GNSS Antenna Array at the Geodetic Observatory Wettzell

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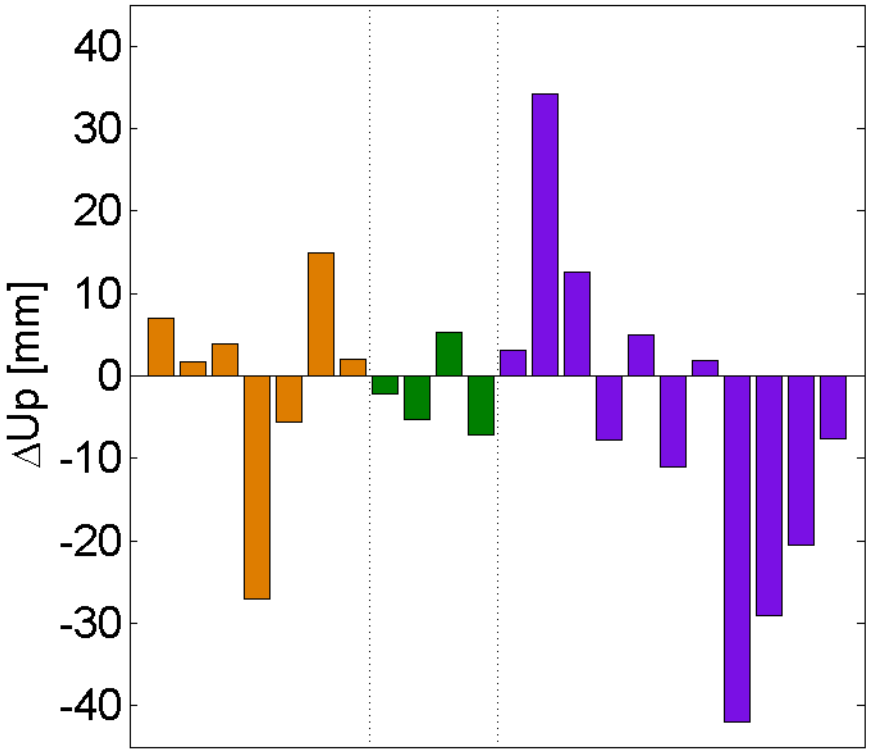
Motivation and Outline

Local tie height discrepancies at Wettzell from ITRF2008D



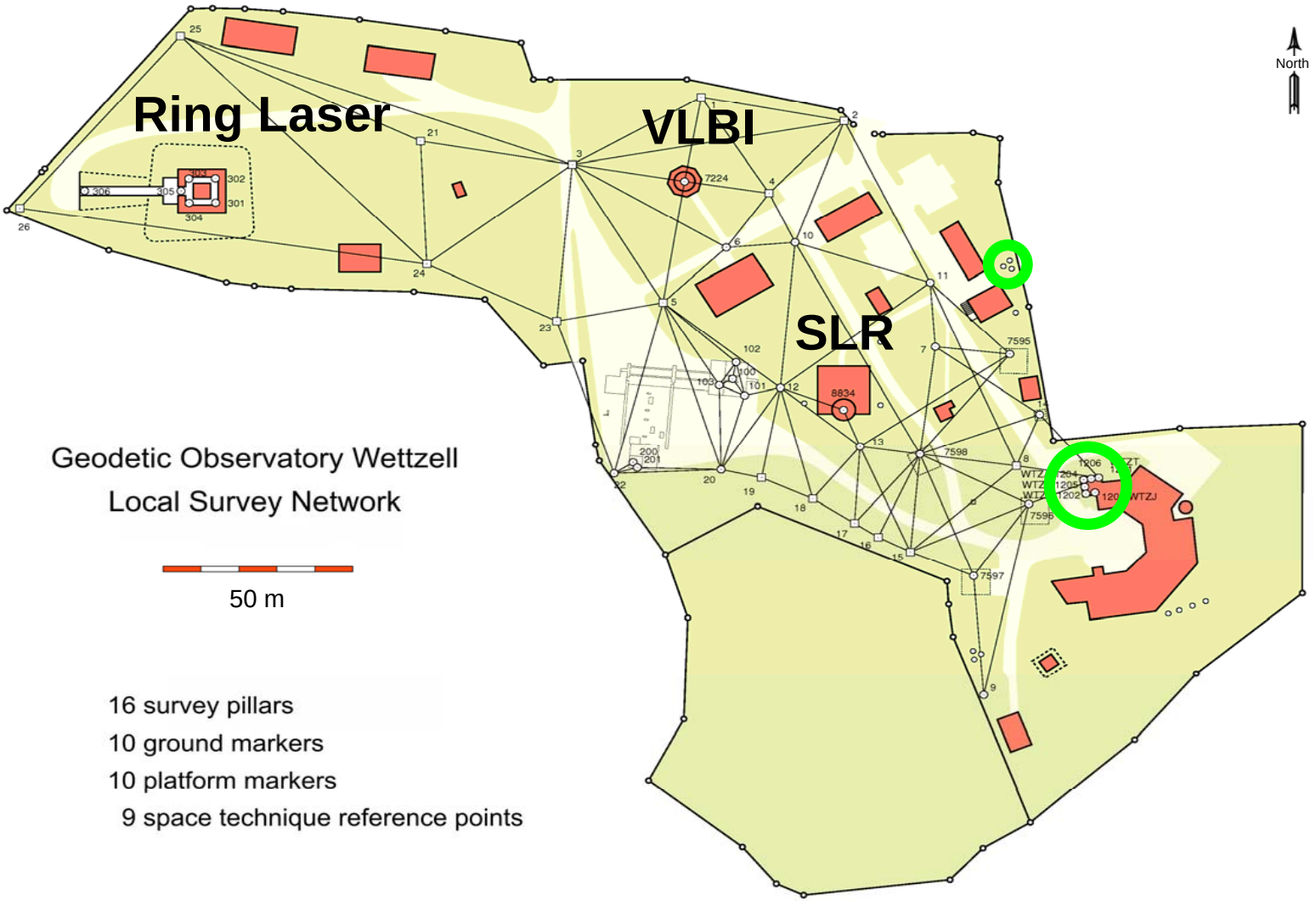
Outline

- GNSS network at Wettzell
- GNSS processing
- Station coordinate time series
- Accumulated solution
- Local tie comparisons
- Kinematic solution
- Impact of individual antenna calibrations
- Conclusions

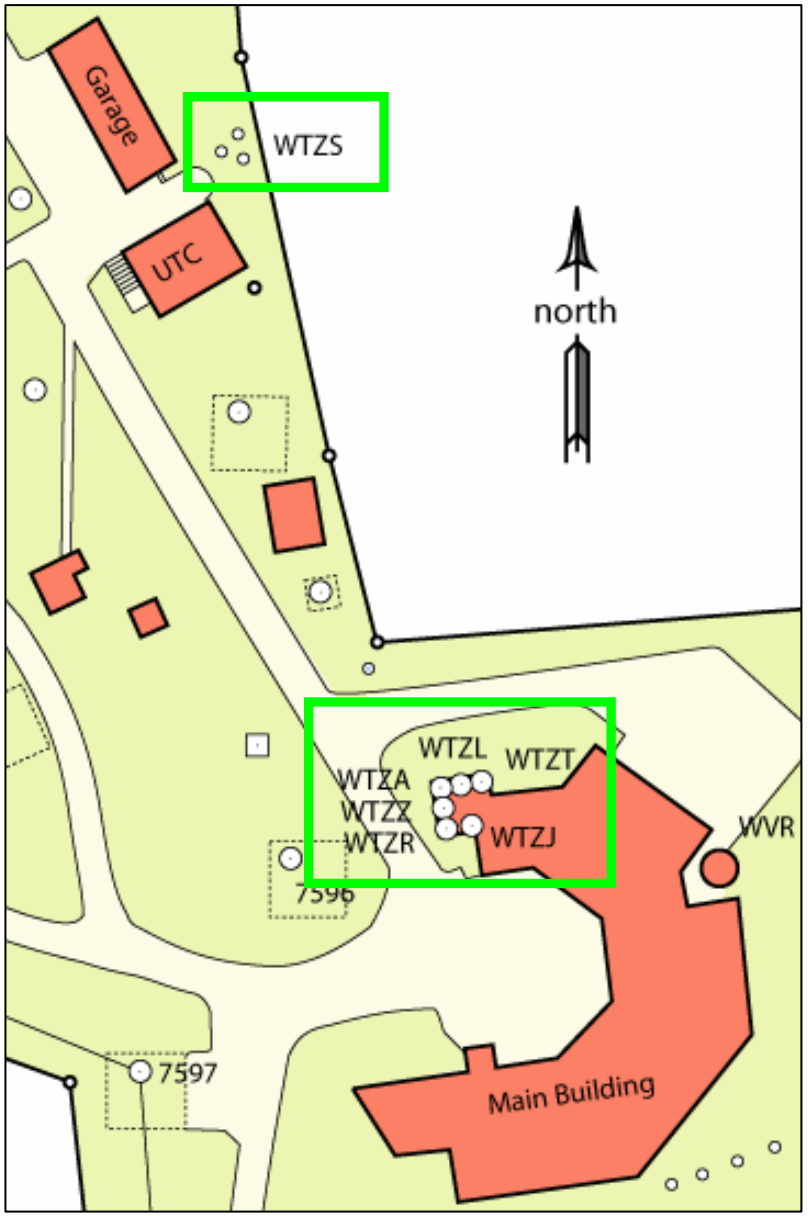
GNSS Station History

Site	Start	End	Network	# ACs
WETT	07/1991	01/1997	IGS	-
WTZR	**02/1995**		**IGS**	**7**
WTZT	02/1997	05/2005	IGS	-
WTZA	11/1997		IGS	3
WTZZ	02/1999		IGS	4
WTZJ	07/2001		IGS	2
WTZL	03/2004	09/2008	DREF	-
WTZS	07/2005		IGS	1
WTZX	01/2009		CONGO	-

GNSS Permanent Stations at Wettzell (1)

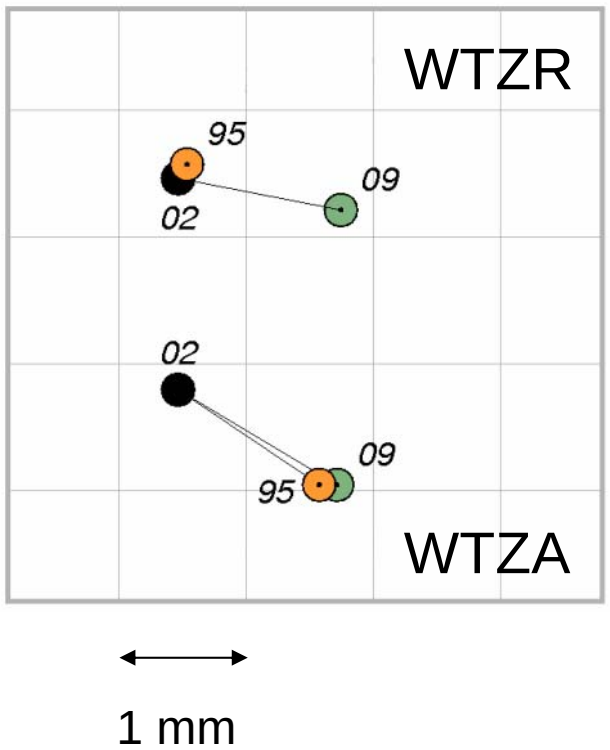


GNSS Permanent Stations at Wettzell (2)

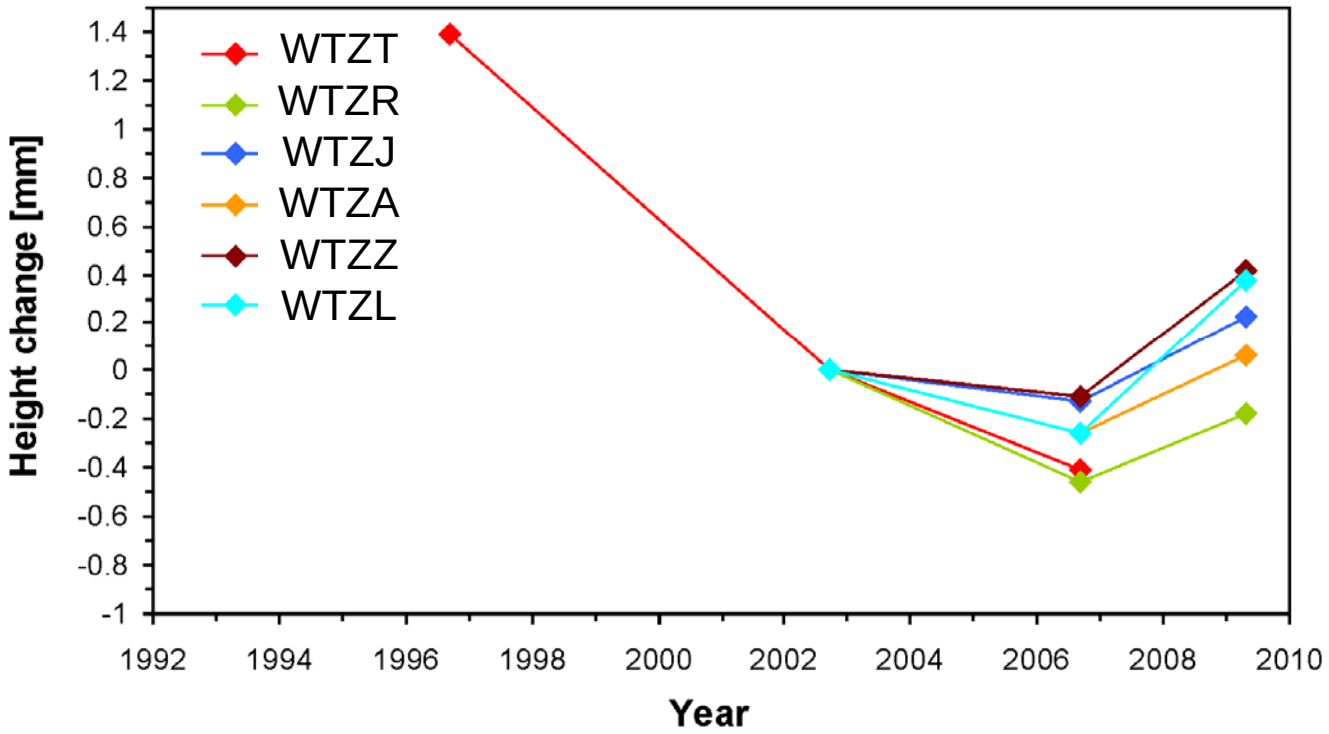


Local Surveys

Horizontal displacement



Vertical displacement

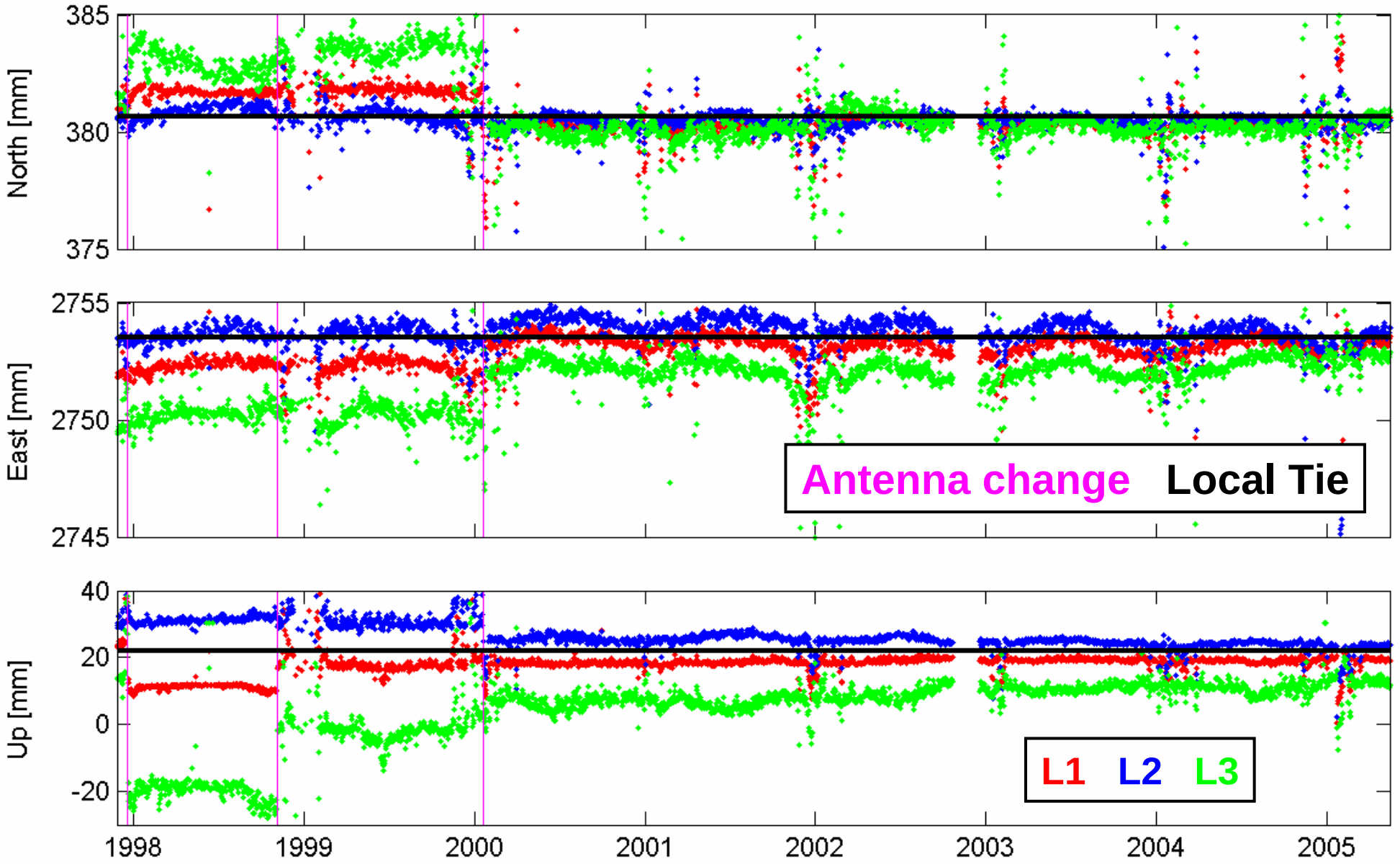


The precision of the local ties in Wettzell is in the order of 1-2 mm

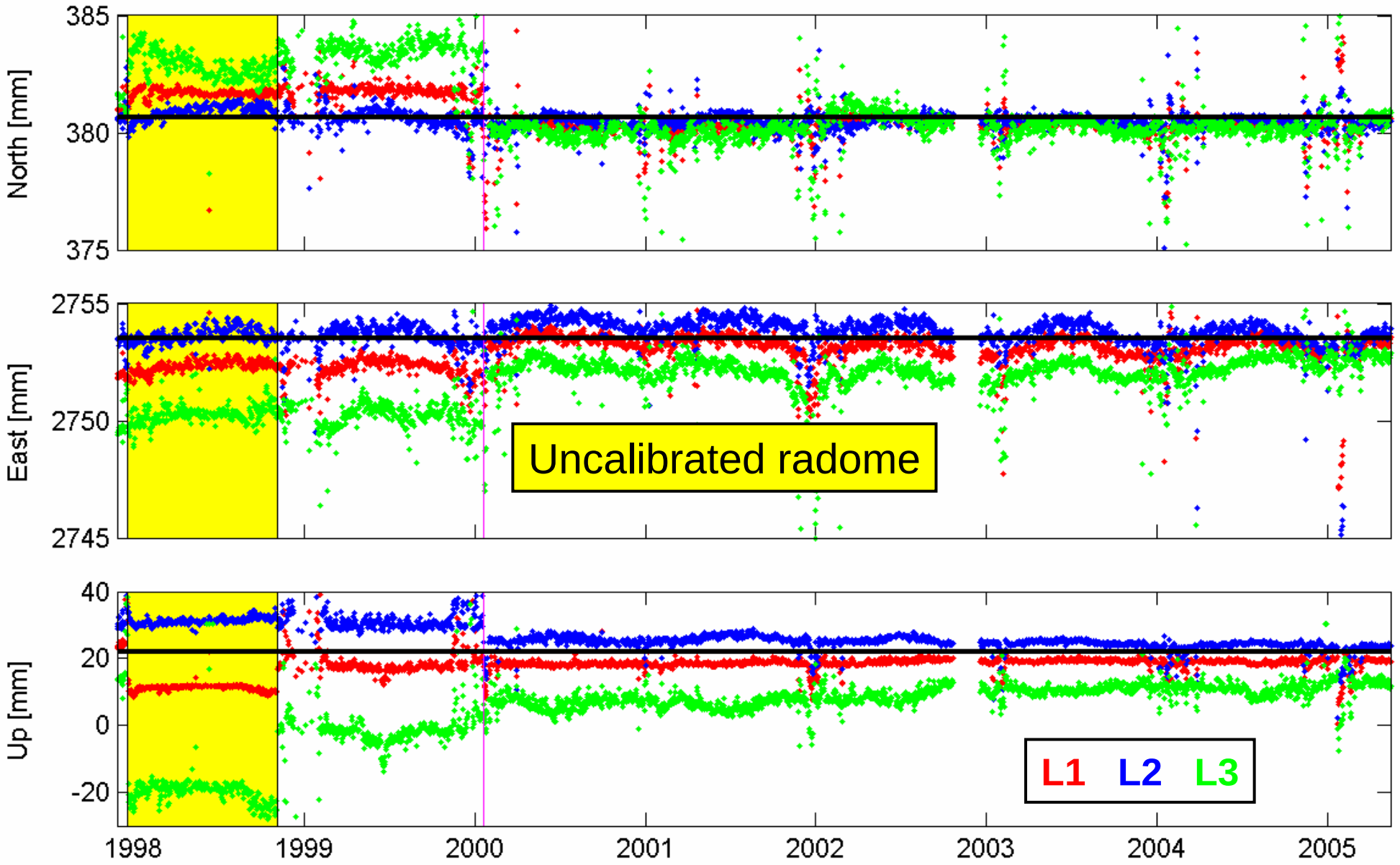
GNSS Processing

- **Double difference** solution with Bernese 5.1
- **WTZA** as **reference**: no antenna change, no discontinuities
- Reprocessed (1997–2008) and operational (2009/10) **CODE products**:
  - Satellite orbits and Earth rotation parameters
  - Troposphere zenith delays and gradients for WTZR
- Estimation of **troposphere parameters** for all stations but WTZR
  - Zenith delays with 2h parameter spacing, GMF, GPT
  - 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 94 %
- Computation of L1, L2, and L3 (ionosphere-free) solutions

Coordinate Time Series of WTZT w.r.t. WTZA



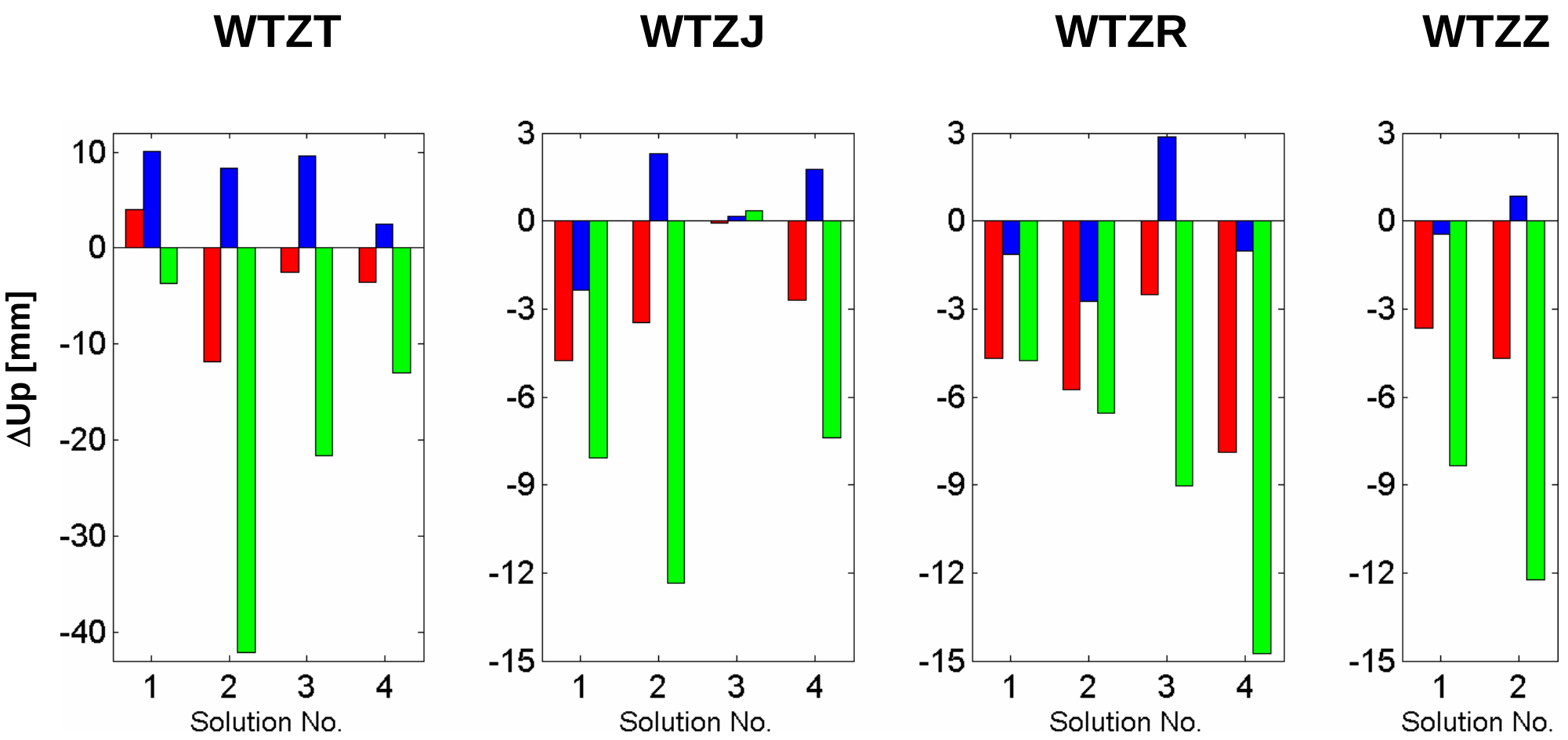
Coordinate Time Series of WTZT w.r.t. WTZA



Cumulative Solutions: Height Component

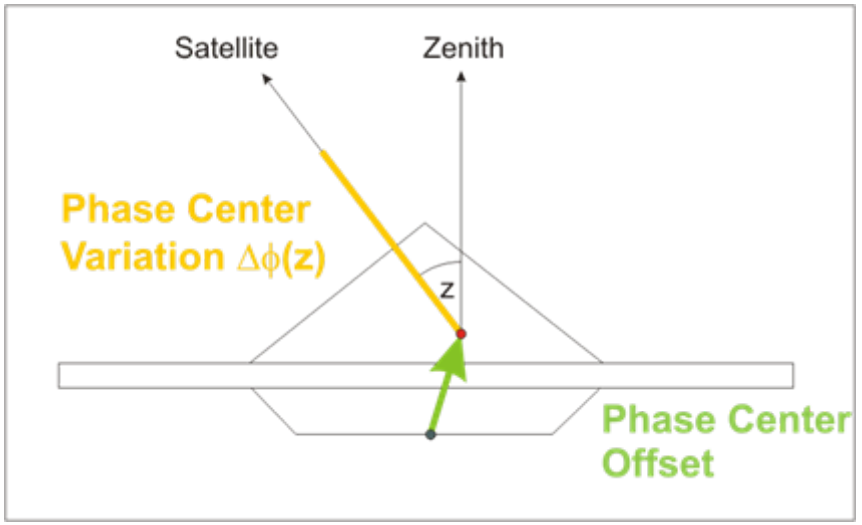
Differences between baseline (w.r.t. WTZA) and local tie

L1 L2 L3



Possible Error Sources

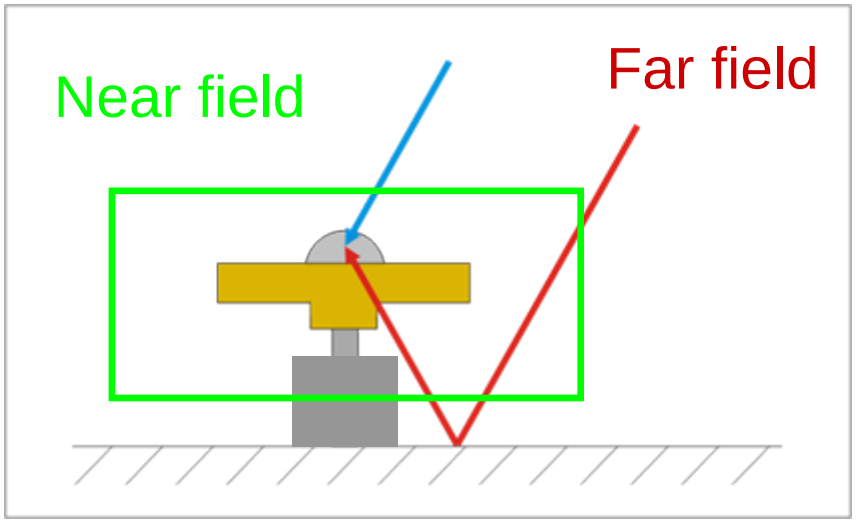
Antenna calibration



Individual robot calibrations for several antennas available

Comparison of solutions with type-mean and individual calibrations

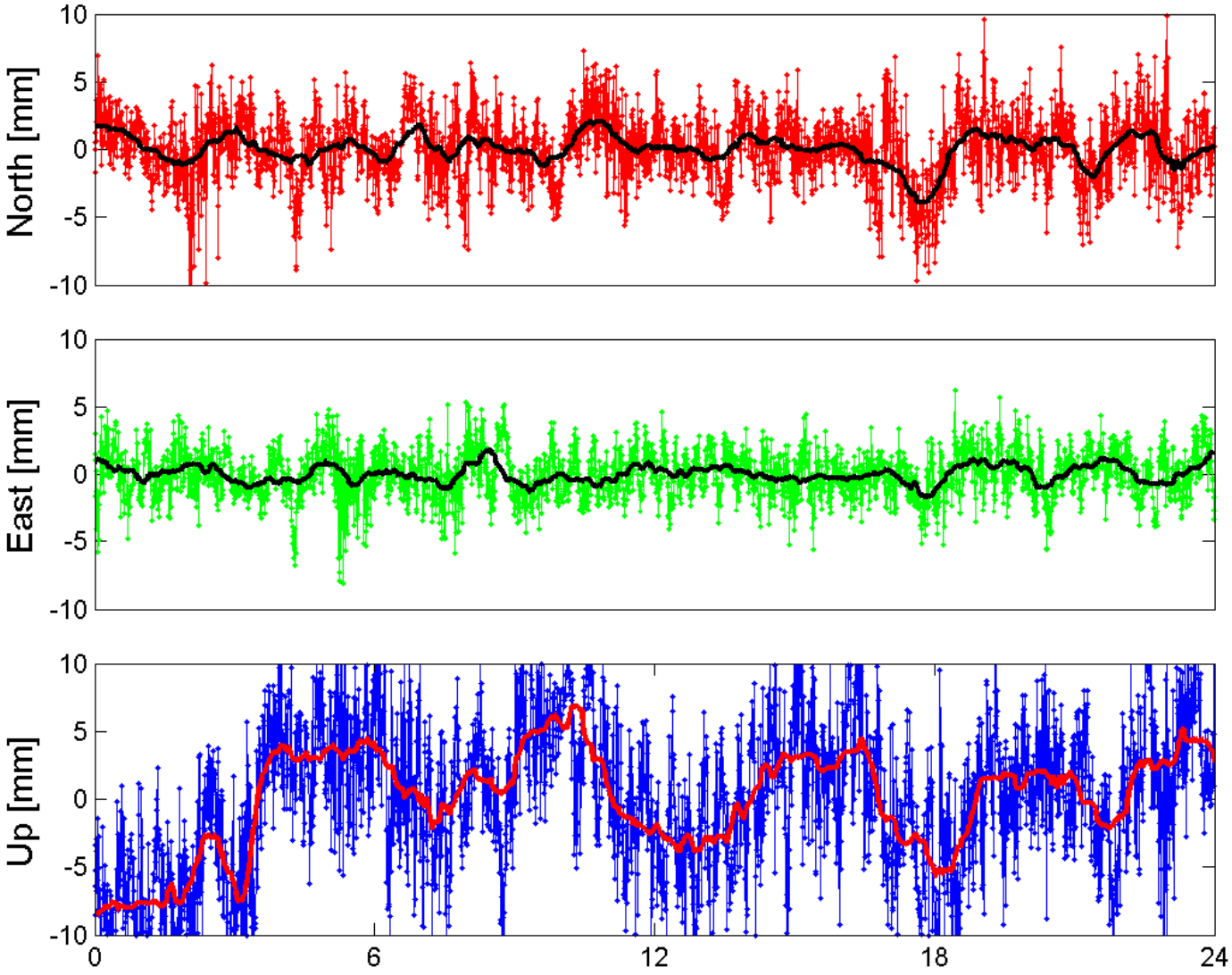
Multipath



Multipath effects repeat after one **sidereal day** ($23^h\ 56^m$)

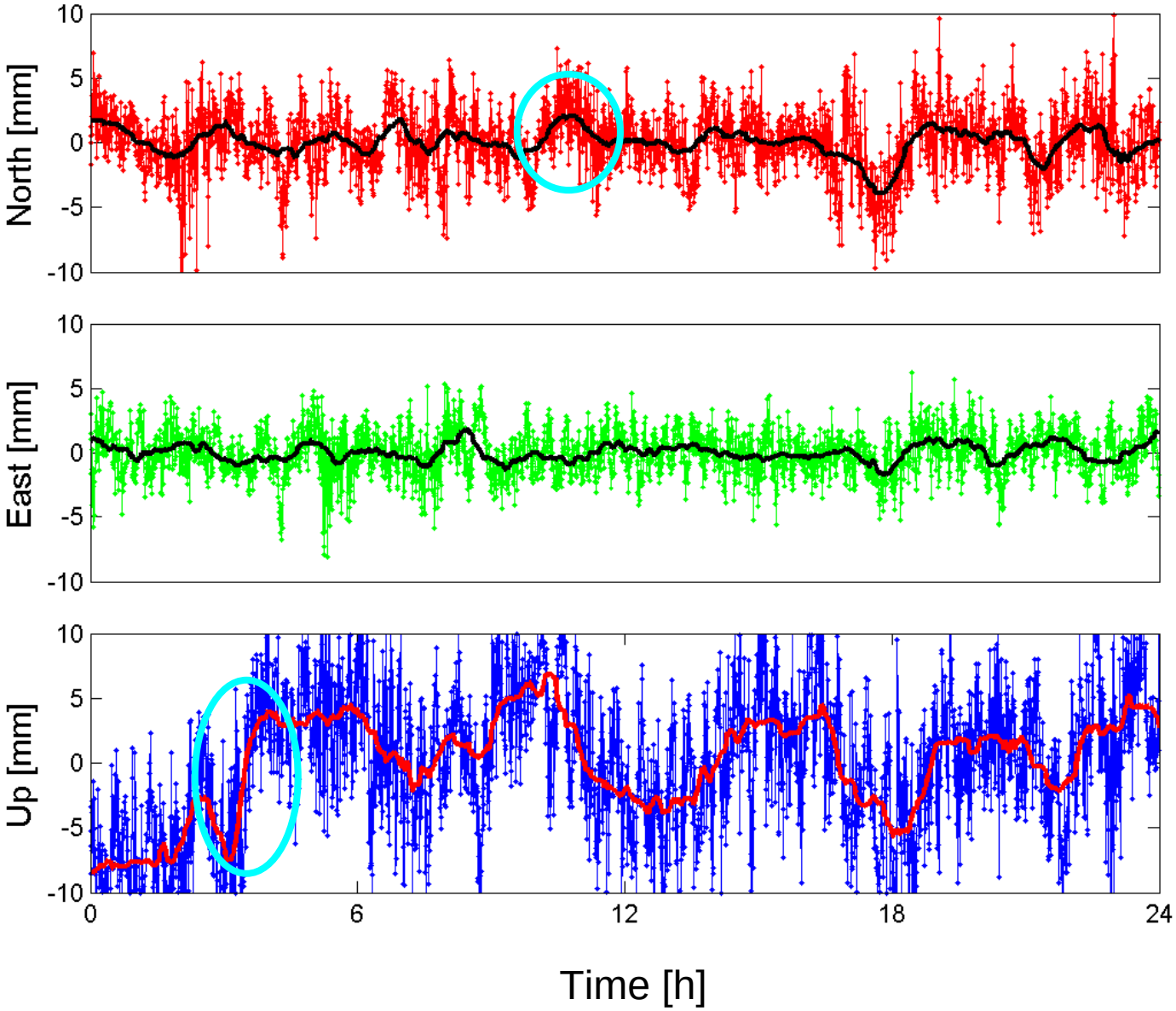
Estimation of kinematic coordinates
Comparison of different days

Kinematic Solution: WTZR w.r.t. WTZA



10 April 2010

Kinematic Solution: WTZR w.r.t. WTZA



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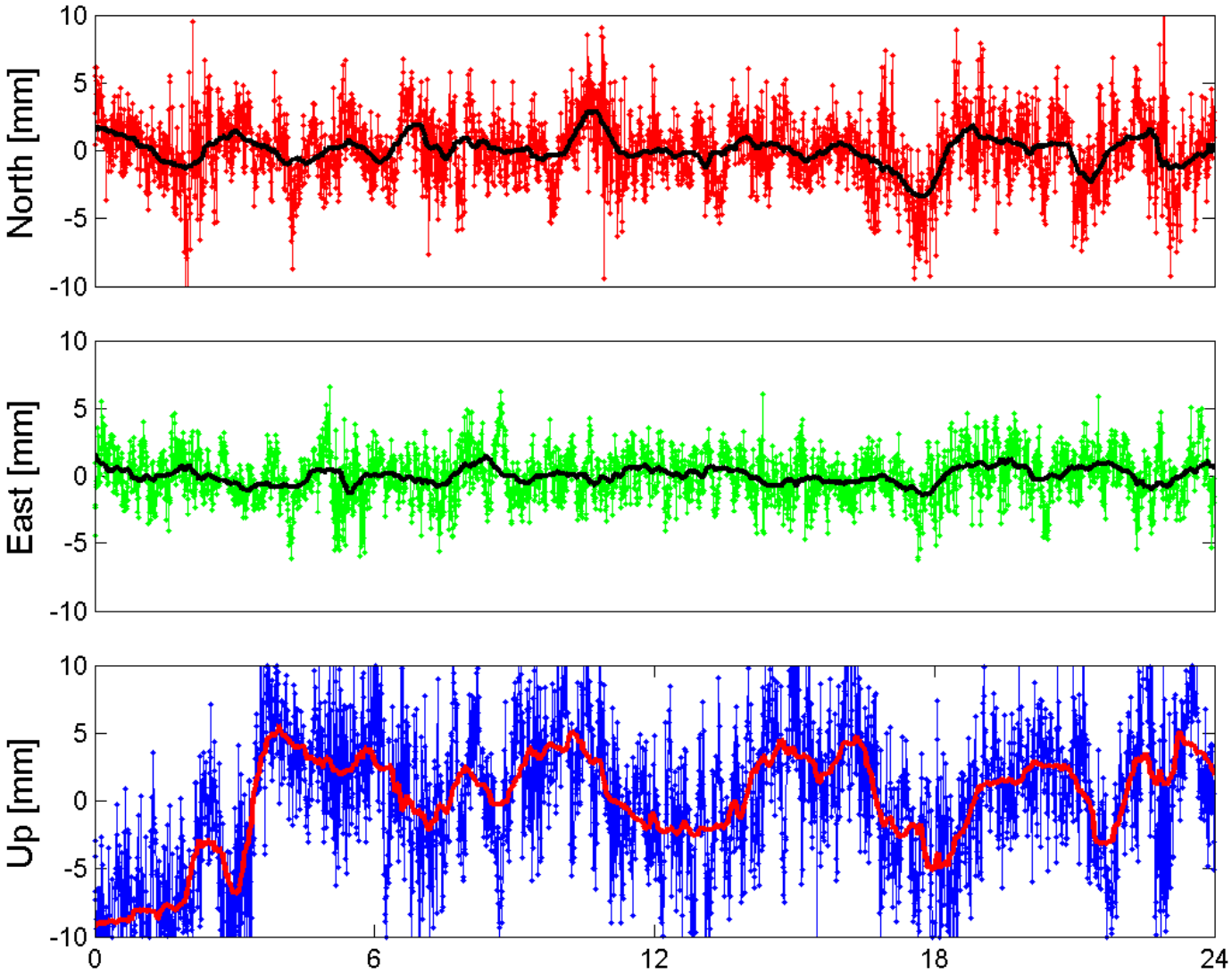
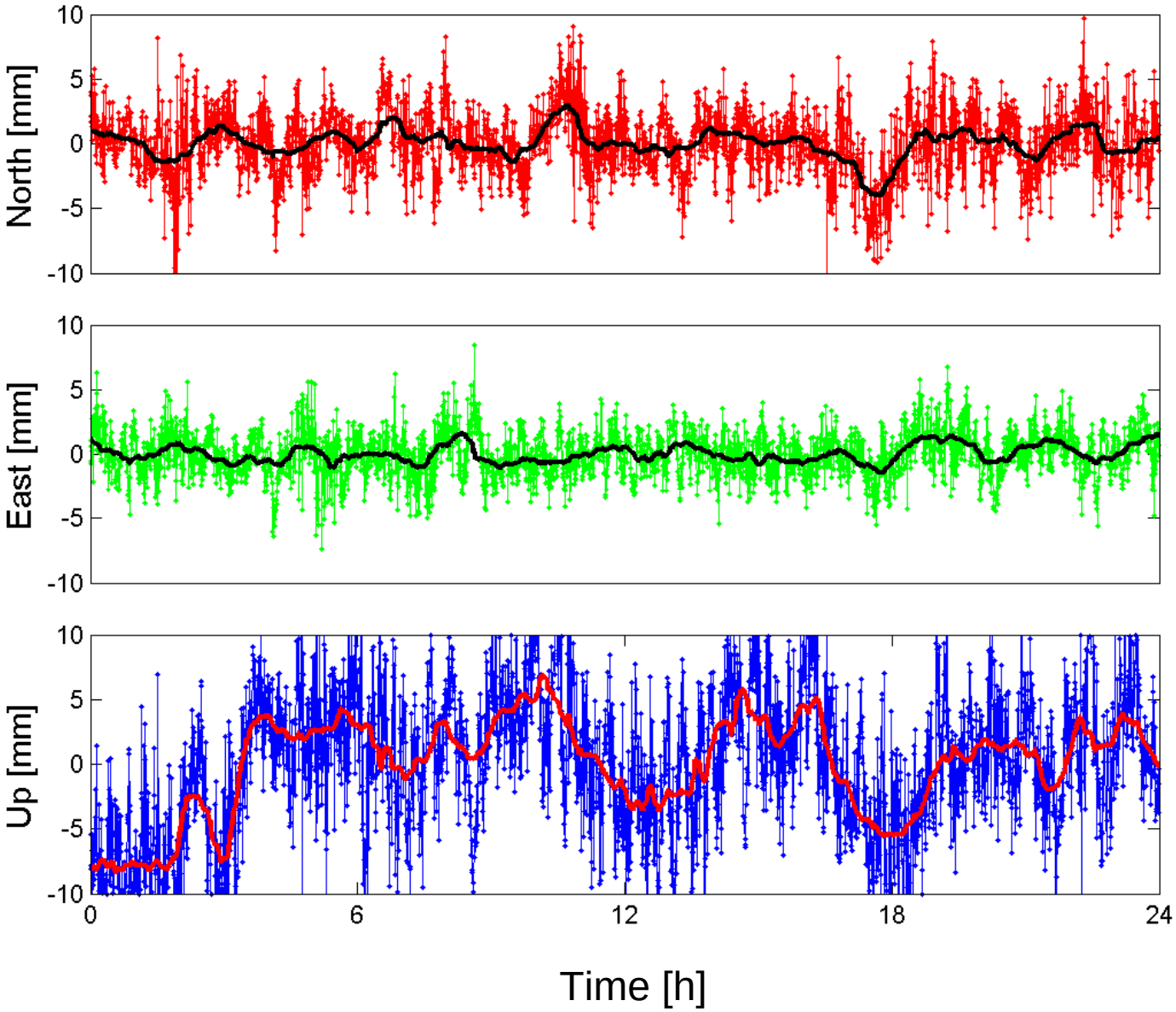
Kinematic Solution: WTZR w.r.t. WTZA



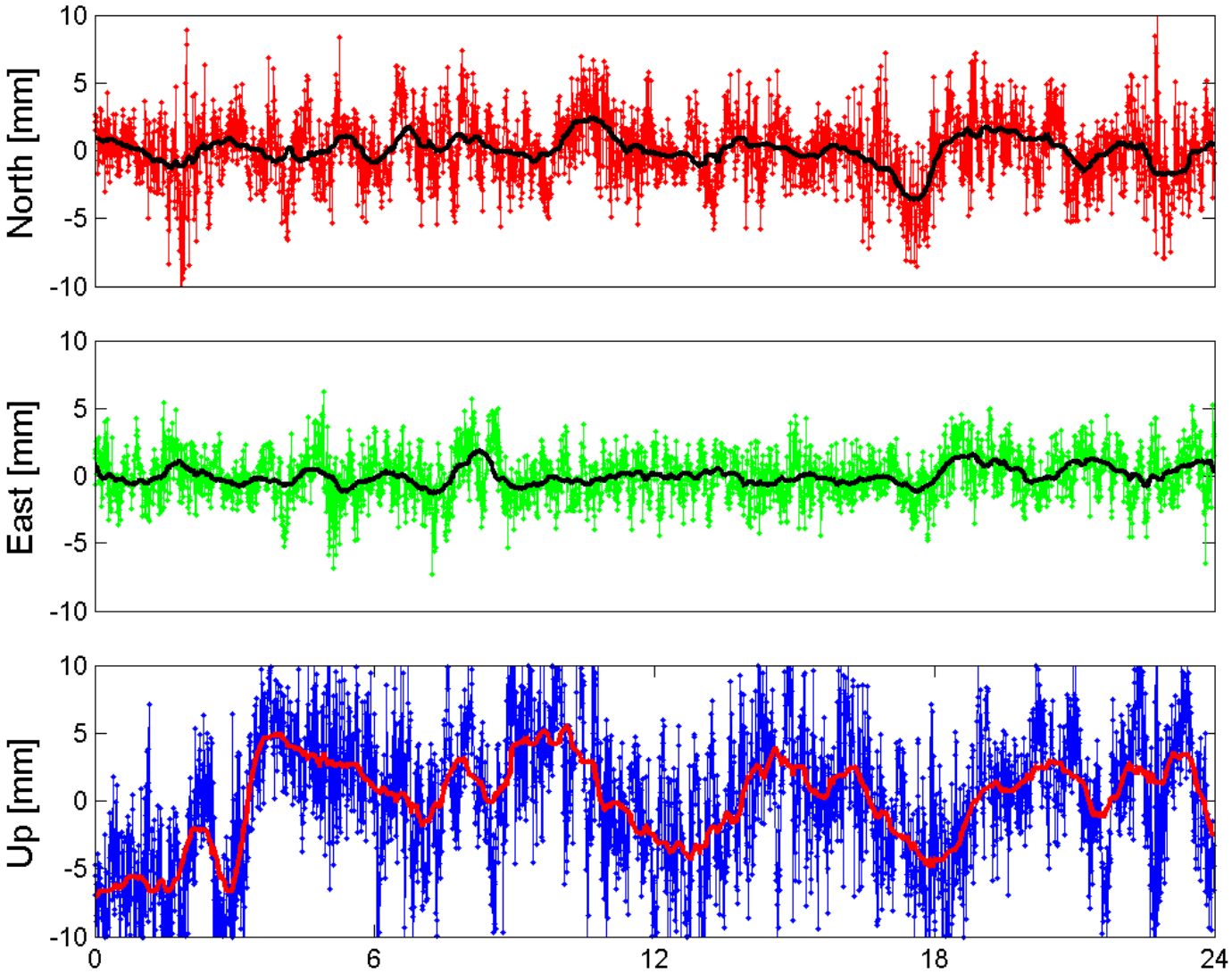
11 April 2010

Kinematic Solution: WTZR w.r.t. WTZA



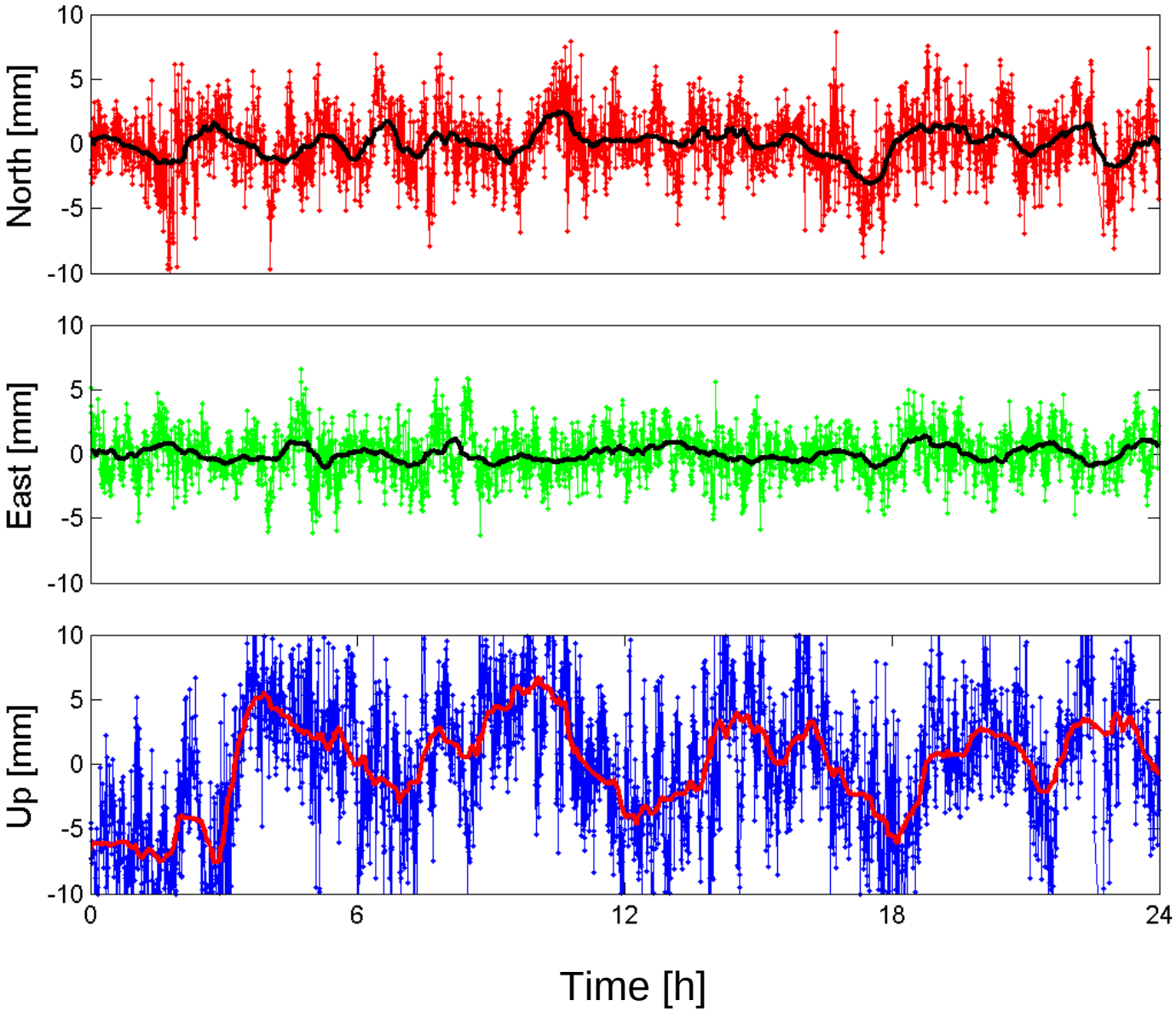
12 April 2010

Kinematic Solution: WTZR w.r.t. WTZA



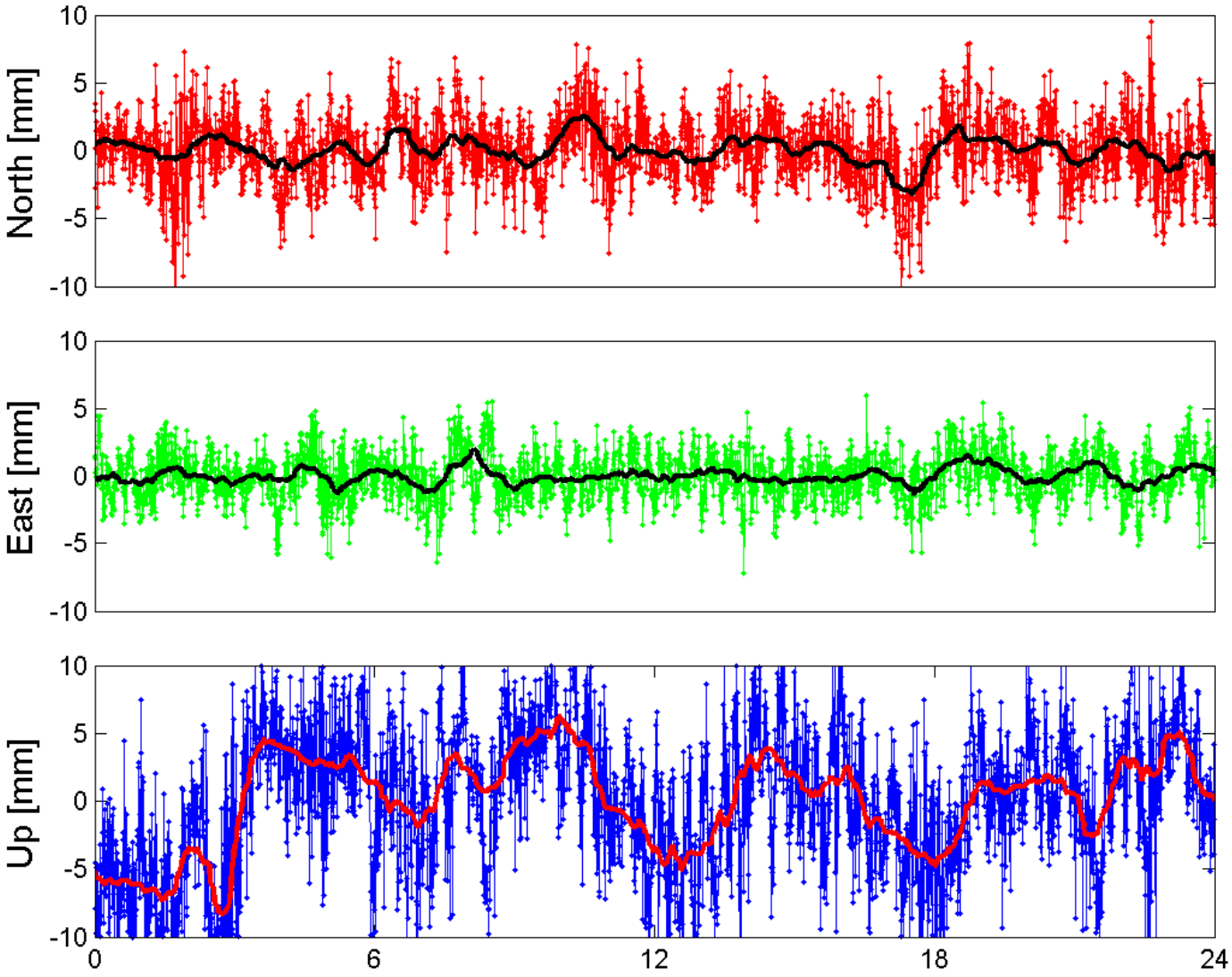
13 April 2010

Kinematic Solution: WTZR w.r.t. WTZA



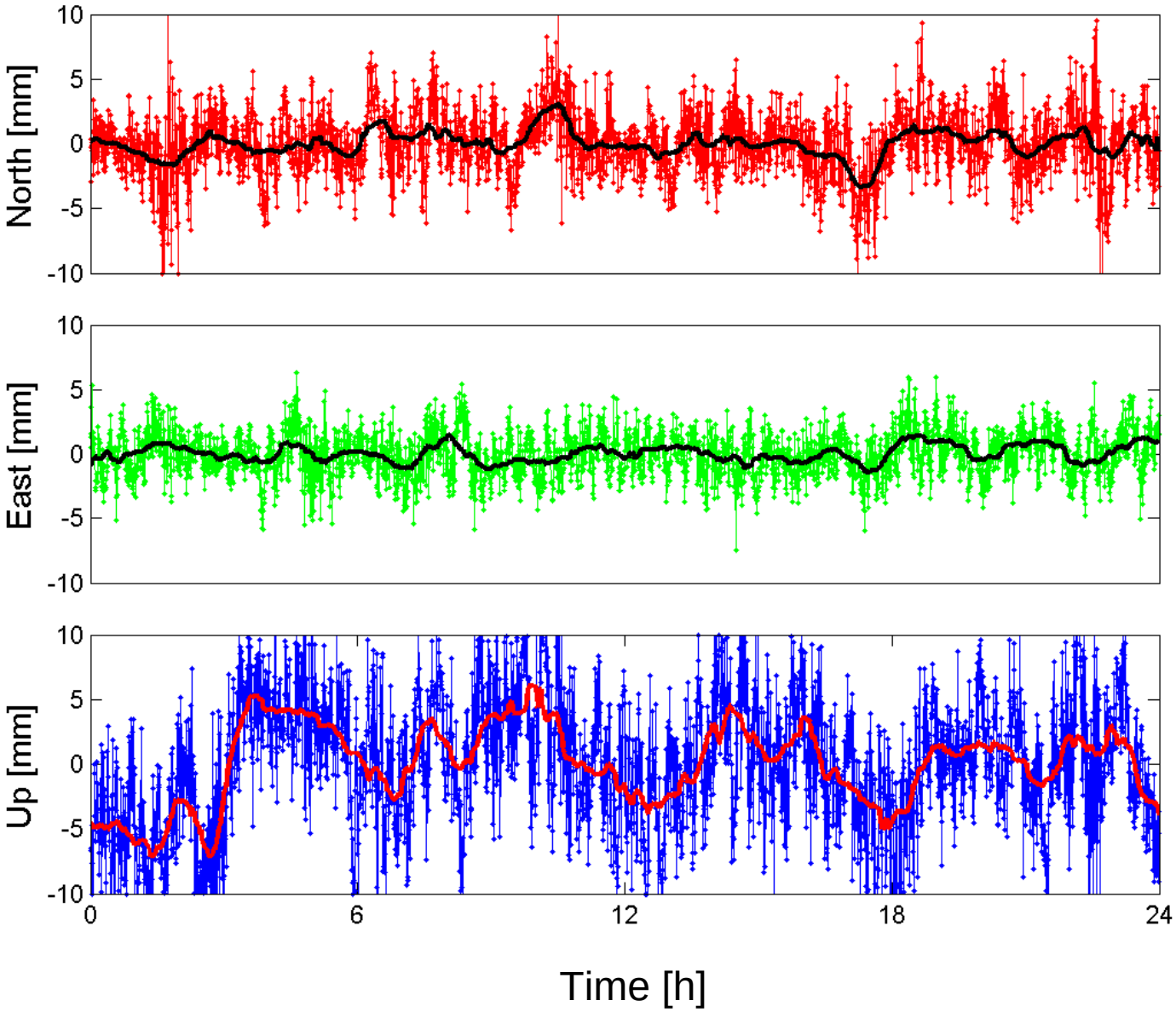
14 April 2010

Kinematic Solution: WTZR w.r.t. WTZA



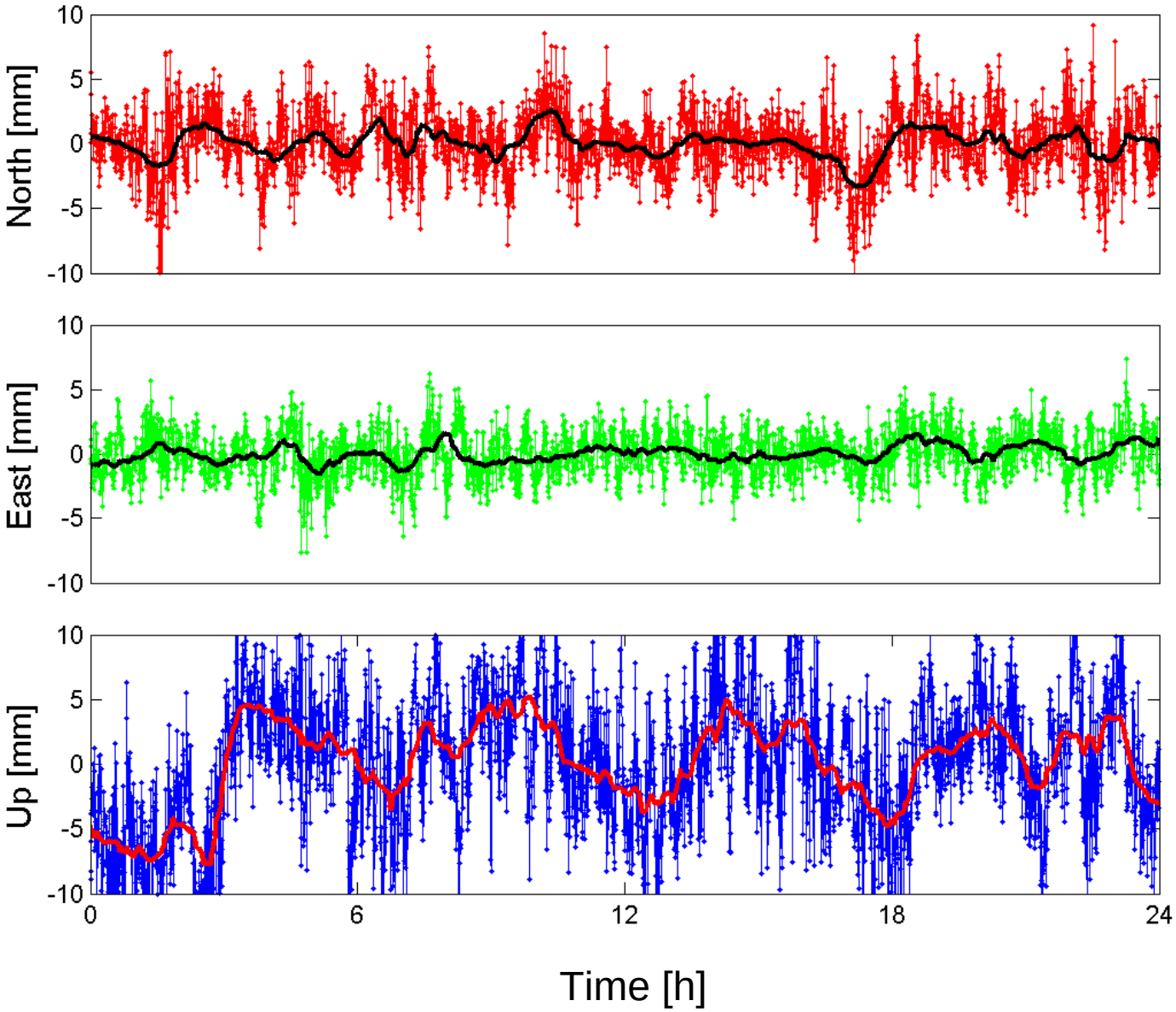
15 April 2010

Kinematic Solution: WTZR w.r.t. WTZA



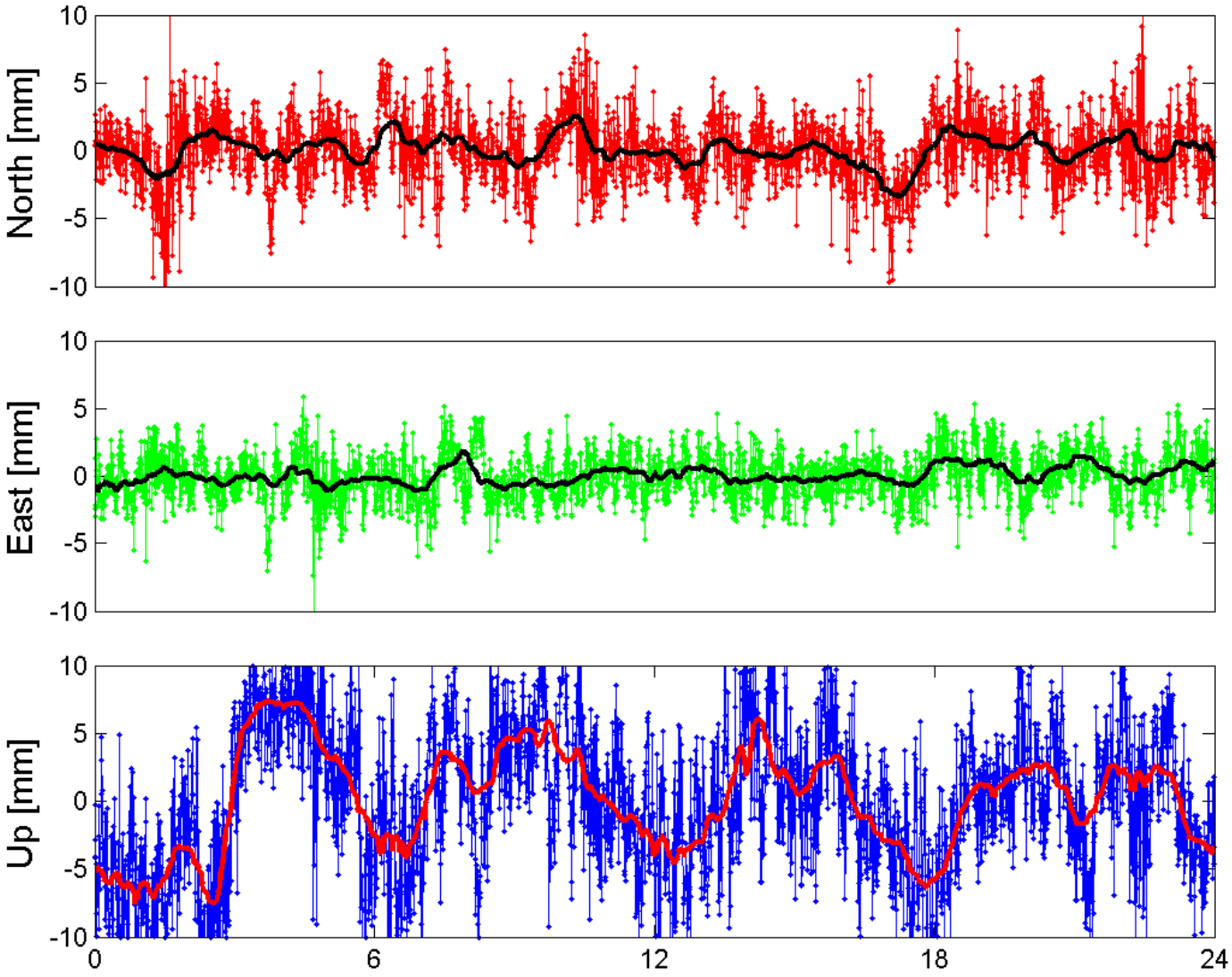
16 April 2010

Kinematic Solution: WTZR w.r.t. WTZA



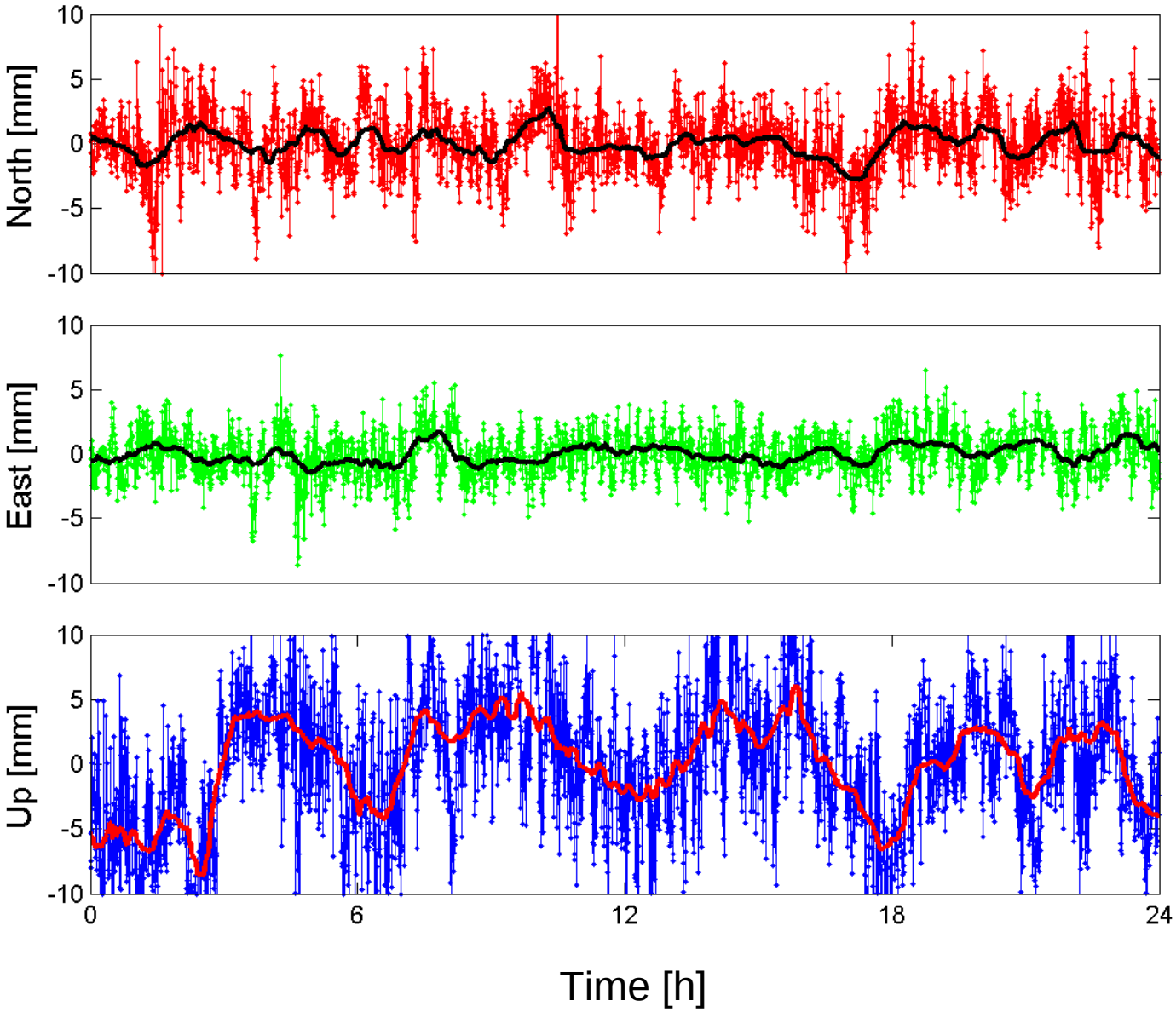
17 April 2010

Kinematic Solution: WTZR w.r.t. WTZA



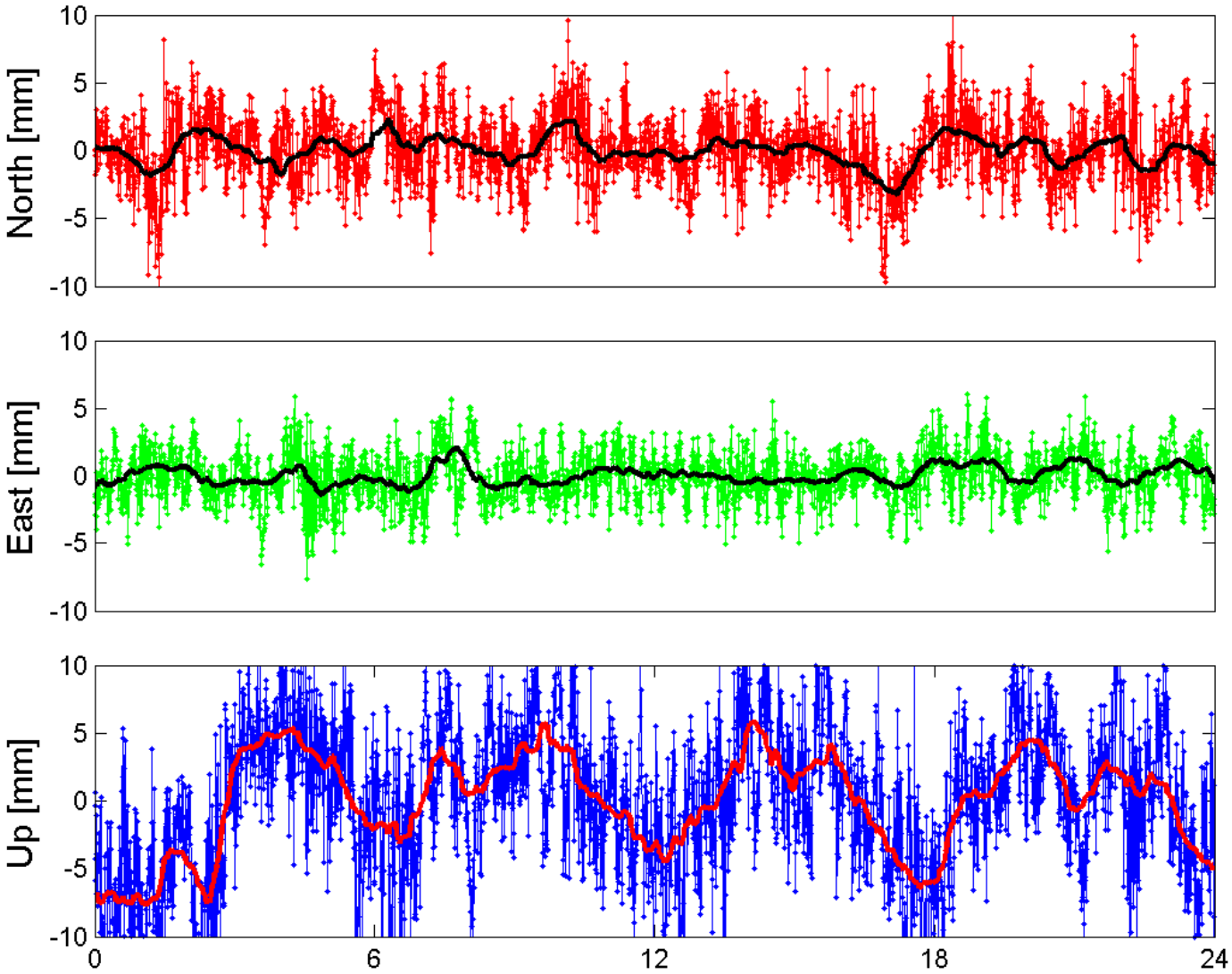
18 April 2010

Kinematic Solution: WTZR w.r.t. WTZA



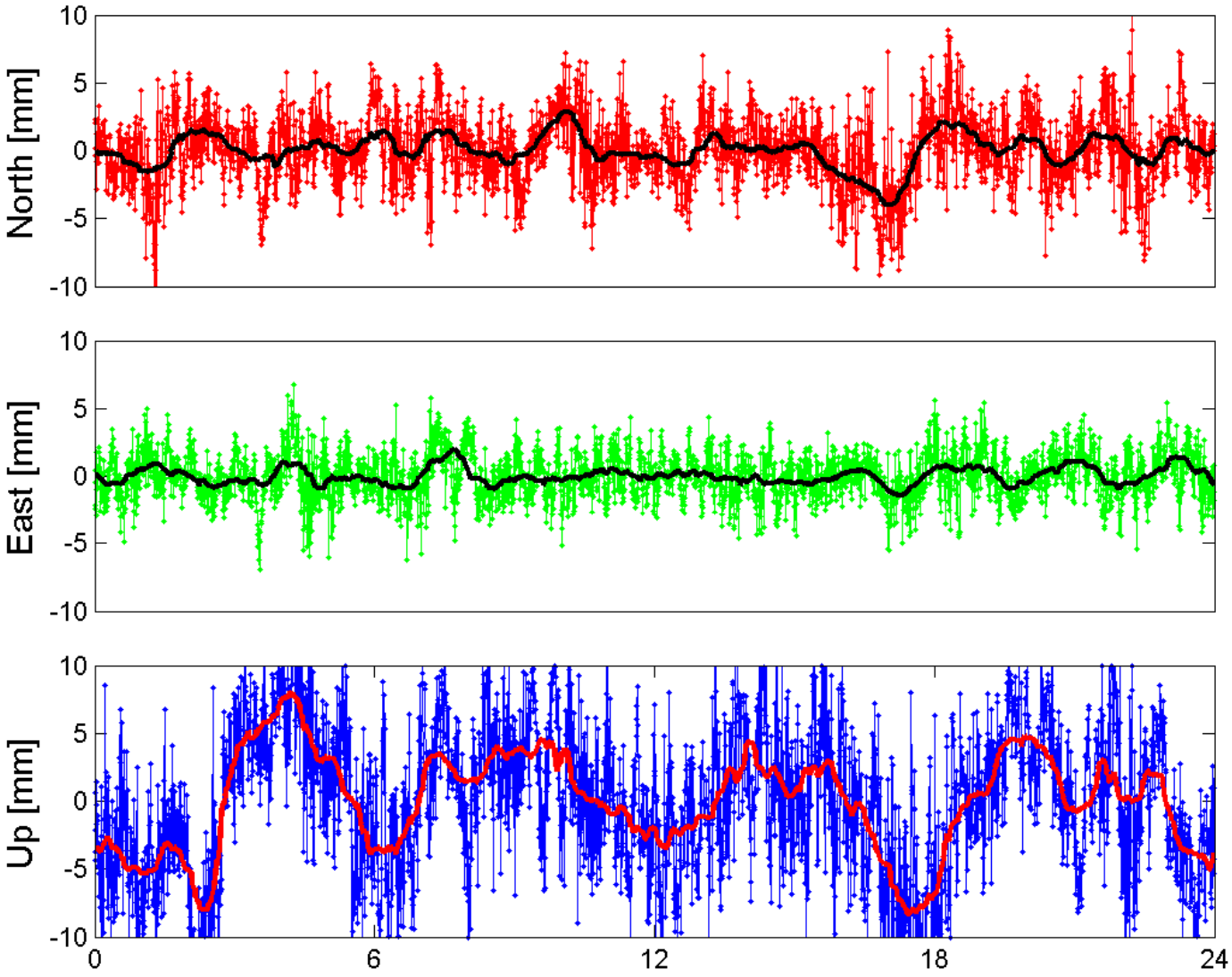
19 April 2010

Kinematic Solution: WTZR w.r.t. WTZA



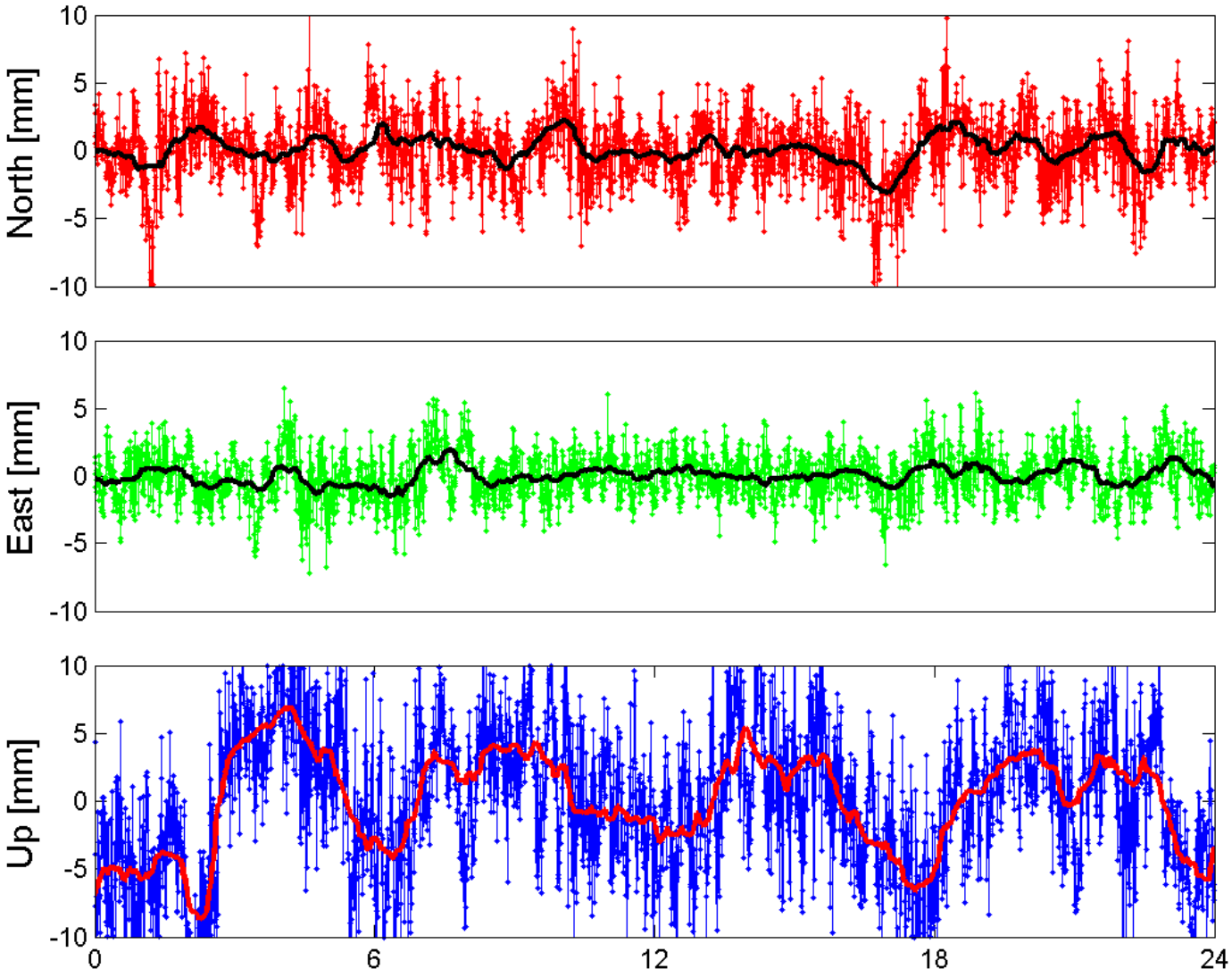
20 April 2010

Kinematic Solution: WTZR w.r.t. WTZA



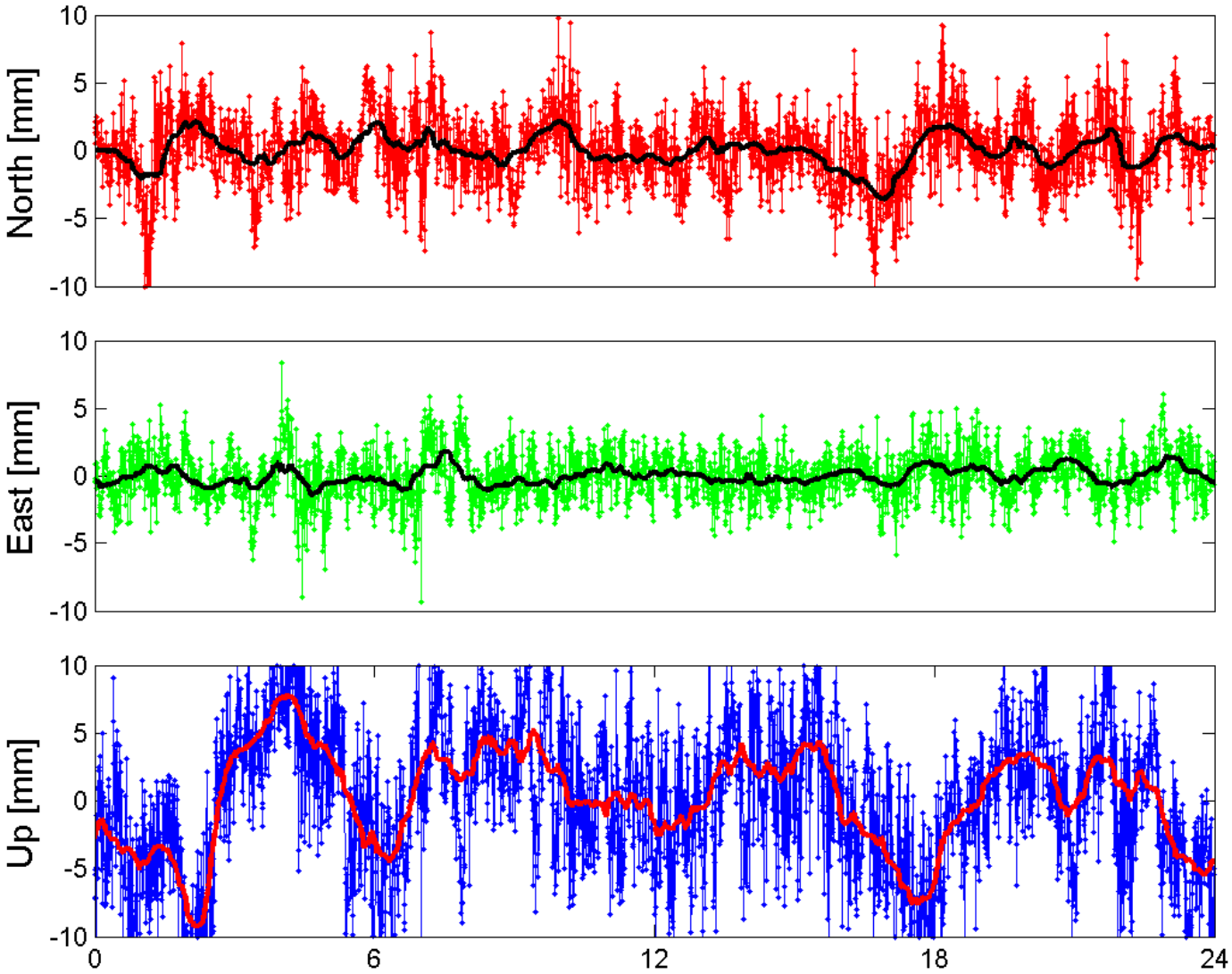
21 April 2010

Kinematic Solution: WTZR w.r.t. WTZA



22 April 2010

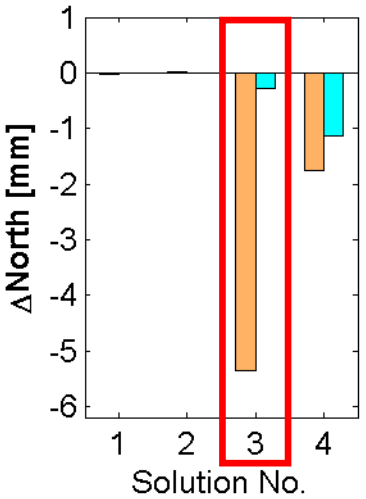
Kinematic Solution: WTZR w.r.t. WTZA

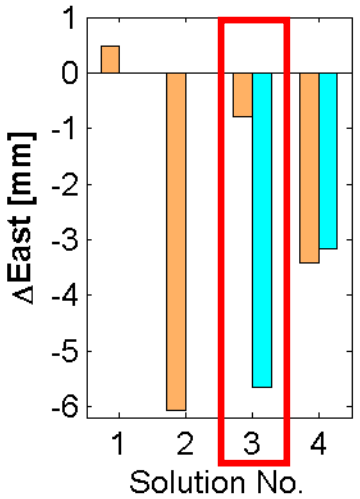


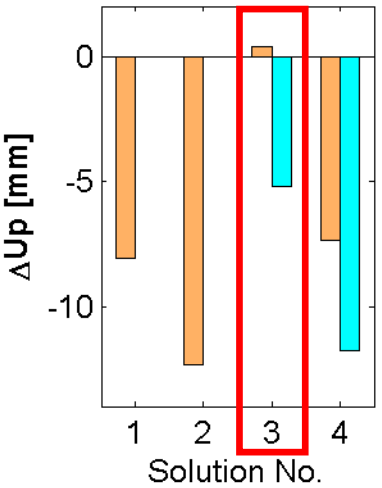
23 April 2010

Pattern shifted by 4 minutes per day due to multipath

Impact of Individual Antenna Calibrations: WTZJ



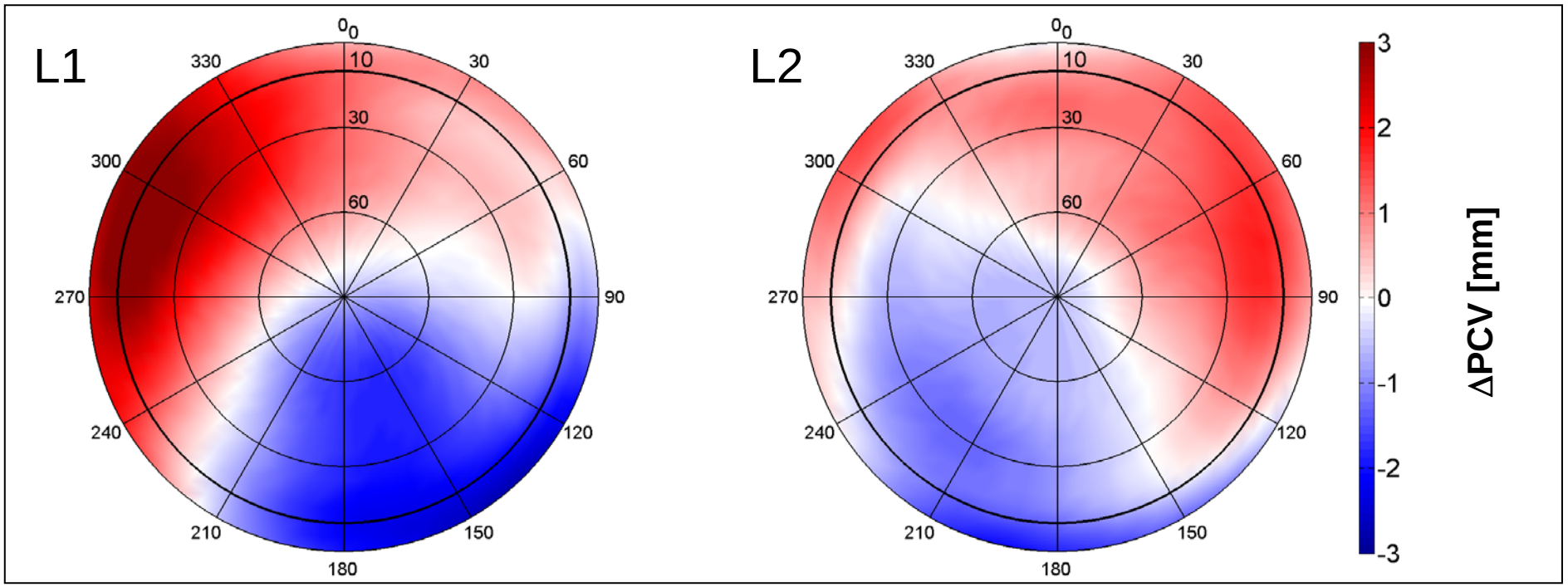




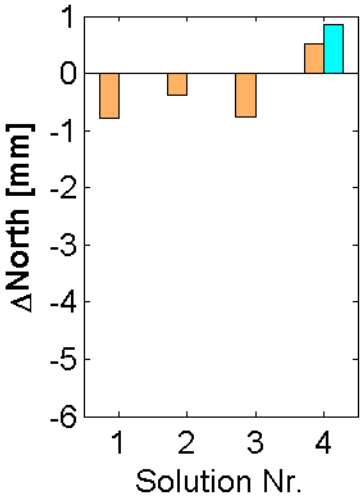
igs05.atx
Indiv. calibration

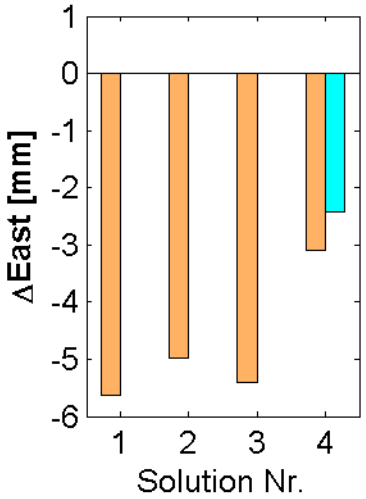
Solution No. 3

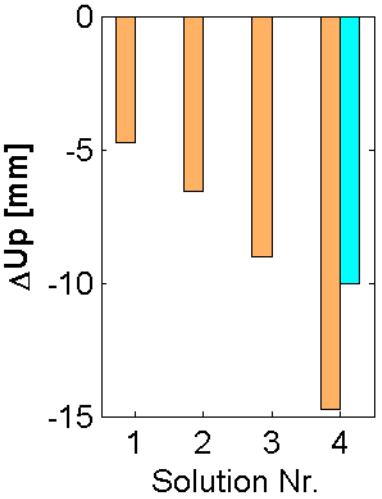
TRM29659.00 NONE



Impact of Individual Antenna Calibrations: WTZR



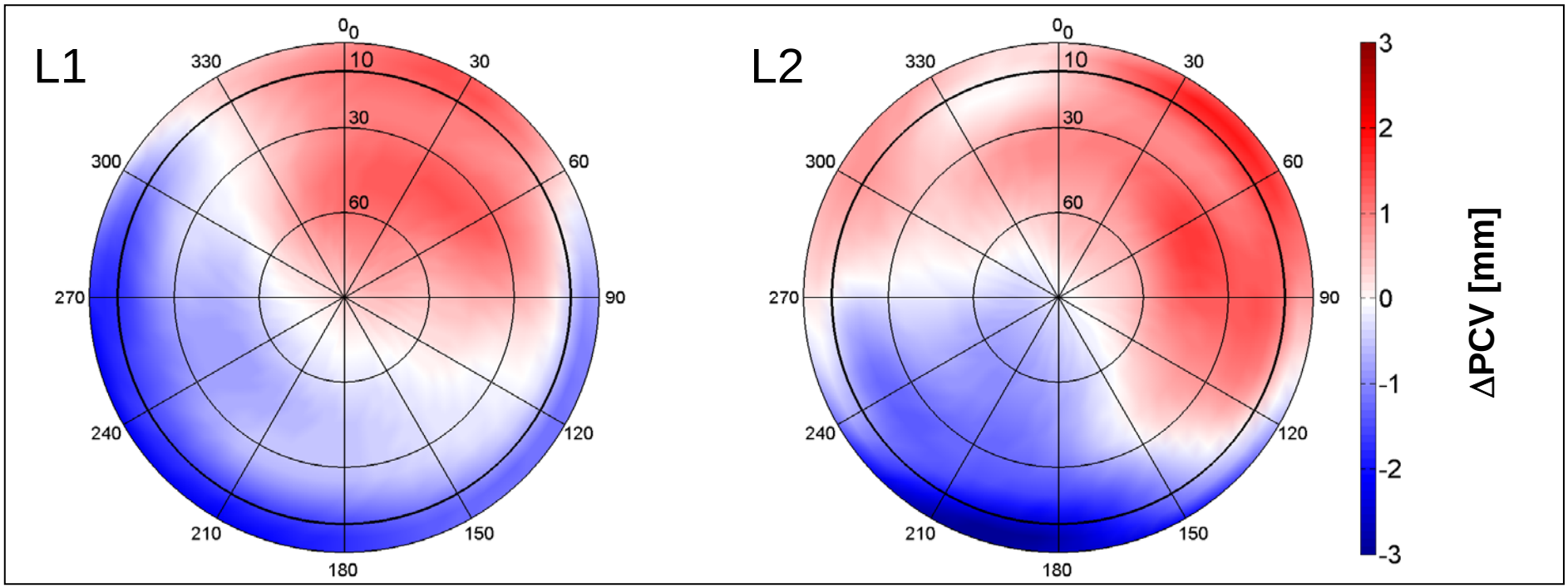




igs05.atx
Indiv. calibration

Solution No. 4

LEIAR25.R3 LEIT



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
- In particular L3 differences to local ties can reach cm level
- **Discrepancies** are **caused by GPS**, **not** the **local tie measurements**
- **Multipath** can clearly be seen in kinematic coordinate solutions
- Multipath is most probably causing the frequency-dependent biases
- **Worst case** scenario: **uncalibrated radome**
- **Individual antenna calibrations** can change estimated station positions by several mm but no clear improvement compared to type-mean calibrations
- Testing new locations for the permanent GNSS stations
- Further analysis: residual maps, troposphere, …

Thank you for your attention.