Status of the TanDEM-X Mission

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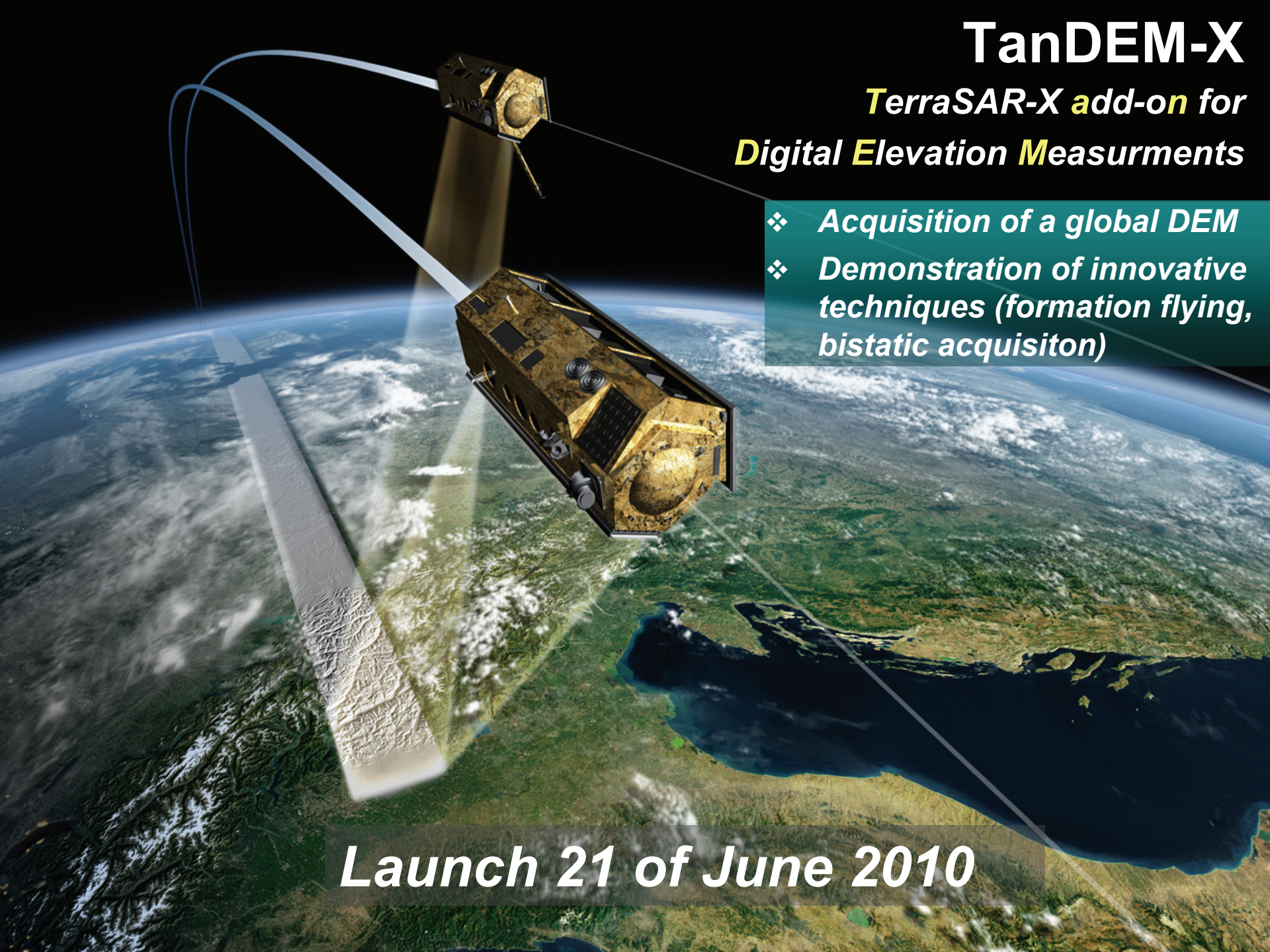
TanDEM

Content

1. What is TanDEM-X?
2. What are the capabilities of TanDEM-X?
3. Which are the provided products?
4. What is the mission status of TanDEM-X?
5. How can I submit a proposal?
6. What is the time plan?

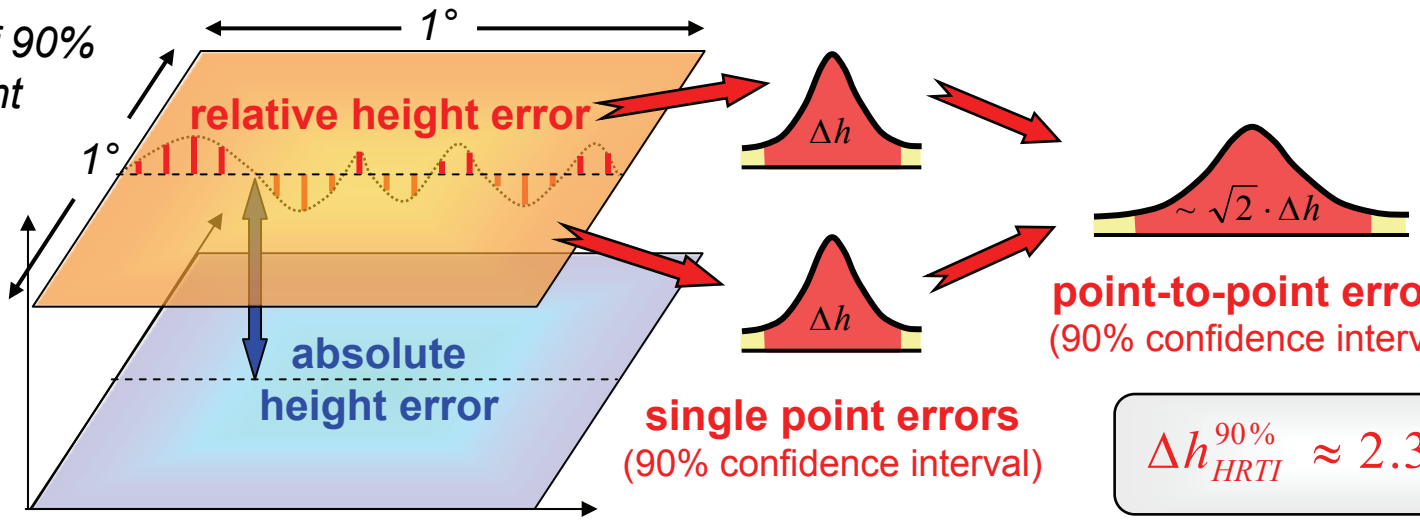

TanDEM-X
TerraSAR-X add-on for
Digital Elevation Measurments
Acquisition of a global DEM
Demonstration of innovative techniques (formation flying, bistatic acquisiton)
Launch 21 of June 2010

Standards for Digital Elevation Models

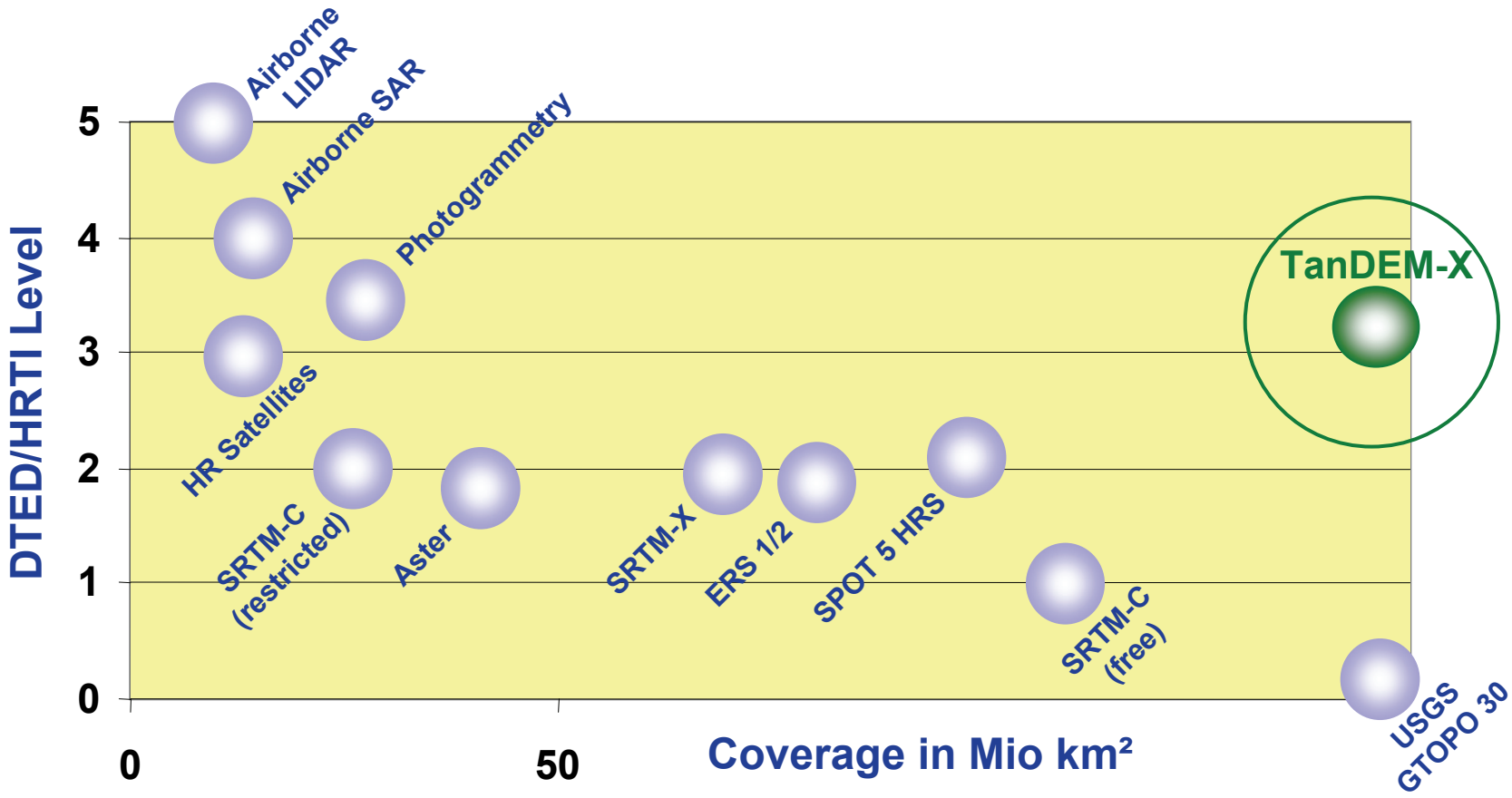
DEM's	Spatial Resolution	Absolute Vertical Accuracy (90%)	Relative Vertival Accuracy (point-to-point in 1°cell, 90%)
Globe	90 x 90 m	< 30 m	< 20 m
SRTM	30 x 30 m	< 18 m	< 12 m
TanDEM-X DEM	12 x 12 m	< 10 m	< 2 m
Experimental TanDEM-X DEM	6 x 6 m	< 5 m	0.8 m

TanDEM-X DEM better than HREGP defined by National Geospatial-Intelligence Agency (US)

Definition of 90% point-to-point errors:

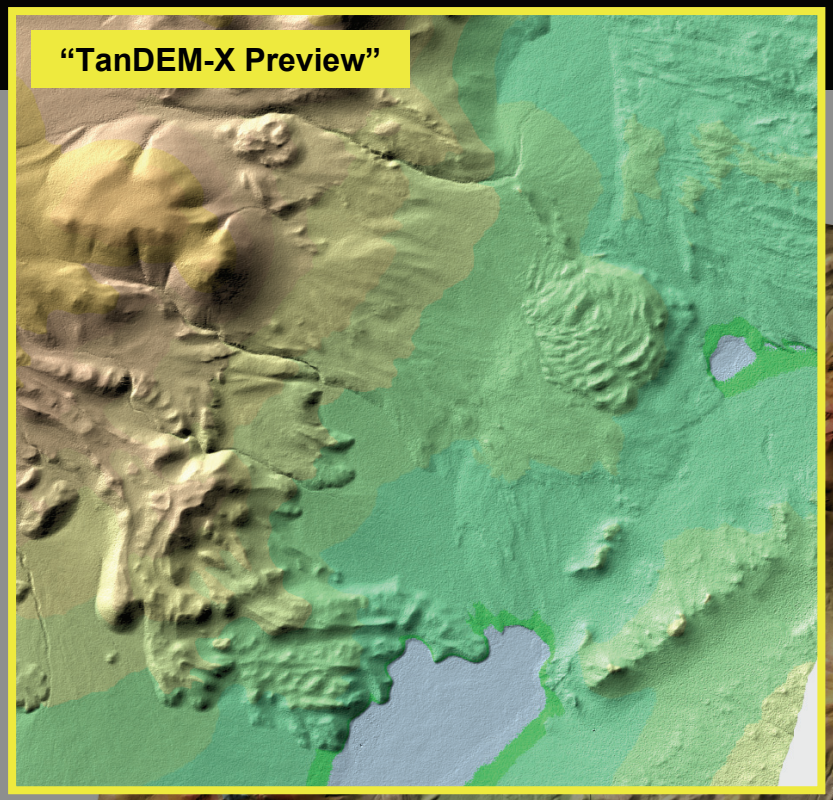


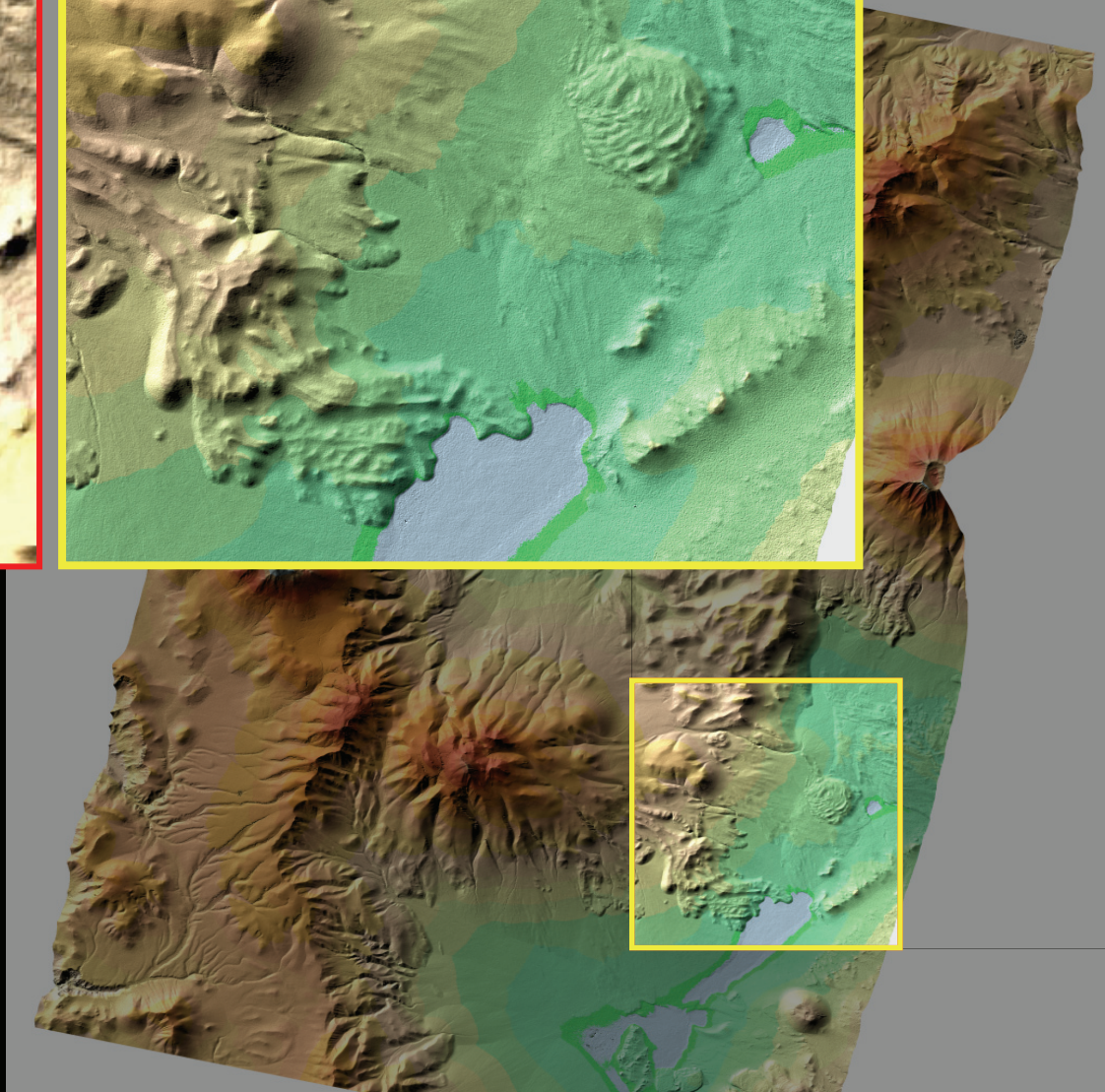
Available DEM Data Products



→ **global TanDEM-X DEM is a unique data product**

TanDEM-X DEM Quality





Identified Scientific Needs

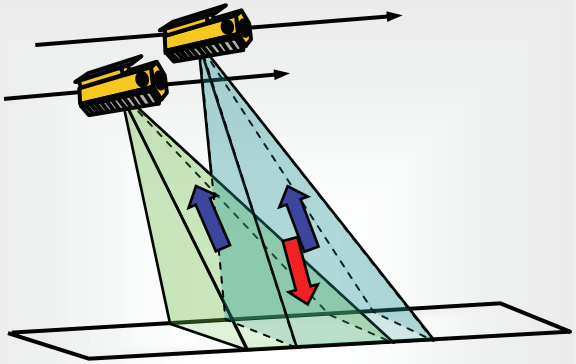
- **Across track InSAR (Digital Elevation Model)**
  - ***Development & improvement of algorithm for validation of heights derived from InSAR; Input parameter for a variety of different applications*** *(e.g. the safety critical aviation terrain database, crisis management (determination of infrastructure), glacier/ice mass changes & retreat, hydrodynamical models, coastal zone lineation, wind fields determination, geological maps, etc.)*
  - ***Added values and generation of scientific products***

- **Along track InSAR (Velocity Measurements)**
  - ***Exploitation of innovative applications*** *and development of algorithm for velocity measurements for traffic flow monitoring, ocean currents, river flow monitoring*
  - ***New application and scientific product development***

- **New SAR Techniques (First Technical Demonstrations)**
  - ***Demonstration and exploitation of new SAR techniques****, understanding and development of new algorithms for multistatic SAR, polarimetric SAR interferometry, super resolution, digital beamforming, InSAR processing, formation flying*
  - ***New perspectives for future SAR systems and development of new applications***

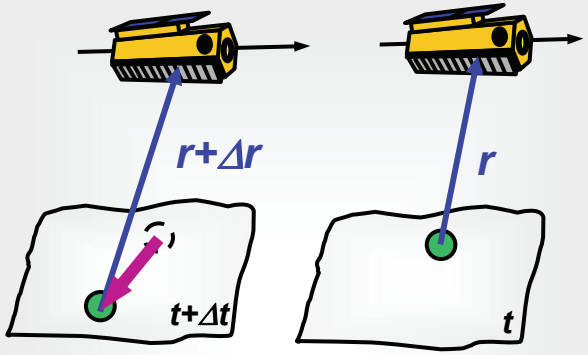
Capabilities of TanDEM-X

Cross-Track Interferometry



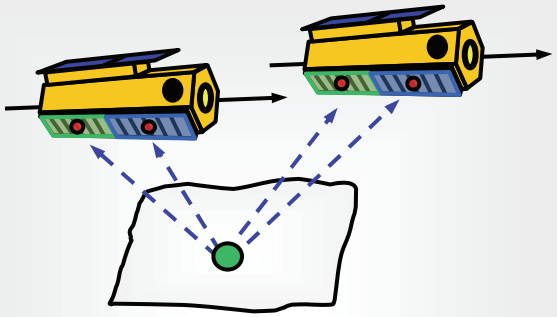
- → **Digital Elevation Models**
- → **Spatial Coherence** (forest, …)
- → **Double DInSAR** (change maps, ..)
- → **High Resolution SAR Images**

Along-Track Interferometry



- → **Large Scale Velocity Fields** (ocean currents, ice drift, …)
- → **Moving Object Detection**
- → **Temporal Coherence Maps**

New Techniques



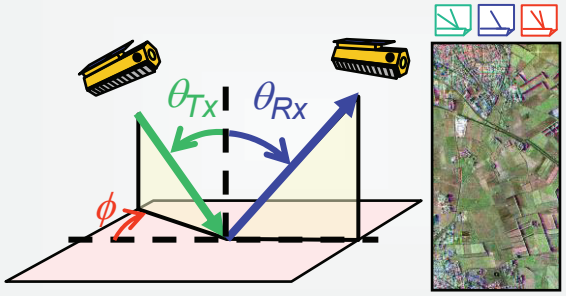
- → **4 Phase Center MTI** (traffic, …)
- → **PolInSAR** (vegetation height, …)
- → **Digital Beamforming** (HRWS, …)
- → **Bistatic Imaging** (classification, ..)

TanDEM-X is a highly flexible sensor enabling multiple powerful imaging modes

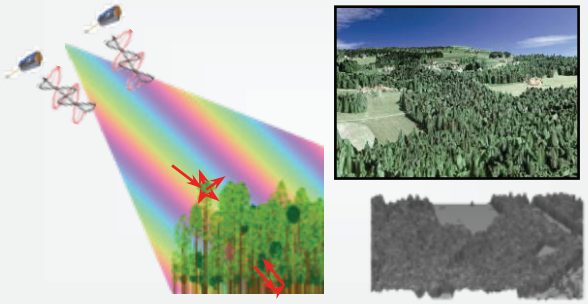
- cross-track baselines (0 km to several km)
- along-track baselines (0 km to several 100 km)
- interferometric modes (bistatic, alternating, monostatic)
- SAR modes (ScanSAR, Stripmap, …)
- bandwidth / resolution (0 ... 150/300 MHz)
- incident angles (20° ... 55°)
- polarisations (single, dual, quad)
- …

Secondary Mission Goals / New Techniques

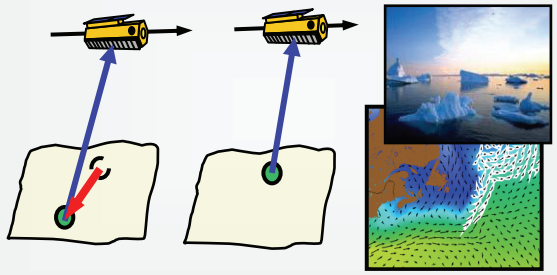
Bistatic SAR Imaging



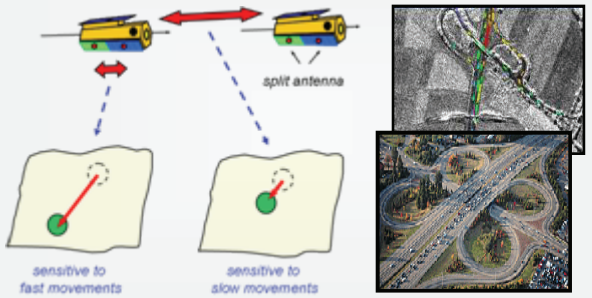
Polarimetric SAR Interferometry



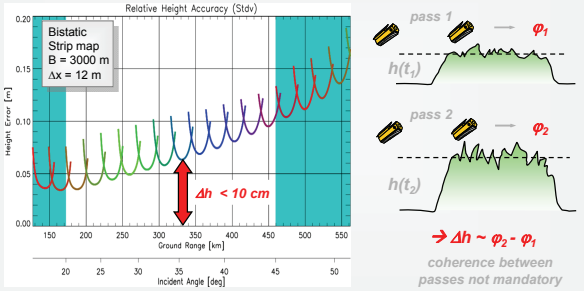
Along-Track Interferometry



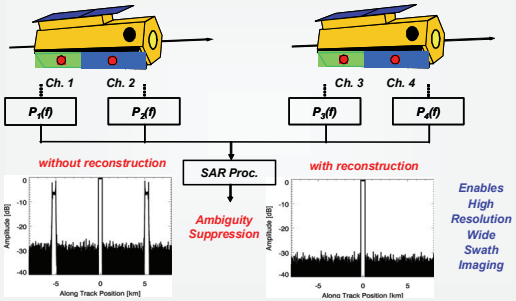
Ground Moving Target Indication



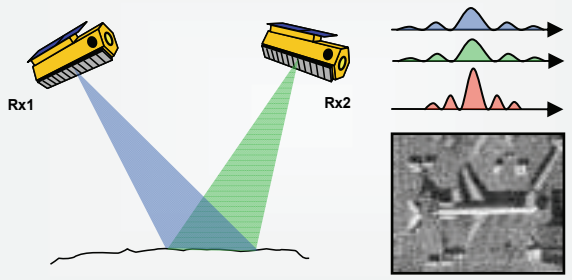
Double Differential Interferometry



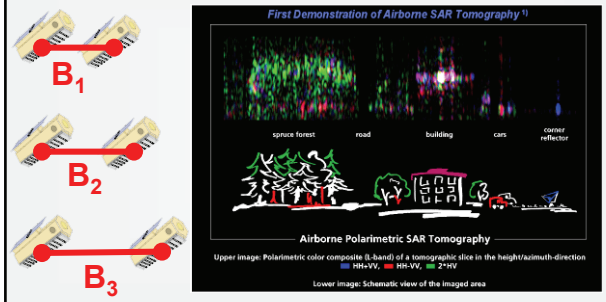
Digital Beamforming



Super Resolution



SAR Tomography



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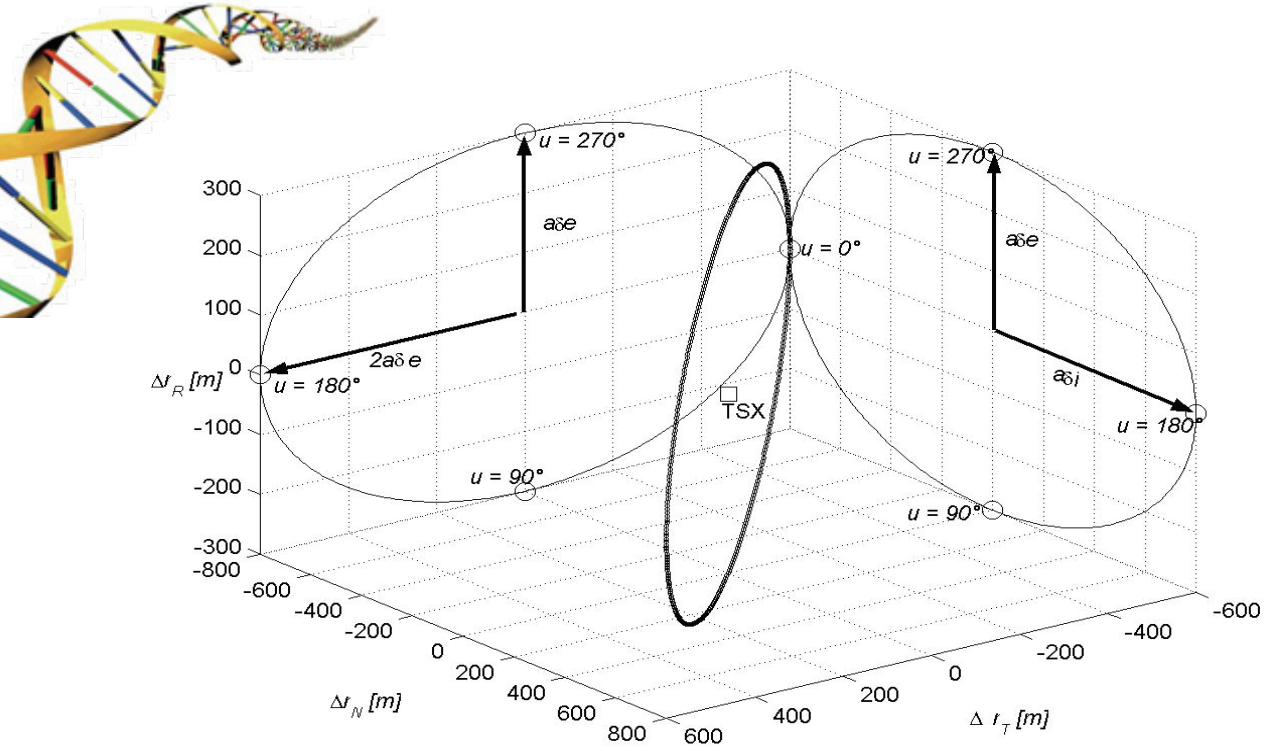
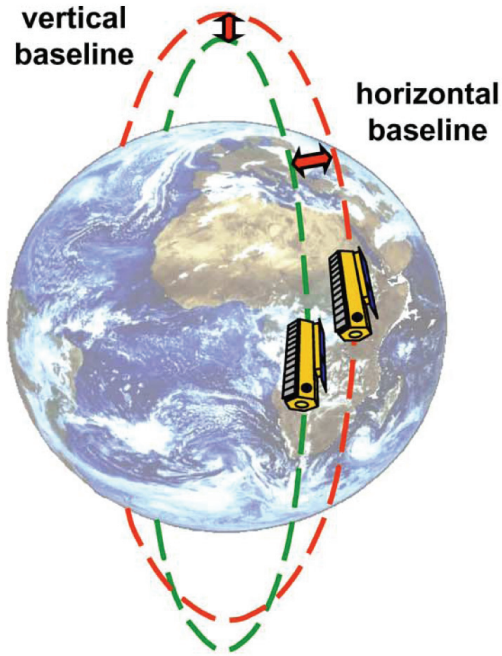
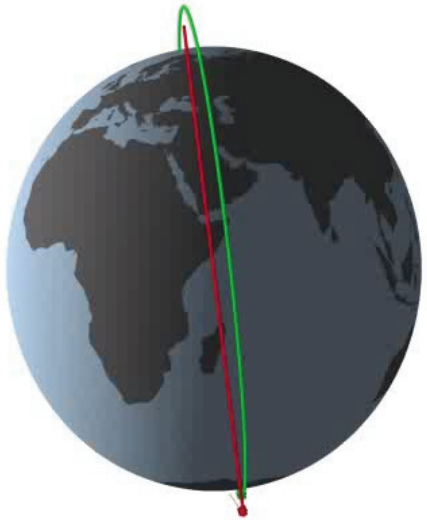
Collision Avoidance - HELIX Formation

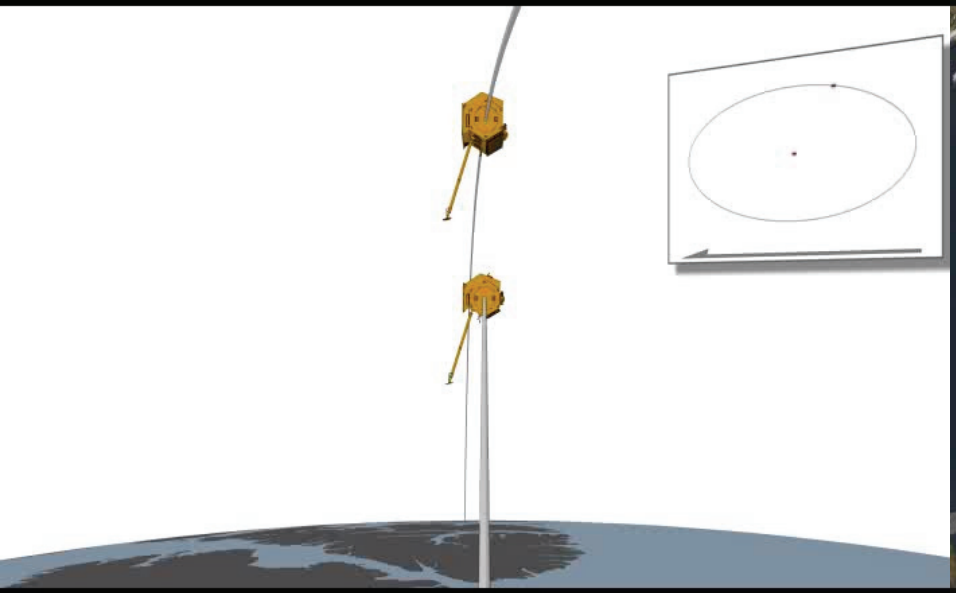




HELIX satellite formation enables safe operation

- *horizontal cross-track separation at equator by different ascending nodes*
- *vertical (radial) separation at poles by orbits with different eccentricity vectors*



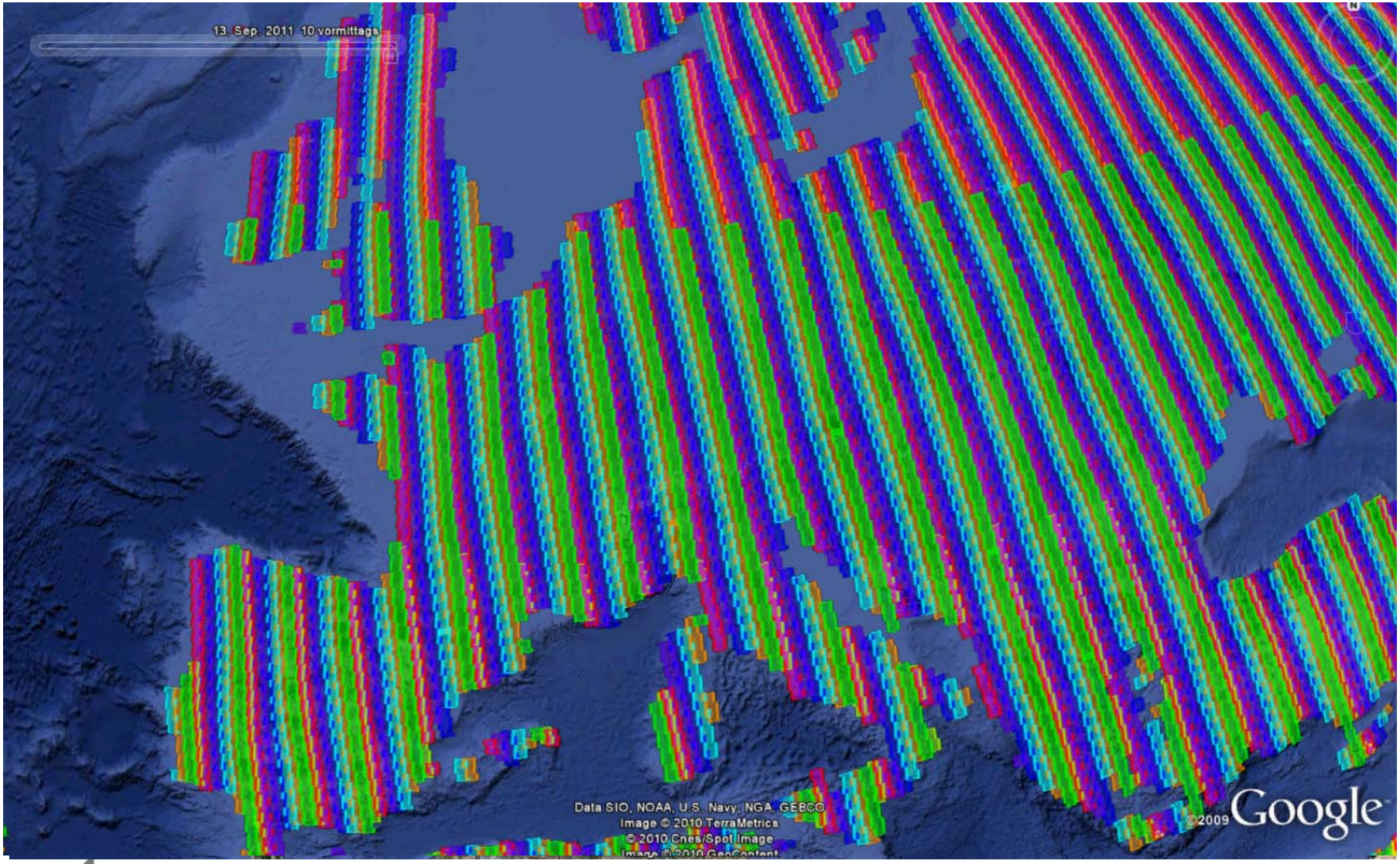


General Outline of the Data Acquisition Plan

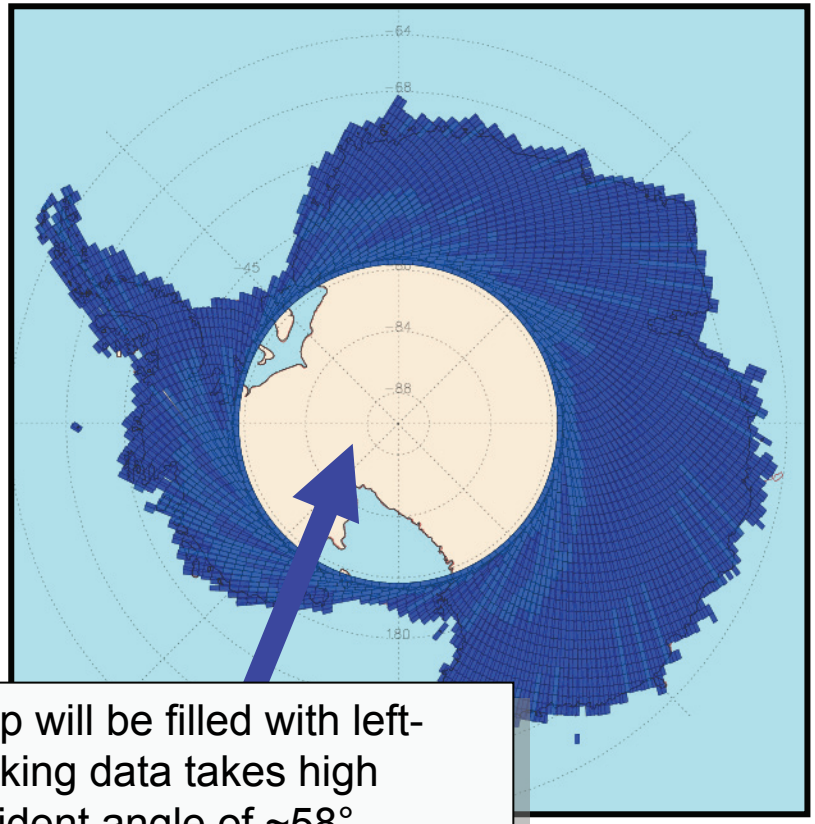
Nominal Data Acqusition 3 (+?) Years **t**

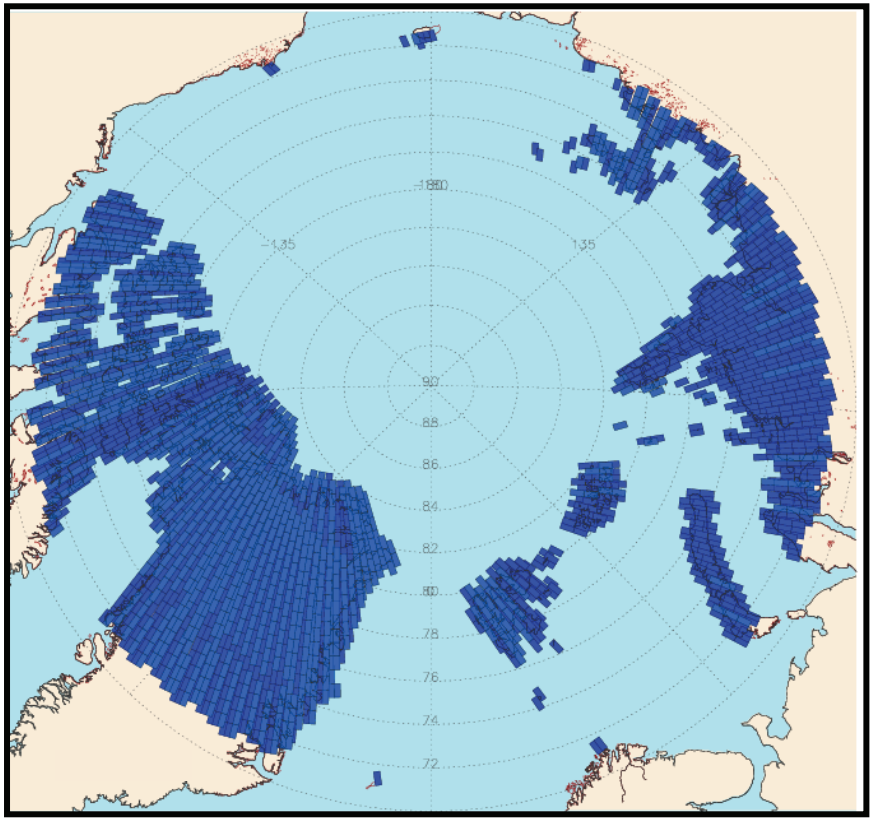
5 months	1 year	1 year	6 months	≥ 3 months
Commissioning Phase	1 global DEM acquisition with small baselines + acquisition of approx. 1000 scientific radar data products	1 global DEM acquisition with scaled (larger) baselines + acquisition of scientific radar data products	DEM data takes for difficult terrain with different viewing geometry + radar data products	radar data products and customized DEMs with large interferometric baselines

Example of First Year: Mapping Europe



Example of First Year Data Acqusition of Polar Regions

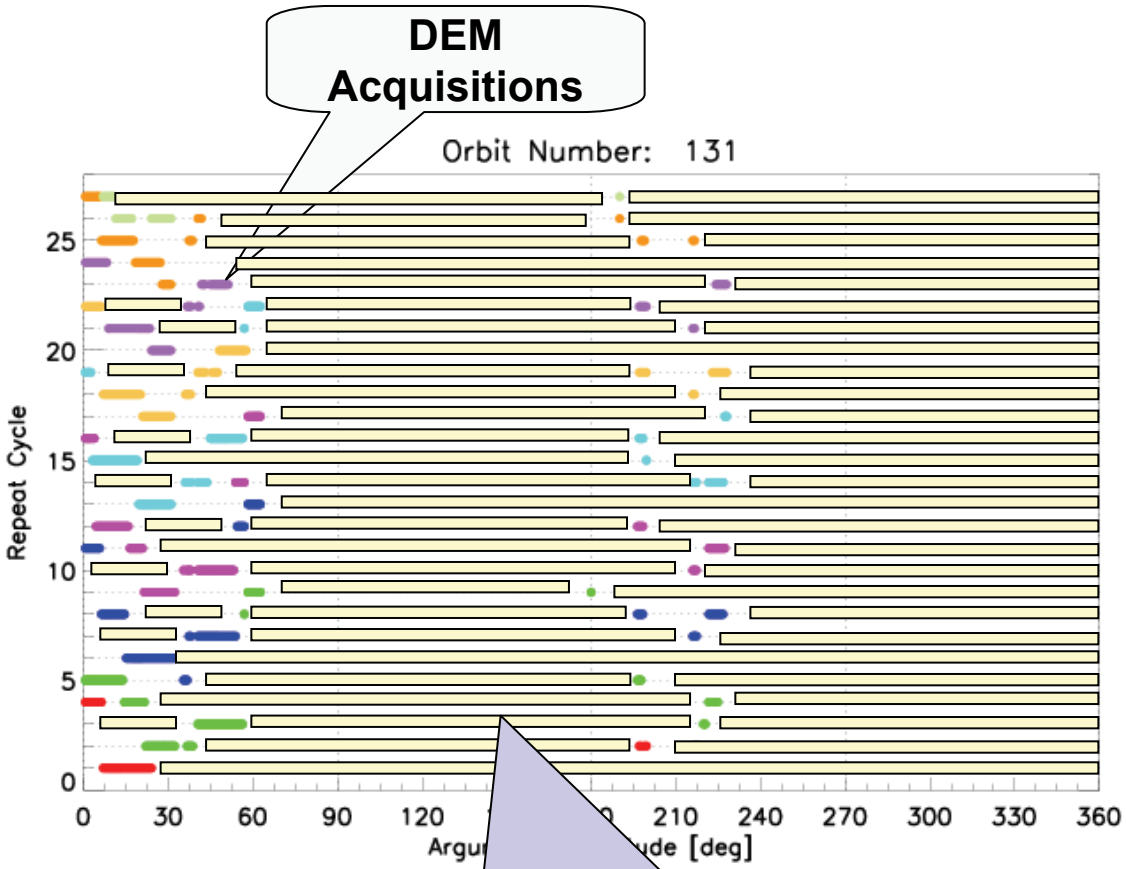


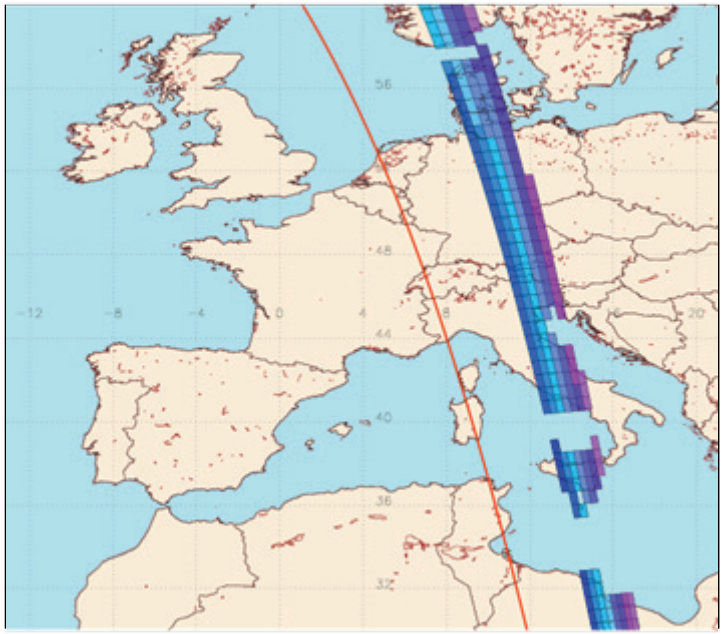


Gap will be filled with left-looking data takes high incident angle of ~58°. Required time will be two repeat 22 day.

~44 days to map outer polar regions
~22 days to map central Antarctic region

Opportunities for Science Data Takes: Example Orbit 131





Used for TerraSAR-X & secondary mission goals & new techniques

TanDEM-X Data Products

SAR products:

- ***experimental products*** from operational modes (co-registered complex slant range images – “CoSSCs”)
- ***TerraSAR-X basic products**** from selected TanDEM-X raw data sets
- **„byproduct“ of operational DEM processing chain:** archive of *CoSSCs from all acquisitions* for DEM generation (multi-temporal global coverage)
- ***experimental mode products*** (special processing with help from DLR contact scientist)

*) TerraSAR-X basic product performance parameter specification does not apply

DEM products:

- ***TanDEM-X DEM*** (better than HREGP)
- ***Intermediate DEM:*** close to HREGP specified DEM
- ***FDEMs***: DEMs processed to finer pixel spacing and higher random height error
- ***HDEMs****:* better than HRE08 like DEMs (high resolution DEM, were additional acqusitions are needed, lokal area only)

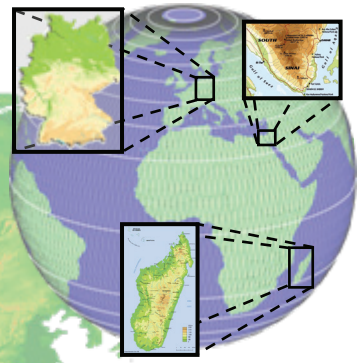
Global TanDEM-X DEM - Characteristics

- Data stored and delivered in tiles
- Terrain elevation given as WGS84 ellipsoidal height [m]
- Optional delivery of SAR amplitude data
- Latitude-dependent pixel spacing (zones)
- Raw DEM mosaicking on continent level
- Quality control and post-processing incl. flattening of water bodies
- Final DEM available 4 years after launch (intermediate DEM earlier)

Zone	Latitude (North/ South)	Latitude pixel spacing	Longitude pixel spacing	Tile size (Latitude x Longitude)	Tile size (example, MB)
I	0° – 50°	0.4''	0.4''	1° x 1°	891
II	50° – 60°		0.6''	1° x 1°	595
III	60° – 70°		0.8''	1° x 2°	890
IV	70° – 80°		1.2''	1° x 2°	596
V	80° – 85°		2.0''	1° x 4°	712
VI	85° – 90°		4.0''	1° x 4°	356

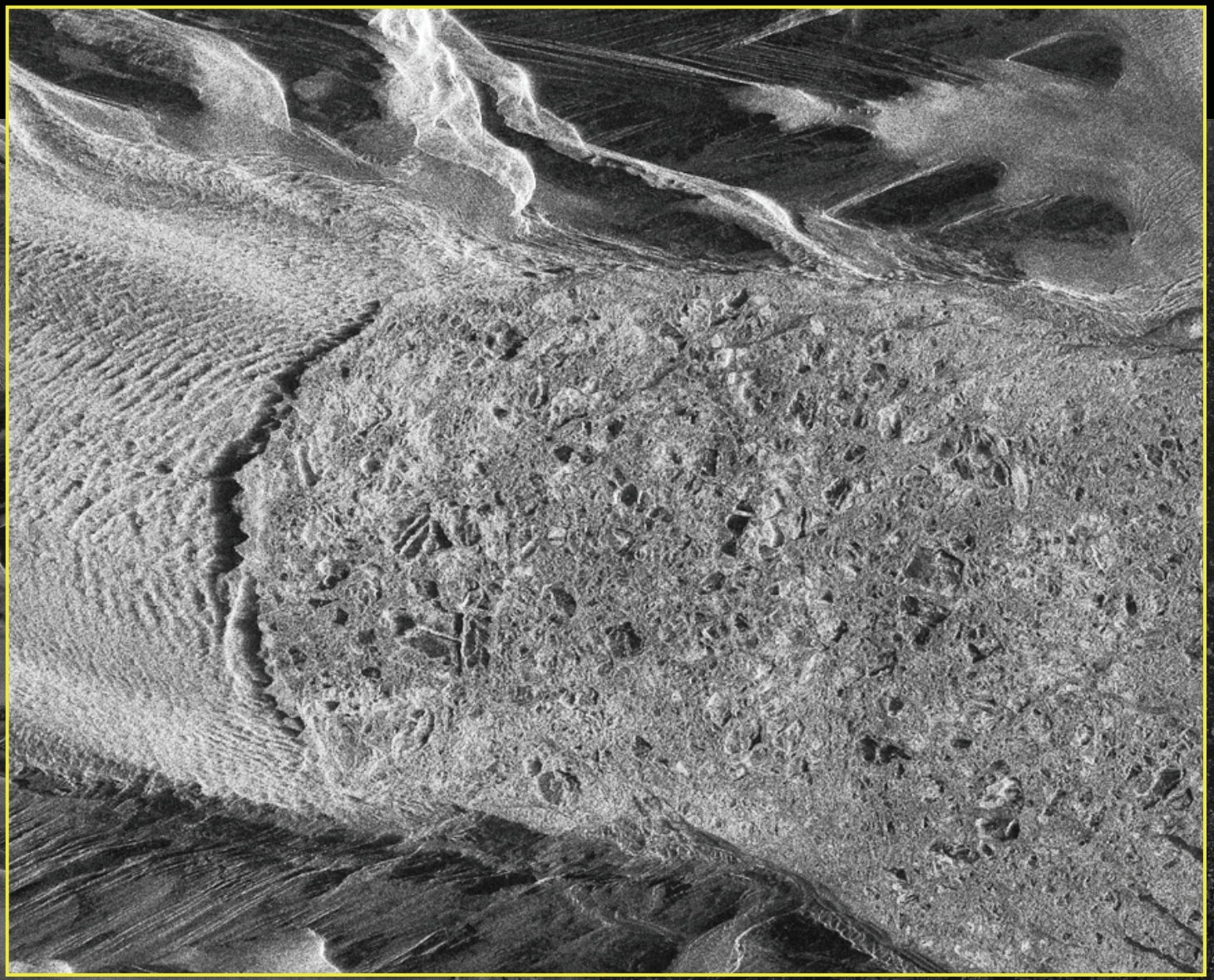
Local DEM products - Characteristics

- High Resolution DEMs generated on request
- For areas of limited size only
- Sub-meter resolution (e.g. HRTI-4)
- Multiple data acquisitions with large and small baselines



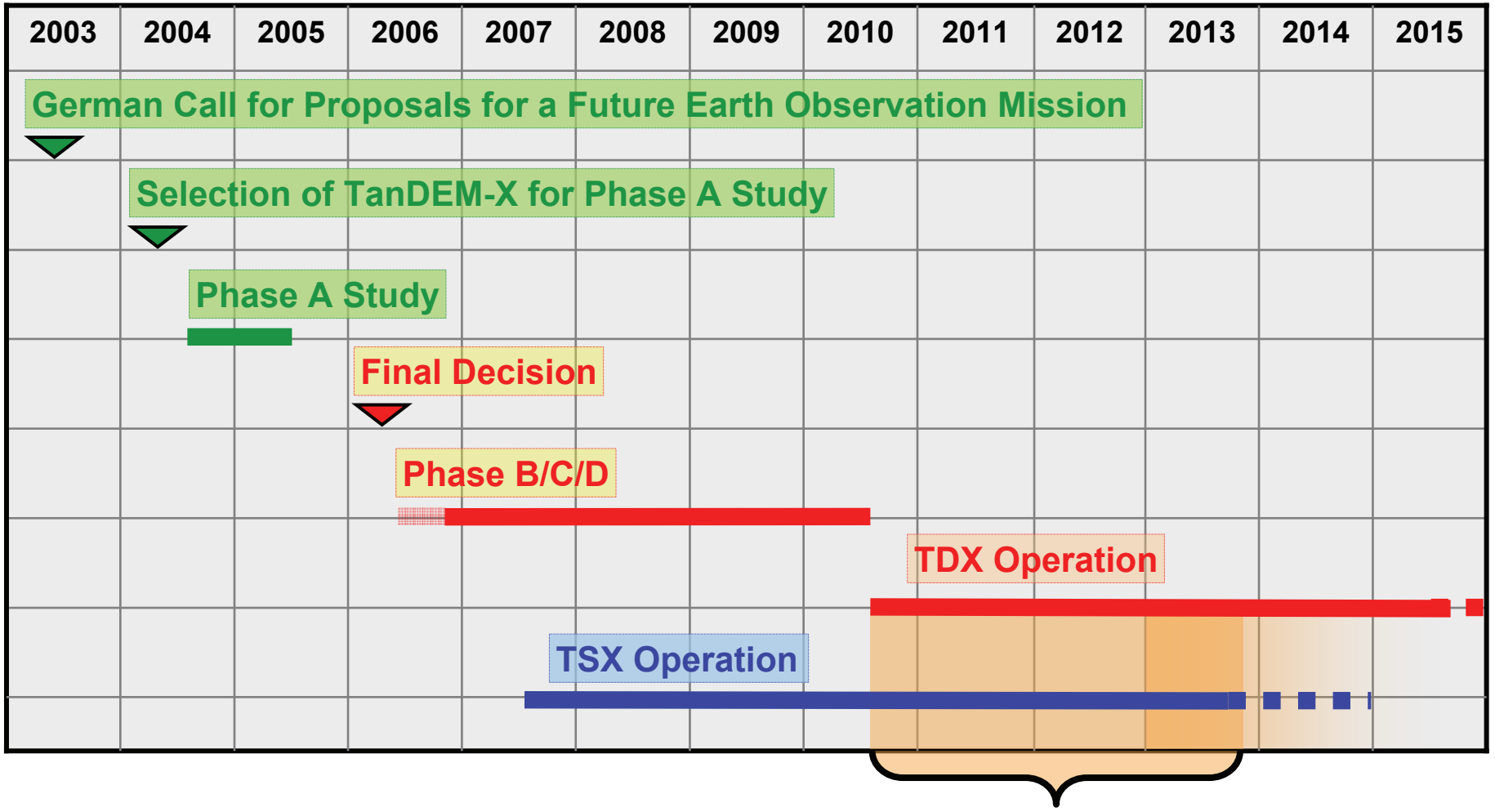
Larsen Ice-field / Antarctica

Date: 26. June 2007,
Resolution: 3 Meter
Mode: Stripmap; Polarisation: VV

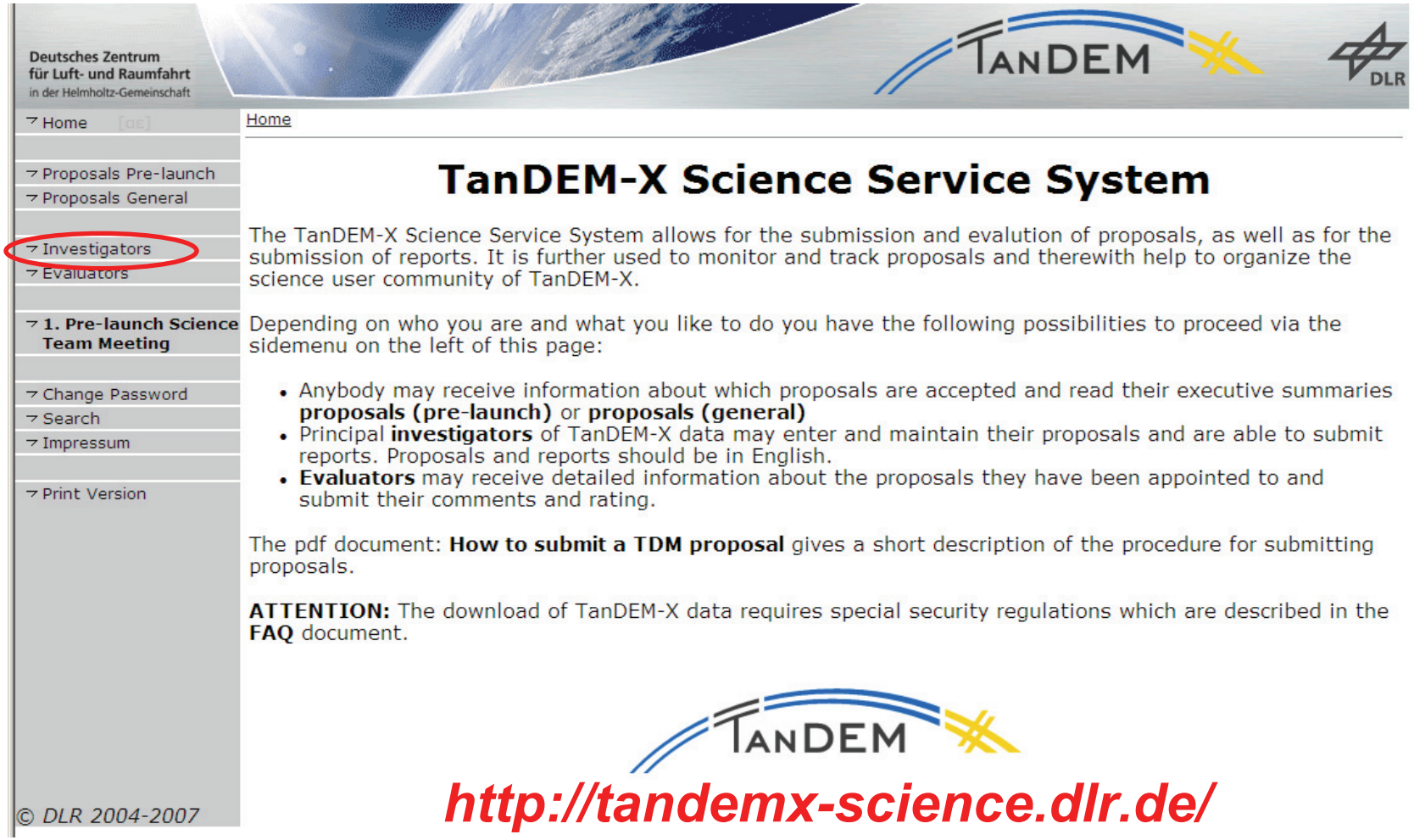


DLR

TanDEM-X Schedule



TanDEM-X Sciene Data Proposal Submission



http://tandemx-science.dlr.de/

OPEN FROM 17 May 2010

Time for Questions