Precise baseline determination for the TanDEM-X mission

Rolf König[1], Yongjin Moon[1], Hans Neumayer[1], Martin Wermuth[2], Oliver Montenbruck[2], Adrian Jäggi[3]

[1] GFZ German Research Centre for Geosciences

[2] DLR German Aerospace Center

[3] AIUB Astronomical Institute of the University of Berne

GFZ Helmholtz Centre Potsdam

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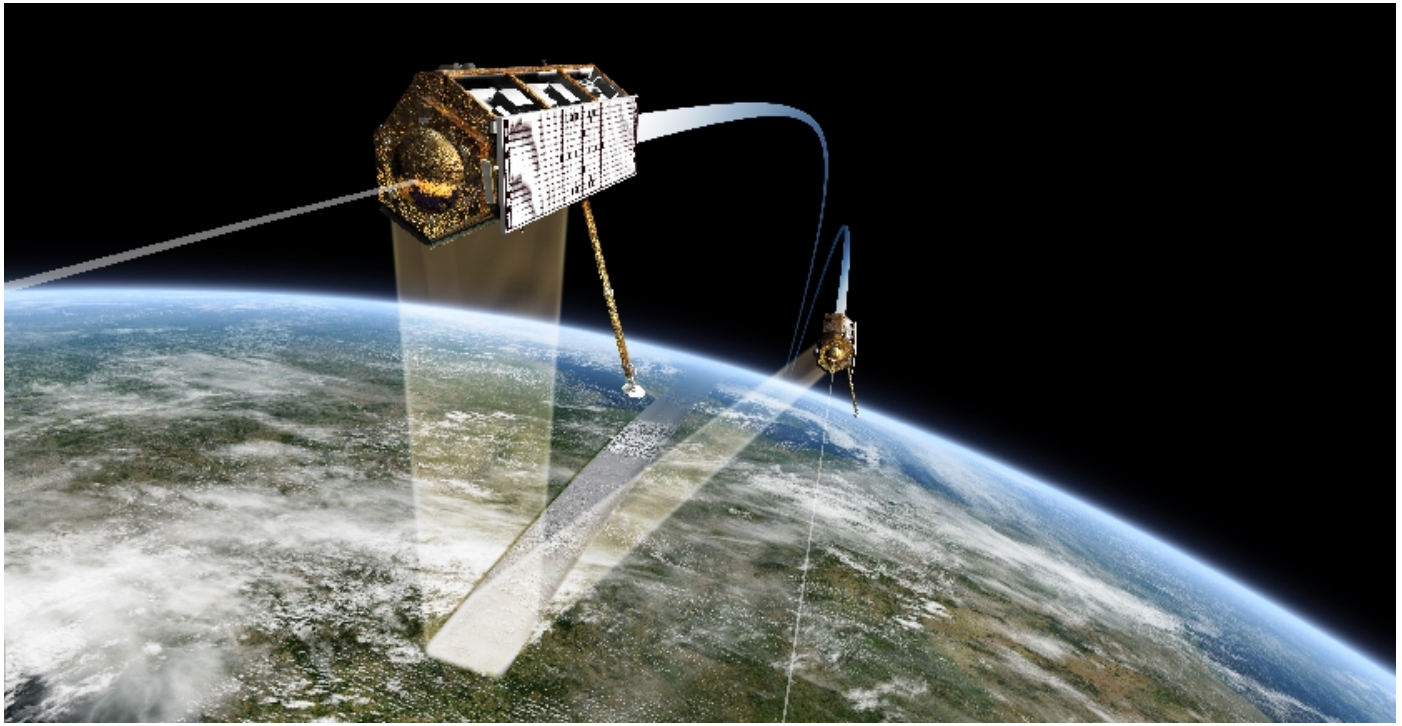
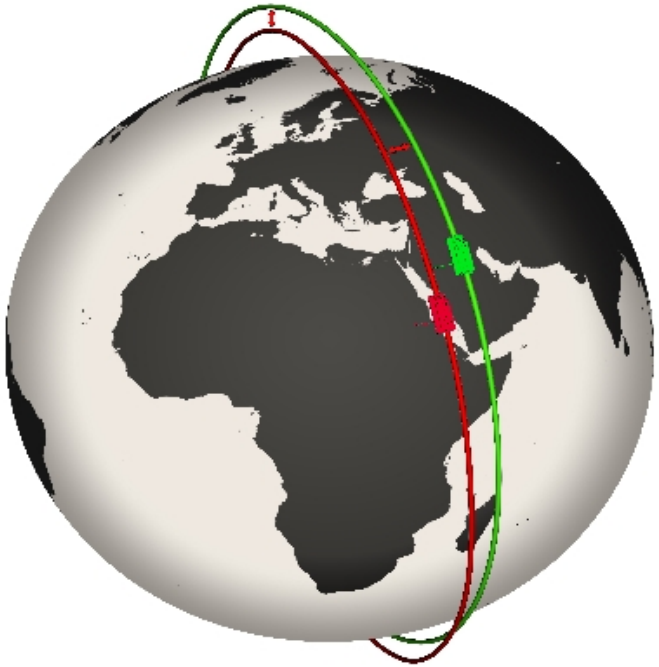
TanDEM-X Mission

- Twins TerraSAR-X (*070615) and TanDEM-X (*100621)
- Objective: Global DEM at 2 meter height accuracy



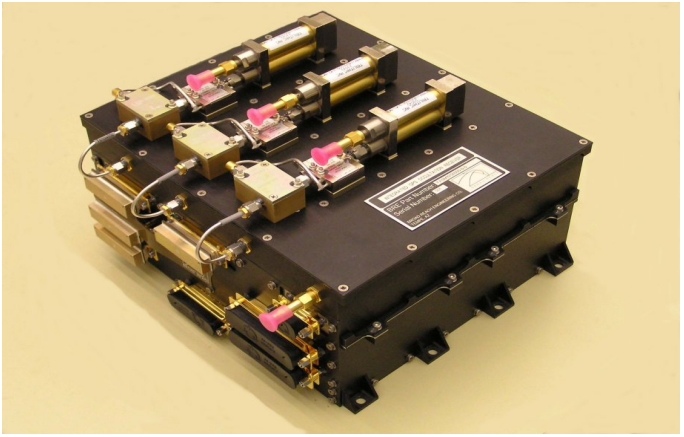
TanDEM-X Mission, II

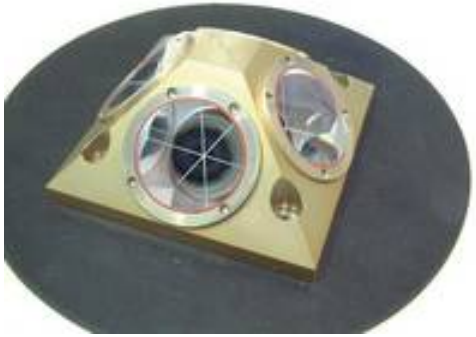
- Satellite size 5 x 2.4 x 2.4 m³
- Close formation: “Helix”
  - Cross-track distance at equator: 360 m
  - Radial distance at pole: 400 m
  - Mean along-track distance: 0 m
- Circular dusk-dawn orbit
  - Altitude 514 km
  - Inclination 97.4 deg
  - 11 day repeat



TOR Instrument

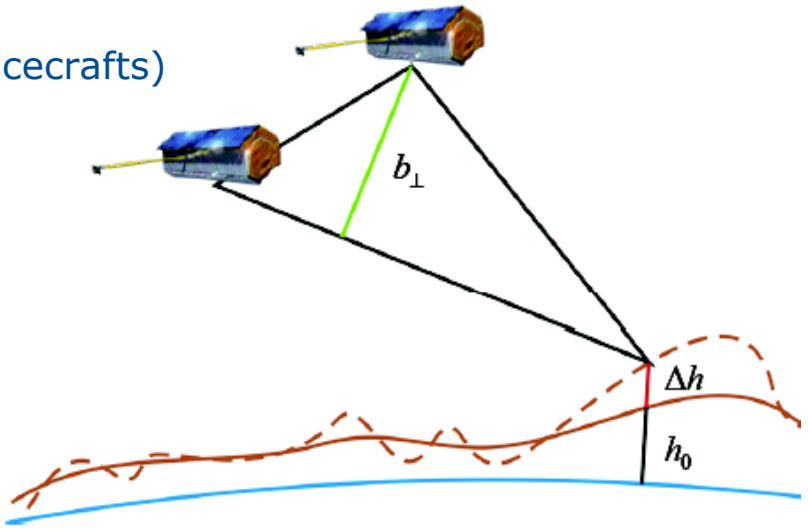
- Integrated GPS Occultation Receiver (IGOR)
  - JPL Blackjack -> Broadreach Inc., USA
  - Geodetic grade, two-frequency receiver
  - Choke rings manufactured at GFZ
- Laser Retro-Reflector (LRR)
  - Housing manufactured at GFZ
  - Prisms from small company in Germany





Baseline Generation

- Baseline = prerequisite for DEM processing
- Baseline provider GFZ
  - Two chains:
    - EPOS (Earth Parameter and Orbit System)
    - BERNESE
- Baseline from DLR
  - FRNS (Filter for Relative Navigation for Spacecrafts)
- Baseline product types
  - Coarse
    - Low latency, few centimeters accuracy
  - Precise
    - 1 mm standard deviation
  - Calibrated
    - 1 mm RMS



Validation via GRACE

- K-band range data at μm accuracy taken for truth
  - Along-track only
  - Unknown bias removed
- Comparison among independent baseline solutions
  - GFZ
  - DLR
  - AIUB
- 30daily arcs March 2007
- 424,738 K-band ranges

Residuals (mm)		
AIUB	FRNS	GFZB
0.70	0.78	0.71

Validation via GRACE, II

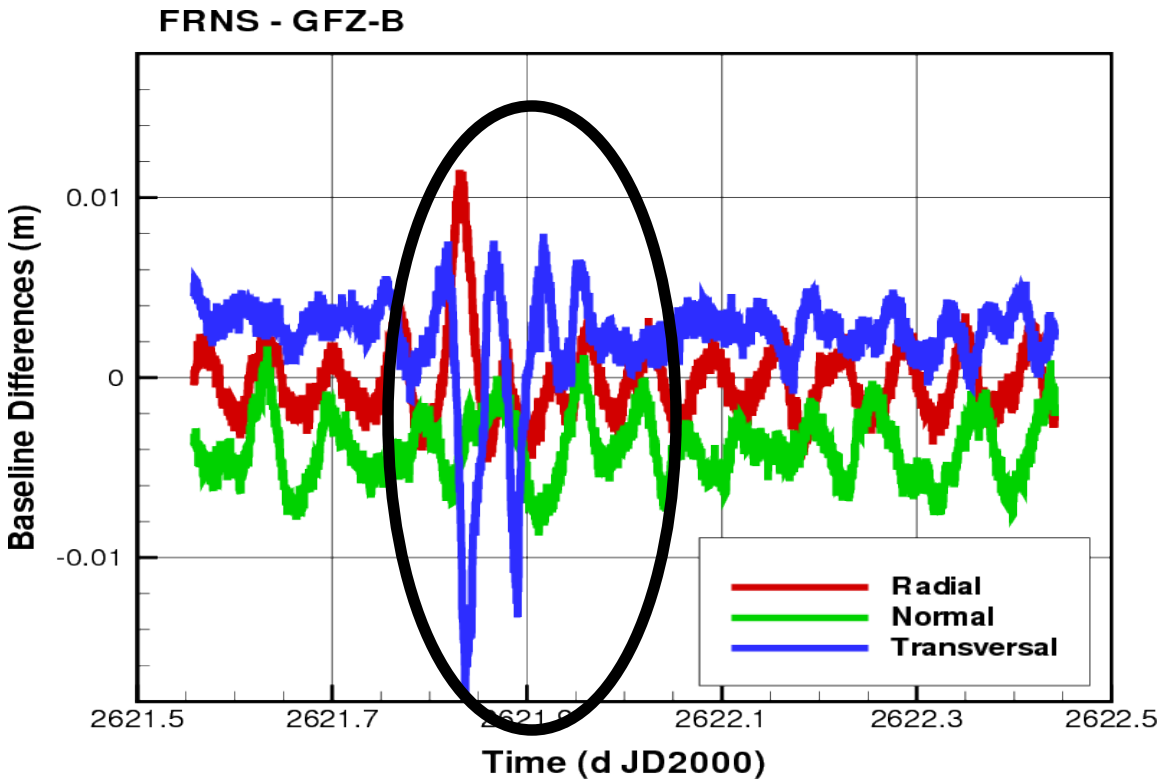
- Baseline comparison

Mean Differences (mm)

	Radial	Normal	Transv.
AIUB – FRNS	-0.7	-2.0	0.9
AIUB – GFZB	-1.0	-6.1	4.0
FRNS – GFZB	-0.3	-4.0	3.1

Baseline Comparison

- Particular events where one of the softwares failes



Merging of Baselines

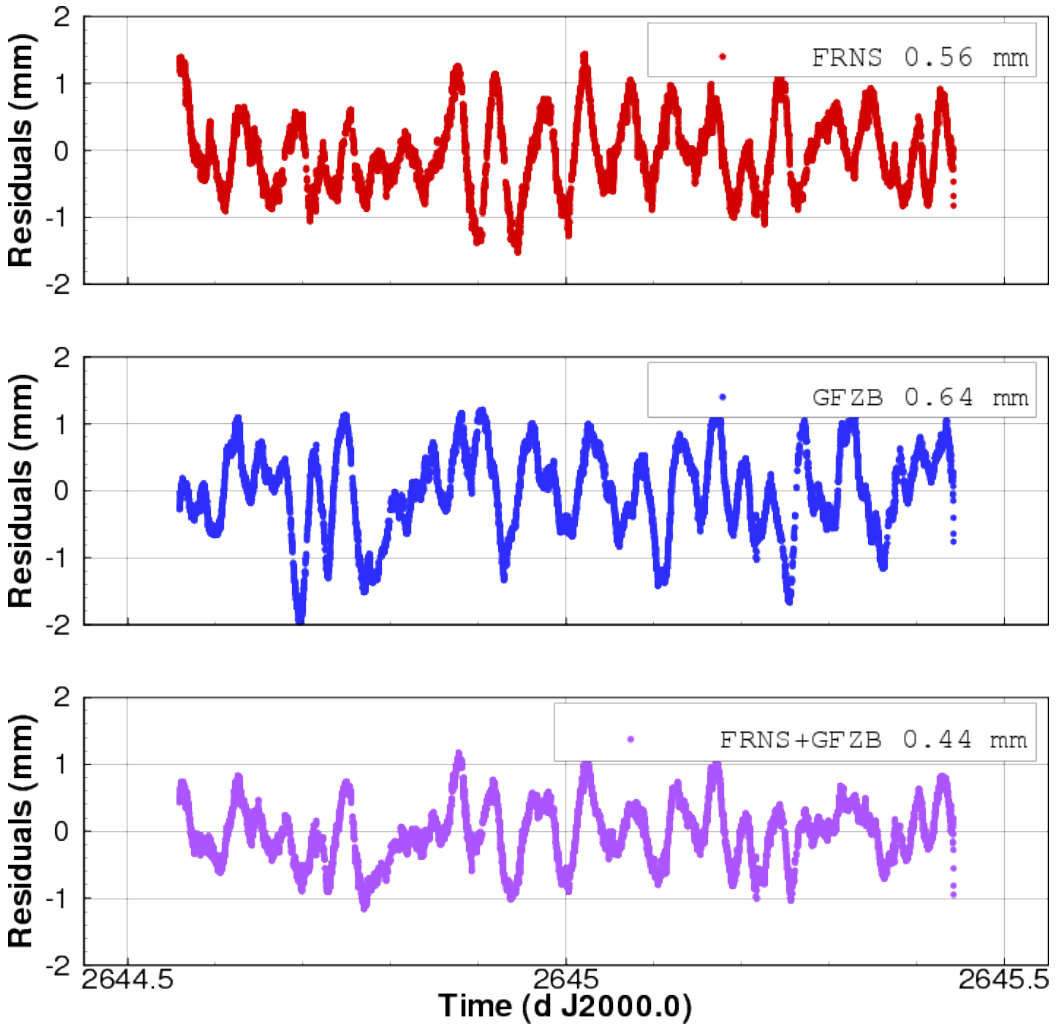
- Improves accuracy by ~20%

Residuals (mm)		
AIUB+FRNS	AIUB+GFZB	FRNS+GFZB
0.62	0.58	0.59

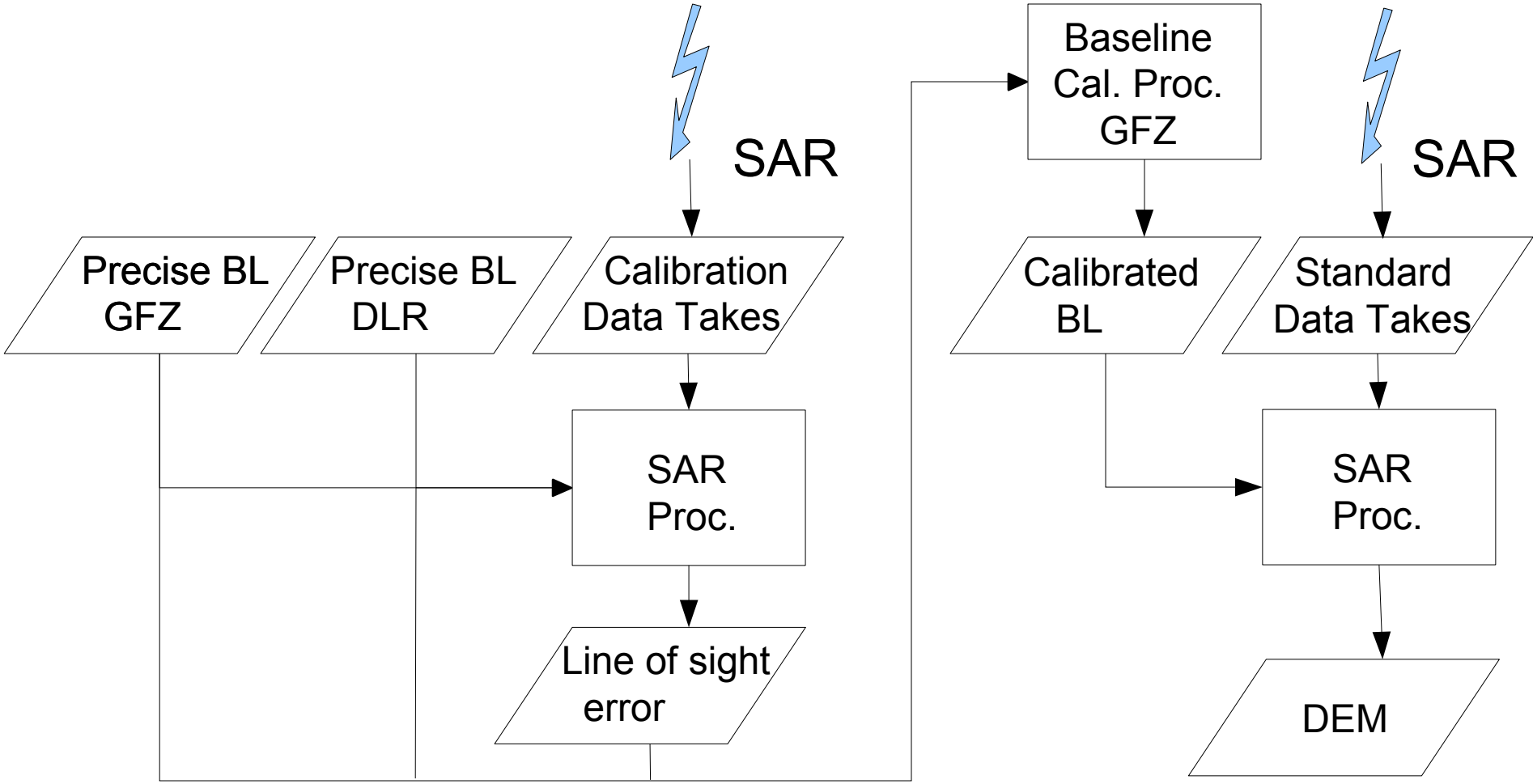
Improvement Factor		
1.2	1.2	1.3

Merging of Baselines, II

- Example day 070330



Baseline Bias Calibration



Summary

- TOR instrument works fine on both TerraSAR-X and TanDEM-X
- Baseline generation systems are in place
- Baseline comparison will reveal outliers
- Baseline merging will improve accuracy
- Baseline calibration will remove bias