TANDEM-X: STATUS AND SCIENCE ACTIVITIES

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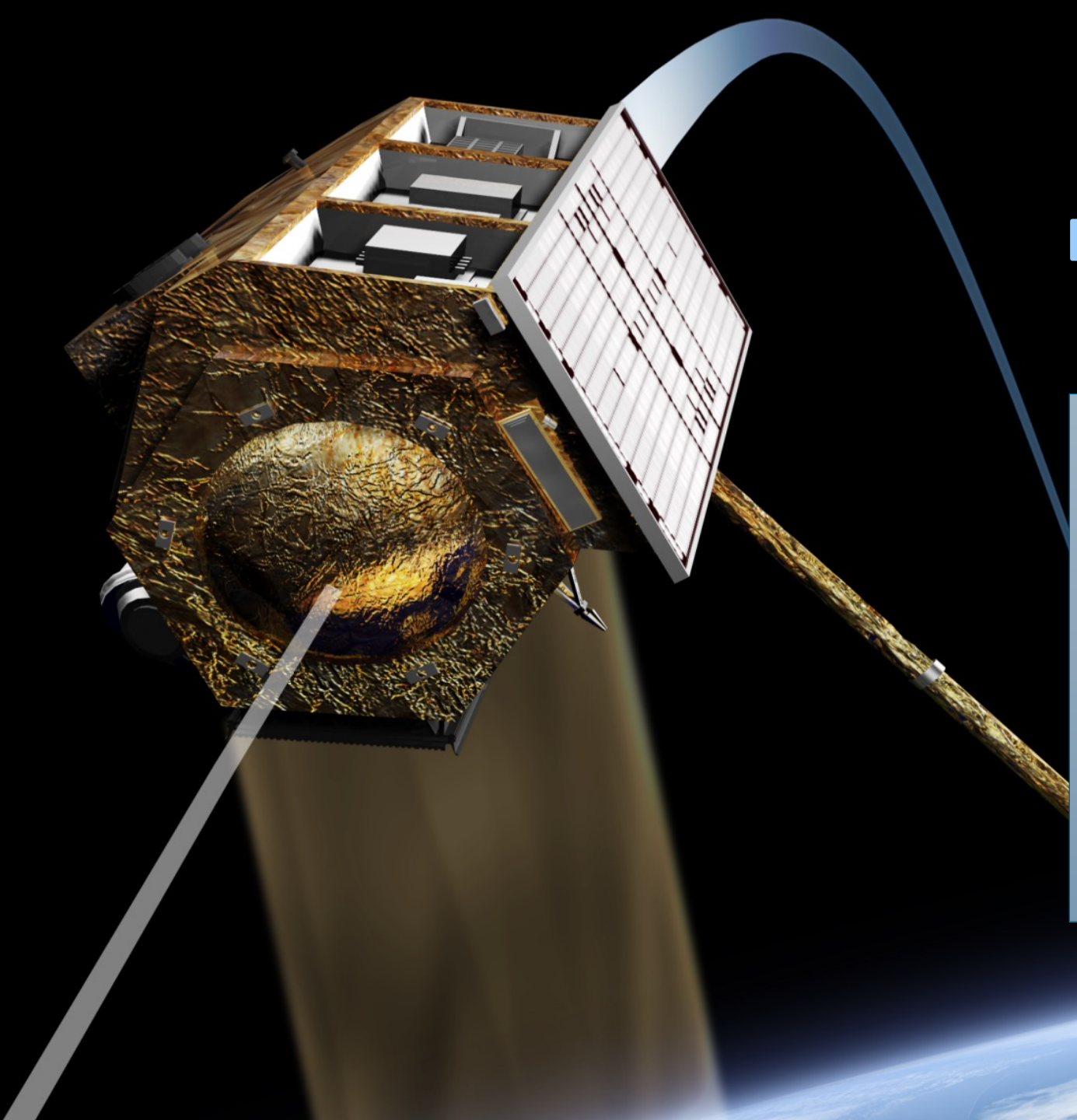

TerraSAR-X-add-on for Digital Elevation Measurements

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: **$\sigma \approx 0.2$ dBm²** - still excellent!
- Both TerraSAR-X and TanDEM-X satellites are fully functional
- Irretrievable on-board resources allow operations at least until 2029

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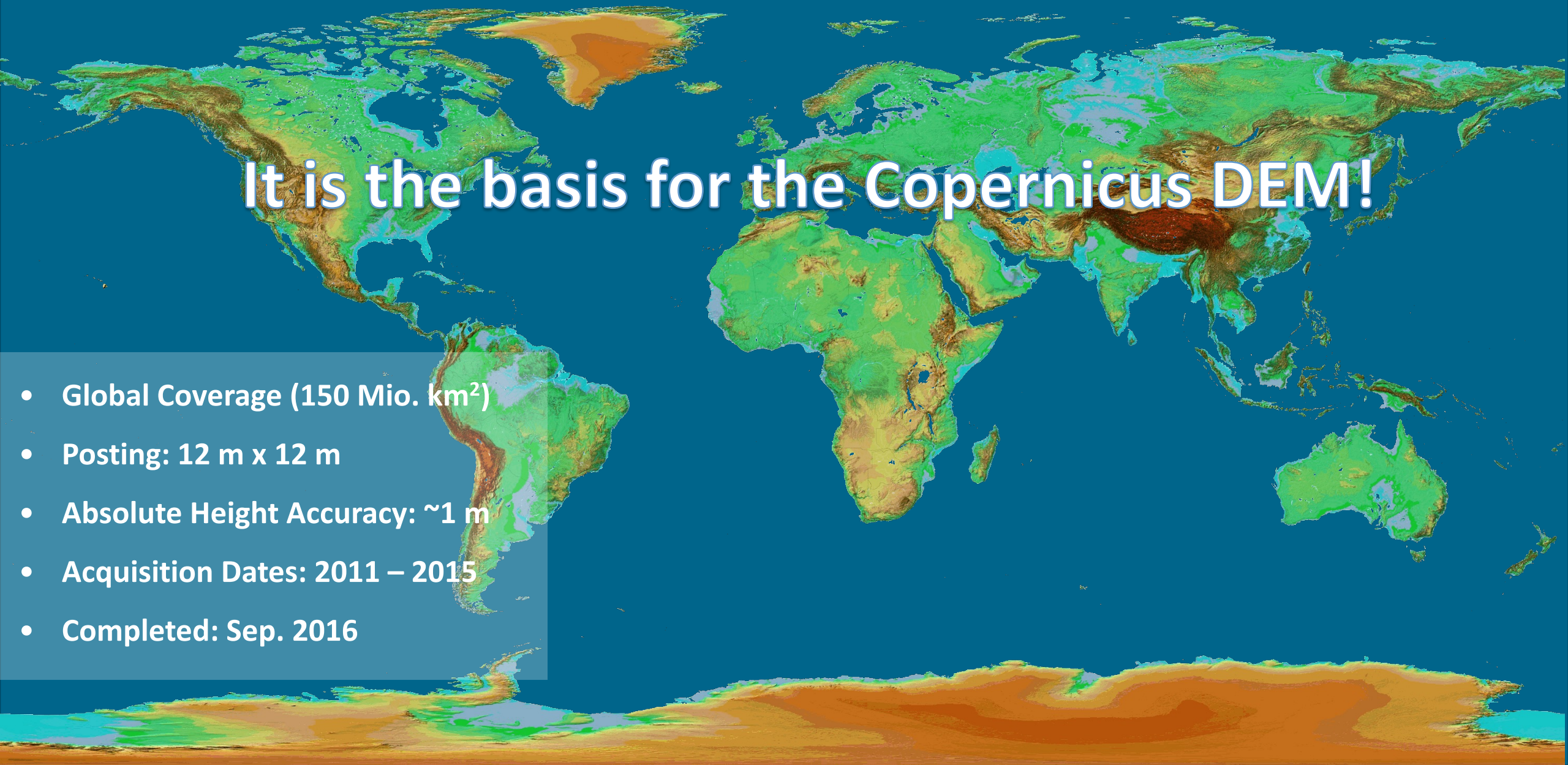
AIRBUS DEFENCE & SPACE

TanDEM-X DEM



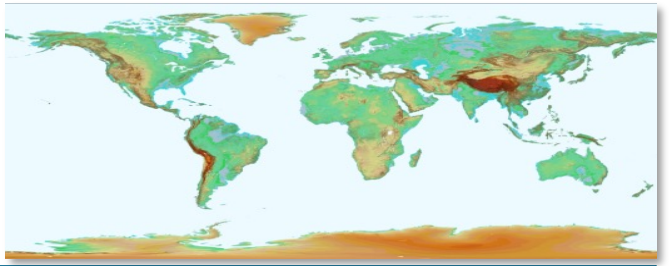
It is the basis for the Copernicus DEM!

- Global Coverage (150 Mio. km^2)
- 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

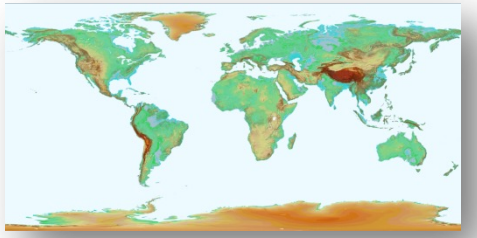
~ 5 Mio (~257x Global DEM) downloads
from 8549 registrations

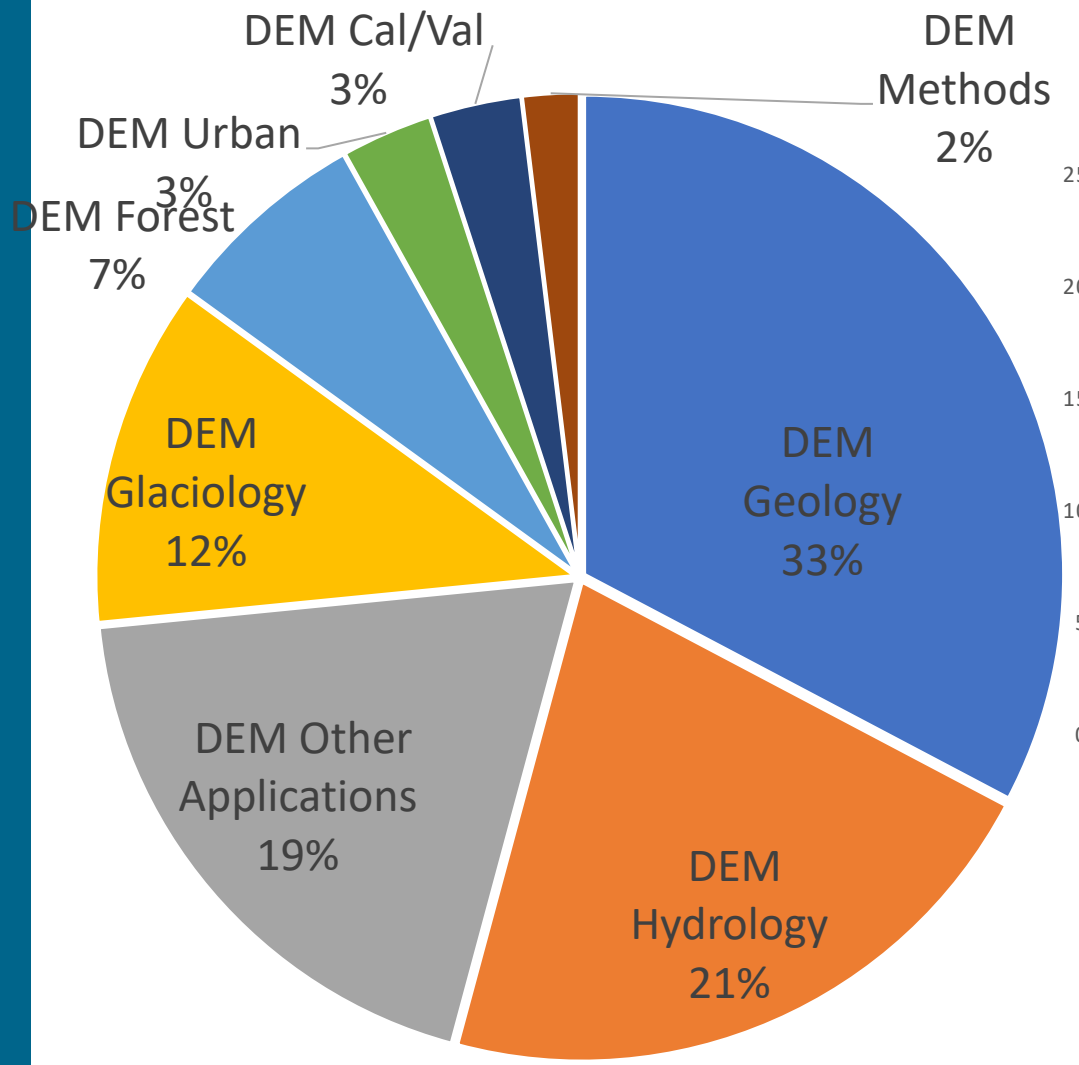


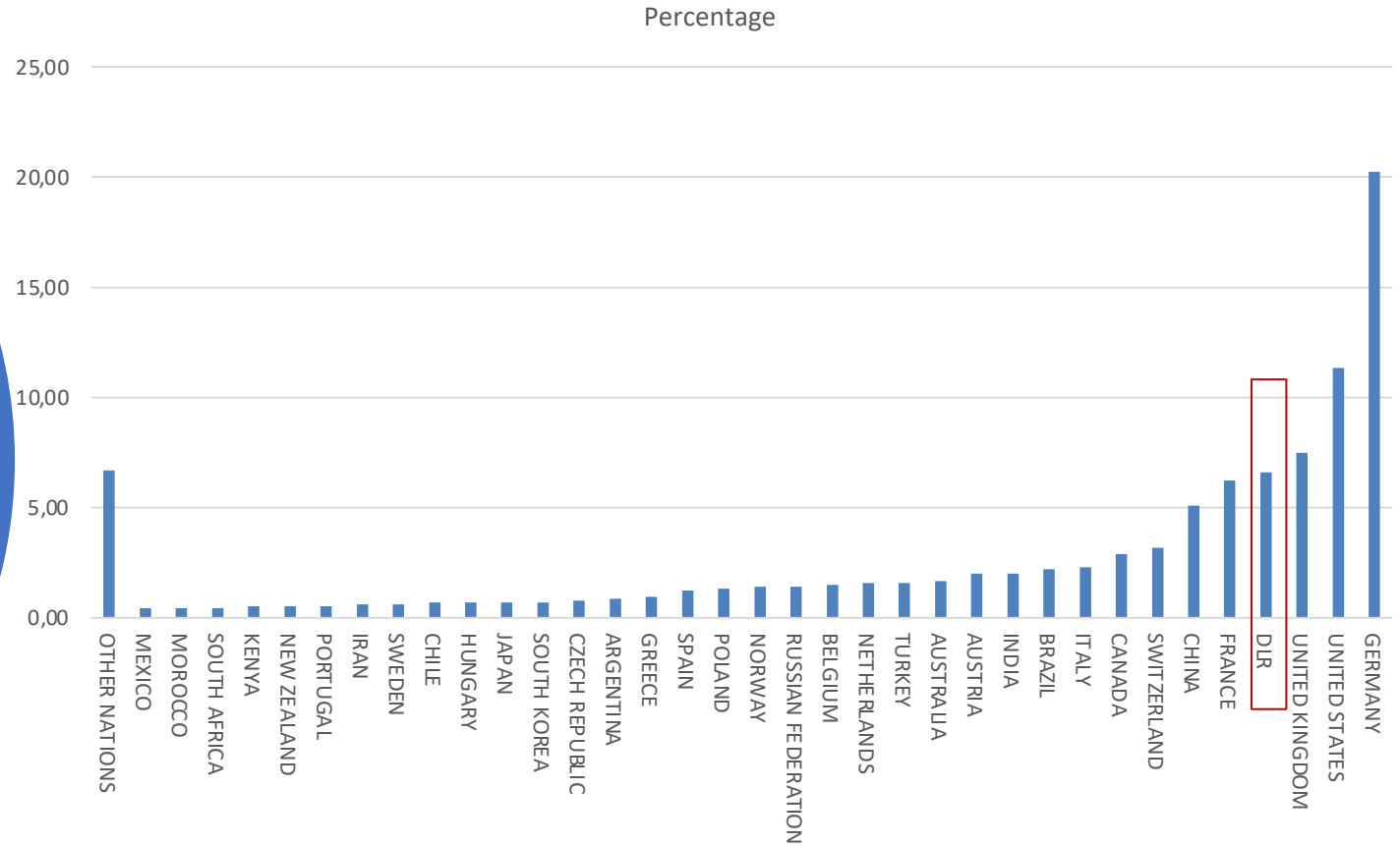
Global TanDEM-X DEM (12 m) production finished Sept. 2016
Global TanDEM-X DEM (90 m) available since 2018
Global TanDEM-X Forest/Non-Forest Map (50 m) available since 2019

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

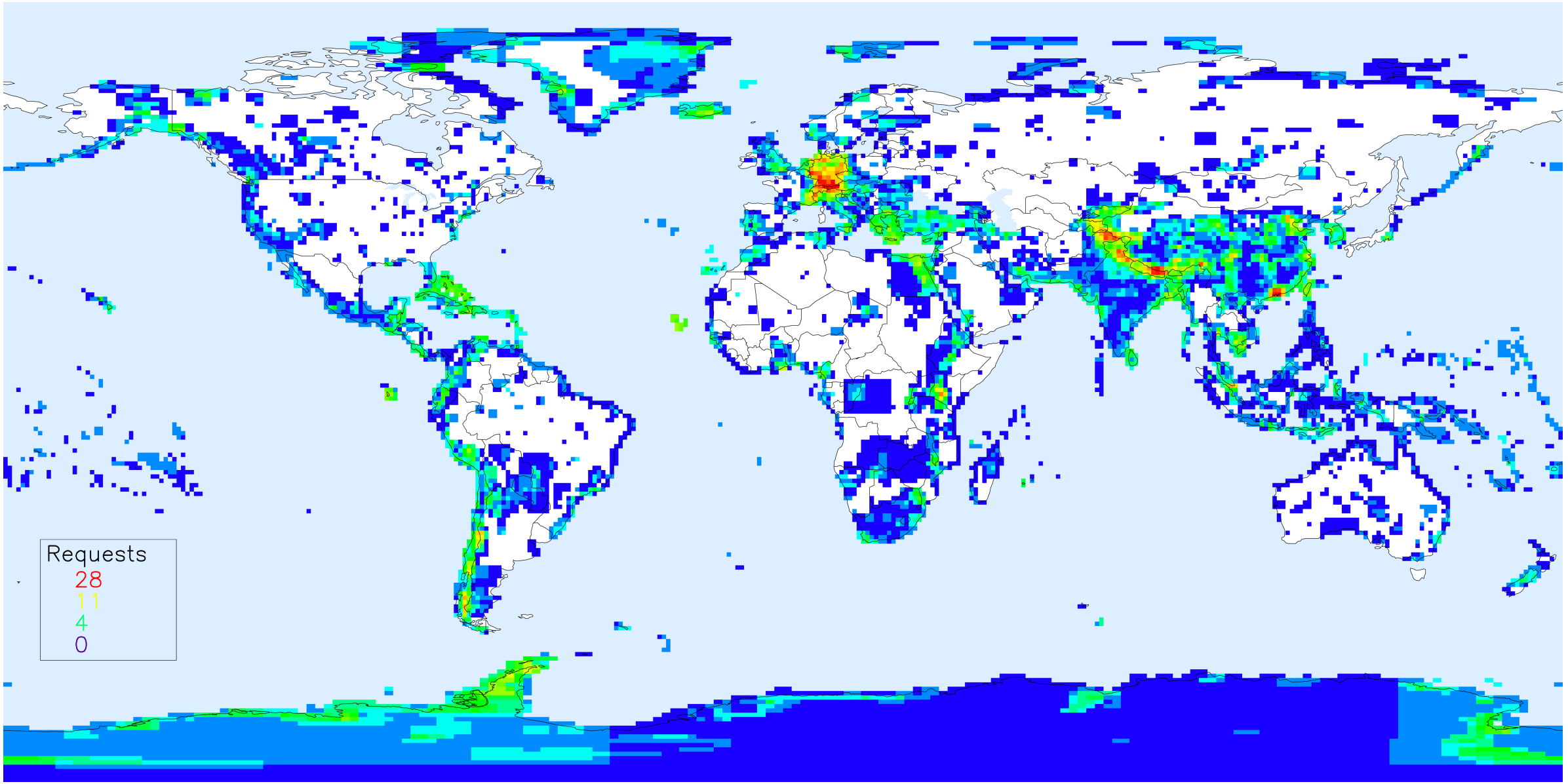
DEM AO: Application Domains & Countries 2022



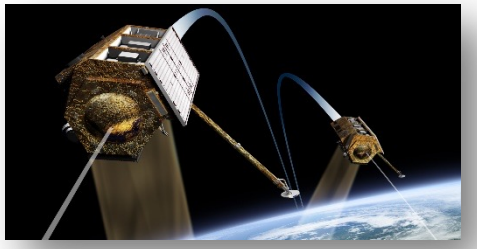


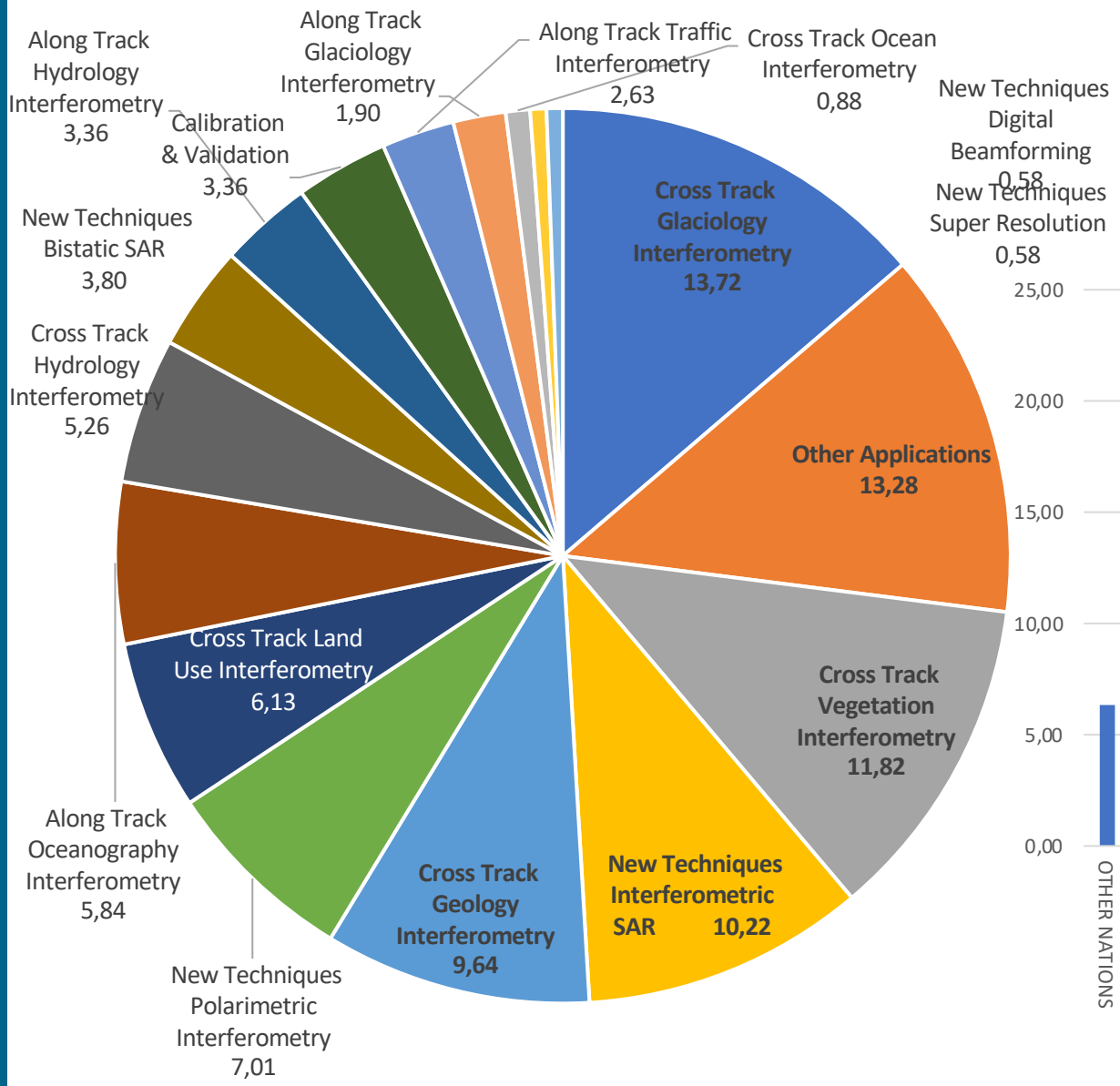


DEM Product: Heat Map

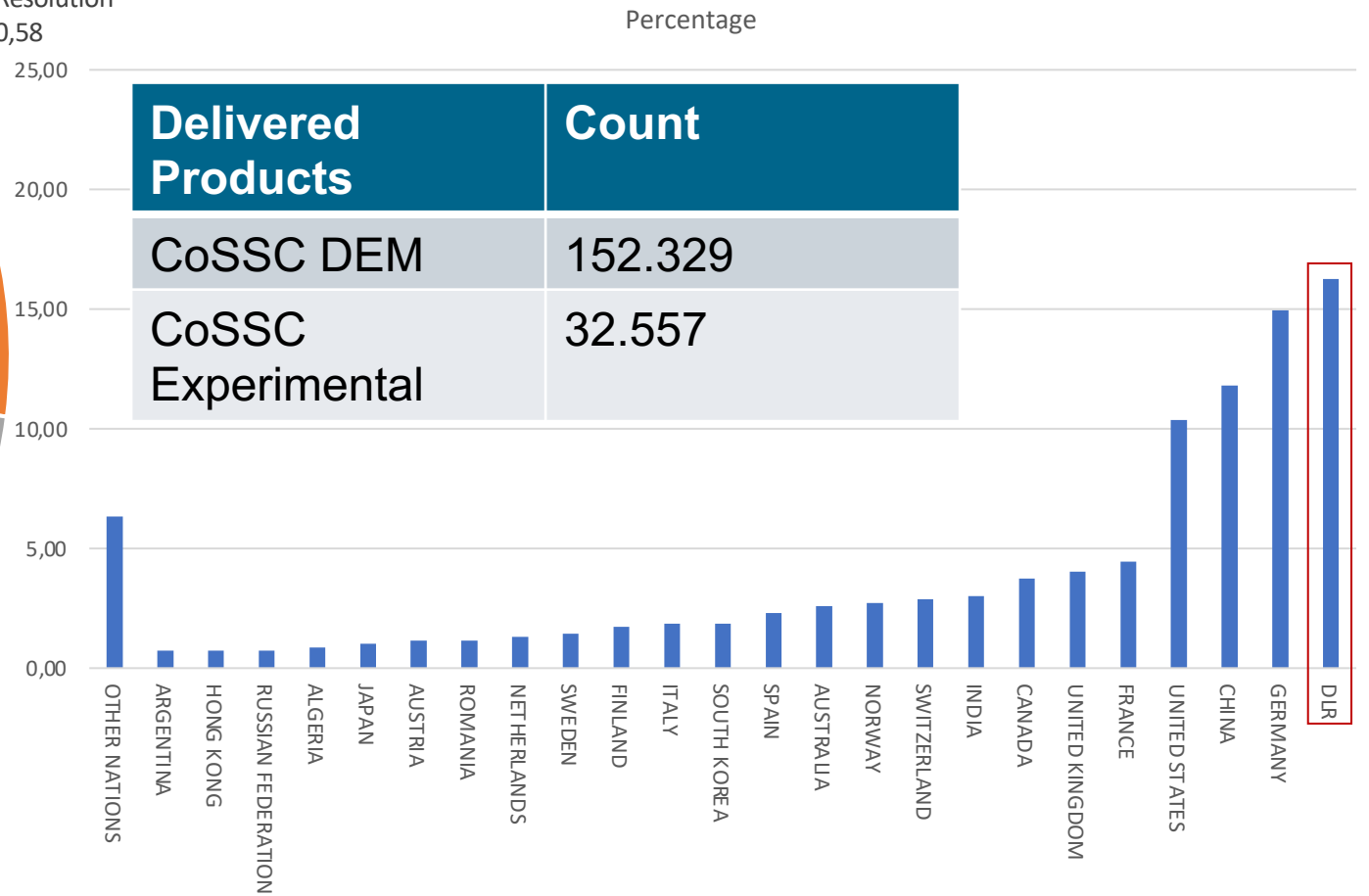


CoSSC AO: Application Domains & Countries





Delivered Products	Count
CoSSC DEM	152.329
CoSSC Experimental	32.557



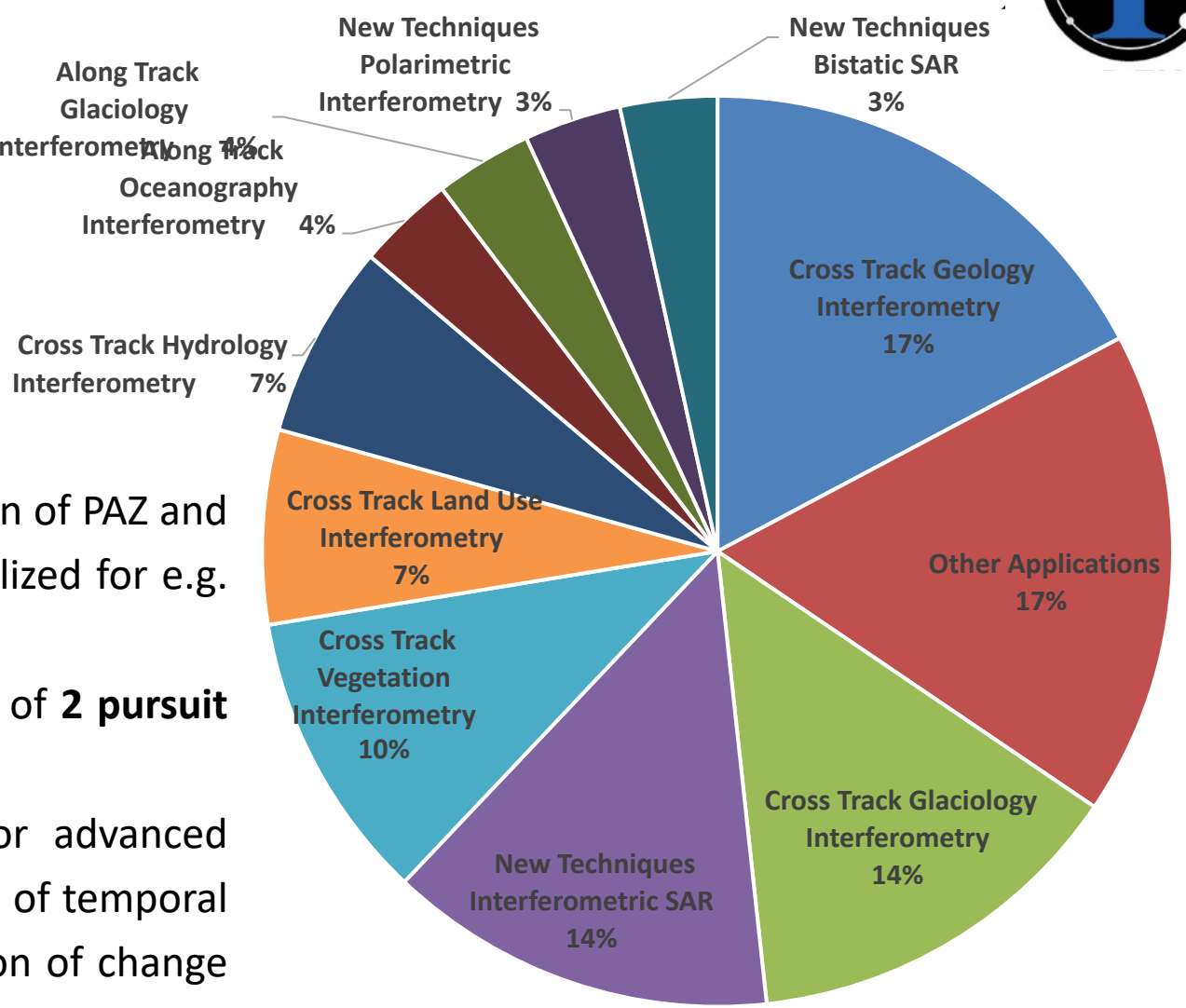
Joint PAZ/TDX/TSX Proposal Submission (since 2022)

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.

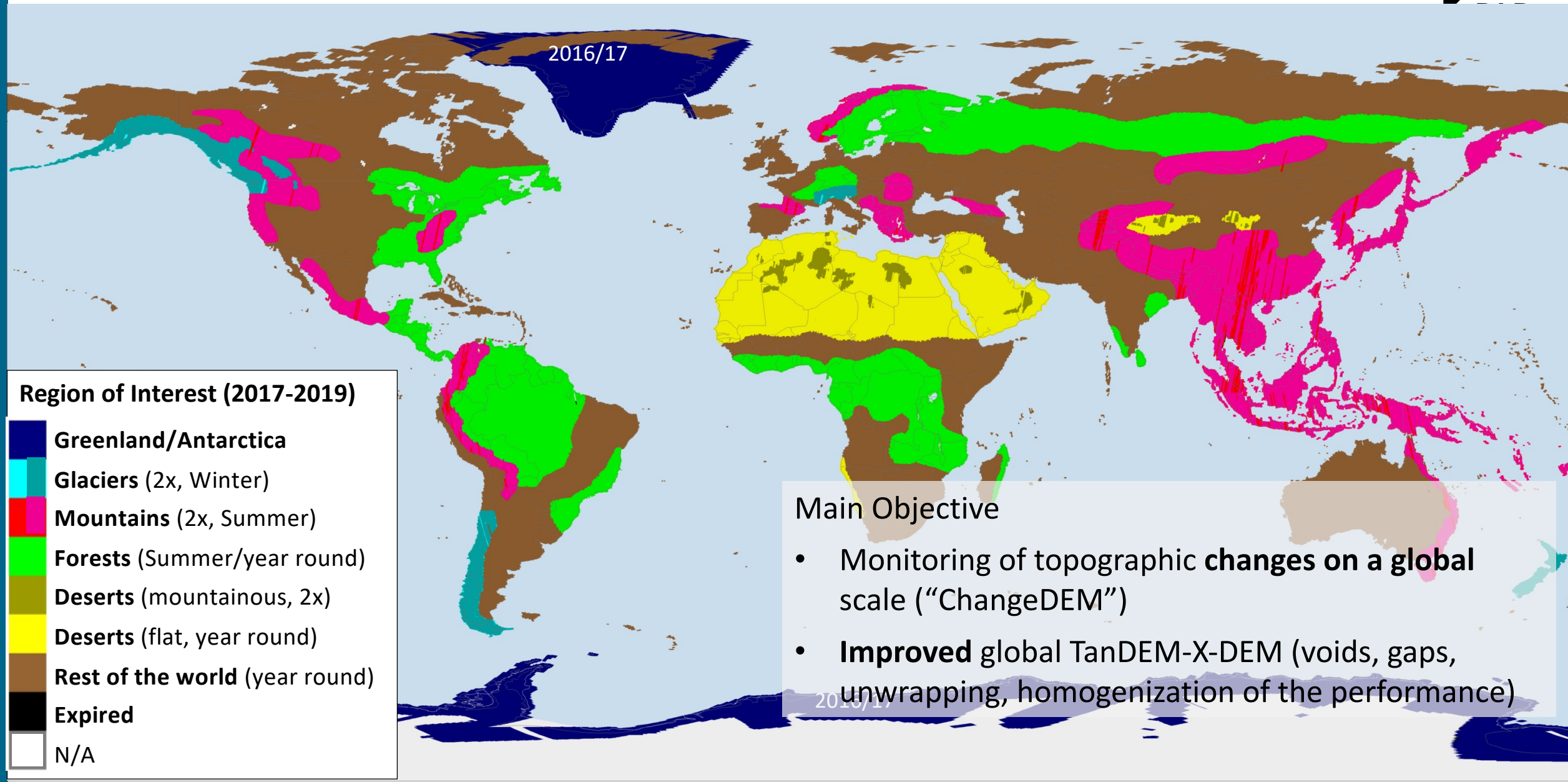
Different scenarios can be considered:

- 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

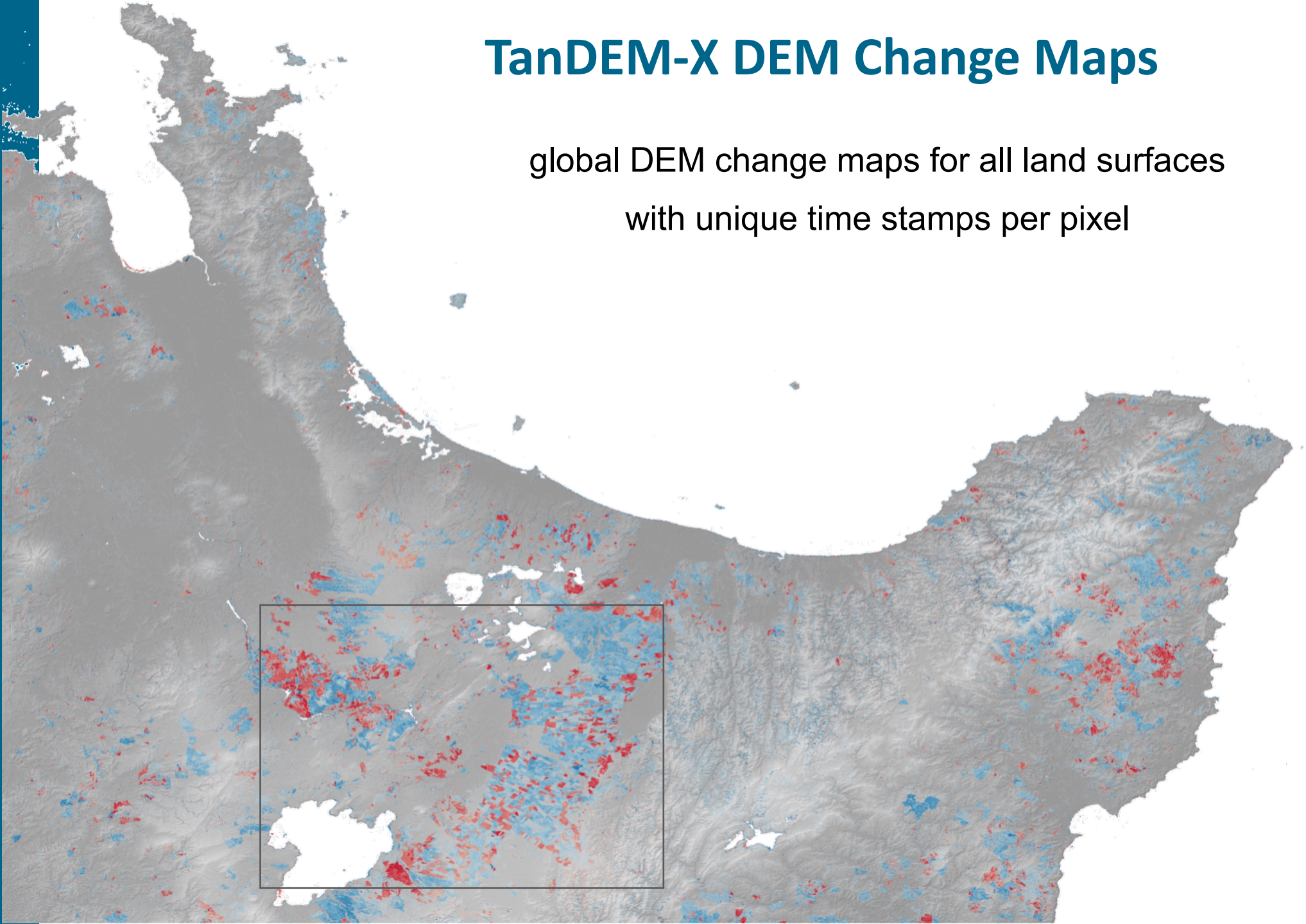
- 19 780 acquisitions successfully performed
- Currently in processing

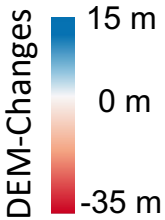


TanDEM-X DEM Change Maps

global DEM change maps for all land surfaces

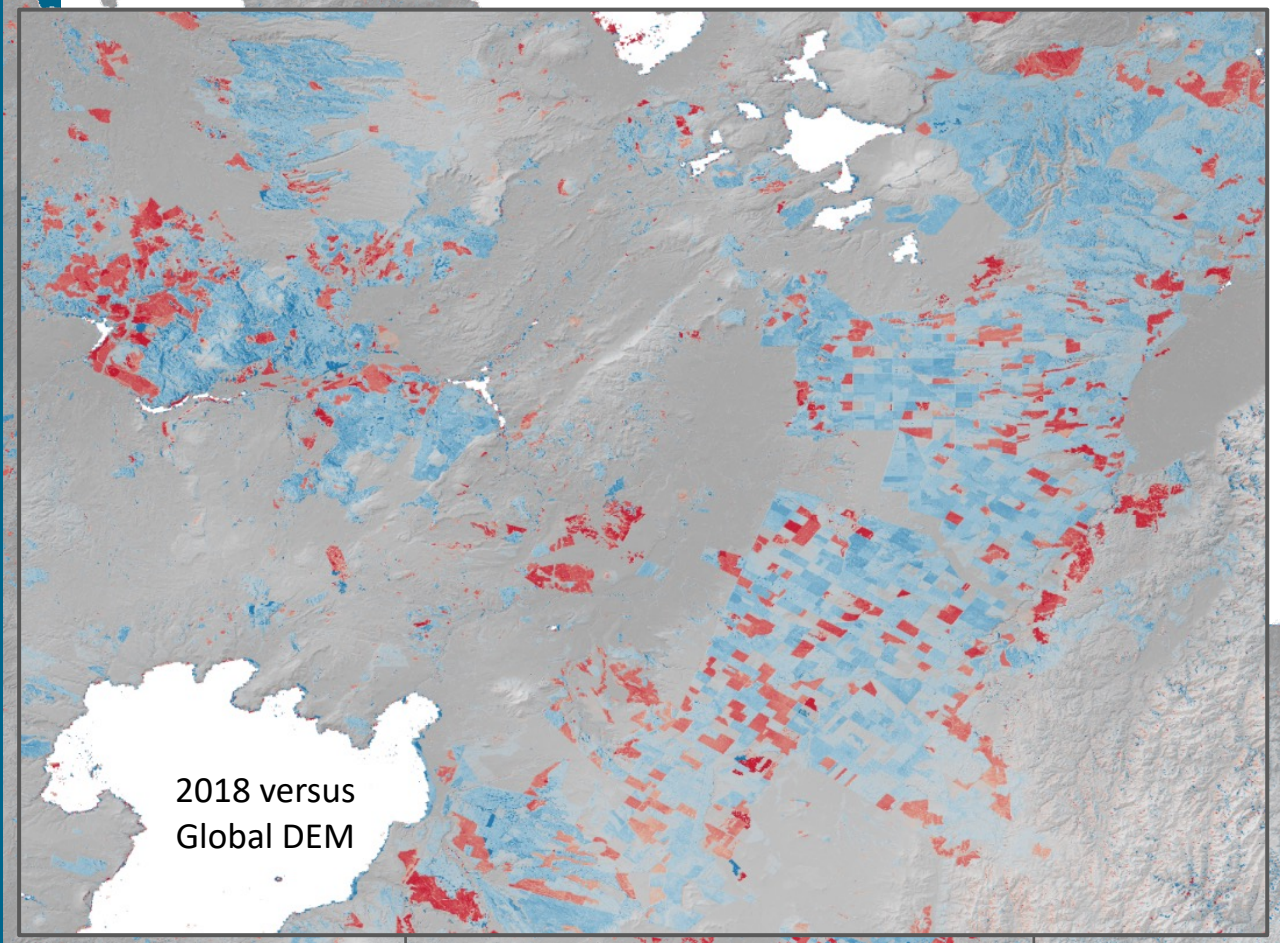
with unique time stamps per pixel

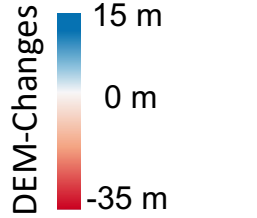




TanDEM-X DEM Change Maps

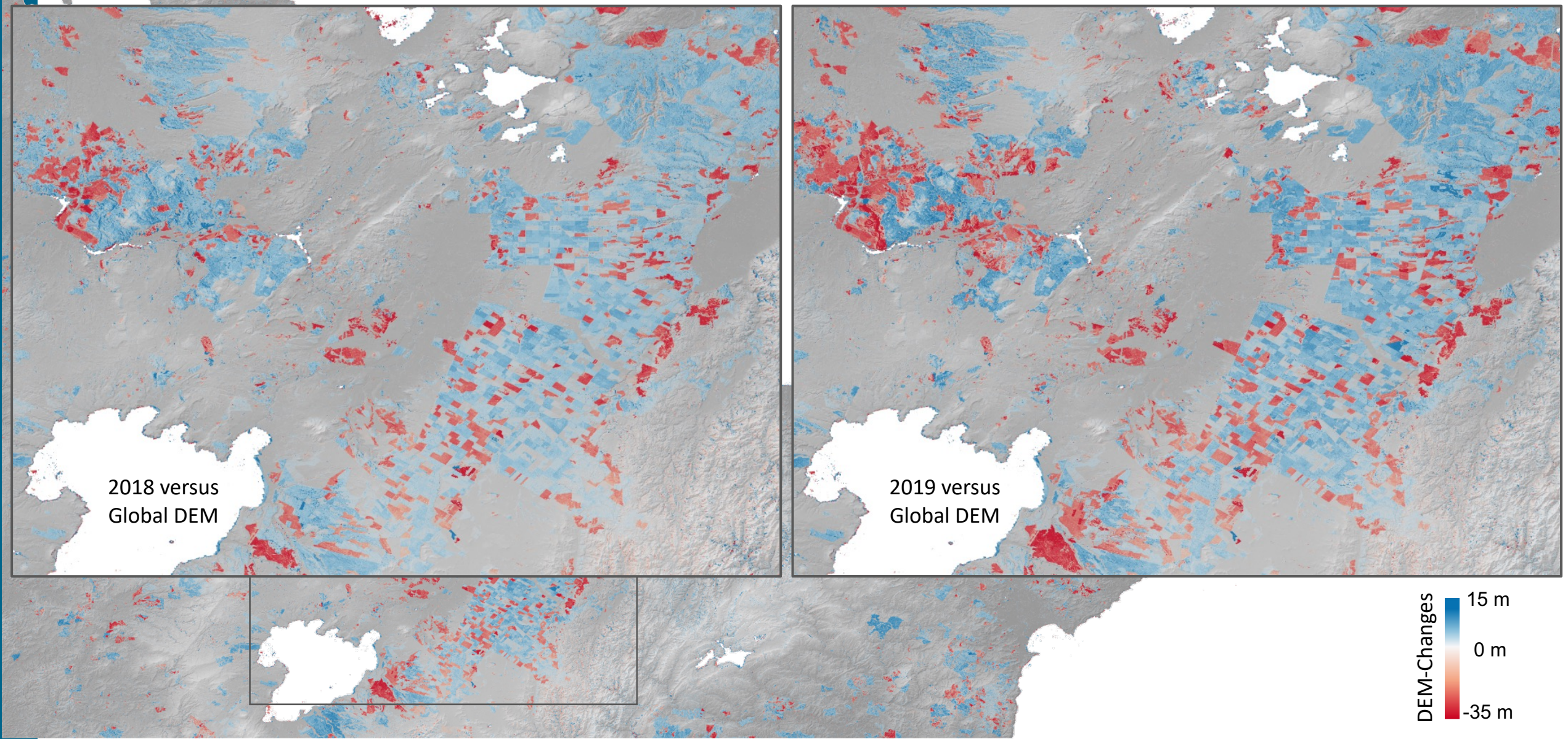
Time series to track height changes





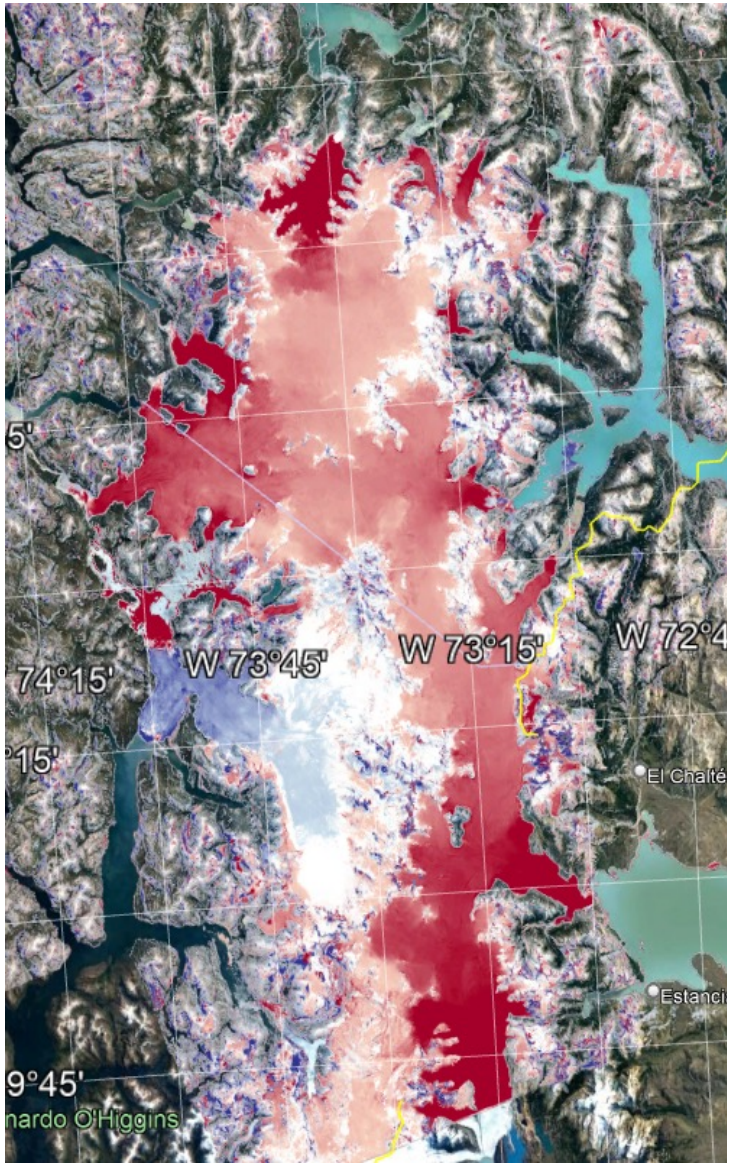
TanDEM-X DEM Change Maps

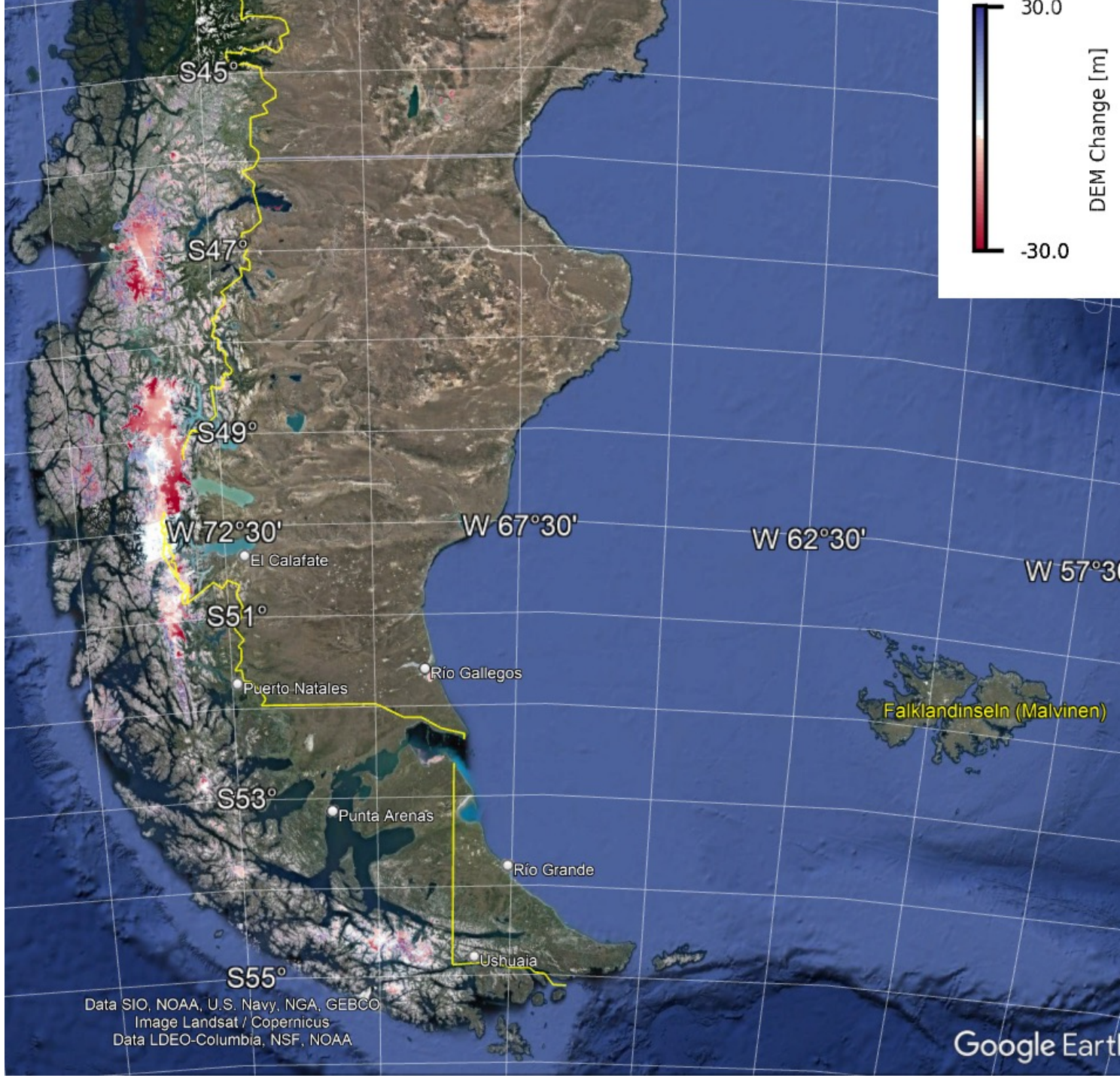
Time series to track height changes



TanDEM-X DEM Change Maps:

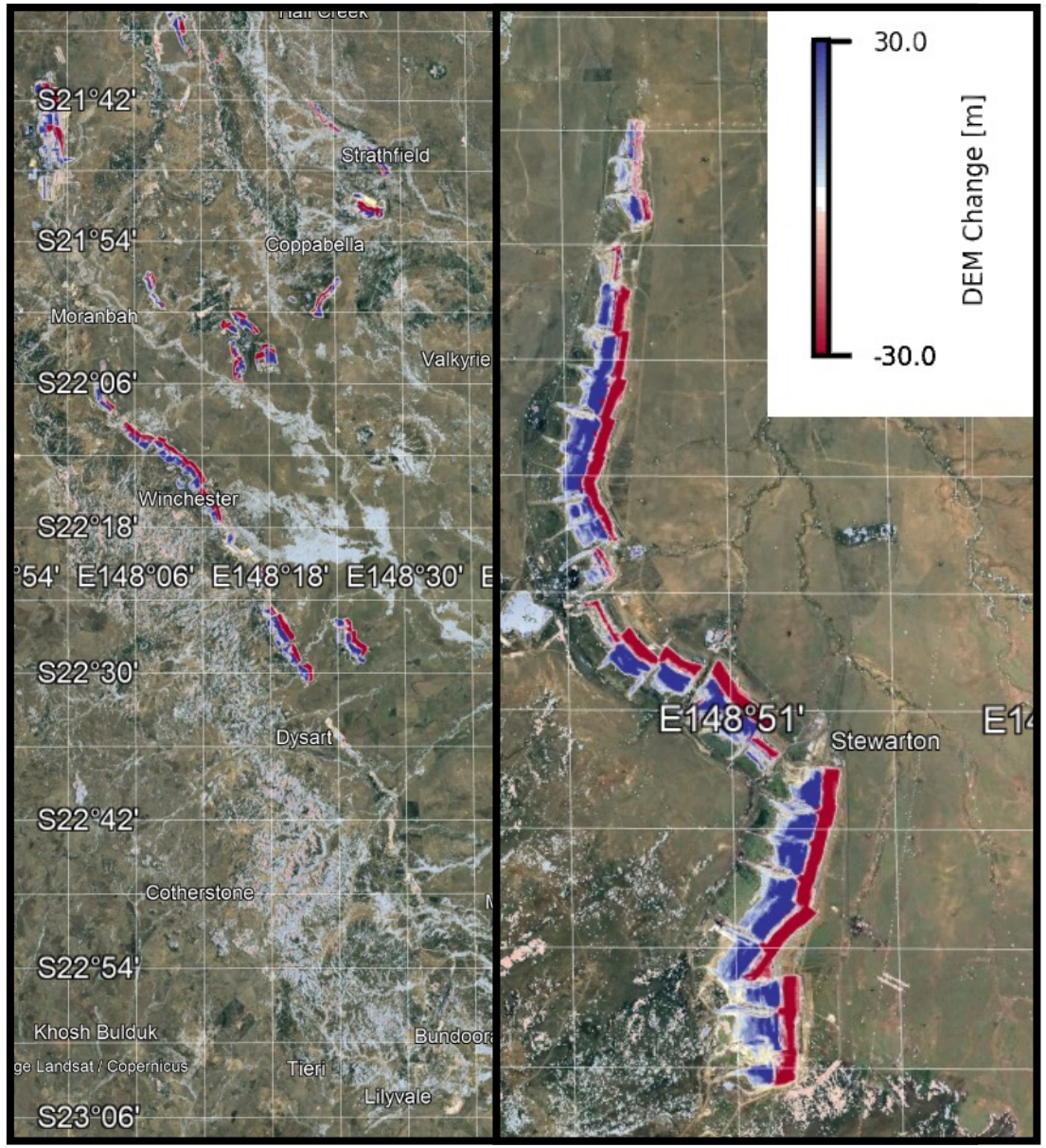
Southern Patagonian Ice Field

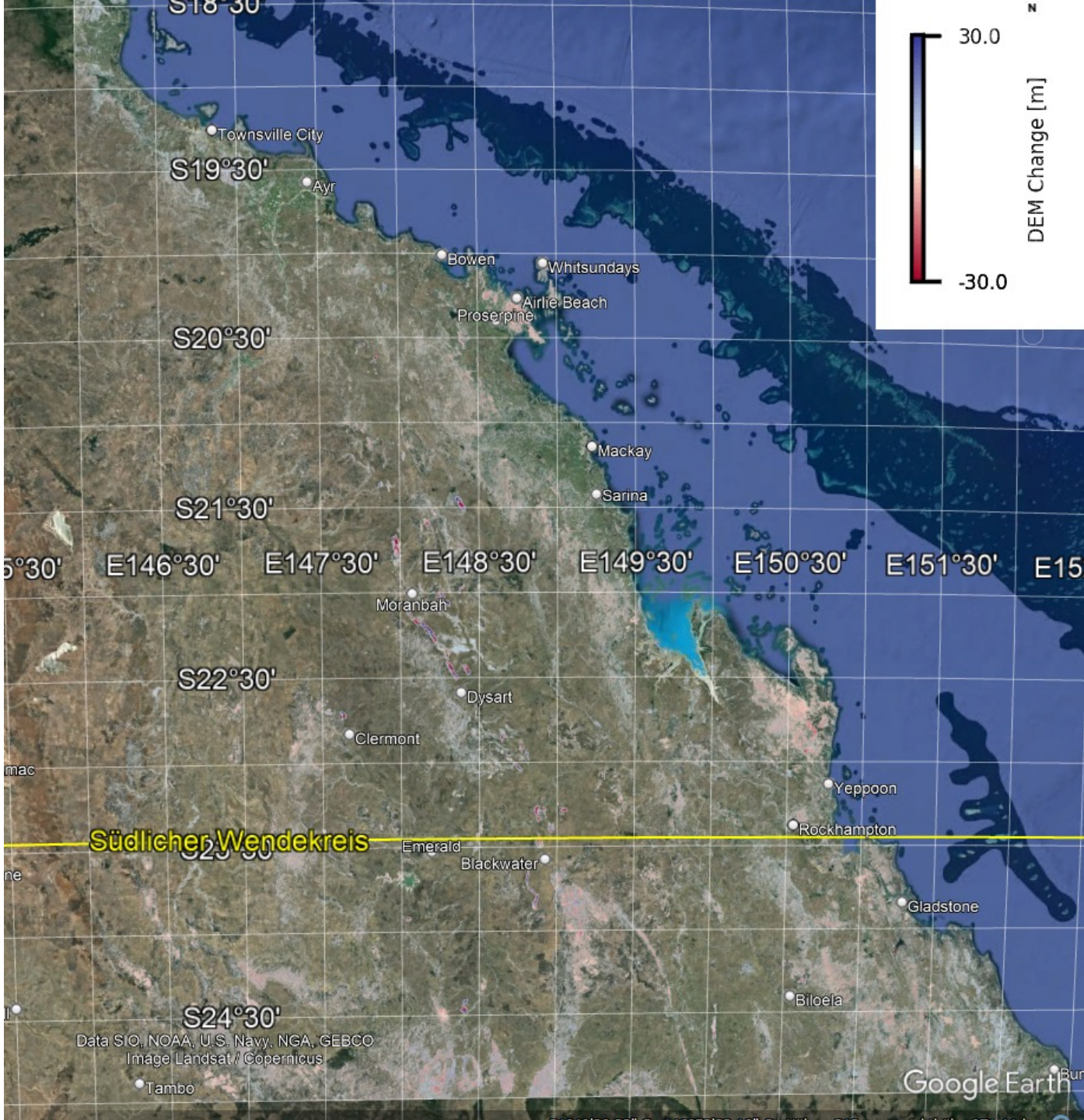




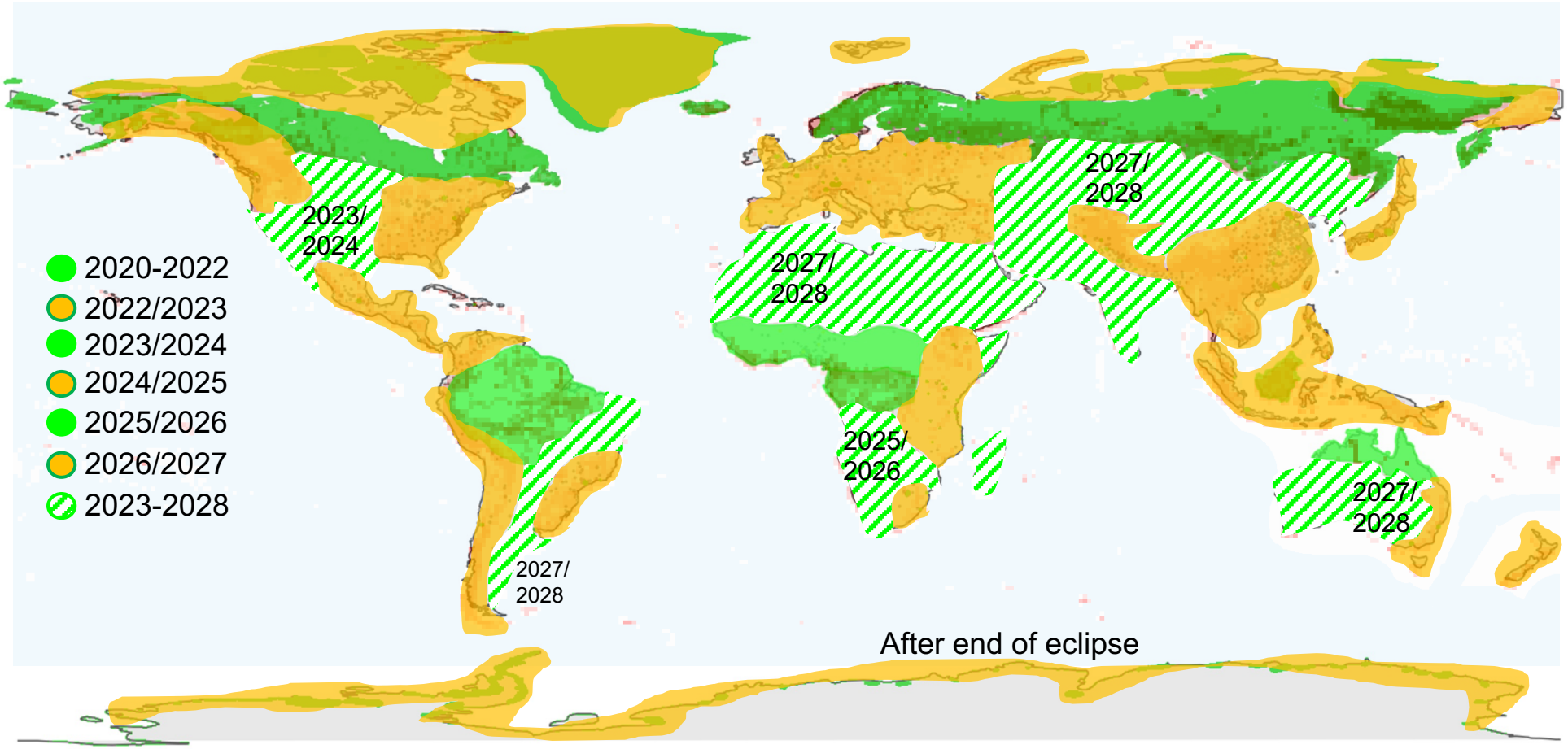
TanDEM-X DEM Change Maps:

Open Pit Mining Australia



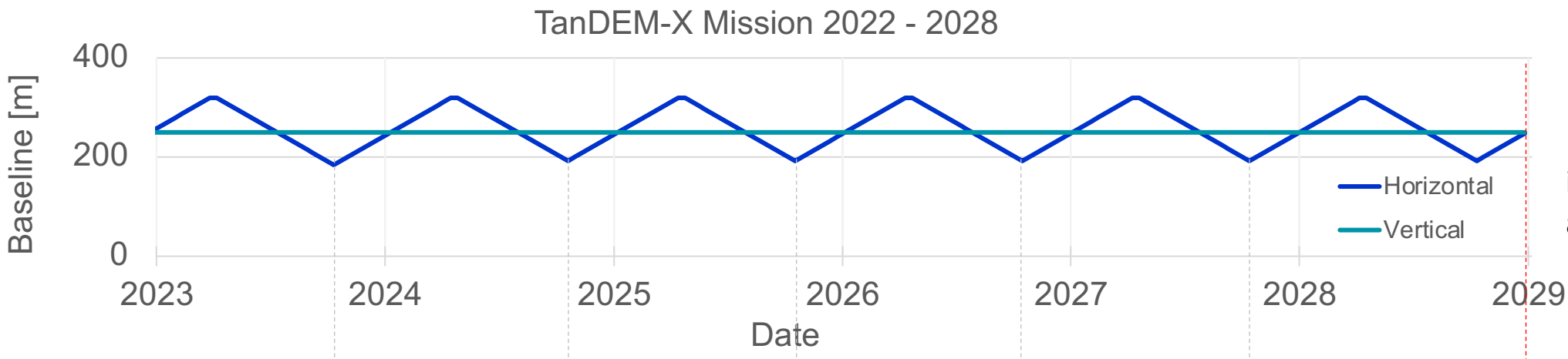


TanDEM-X 4D Phase – Long-Term Coverage Plan 2020 - 2028



- 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

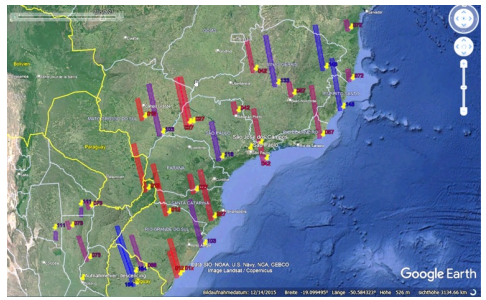


Fuel saving:
Drifting formation via inclination difference as for Tandem-L

Change Regions	Forests	Change Regions	Forests	Change Regions	Small parts of Forests, Arctic, Glaciers, Urban
Europe	Arctic, Glaciers, Ice shields	Europe	Arctic, Glaciers, Ice shields	Europe	Residual Areas
Antarctica Outer Region	Urban Areas	Antarctica Outer Region	Urban Areas	Antarctica Outer Region	
	Residual Areas		Residual Areas		

DEMs on Demand / DEM Updates

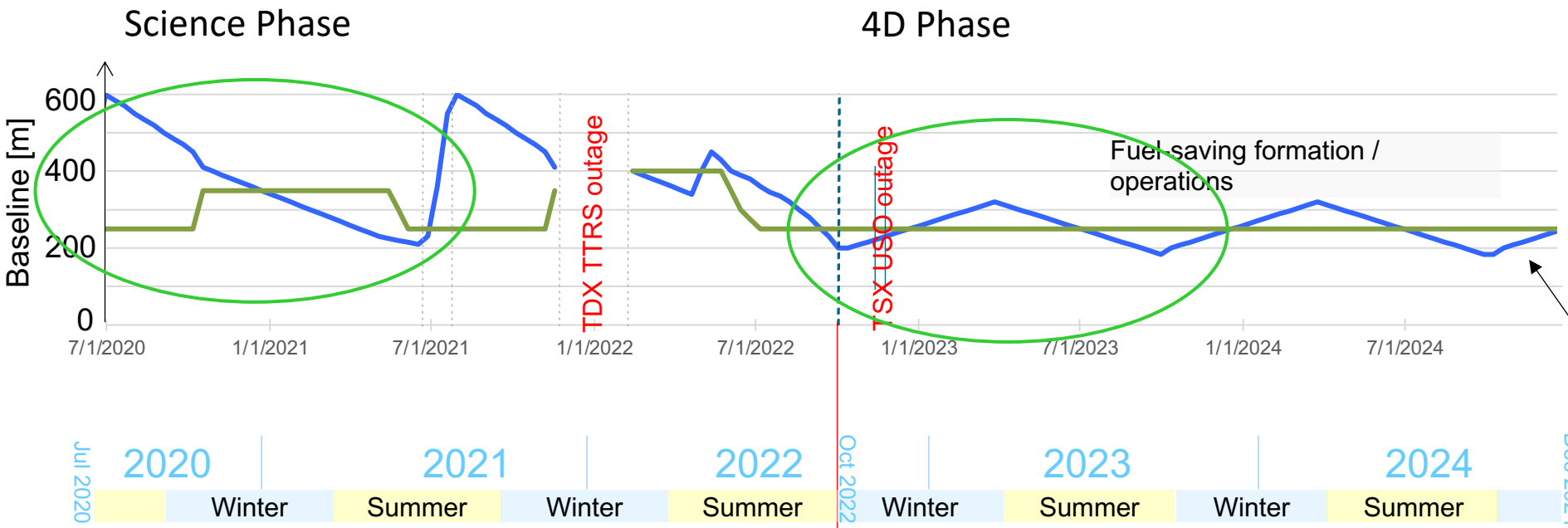
Battery preservation:
Shorter DTs ~ 40 sec with gaps afterwards



Projected end of TanDEM-X Mission

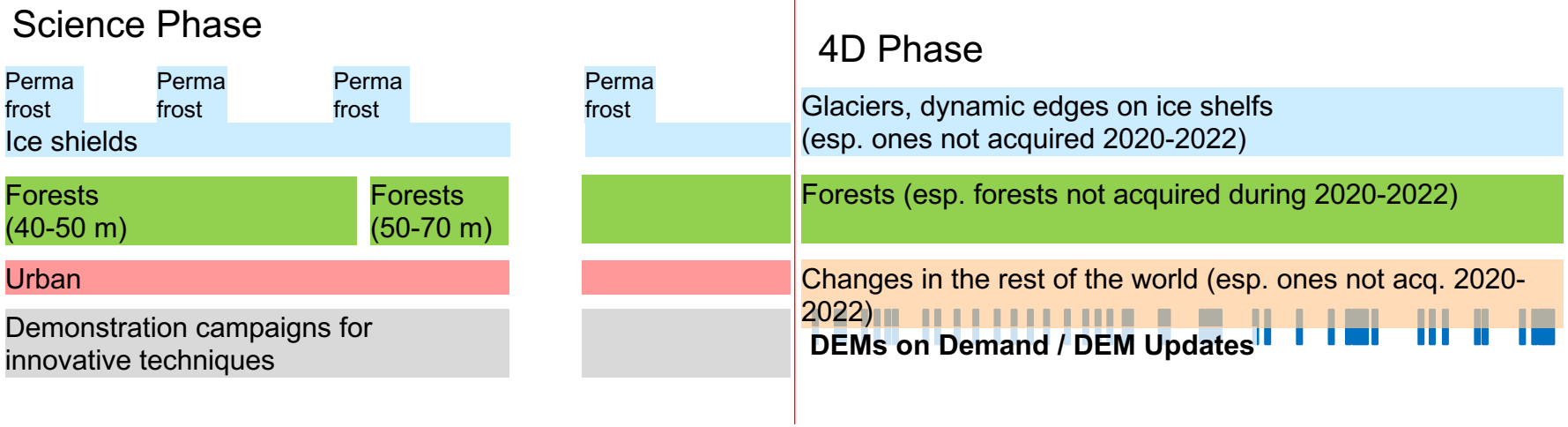
Irena Hajnsek, PolinSAR Workshop, 19.06.-23.06.2023 – irena.hajnsek@dlr.de

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

Irena Hajnsek, PolinSAR Workshop, 19.06.-23.06.2023 – irena.hajnsek@dlr.de

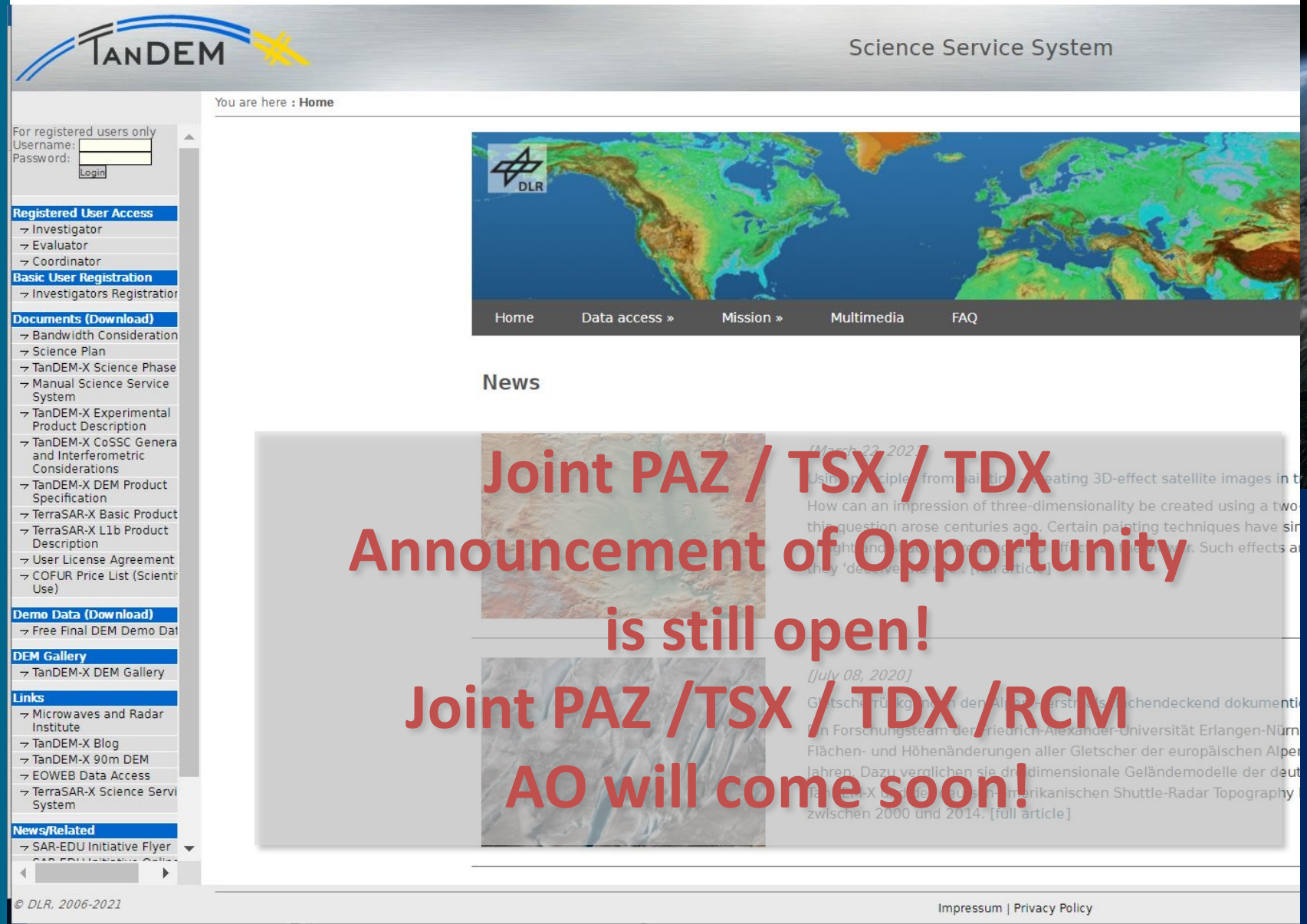
NEW TanDEM-X Products for Scientific Use

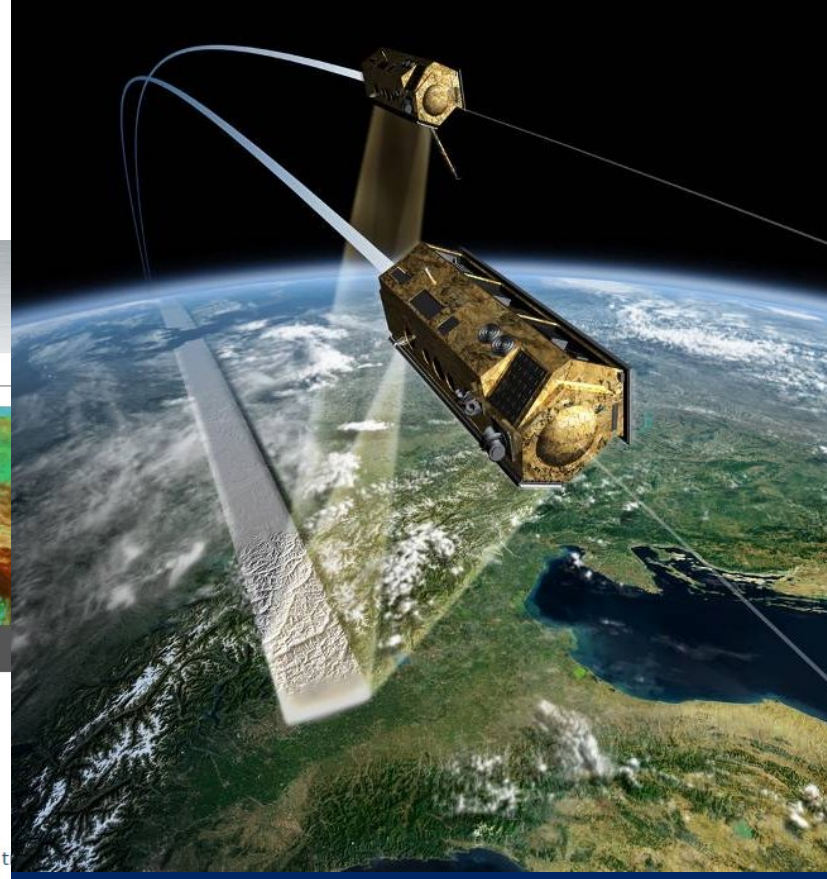
- **TanDEM-X DEM 2020**
  - Contains absolute elevations measured from 2017 to 2020 and represents an update of the Global TanDEM-X DEM (period 2010 - 2015).
  - Provision by means of the well-known proposal process
  - Completion mid-2024
- **TanDEM-X DEM Change Map**
  - Change between 2010-2015 and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





TerraSAR-X / TanDEM-X Science Team Meeting

DLR Oberpfaffenhofen, Germany
October 18 - 20, 2023

Check the TanDEM-X News!

https://tandemx-science.dlr.de