

Spatio-temporal evaluation of rock glacier activity in the semi-arid Andes using optical and radar satellite imagery

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Thomas ECHELARD, PACTE, UGA, France

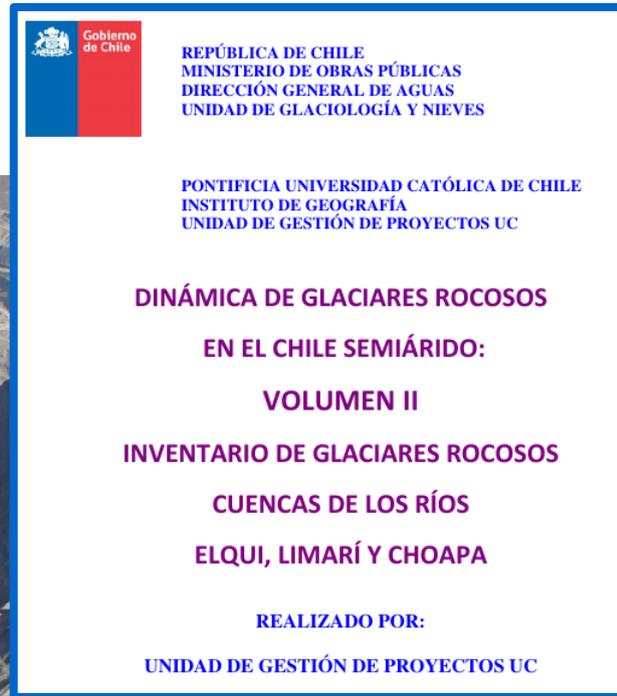
Pierre PITTE, IANIGLA, CONICET, Argentina

General aspects | Societal issues



Photo : A. Brenning , 2012

General aspects | Societal issues



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UNIDAD DE GLACIOLOGÍA Y NIEVES

PONTIFICIA UNIVERSIDAD CATÓLICA DE CHILE
INSTITUTO DE GEOGRAFÍA
UNIDAD DE GESTIÓN DE PROYECTOS UC

DINÁMICA DE GLACIARES ROCOSOS
EN EL CHILE SEMIÁRIDO:
VOLUMEN II
INVENTARIO DE GLACIARES ROCOSOS
CUENCAS DE LOS RÍOS
ELQUI, LIMARÍ Y CHOAPA

REALIZADO POR:
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Photo : A. Brenning , 2012



IANIGLA

CONICET
U. N. C U Y O
GOBIERNO
DE MENDOZA

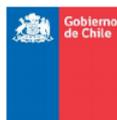
**Inventario Nacional
de Glaciares**

Cuenca del río Mendoza
Subcuencas de los ríos
Blancos y del Cordón del
Plata
Provincia de Mendoza

 **Secretaría
de Ambiente
y Desarrollo
Sustentable
de la Nación**

Fecha de elaboración: Octubre 2012

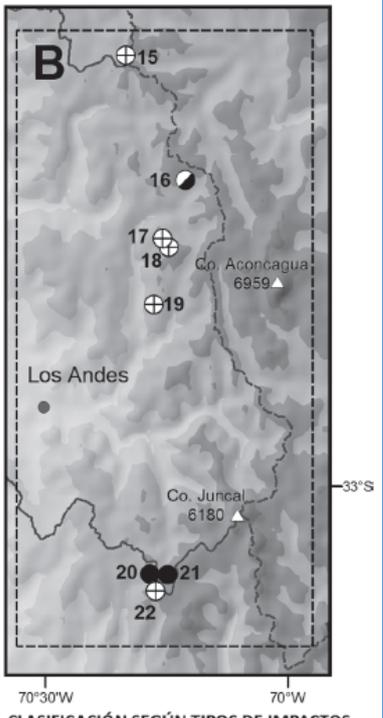
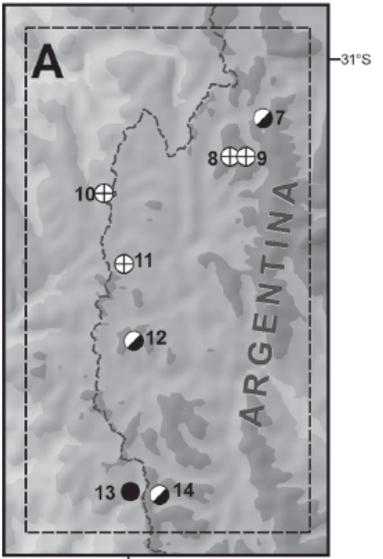
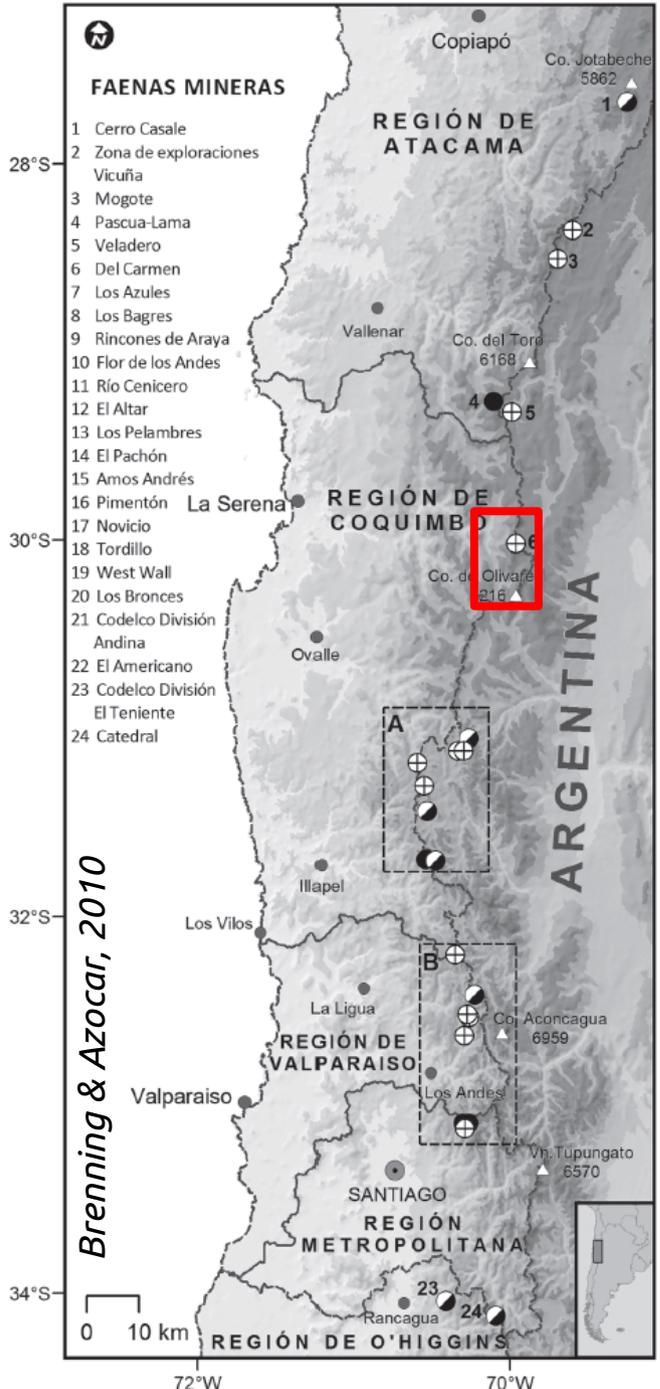
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CLASIFICACIÓN SEGÚN TIPOS DE IMPACTOS:

- Fuerte (depósito de lastre o remoción)
- ⊙ Menor (caminos)
- ⊕ Potencial impacto futuro




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U. N. CUYO
GOBIERNO DE MENDOZA

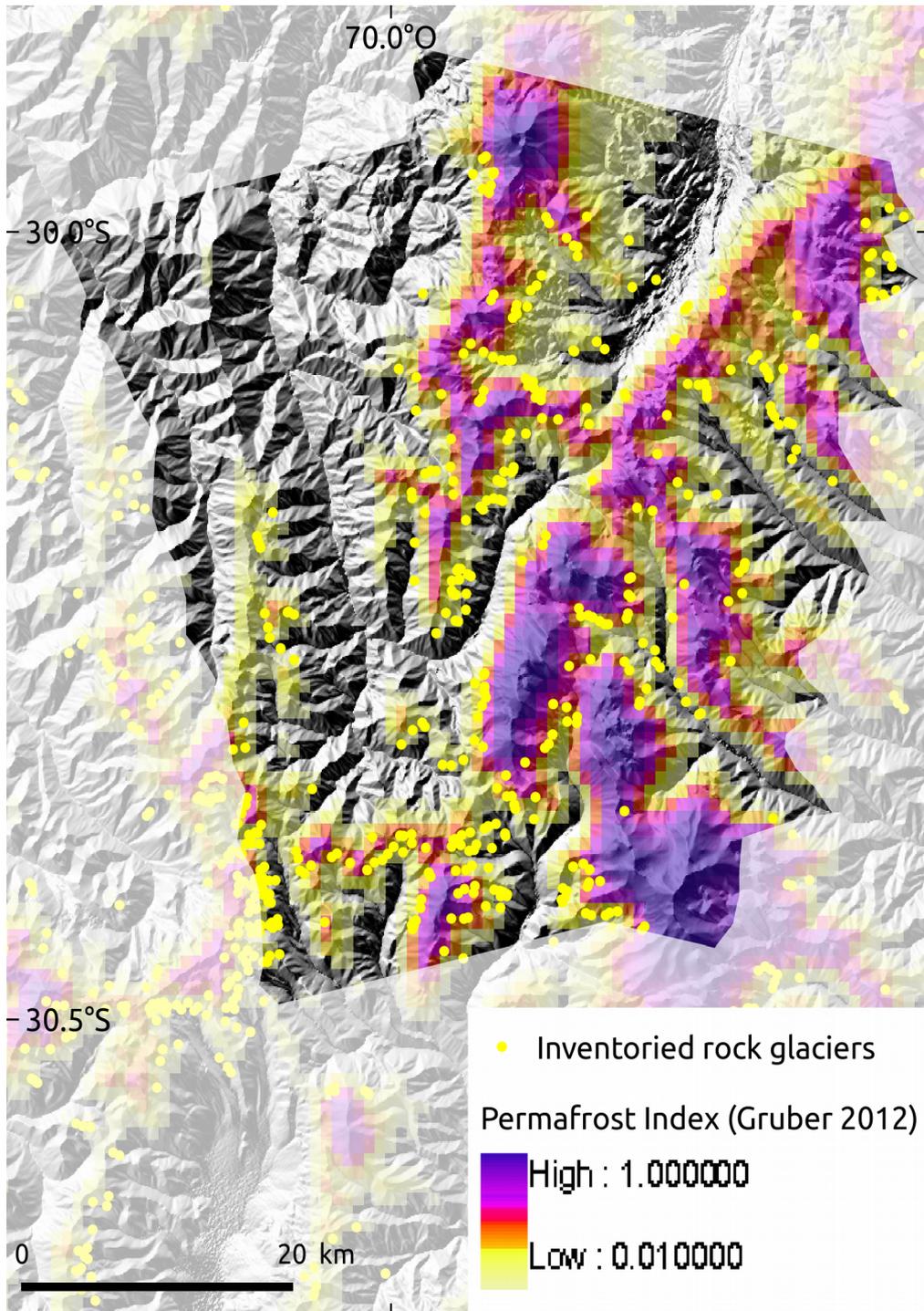
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General aspects | Study area & datasets



Semi-arid Andes of Chile and Argentina
Mean elev. = 4300 m asl

371 rock glaciers in the study area
266 in Arg.
105 in Ch.

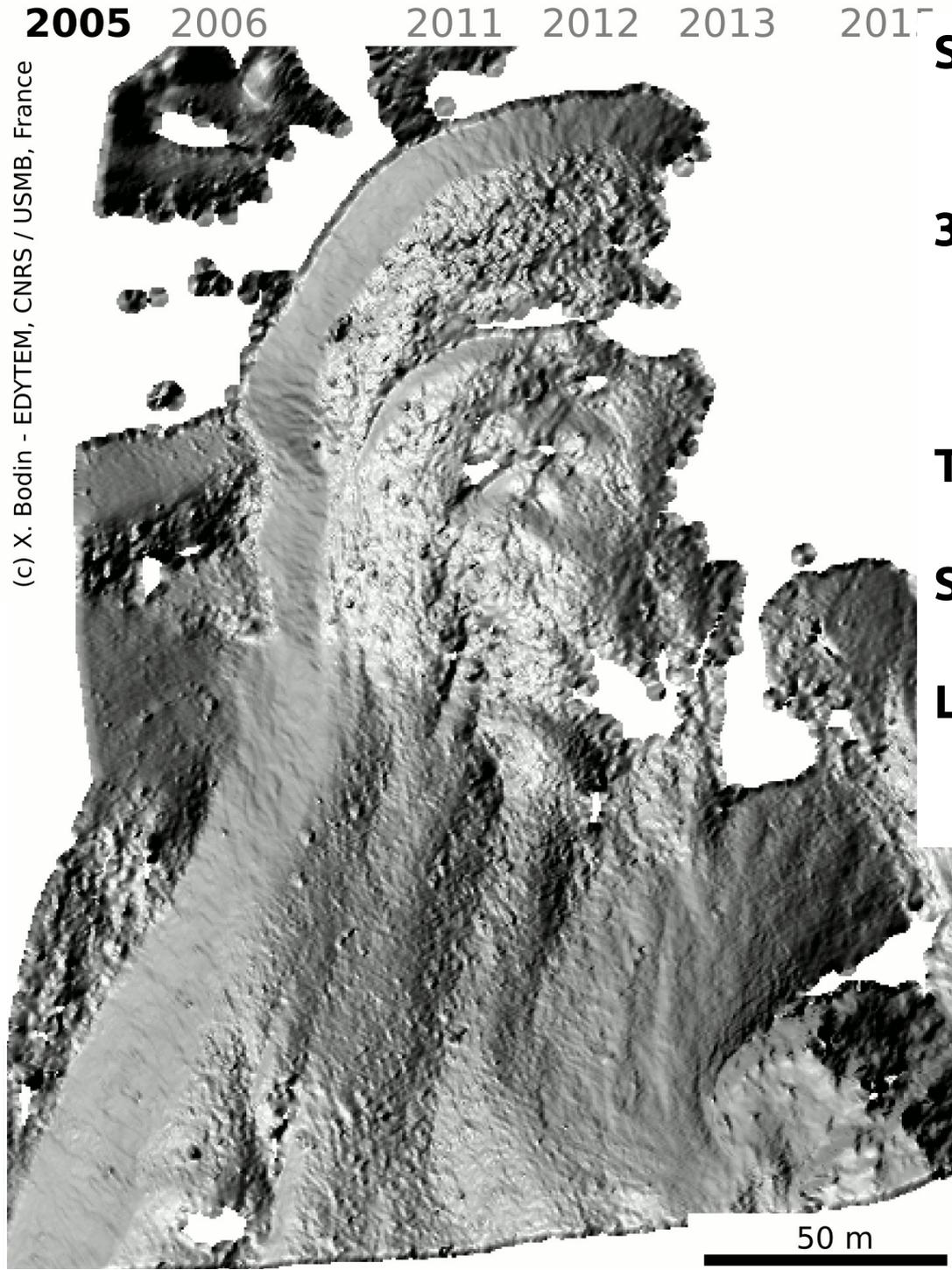
TSX images from 2014-2015

Sentinel-1 images from 2015-2017

Landsat images from 2013 to 2018

General aspects | Study area & datasets

(c) X. Bodin - EDYTEM, CNRS / USMB, France



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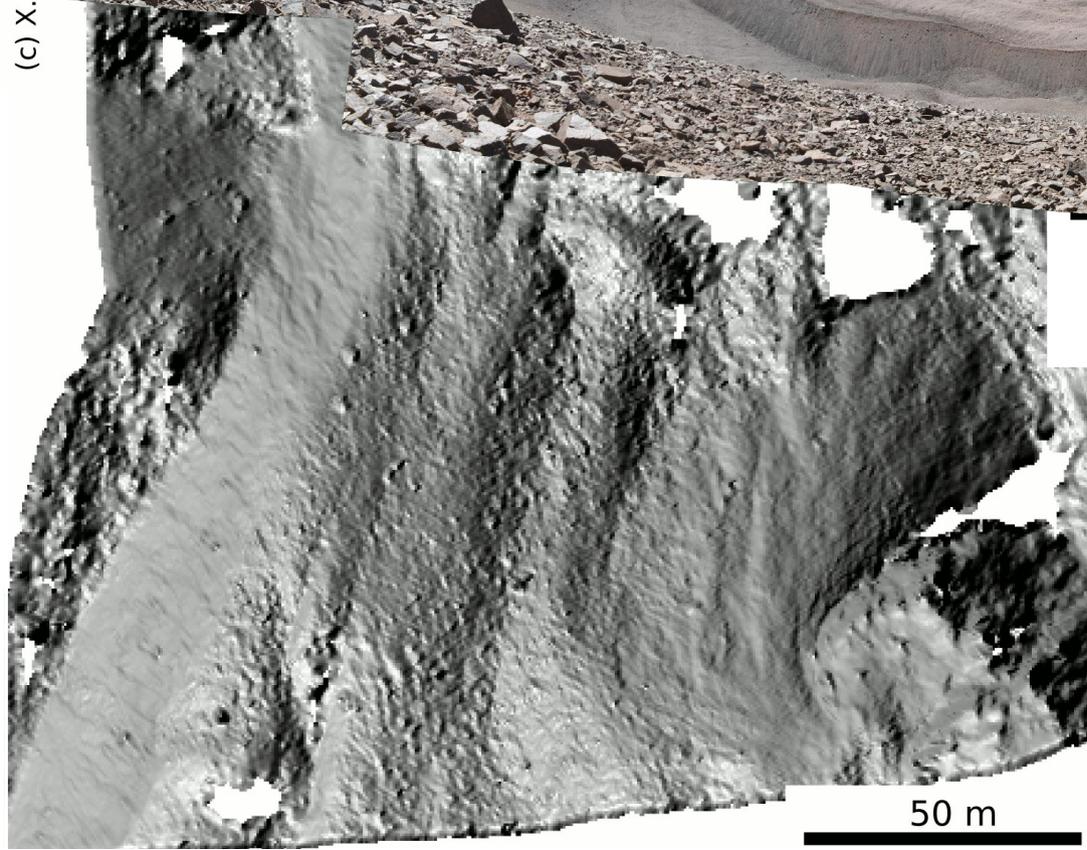
El paso rock glacier

2017

Semi-arid Andes of Chile and Argentina
Mean elev. = 4300 m asl



(c) X



50 m

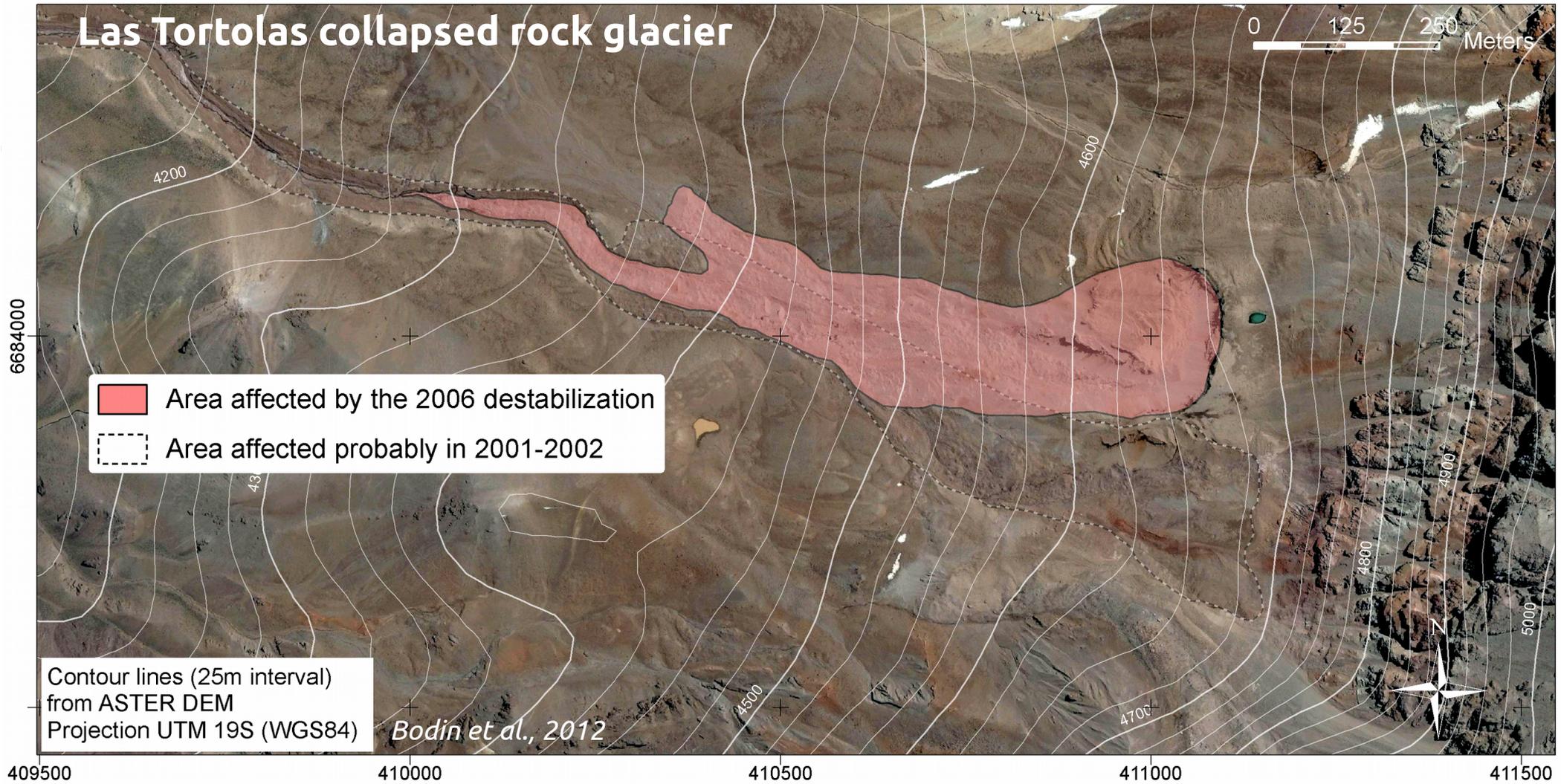
General aspects | Study area & datasets



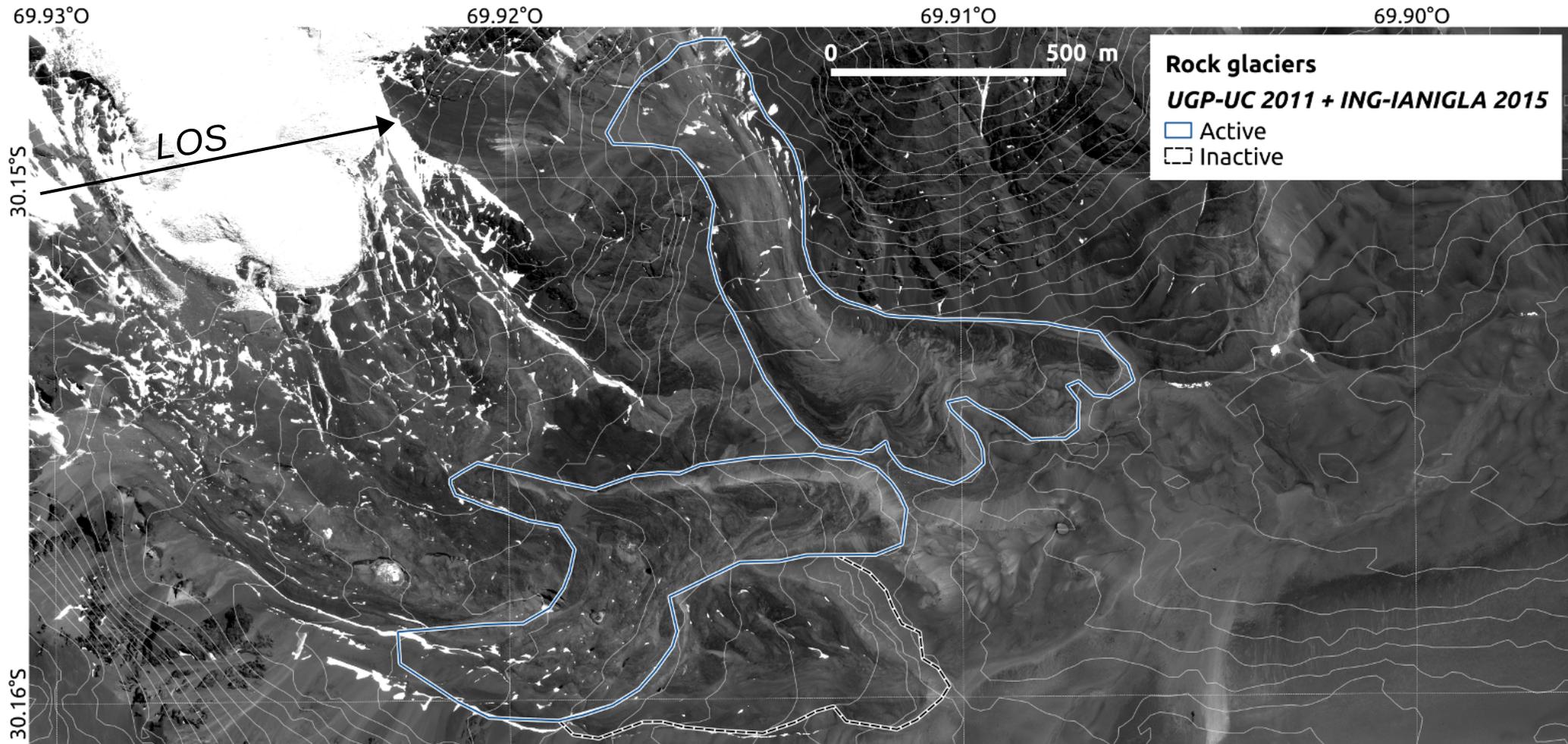
2017

Semi-arid Andes of Chile and Argentina
Mean elev. = 4300 m asl

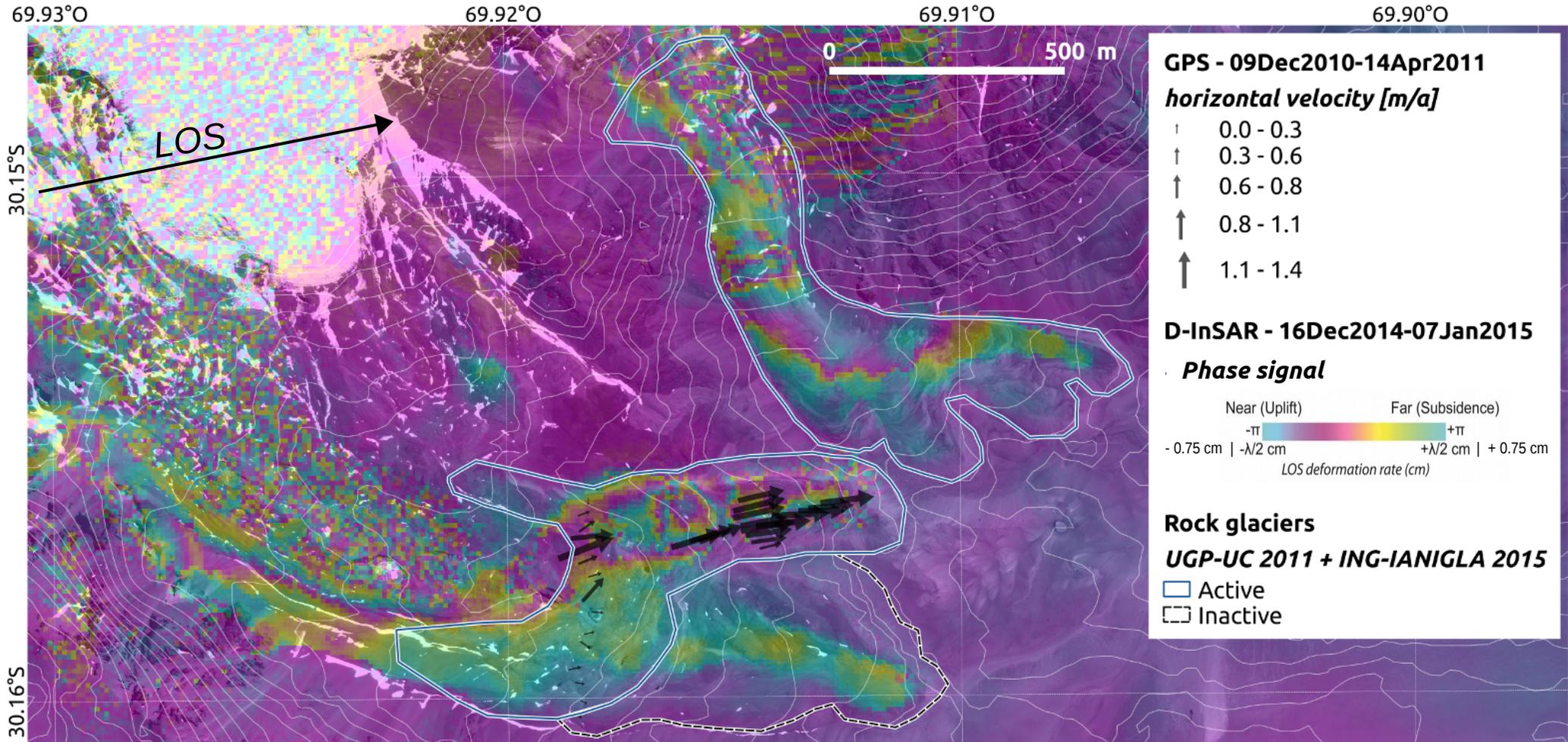
Las Tortolas collapsed rock glacier



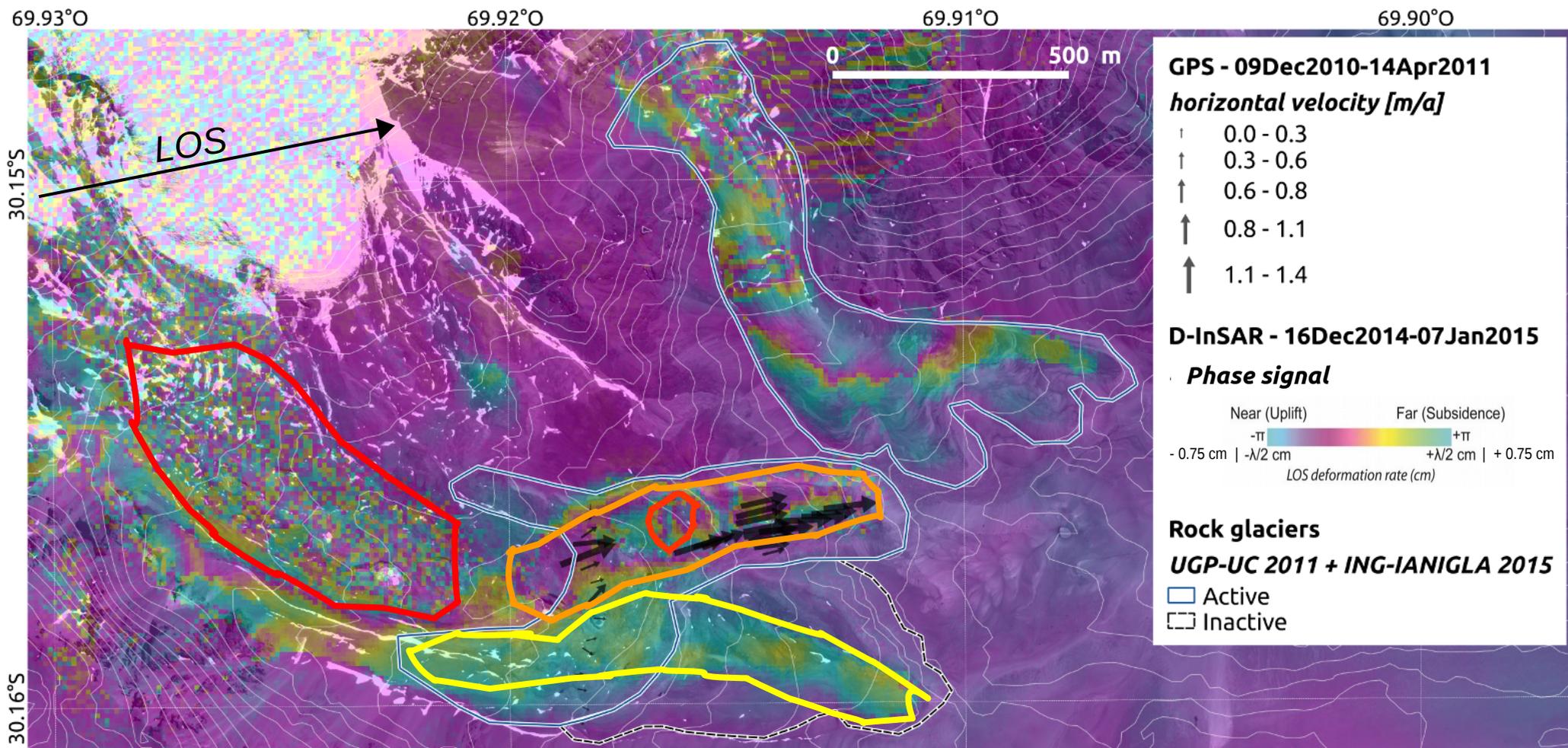
Methods | Detecting movement with d-InSAR



Methods | Detecting movement with d-InSAR

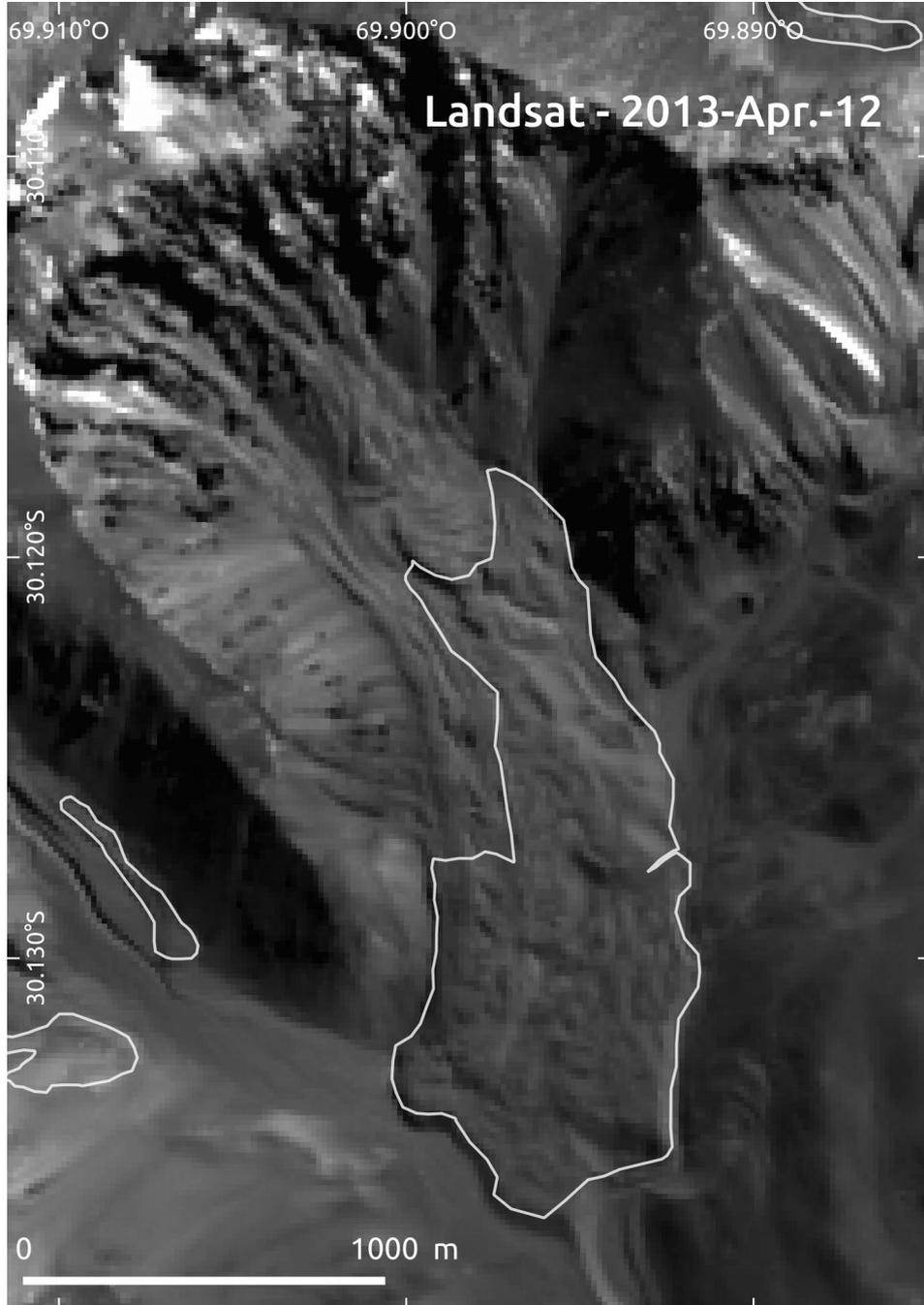


Methods | Detecting movement with d-InSAR

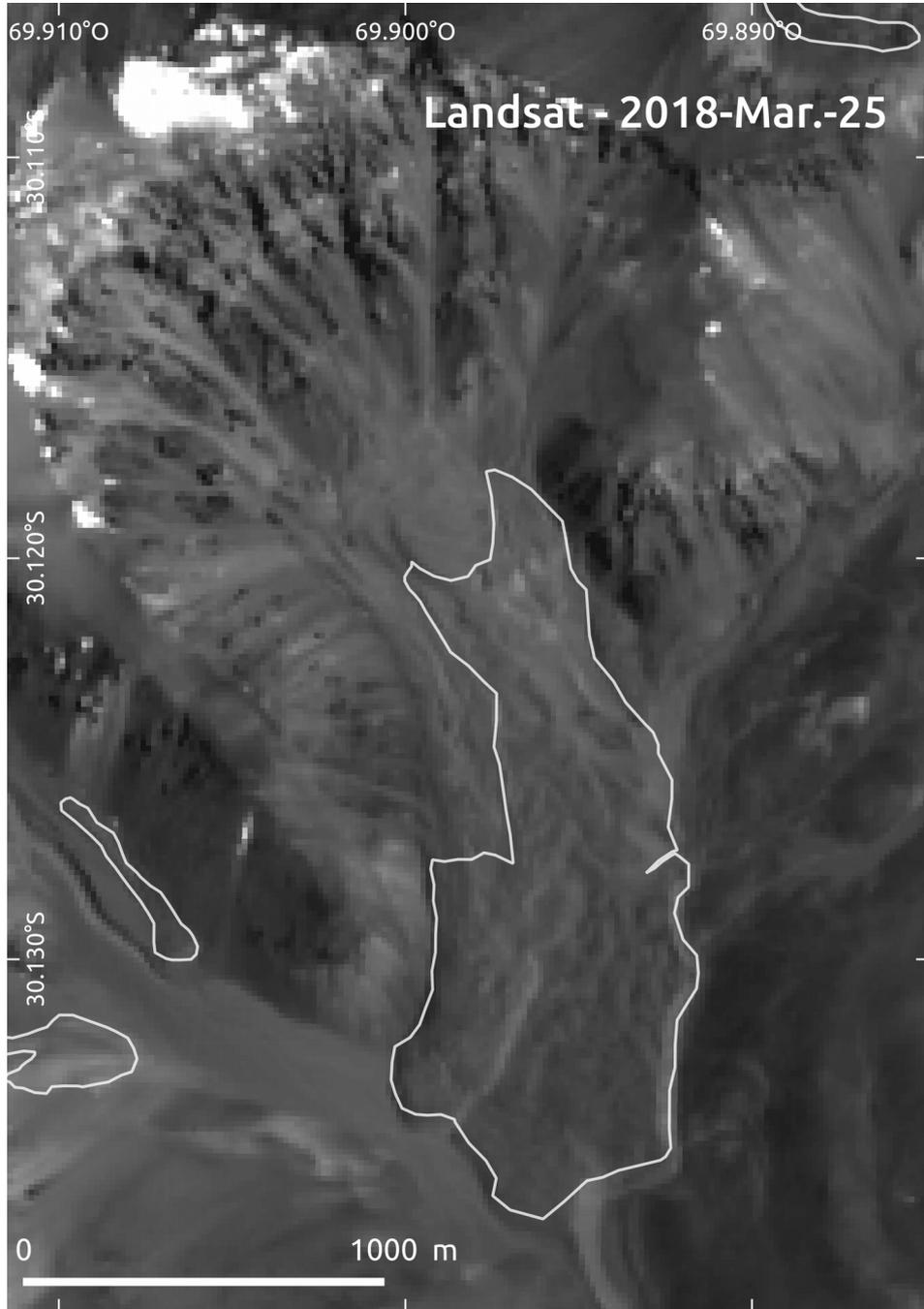


Classification <i>(estimated surface velocity)</i>	Class	TSX InSAR signal	Sentinel InSAR signal
< 1 cm/y	1	1 - 2 years c	1 - 2 - 3 years c
1-3 cm/y	2	1 year c/d - 2-3 months c	2 years c/d - 1 year c - (1 month c)
3-10 cm/y	3	2-3 months c/d - 1 month c	1 year c/d - 1 month c
10-30 cm/y	4	1 months c/d - 22 days c	1 month c/d - 12 days c
30-100 cm/y	5	22 days c/d - 11 days c	12 days c/d - 6 days c
> 100 cm/y	6	11 days d	6 days c/d

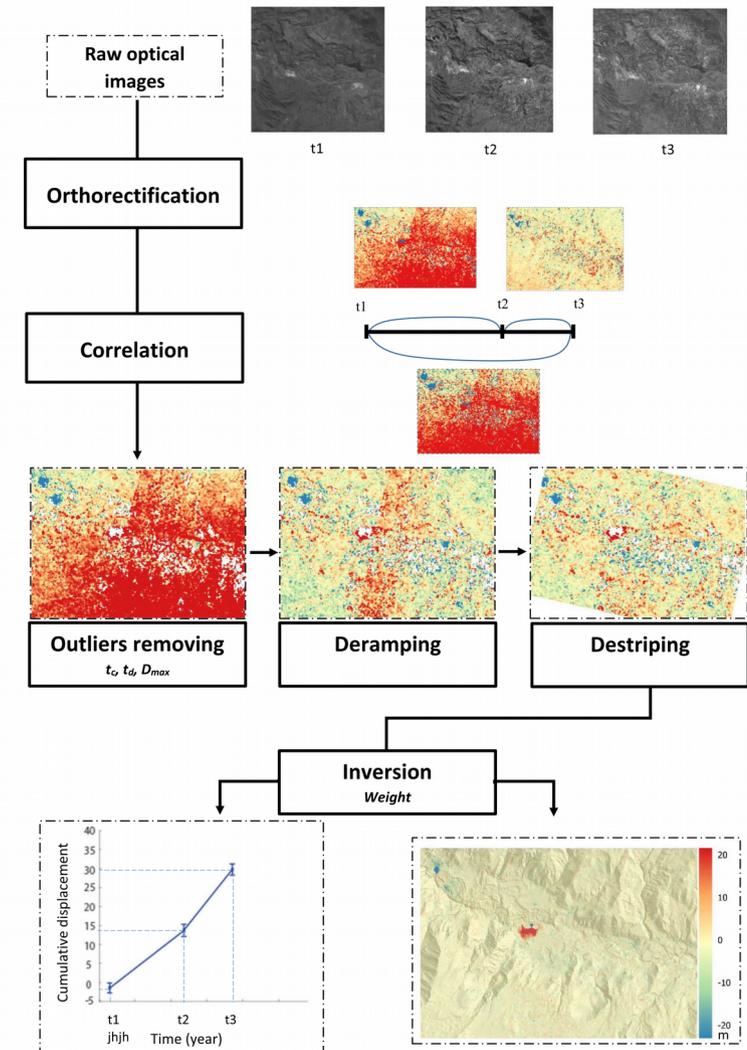
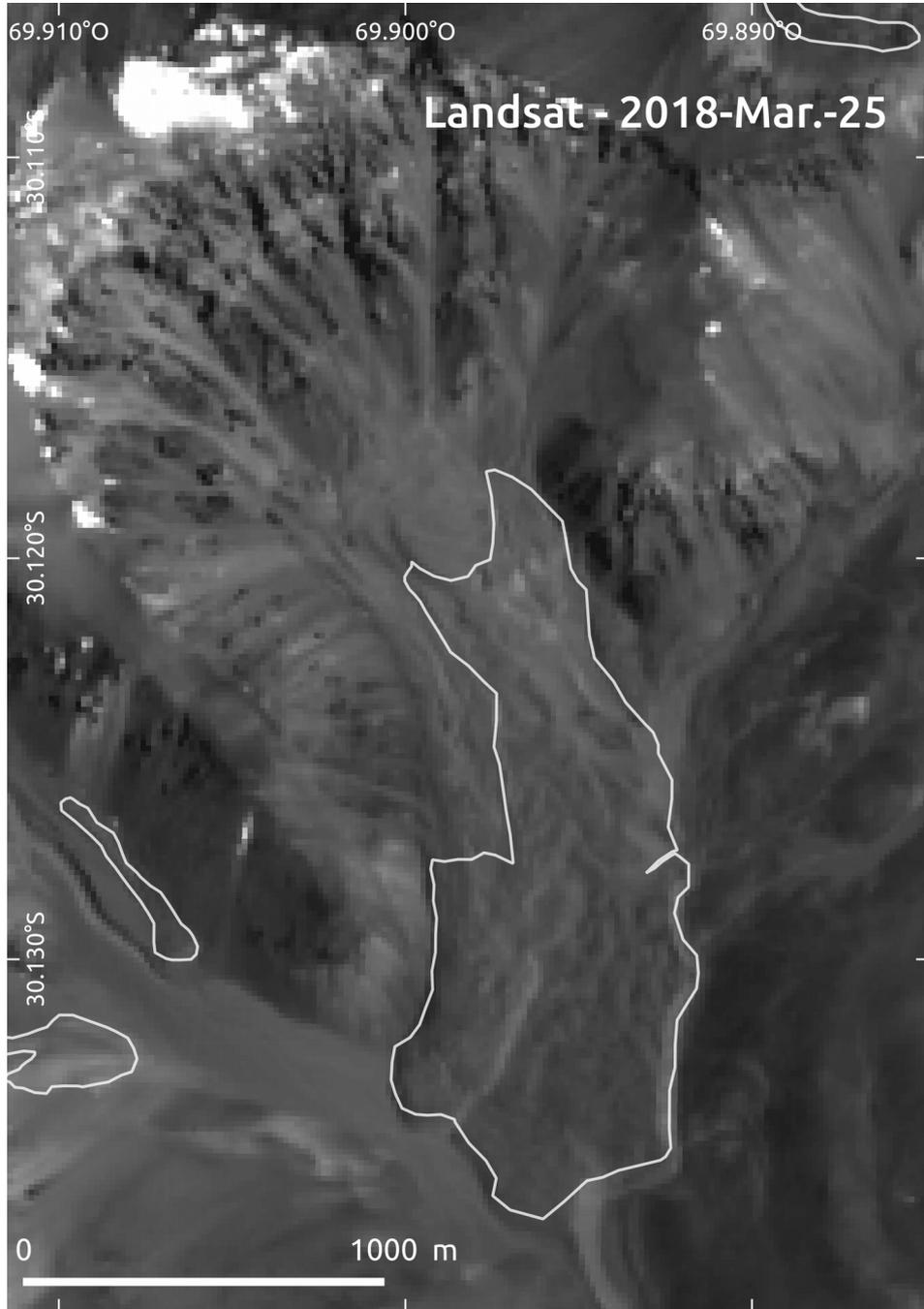
Methods | Quantifying displacement with Landsat



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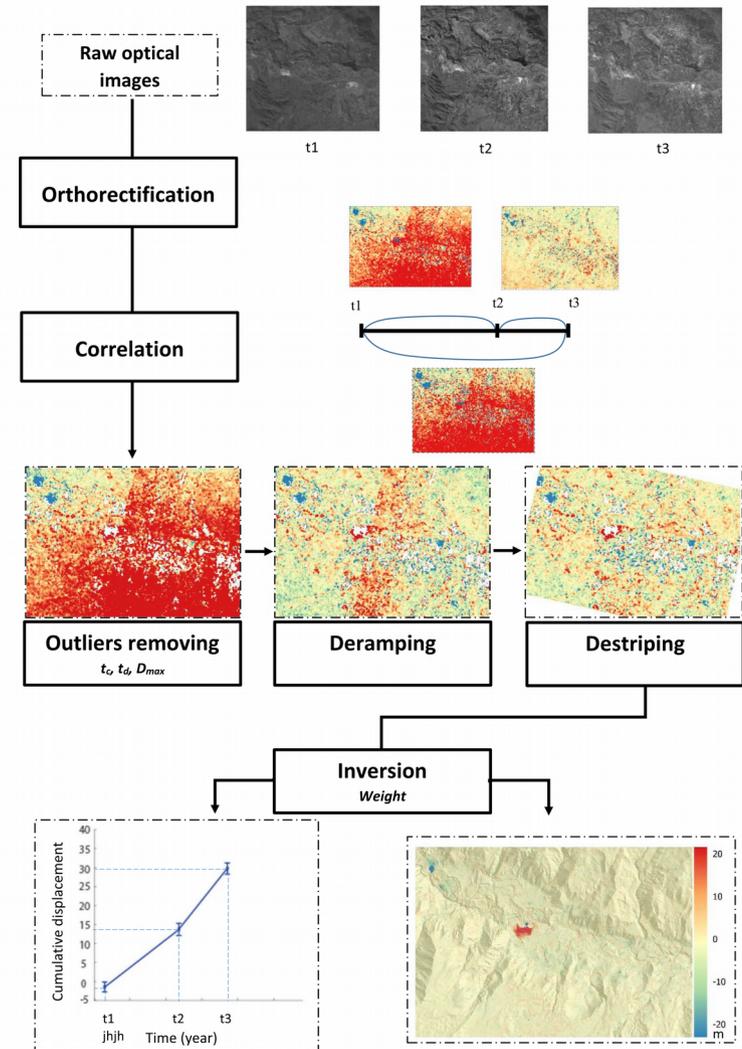
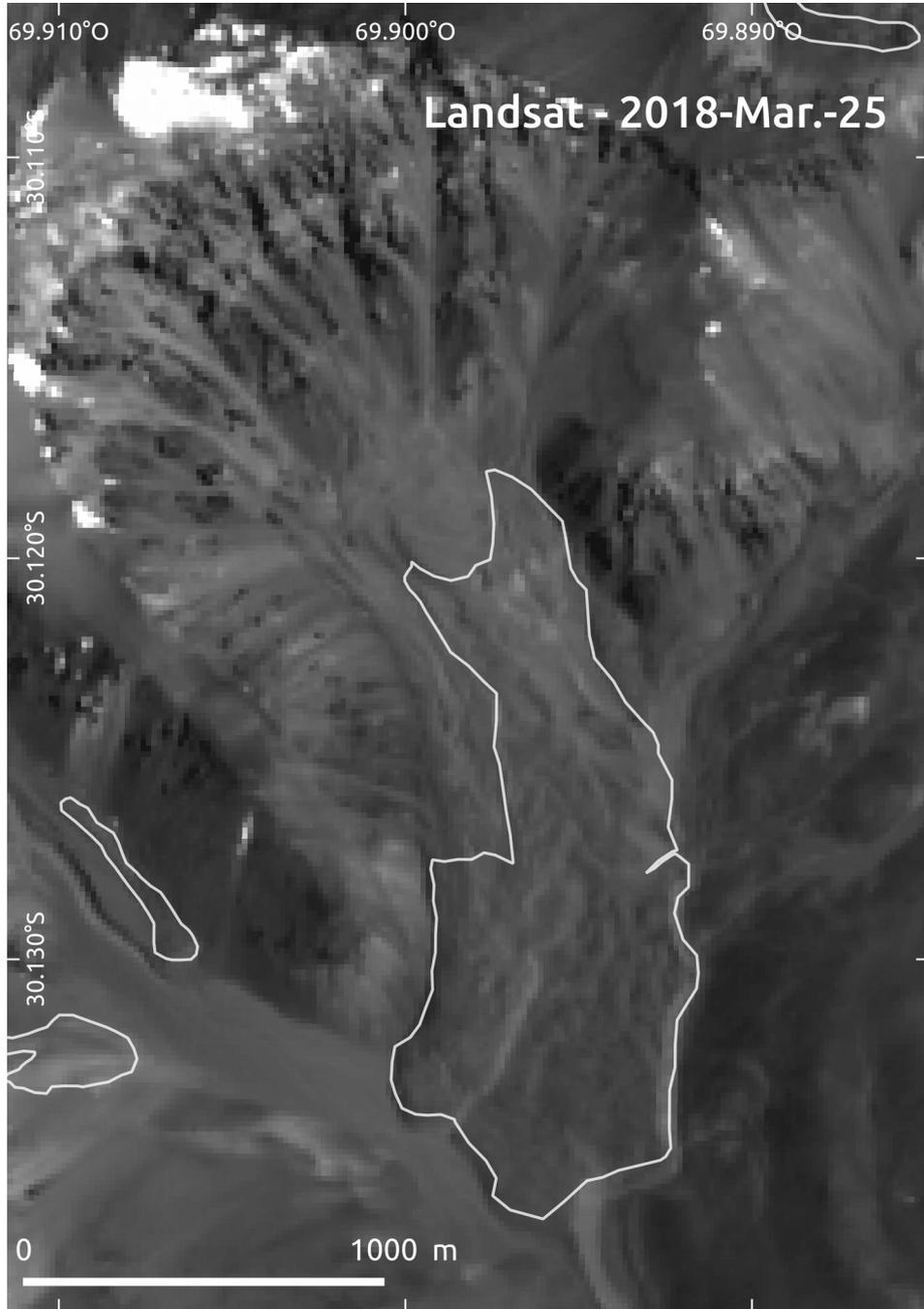


Methods | Quantifying displacement with Landsat



Bontemps et al., 2018

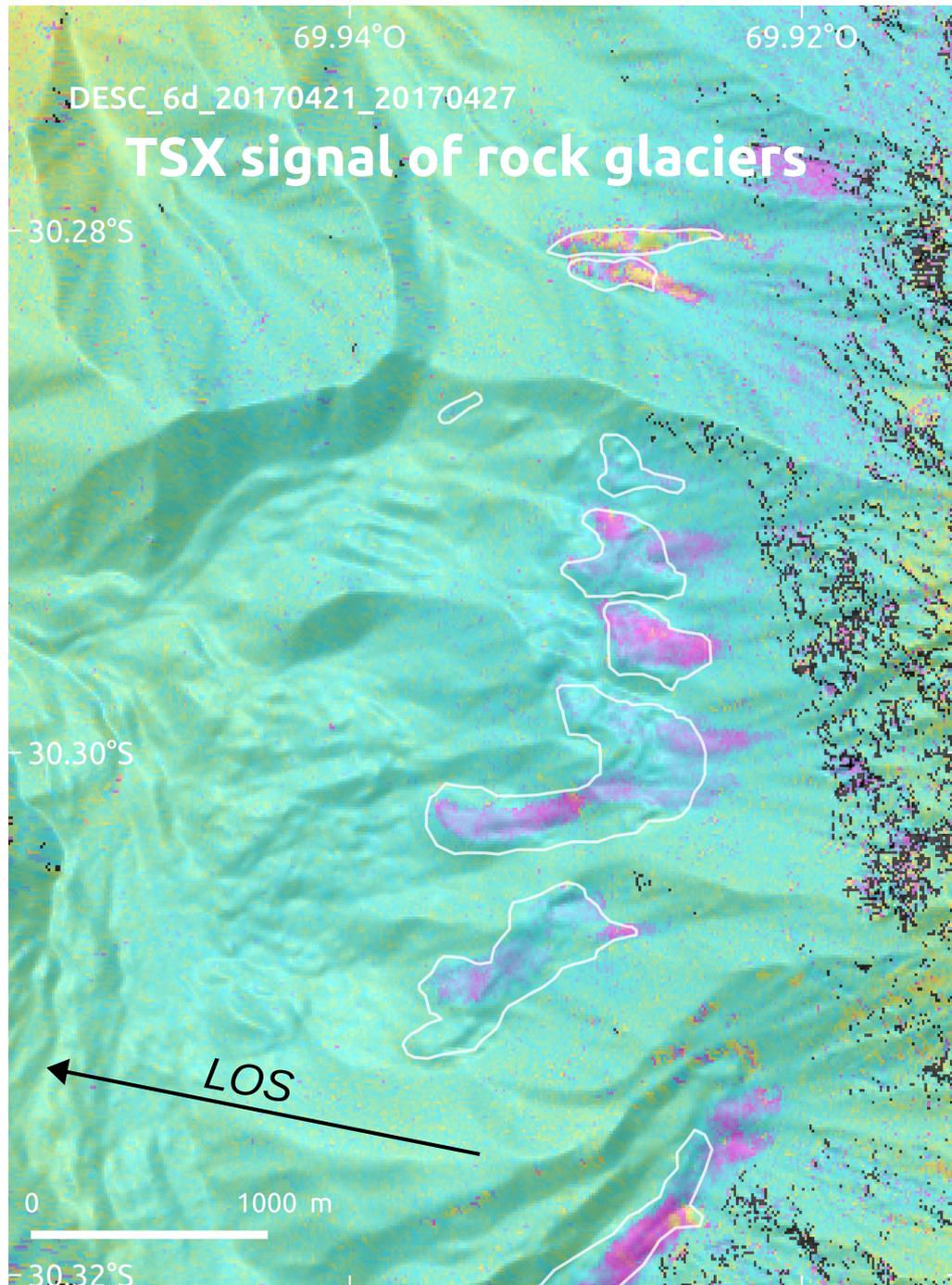
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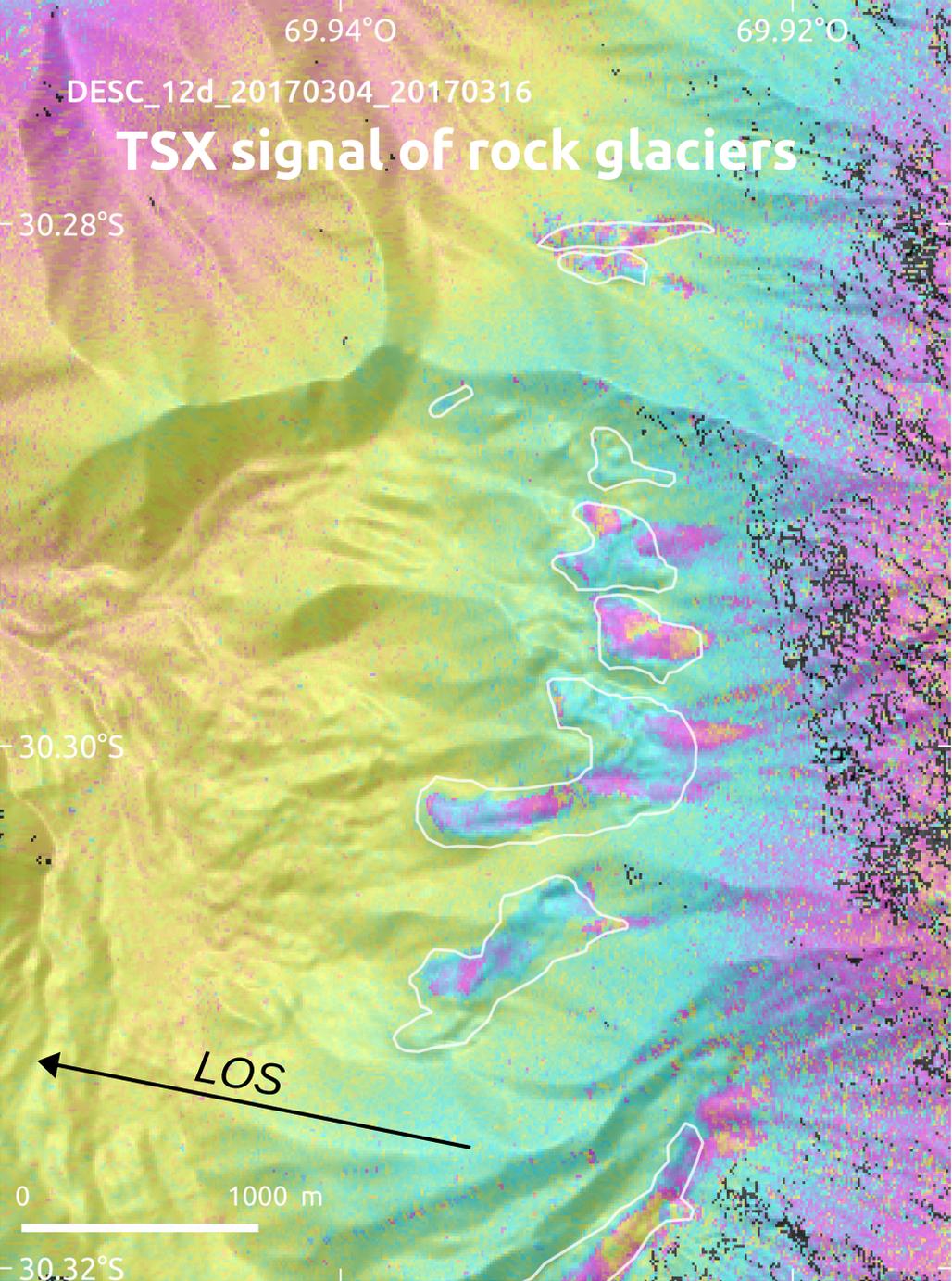
Bontemps et al., 2018

Filtering of the raw displ. =
f(dir. mvt, coher. slope, larger patches)

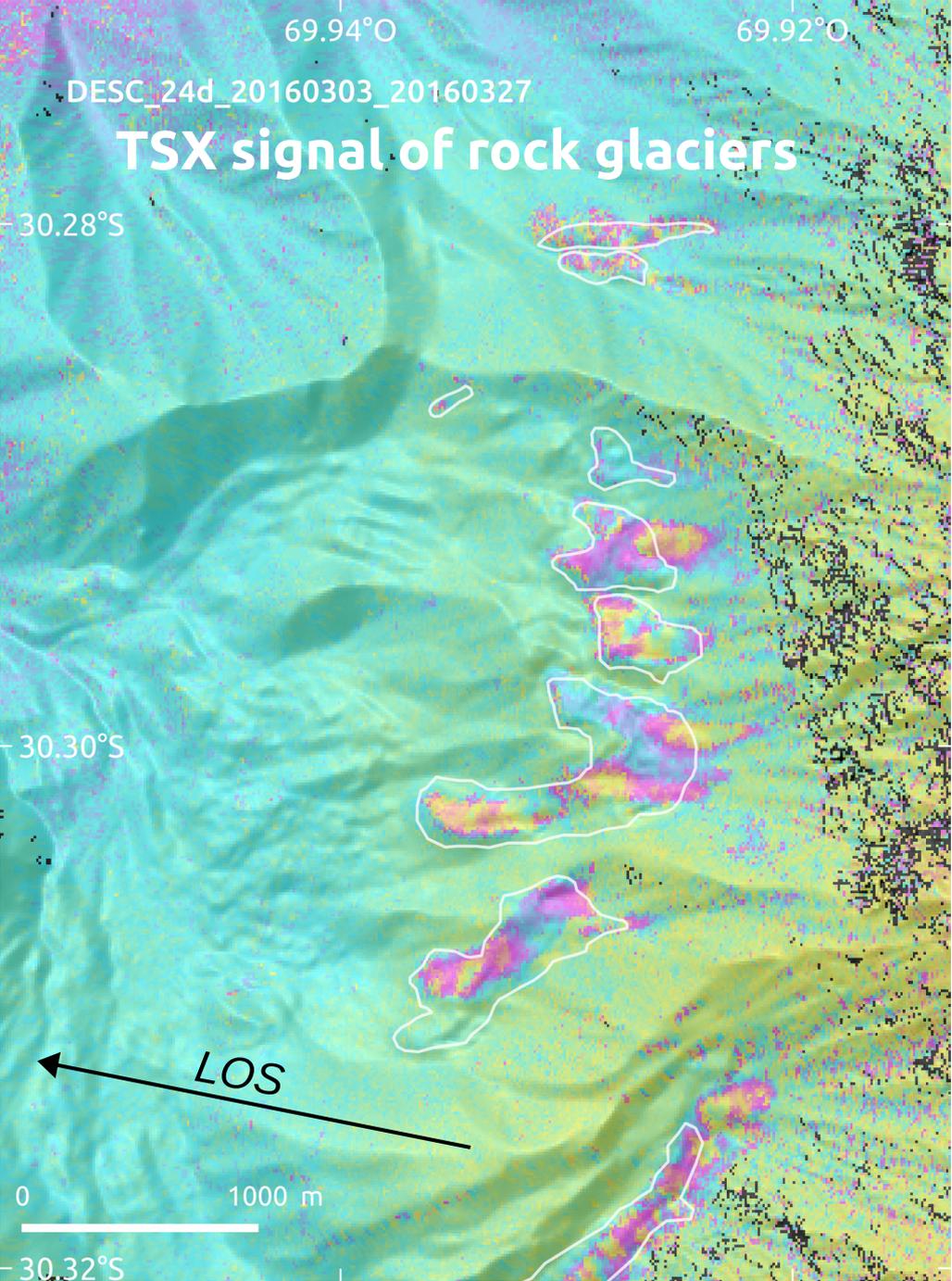
Results | d-InSAR detections



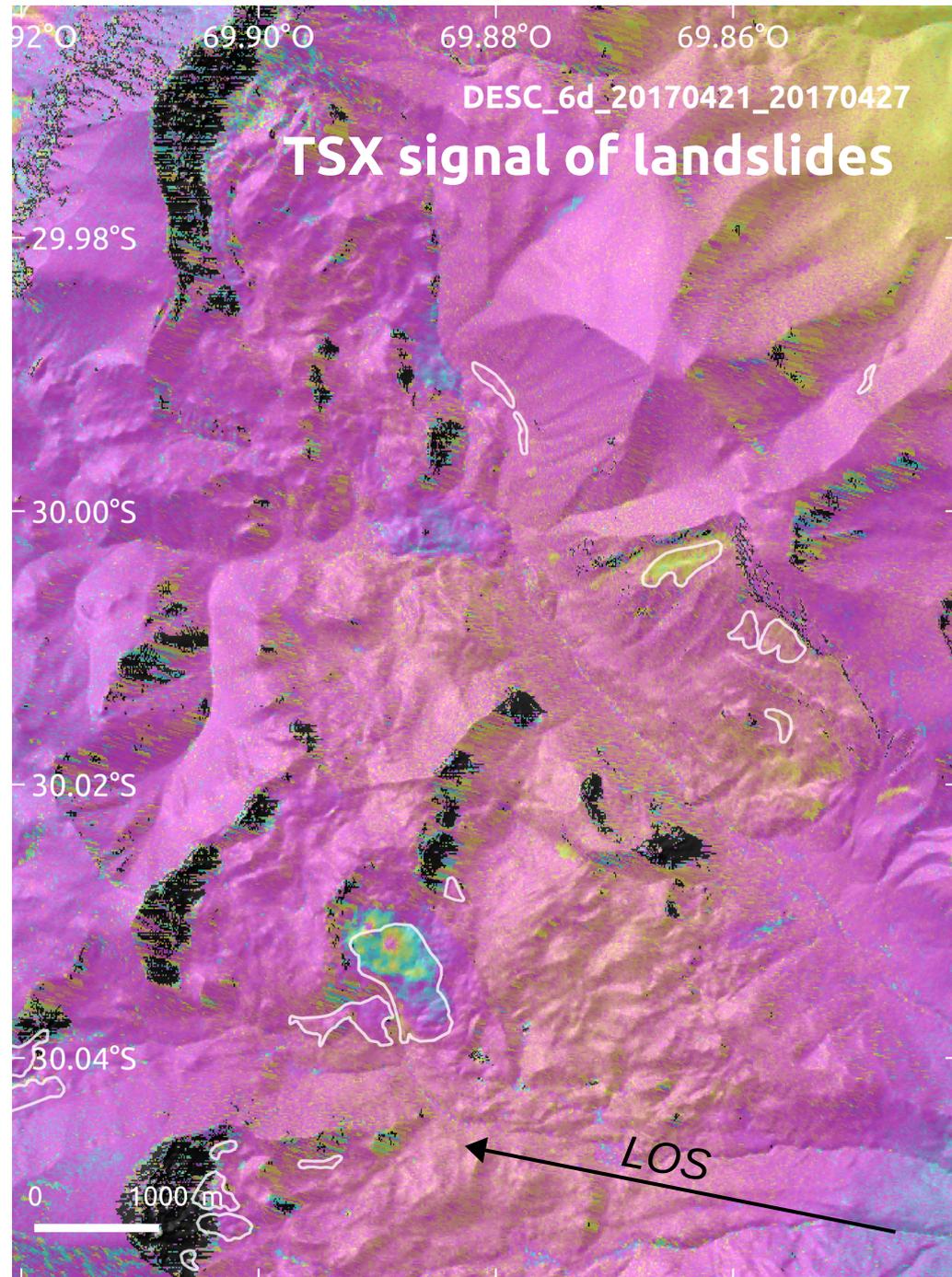
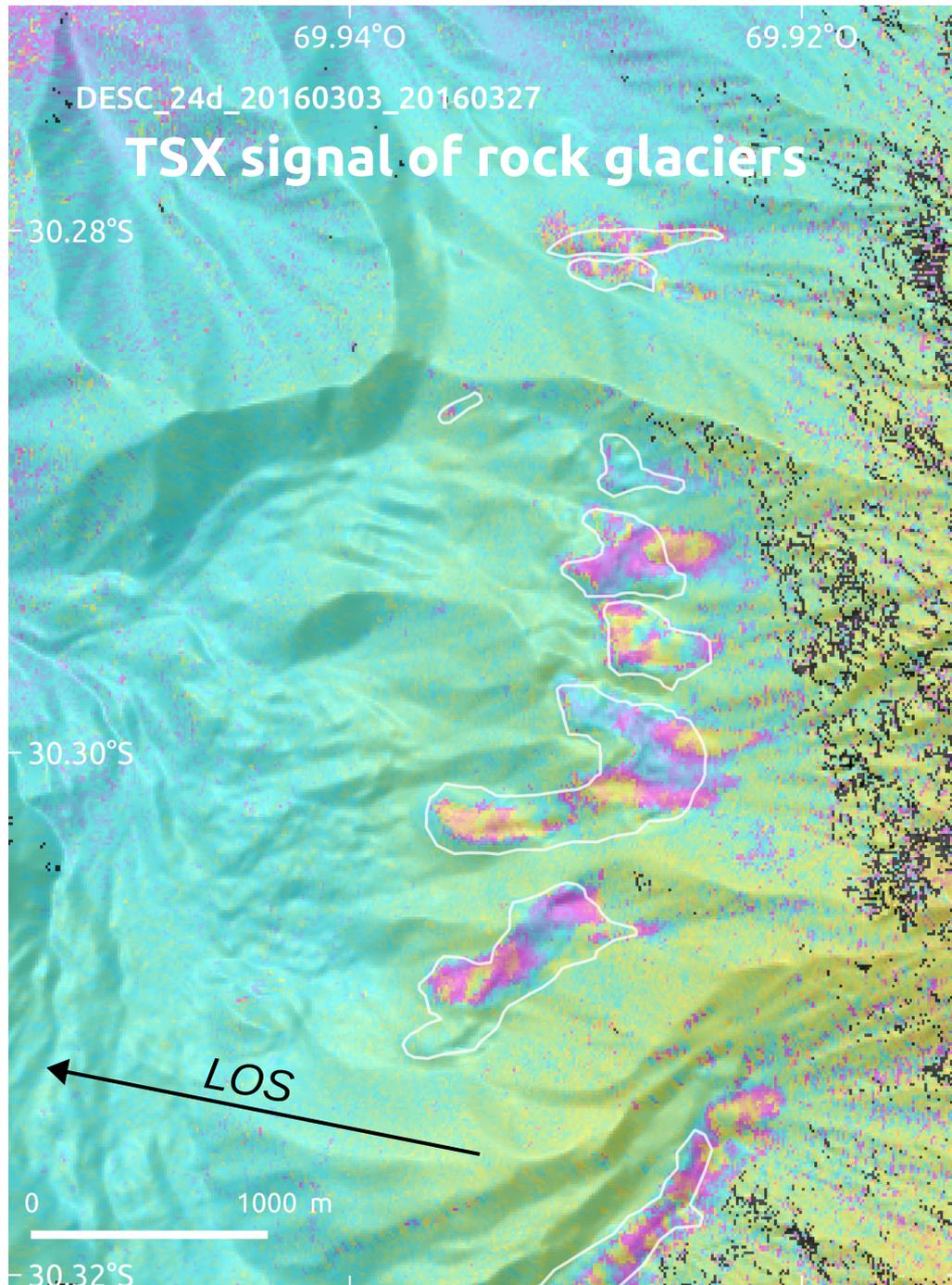
Results | d-InSAR detections



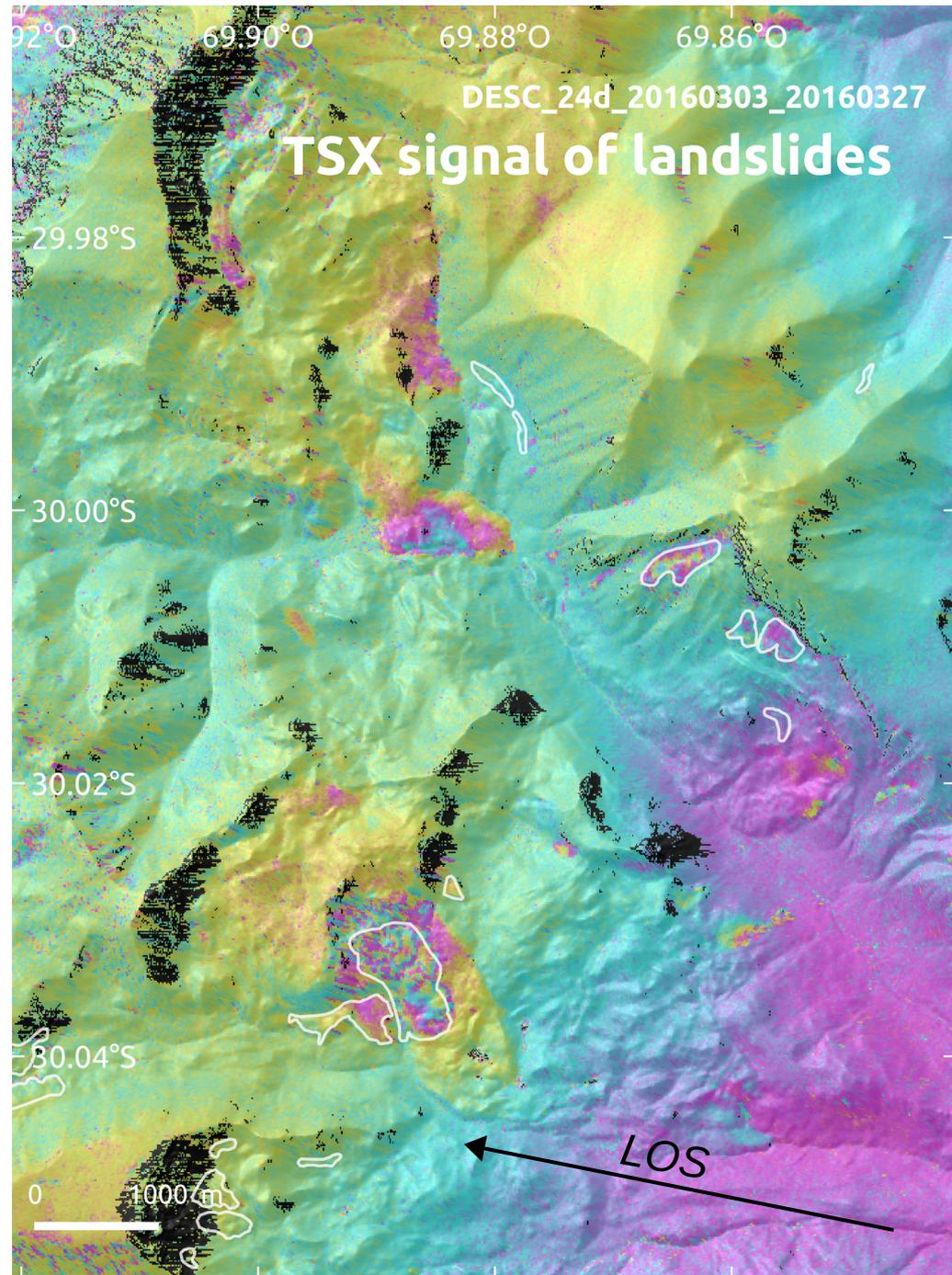
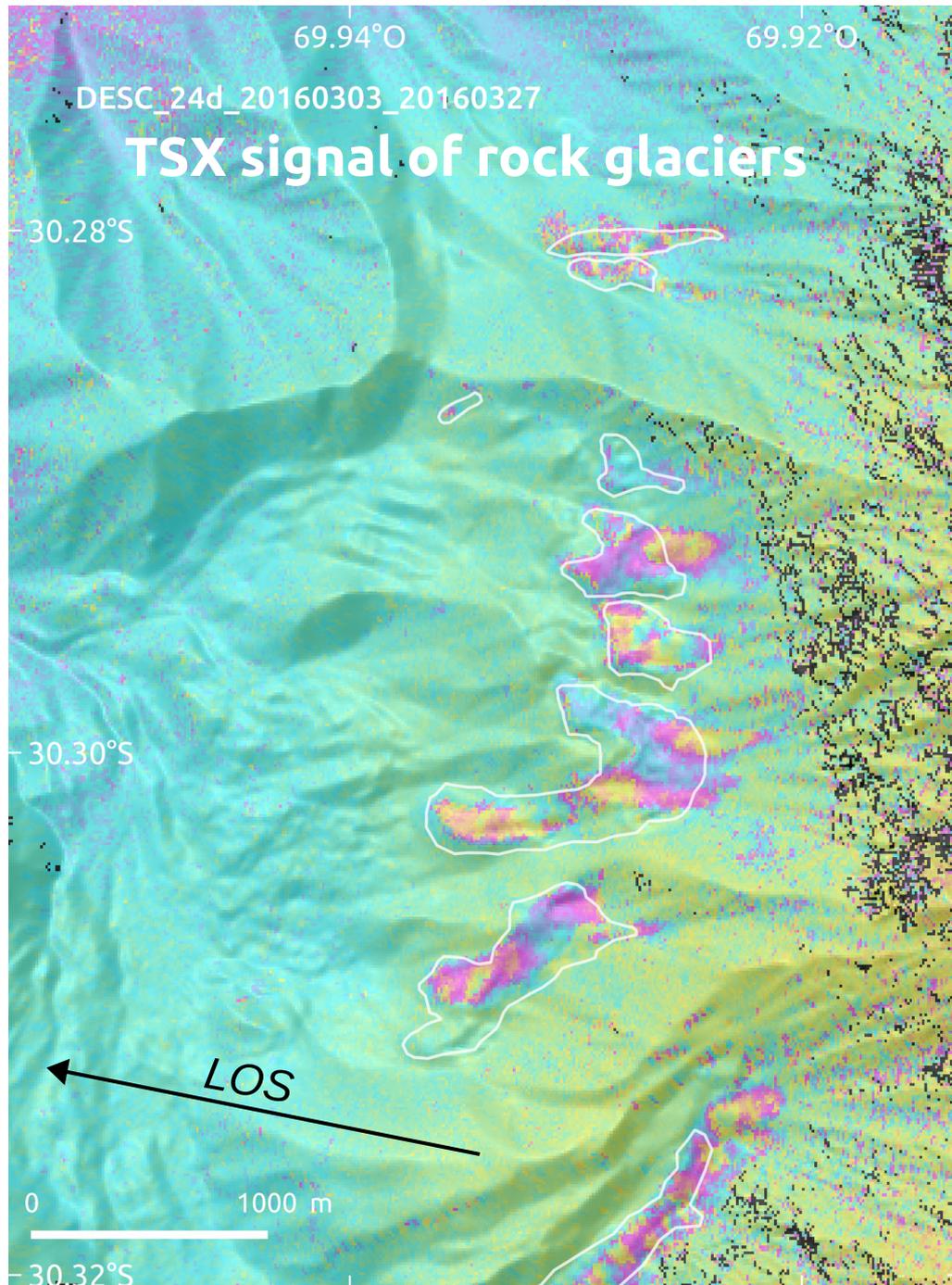
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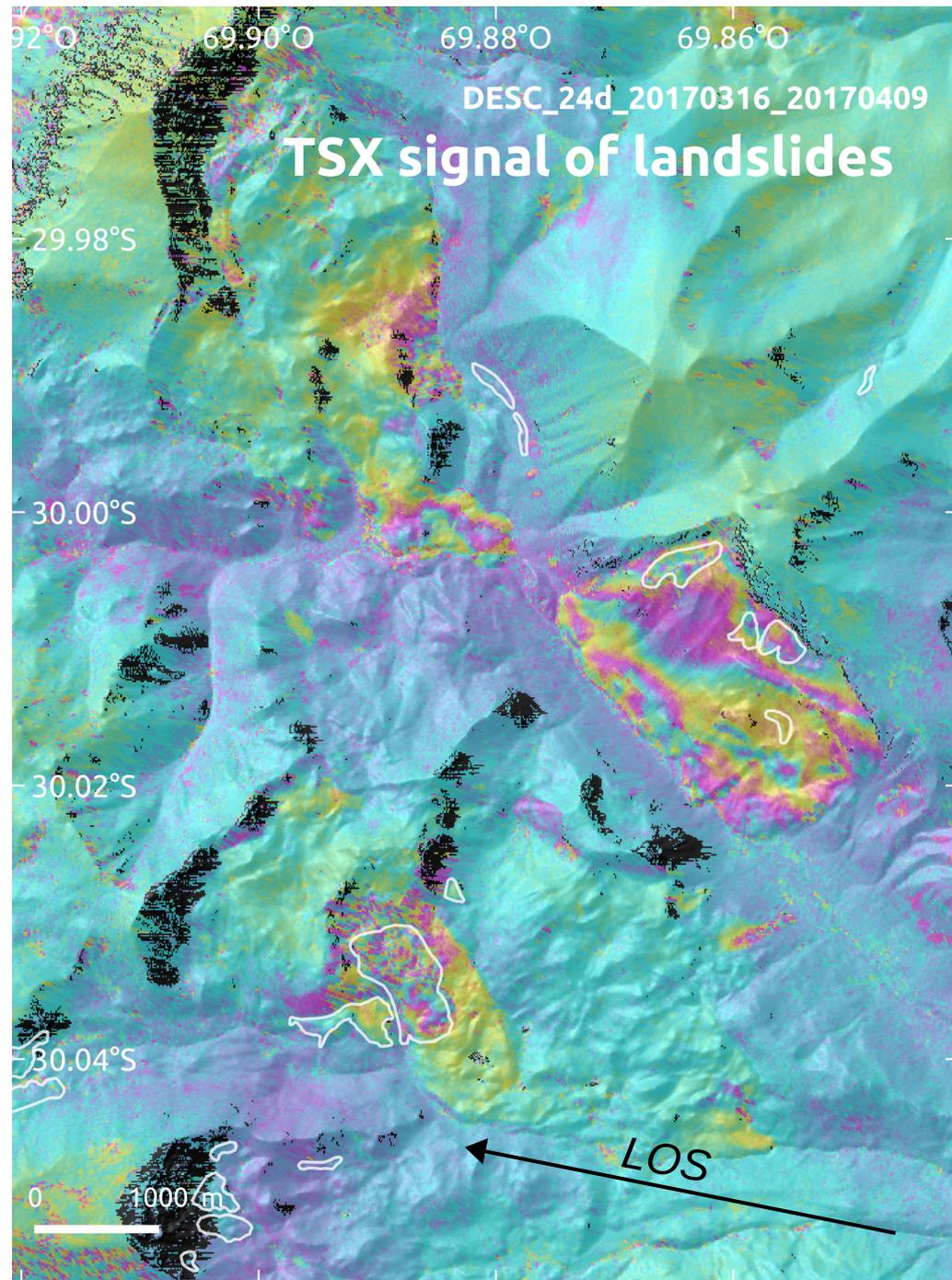
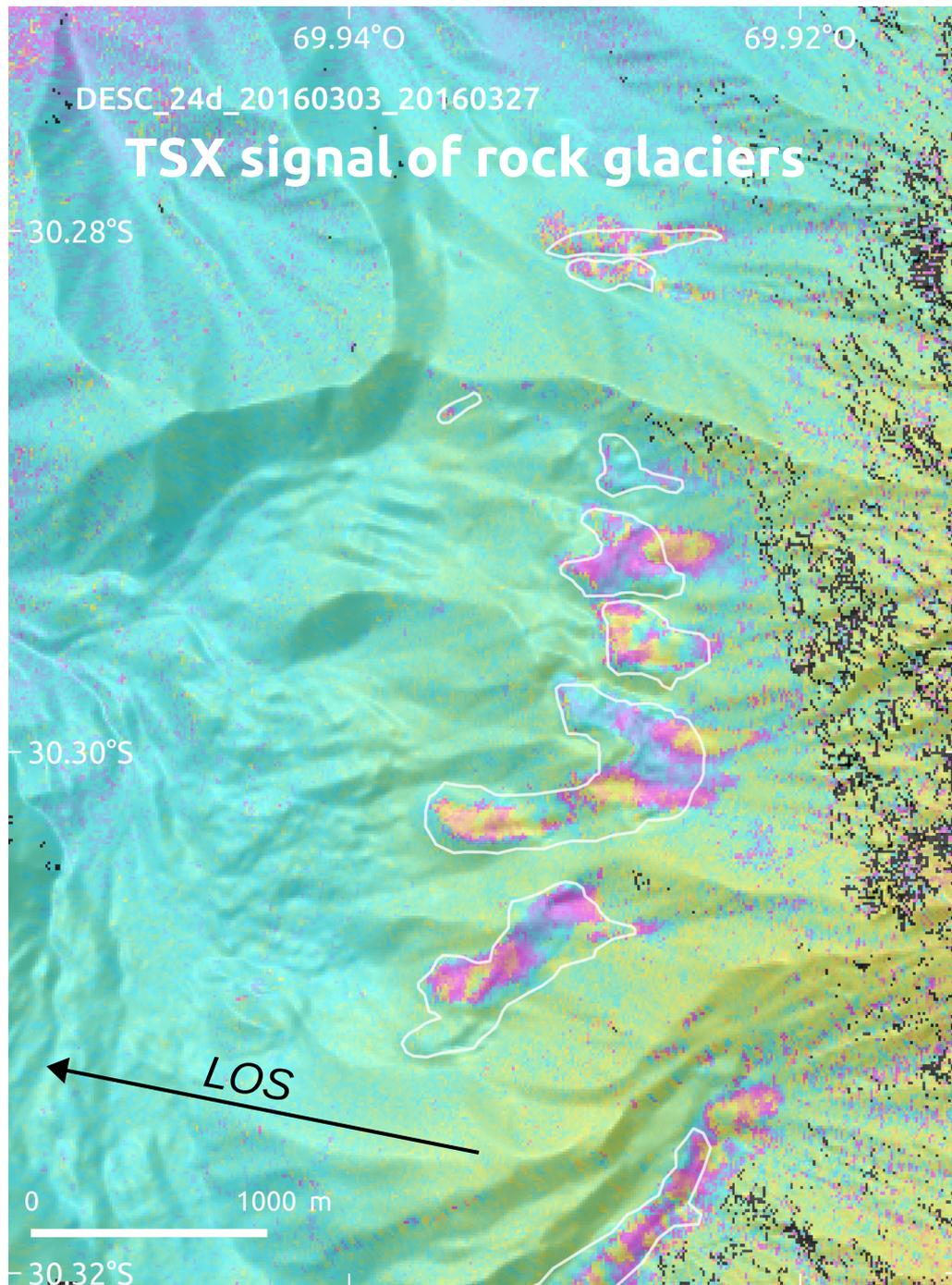
Results | d-InSAR detections



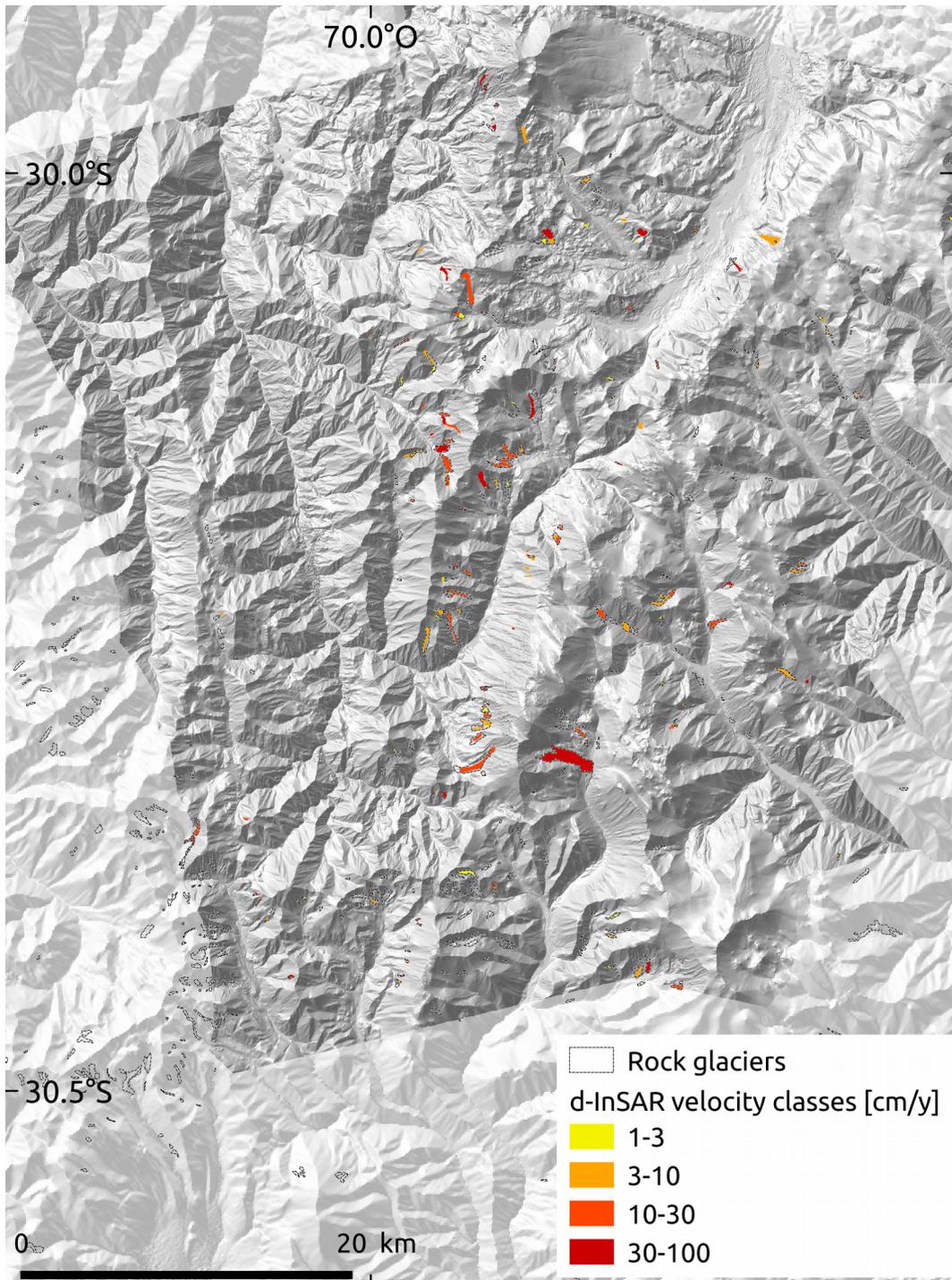
Results | d-InSAR detections



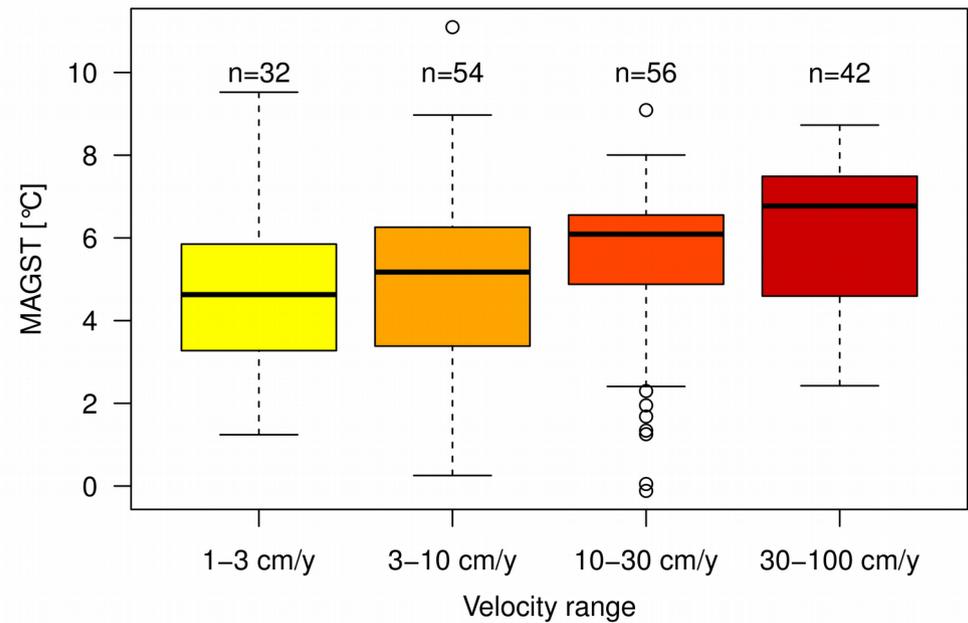
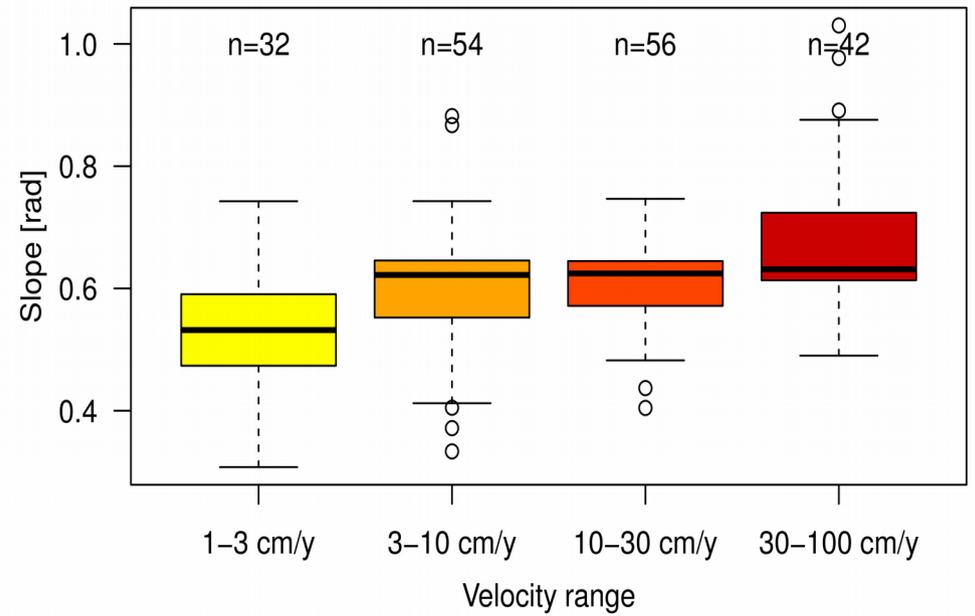
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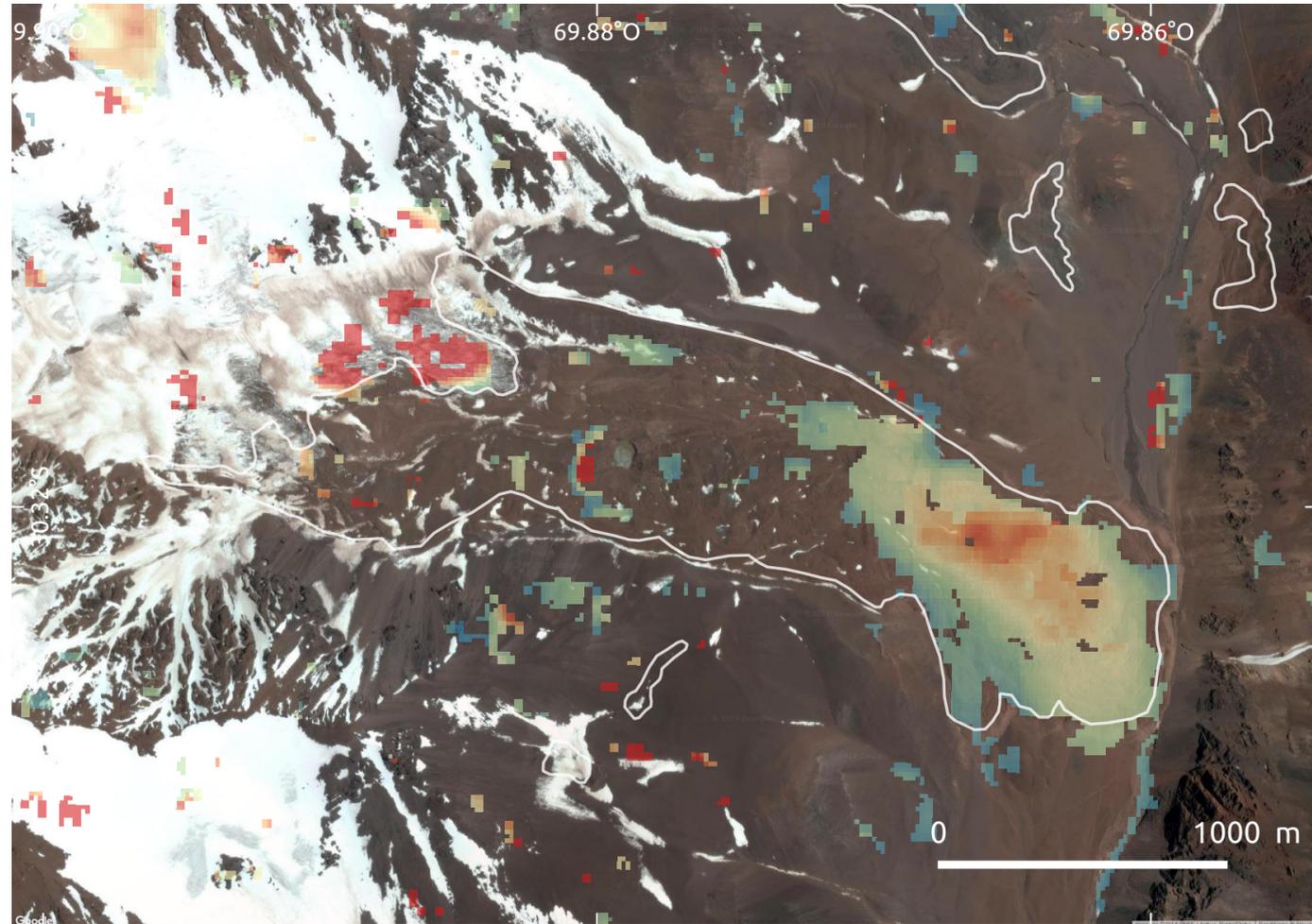
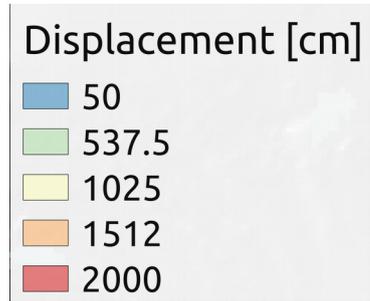
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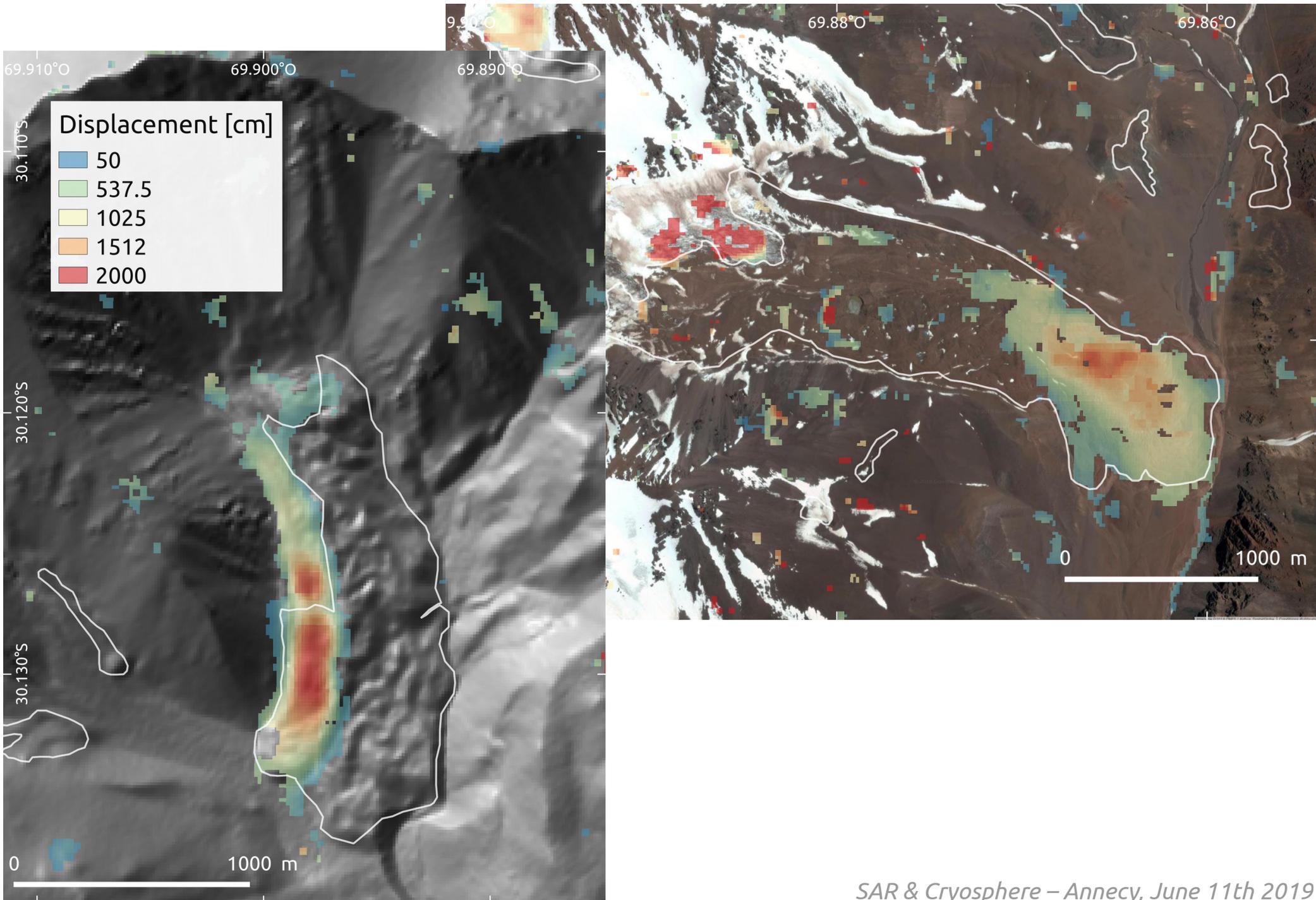
229 detected rock glaciers



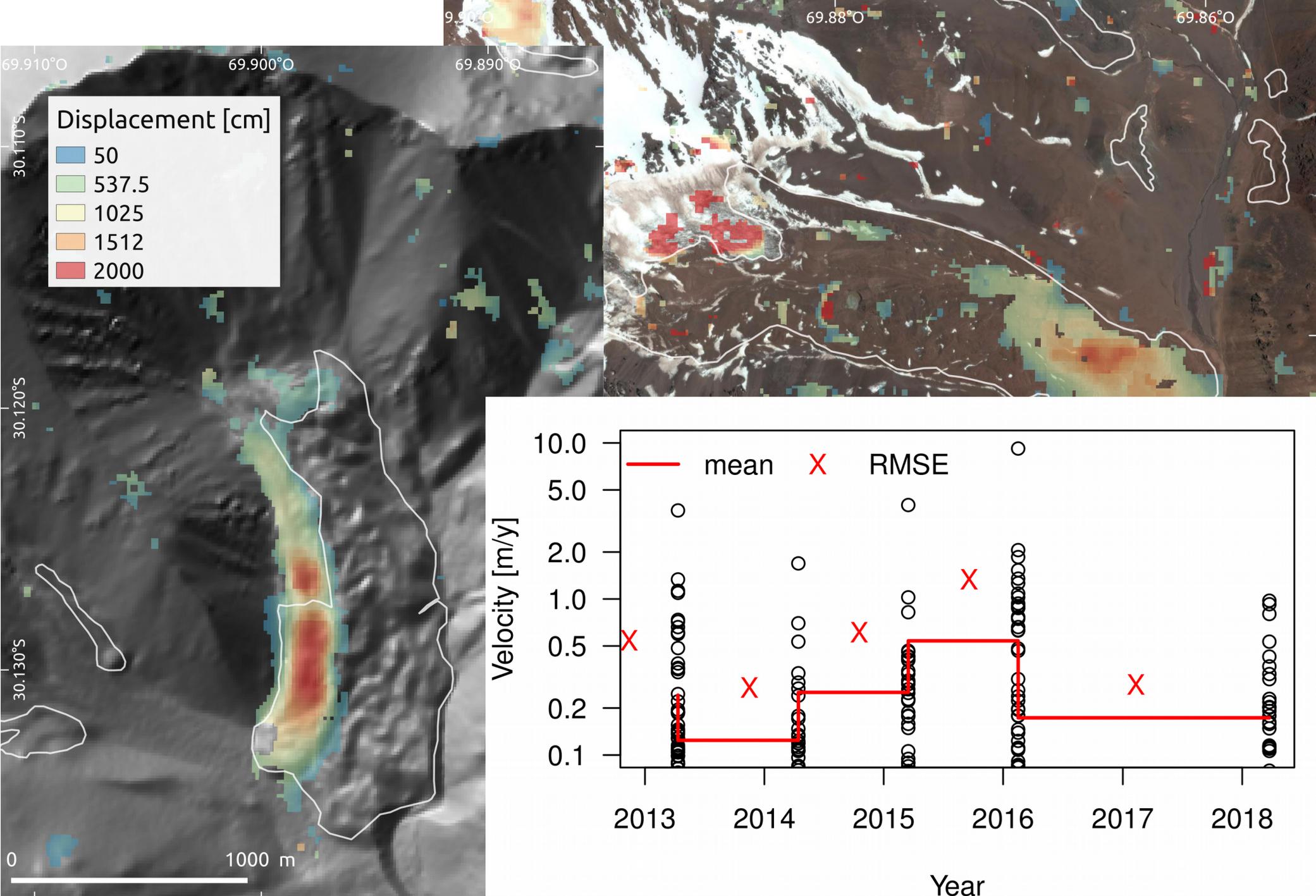
Results | Evolution of surface kinematics



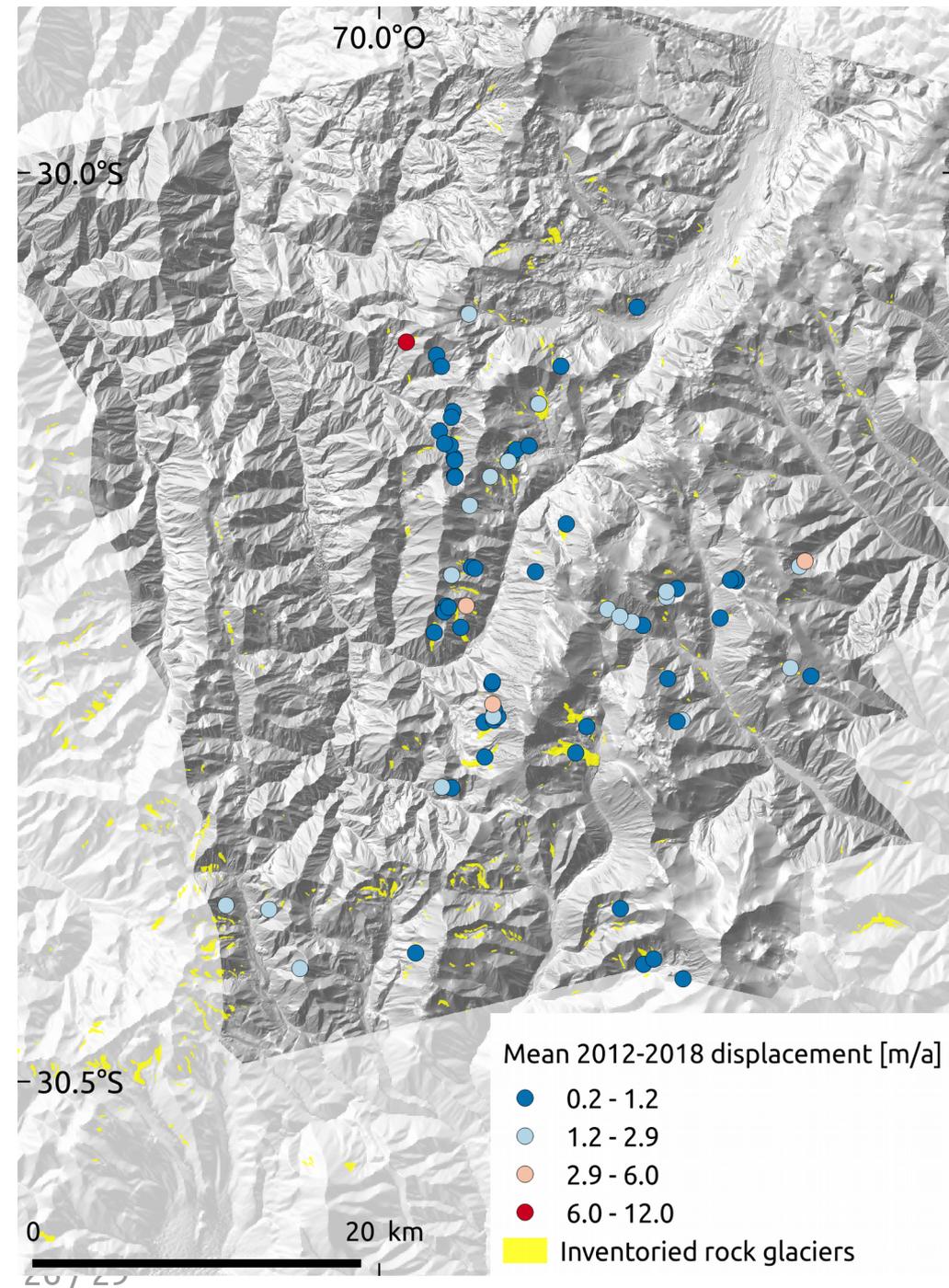
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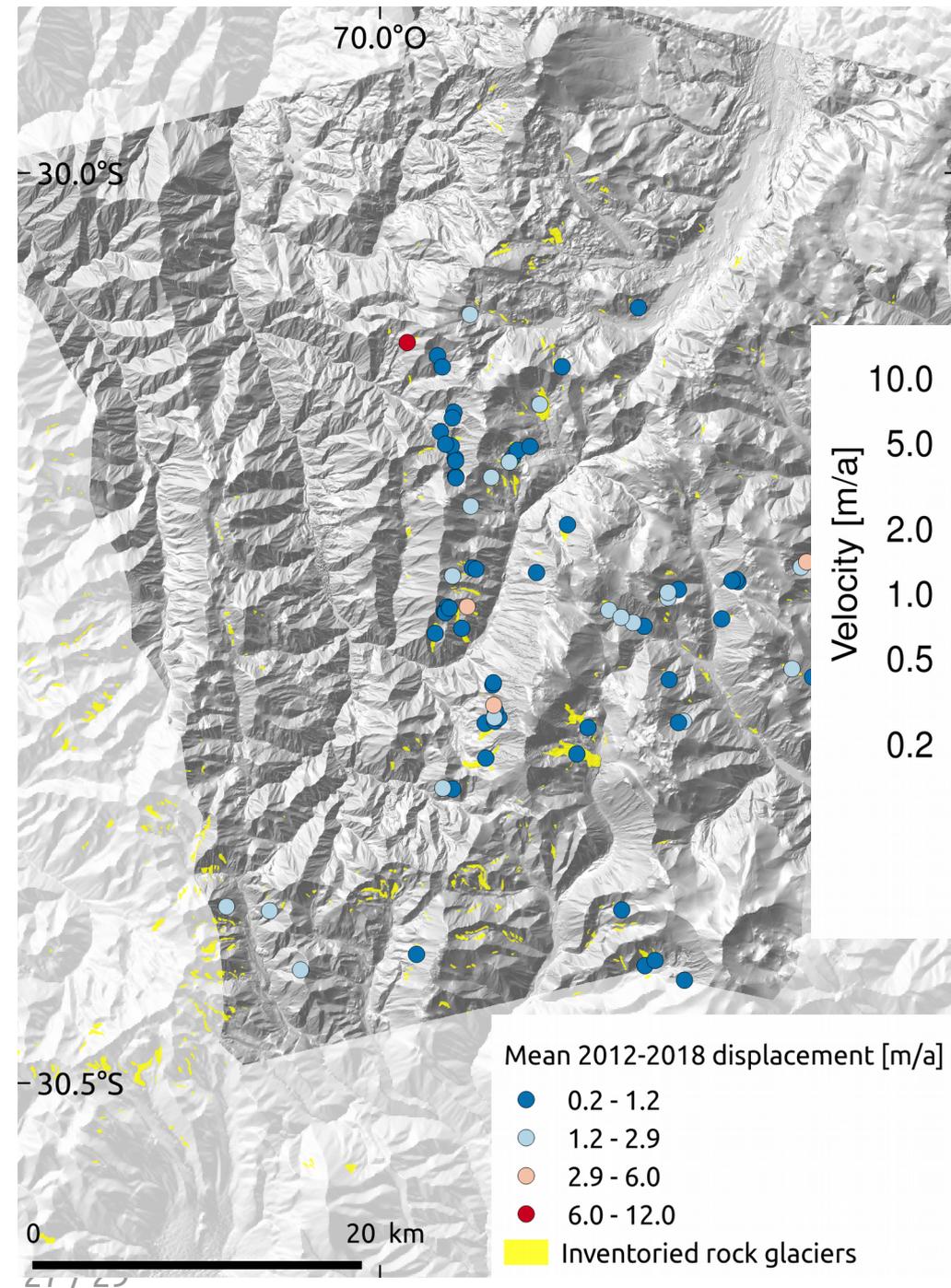


Results | Comparison InSAR / Optical

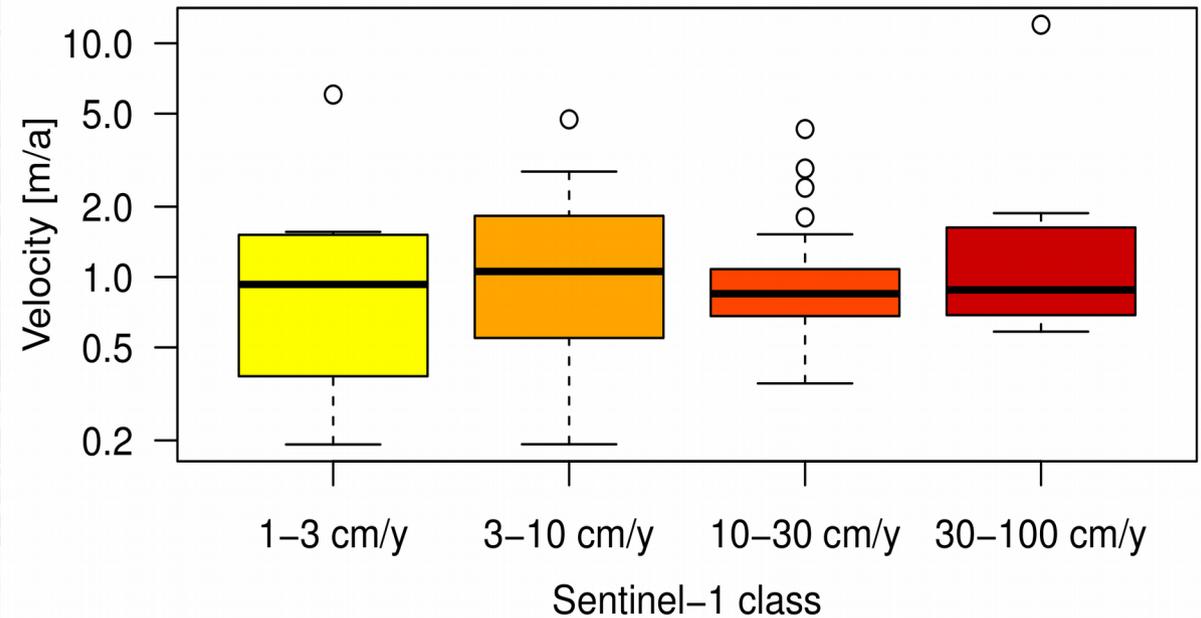


Low coherence between both...

Results | Comparison InSAR / Optical



Low coherence between both...



Conclusion & perspectives

Insights:

- Reliable evaluation of surface movements
- Significant improvement of the existing inventories
- Suited for monitoring local dynamics

To be continued:

- Evaluating the accuracy of both InSAR and optical image correlation
- Analyzing topo-environmental controls on rock glacier kinematics
- Improving the inventoring and monitoring of regional rock glacier activity using remote sensing

Merci de votre attention !

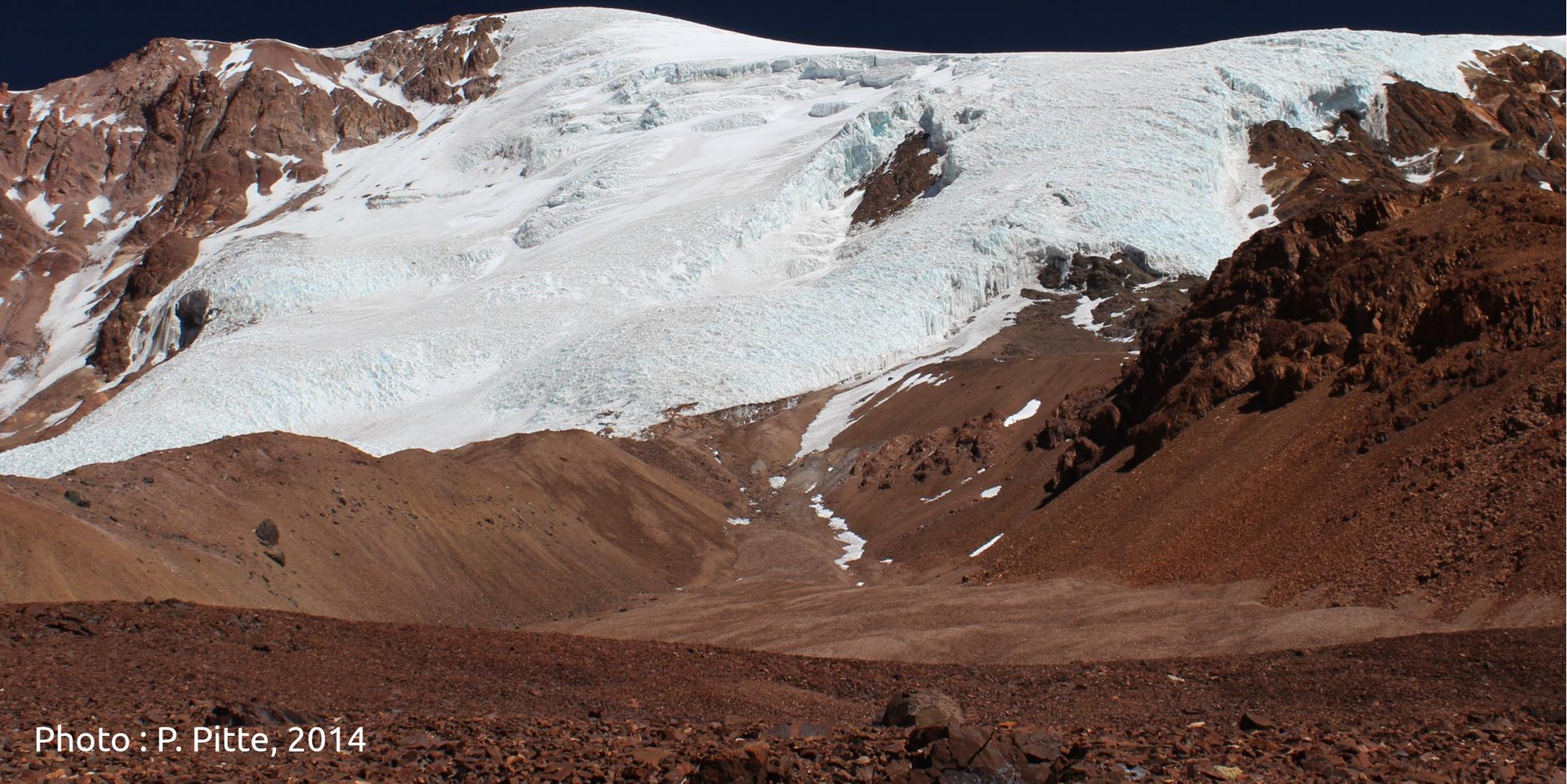


Photo : P. Pitte, 2014