

# TANDEM-X: STATUS AND SCIENCE ACTIVITIES

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# TerraSAR-X-add-on for Digital Elevation Measurements

Launched: 21-Jun-2010

## Satellite Status

- **Hydrazine:** TSX: 39% TDX: 34%
- **Battery Capacity:** TSX: 62% TDX: 68%
- **Instrument Performance:**  
(stability of the measured radar cross section):  
TSX and TDX:  $\sigma \approx 0.2 \text{ dBm}^2$  - still excellent!
- Both TerraSAR-X and TanDEM-X satellites are fully functional
- Irretrievable on-board resources allow operations at least until 2029



# TanDEM-X DEM



It is the basis for the Copernicus DEM!

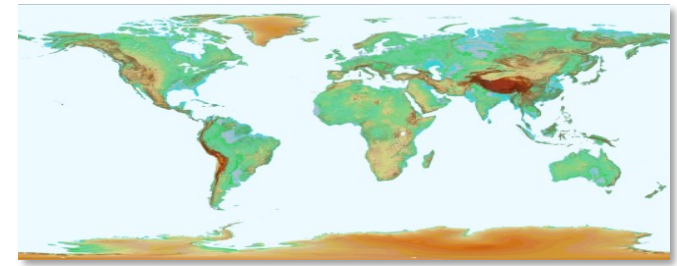
- Global Coverage (150 Mio. km<sup>2</sup>)
- Posting: 12 m x 12 m
- Absolute Height Accuracy: ~1 m
- Acquisition Dates: 2011 – 2015
- Completed: Sep. 2016

# DEM Products for Scientific Use

TanDEM-X: 90 m DEM free for download available

~ 5 Mio (~257x Global DEM) downloads

from 8549 registrations



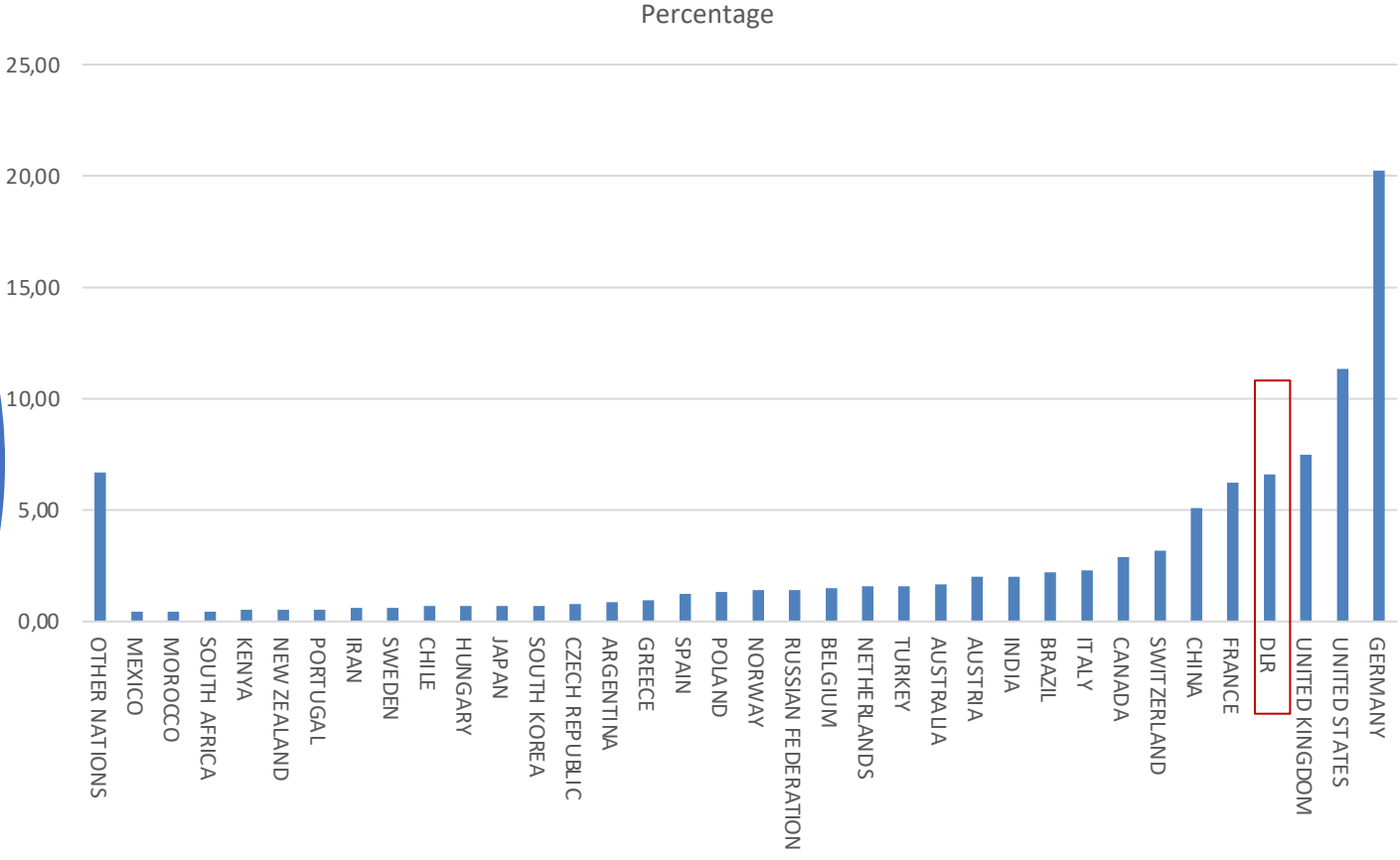
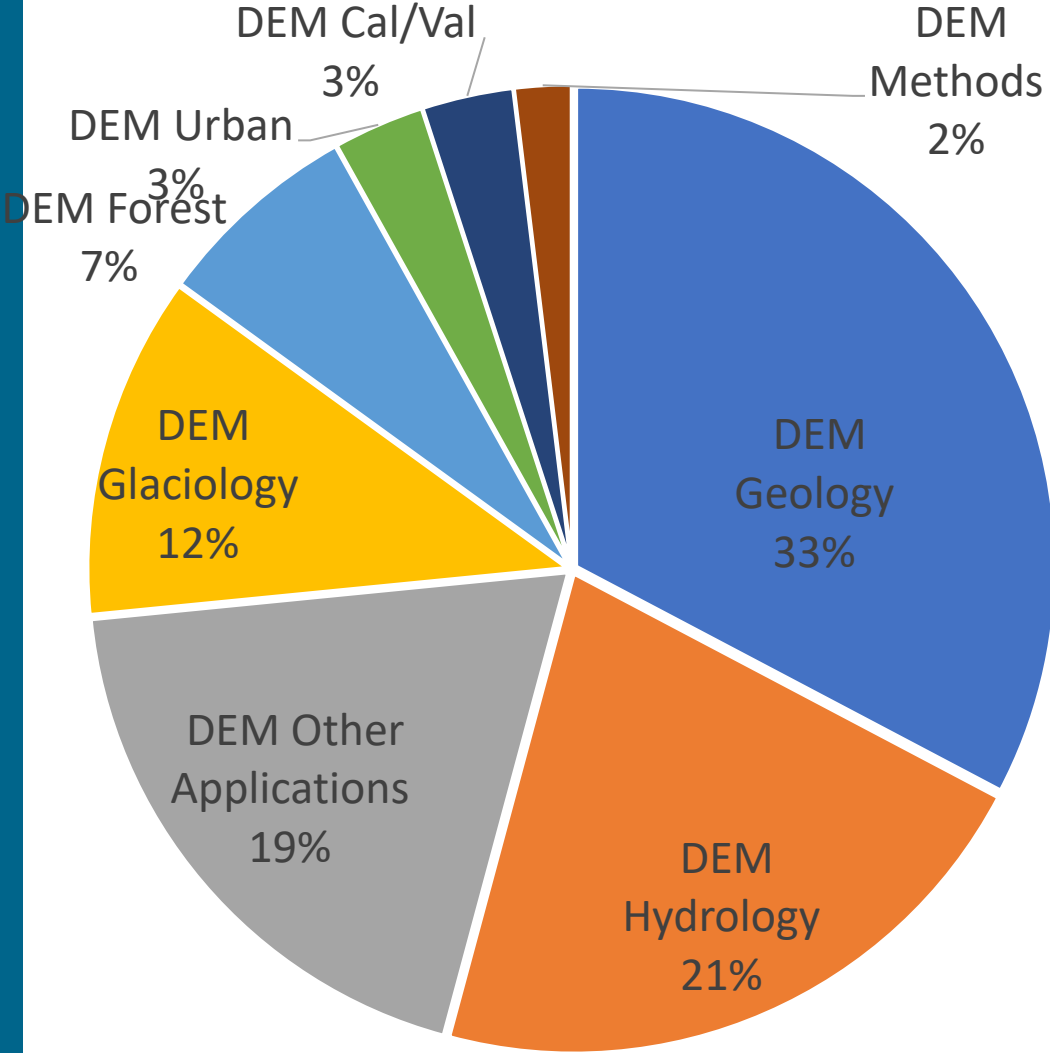
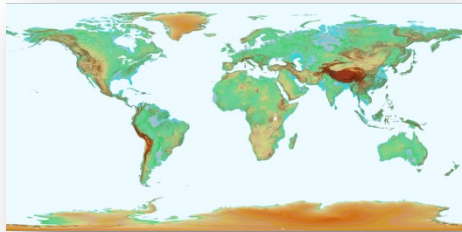
Global TanDEM-X DEM (12 m) production finished Sept. 2016

Global TanDEM-X DEM (90 m) available since 2018

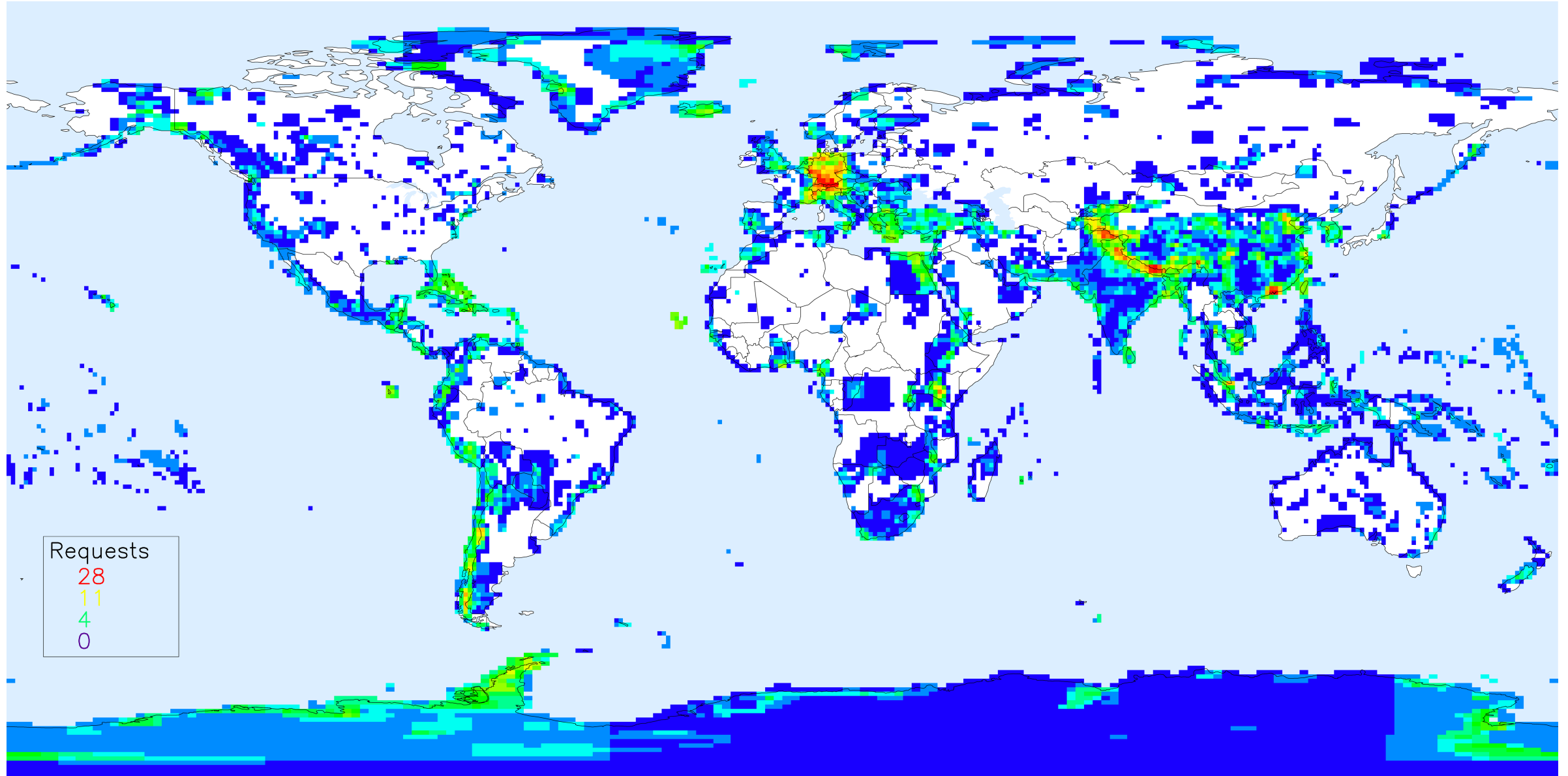
Global TanDEM-X Forest/Non-Forest Map (50 m) available since 2019

DEM Product	Spatial Resolution Absolute	Horizontal Accuracy CE90	Absolute Vertical Accuracy LE90	Relative Vertical Accuracy
TanDEM-X DEM (standard product 0.4 arcsec)	~12 m (0.4 arcsec @ equator)	<10 m	<10 m	< 2 m (slope @ 20%) < 4 m (slope > 20%) 90% linear point-to-point error within an area of 1°x1°
TanDEM-X DEM (1 arcsec)	~30 m (1 arcsec @ equator)	<10 m	<10 m	Not specified
TanDEM-X DEM (3 arcsec)	~90 m (3 arcsec @ equator)	<10 m	<10 m	Not specified

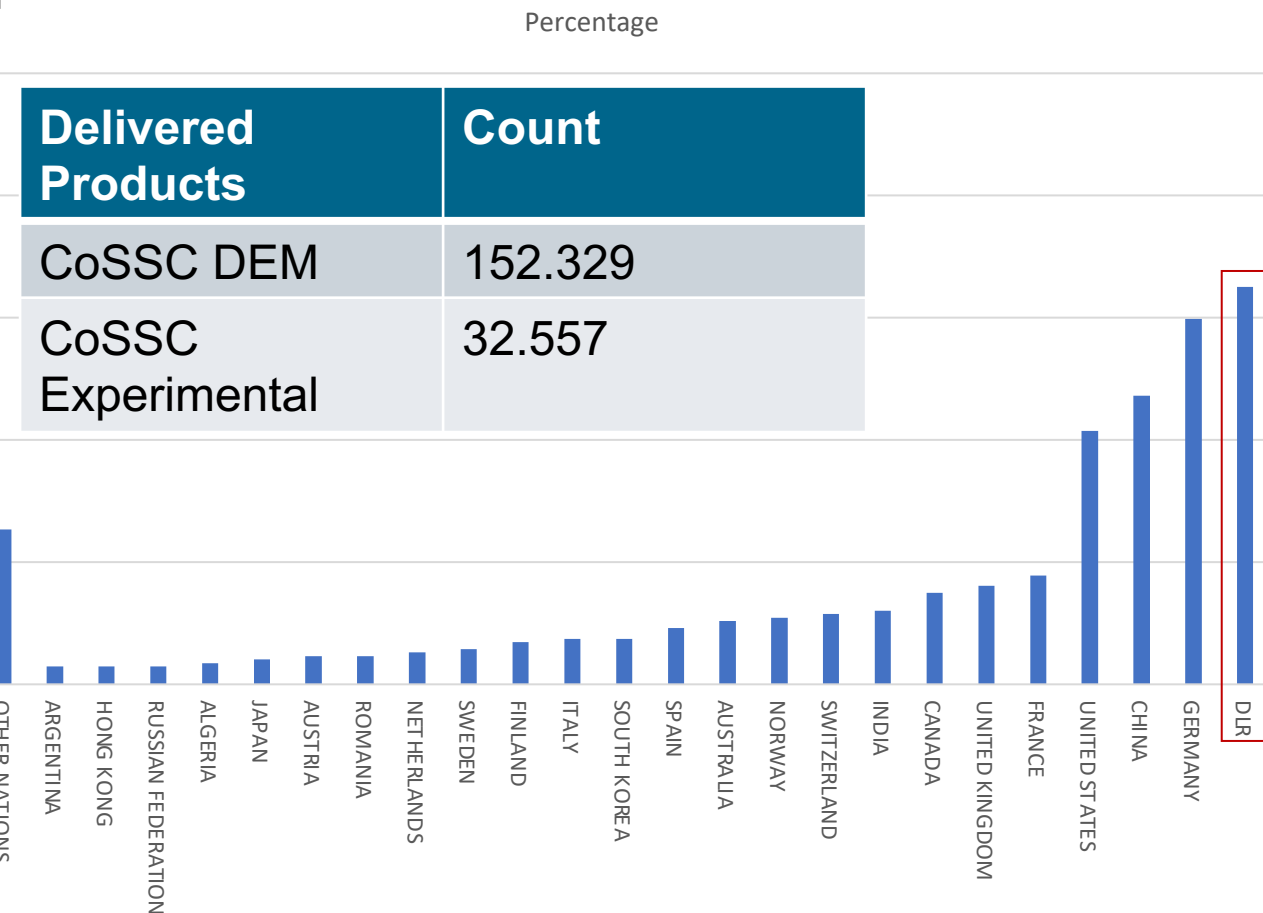
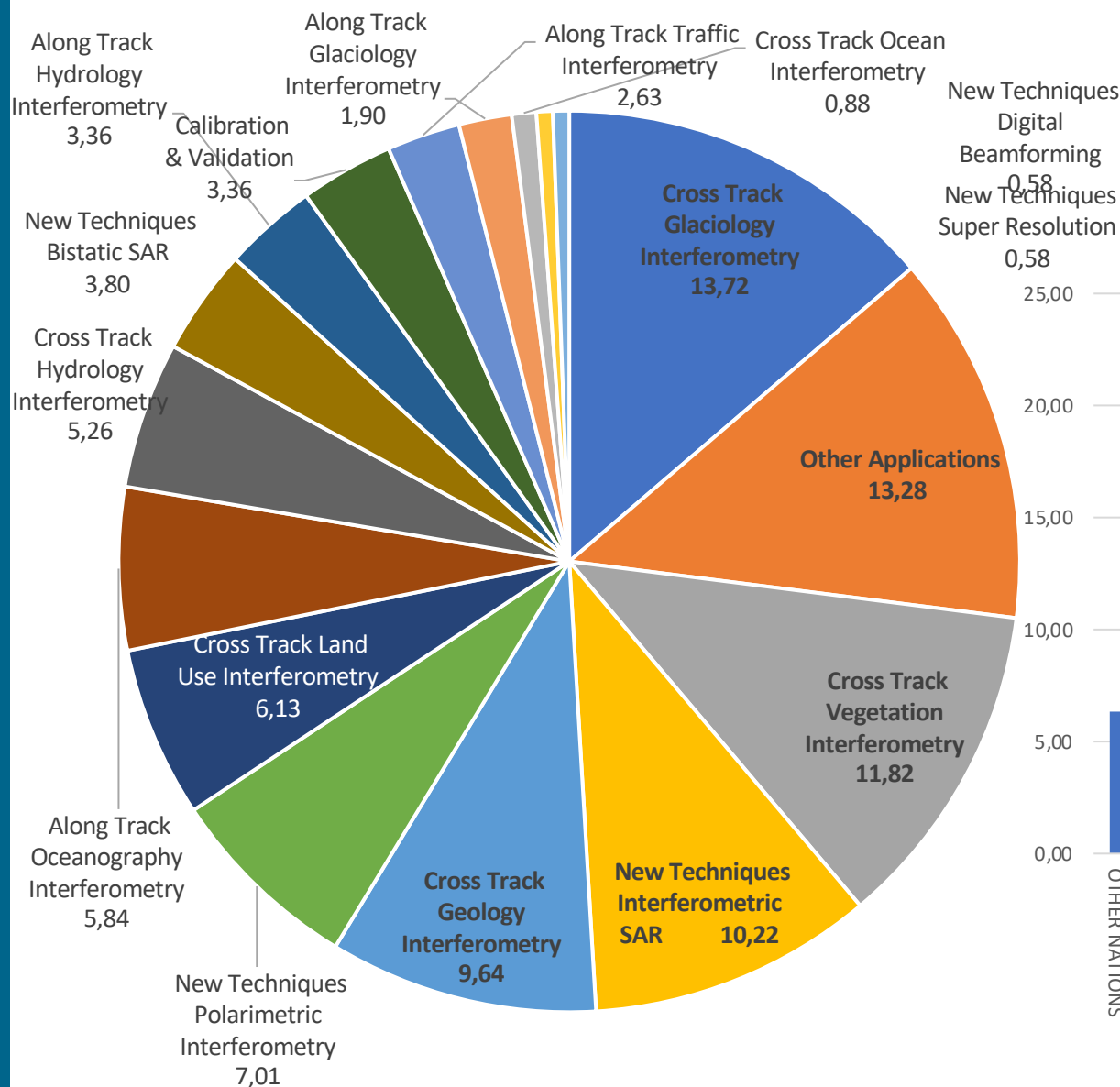
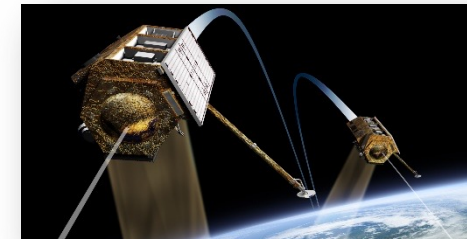
# DEM AO: Application Domains & Countries 2022



# DEM Product: Heat Map



# CoSSC AO: Application Domains & Countries



# Joint PAZ/TDX/TSX Proposal Submission (since 2022)

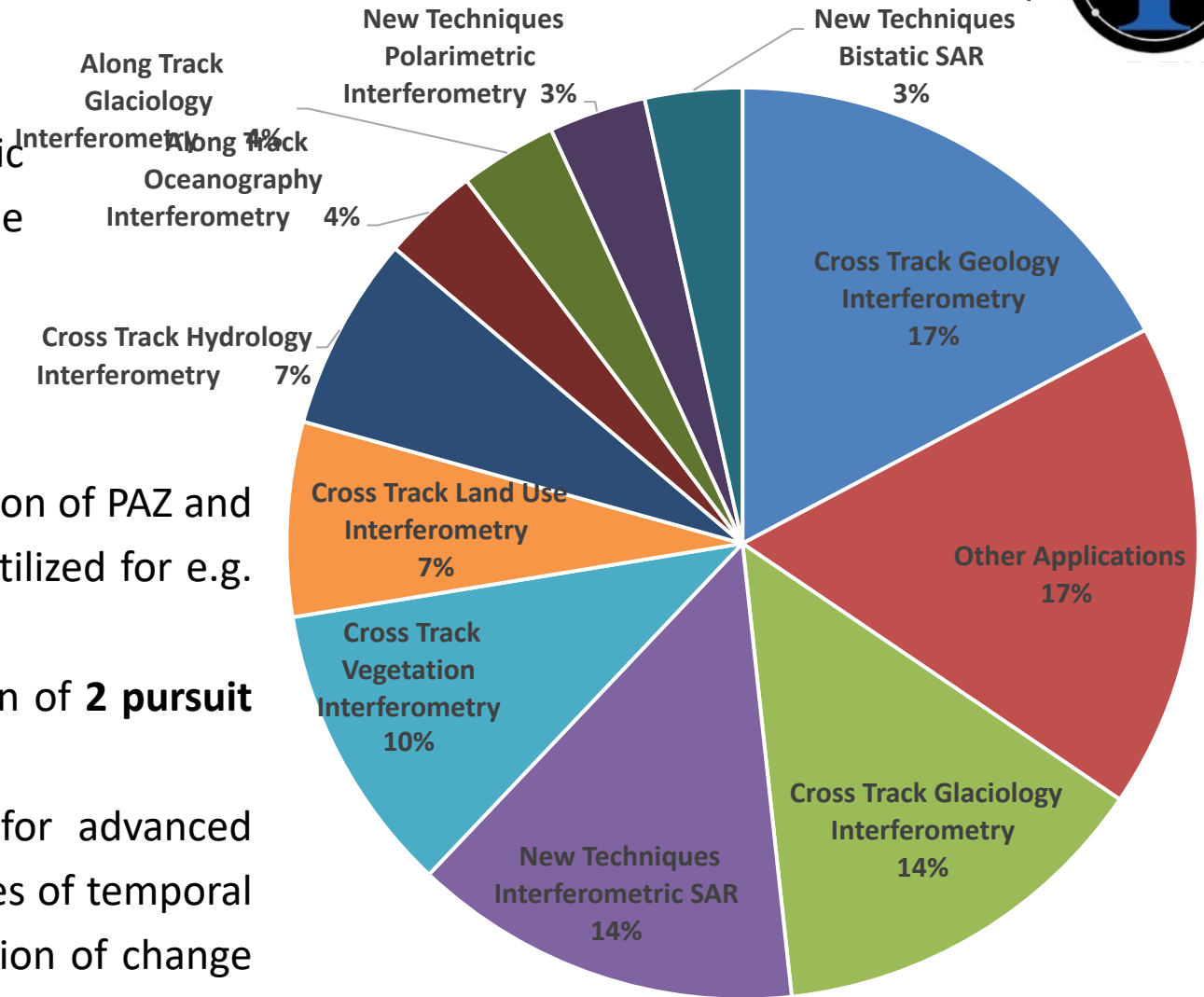


## Total approved proposals >40

Combination of 3 almost identical satellites for scientific purposes is a unique data acquisition opportunity by the combination of monostatic and bistatic images.

Different scenarios can be considered:

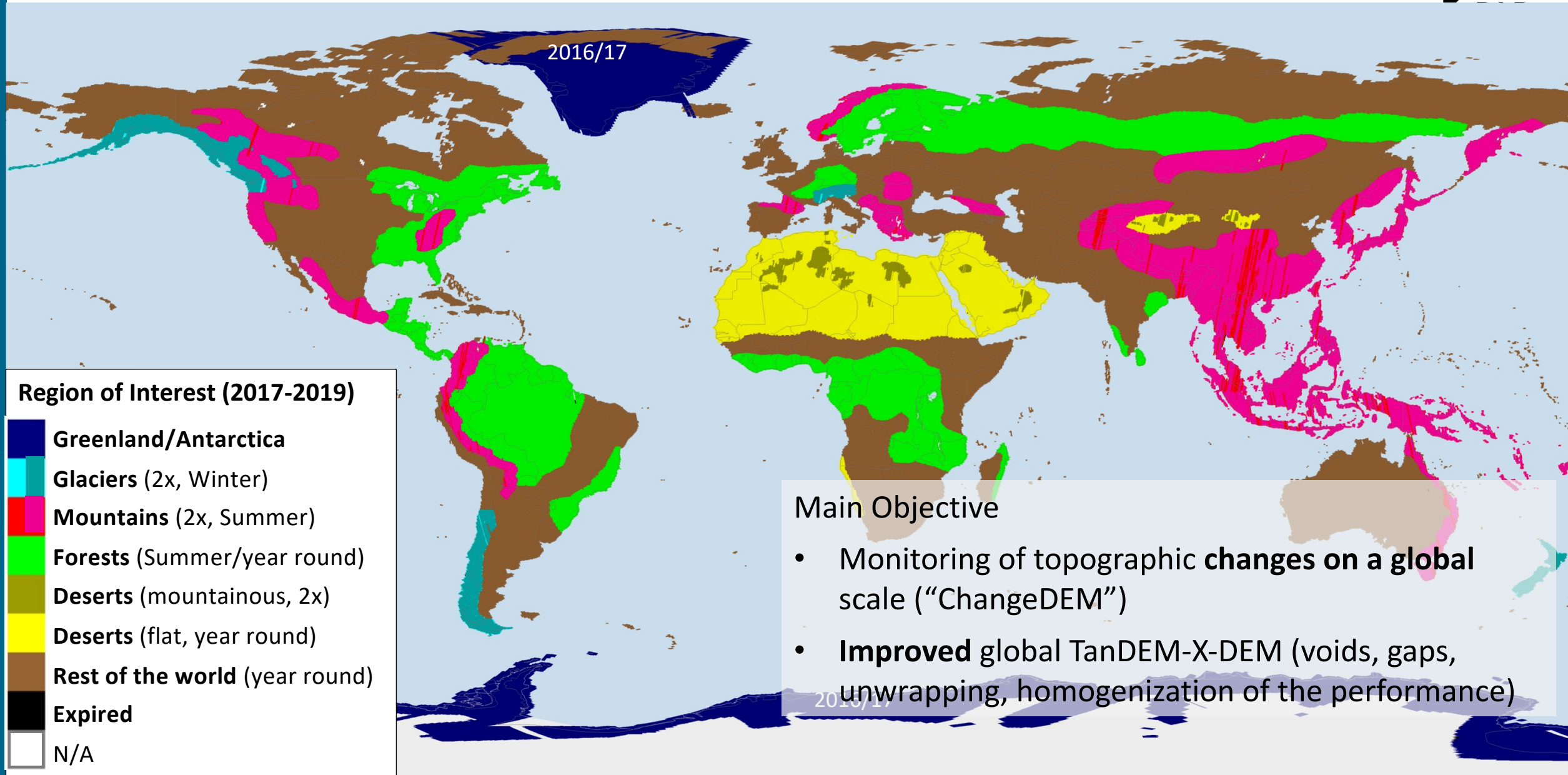
- acquisition of pursuit monostatic data sets (Combination of PAZ and one out of TerraSAR-X or TanDEM-X), which can be utilized for e.g. repeat pass interferometry; (**repeat pass of 4-7 days**).
- combination of all 3 satellites will allow the derivation of **2 pursuit monostatic pairs** (PAZ-TerraSAR-X, PAZ-TanDEM-X)
- and **1 bistatic image pair** (TerraSAR-X-TanDEM-X) for advanced studies. The latter will e.g. allow interferometry studies of temporal decorrelation for natural targets, or allow the derivation of change detection products, or pseudo-quadpol data sets.





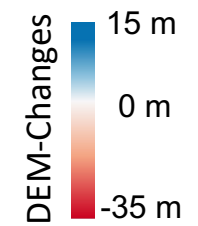
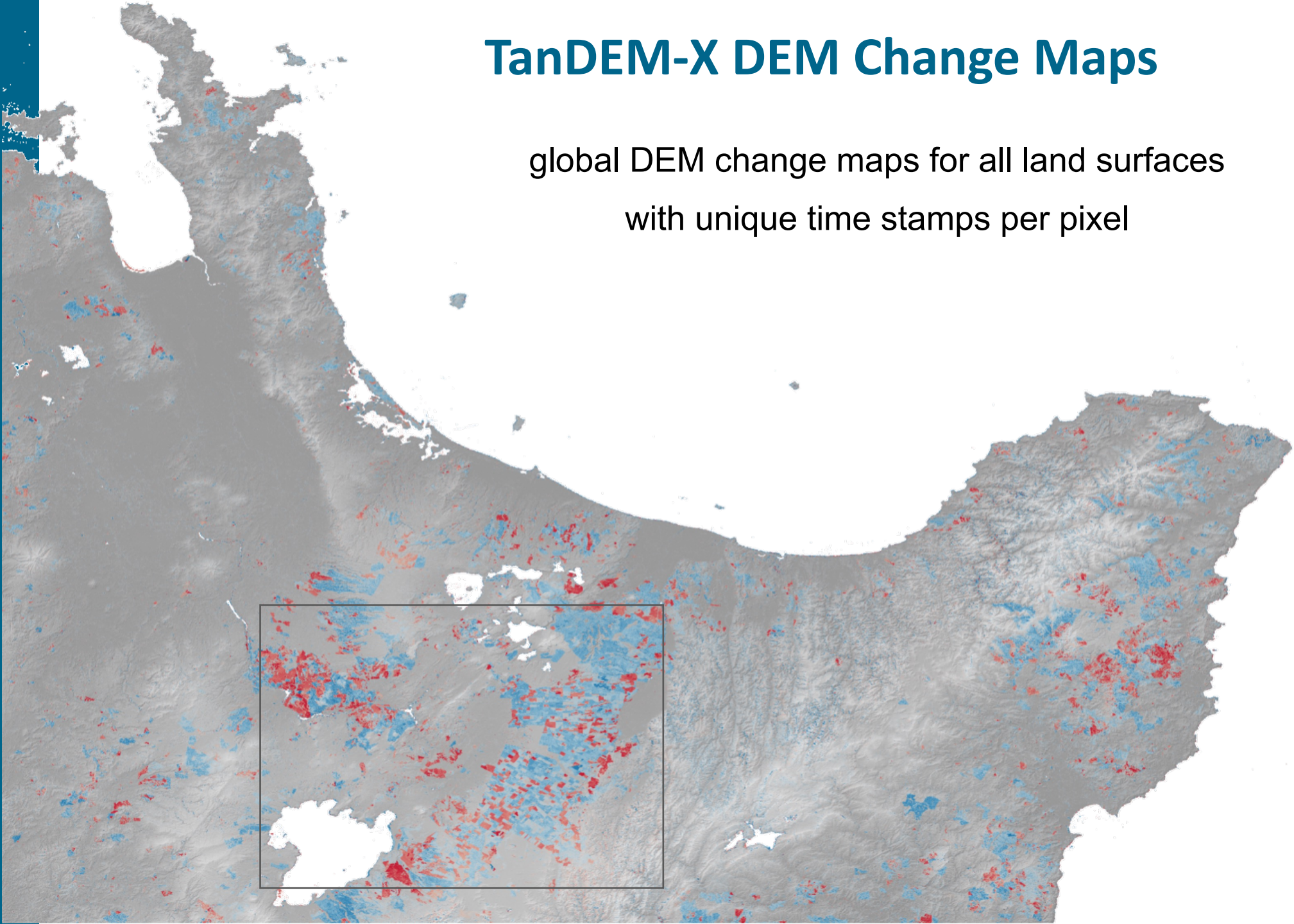
# TanDEM-X DEM Change Map

- 19 780 acquisitions successfully performed
- Currently in processing



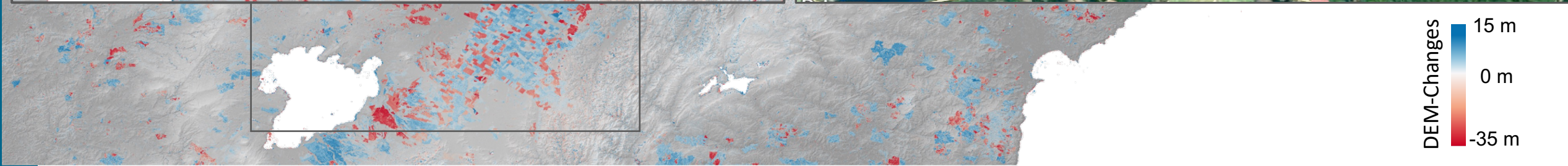
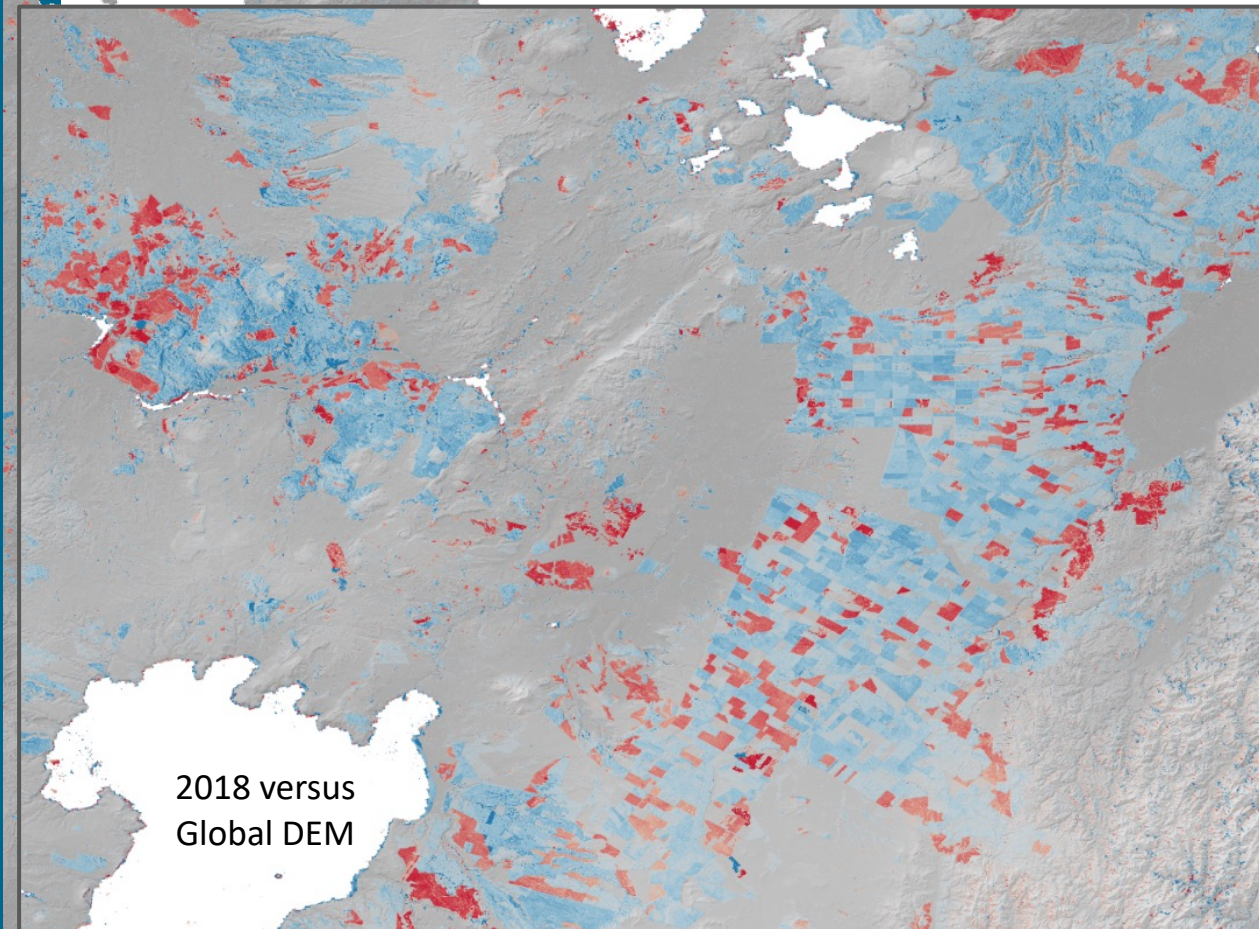
# TanDEM-X DEM Change Maps

global DEM change maps for all land surfaces  
with unique time stamps per pixel



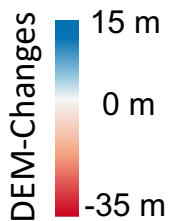
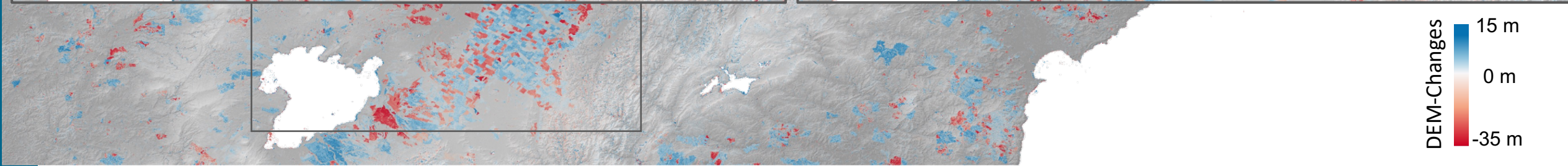
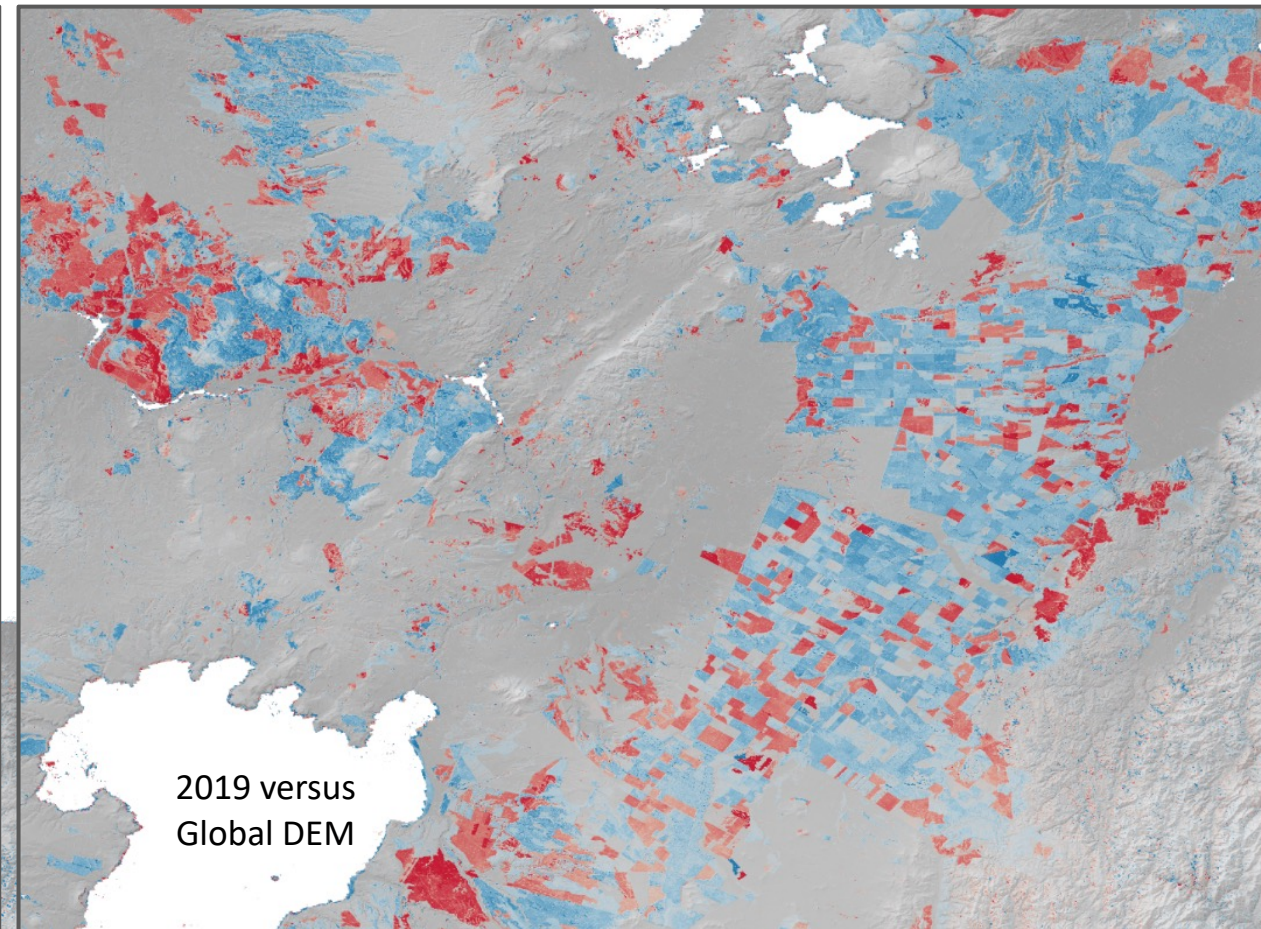
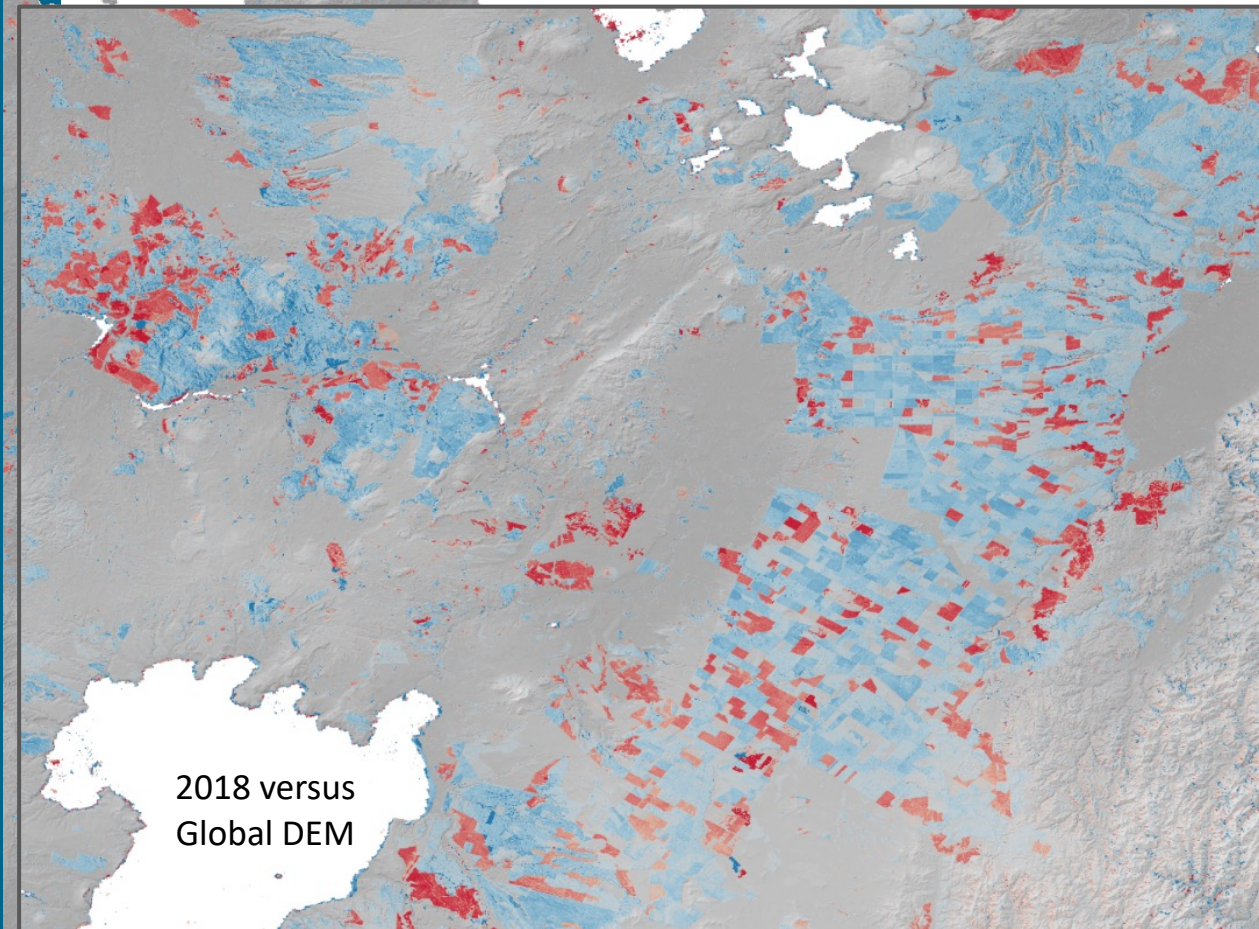
# TanDEM-X DEM Change Maps

Time series to track height changes

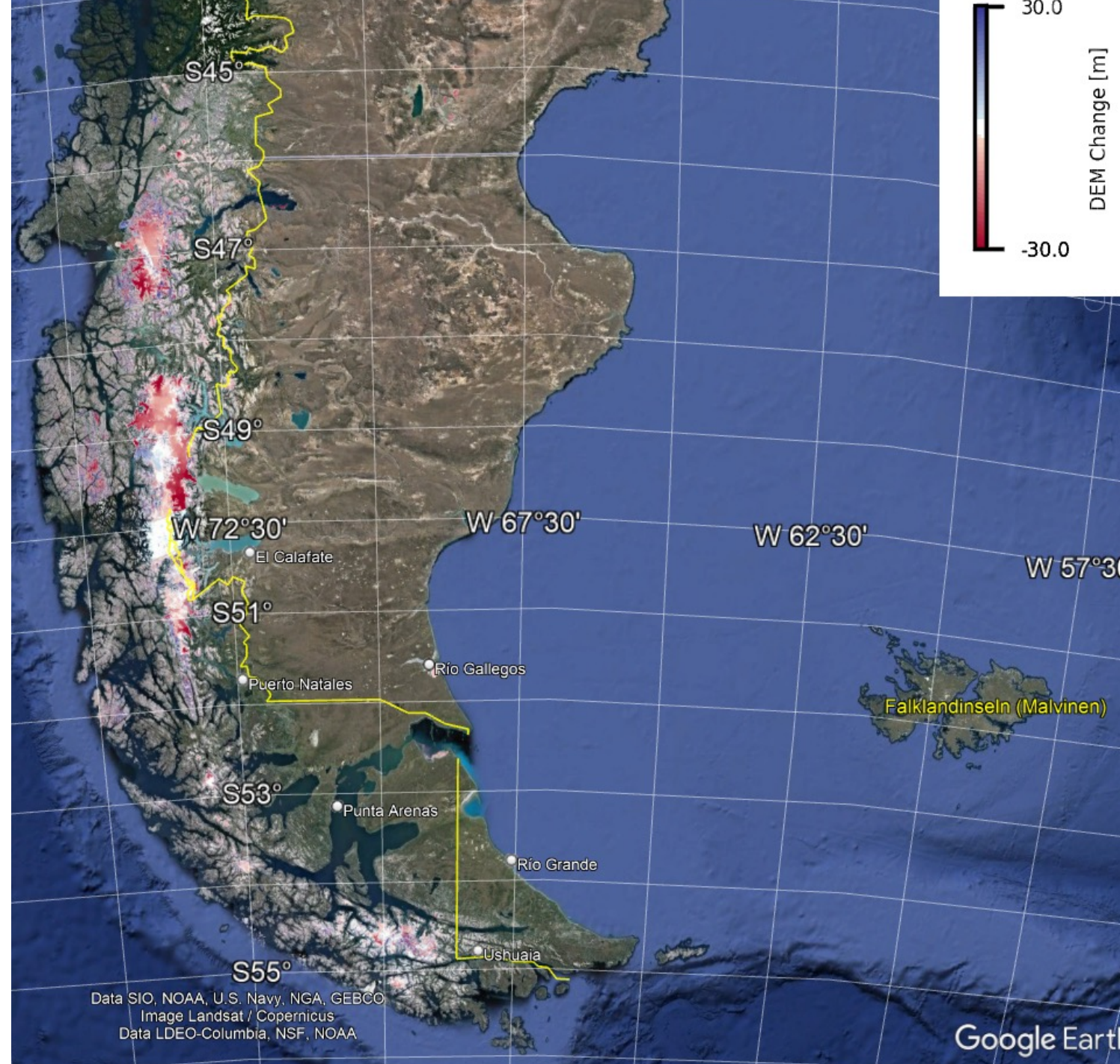
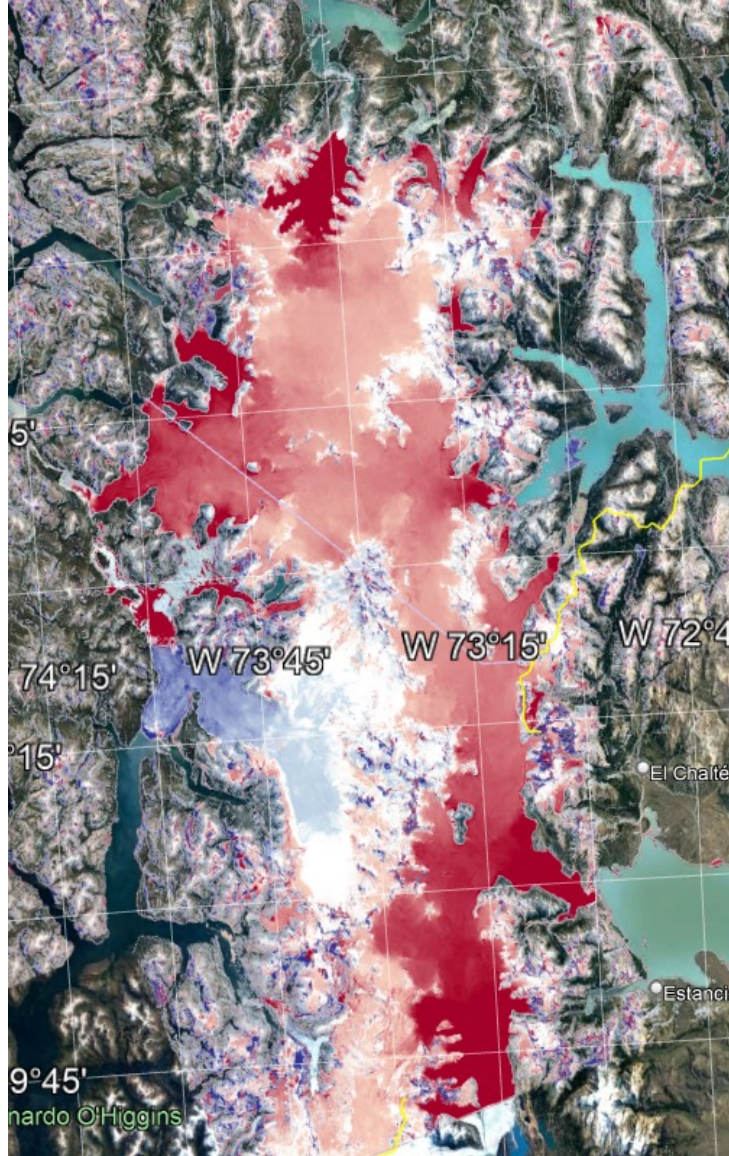


# TanDEM-X DEM Change Maps

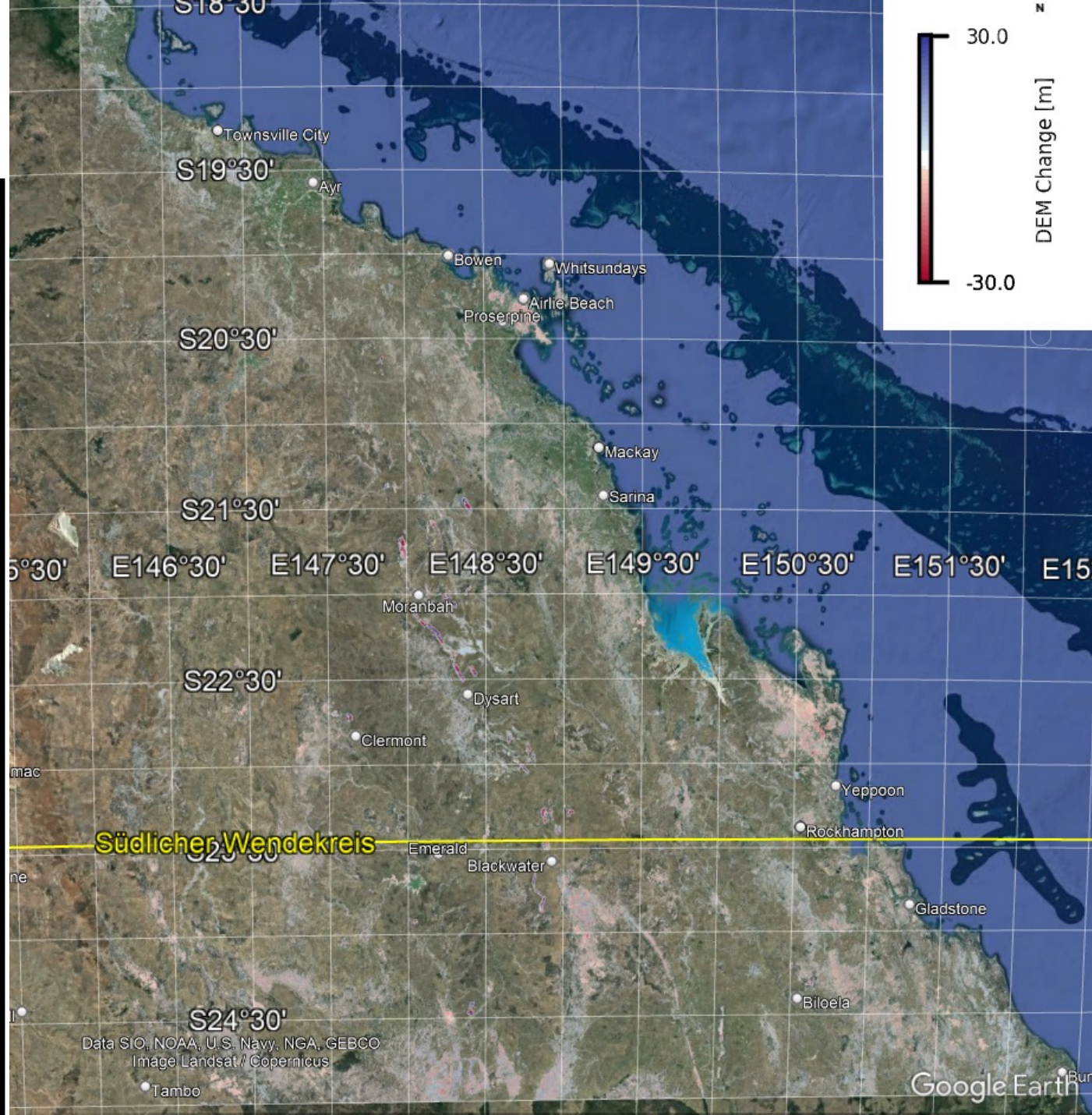
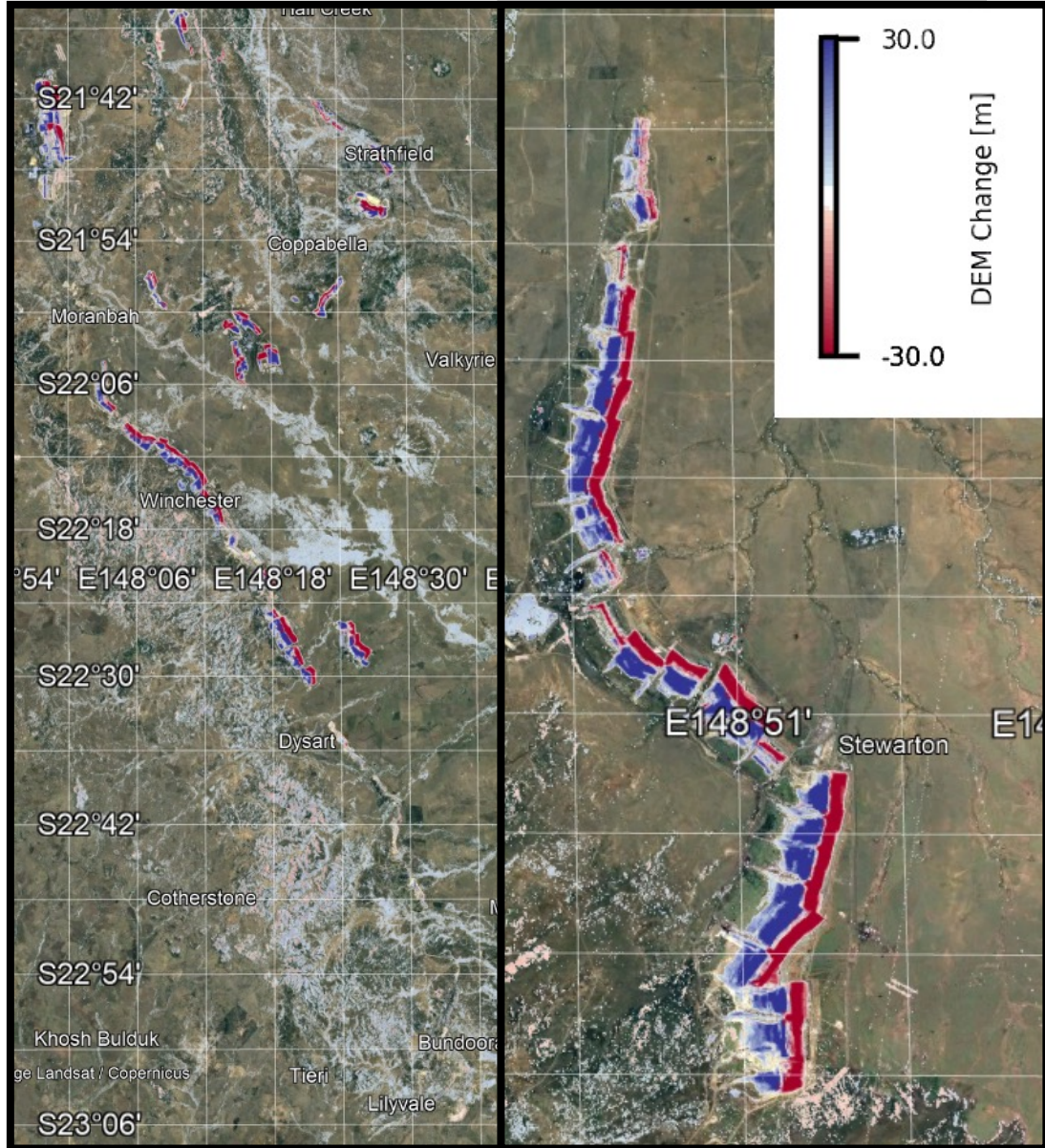
Time series to track height changes



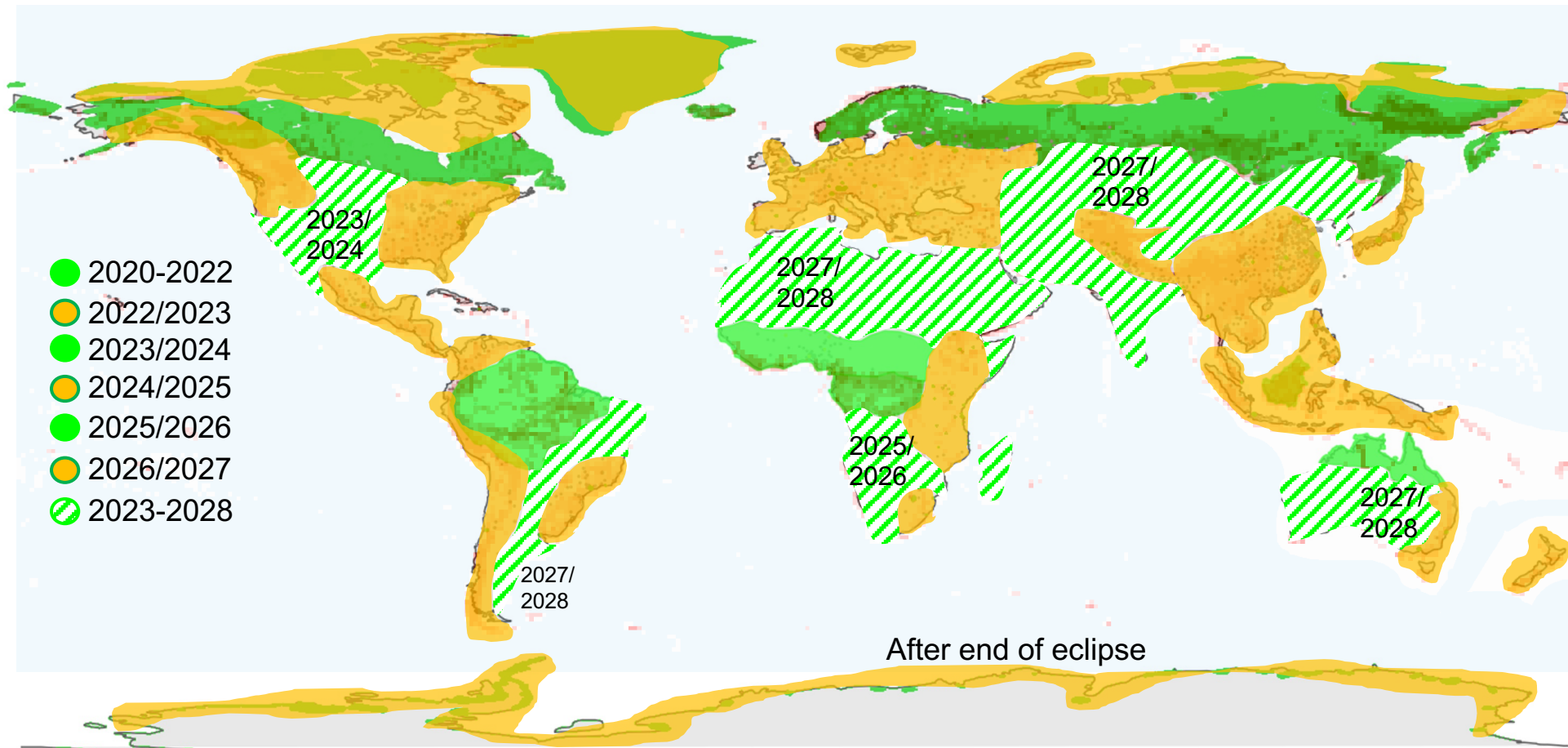
# TanDEM-X DEM Change Maps: Southern Patagonian Ice Field



# TanDEM-X DEM Change Maps: Open Pit Mining Australia



# TanDEM-X 4D Phase – Long-Term Coverage Plan 2020 - 2028

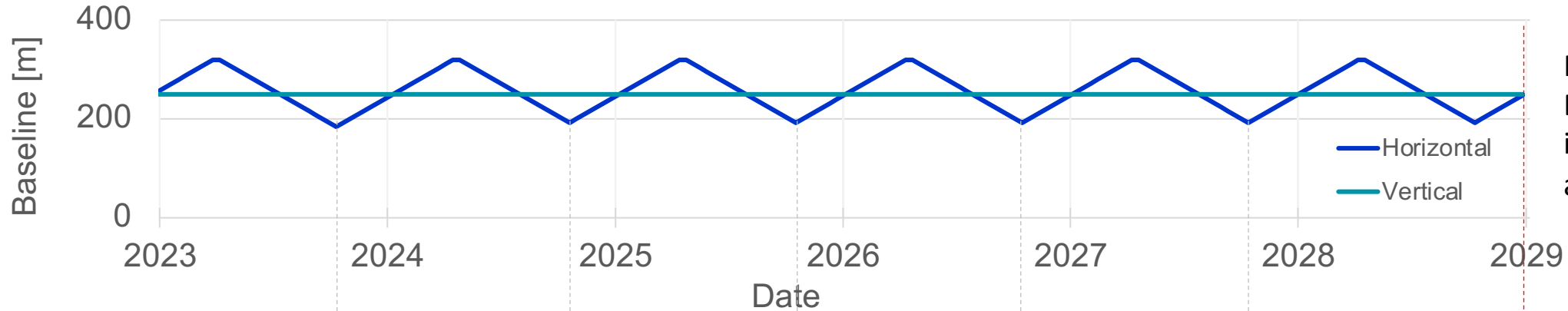


- Multi-Temporal Coverages of the Earth over more dynamic height changes
- Also try to cover more stable areas once more only

# TanDEM-X 4D Phase – Long-Term Timeline 2023 - 2028



TanDEM-X Mission 2022 - 2028



Fuel saving:  
Drifting formation via inclination difference as for Tandem-L

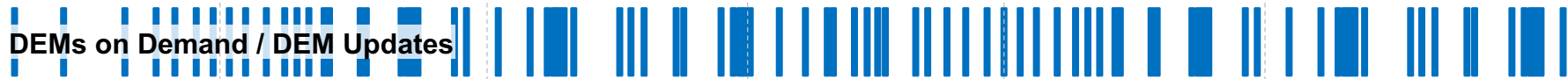
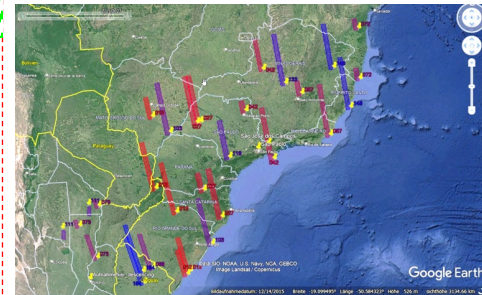
Change Regions	Forests	Change Regions	Forests	Change Regions	Small parts of Forests, Arctic, Glaciers, Urban
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Battery preservation:  
Shorter DTs ~ 40 sec with gaps afterwards

Europe	Arctic, Glaciers, Ice shields	Europe	Arctic, Glaciers, Ice shields	Europe	Residual Areas
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Antarctica Outer Region	Urban Areas	Antarctica Outer Region	Urban Areas	Antarctica Outer Region	
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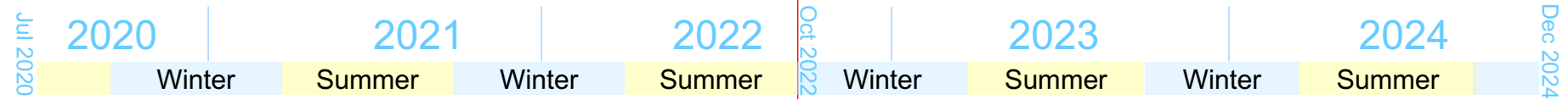
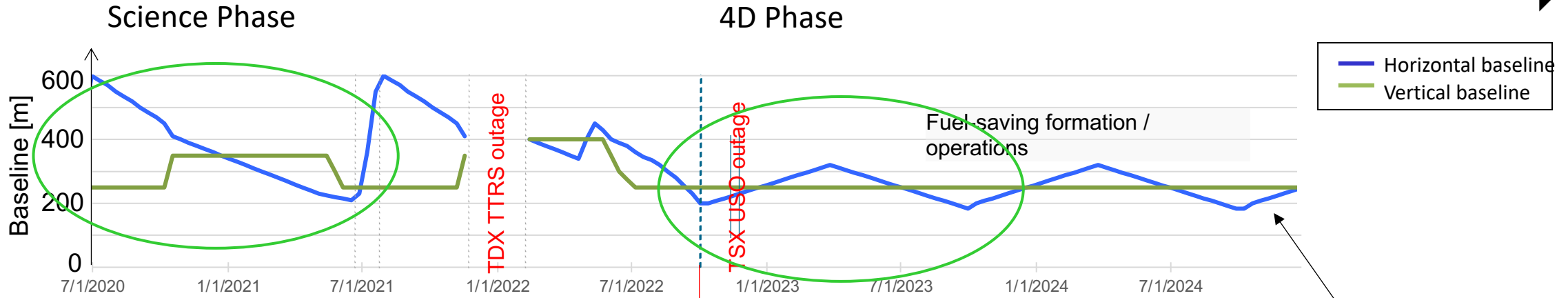
Residual Areas	Residual Areas	
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Projected end of TanDEM-X Mission



# Formation

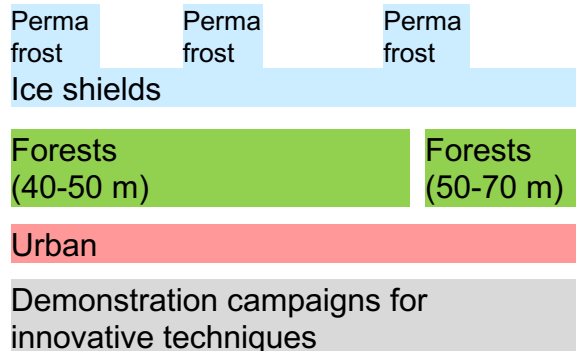


Drifting formation: exploitation of inclination difference as for Tandem-L saves hydrazine

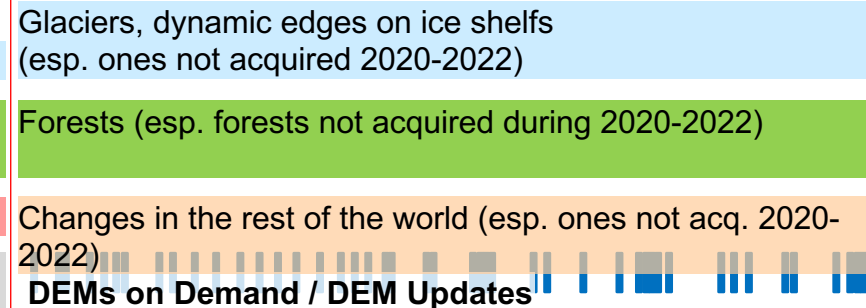
Battery preservation: Shorter DTs < 60 sec with 30 sec gaps afterwards

Careful handling of satellite resources

## Science Phase



## 4D Phase



# NEW TanDEM-X Products for Scientific Use



- **TanDEM-X DEM 2020**

- Contains absolute elevations measured from 2017 to 2020 and represents an update of the Global TanDEM-X DEM (period 2010 - 2015).
- Provision by means of the well-known proposal process
- Completion mid-2024

- **TanDEM-X DEM Change Map**

- Change between 2010-2015 and 2017-2020 - 30m-DEM (edited)
- Two versions are provided with different vertical reference systems:
  - 1. WGS84-G1150 (ellipsoidal heights, TanDEM-X DEM reference frame) and
  - 2. EGM2008 (geoid heights, Copernicus-DEM reference frame)
- DEM Change Map (DCM) will be included in the product
- Completion September 2023
- Release date is pending (approval process at BAFA\* still ongoing) or open via AO

\*) Federal Office for Economic Affairs and Export Control

# TanDEM-X DEM: Science Service System

<https://tandemx-science.dlr.de>



Science Service System

You are here : [Home](#)

For registered users only

Username:   
Password:

### Registered User Access

- Investigator
- Evaluator
- Coordinator

### Basic User Registration

- Investigators Registration

### Documents (Download)

- Bandwidth Consideration
- Science Plan
- TanDEM-X Science Phase
- Manual Science Service System
- TanDEM-X Experimental Product Description
- TanDEM-X CoSSC General and Interferometric Considerations
- TanDEM-X DEM Product Specification
- TerraSAR-X Basic Product
- TerraSAR-X L1b Product Description
- User License Agreement
- COFUR Price List (Scientific Use)

### Demo Data (Download)

- Free Final DEM Demo Data

### DEM Gallery

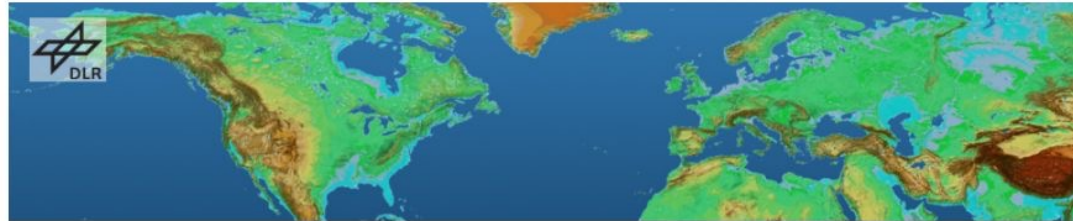
- TanDEM-X DEM Gallery

### Links

- Microwaves and Radar Institute
- TanDEM-X Blog
- TanDEM-X 90m DEM
- EOWEB Data Access
- TerraSAR-X Science Service System

### News/Related

- SAR-EDU Initiative Flyer



[Home](#) [Data access »](#) [Mission »](#) [Multimedia](#) [FAQ](#)

### News

**Joint PAZ / TSX / TDX**  
**Announcement of Opportunity**  
**is still open!**

**Joint PAZ / TSX / TDX / RCM**  
**AO will come soon!**

*[March 22, 2020]*  
Using principles from painting, creating 3D-effect satellite images in this way... How can an impression of three-dimensionality be created using a two-dimensional image? This question arose centuries ago. Certain painting techniques have since been used to create the illusion of depth. Such effects are achieved by 'deceiving the eye'. [full article]

*[July 08, 2020]*  
Gletscherrückgang in den Alpen - ein erschreckend dokumentiertes Phänomen. Ein Forschungsteam der Friedrich-Alexander-Universität Erlangen-Nürnberg hat die Flächen- und Höhenänderungen aller Gletscher der europäischen Alpen in den letzten Jahren. Dazu verglichen sie dreidimensionale Geländemodelle der TerraSAR-X Satelliten mit den amerikanischen Shuttle-Radar Topography Maps zwischen 2000 und 2014. [full article]

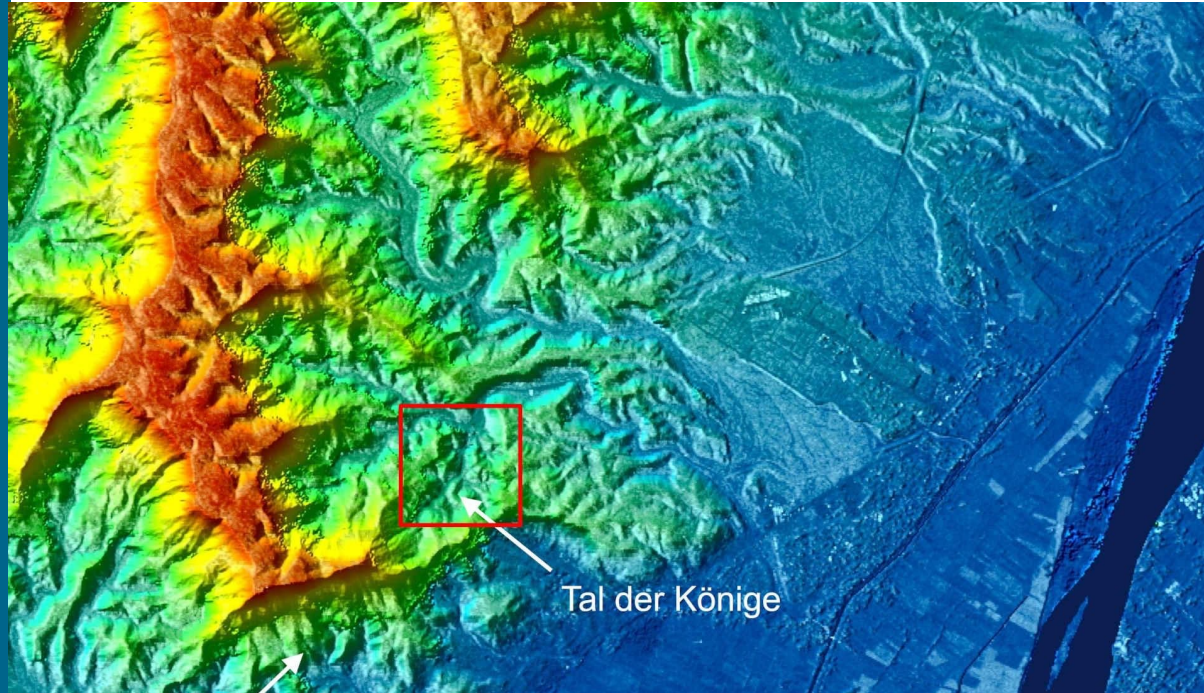


**TerraSAR-X / TanDEM-X  
Science Team Meeting**

DLR Oberpfaffenhofen, Germany  
October 18 - 20, 2023

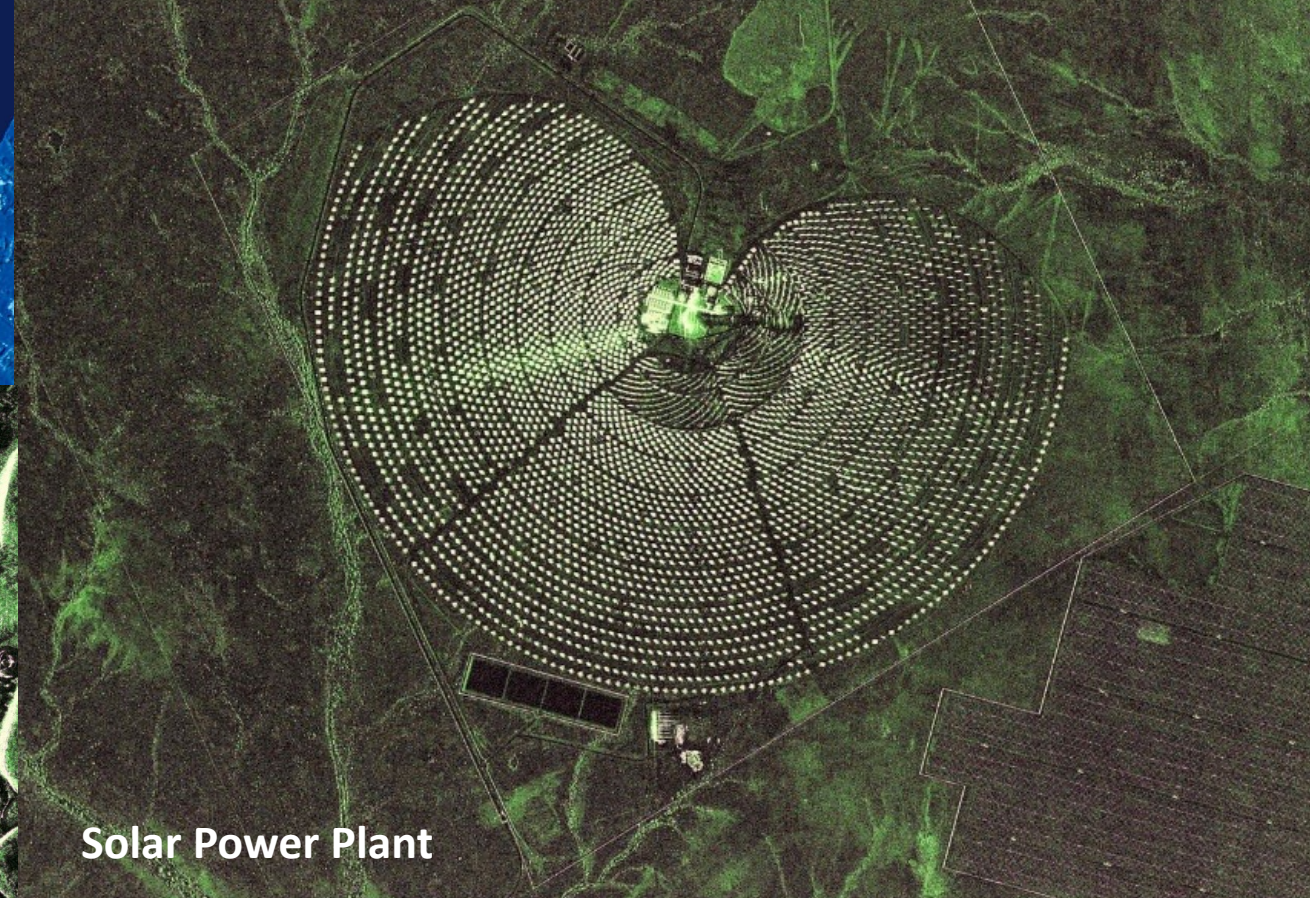
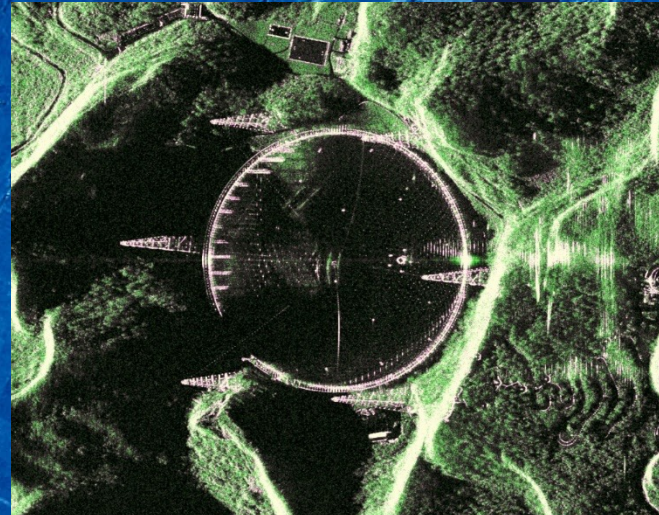
# Check the TanDEM-X News!

<https://tandemx-science.dlr.de>



Tal der Könige

Tal der Königinnen



Solar Power Plant