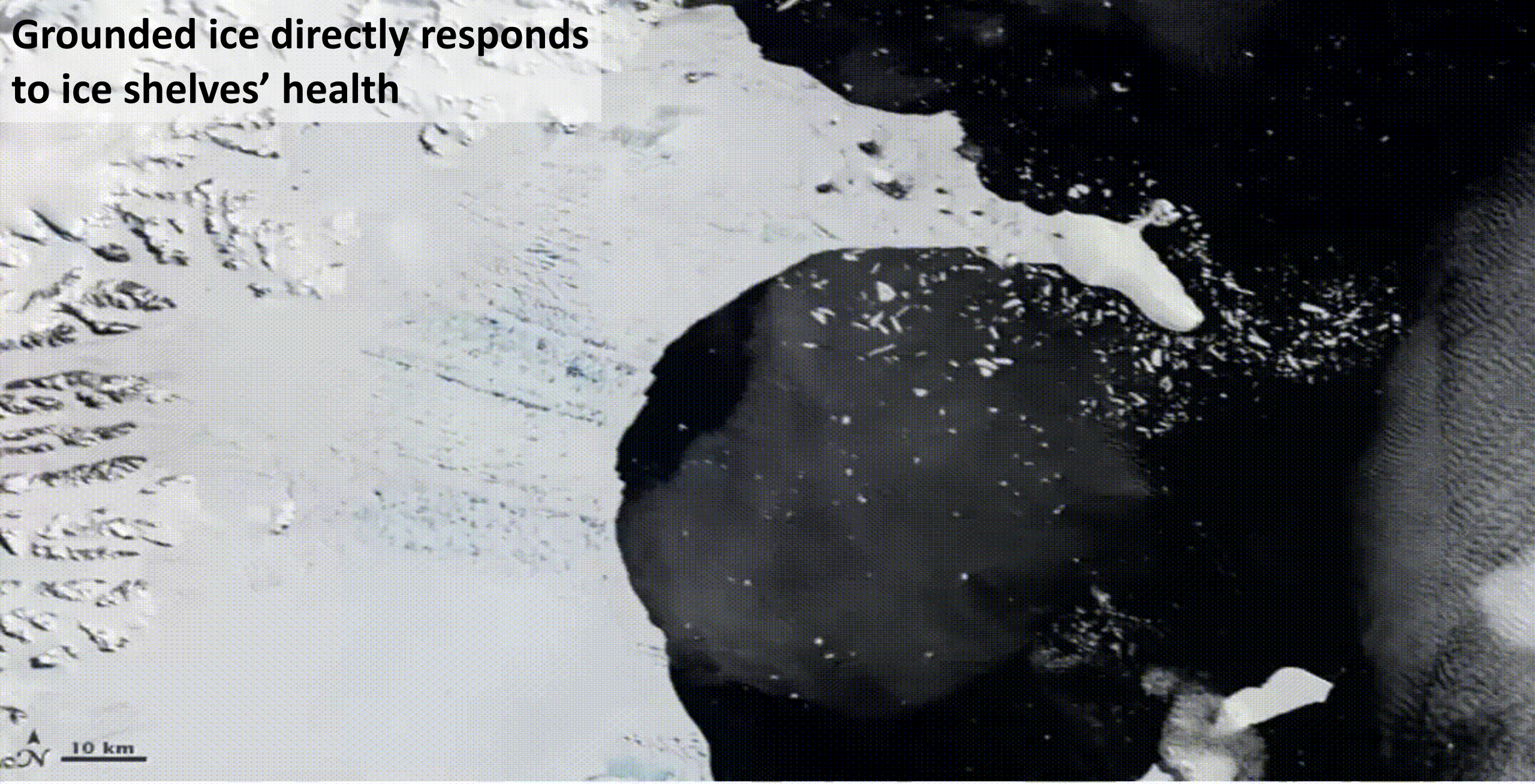


[Howat, 2019]

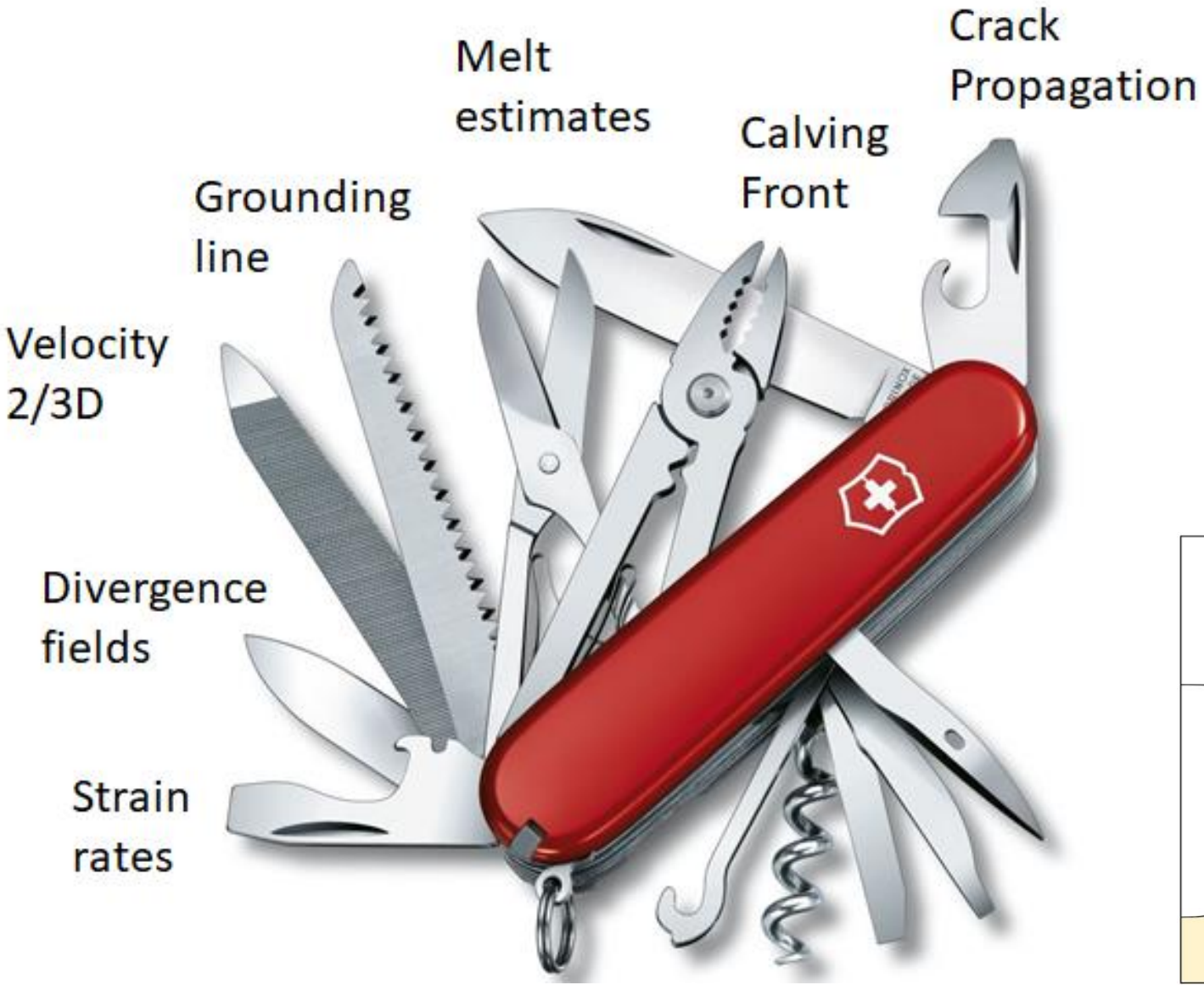


[Reese, 2017]

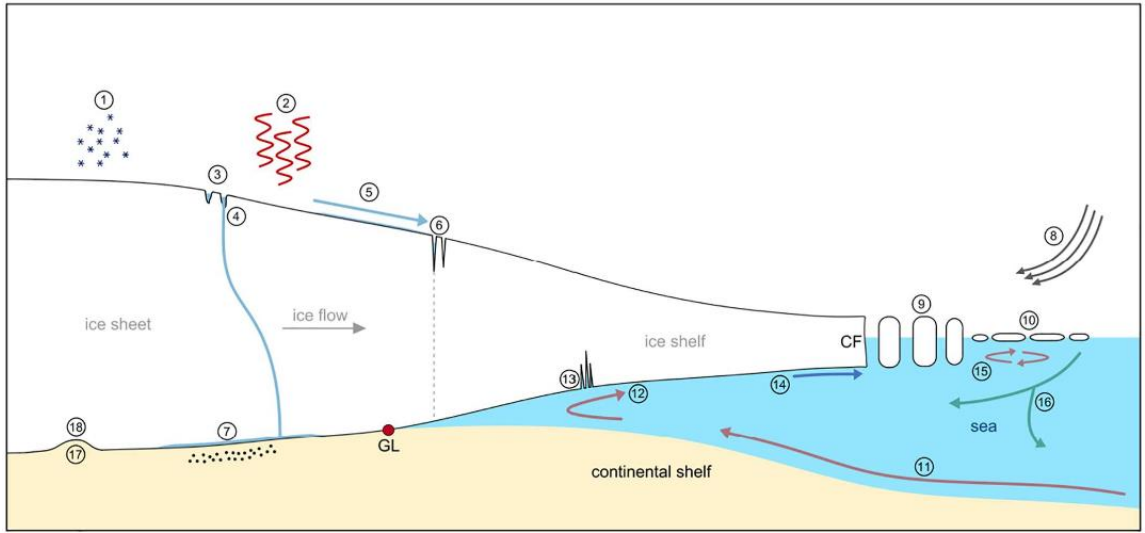
Grounded ice directly responds to ice shelves' health

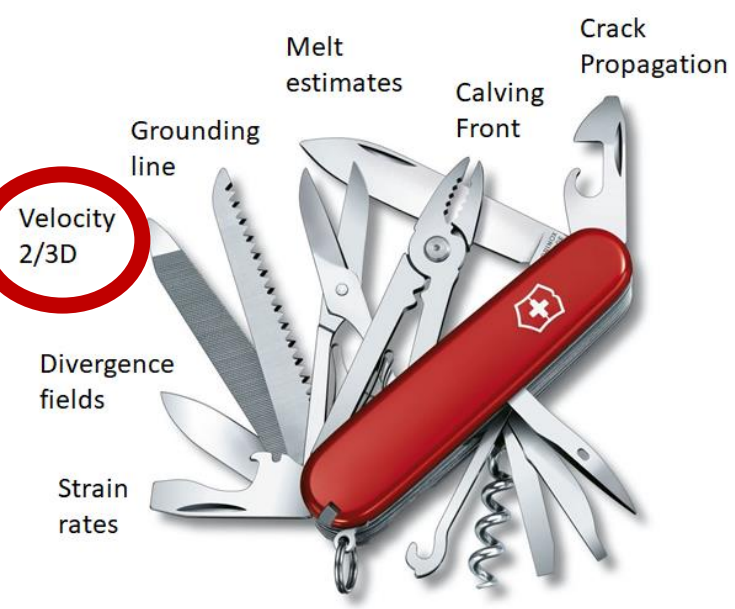


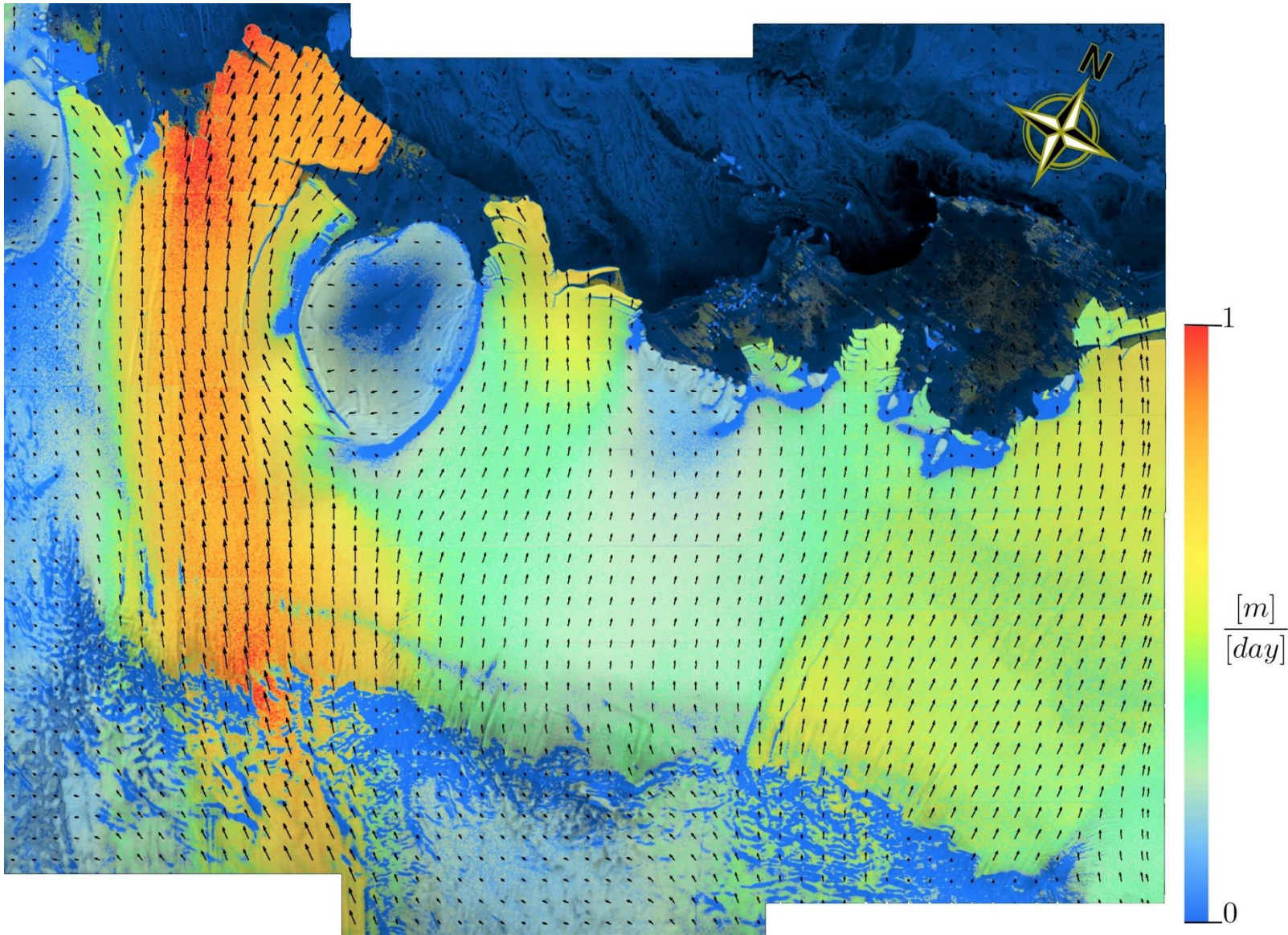
SAR remote sensing provide a range of tools that are useful for understanding the dynamics of ice shelves



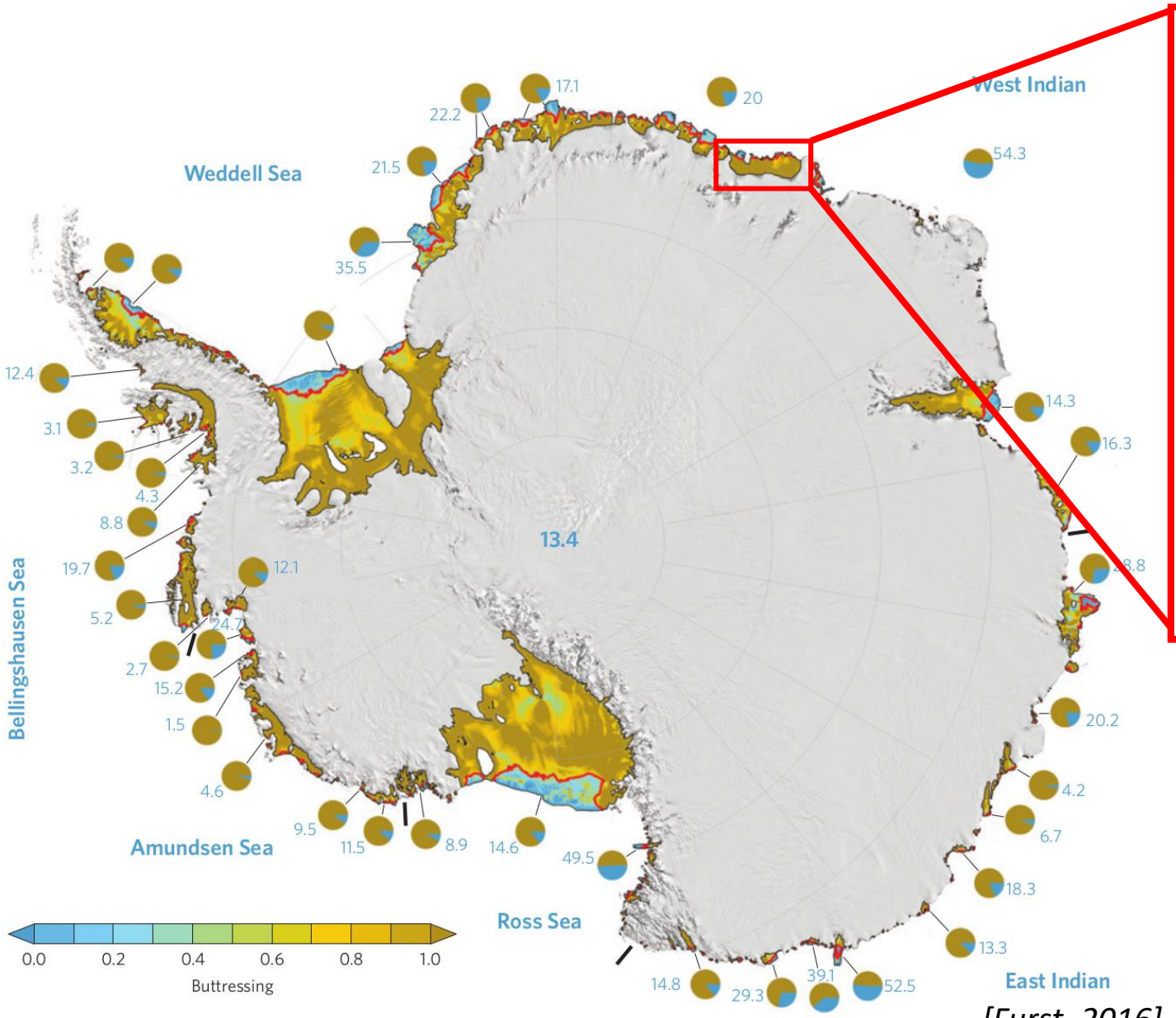
[Dirscherl, 2019]

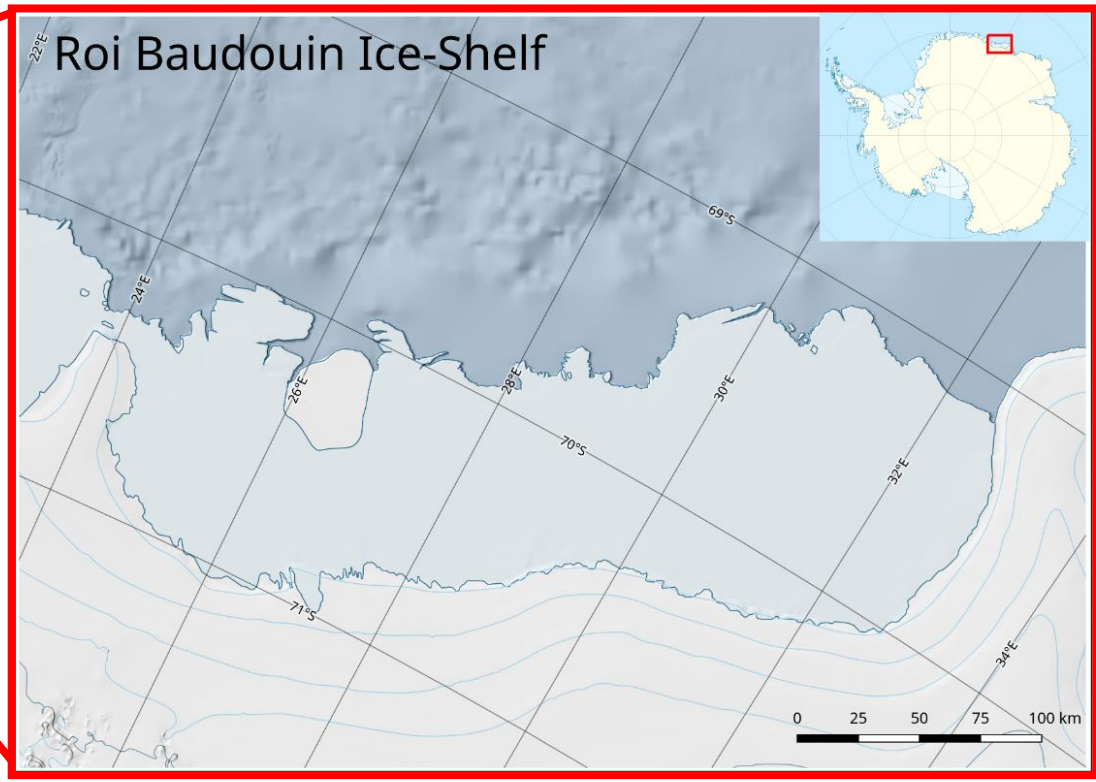



Melt
estimates
Crack
Propagation
Calving
Front
Grounding
line
Velocity
2/3D
Divergence
fields
Strain
rates


N
1
0
$\frac{[m]}{[day]}$

We applied the technique in Dronning Maud Land (300 meters/year), East Antarctica

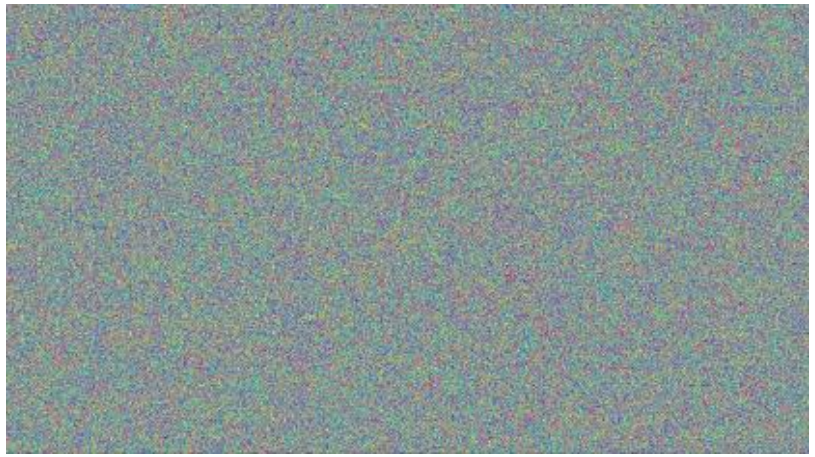




[Furst, 2016]

By subtracting the phase of 2 SAR images, we make an interferogram. DInSAR consists in retrieving the displacement

PHASE MASTER



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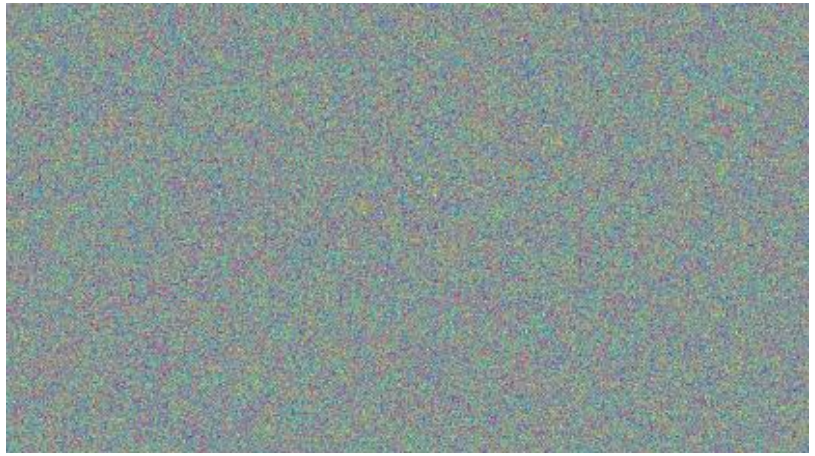
PHASE SLAVE



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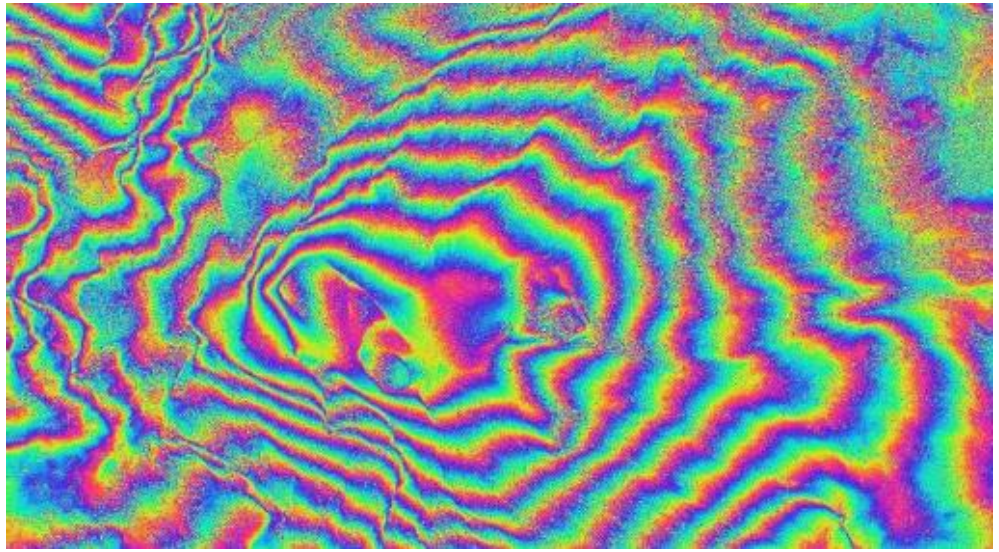
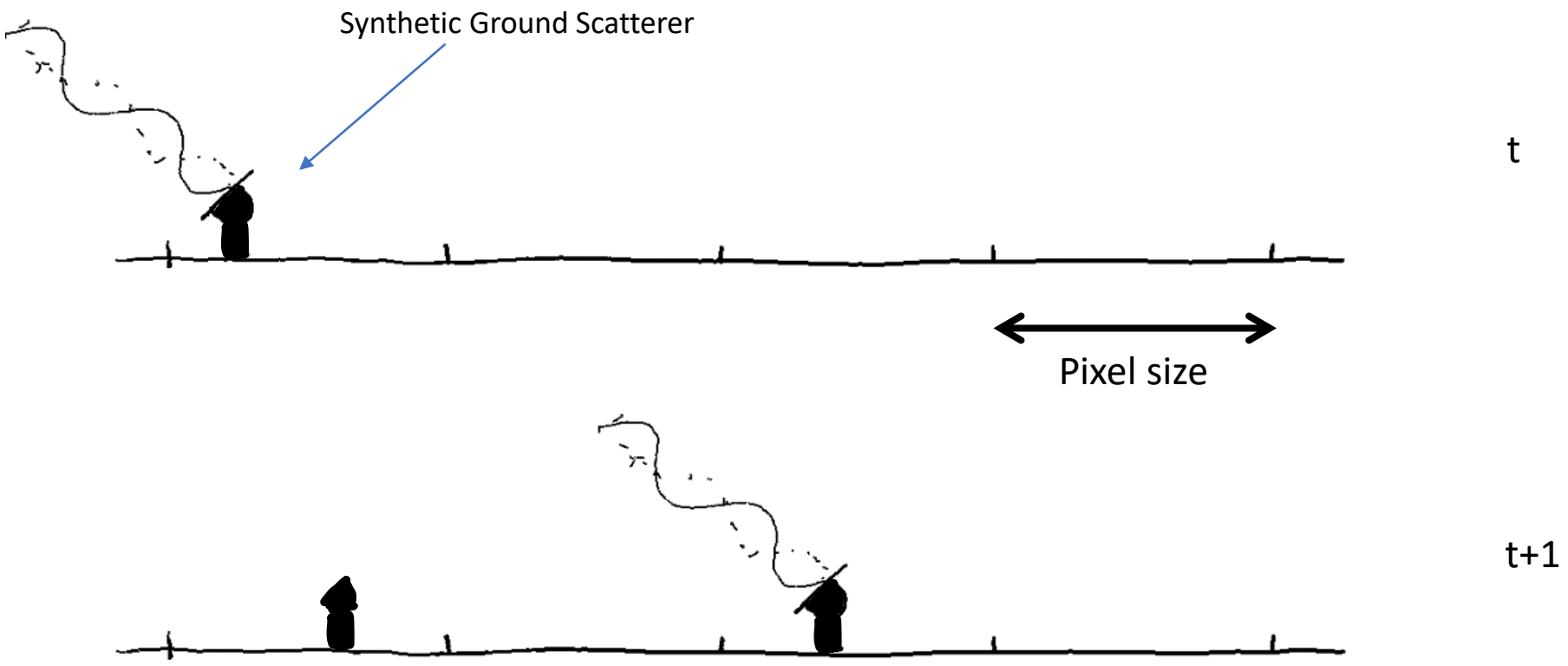


$$\varphi_{intf}$$

$$= \varphi_{orb} + \varphi_{topo} + \varphi_{atm} + \varphi_{mvt}$$

[TanDEM-X – Copahue volcano, i.e.]

While fast moving ice-shelves decorrelate the signal because scatterers are “lost”, coherence tracking attempts to retrieve these scatterers

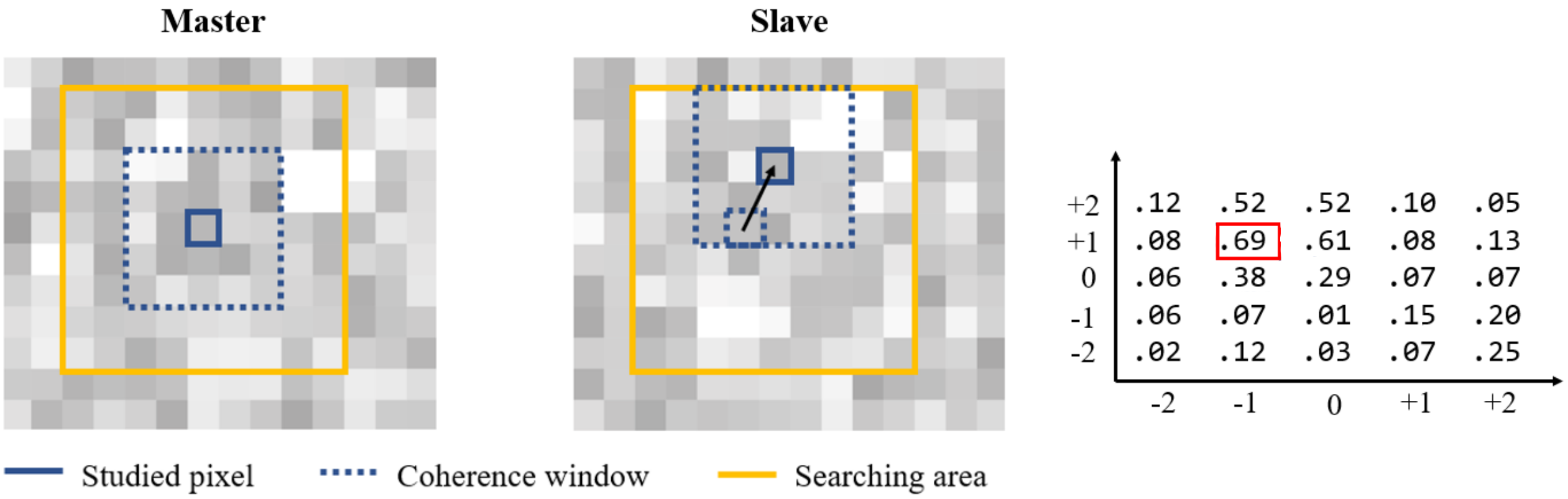


Coherence tracking is a coherent speckle tracking technique used to recover fast-moving induced coherence loss, and to estimate 2D displacements

$$(i,j) = \arg\max_{(i,j)} \{\hat{\gamma}(s_1(x,y), s_2(x+i, y+j))\}$$

$$\hat{\gamma}(s_1(x,y), s_2(x,y)) = \frac{\sum_{(x,y)\in n} s_1(x,y) \cdot s_2^*(x,y)}{\sqrt{\sum_{(x,y)\in n} |s_1(x,y)|^2 \cdot \sum_{(x,y)\in n} |s_2(x,y)|^2}}$$

The goal of coherence tracking is to find where scatterers moved by locally performing fine coregistration using coherence maximization criteria

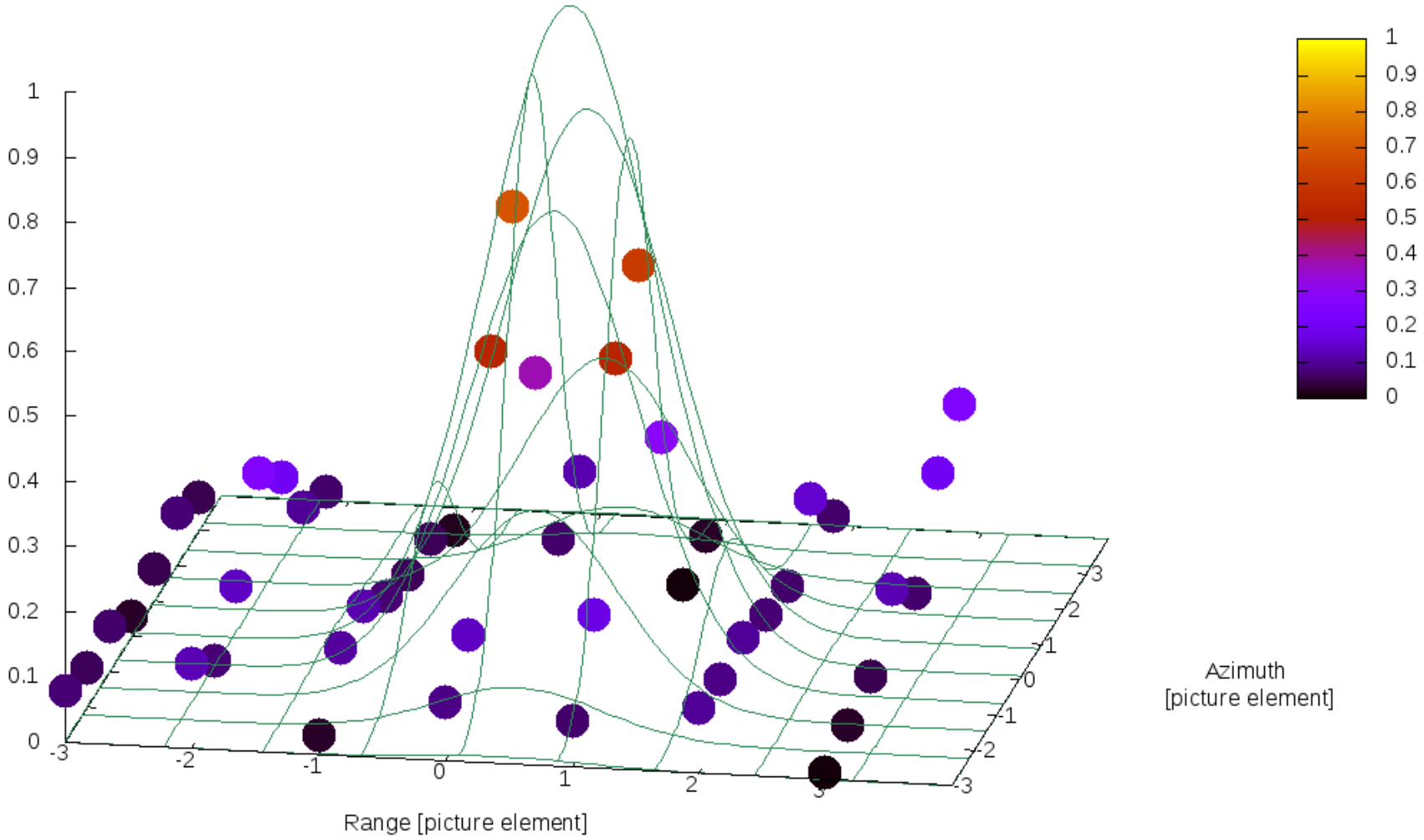


It is possible to *a priori* oversample the image, using the chirp-Z super sampling for improved spatial resolution (here 0.46x2.8 m²)

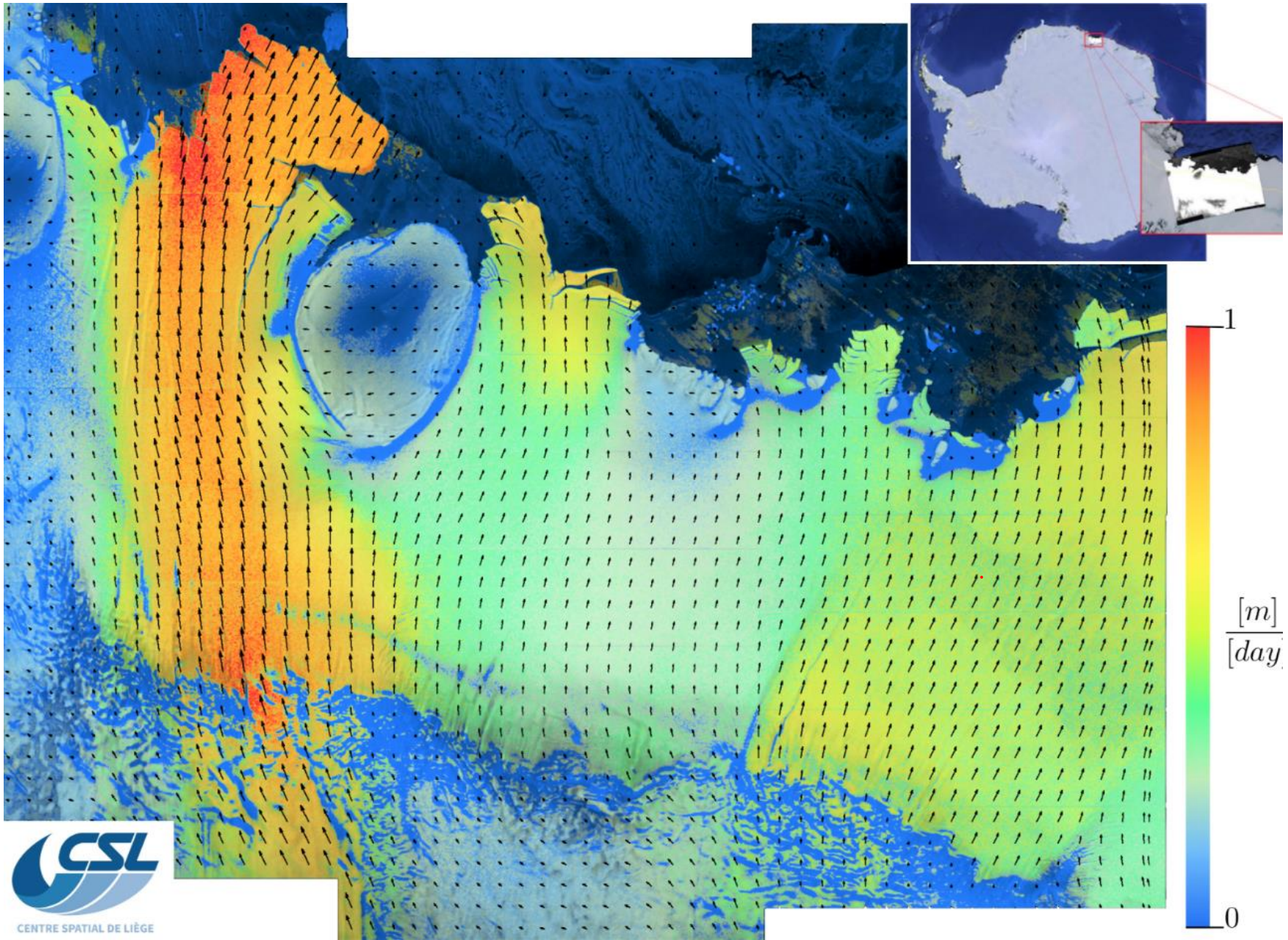
[D.Derauw, 2019]

Around the best shift candidate, we perform a Gaussian fitting using the tracked coherence at the four-connected neighbors for improved 2D displacement estimation

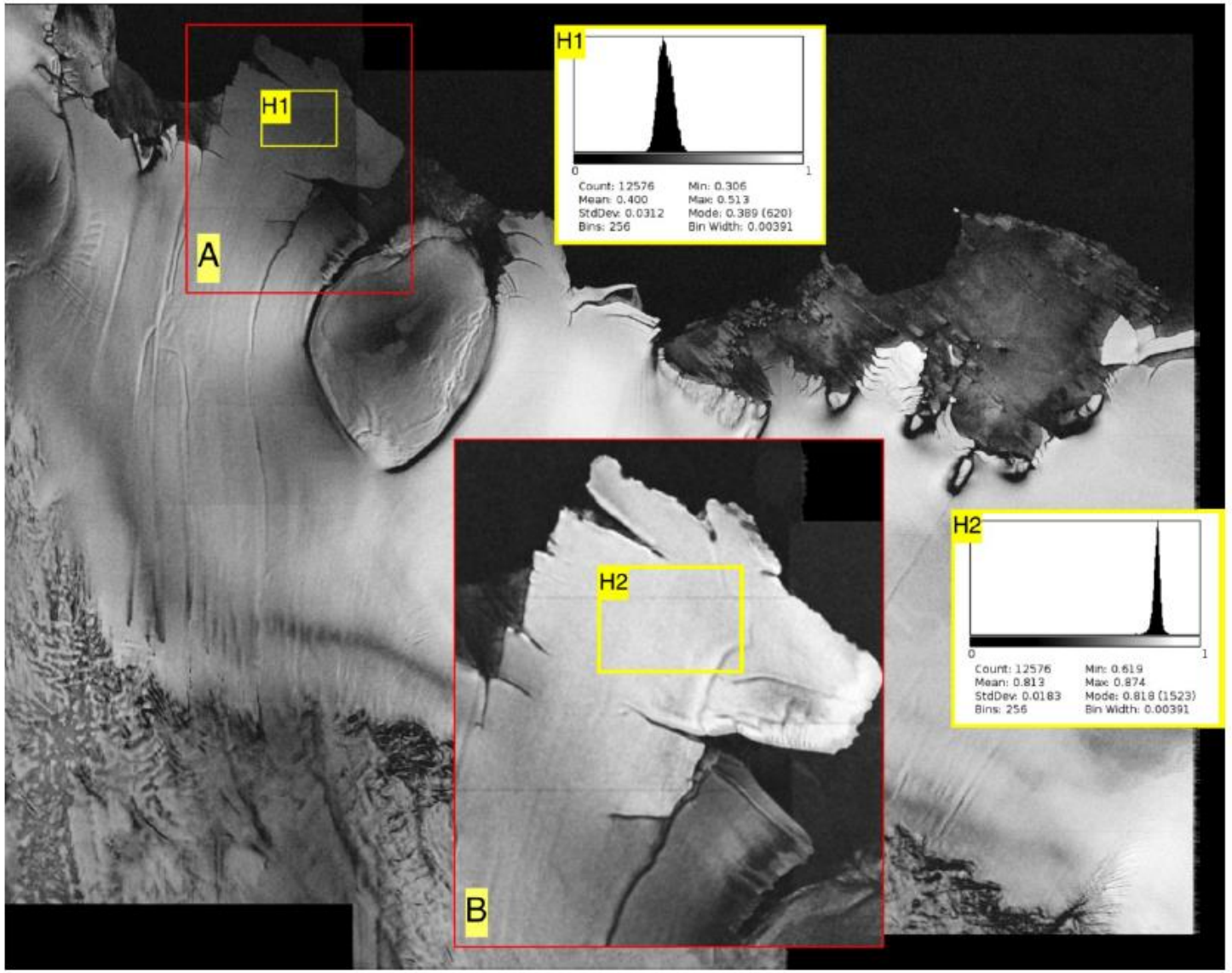
	-2	-1	0	+1	+2
+2	.12	.52	.52	.10	.05
+1	.08	.69	.61	.08	.13
0	.06	.38	.29	.07	.07
-1	.06	.07	.01	.15	.20
-2	.02	.12	.03	.07	.25



Tracking scatterers on moving areas enables to derive bi-dimensional displacement maps



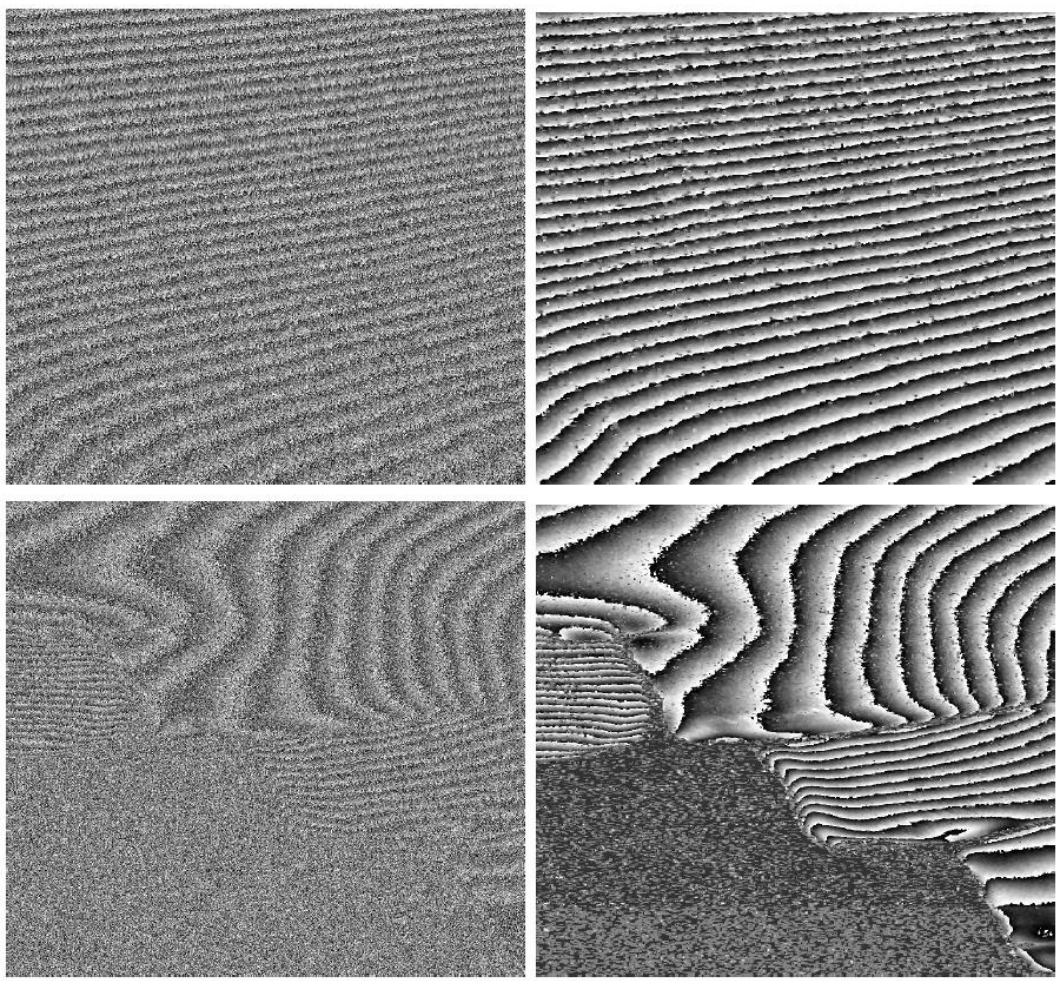
Coherence tracking on deramped SLC images is able to retrieve scatterers and correct interferograms

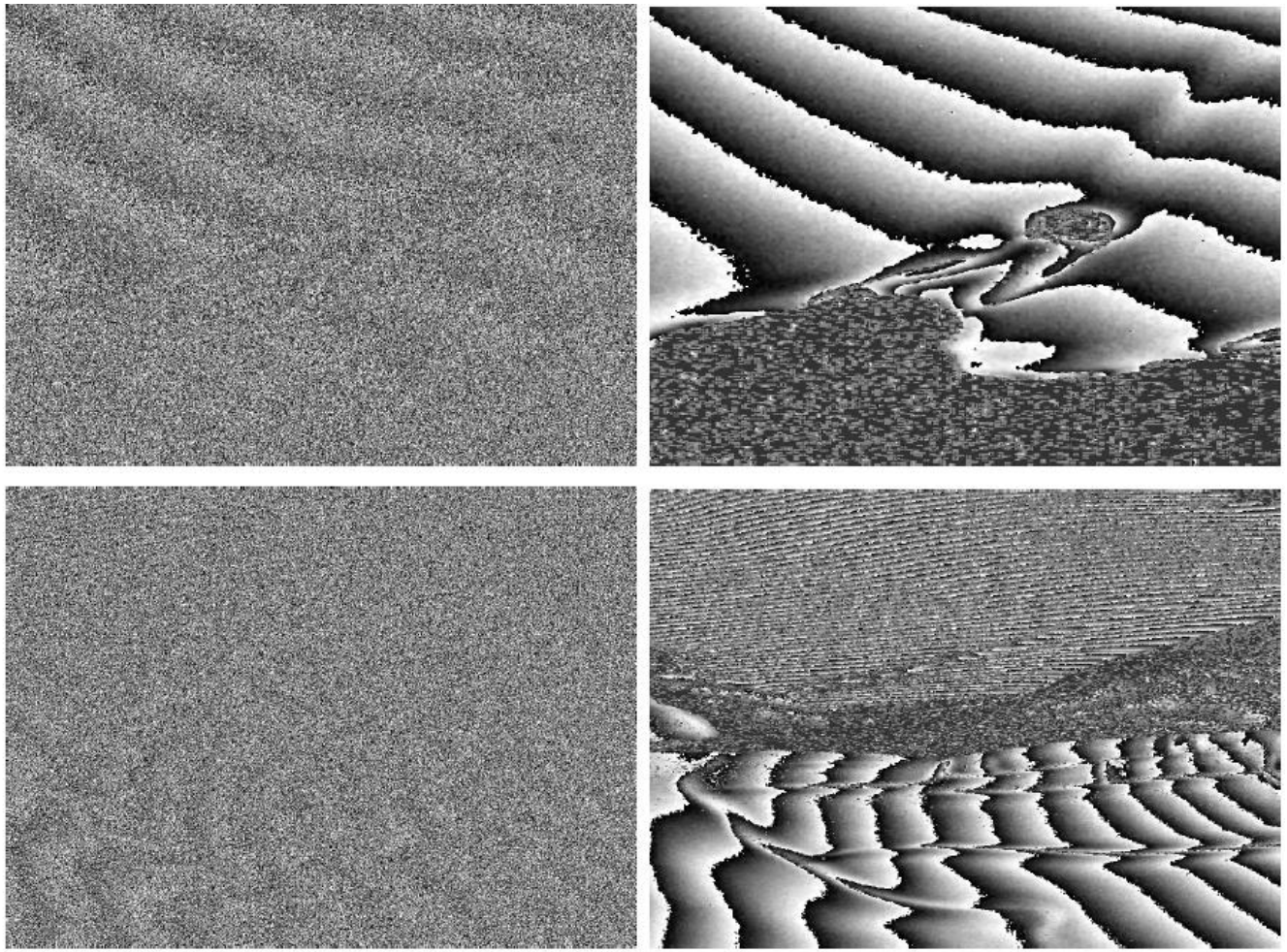


A : classical

B : tracked

Coherence tracking on deramped SLC images is able to retrieve scatterers and correct interferograms





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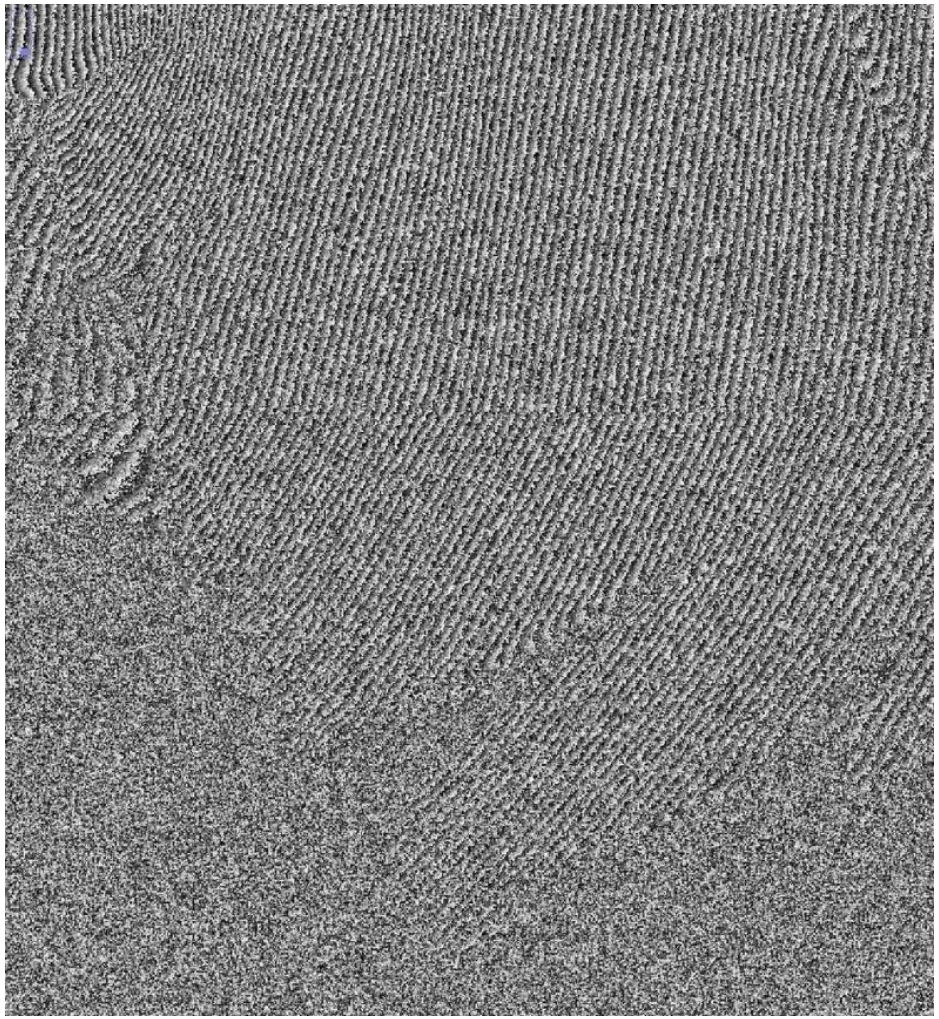
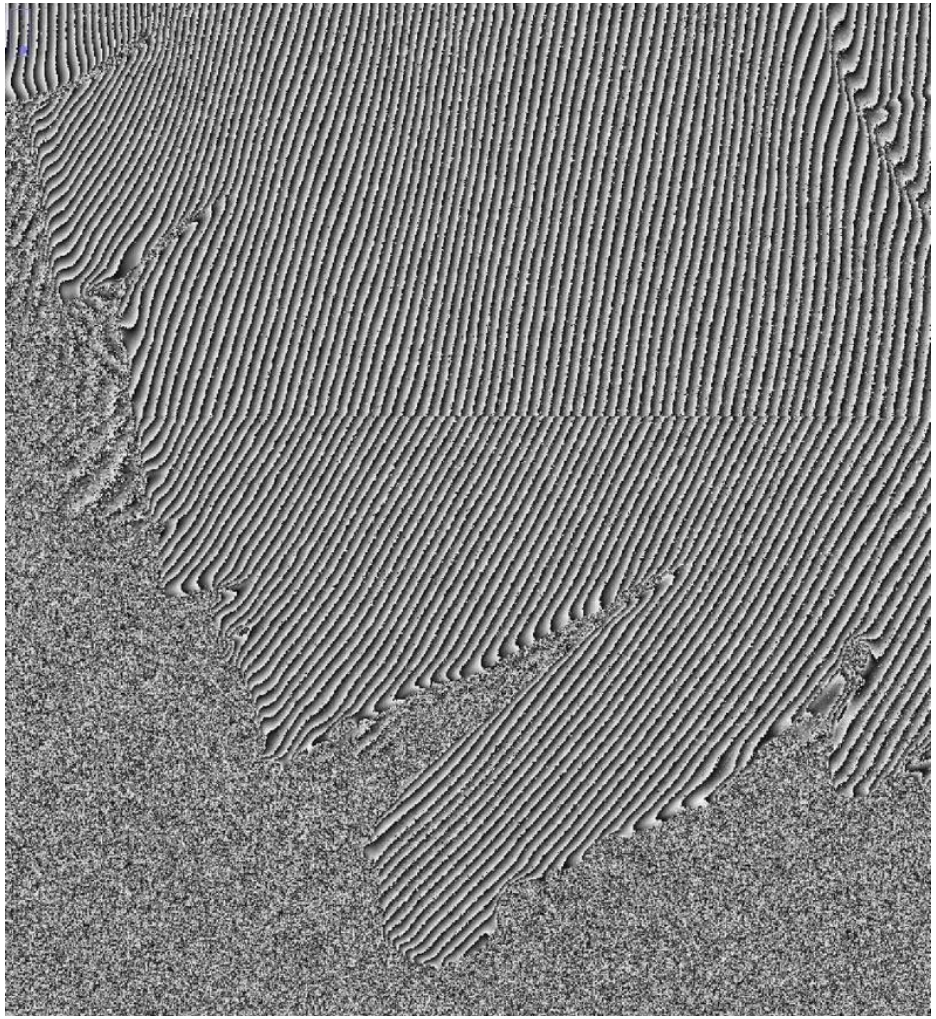
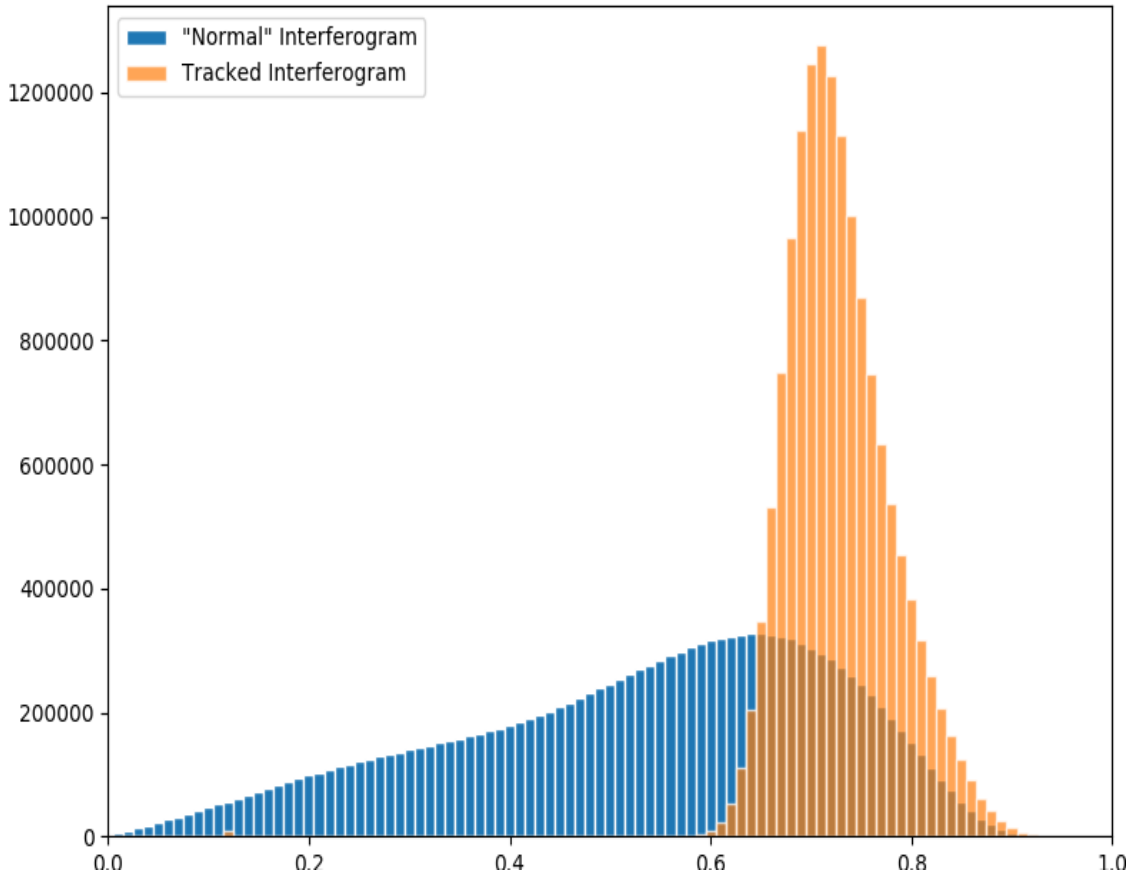
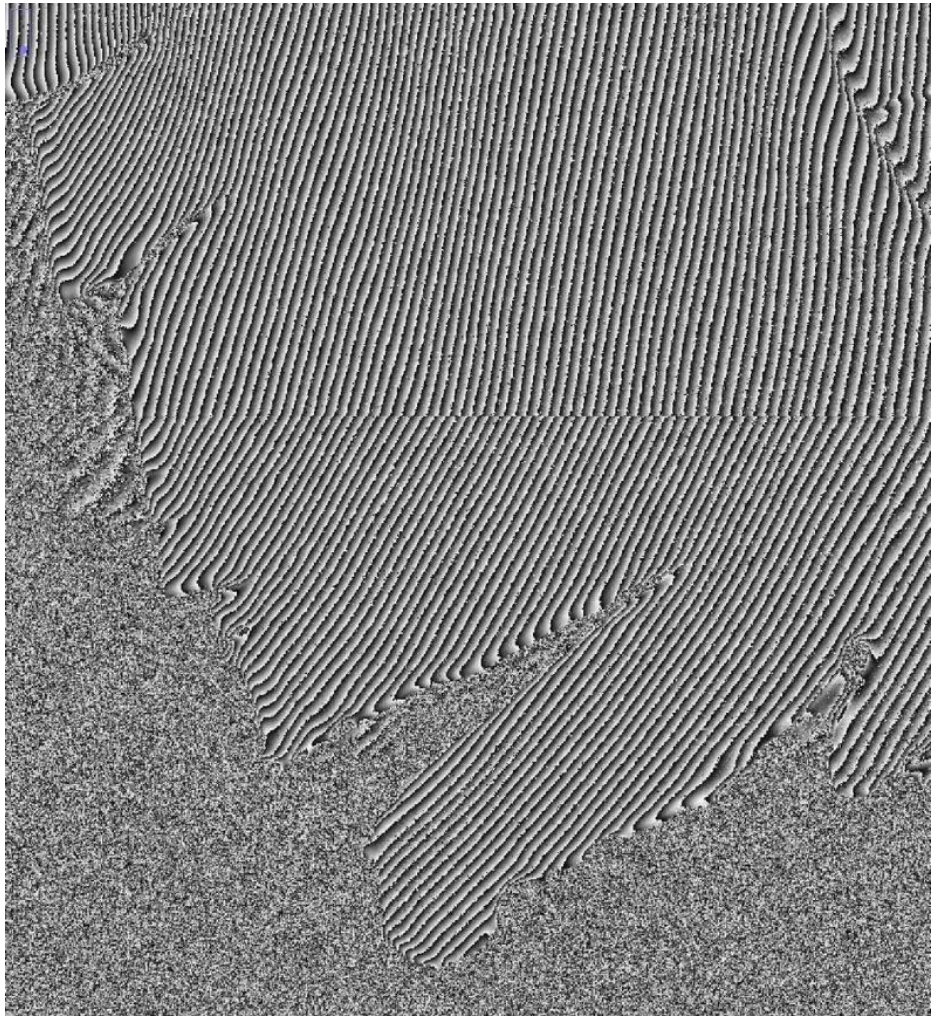


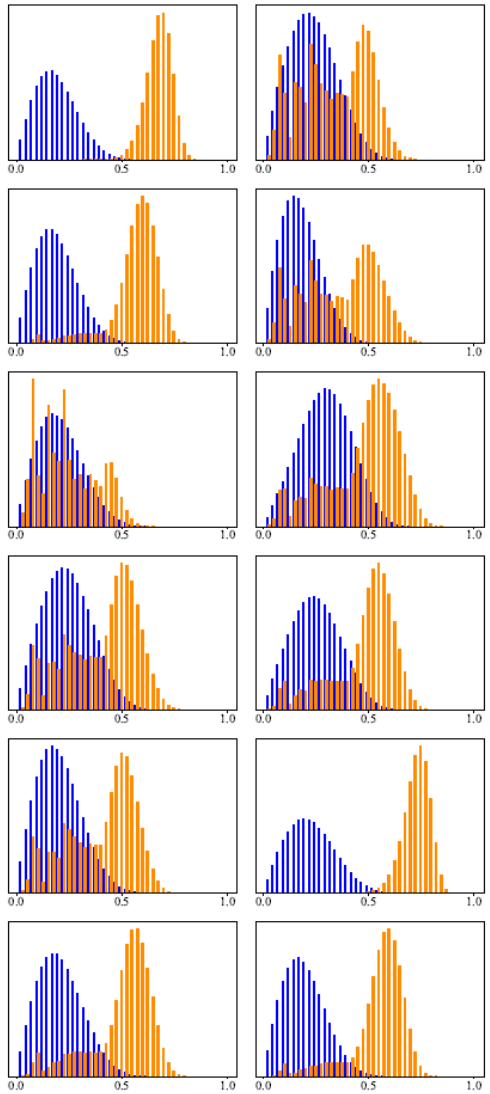


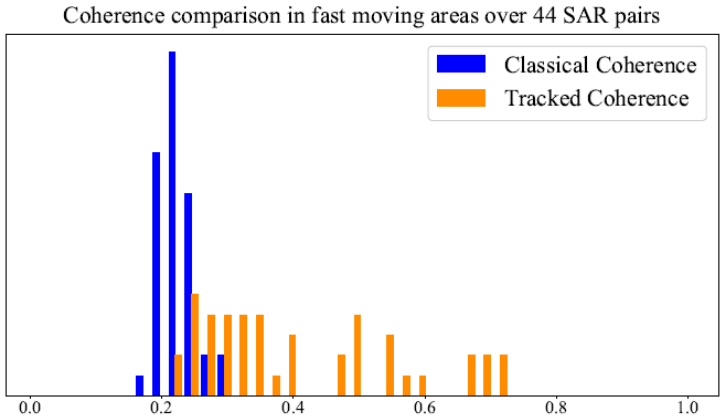
Coherence gain is witness of the strong improvement brought by coherence tracking

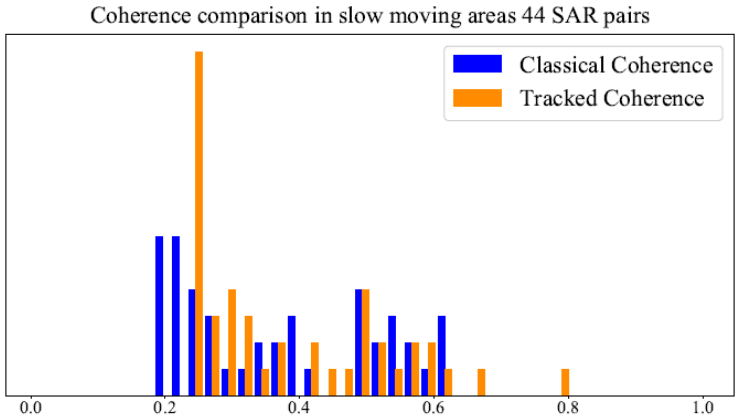




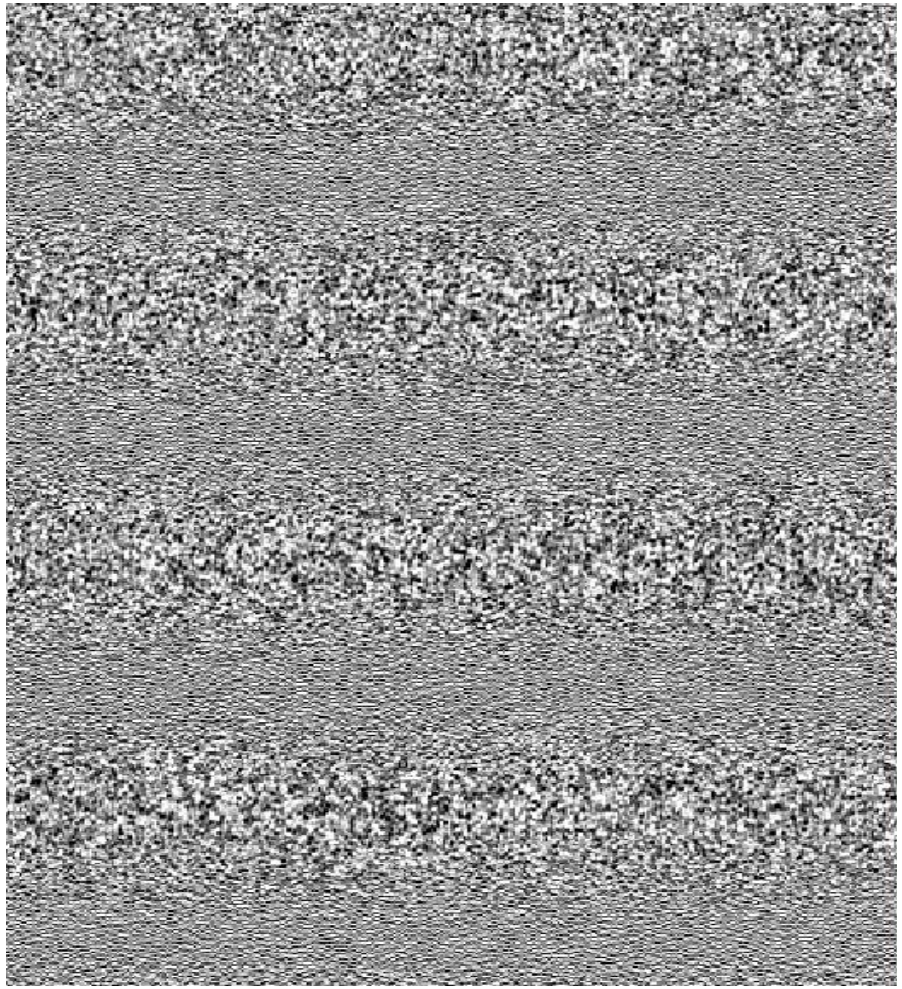
We applied coherence tracking over longer time period and observe the coherence gain brought by coherence tracking

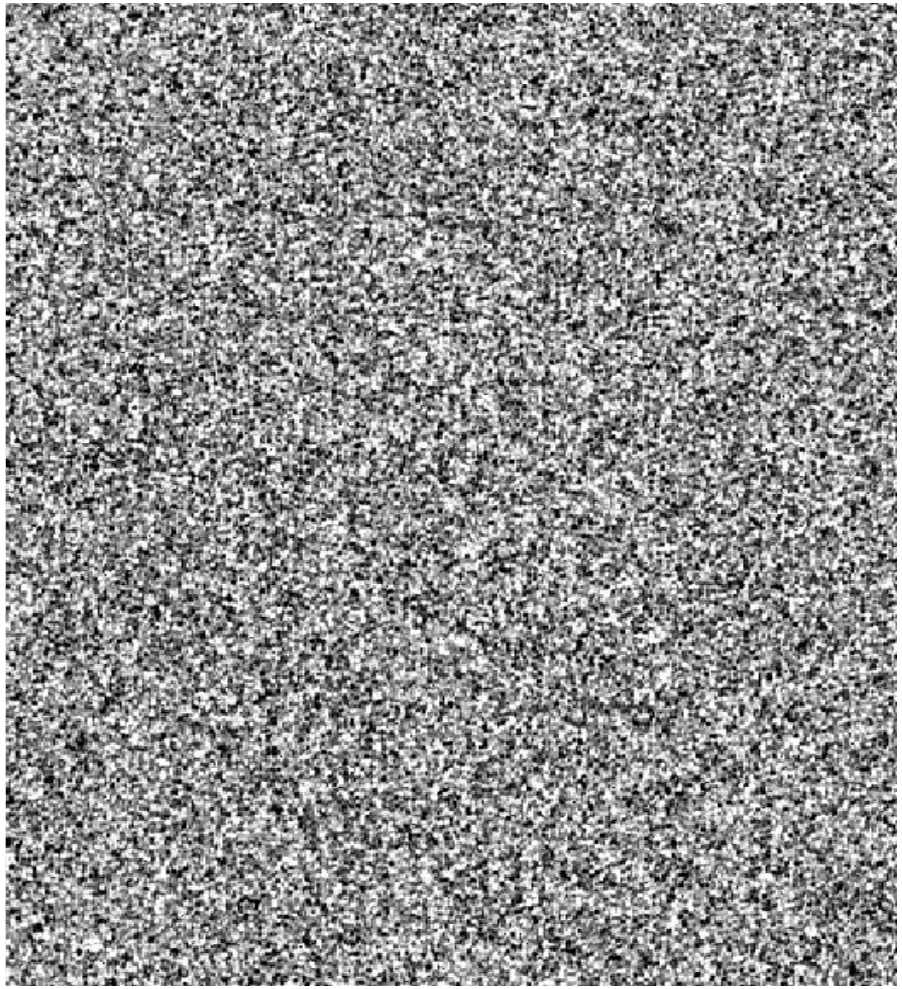






TOPSAR brings an azimuthal phase ramp to be corrected with very high accuracy to remove bias in coherence tracking measurements





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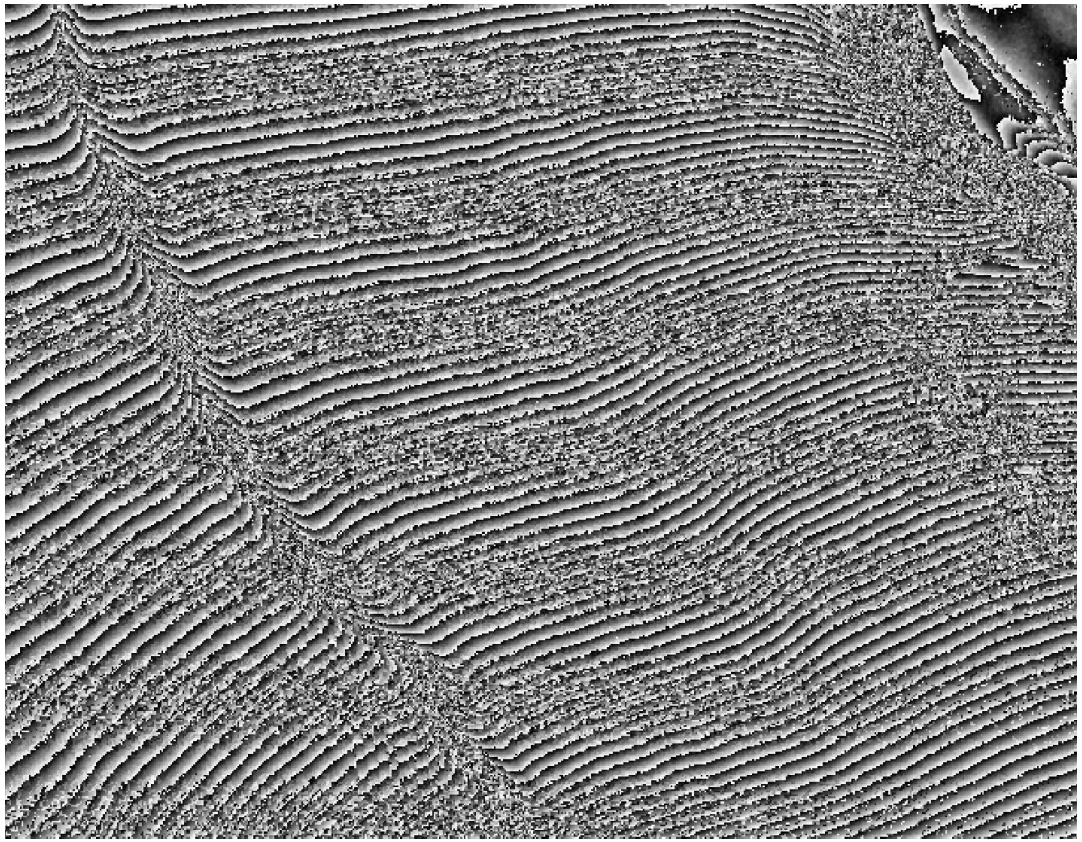
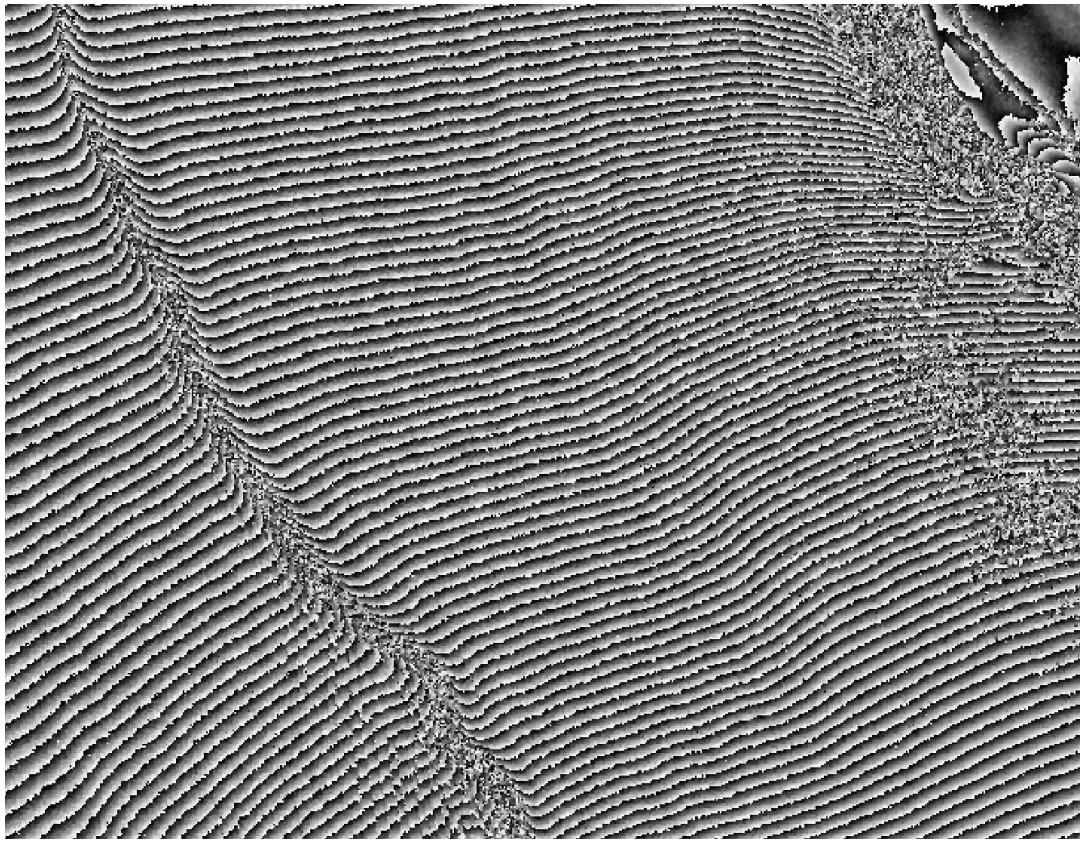
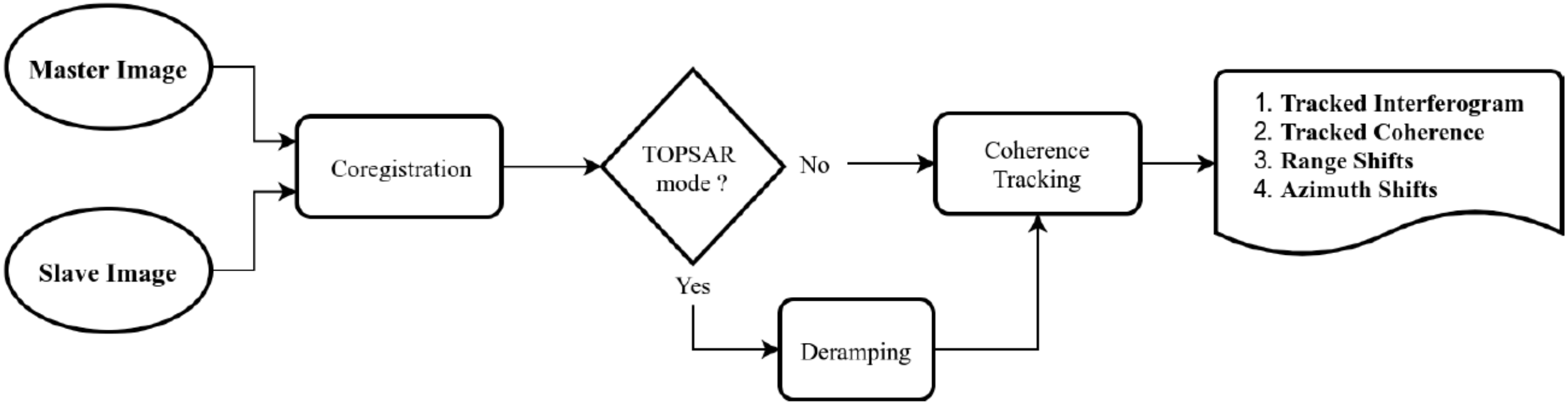




Four main products are generated: the tracked coherence, the tracked interferogram, the range local displacements, the azimuth local displacements



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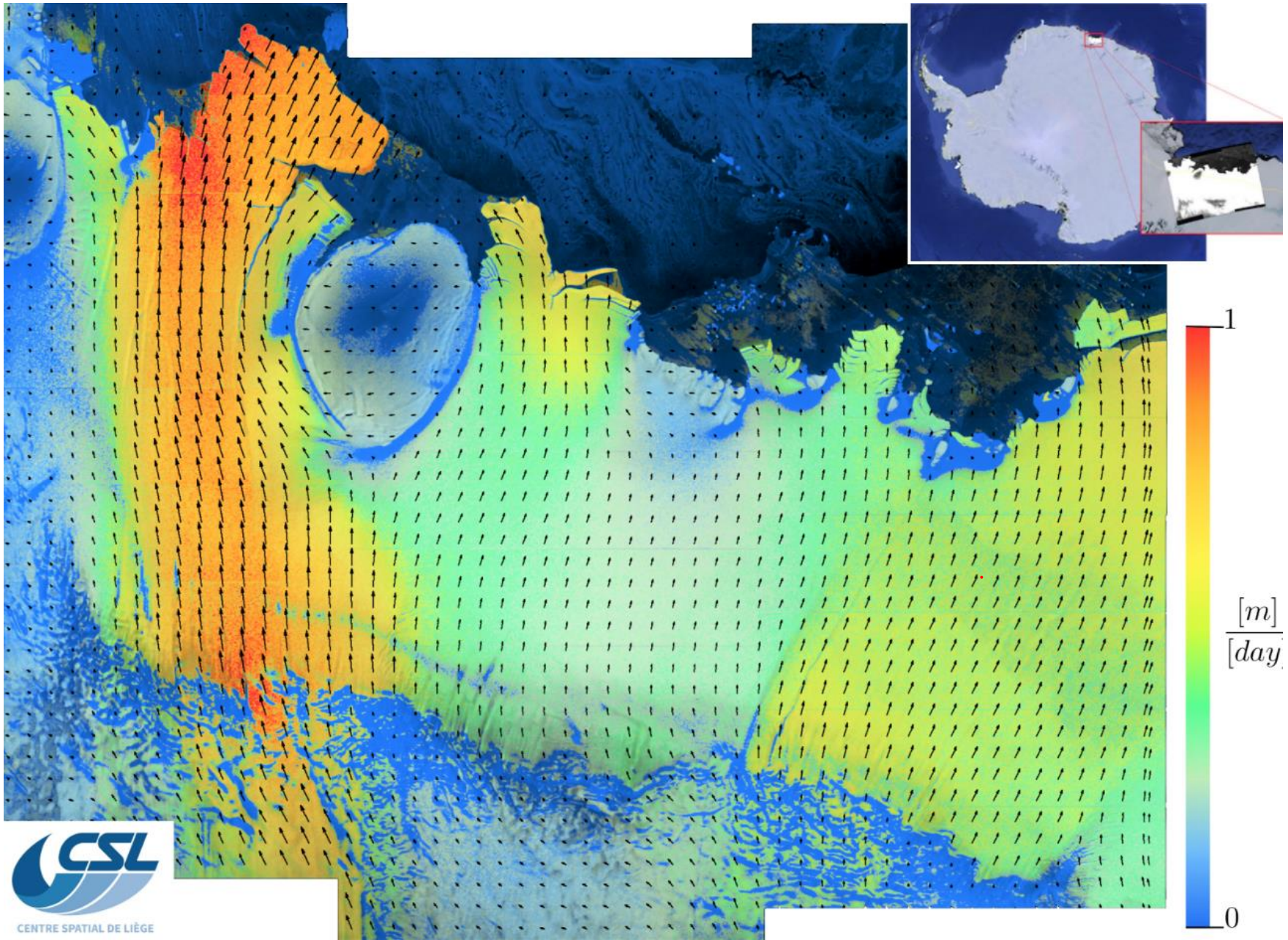

Thank you very much for your attention,

Cheers,

Quentin Glaude