



# Challenges of the TerraSAR/TanDEM-X formation

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# TerraSAR-X



**TerraSAR-X (TSX):** German radar satellite launched on June 15th 2007 to provide high-quality topographic information for commercial and scientific applications.

## Characteristics:

- Height: **5 m**
- Wet mass: **1.230 kg**
- Orbit
- Attitude: **514 km**
- Inclination: **98°**
- sun-synchronous
- Lifetime: **5 years**

# TanDEM-X

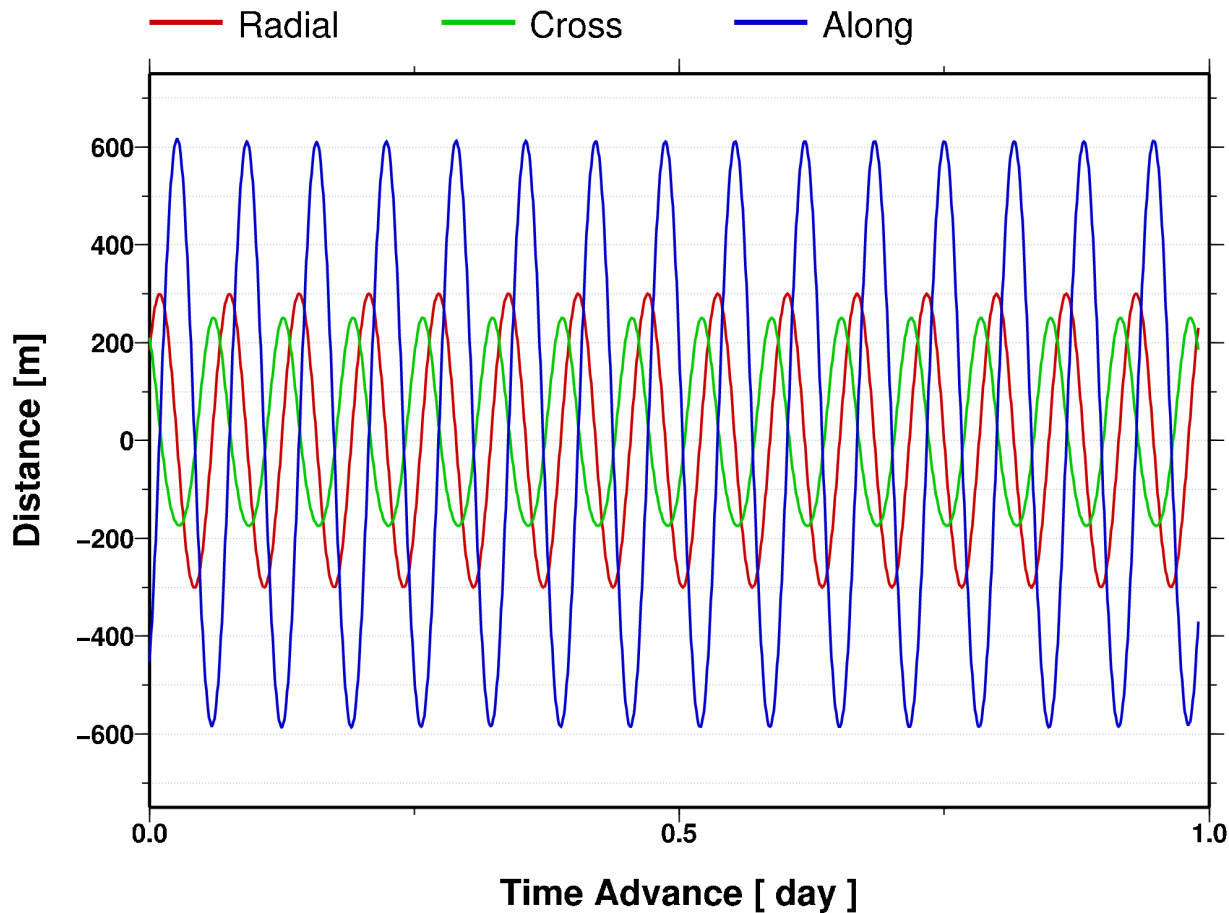


**TanDEM-X (TDX):** TerraSAR-X add-on for Digital Elevation Measurements. Launch planned in fall 2009.

Characteristics:

- almost **identical** to **TSX**
- TSX and TDX will fly in a very close formation called **helix**. Distances between the two satellites will vary from **~300 m** to **~600 m**
- Lifetime: **5 years** (3 years overlap with **TSX**)

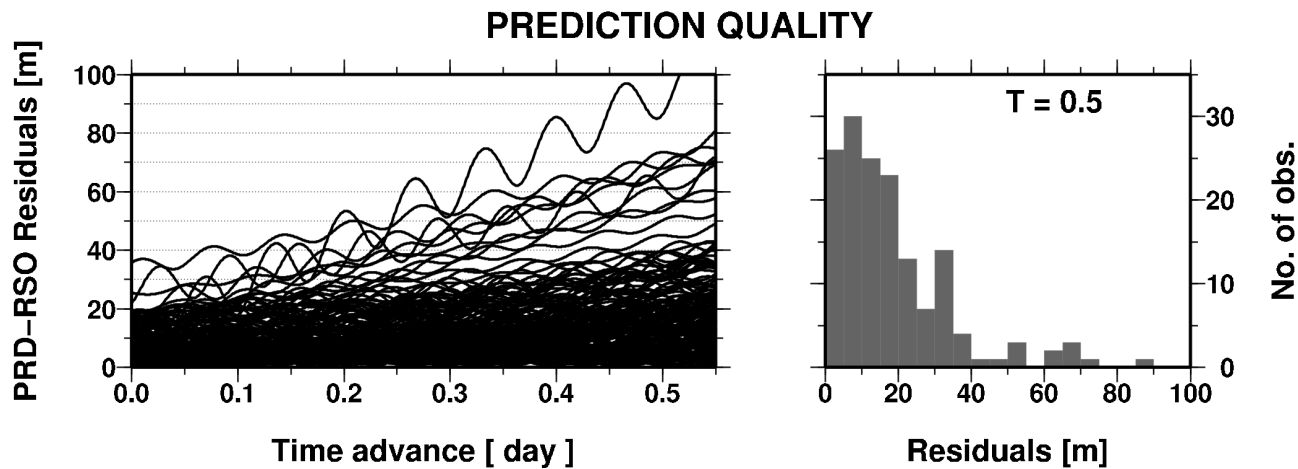
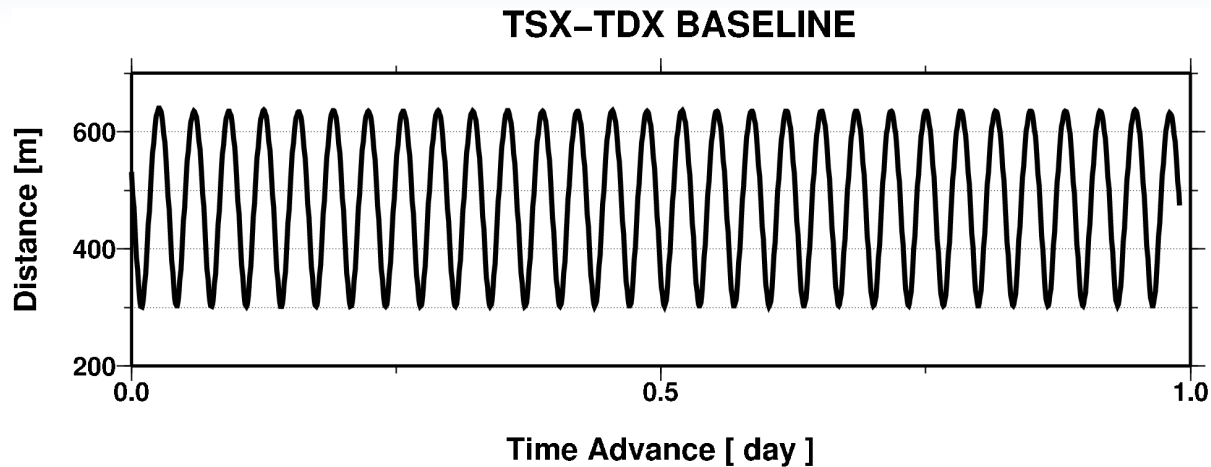
# TSX-TDX Formation



# Motivation for SLR

- Challenge: very small angular difference between TSX and TDX
  - adaptation of software
  - development of tracking strategy
- Opportunity: simultaneous tracking of both spacecrafts
  - validation of baseline between two satellites at millimeter accuracy

# TSX Prediction Accuracy



# SLR Simulation

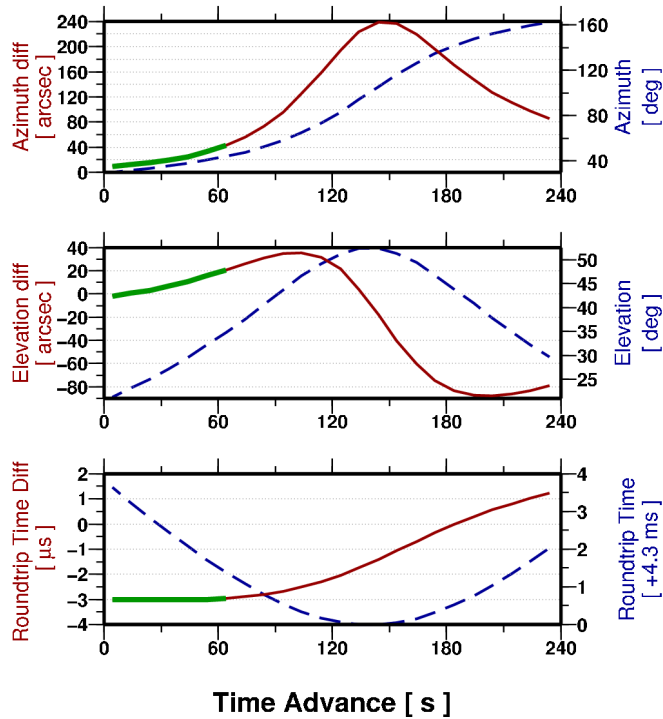


- Period of simulation: **1 day** (24 h)
- Number of stations: **11** (Yarragadee, Washington, Arequipa, San Juan, Zimmerwald, Mount Stromlo, Graz, Herstmonceux, Potsdam, Matera and Wettzell)
- Software: **EPOSOC**
- Number of simulated passages: **35**, pass duration: **4 min**, minimum elevation **20 deg**
- Number of observations: **555**
- **Question:** it is possible to track both satellites at once e.g. **how often angular difference** between TSX and TDX is **less than 60 arcseconds**

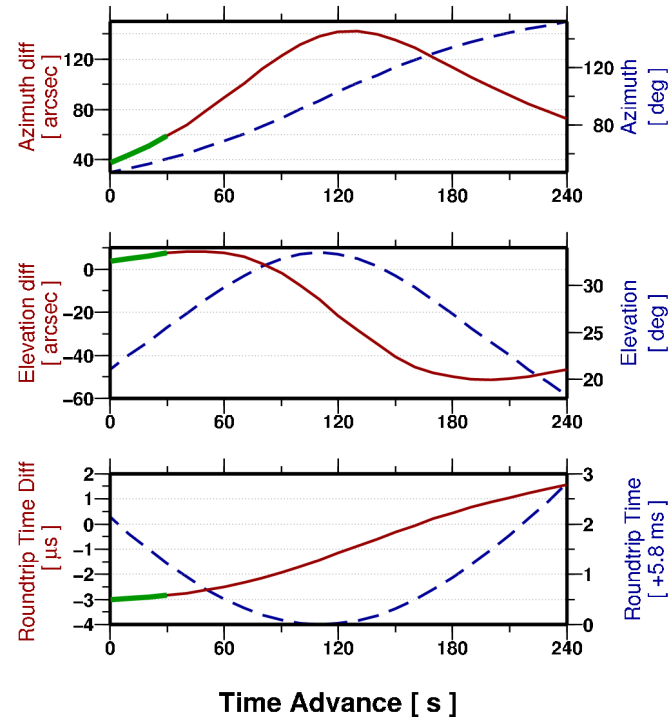
# SLR Simulation



Station: **Potsdam**  
Pass begin: **05:25**



Station: **Zimmerwald**  
Pass begin: **05:28**





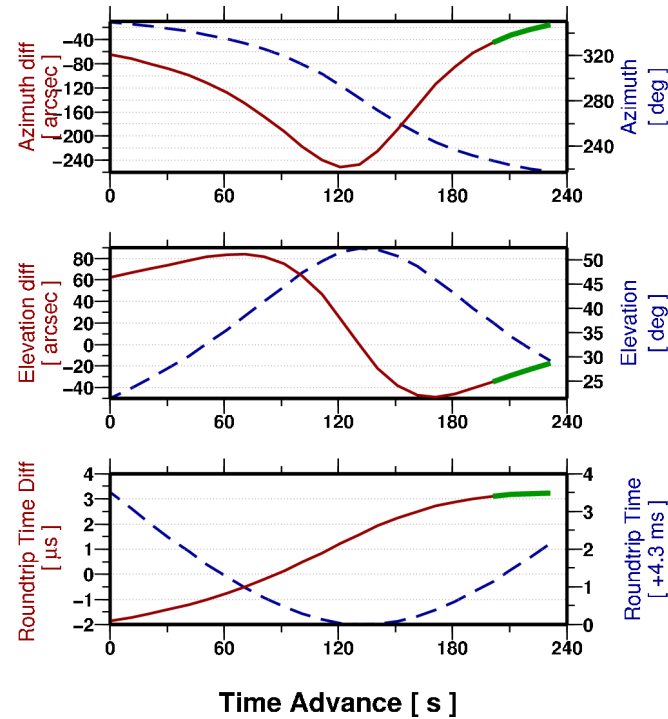
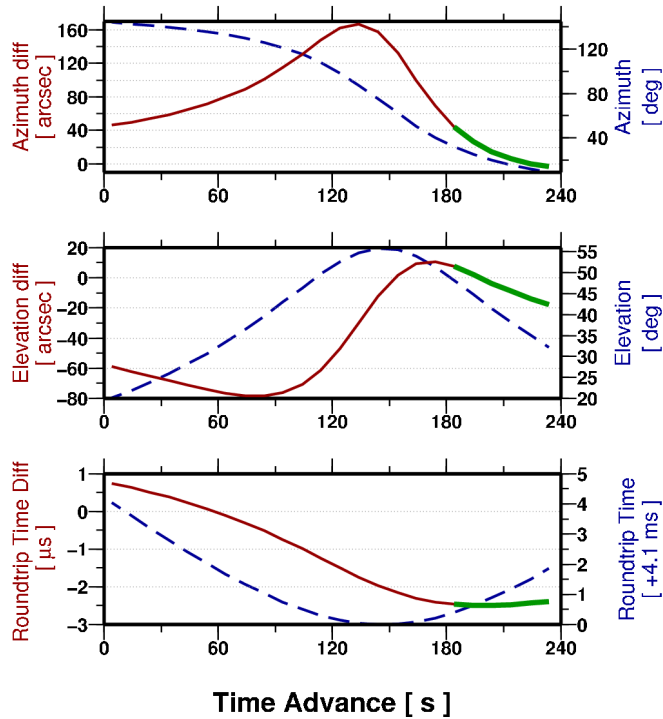
# SLR Simulation



Challenges of the TerraSAR/Tandem-X formation

Station: **Potsdam**  
Pass begin: **16:08**

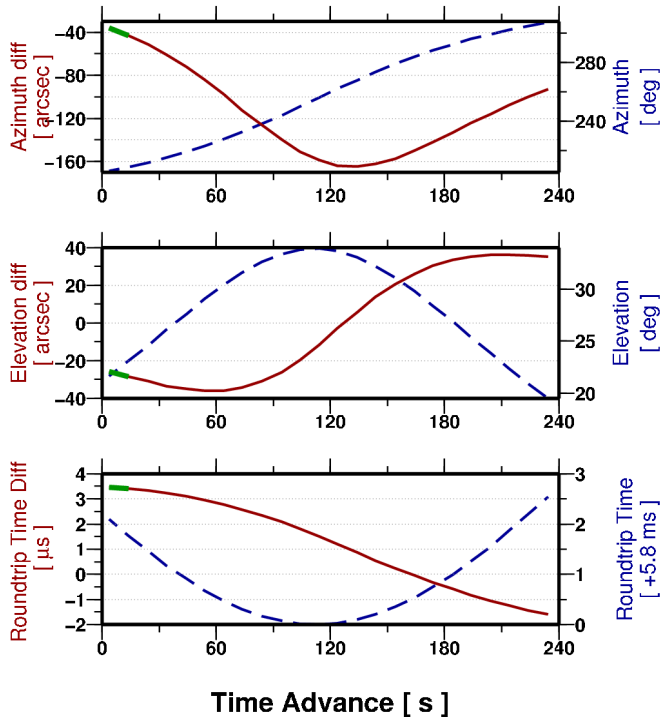
Station: **San Juan**  
Pass begin: **10:30**



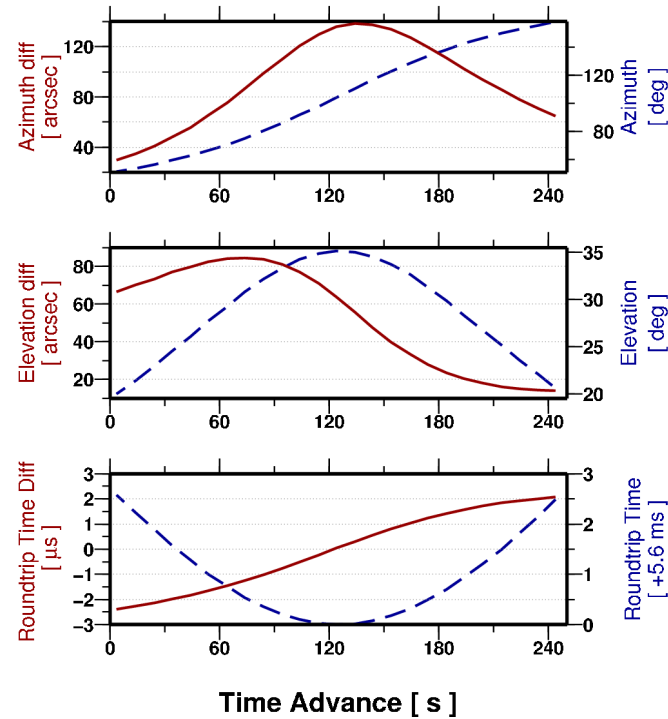
# SLR Simulation



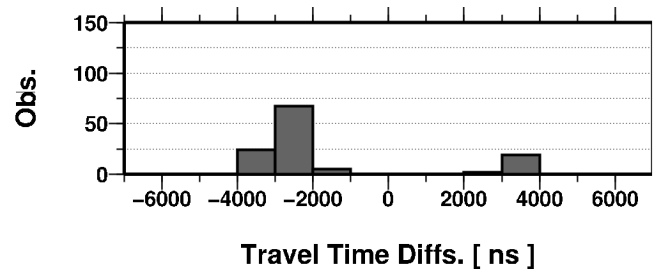
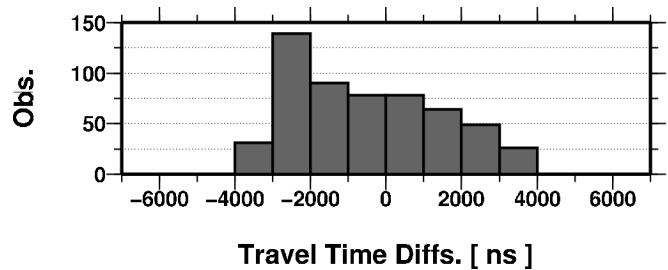
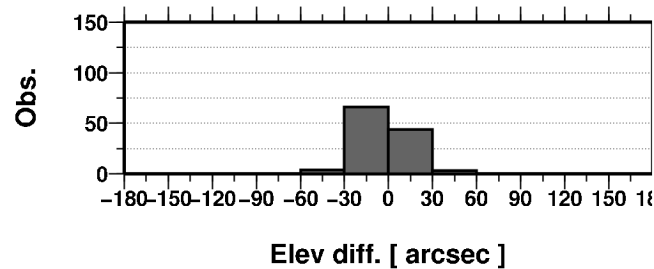
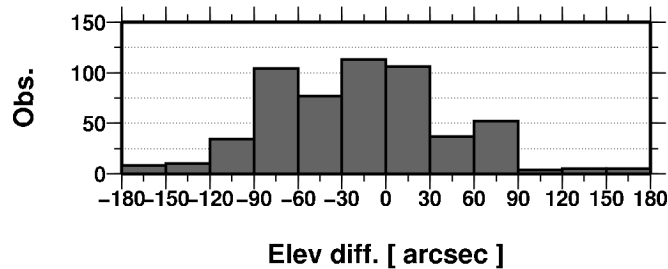
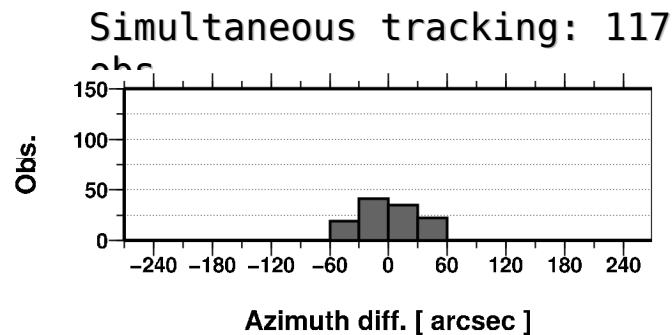
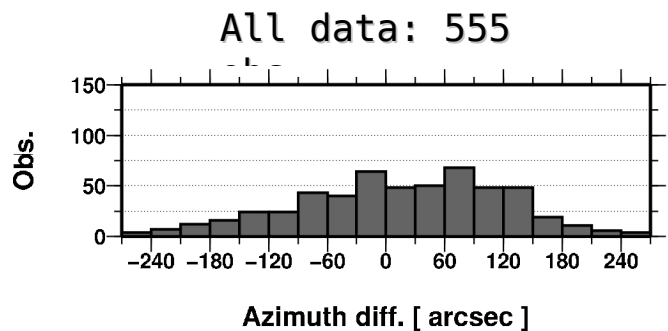
Station: Yarragadee  
Pass begin: 11:01



Station: Yarragadee  
Pass begin: 21:35



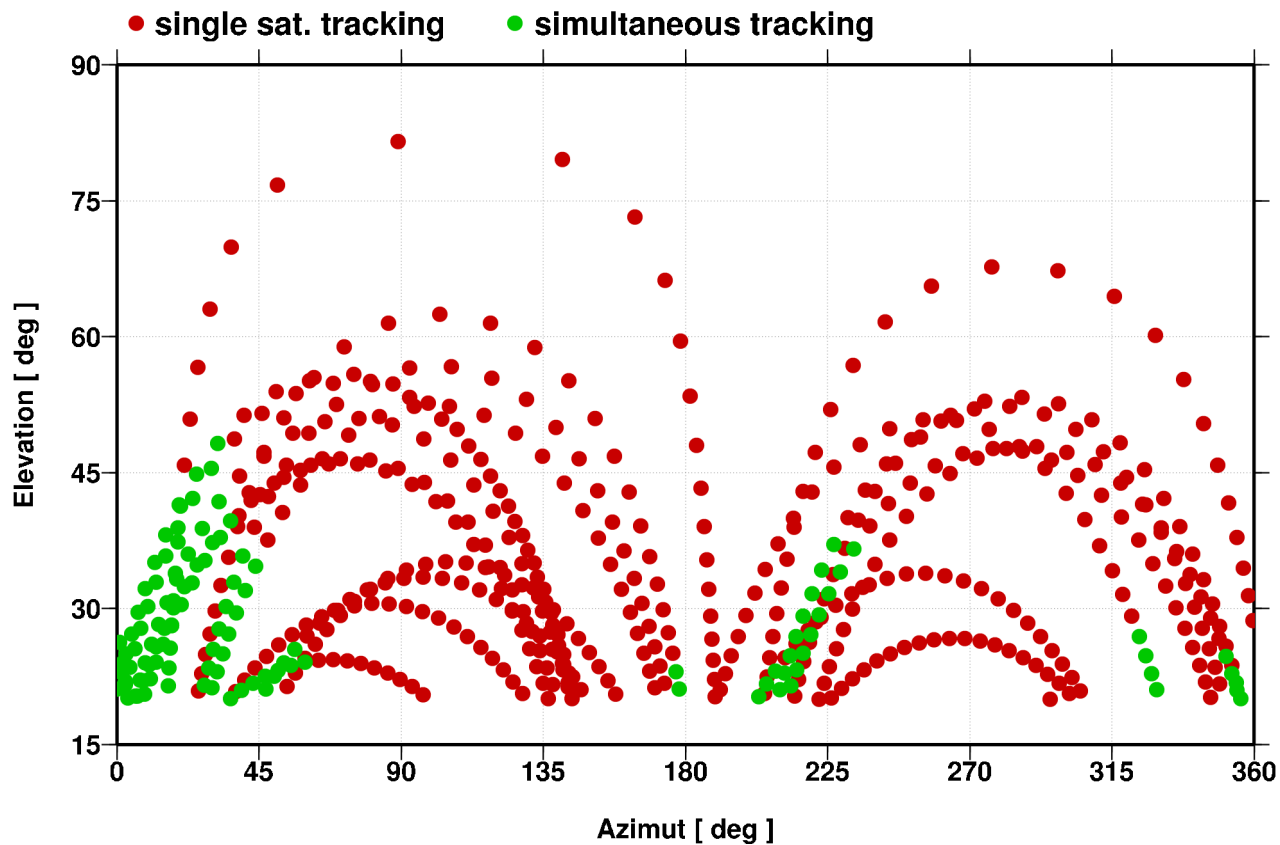
# TSX-TDX Differences for SLR Passes



# TSX-TDX Simultaneous Tracking



Challenges of the TerraSAR/Tandem-X formation



# Conclusions



- close formation flight of TerraSAR-X and TanDEM-X poses a challenge for the SLR observation strategies
- in a certain percentage of tracks, both spacecraft will be within the transmitting beam from SLR ground station at the same time, but with clear separation in range
- in other cases only one will develop a tracking strategy:
  - single satellite tracking per pass
  - dual satellite tracking per pass
  - cluster tracking: some stations track TSX, others TDX