TanDEM-X: Mission Status & Scientific Contribution

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Deutsches Zentrum für Luft- und Raumfahrt e.V. in der Helmholtz-Gemeinschaft

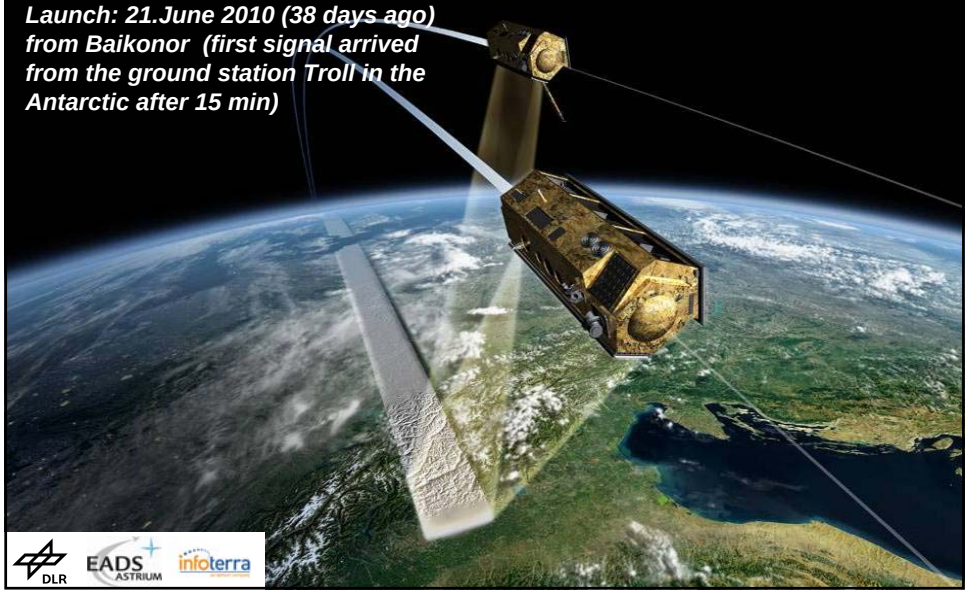
TanDEM

IGASS 2010 - Honolulu
29-July-2010

TanDEM-X: TerraSAR-X-Add-on for Digital Elevation Measurements

TanDEM

Launch: 21.June 2010 (38 days ago) from Baikonor (first signal arrived from the ground station Troll in the Antarctic after 15 min)

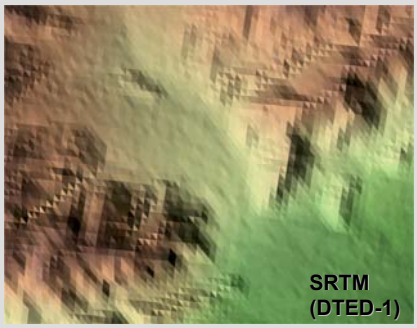


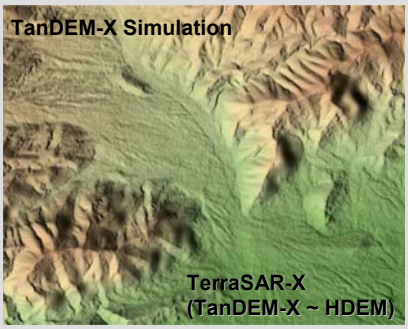
DLR EADS ASTRIUM infoterra

Primary Mission Objectives

Standards for Digital Elevation Models (DEM)

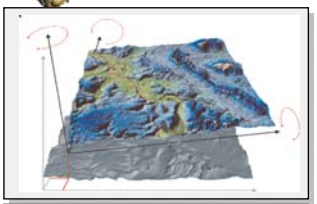
DEMs	Spatial Resolution	Absolute Vertical Accuracy(90%)	Relative Vertical Accuracy (point-to-point in 1° cell, 90%)
DTED-1	90 m x 90 m	< 30 m	< 20 m
DTED-2	30 m x 30 m	< 18 m	< 12 m
TanDEM-X DEM	12 m x 12 m	< 10 m	< 2 m
HDEM	6 m x 6 m	< 5 m	< 0.8 m

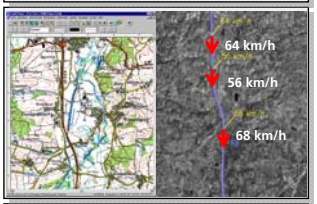


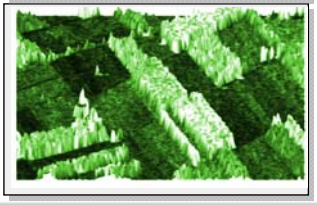


Secondary Mission Objectives

- **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*
  - *Added values and generation of scientific products*
- **Along track InSAR (Velocity Measurements)**
  - *Exploitation of innovative applications and development of algorithm*
  - *New application and scientific product development*
- **New SAR Techniques (First Technical Demo.)**
  - *Demonstration and exploitation of new SAR techniques*
  - *New perspectives for future SAR systems and development of new applications*







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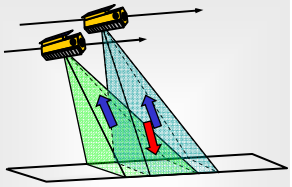
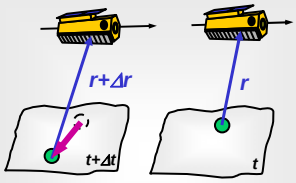
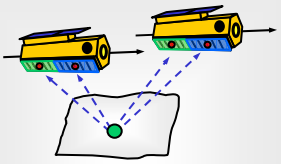
Capabilities of TanDEM-X

Cross-Track Interferometry	Along-Track Interferometry	New Techniques
		
→ **Digital Elevation Models** → **Spatial Coherence** (forest, ...) → **Double DInSAR** (change maps, ..) → **High Resolution SAR Images**	→ **Large Scale Velocity Fields** (ocean currents, ice drift, ...) → **Moving Object Detection** → **Temporal Coherence Maps**	→ **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) ▪...

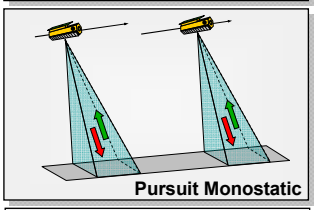
General Outline of the Data Acquisition Plan

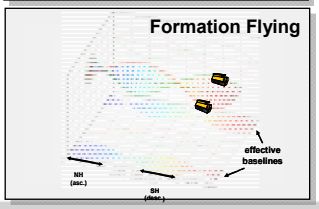
Nominal Data Acqusition 3 (+?) Years — t

5 months	1 year	1 year	6 months	≥ 3 months
Commissioning Phase	1 global DEM acquisition with small baselines + acquisition of 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

Commissioning Phase (CP)

- ***Launch and Early Orbit Phase (LEOP)***
  - Duration: **21 June to 19 July 2010**
  - Ground station checkout
  - Instrument & processor checkout
- ***Pursuit Monostatic Phase***
  - Duration: 7 Cycles **(20 July to 07 Oct 2010)**
  - Satellite config: ground-track 0m & along-track 20km
  - Safe formation flight & Exclusion Zone Test
  - SAR system calibration campaign
  - SAR system performance
  - Mission planning system operationalisation
- ***Bistatic Phase***
  - Duration: 5 Cycles **(08 Oct to 29 Nov 2010**)
  - Satellite config: Across-track 500m & along-track 0m
  - Bistatic commanding and performance
  - Interferometric processor adaptation
  - Baseline bias characterisation
  - DEM calibration tests & error model verification





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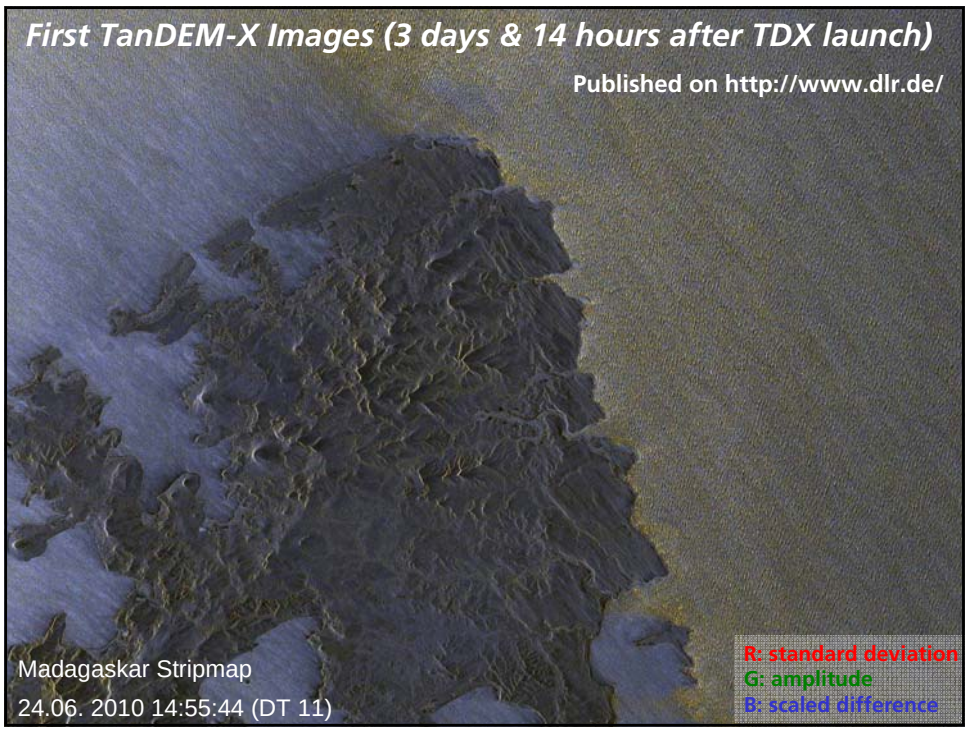
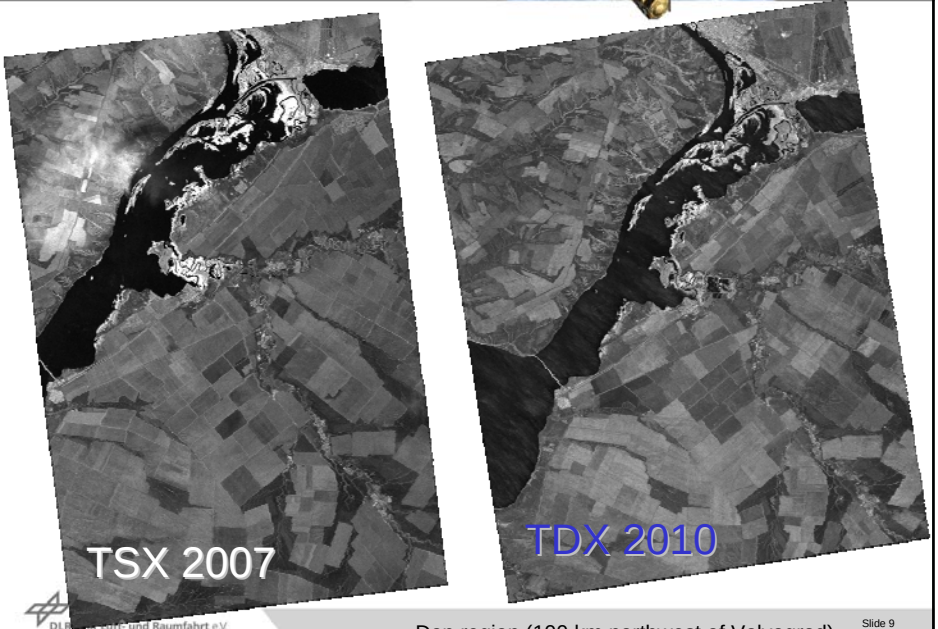
First TanDEM-X Images (3 days & 14 hours after TDX launch)

Published on http://www.dlr.de/



TanDEM-X / TerraSAR-X – First TSX Image 2007 vs. 2010



Don region (100 km northwest of Volvograd)

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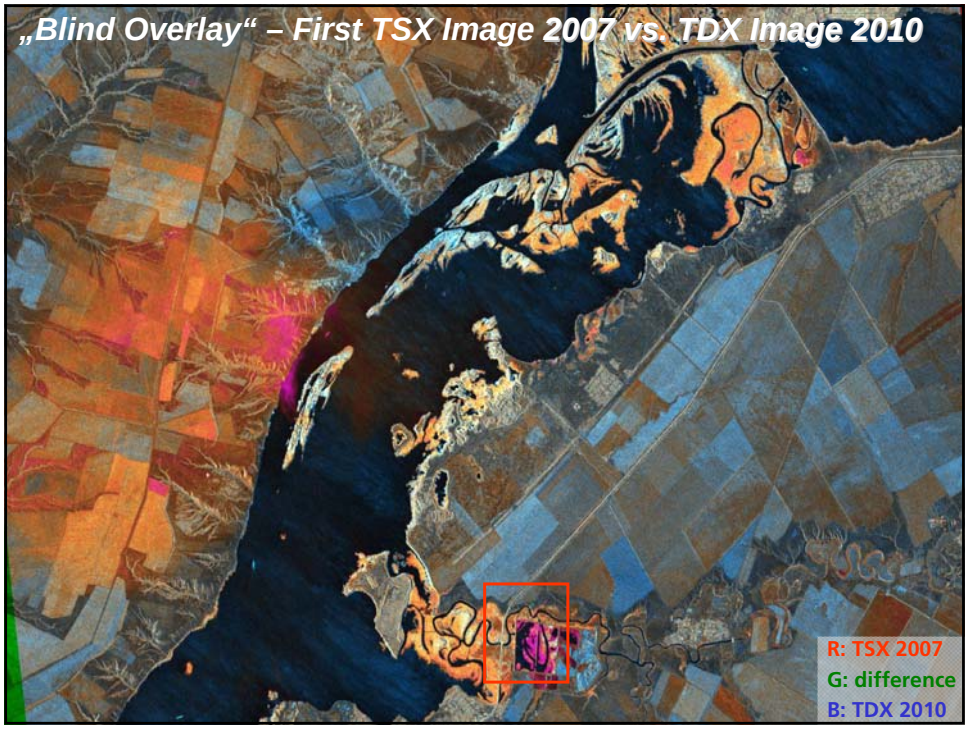
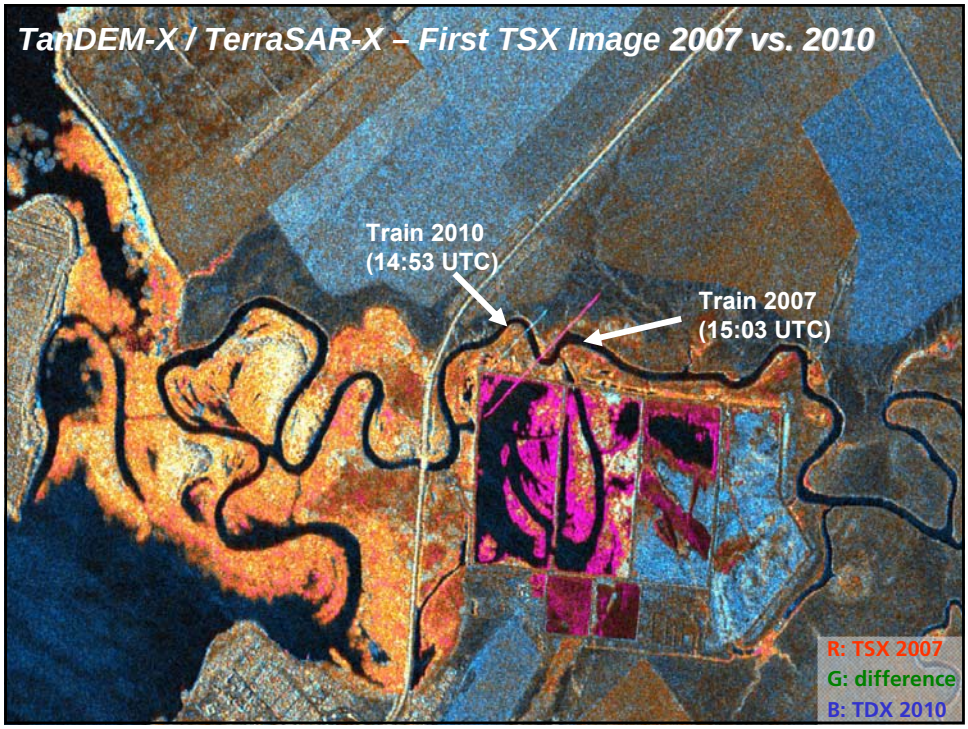
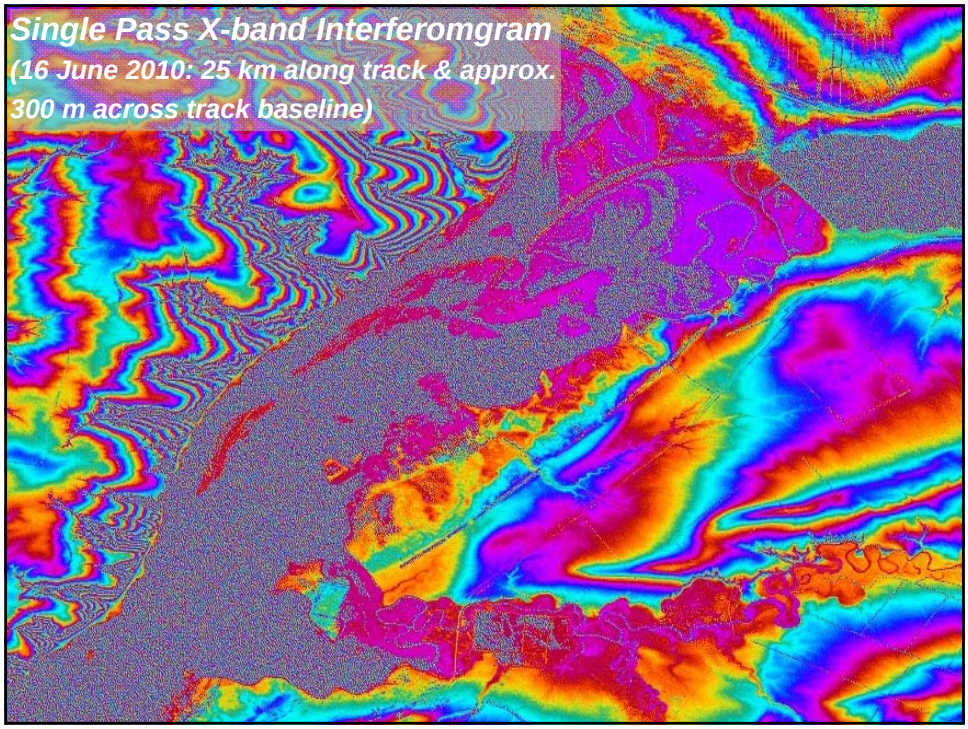
„Blind Overlay“ – First TSX Image 2007 vs. TDX Image 2010

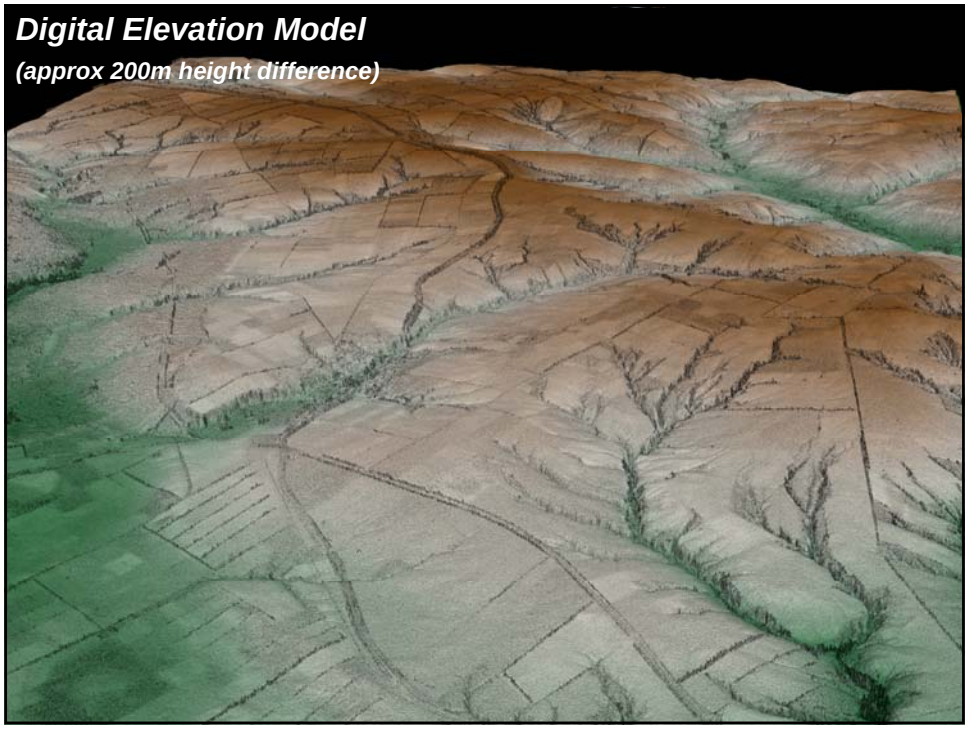



TanDEM-X / TerraSAR-X – First TSX Image 2007 vs. 2010
Train 2010
(14:53 UTC)
Train 2007
(15:03 UTC)
R: TSX 2007
G: difference
B: TDX 2010


Single Pass X-band Interferomgram
(16 June 2010: 25 km along track & approx.
300 m across track baseline)

Digital Elevation Model

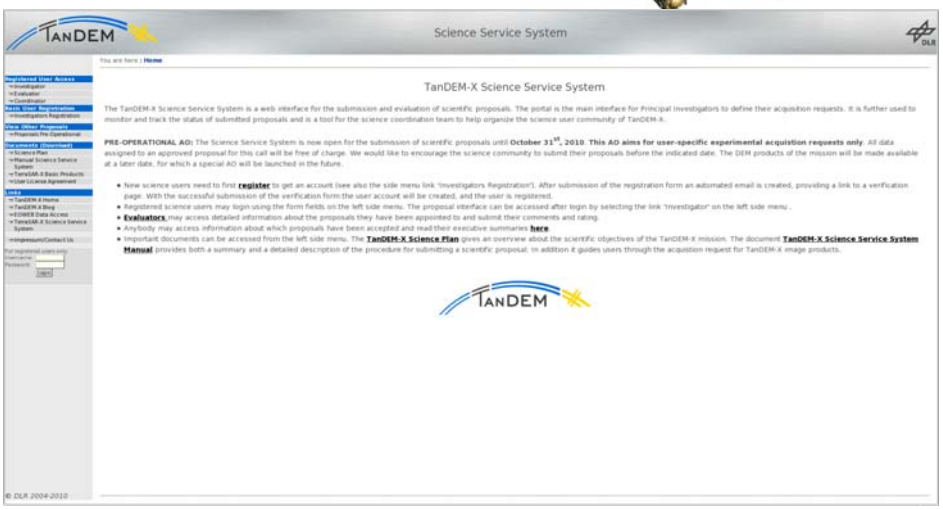
(approx 200m height difference)



TanDEM-X Scientific Experiments: Topic's

TDX Experiments	*CP Phase*	*Comments*
Temporal Decorrelation Analysis	***Pursuit Monostatic*** **Along-track baseline: 20 km**	~3s time lag suitable for short term temporal decorrelation studies
Velocity Measurements		Only possibility to investigate very long baseline GMTI
Superresolution		Investigation of high resolution processing (azimuth)
Bistatic Experiment		First long baseline bistatic imaging
Polarimetric SAR Interferometry	***Bistatic Phase*** **Across-track baseline: 500 m**	Potential of X-band for short volume characterisation
Double differential SAR Interferometry		Assessment of the interferometric phase
Bistatic Processing		Bistatic processing performance

TanDEM-X Proposal Submission



Open for Experimental Products
Please have a look @ http://tandemx-science.dlr.de

Operational Mode Products

	Operational Mode		
Commanding			
TanDEM-X cooperative mode	***Bistatic***	***Alternating Bistatic***	***Pursuit Monostatic***
Imaging mode	Stripmap	Stripmap	all basic modes
Polarisation mode	all basic polarisation modes (incl. DRA mode for quad polarimetry)	Single	all basic polarisation modes (incl. DRA mode for quad polarimetry)
Formation Geometry			
Across-track baseline	< 4 km	< 4 km	< 4 km
Along-track baseline	< 1 km	< 1 km	Any
Processing and Products			
Experimental products generated from the TanDEM-X processor	CoSSC (coregistered slant range single look complex) and interferograms for all acquisitions	Two CoSSC (coregistered slant range single look complex) for all acquisitions	CoSSC (coregistered slant range single look complex) for Stripmap and single polarisation
Experimental products generated by the TerraSAR-X processor	Standard TerraSAR-X level 1 products* (including geocoding) of the monostatic channel for all acquisitions	Non	Two standard TerraSAR-X level 1b products* (including geocoding) for all acquisitions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The first 3D experiment
22. July 2010, 10.30, 0 Comment/s
It was during a sleepless night, with hardly any drop in the midsummer temperatures, when the idea for a radar experiment with both satellites, TerraSAR-X and TanDEM-X occurred: "What if we could prove that interferometry is possible with two satellites even before the final formation is reached?"
Full article
Posted by
Stress tests in space and rivers of sand
14. July 2010, 14.02, 0 Comment/s
As ground teams prepared for the formation flight of TanDEM-X and TerraSAR-X, TanDEM-X was put through its paces in the last week before approach. The instrument team ran a set of hot/cold tests to check the instrument's performance limits by first allowing the radar system to cool down and then running it at full load. This was followed by tests in which a large number of randomly targeted radar images of the Earth's surface were used to test the reliability of the reception and processing systems. The images acquired during these tests include a number
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Functional tests
launch
launch campaign
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Baikonur


Thanks for your attention
TanDEM-X Team
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