TanDEM-X Science Products – Land Ice

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TanDEM-X
Mission Goals

- acquisition of a global DEM according to HRTI-3 standard
- generation of local DEMs with HRTI-4 like quality
- demonstration of innovative bistatic imaging techniques and applications

TerraSAR add-on for Digital Elevation Measurements
Available DEM Data Products

- Airborne LiDAR
- Airborne SAR
- Photogrammetry
- HR Satellites
- SRTM-C (restricted)
- Aster
- SRTM-X
- ERS 1/2
- SPOT 5 HRS
- SRTM-C (free)
- TanDEM-X
- USGS GTOPO 30

→ global HRTI-3 DEM is a unique data product at a competitive price
NGA (NIMA) Standards for Digital Elevation Models

<table>
<thead>
<tr>
<th>Spatial Resolution</th>
<th>Absolute Vertical Accuracy (90%)</th>
<th>Relative Vertical Accuracy (point-to-point in 1° cell, 90%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DTED-1</td>
<td>90 m x 90 m</td>
<td>&lt; 30 m</td>
</tr>
<tr>
<td>DTED-2</td>
<td>30 m x 30 m</td>
<td>&lt; 18 m</td>
</tr>
<tr>
<td>HRTI-3</td>
<td>12 m x 12 m</td>
<td>&lt; 10 m</td>
</tr>
<tr>
<td>HRTI-4</td>
<td>6 m x 6 m</td>
<td>&lt; 5 m</td>
</tr>
</tbody>
</table>

SRTM / X-SAR

TanDEM-X Simulation

~ DTED 2

~ HRTI 3-4
## TanDEM-X Radar Techniques and Application Areas

### TanDEM-X Application

<table>
<thead>
<tr>
<th>Across-track</th>
<th>Along-track</th>
<th>New Techniques</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oceanography</td>
<td>Hydrology</td>
<td>InSAR Processing</td>
</tr>
<tr>
<td>Geology</td>
<td>Glaciology</td>
<td>Formation Flying</td>
</tr>
<tr>
<td>Land Cover &amp; Vegetation</td>
<td>Traffic</td>
<td>Super Resolution</td>
</tr>
<tr>
<td>Land Environment</td>
<td>Oceanography</td>
<td>Bistatic Processing</td>
</tr>
<tr>
<td>Glaciology/Hydrology</td>
<td></td>
<td>Digital Beamforming</td>
</tr>
</tbody>
</table>

- **InSAR Processing**
  - Topography
  - Glaciology
  - Navigation
  - Urban Area

Use of TanDEM-X radar techniques in various application areas:

- **Land Cover & Vegetation**
- **Land Environment**
- **Geology**
- **Oceanography**
- **Traffic**
- **Hydrology/Glaciology**
- **Urban Area**
Applications ATI & New Techniques

- Bi-Static SAR
- InSAR Processing
- InSAR Processing Super Resolution
- Ocean Currents
- Traffic Monitoring
- Glacier Mass Balance
- Digital Beamforming
- Formation Flying

Along-Track Interferometry

New SAR Techniques
Collision Avoidance - Helix Formation
### Capabilities of TanDEM-X

<table>
<thead>
<tr>
<th>Cross-Track Interferometry</th>
<th>Along-Track Interferometry</th>
<th>New Techniques</th>
</tr>
</thead>
<tbody>
<tr>
<td>→ Digital Elevation Models</td>
<td>→ Large Scale Velocity Fields</td>
<td>→ 4 Phase Center MTI (traffic, ...)</td>
</tr>
<tr>
<td>→ Spatial Coherence (forest, ...)</td>
<td>(ocean currents, ice drift, ...)</td>
<td>→ PollInSAR (vegetation height, ...)</td>
</tr>
<tr>
<td>→ Double DInSAR (change maps, ..)</td>
<td>→ Moving Object Detection</td>
<td>→ Digital Beamforming (HRWS, ...)</td>
</tr>
<tr>
<td>→ High Resolution SAR Images</td>
<td>→ Temporal Coherence Maps</td>
<td>→ Bistatic Imaging (classification, ..)</td>
</tr>
</tbody>
</table>

TanDEM-X is a highly flexible sensor which enables multiple powerful imaging modes.

- **Cross-Track Interferometry**
  - Along-Track Interferometry
  - New Techniques

- **Along-Track Interferometry**
  - Cross-Track Interferometry
  - New Techniques

- **New Techniques**
  - Cross-Track Interferometry
  - New Techniques

- **Cross-Track Interferometry**
  - Along-Track Interferometry
  - New Techniques

- **Along-Track Interferometry**
  - New Techniques

- **New Techniques**
  - Cross-Track Interferometry
  - Along-Track Interferometry

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

<table>
<thead>
<tr>
<th>Year</th>
<th>Event Description</th>
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<tbody>
<tr>
<td>2003</td>
<td>German Call for Proposals for a Future Earth Observation Mission</td>
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<tr>
<td>2004</td>
<td>Selection of TanDEM-X for Phase A Study</td>
</tr>
<tr>
<td>2005</td>
<td>Phase A Study</td>
</tr>
<tr>
<td>2006</td>
<td>Final Decision</td>
</tr>
<tr>
<td>2007</td>
<td>Phase B/C/D</td>
</tr>
<tr>
<td>2008</td>
<td>TDX Operation</td>
</tr>
<tr>
<td>2009</td>
<td>TSX Operation</td>
</tr>
<tr>
<td>2010</td>
<td>At least 3 years of joint operation</td>
</tr>
<tr>
<td>2011</td>
<td></td>
</tr>
<tr>
<td>2012</td>
<td></td>
</tr>
<tr>
<td>2013</td>
<td></td>
</tr>
<tr>
<td>2014</td>
<td></td>
</tr>
<tr>
<td>2015</td>
<td></td>
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Relevance to STG-IPY SAR Data Coordination

- Planned X-band SAR data acquisition over the Earth land mass (including Antarctica and land regions at the Arctic)
- Generation of a global DEM’s (covering also the whole Antarctic region)
- DEM products will be available for PI’s (TanDEM-X User-Web-Interface)

Definition of requirements for a DEM over Arctic land and Antarctic regions:

- Data acquisition at which time of the year requested?
  - whole coverage @ short time (3-4 month) of land masses (right-looking nominal / whole coverage left-looking needed)
  - different baselines ~ different height of ambiguities (in time) over pole regions
  - data storage contraints (download stations distributed @ north & south lat.)
- Are there special requests for a 'super test site', where data should be acquired?
- Is a concentration over marginal regions (costal zones) requested?
  - What is the swath of a costal zone (100 km)?
  - Is a seasonal observation of a defined area of importance?
  - Observation with 2 years difference over a defined area?
Announcement: TanDEM-X Science Meeting
November 24, 2008 (Monday) @
DLR, Oberpfaffenhofen Germany
http://www.dlr.de/HR/tdmx

Topics to be covered during the
Pre-Launch Science Meeting:
- TanDEM-X system capabilities
- Performance Analysis
- Calibration activities
- Science & commercial activities
- Scientific proposal submission
- Commercial proposal submission
- Data ordering procedures
- Status of the ground segment
- Status of space segment

TerraSAR-X Science Meeting
November 25-26, 2008 (Tue-Wed) @ DLR

CEOS Cal/Val Meeting
November 27-28, 2009 (Thu-Fri) @ DLR