

TanDEM-X Mission Status

M. Zink

TanDEM-X Ground Segment Manager

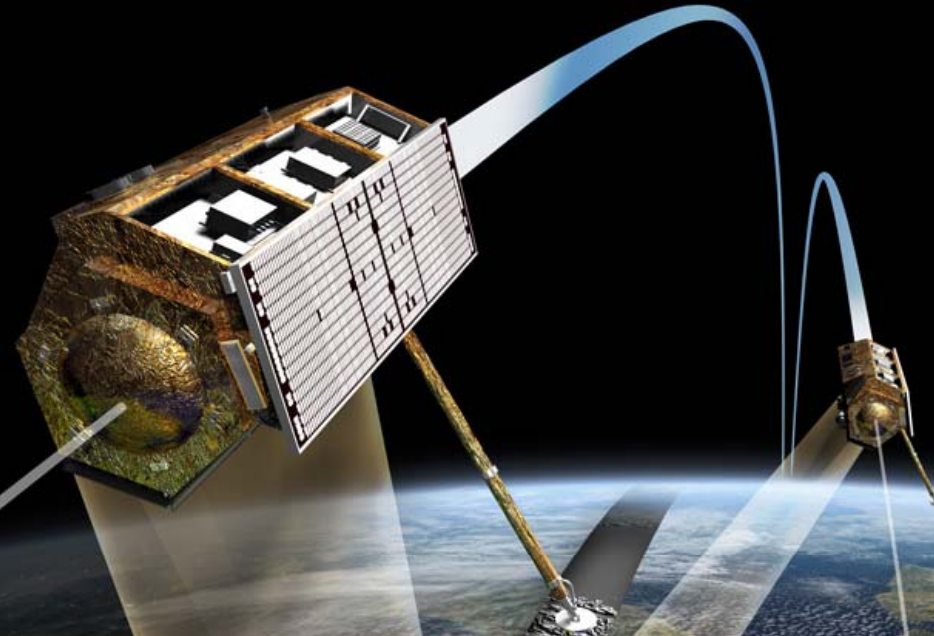
TerraSAR-X-Add-on for Digital Elevation Measurements



acquisition of a global DEM according to Level-3 standard

generation of local DEMs with Level-4 like quality

demonstration of innovative bistatic imaging techniques and applications

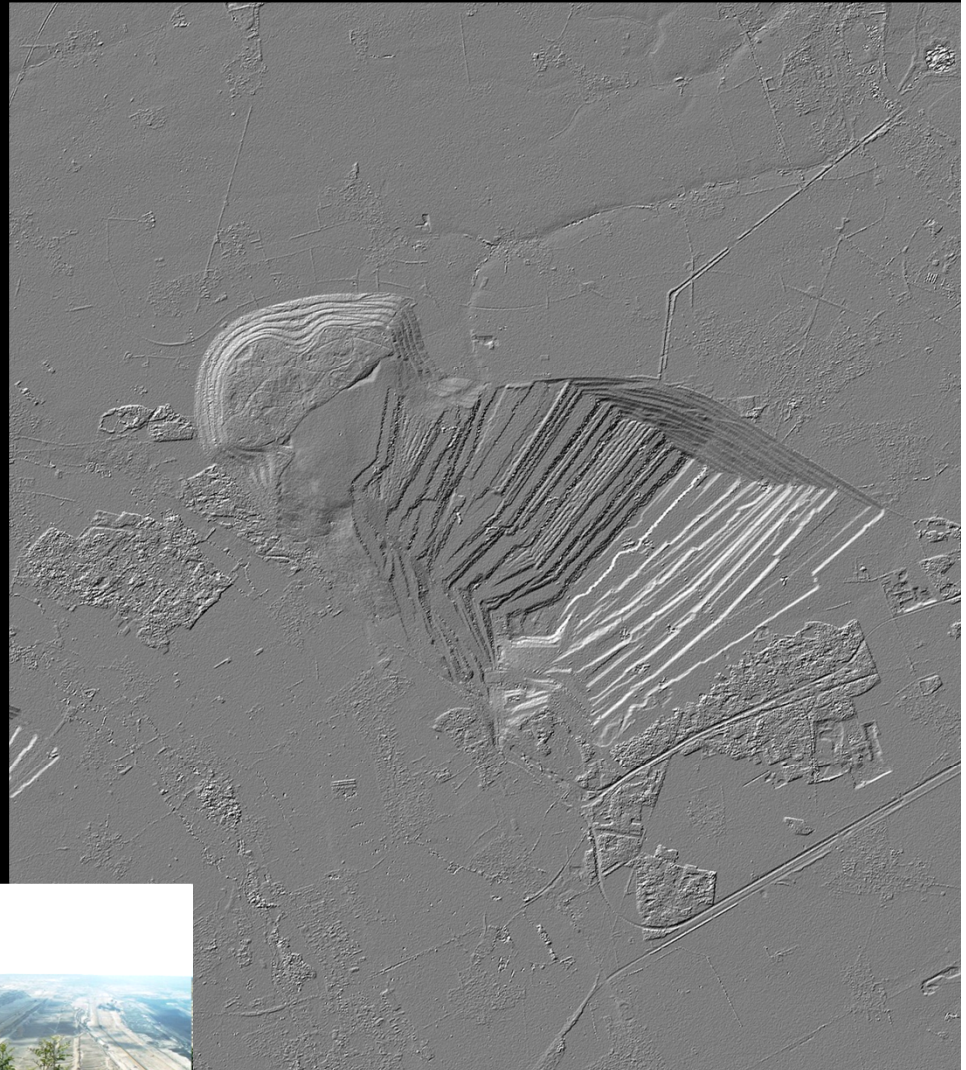
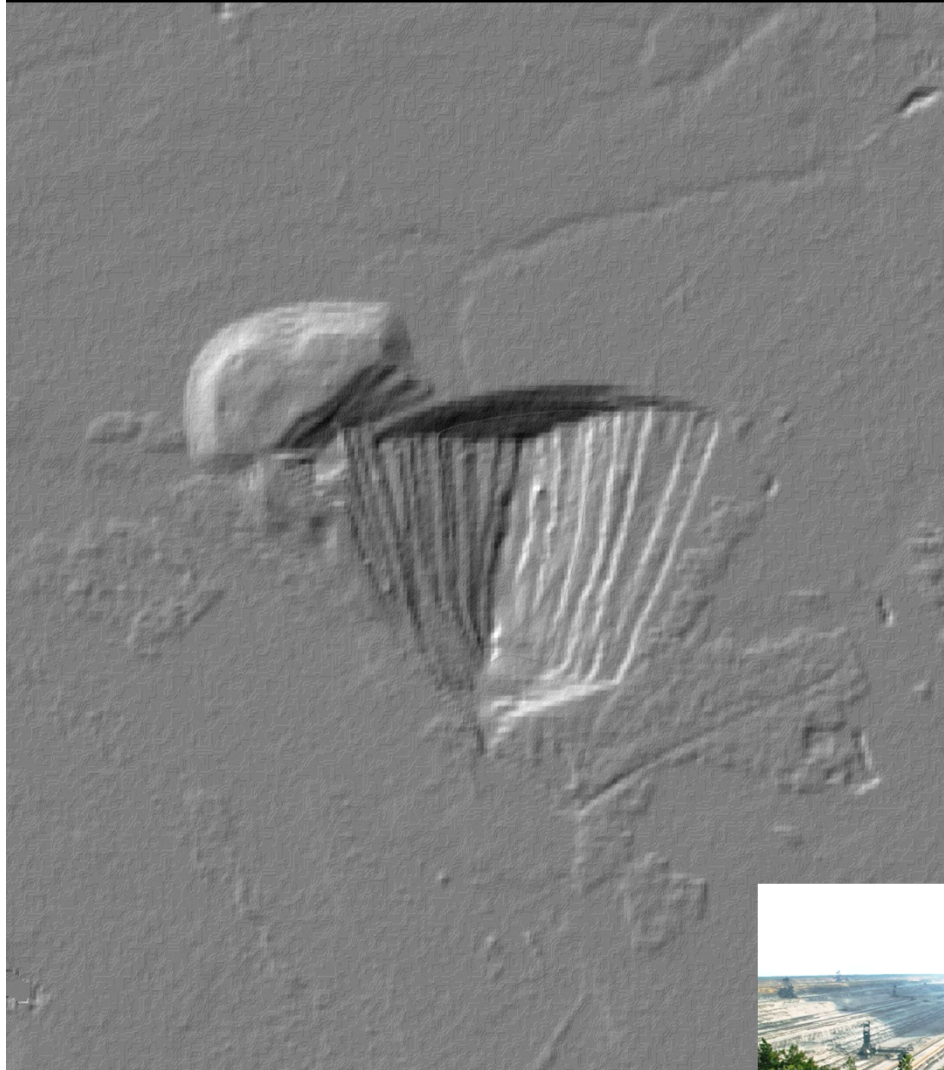


<i>DEMs</i>	<i>Spatial Resolution</i>	<i>Absolute Vertical Accuracy (90%)</i>	<i>Relative Vertical Accuracy (point-to-point in 1° cell, 90%)</i>
<i>DTED-1</i>	<i>90m x 90m</i>	<i>< 30m</i>	<i>< 20m</i>
<i>DTED-2</i>	<i>30m x 30m</i>	<i>< 18m</i>	<i>< 12m</i>
<i>TanDEM-X DEM</i>	<i>12m x 12m</i>	<i><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



SRTM

TanDEM-X



Coal Mine Hambach - Germany

Secondary Mission Objectives



Bistatic SAR Imaging

Diagram illustrating Bistatic SAR Imaging. Two antennas are shown: one transmitting (Tx) and one receiving (Rx). The transmission angle is θ_{Tx} and the reception angle is θ_{Rx} . The angle between the antennas is ϕ . A SAR image of a forest is shown on the right.

Polarimetric SAR Interferometry

Diagram illustrating Polarimetric SAR Interferometry. Two antennas are shown. A rainbow spectrum is shown. SAR images of a forest are shown on the right.

Along-Track Interferometry

Diagram illustrating Along-Track Interferometry. Two antennas are shown. SAR images of a forest are shown on the right.

Ground Moving Target Indication

Diagram illustrating Ground Moving Target Indication. A split antenna is shown. SAR images of a road are shown on the right. Labels: "sensitive to fast movements" and "sensitive to slow movements".

Double Differential Interferometry

Graph showing Relative Height Accuracy (Stdv) vs Incident Angle [deg]. Parameters: Bistatic Strip map, B = 3000 m, Ax = 12 m. Accuracy is $\Delta h < 10 \text{ cm}$. Diagrams show "process 1" and "process 2".

Digital Beamforming

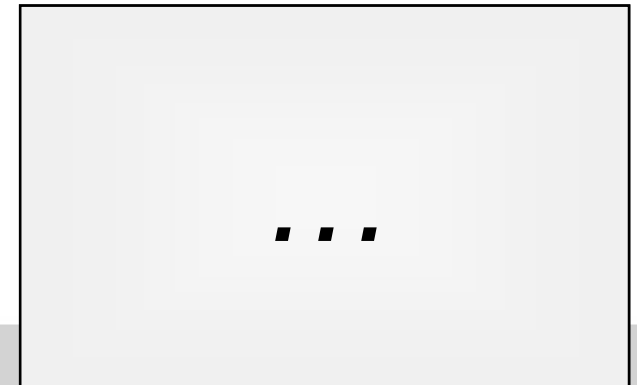
Diagram illustrating Digital Beamforming. Four channels (Ch. 1, Ch. 2, Ch. 3, Ch. 4) are shown. SAR images are shown on the right. Labels: "without reconstruction", "SAR Proc.", "with reconstruction", "Ambiguity Suppression", "Enables High Resolution Wide Swath Imaging".

Super Resolution

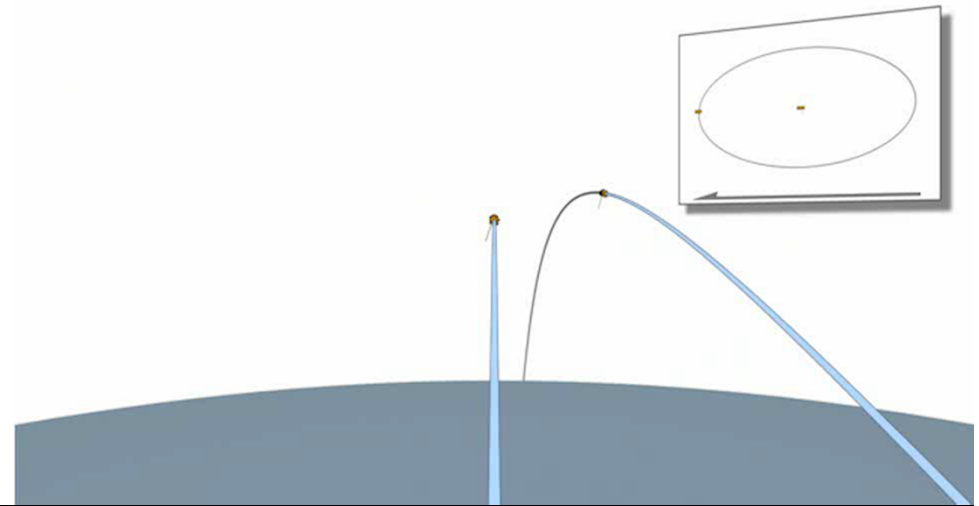
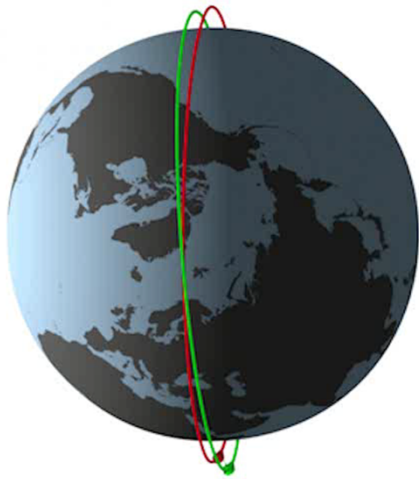
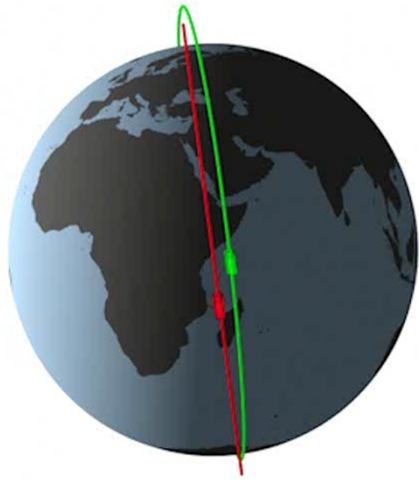
Diagram illustrating Super Resolution. Two antennas (Rx1, Rx2) are shown. SAR images are shown on the right.

SAR Tomography

Diagram illustrating SAR Tomography. Three antennas (B_1, B_2, B_3) are shown. SAR images of a forest are shown on the right. Labels: "First Demonstration of Airborne SAR Tomography", "Airborne Polarimetric SAR Tomography", "Upper image: Polarimetric color composite (L-band) of a tomographic slice in the height/azimuth-direction", "Lower image: Schematic view of the imaged area".

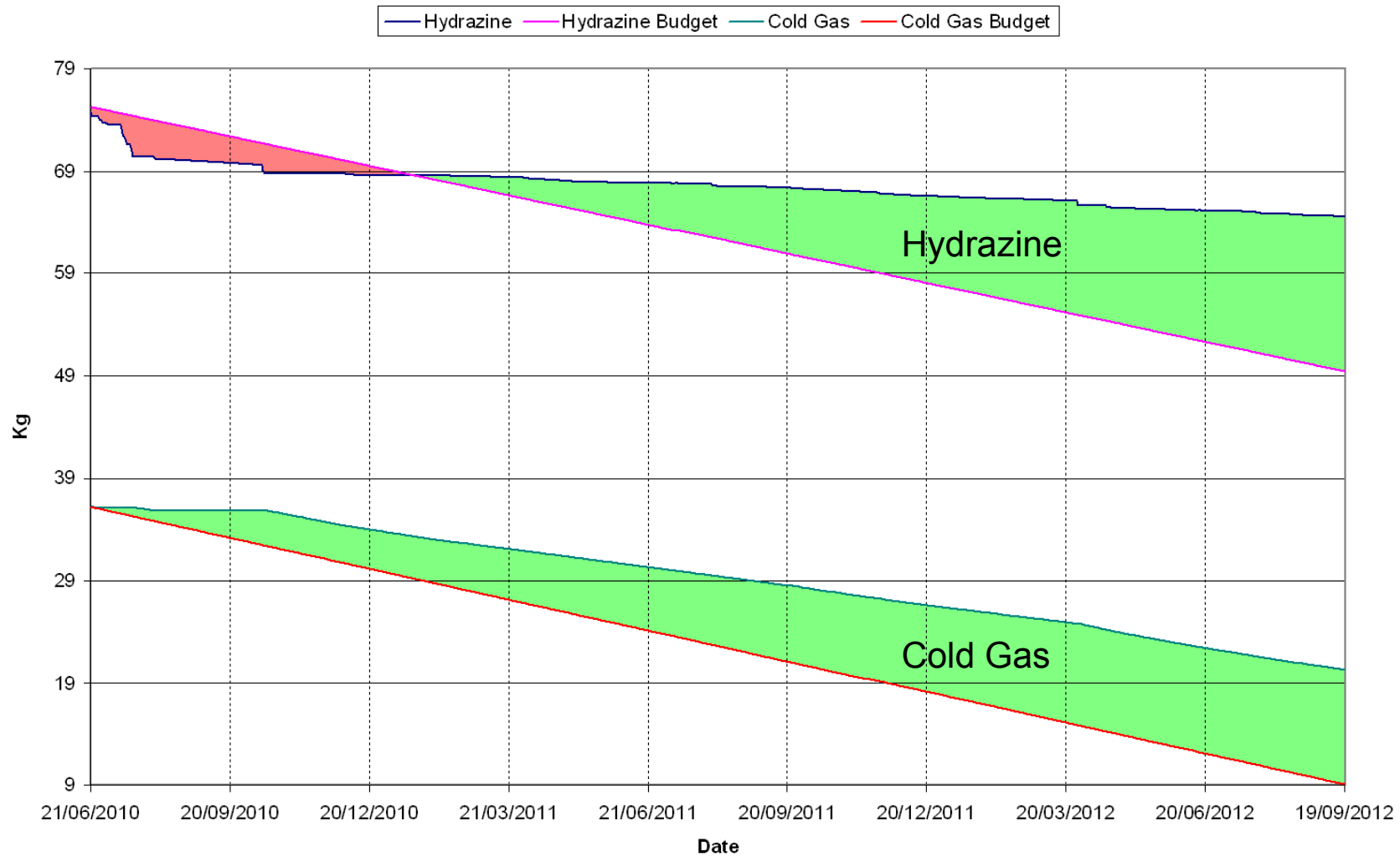


Close Formation Flight





Status Cold Gas Consumption





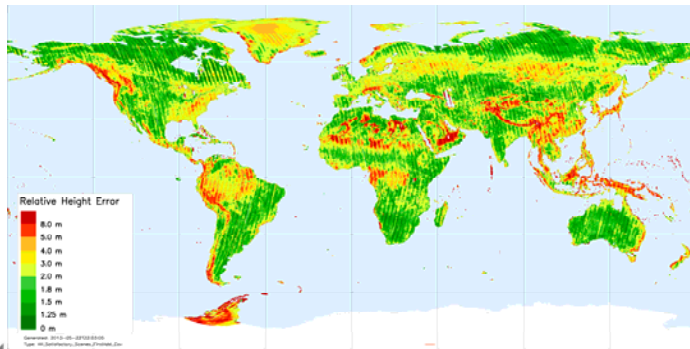
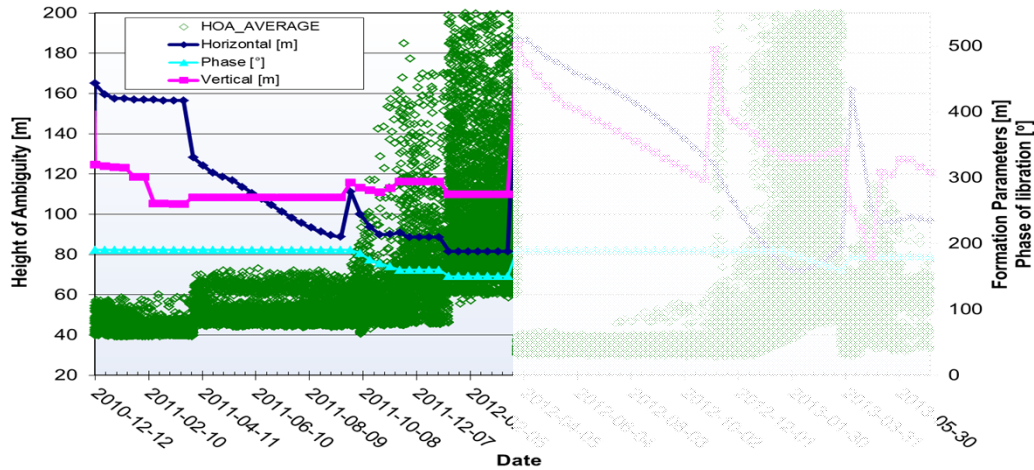
TanDEM-X Global DEM Acquisition Plan



commissioning phase

1st global coverage

2nd global coverage



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



Relative Height Error First Coverage





TanDEM-X Global DEM Acquisition Plan

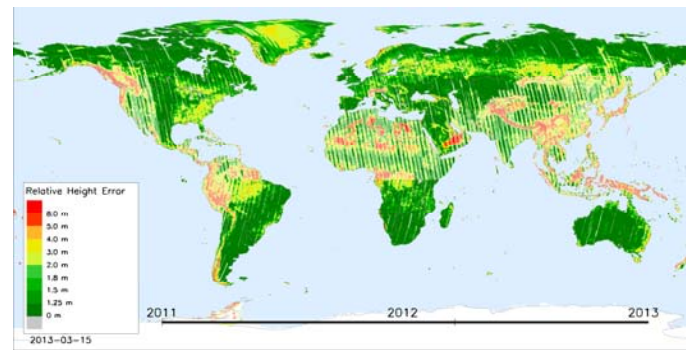
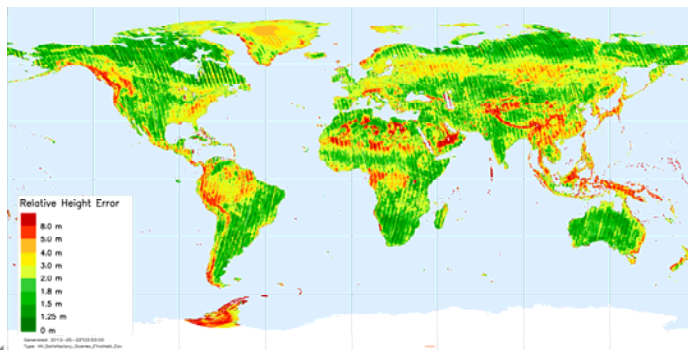
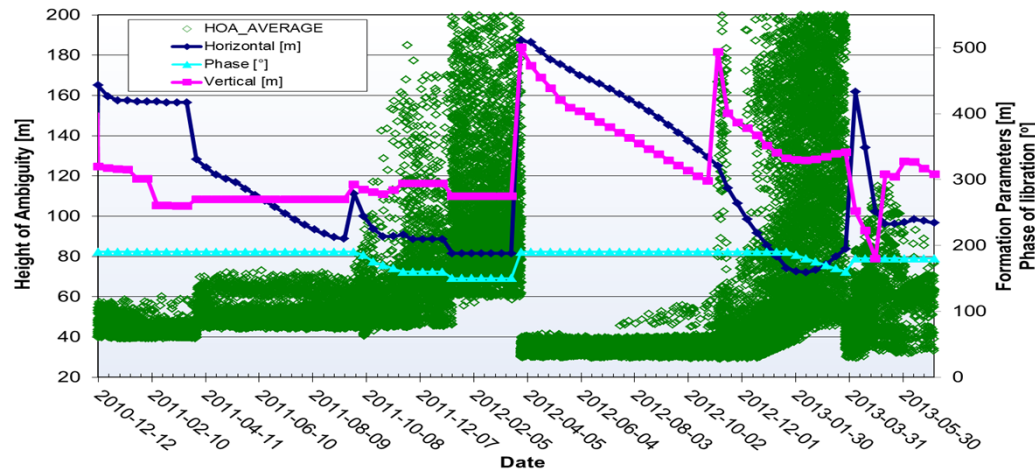


commissioning phase

1st global coverage

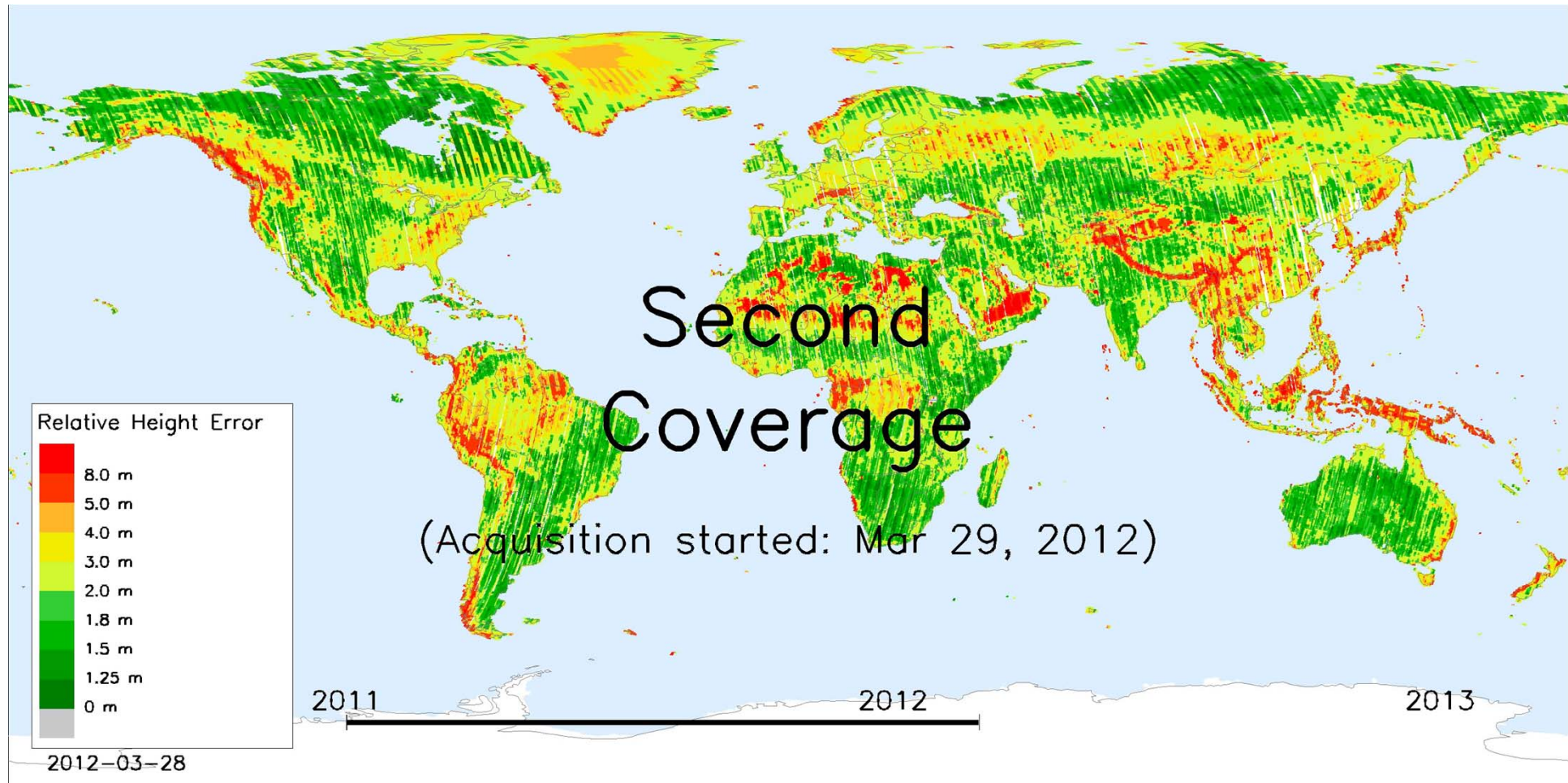
2nd global coverage

difficult terrain & Antarctica & gap filling



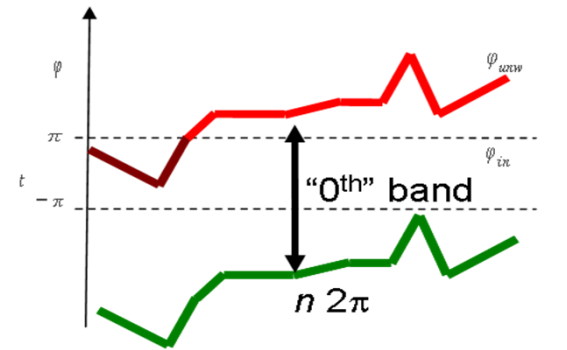
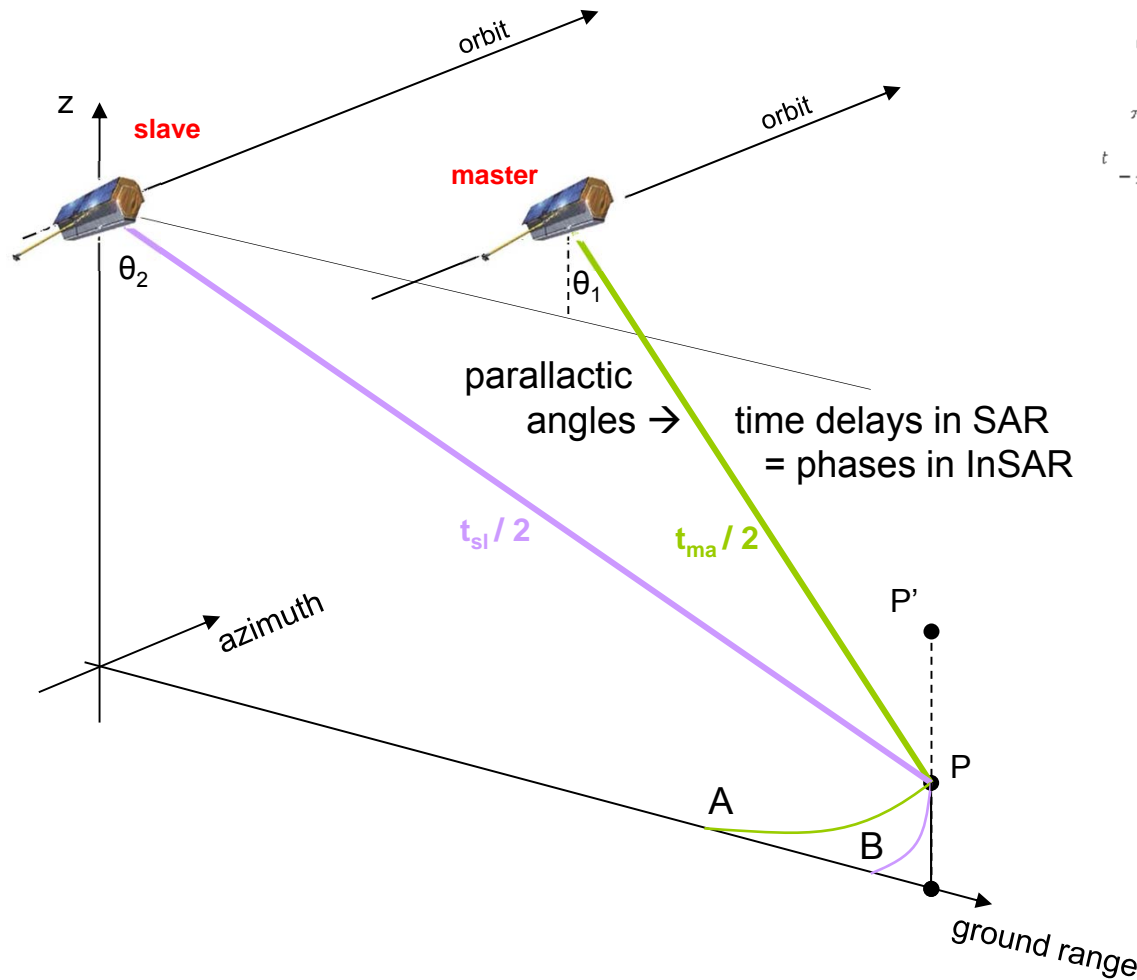


Relative Height Error Second Coverage





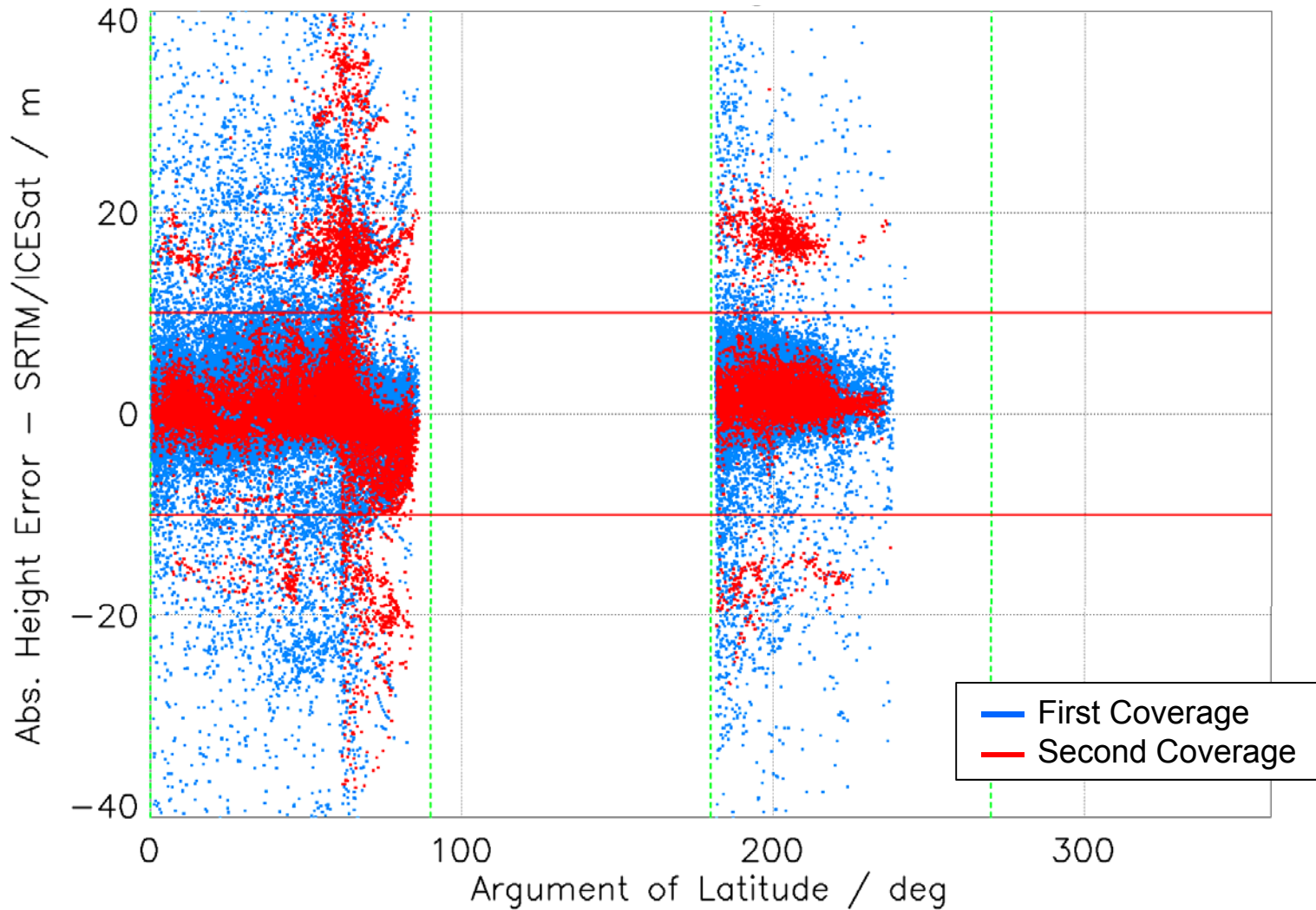
Radargrammetry to Resolve Phase Ambiguity Band

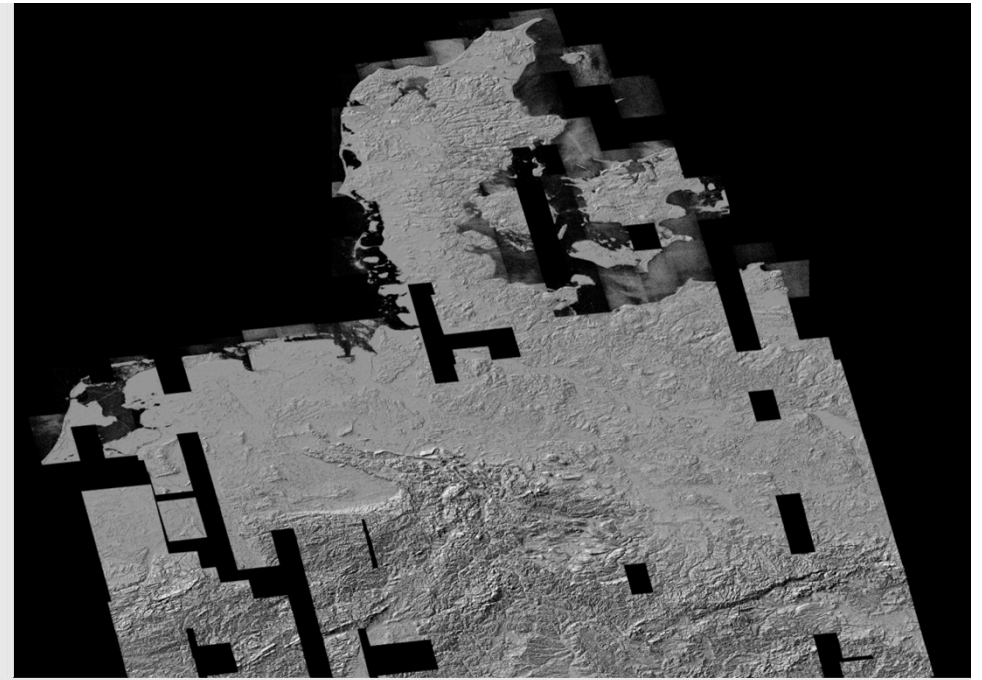
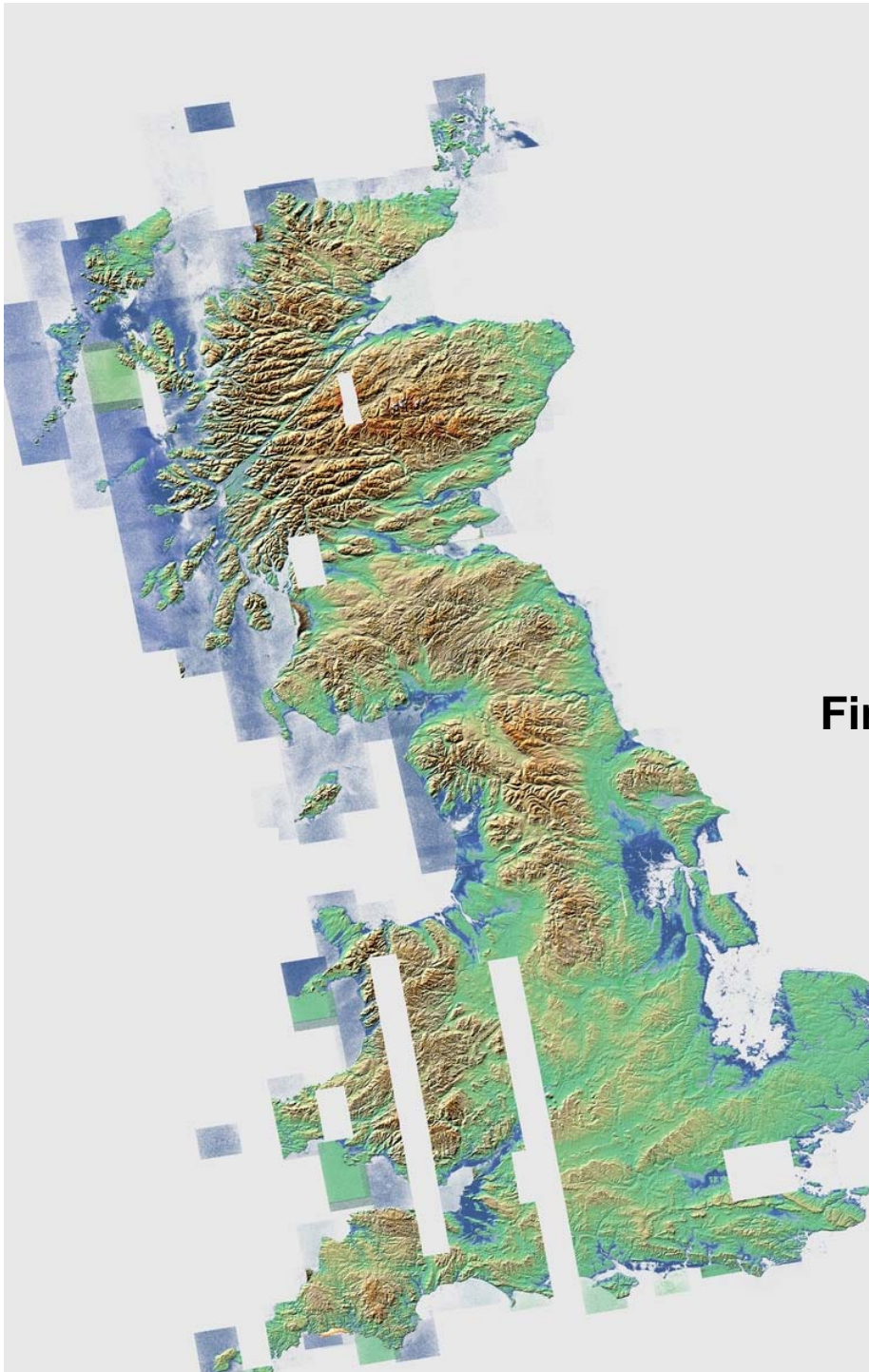


- especially important in regions > 60 deg latitude where no SRTM is available
- becoming globally independent of SRTM as reference DEM for phase unwrapping

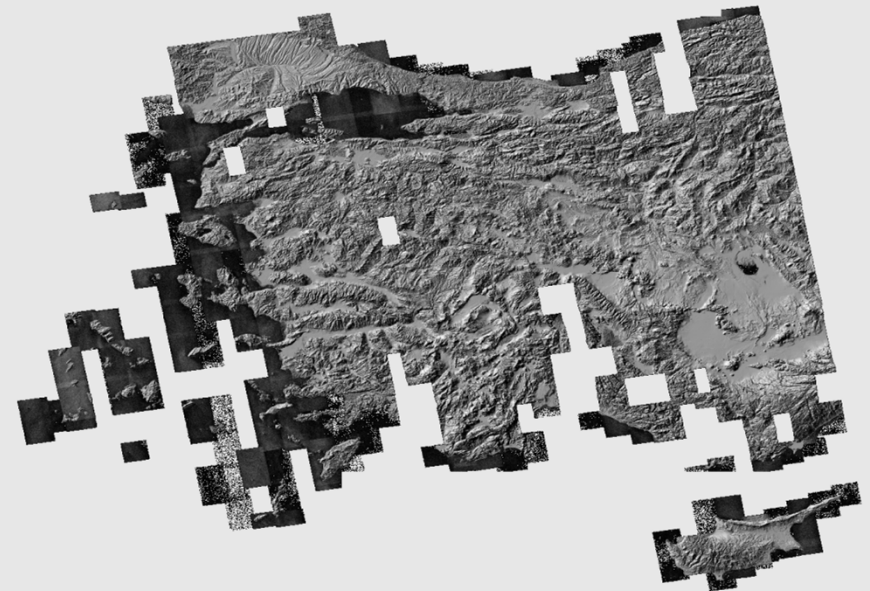


Absolute Height Error of Scene-Based RawDEMs



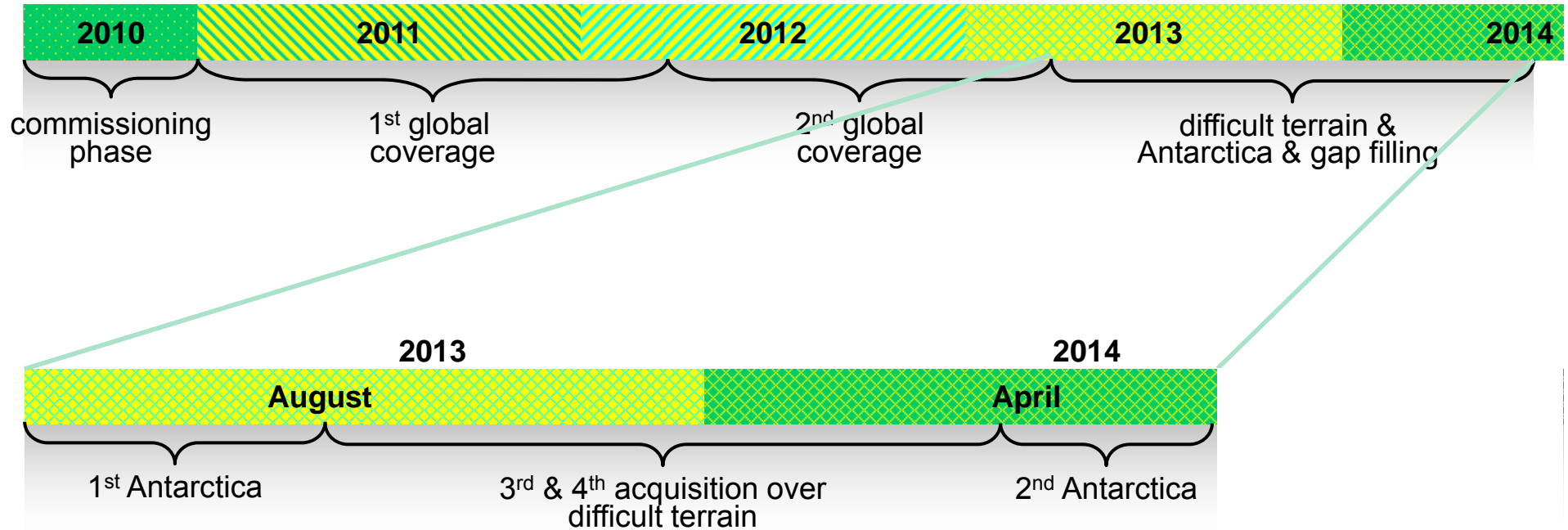


First IDEM Samples





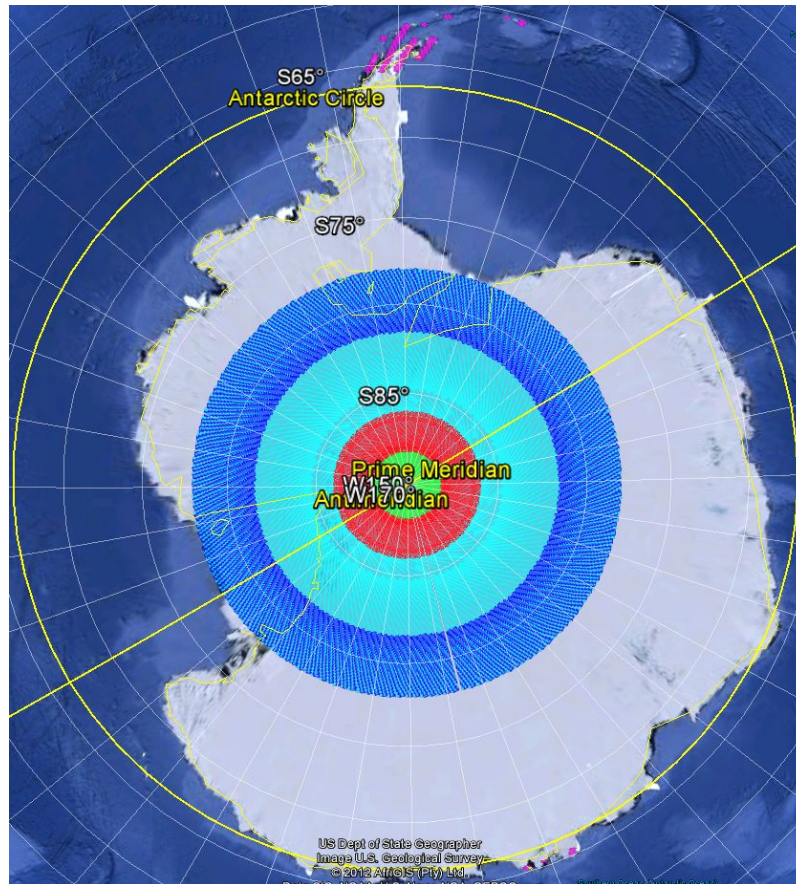
TanDEM-X Global DEM Acquisition Plan



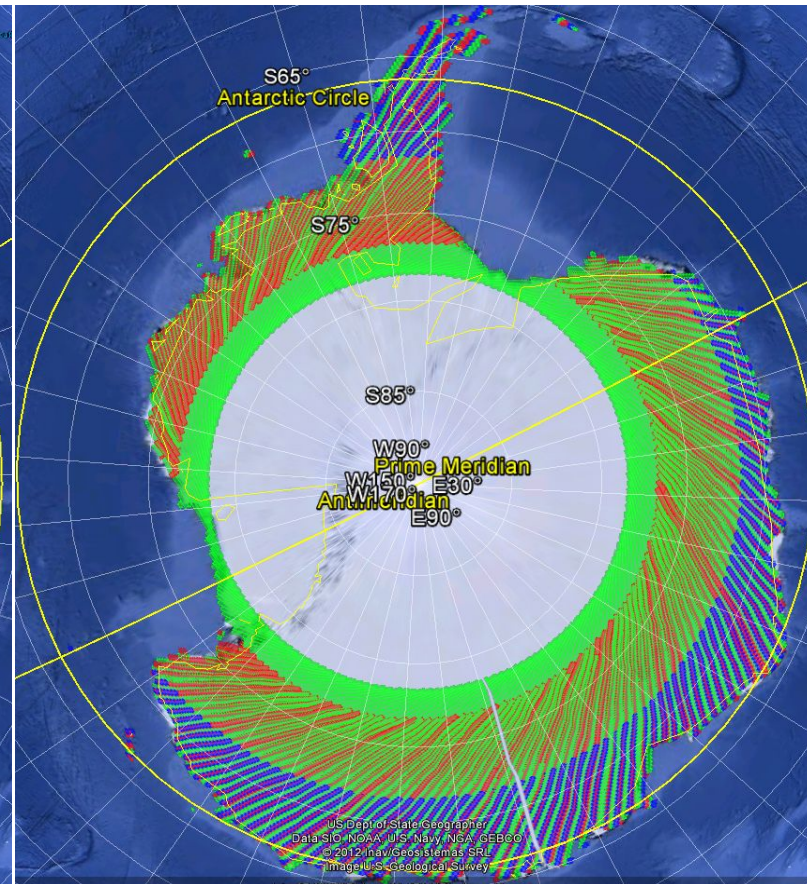


Antarctica

Left-Looking



Right-Looking





Formation Change for 3rd & 4th Coverage

1st & 2nd coverage



Useful cross-track baselines on northern (southern) hemisphere in ascending (descending) orbit

3rd & 4th coverage

August 2013
for
8 month

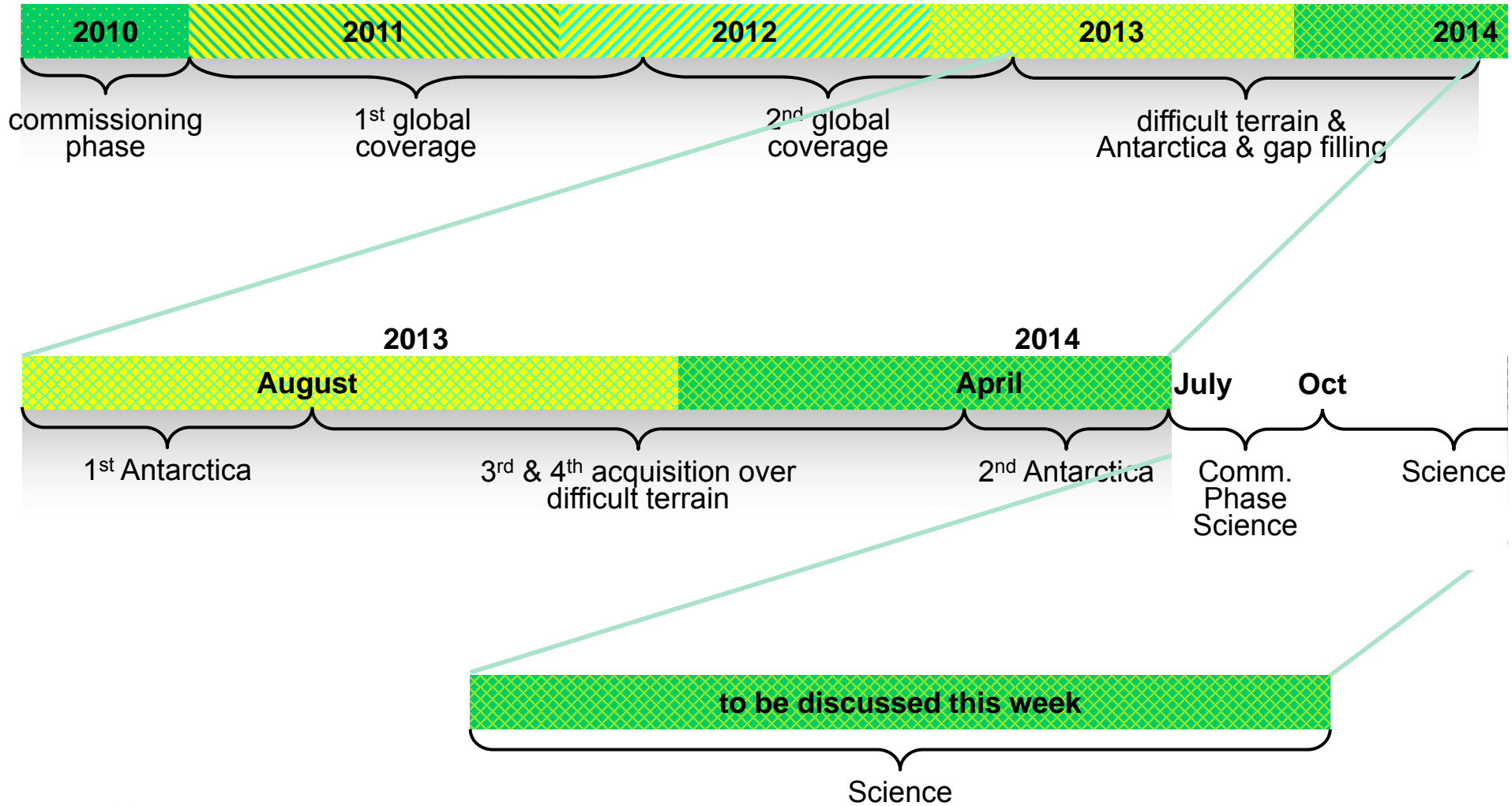


Useful cross-track baselines on northern (southern) hemisphere in descending (ascending) orbit





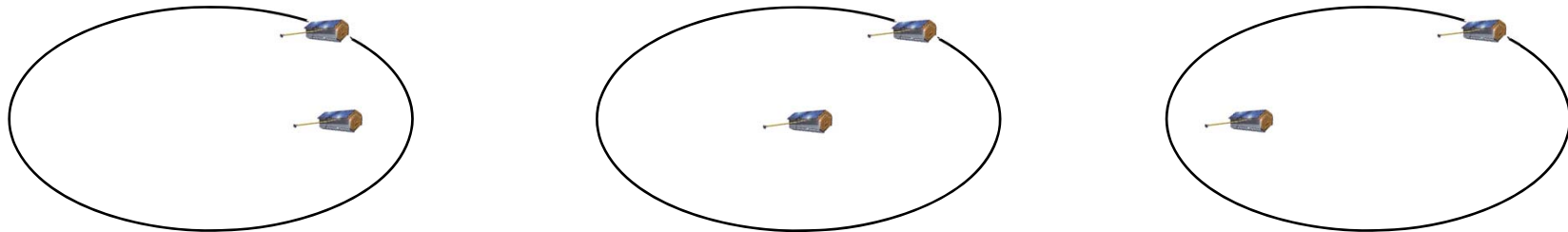
TanDEM-X Global DEM Acquisition Plan





Constraints on the HELIX-Formation

- Up to 4km cross-track baselines at the equator are feasible
- Fuel efficient drift phase would provide slowly increasing/decreasing cross-track baselines
- Along-track baseline is in principle freely adjustable → but optimization at certain argument of latitude impacts the remaining orbit



- Split-antenna (DRA) mode requires activation of the redundant receiver chain
 - In quad pol mode only 15km swath width (timing challenge)
- Considerable additional acquisition time for science available



TanDEM-X Mission Status

- Stable operations in close formation since almost 3 years
- TSX & TDX Satellites and the combined TerraSAR-X/TanDEM-X Ground Segment are performing remarkably well
- Outstanding calibration of the bi-static interferometer achieved
- First & second global (excluding Antarctica) acquisition completed
- Currently first acquisition of Antarctica and recovery of gaps
- Starting from August acquisitions over difficult terrain from opposite viewing geometry
- Sample Intermediate DEMs (based on first coverage only) available via EOWEB
- Final TanDEM-X DEM delivery to commence early 2014