

GNSS-specific local effects at the Geodetic Observatory Wettzell



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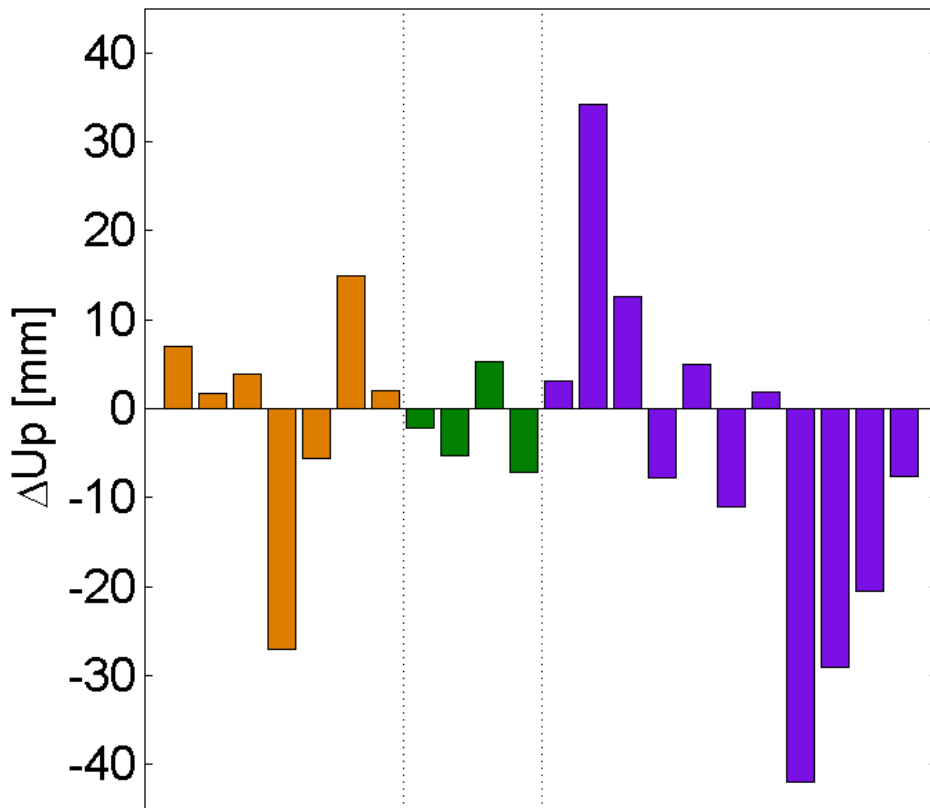
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Motivation and Outline

Local tie height discrepancies
at Wettzell from DTRF2008



GPS
VLBI

GPS
SLR

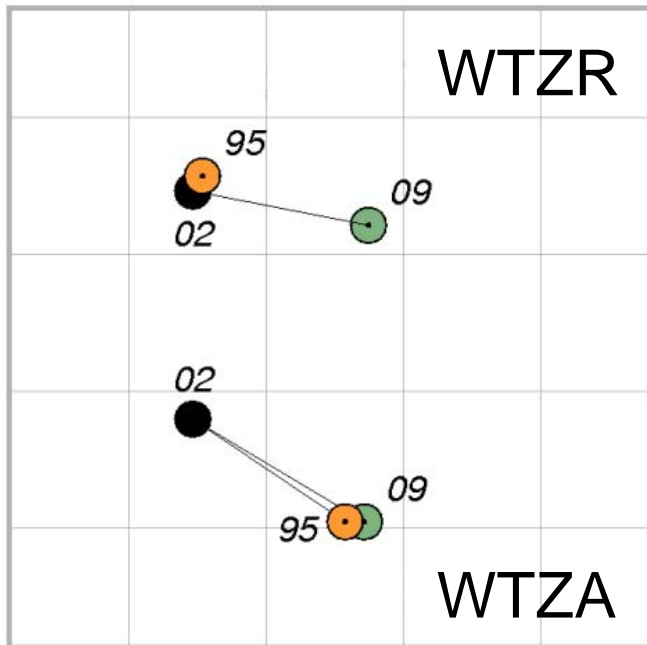
GPS
GPS

Outline

- GNSS network at Wettzell
- GNSS processing
- Frequency-dependent systematic effects on station coordinates
- Residual maps
- igs08.atx receiver antenna calibrations
- Conclusions

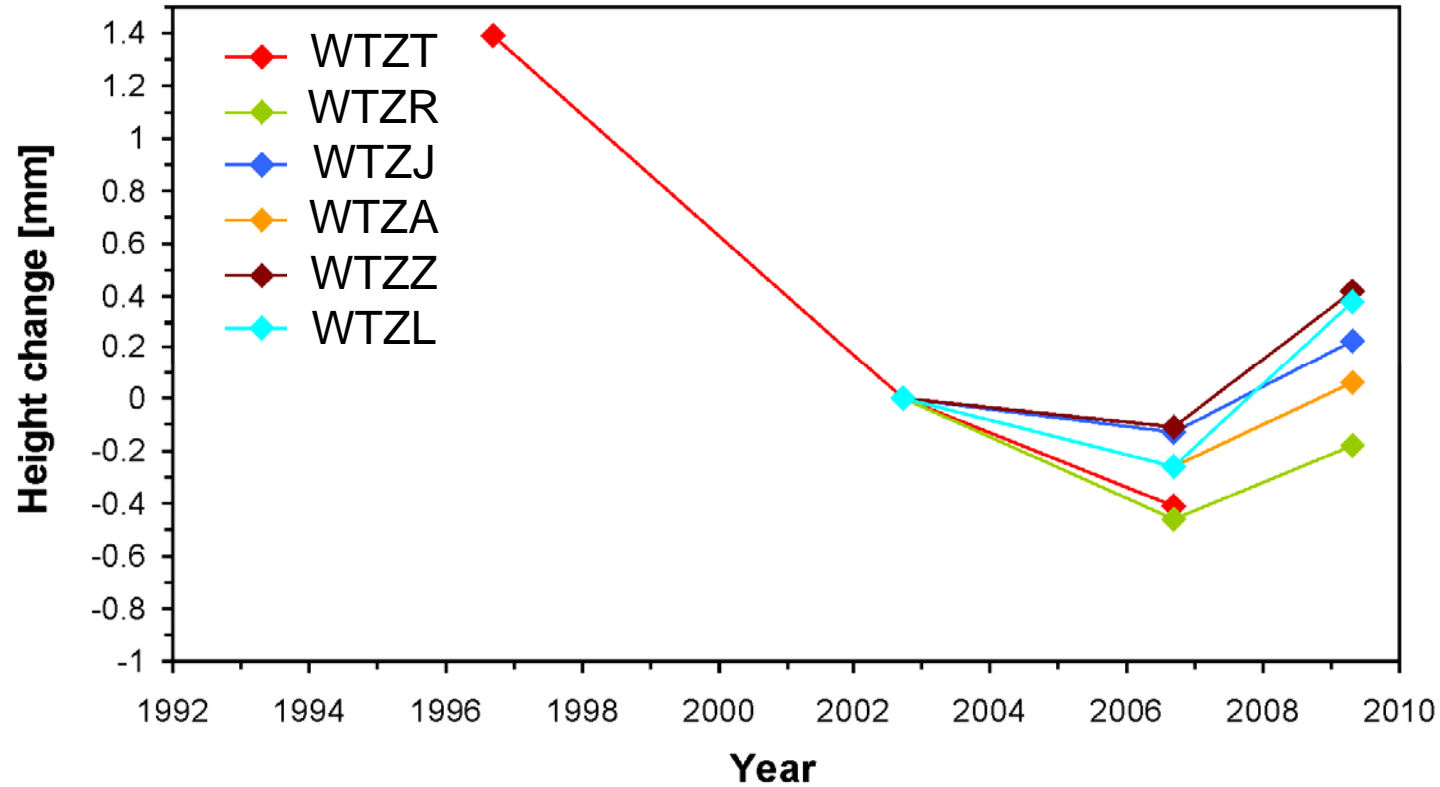
Local Surveys

Horizontal displacement



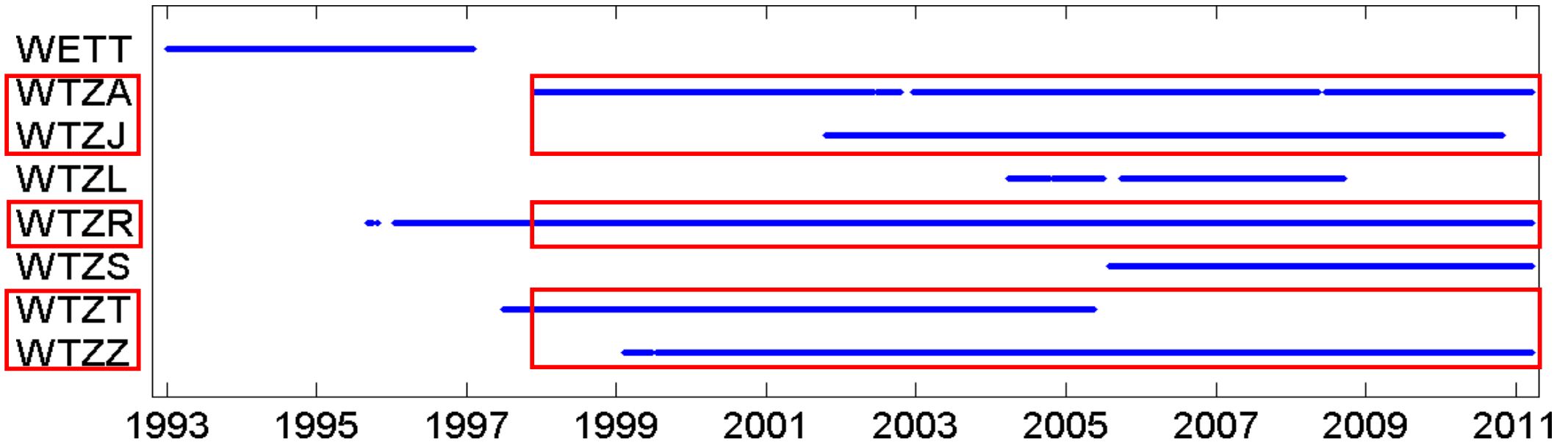
1 mm

Vertical displacement



The precision of the local ties in Wettzell is at the 1-2 mm level

GNSS Sites at Wettzell



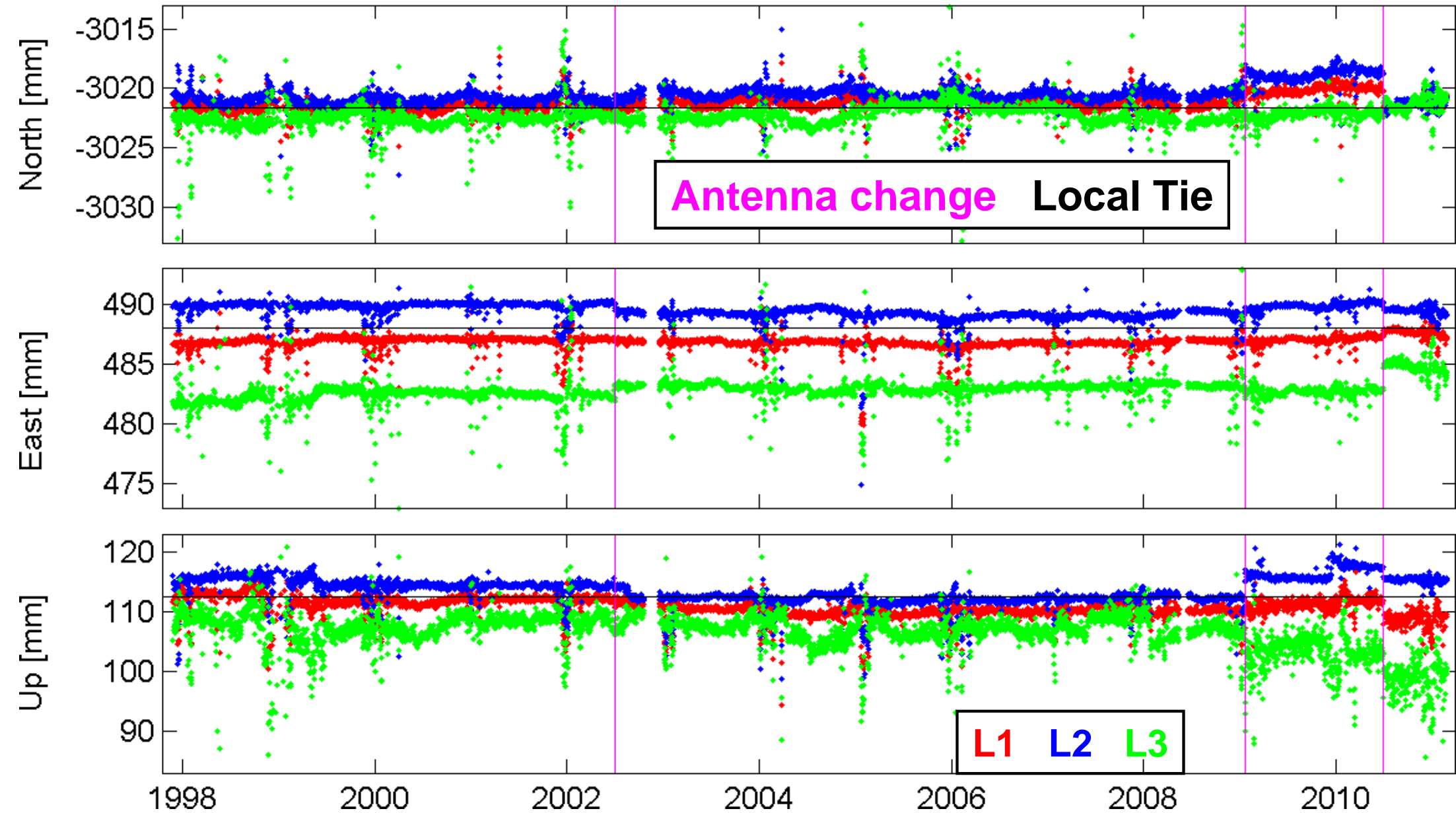
Data analyzed from 329/1997 – 57/2011



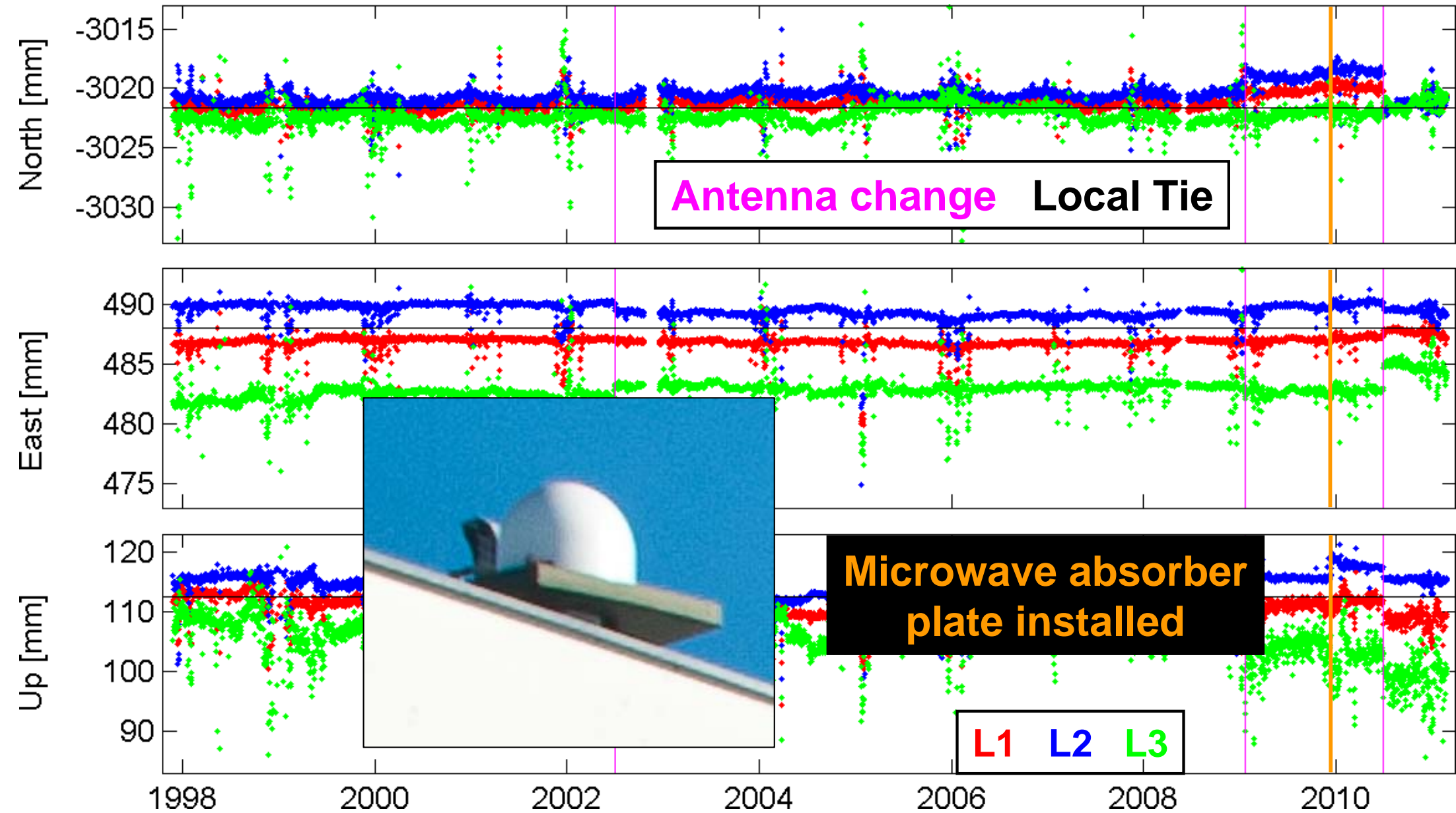
GNSS Processing

- **Double difference** solution with Bernese 5.1, IGS05 reference frame, igs05.atx antenna model
- **WTZA as reference**: no antenna change, no discontinuities
- Reprocessed (1997 – 2008) and operational (2009 – 2011) **CODE products**:
 - Satellite orbits and Earth rotation parameters
- Estimation of **troposphere parameters** for all stations but WTZA
 - Zenith delays with 2^h parameter spacing, VMF1, ECMWF
 - One pair of east-west and north-south gradients per day
 - Elevation-dependent weighting: $\cos^2 z$
- **Ambiguity fixing** for L1 and L2 with Sigma method, mean resolution rate of 99.5%
- Computation of L1, L2, and L3 (ionosphere-free) solutions

WTZR w.r.t. WTZA with Troposphere Estimation



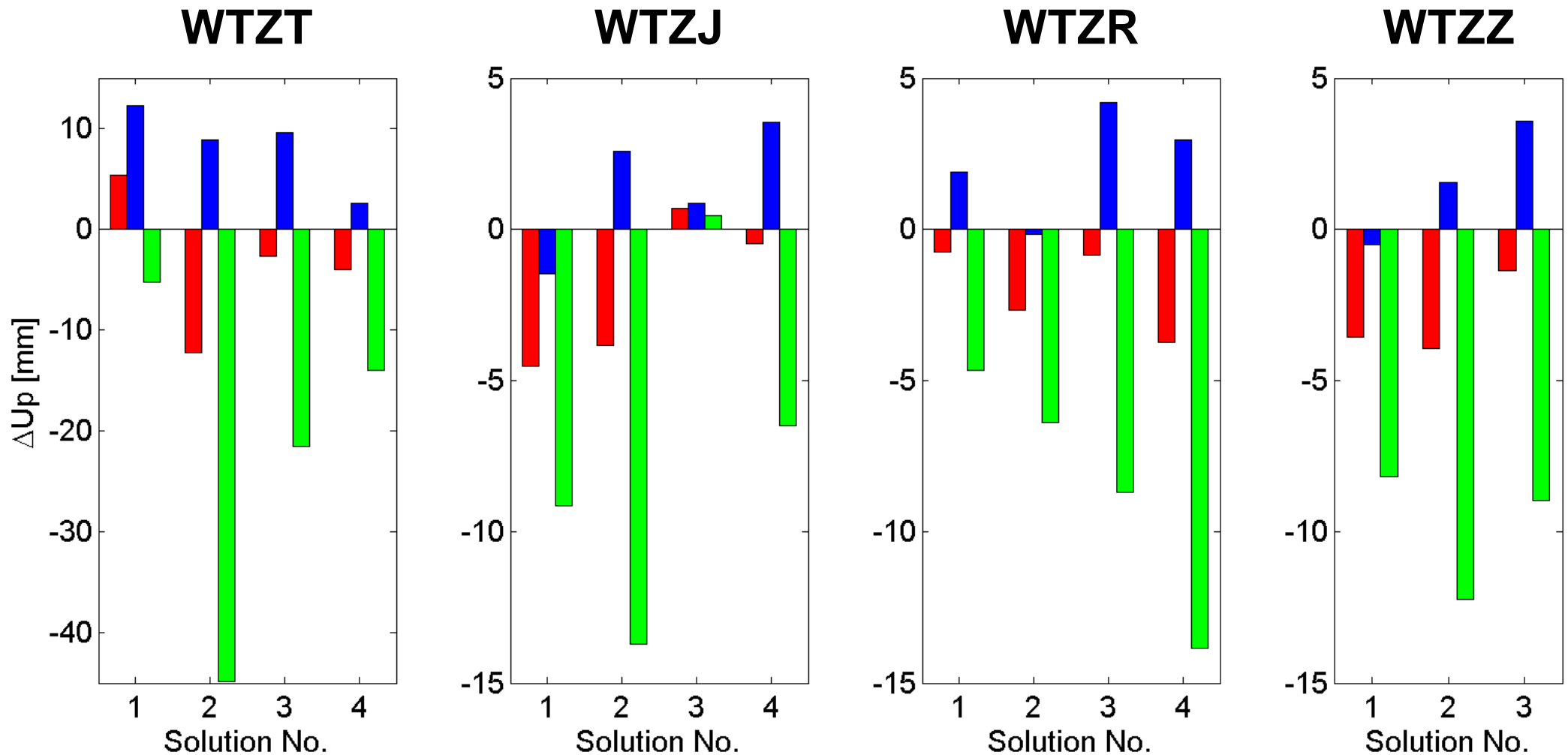
WTZR w.r.t. WTZA with Troposphere Estimation



Cumulative Solution: Height Component

Differences between baseline w.r.t. WTZA and local tie
Troposphere parameters estimated

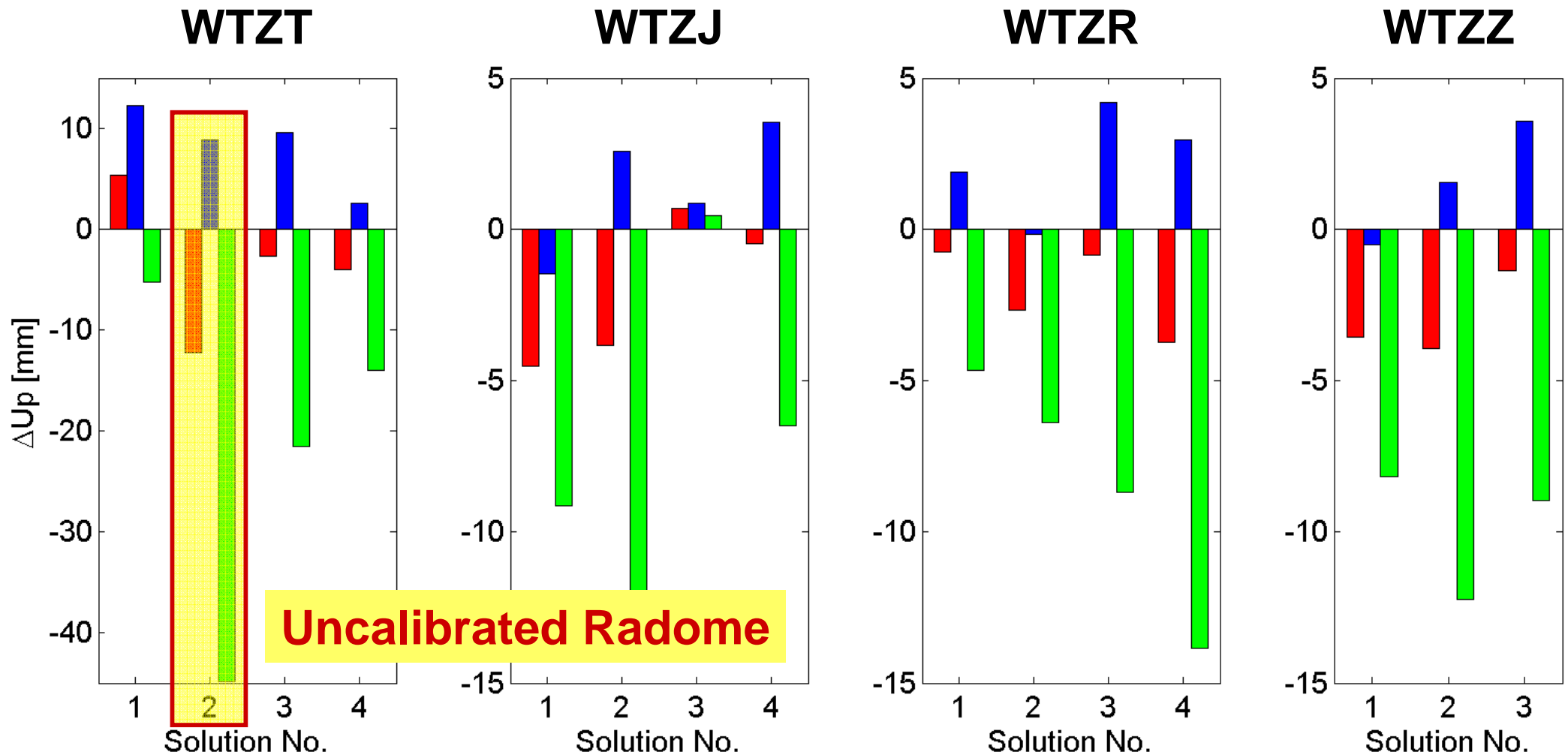
L1 L2 L3



Cumulative Solution: Height Component

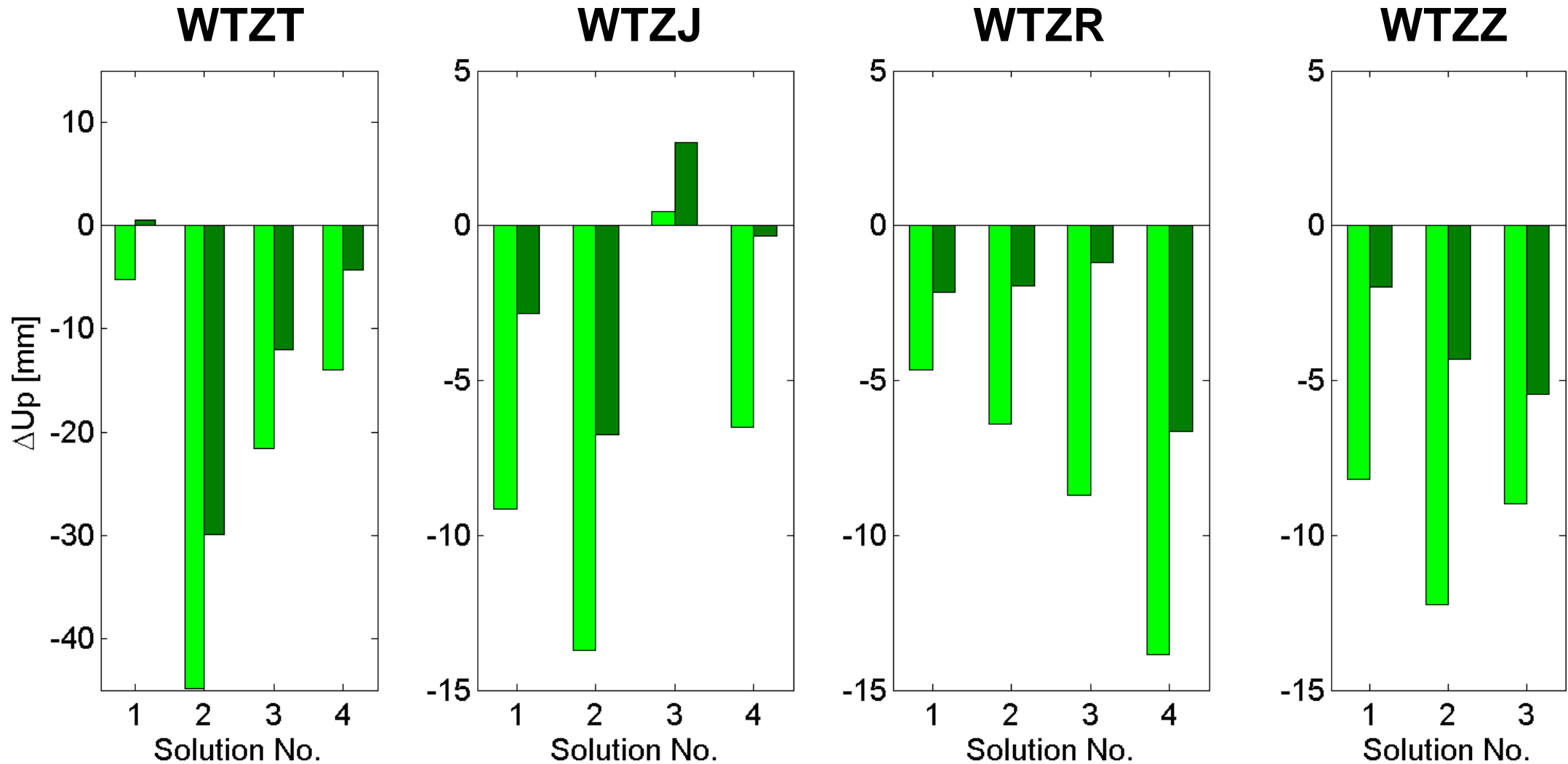
Differences between baseline w.r.t. WTZA and local tie
Troposphere parameters estimated

L1 L2 L3

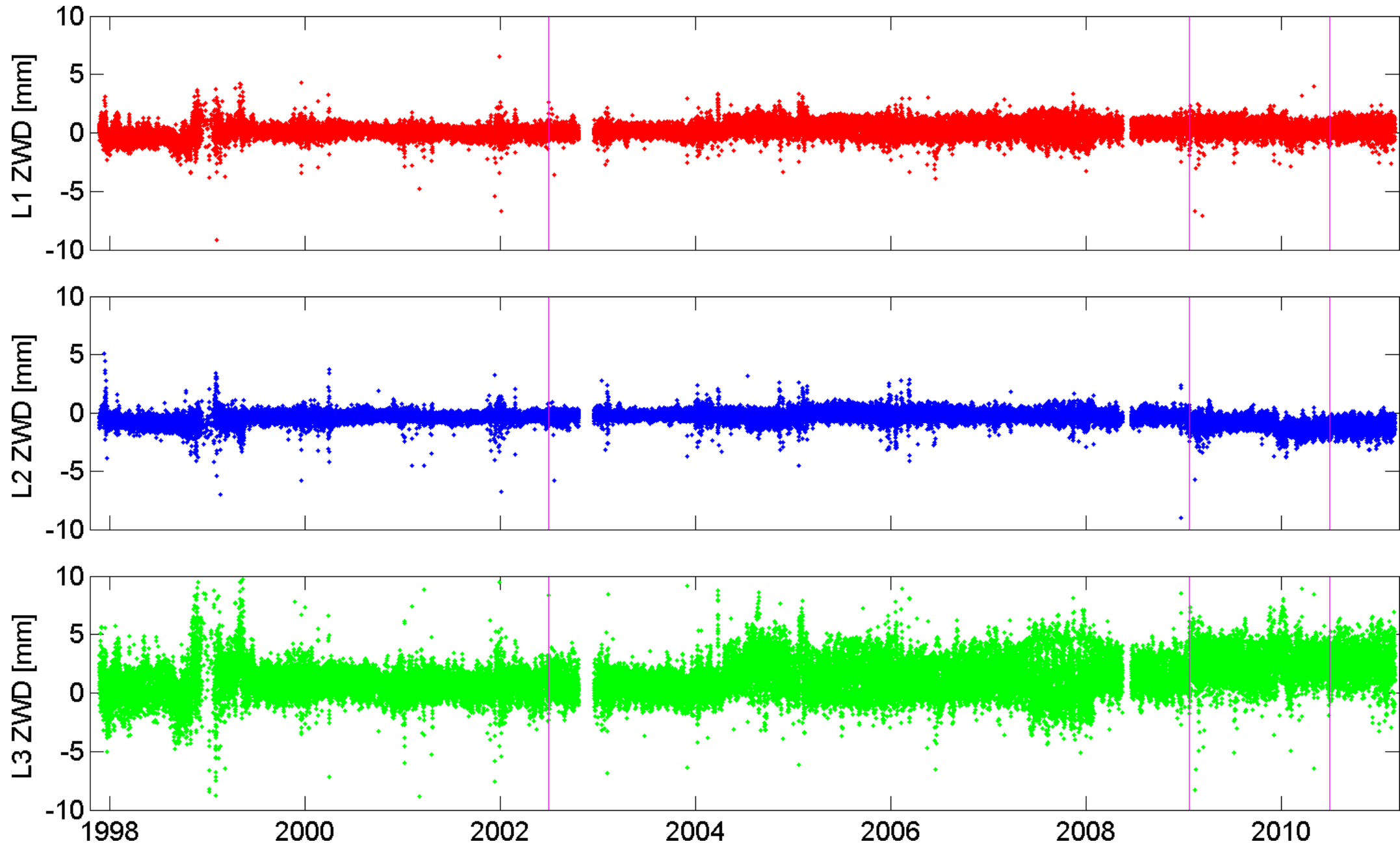


Impact of Troposphere Estimation

L3 station height discrepancies **with** and **without** troposphere estimation

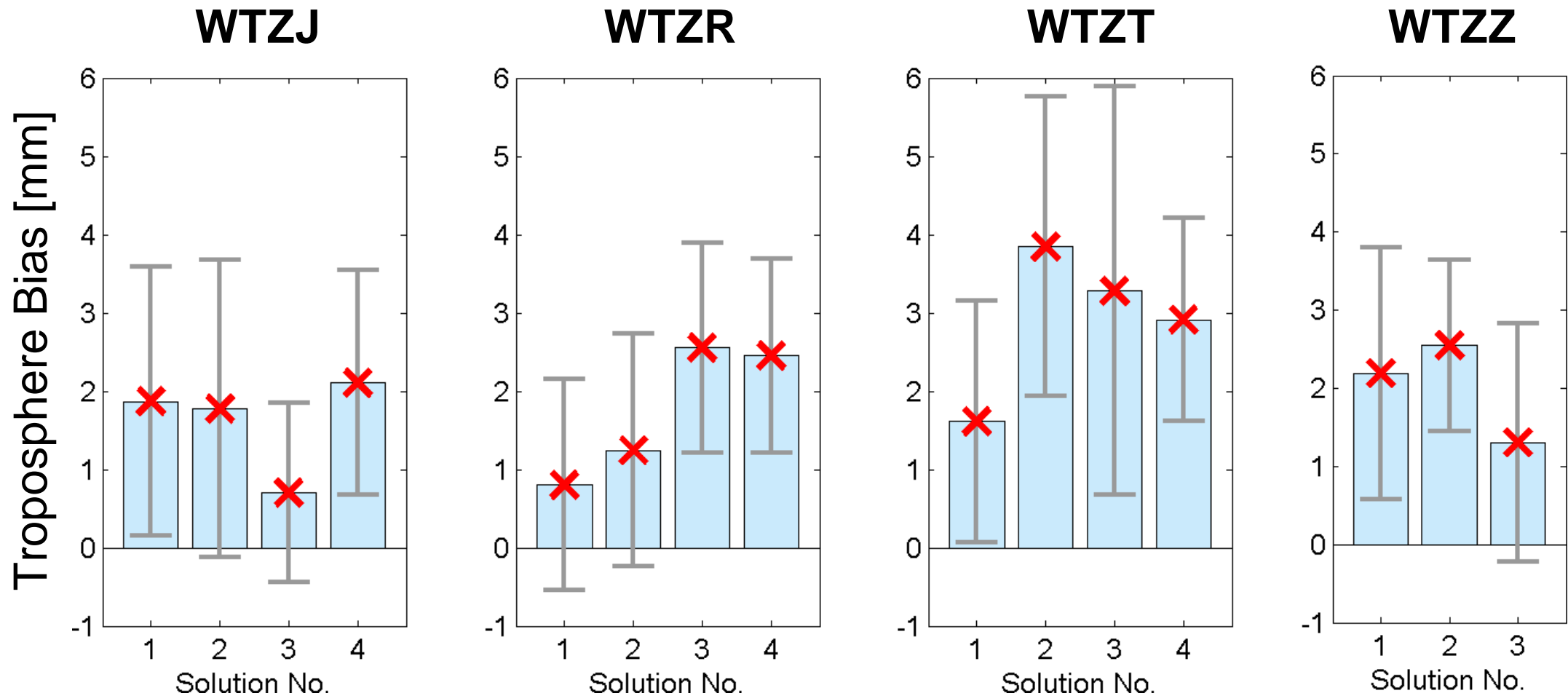


Troposphere Zenith Delays for WTZR



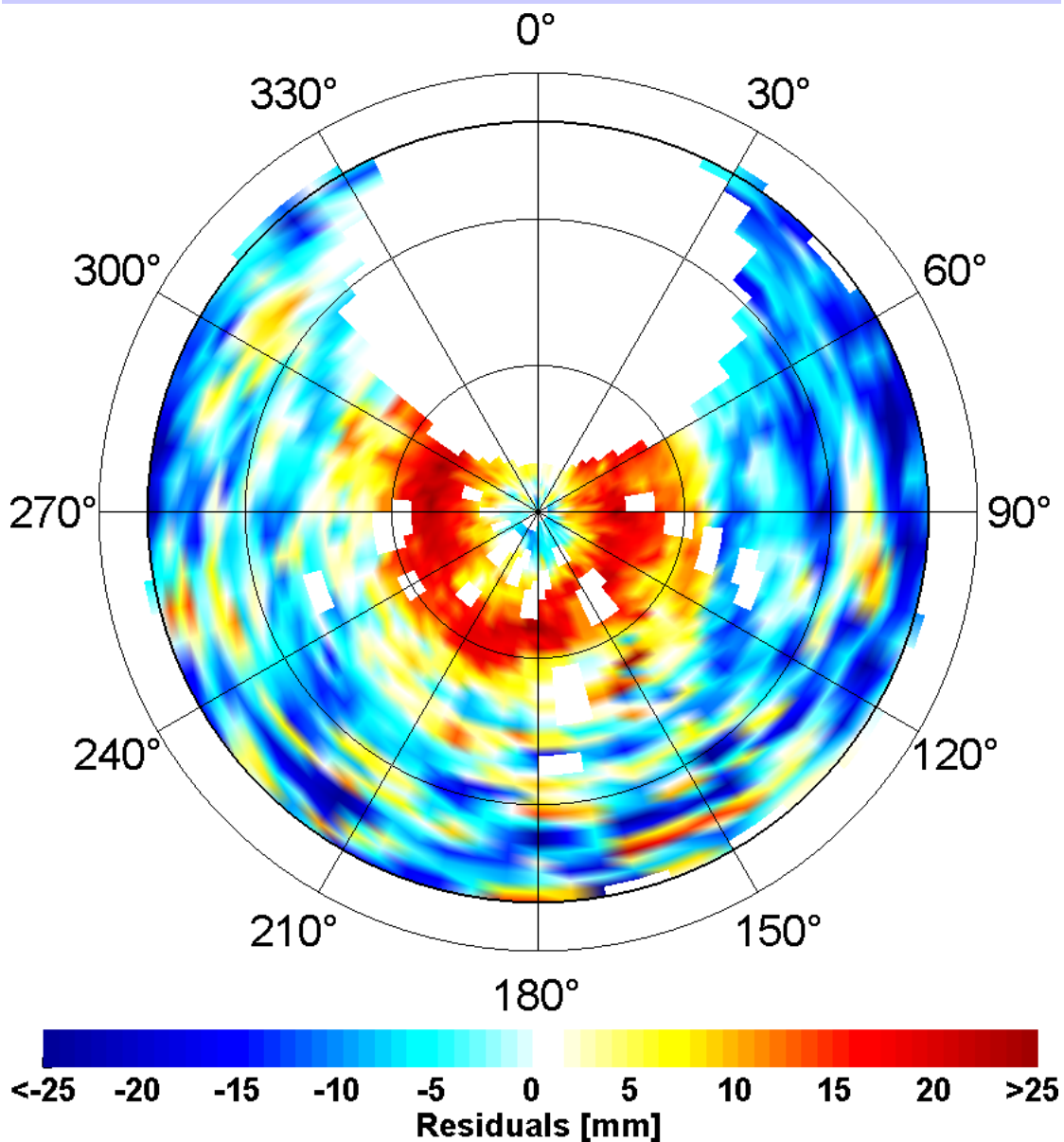
L3 Troposphere Biases

Mean bias and standard deviation per solution interval
(due to antenna changes) for ionosphere-free linear combination

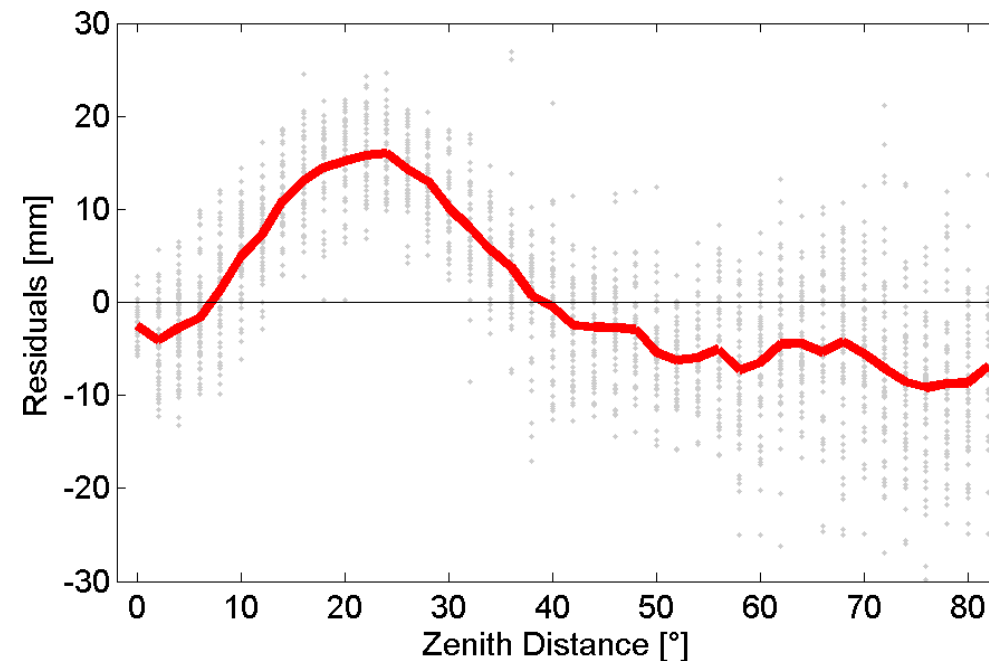


Estimation of Residual Maps

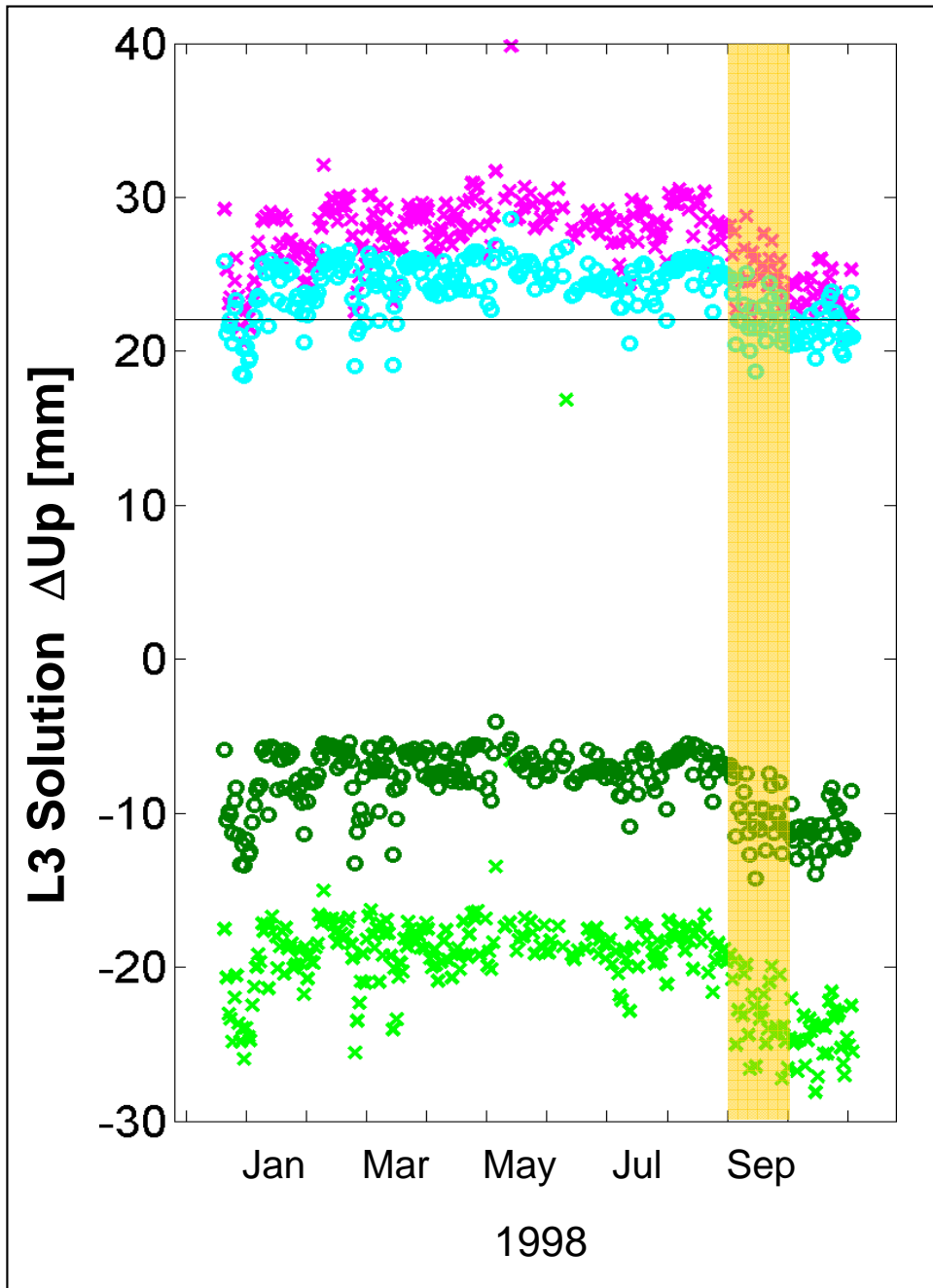
WTZT, September 1998 (uncalibrated radome)



- Local ties fixed
- No elevation-dependent weighting, 10° cut-off
- L3 residuals for WTZT with uncalibrated radome



Application of Residual Maps



residual-corrected **with**
troposphere estimation

residual-corrected **without**
troposphere estimation

WTZT with uncalibrated radome
zenith-dependent corrections from
September 1998 applied

uncorrected **without**
troposphere estimation

uncorrected **with**
troposphere estimation

Residual Maps: WTZR



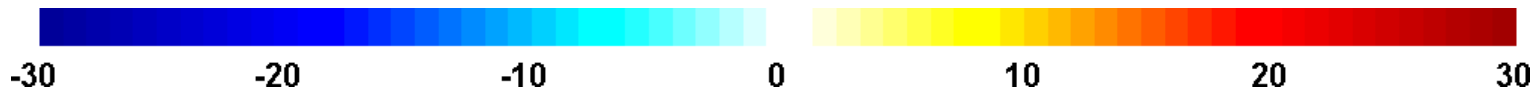
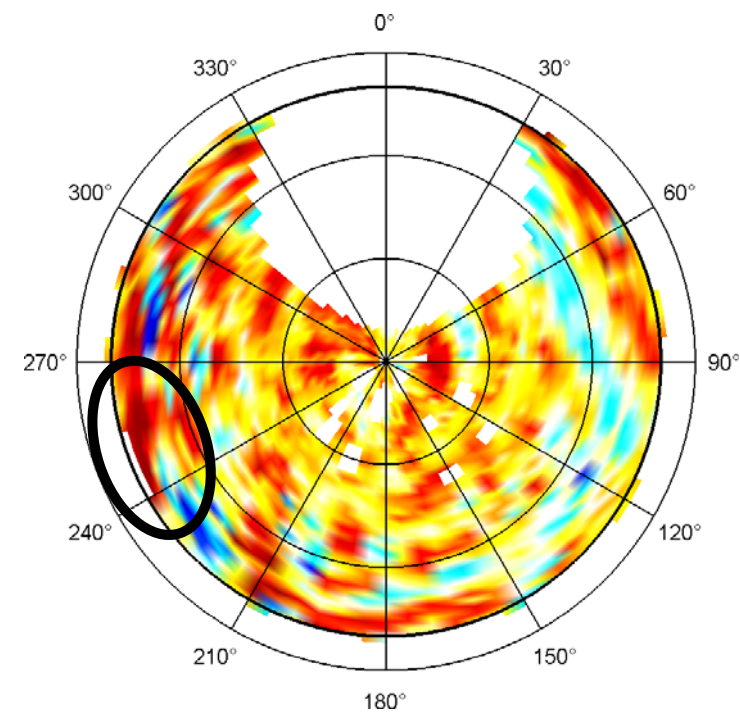
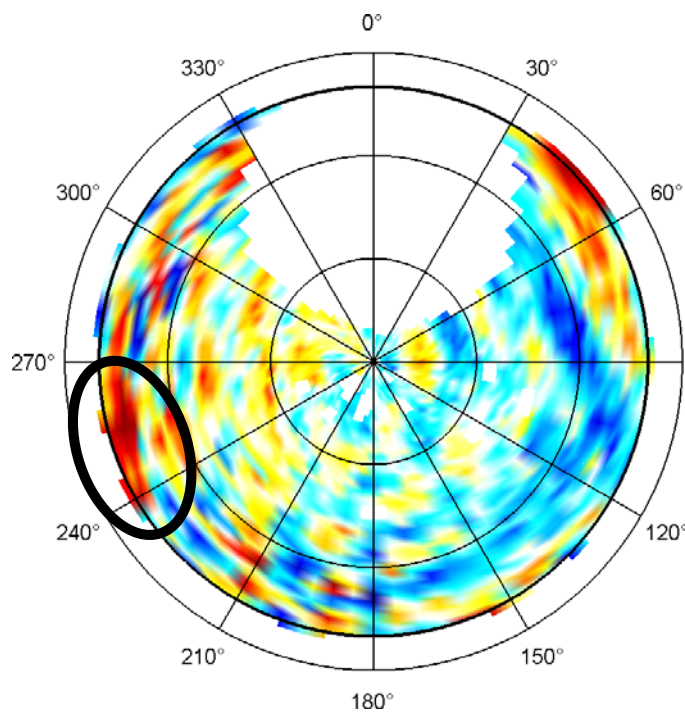
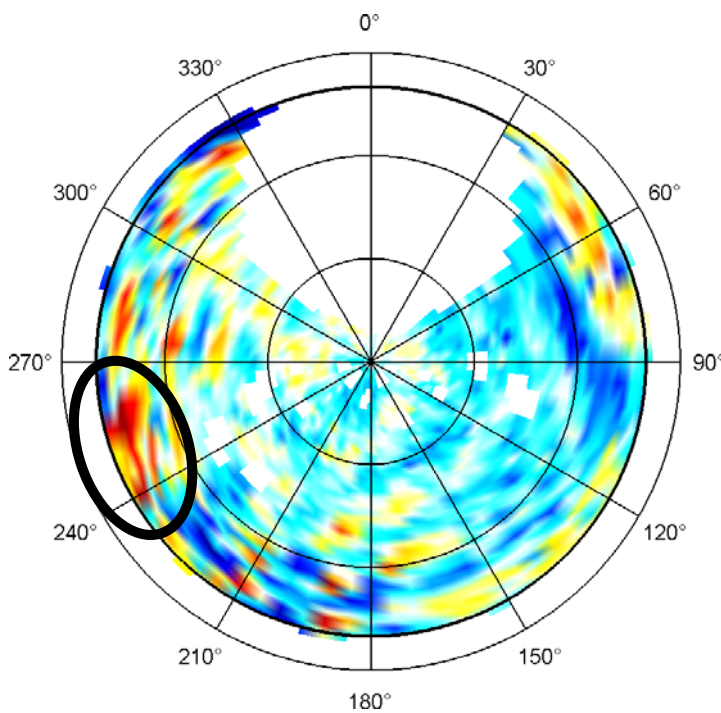
September 2008
AOAD/M_T NONE



September 2009
LEIAR25 LEIT



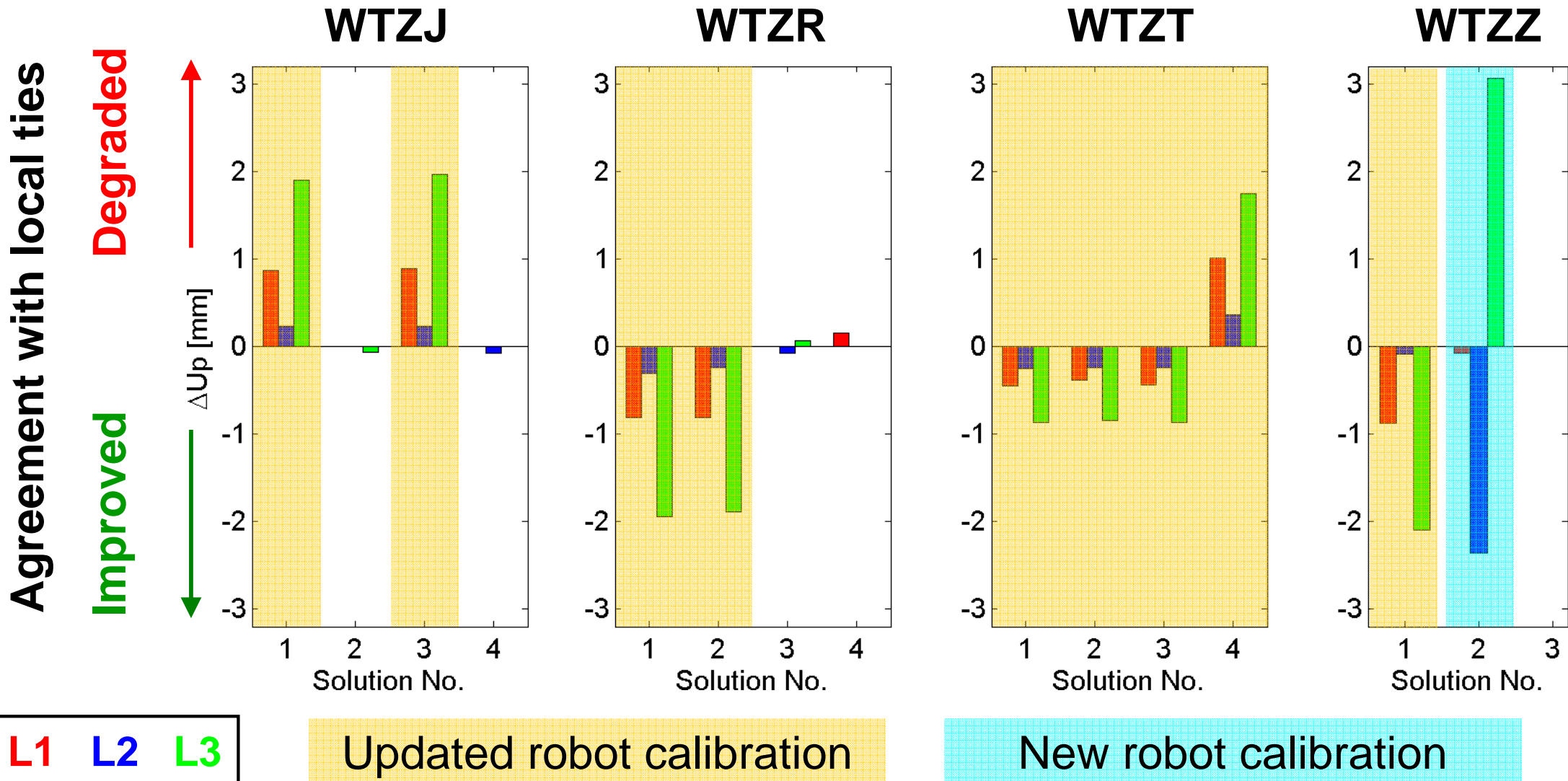
September 2010
LEIAR25.R3 LEIT



Residuals [mm]

igs08.atx Receiver Antenna Calibrations

Differences to station heights derived with igs05.atx receiver calibrations



Summary and Conclusions

- **Precision** of the **local ties** at Wettzell is at the **1-2 mm** level
- L1, L2, and L3 GPS solutions differ by **up to 5 cm**
- L3 differences w.r.t. local ties can reach the **cm level**
- **Discrepancies** are **caused by GPS**, not the **local tie measurements**
- Discrepancies **amplified** by estimation of **troposphere** parameters
- Near-field effects like **multipath** are most likely the source for these frequency-dependent systematic effects
- **Residual maps** show systematic effects at the **cm level**
- Residual maps could be used for **differential corrections** (w.r.t. reference site or previous antenna at same site)
- Should such corrections be applied within the IGS?

