Measuring Antarctic Uplift Due to Ice Loss, from Space

[1] Reza Bordbari, [1] Andrew J. Hooper, [2] Pippa Whitehouse, [2] Grace Nield, [3] Alex Brisbourne

[1] COMET, Institute of Geophysics and Tectonics, School of Earth and Environment, University of Leeds, UK

[2] University of Durham

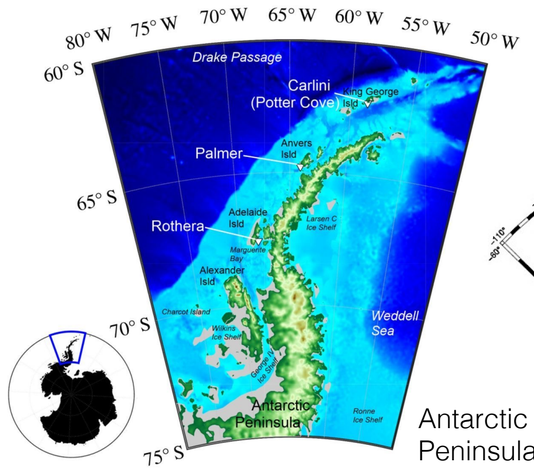
[3] British Antarctic Survey (BAS)

UNIVERSITY OF LEEDS

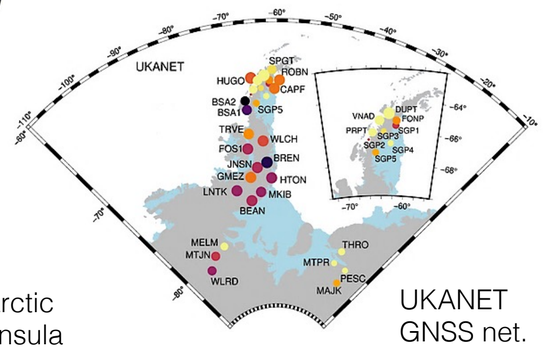
Abstract

Over the last two decades, the glaciers of the Antarctic Peninsula have experienced thinning of tens to hundreds of meters, and several ice shelves have collapsed. These changes in glacial loading, coupled with the millennial-scale glacial isostatic adjustment (GIA) have resulted in a viscoelastic response of the solid earth in the area.

To date, studies of Antarctic bedrock deformation have focused on velocities obtained from a sparse network of continues Global Navigation Satellite System (GNSS) stations. In this project we aim to apply InSAR in Antarctic Peninsula to increase the spatial sampling of deformation measurements and further understand both spatiotemporal ice mass change and the rheology of the solid Earth in the region.

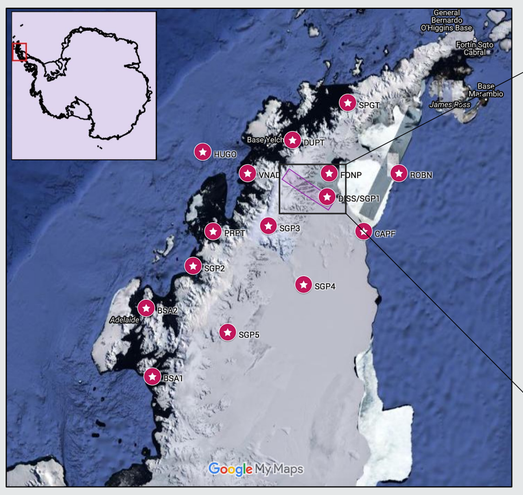


Antarctic Peninsula

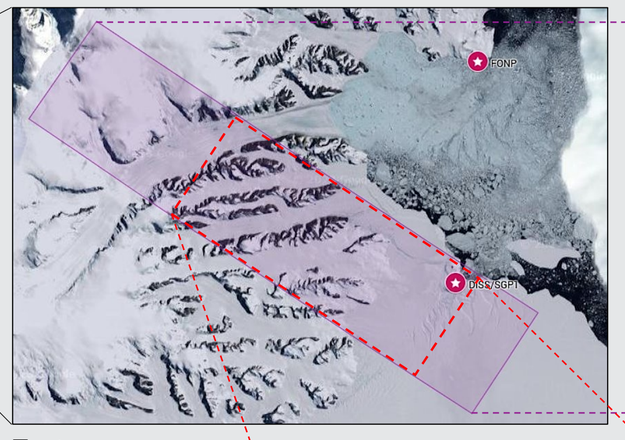


UKANET GNSS net.

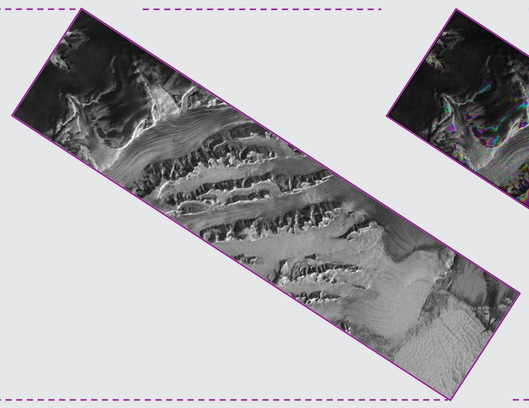
Interferograms and InSAR-detected Velocities



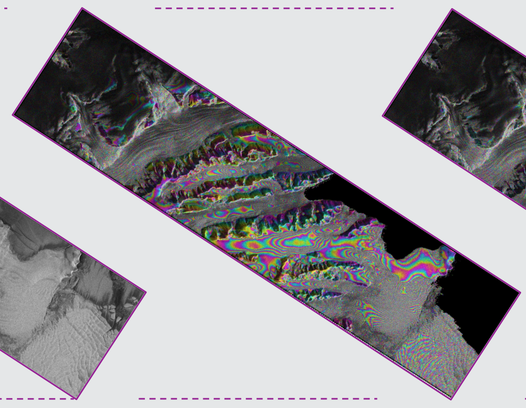
Study area (pink points: GNSS net.)



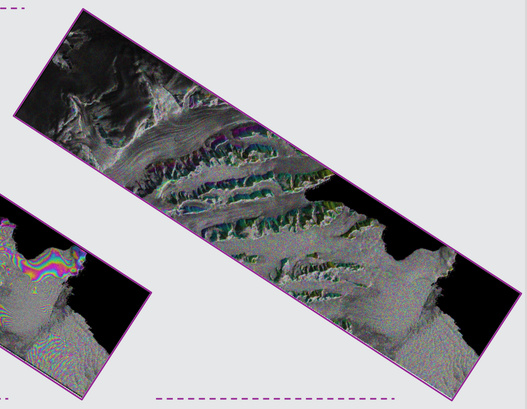
Test area (S-1 burst coverage)



Amplitude image

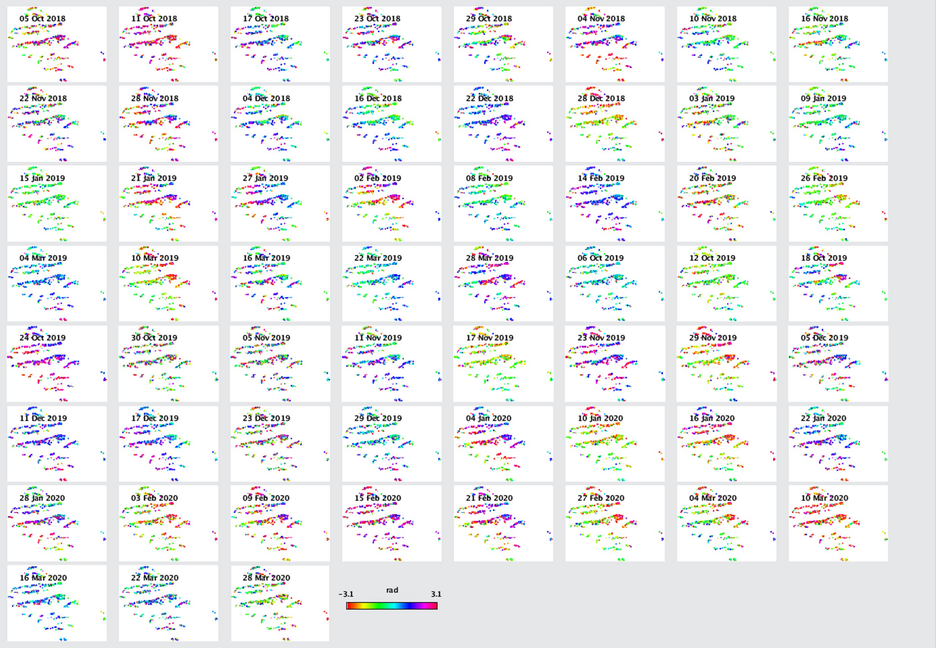


6-day wrapped Interferogram

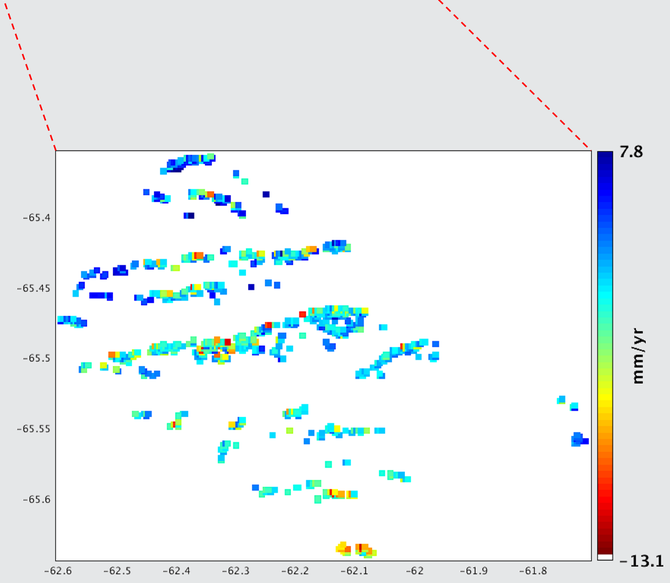


24-day wrapped Interferogram

StaMPS results for 2018.10 - 2020.03 (primary image: 20191006)



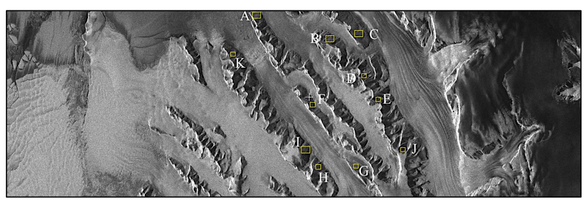
- A total of 59 Sentinel-1 scenes (bursts) utilized
- Images were collected between Oct 2018 and Mar 2020 (summer time)
- InSAR analysis performed using StaMPS software
- Topographic contribution removed using Cop 30 DEM
- 1914 Persistent scatterers identified over rock outcrops



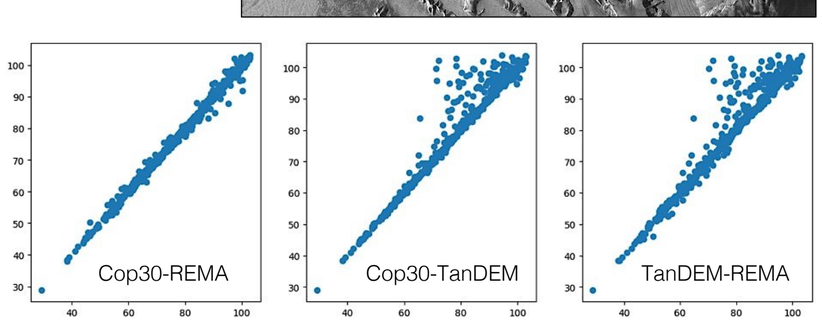
Line-of-sight bedrock deformation velocity (StaMPS) [reference: avg of all PSs]

Comparing the quality of DEM data

- Copernicus 30 (m)
- TanDEM 12 (m)
- REMA 2 (m)



Scatter plots for standard deviations (deg.) of interferometric phase



Effect of using different DEM data on the number of PS points

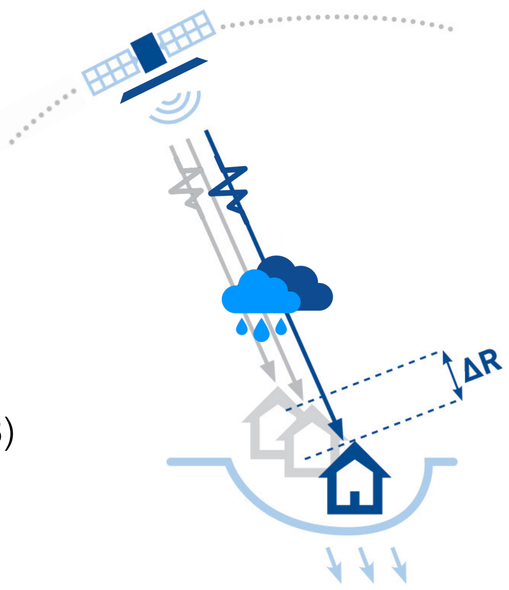
StaMPS parameters (30 patches)	Number of PSs (Cop30)	Number of PSs (TanDEM)	Number of PSs (REMA)

`Amplitude dispersion: 0.42`
`Step2: filter_grid_size = 50`
`clap_win = 32`
`Step3: select_method = DENSITY`
`density_rand = 20`
`Step4: weed_standard_dev = 1`
	1914	1121 (-41%)	1214 (-36%)

Atmospheric Correction of SLC SAR Data

Ionospheric correction
- Center for Orbit Determination in Europe (CODE) vTEC maps

Tropospheric correction
- Vienna Mapping Function 3 (VMF3)



Comparison results with the ESA ETAD

	Ionospheric path delay		Tropospheric path delay	
epoch	ETAD	CODE	ETAD	VMF3
2020-12-29	0.10838 (m)	0.10838 (m)	5.8311 (m)	5.8165 (m)
2020-08-07	0.22069 (m)	0.22069 (m)	6.2721 (m)	6.2816 (m)
2021-05-10	0.40353 (m)	0.40353 (m)	5.9253 (m)	5.8936 (m)

Natural Environment Research Council

Centre for Satellite Data in Environmental Science

Durham University

British Antarctic Survey

Email: eerbs@leeds.ac.uk