Mass balance and ice dynamics of Antarctic Peninsula glaciers

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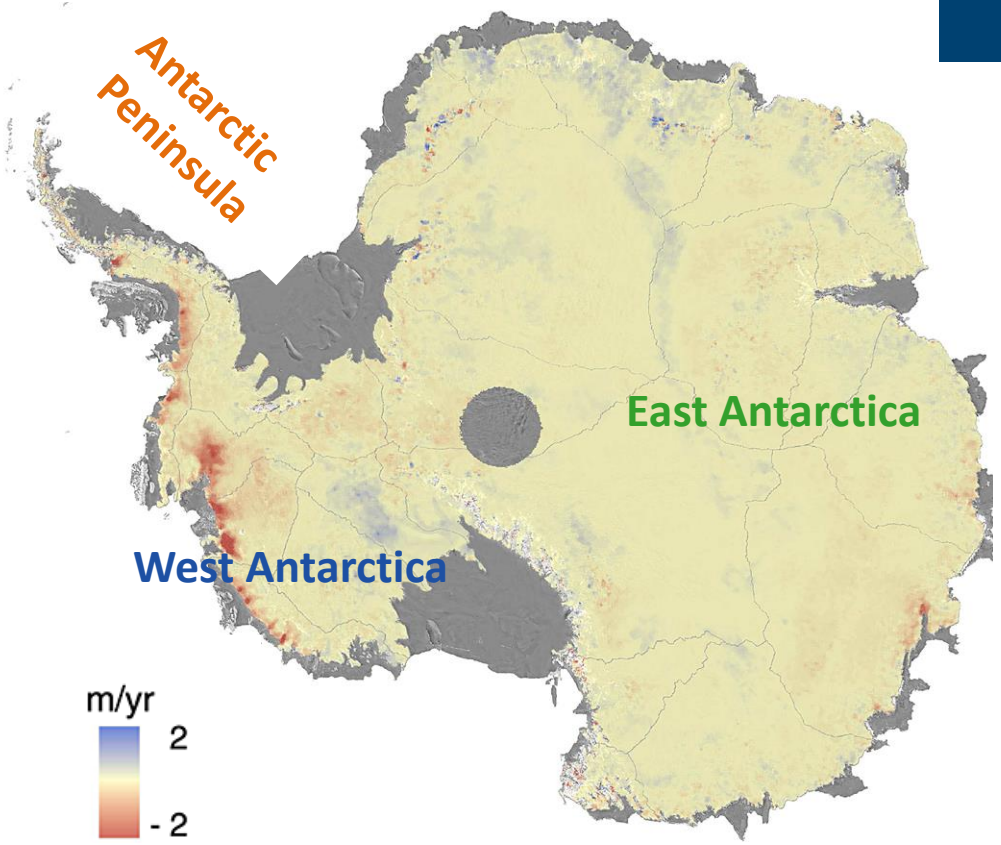
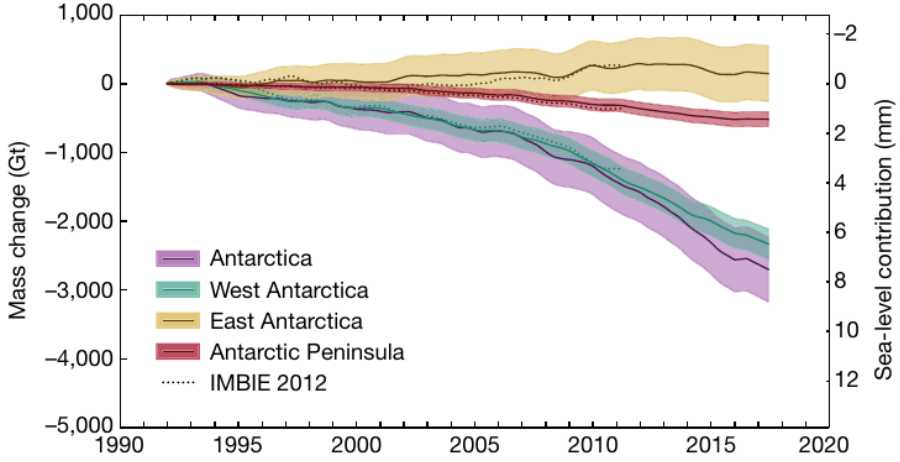
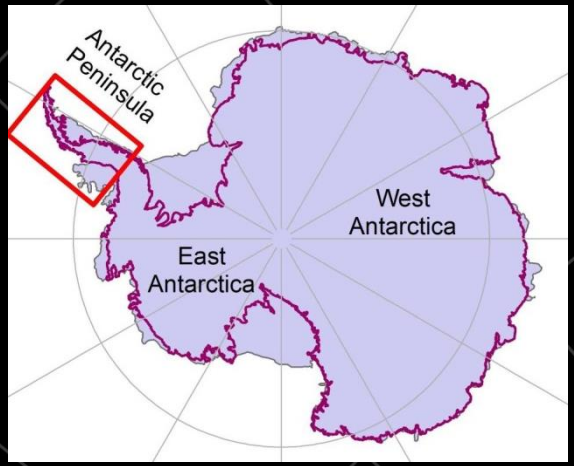
Mass balance of Antarctica





McMillan et al. 2014, GRL
IMBIE 2018, Nature

Study area: Antarctic peninsula north of ~70°S



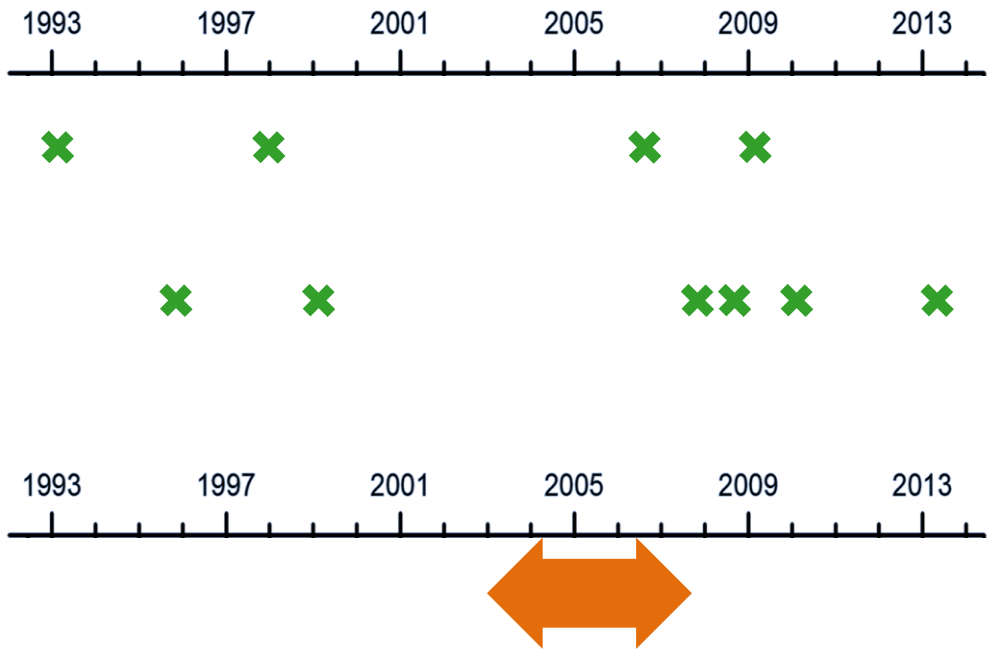
Background: LIMA © USGS
Ice shelf extent: ADD 6.0

0 100 200 300 400 km
Ice shelf extent 1960s

Bellingshausen Sea
Larsen-C
Weddell Sea

-80.000 -75.000 -70.000 -65.000 -60.000 -55.000
-60.000
-65.000
-70.000
-95.000 -90.000 -85.000 -80.000 -75.000 -70.000 -65.000 -60.000

State of the art



e.g. Rott et al. 2002, 2008, 2014; Scambos et al. 2014; Pritchard & Vaughan 2007; Seehaus et al. 2015,2016, 2018

Objectives

- area wide assessment of **geodetic mass balances** using InSAR
- temporal changes of **glacier flow** and quantification of ice discharge
- improved and precise **estimation of ice losses** on regional and glacier scales
- analysis on **spatiotemporal variations**
- assessment of causes for revealed change

Work Packages

1. Geodetic mass balance
2. Temporal changes in ice dynamics

project year	st 1 year				nd 2 year			
quarter / work package	1	2	3	4	1	2	3	4
WP 1	■	■	■	■	■	■		
WP 2			■	■	■	■	■	■

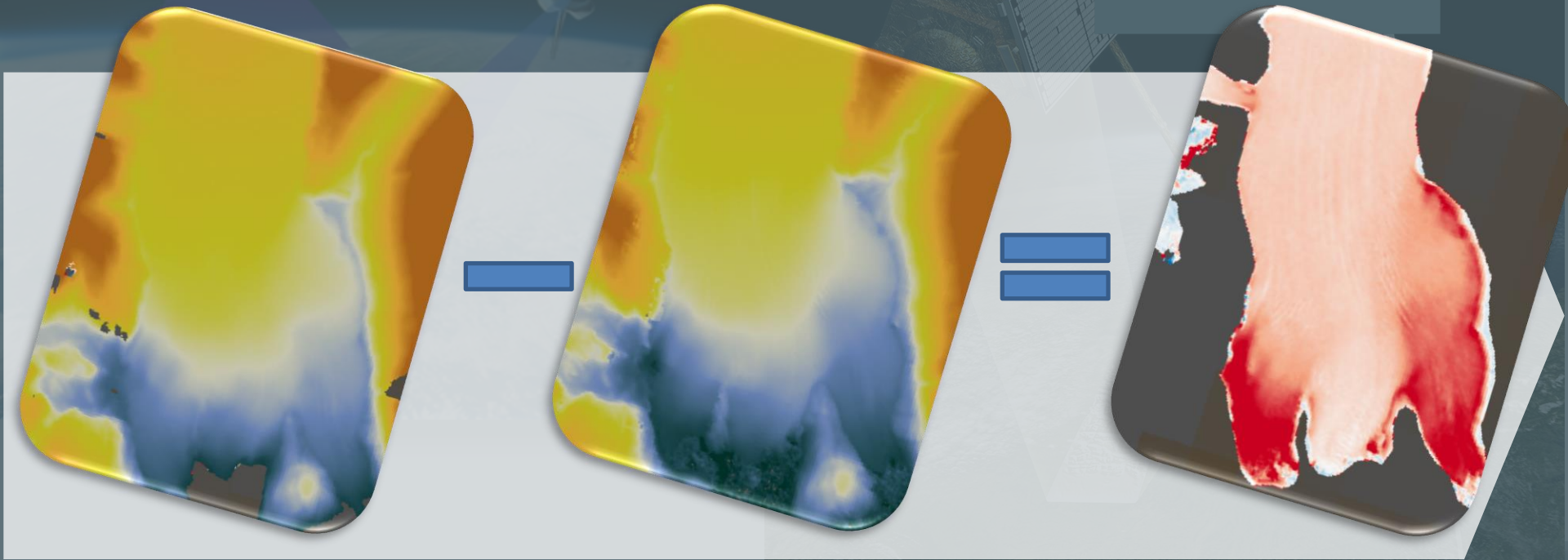
Geodetic glacier mass balance method

DEM 1

DEM 2

dh: elevation change

dV: Ice volume change



Characteristics TanDEM-X Mission

Two satellites:

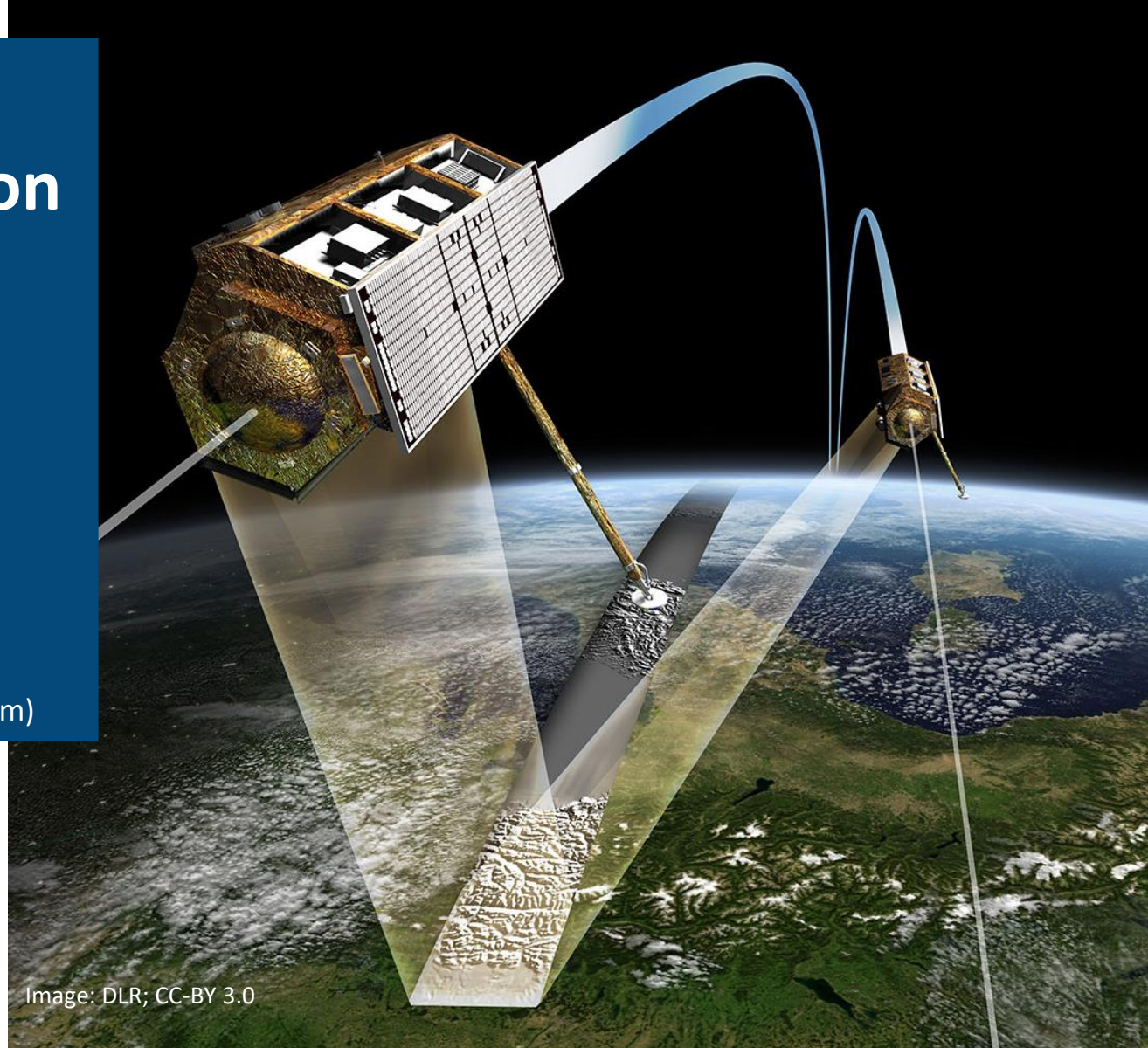
- TerraSAR-X (June 2007)
- TanDEM-X (June 2010)

-> twin satellite

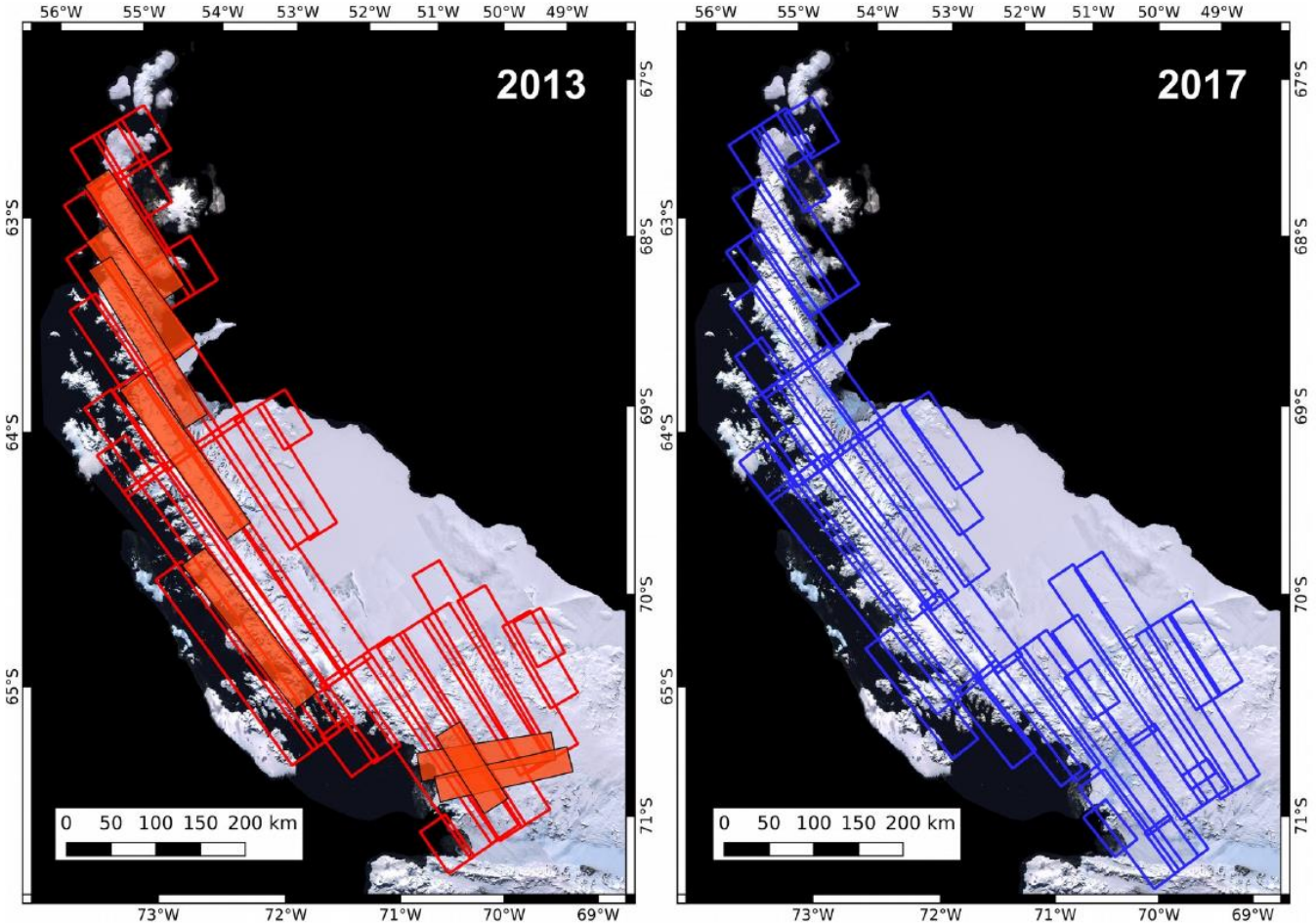
Operating altitude: 514 km

Frequency: 9,65 GHz

(X-Band, micro wave , wavelength ~ 3 cm)



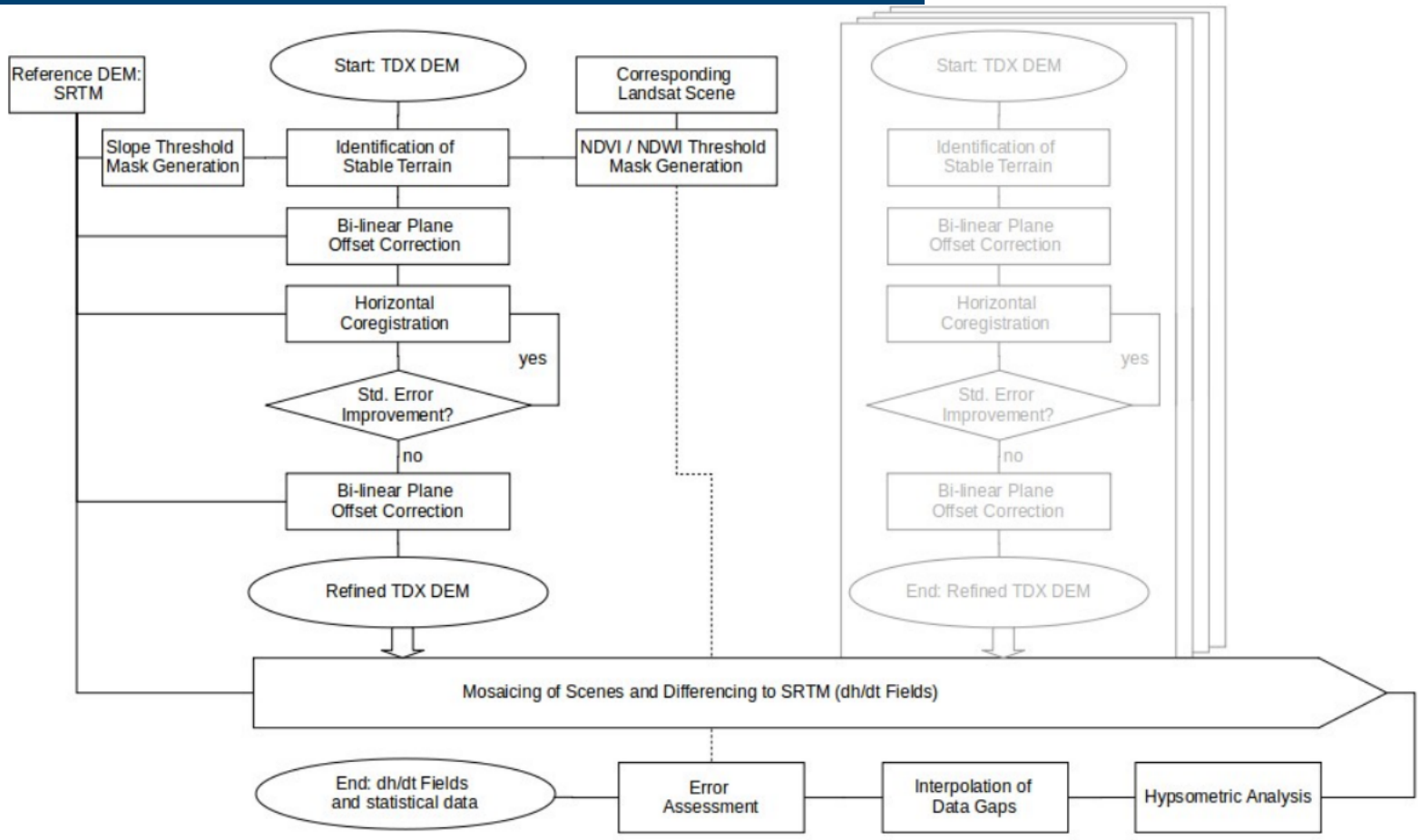
Coverage



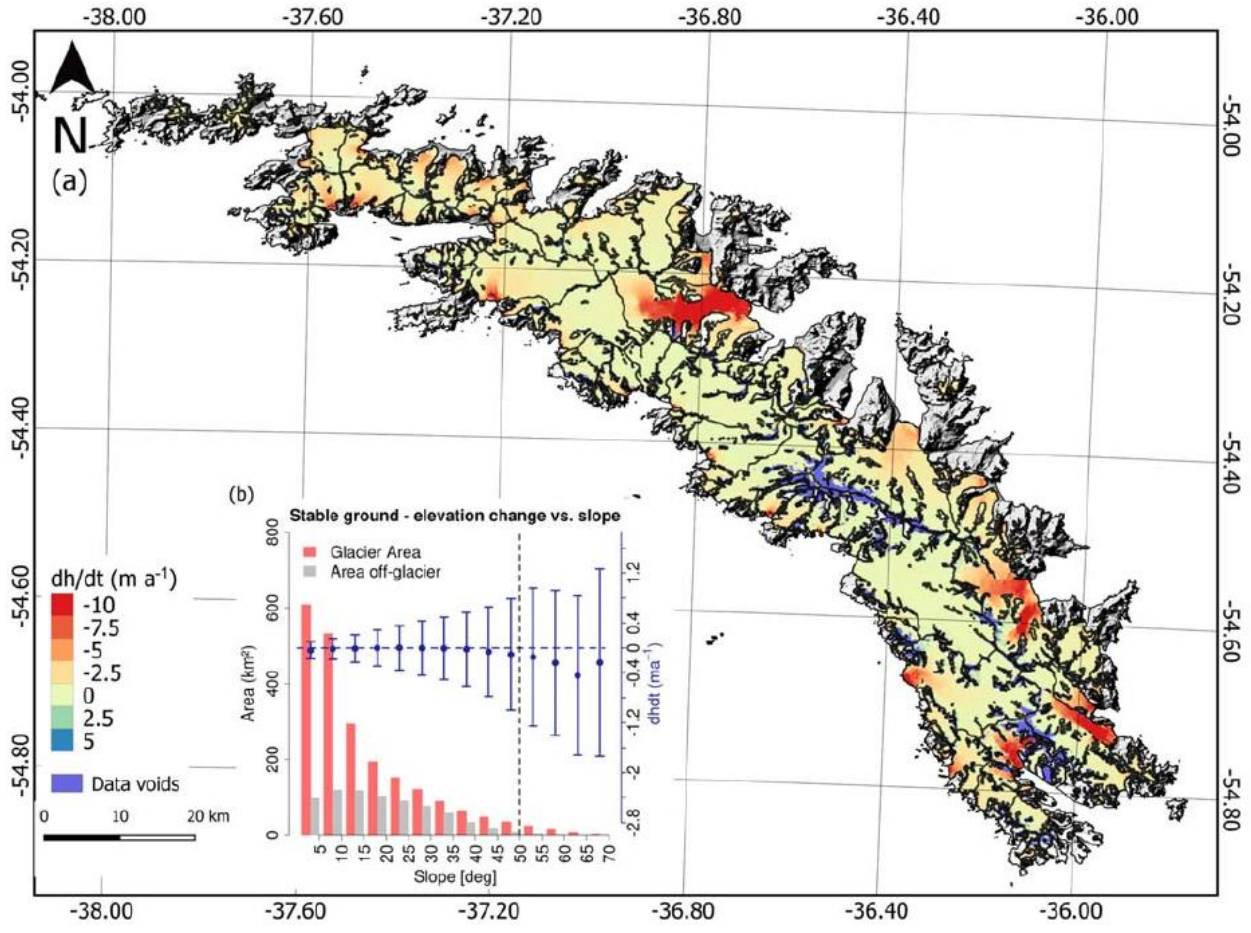
+ additional STS and WorldDEM coverage (expected to be released)

Background: LIMA © USGS

TanDEM-X Processing



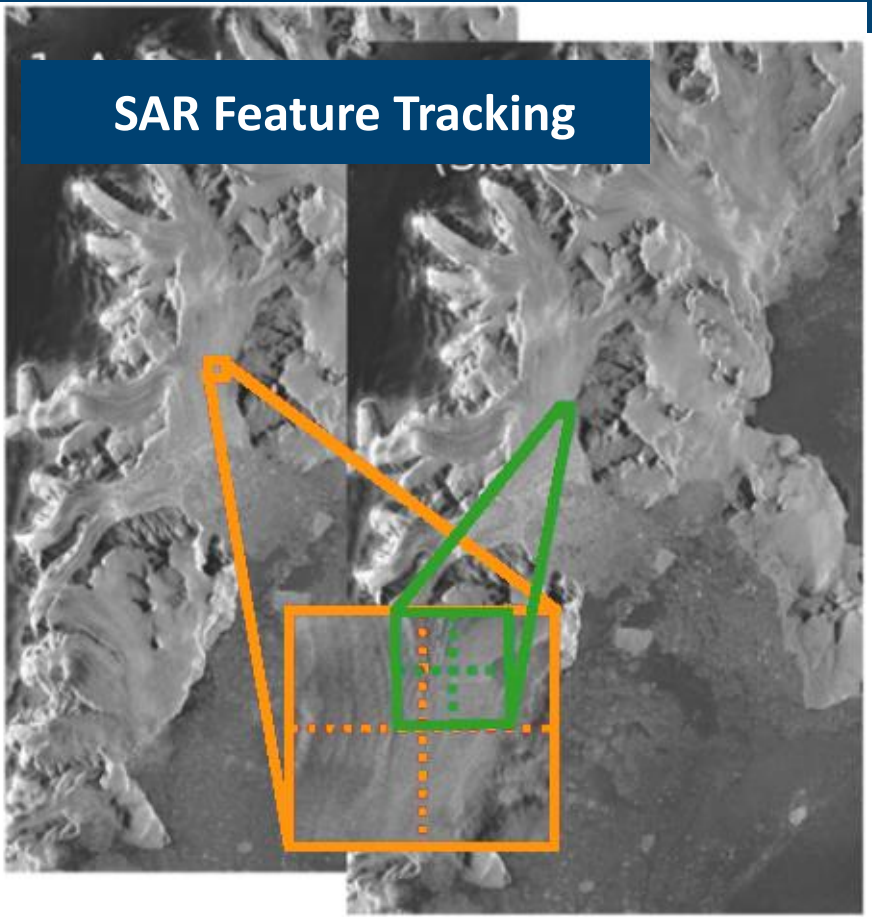
Elevation and Mass changes



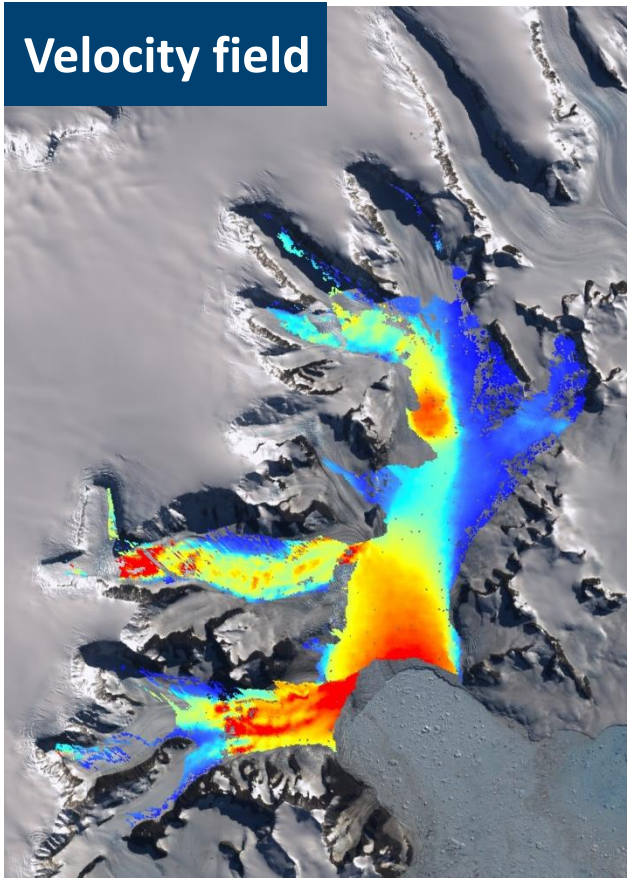
South Georgia
Farias et al. 2020
ERL

Ice dynamics

SAR Feature Tracking



Velocity field



Temporal analysis and characterization of ice dynamics

Velocity trend (1992-2014)

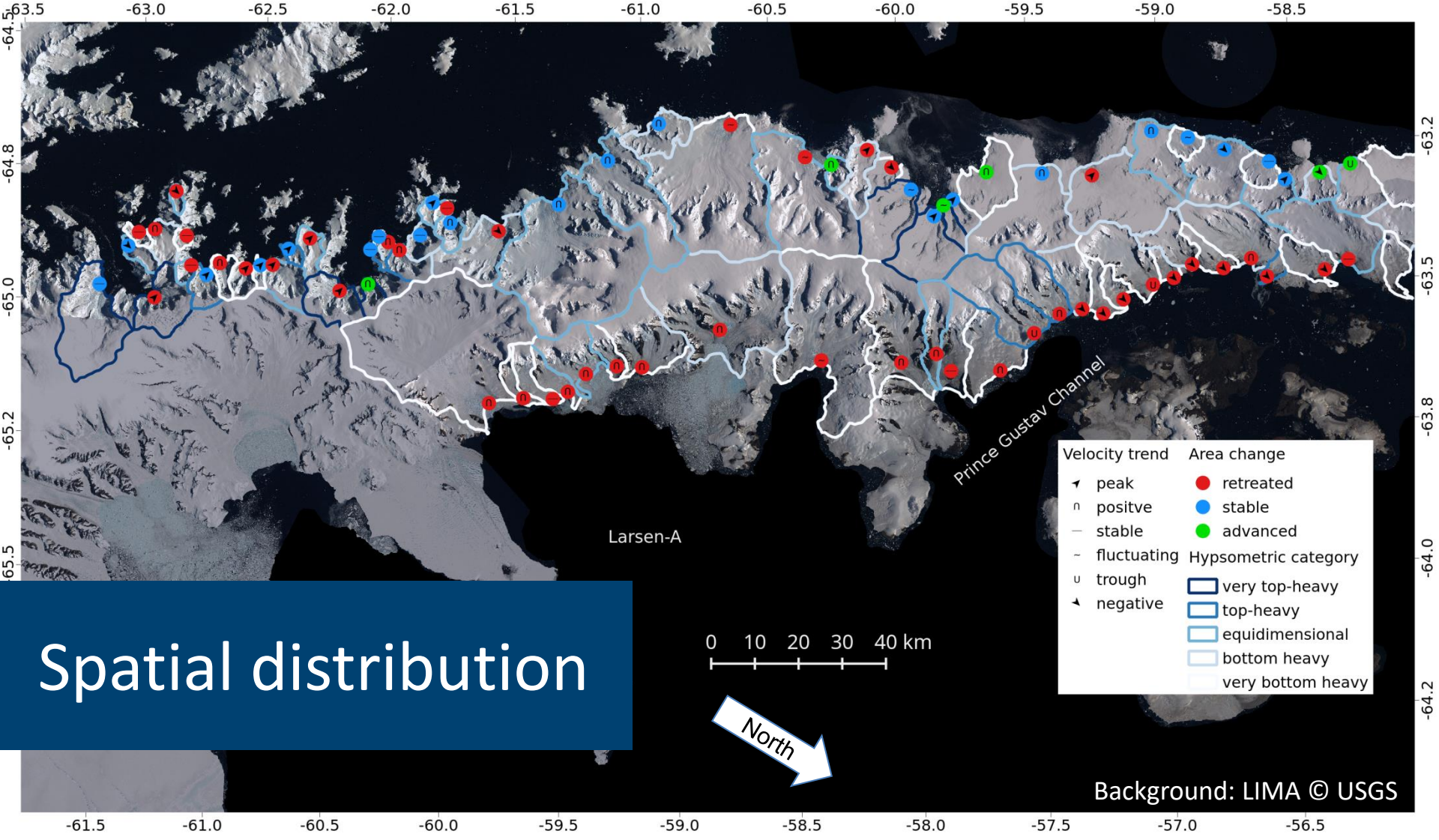
- ∩ *peak*
- ➤ *positive*
- ➤ *negative*
- — *stable*
- ~ *fluctuating*
- U *trough*

Hypsometric Index

Jiskoot et al. 2009

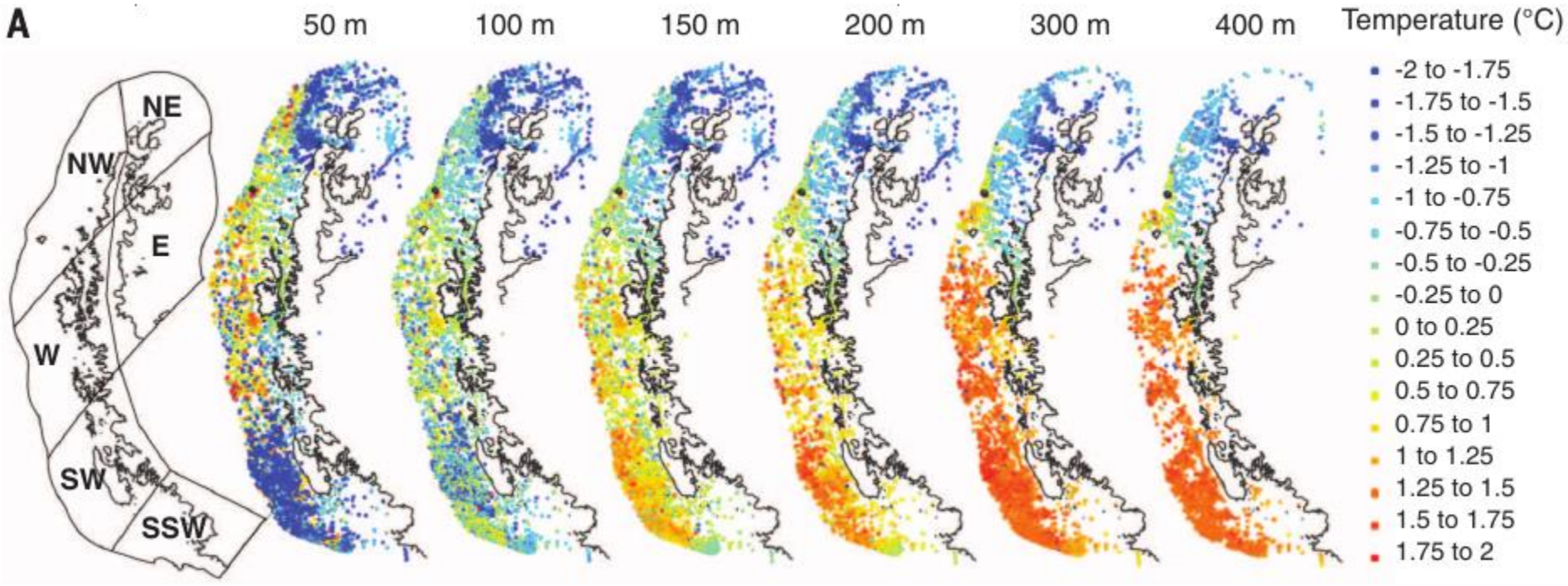
- *very top-heavy*
- *top-heavy*
- *equidimensional*
- *bottom heavy*
- *very bottom heavy*

Seehaus et al. 2018



Spatial distribution

Correlation with Ocean and Atmospheric Variables



e.g. Ocean temperature; Cook et al. 2016, Science Mag.

Collaborations/Support

- Joint supervision of PhD thesis of at Universidad Politécnica de Madrid (intra-annual glacier fluctuations + South Shetland Islands)
- World Glacier Monitoring Service
- IMAU and University of Liege (atmospheric Modelling)