InSAR grounding line mapping with the TSX/TDX/PAZ constellation for fast Antarctic glaciers

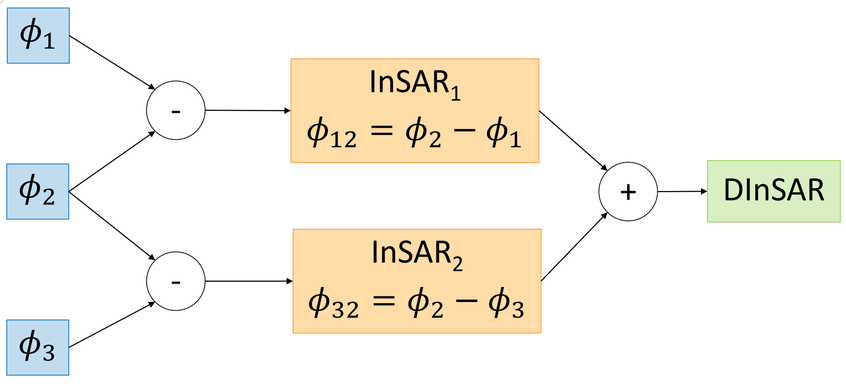
Lukas Krieger, Dana Floricioiu

Remote Sensing Technology Institute, German Aerospace Center (DLR), Wessling, Germany

REMOTE SENSING TECHNOLOGY INSTITUTE

Background

InSAR-derived grounding line mapping is usually performed on a coherent DInSAR combination of two interferograms to eliminate phase contributions from horizontal ice displacement (ice velocity) and separate the vertical displacement of the ice shelf due to the ocean tides.



$$\phi_{12} = \phi_{12,topo} + \phi_{12,ice\ velocity} + \phi_{12,tidal\ deformation} + \phi_{12,atmosphere} + \phi_{12,noise}$$

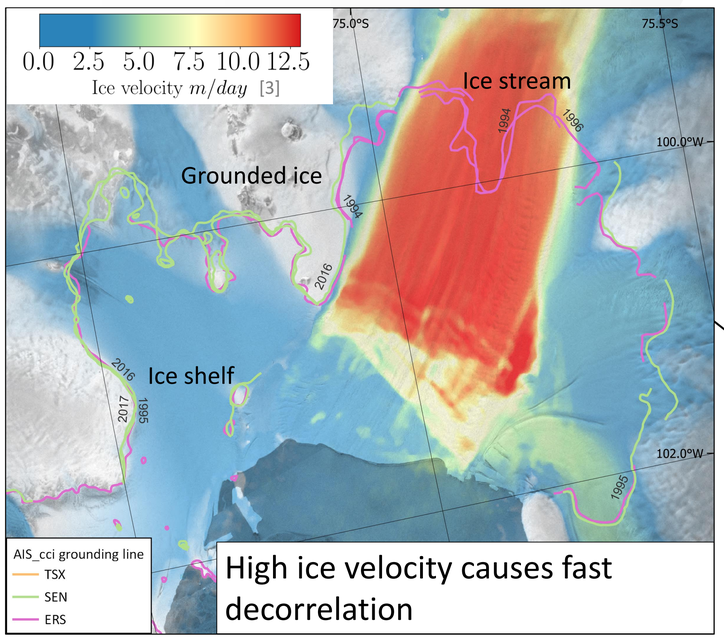
$$\phi_{32} = \phi_{32,topo} + \phi_{32,ice\ velocity} + \phi_{32\ tidal\ deformation} + \phi_{32,atmosphere} + \phi_{32,noise}$$

Removed by DEM | Cancels in DInSAR | Causes fringe belt | Low frequency | Dominates with long temporal baselines

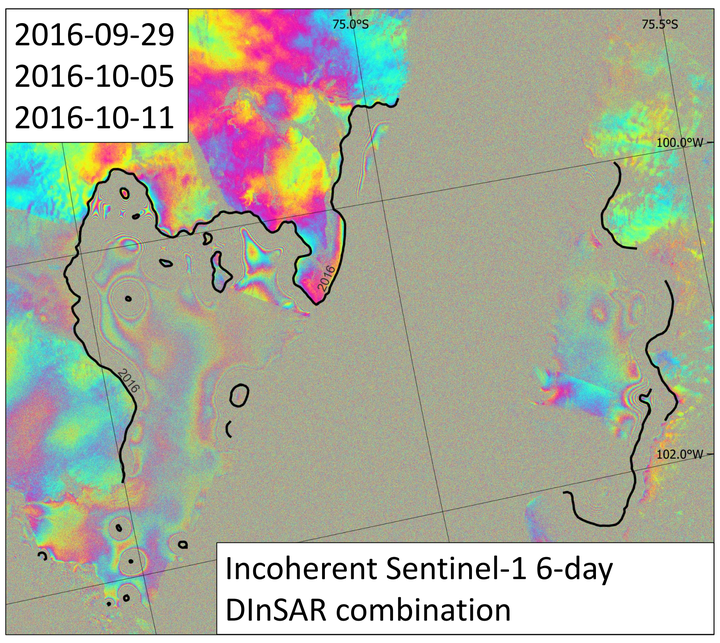
Especially for some of the faster glaciers, the only available InSAR observations of the grounding line have been acquired during the ERS Tandem phases (1991/92, 1994 and 1995/96).

Joint DLR-INTA Scientific Announcement of Opportunity

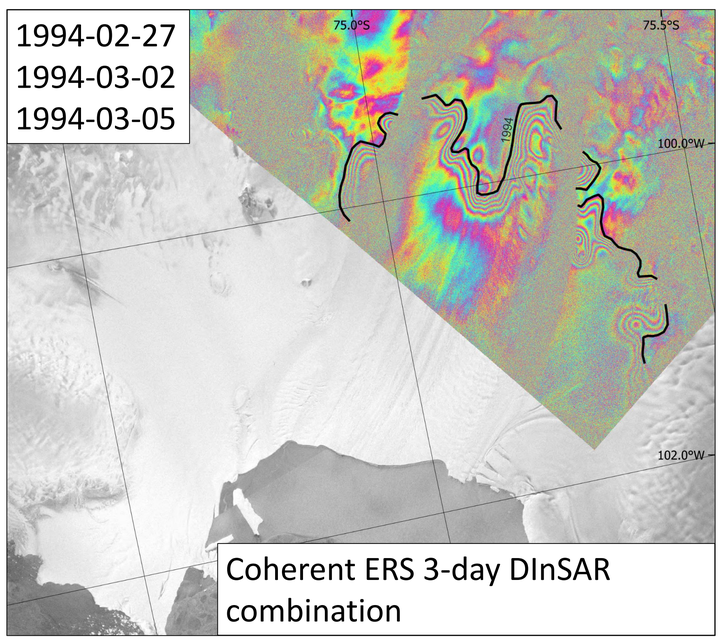
In May 2021, a joint AO of DLR and the Spanish National Institute of Aerospace Technology (INTA) was released which offers the possibility of a common scientific evaluation of SAR acquisitions of the German TerraSAR-X/TanDEM-X and the Spanish PAZ satellite missions. These platforms are almost identical and are operated together in a constellation therefore offering the possibility of combining their acquisitions to SAR interferograms with short temporal baselines of 4 days.



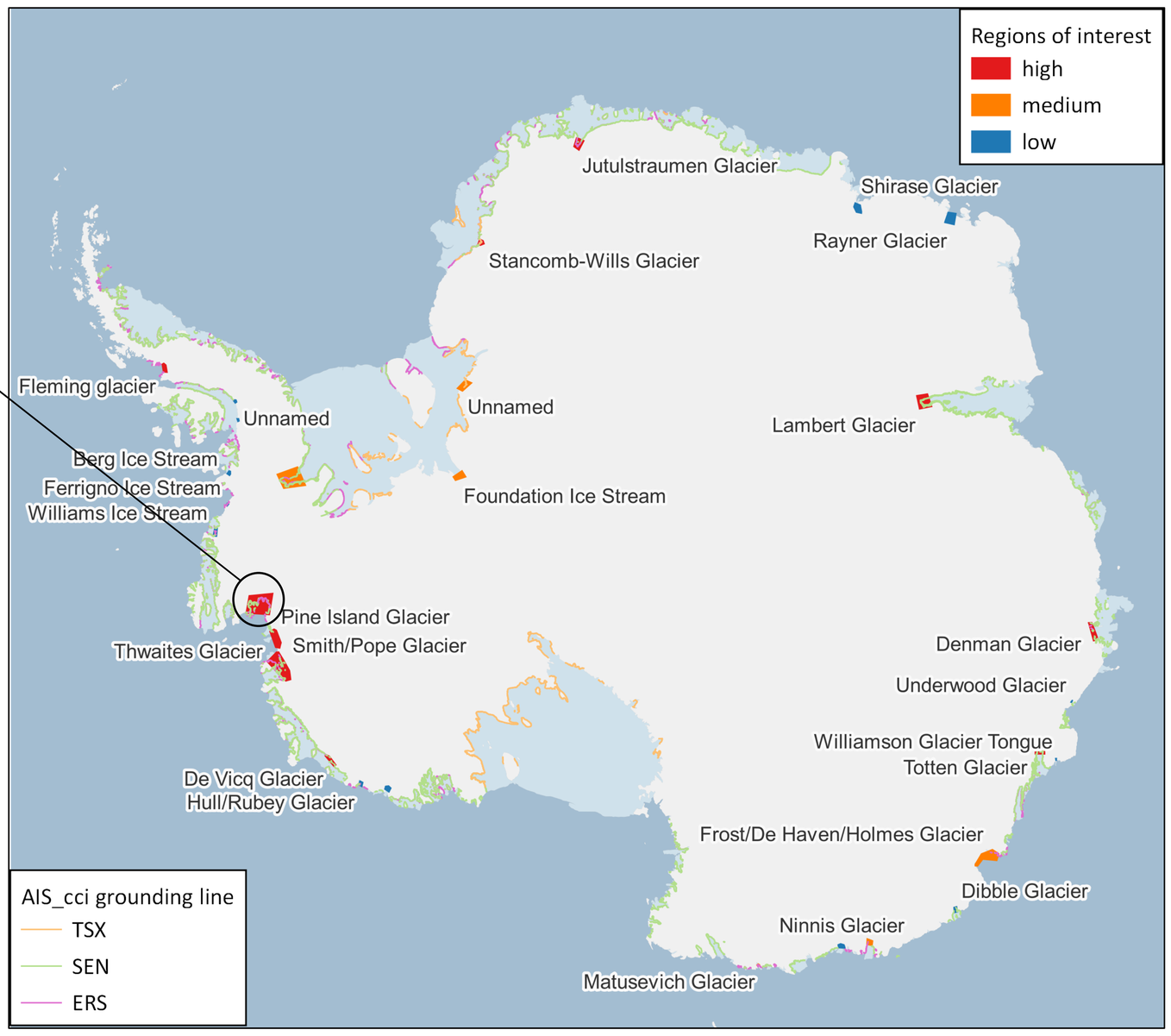
High ice velocity causes fast decorrelation



Incoherent Sentinel-1 6-day DInSAR combination



Coherent ERS 3-day DInSAR combination



Constellation	Repeat pass time interval [days]	Description	Resolution [m]	Band
Sentinel-1	6/12		5m x 20m	C-band
TerraSAR-X (TSX)	11		3m x 3m	X-band
ERS	3/1*	*Ice&Tandem phases (1991/92, 1994 and 1995/96)	8m x 4m	C-band
TSX/PAZ	**4/7**		**3m x 3m**	**X-band**
COSMO-SkyMed	1*	*See [1] and [2]	3m x 3m	X-band
Radarsat-2	24		12m x 5m	C-band

[1] Brancato, V., E. Rignot, P. Milillo, M. Morlighem, J. Mouginot, L. An, B. Scheuchl, u. a. „Grounding Line Retreat of Denman Glacier, East Antarctica, Measured With COSMO-SkyMed Radar Interferometry Data". *Geophysical Research Letters* 47, Nr. 7 (2020): e2019GL086291. https://doi.org/10.1029/2019GL086291.

[2] Milillo, Pietro, Eric Rignot, Paola Rizzoli, Bernd Scheuchl, Jérémie Mouginot, J. Bueso-Bello, und P. Prats-Iraola. „Heterogeneous Retreat and Ice Melt of Thwaites Glacier, West Antarctica". *Science Advances* 5, Nr. 1 (1. Januar 2019): eaau3433. https://doi.org/10.1126/sciadv.aau3433.

[3] Nagler, Thomas, Helmut Rott, Markus Hetzenecker, Jan Wuite, und Pierre Potin. „The Sentinel-1 Mission: New Opportunities for Ice Sheet Observations". *Remote Sensing* 7, Nr. 7 (Juli 2015): 9371–89. https://doi.org/10.3390/rs70709371.

Contact:
lukas.krieger@dlr.de