Geocenter coordinates from SLR and combined GNSS-SLR analysis

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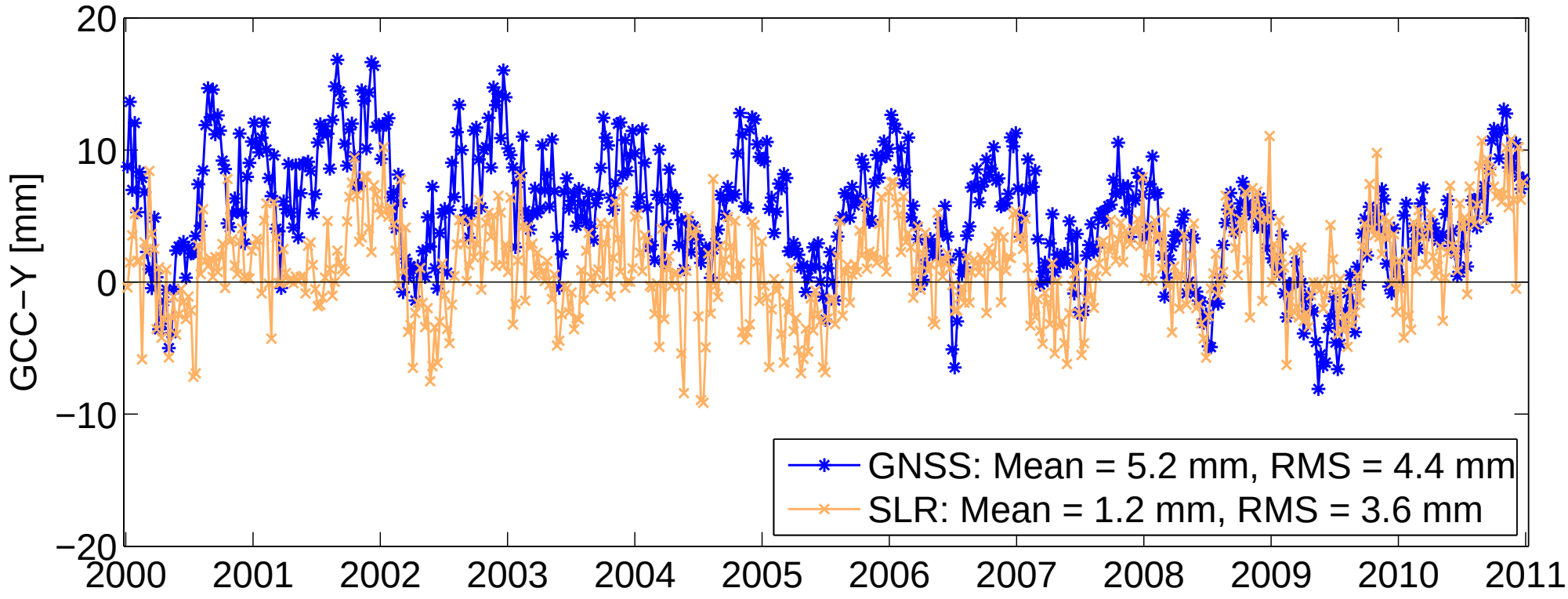
Overview

- Geocenter from single-technique solutions:
  - Comparison of GNSS and SLR
- Geocenter from combined GNSS-SLR solutions:
  - Impact of weighting
  - Impact of range biases
  - Impact of microwave antenna offsets (SAO) and laser array offsets (LRA)
  - Impact of orbit parameterization
- Conclusions

SLR-only and GNSS-only geocenter series

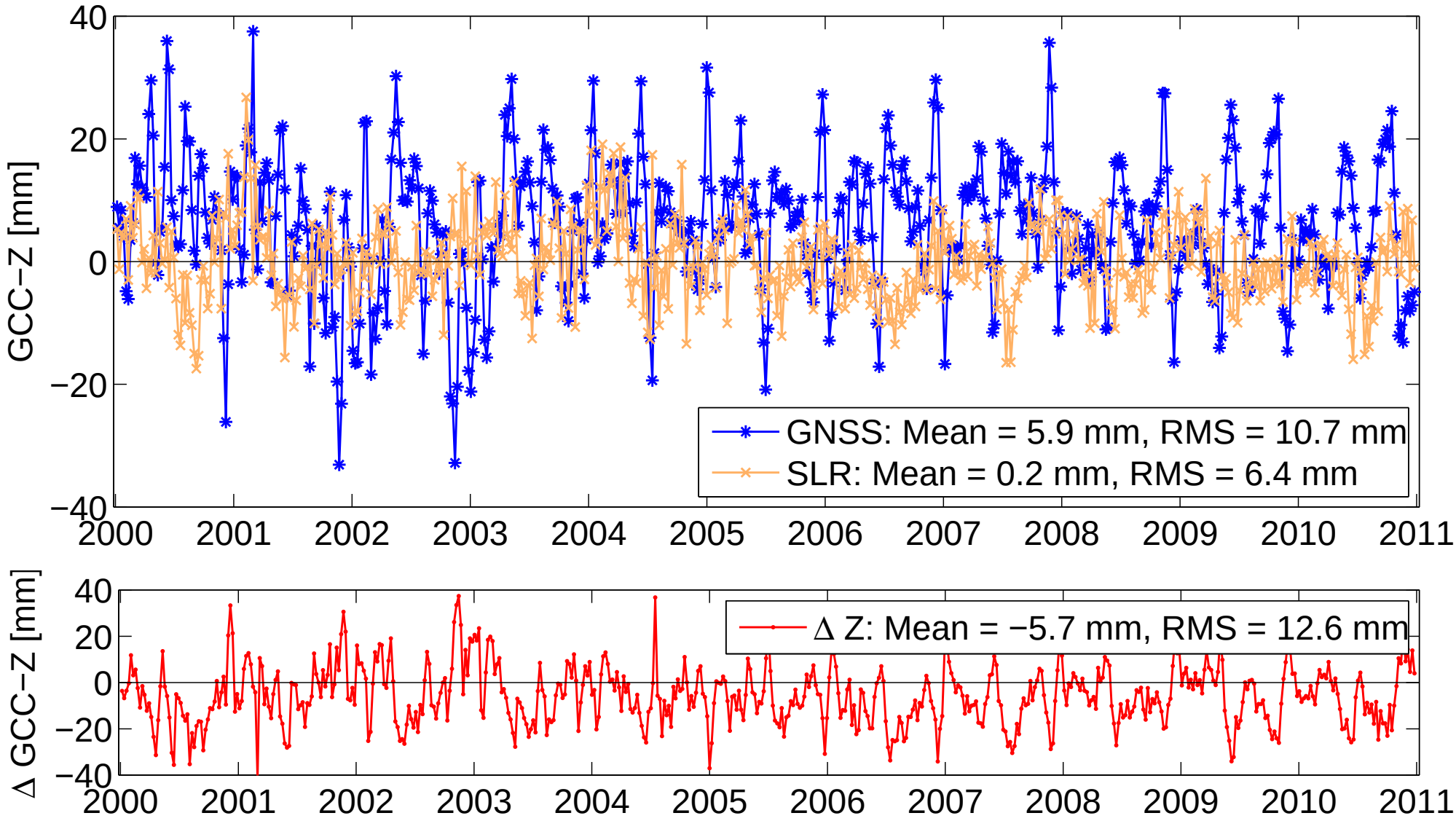
Weekly GNSS: CODE reprocessing using IGS08 (TRF, antenna model)

Weekly SLR: Computed at AIUB, based on LAGEOS satellites



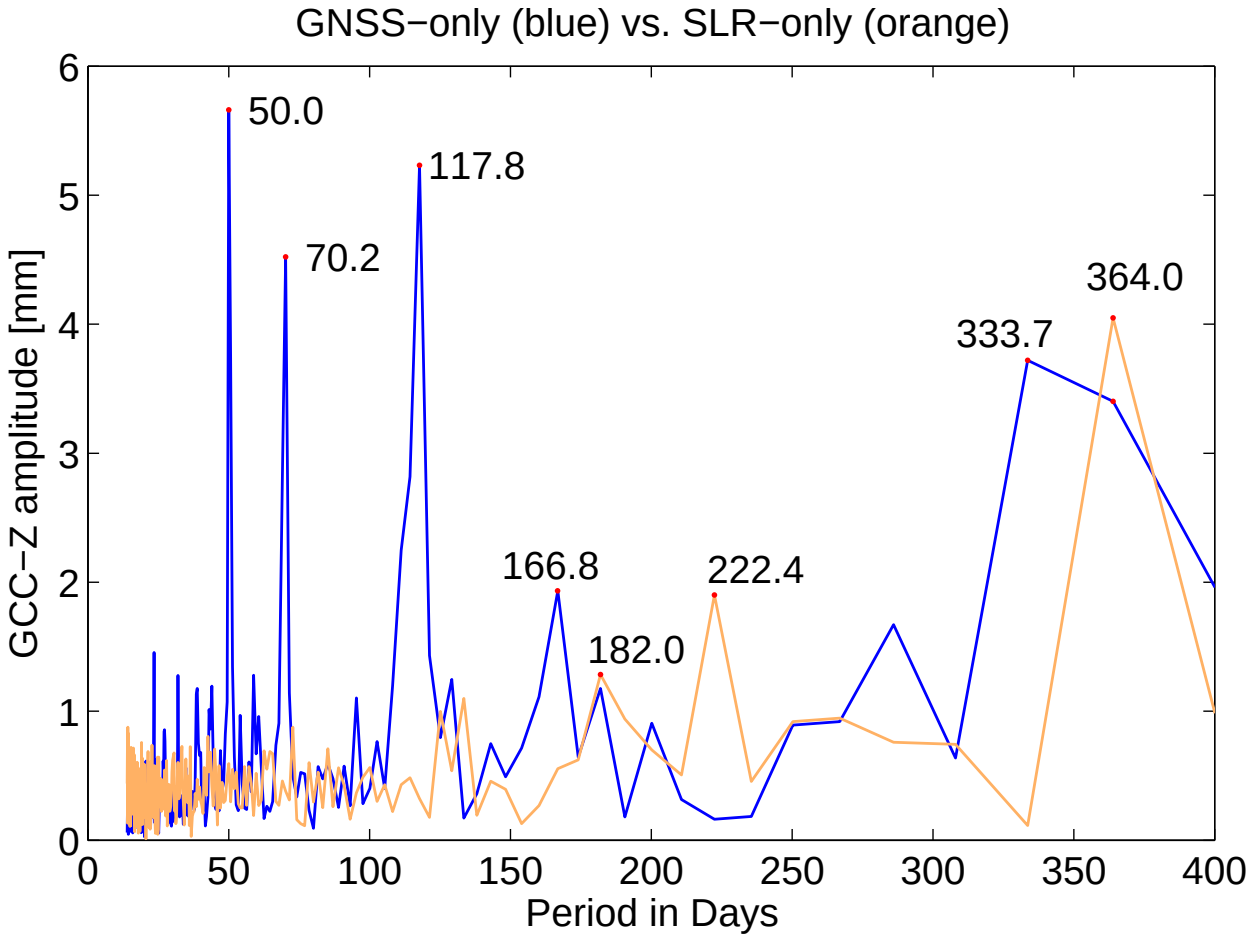
- Comparable series from GNSS and SLR (except for shift: 4 mm)

SLR-only and GNSS-only geocenter series



- SLR shows clearly fewer variations than GNSS

SLR-only and GNSS-only geocenter series



GNSS-only
7-day solutions

SLR-only
7-day solutions

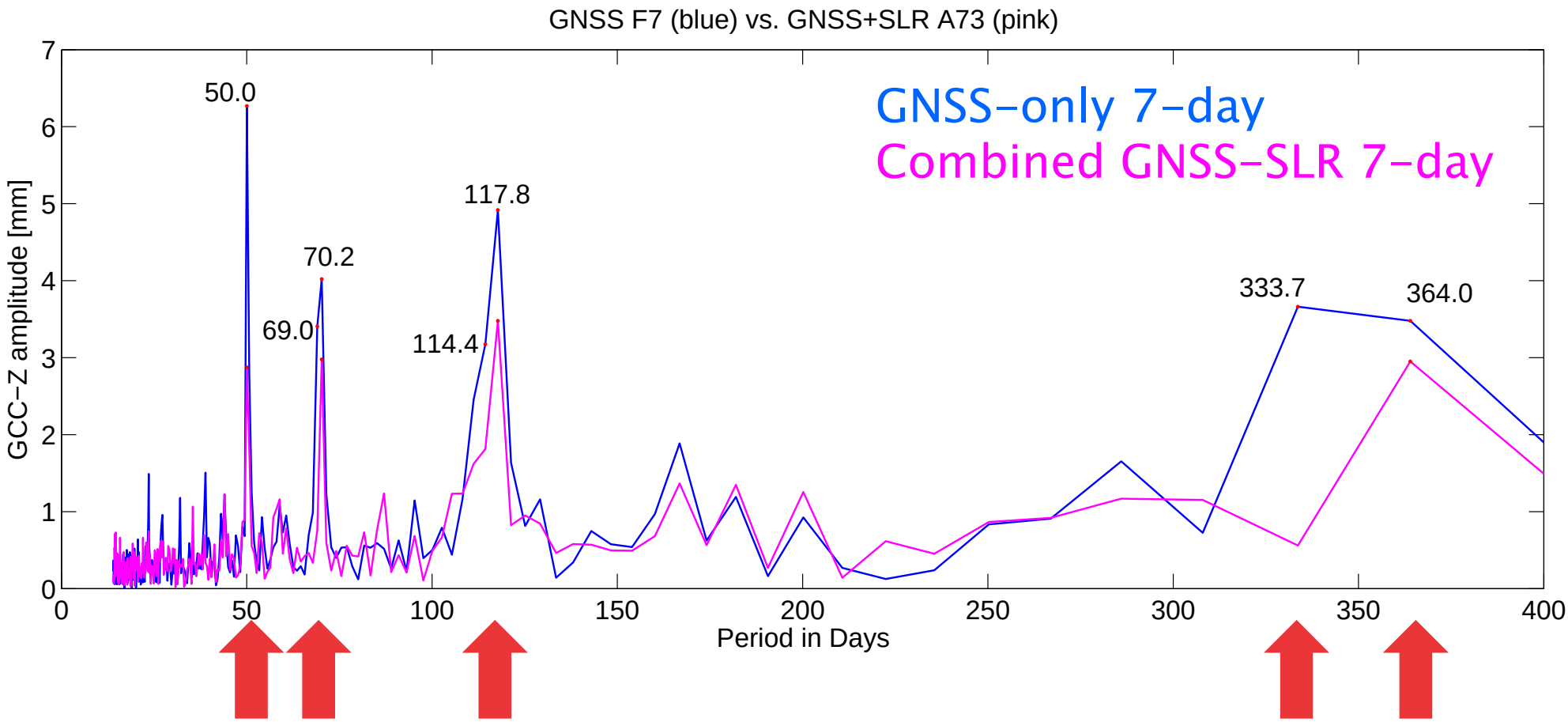
- Draconitic year is clearly visible: GNSS = 352 d, LAG-2 = 222 d
- Annual and draconitic signal are not distinguishable for GNSS
- Big amplitudes at harmonics of draconitic year for GNSS

Combined GNSS-SLR solutions

- Microwave observations to GPS / GLONASS
- SLR observations to GPS / GLONASS
- SLR observations to LAGEOS

- Connection of SLR and GNSS at the GPS / GLONASS satellites („satellite co-location“)
- No local ties applied

Combined geocenter



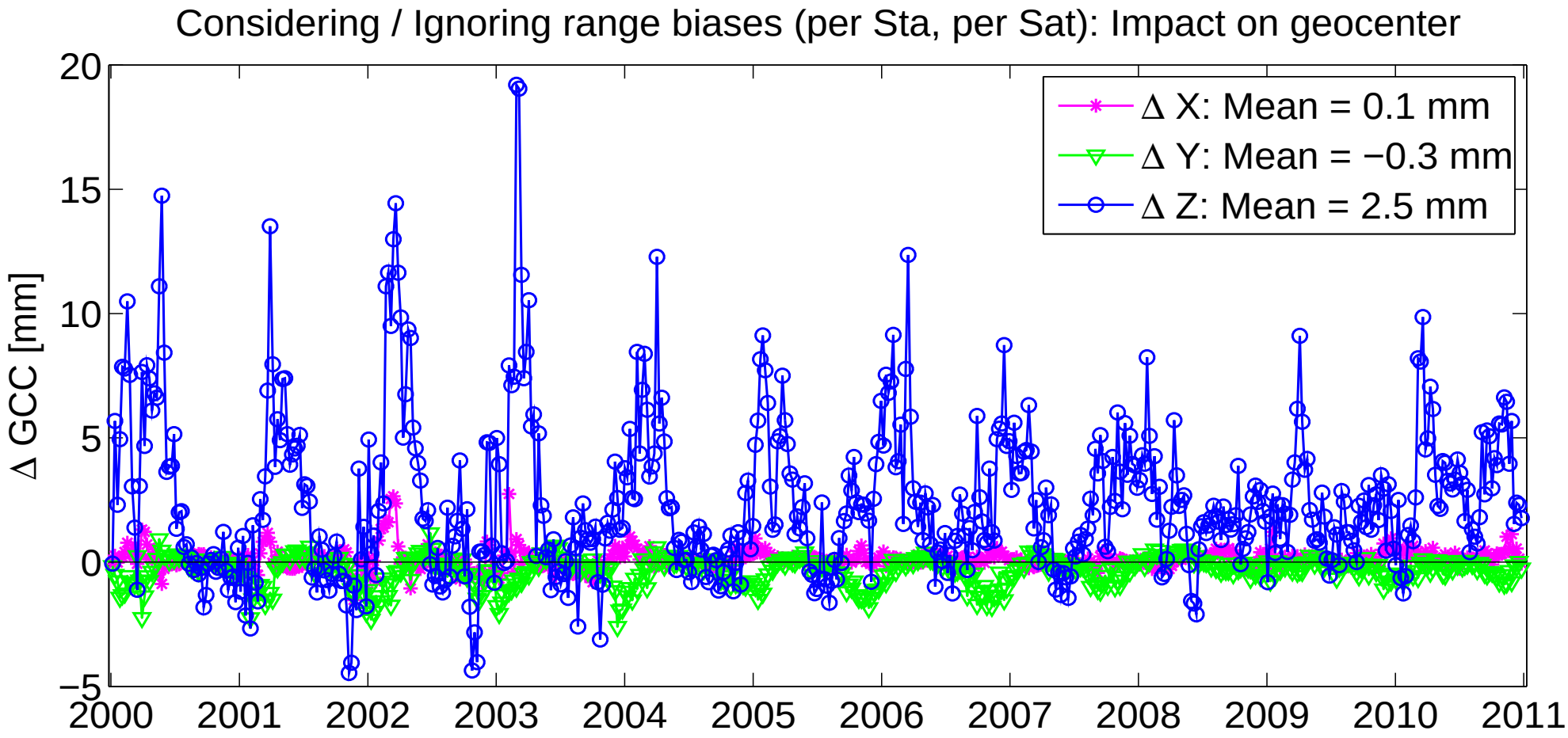
- Annual signal remains; draconitic GNSS signal vanishes
- Harmonics of draconitic GNSS year are reduced but not eliminated

Combined geocenter: Impact of weighting

	$\frac{\sigma_{SLR\_LAG}}{\sigma_{GNSS}}$	$\frac{\sigma_{SLR@GNSS}}{\sigma_{GNSS}}$	Mean X	Y	Z	RMS X	Y	Z
A	1	1	3.7	4.9	5.0	3.9	5.0	7.6
B	10	10	3.7	4.9	3.8	3.9	4.9	7.9
C	0.1	0.1	4.1	4.8	6.8	4.9	5.8	11.7
D	1	10	4.2	5.0	3.8	4.3	5.4	8.2
GNSS-only series			4.6	5.2	5.9	3.5	4.4	10.7
SLR-only series			1.0	1.2	0.2	4.1	3.6	6.4

- Higher weight for SLR data (solution C) degrades the solution
- All other combinations show improvement w.r.t. GNSS-only
- Down-weighting SLR@GNSS data (B or D) not necessarily needed

Combined geocenter: Impact of RGB

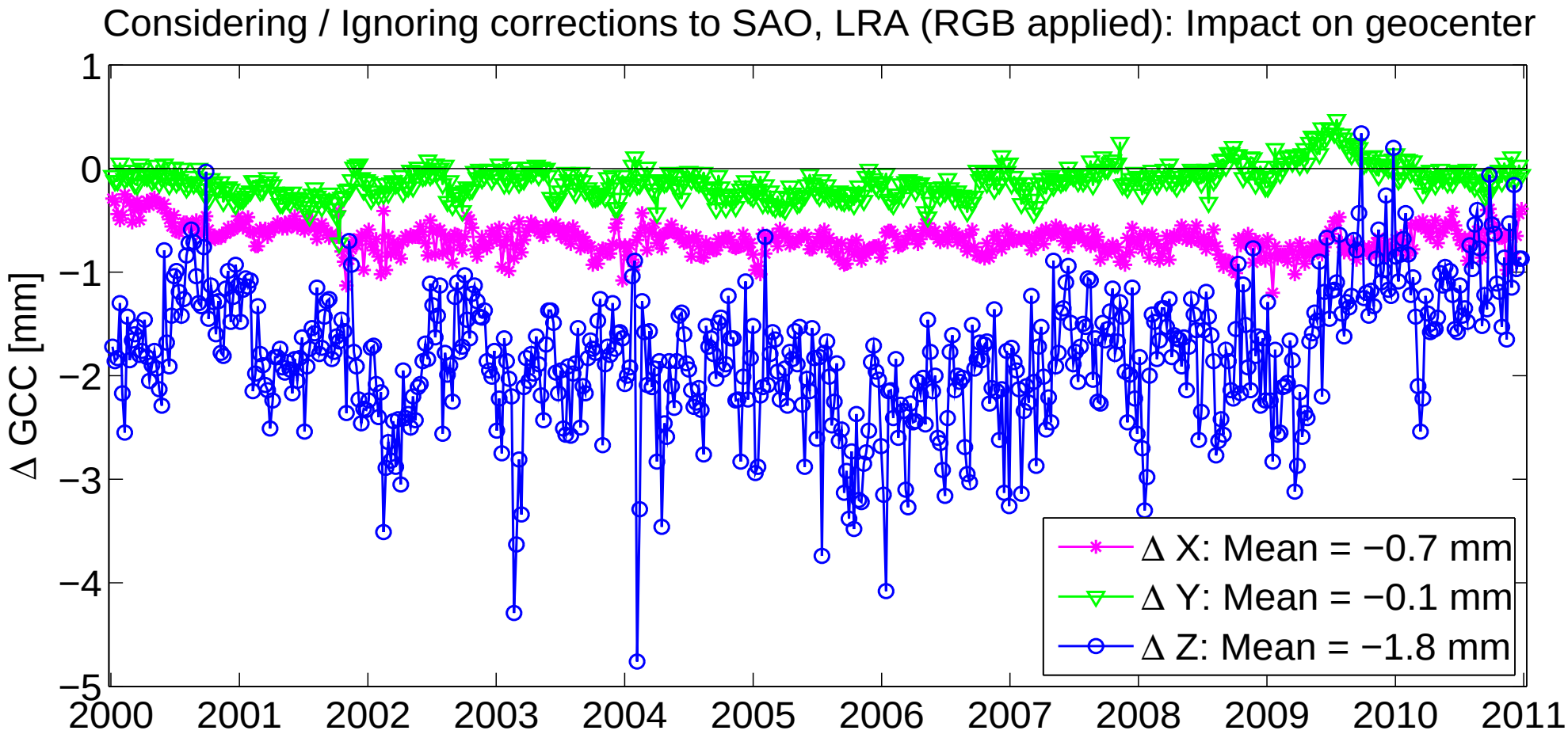


Comb 1: No range bias considered

Comb 2: Range bias per station, per satellite considered

⇒ Bias and annual signal (mainly in z-component): several mm

Combined geocenter: Impact of SAO, LRA



Comb 1: Range bias per station, per satellite considered

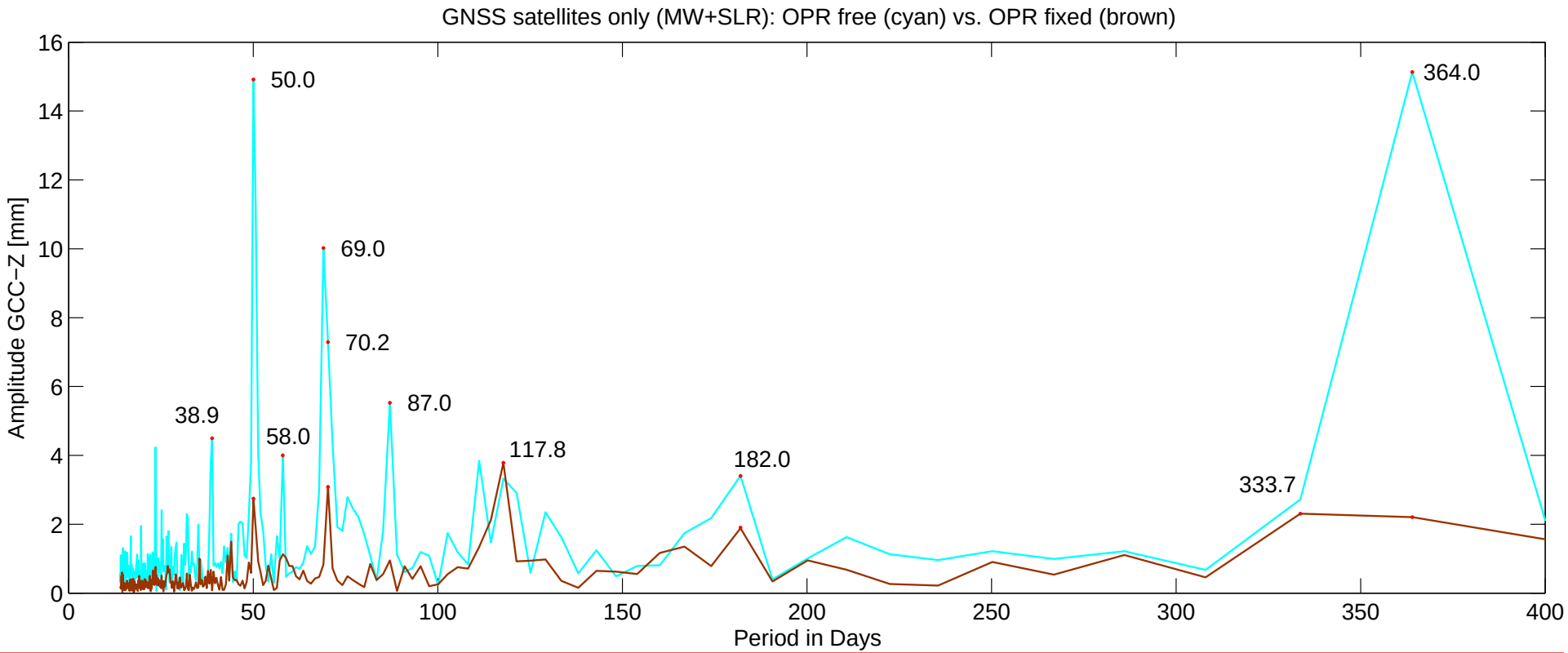
Comb 2: RGB, SAO, LRA corrections considered

⇒ Bias at mm-level (mainly in z-component)

Impact of orbit constraints

GNSS satellites only:

- Test solution: OPR parameters D, Y, X un-constrained
- «Standard» solution due to correlations with geocenter: Once-per-Rev (OPR) parameters D, Y fixed

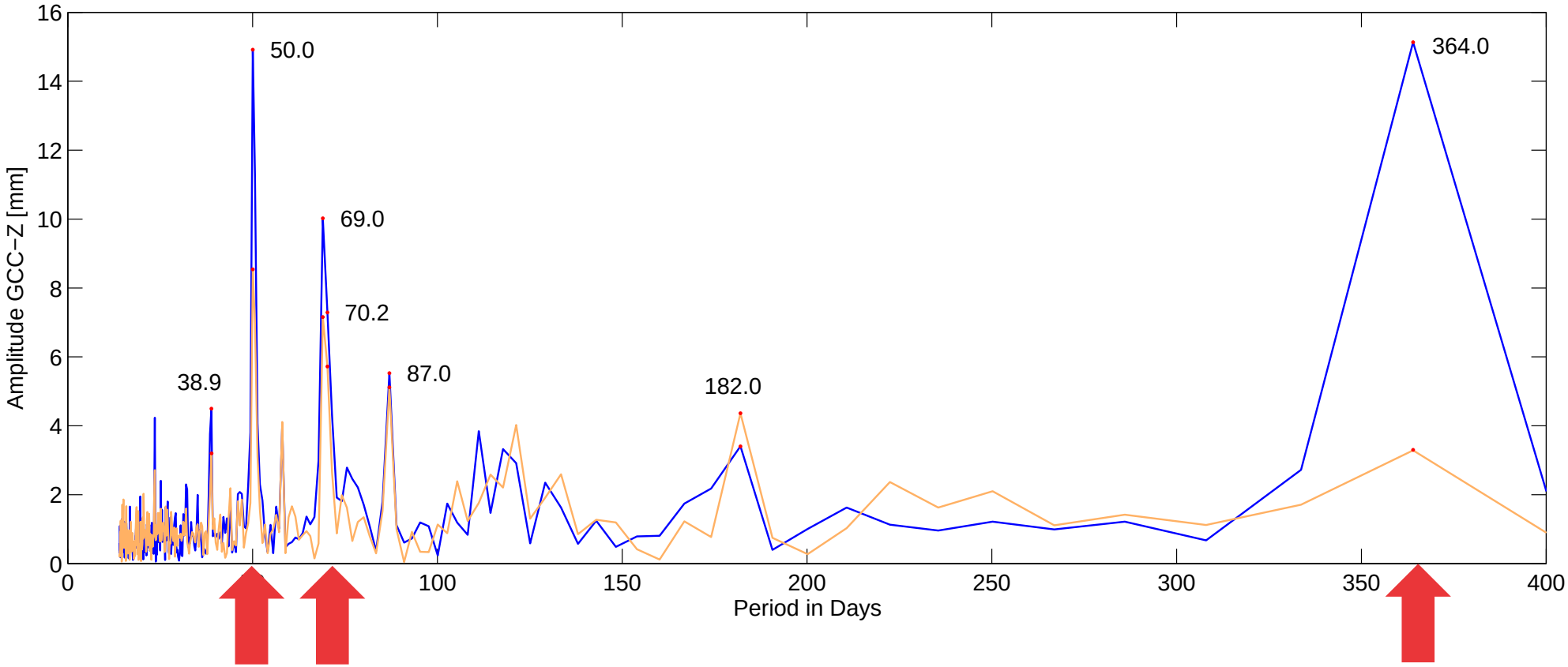


Impact of orbit constraints

Combined GNSS-SLR solution: OPR parameters un-constrained

GNSS satellites only

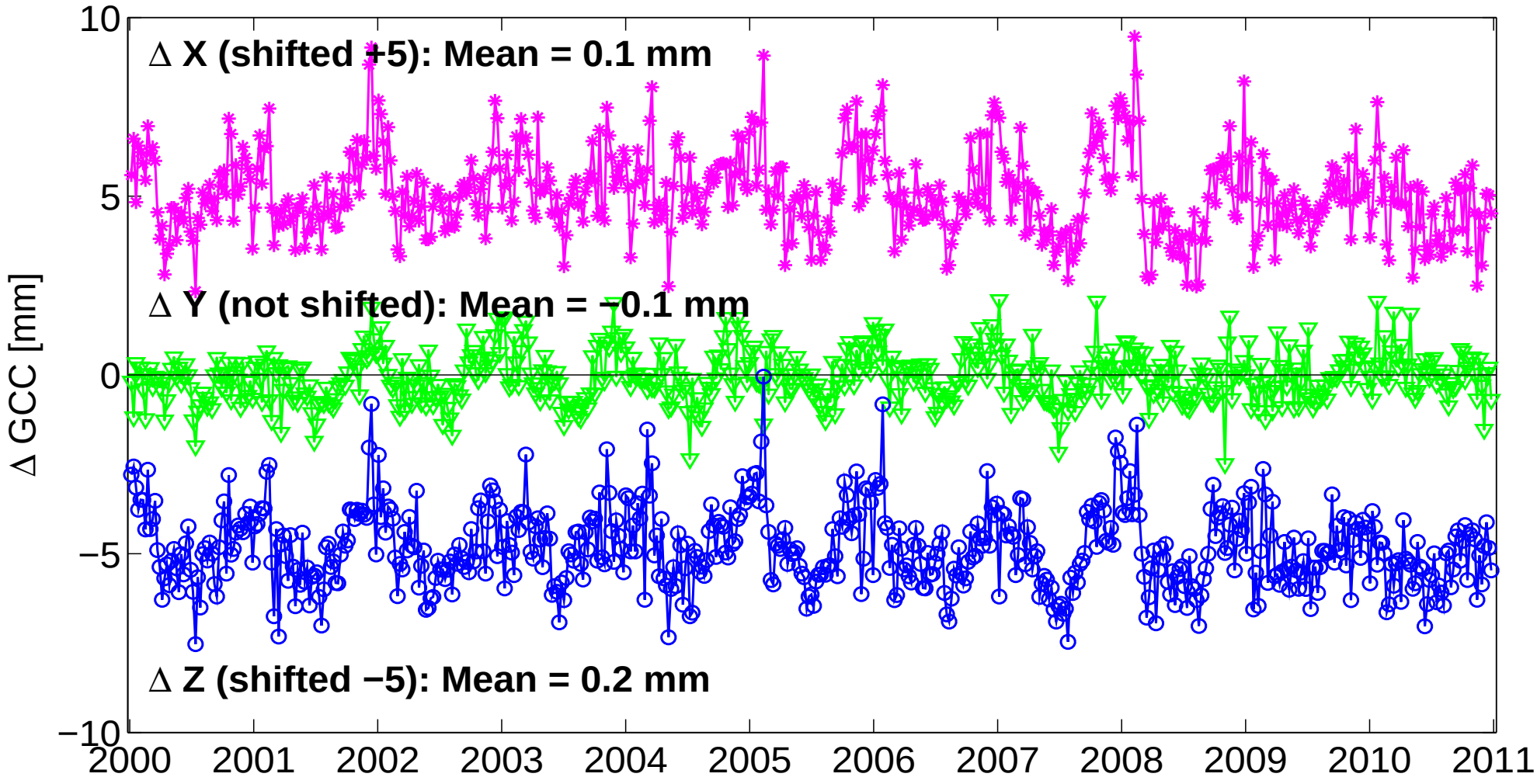
Combined GNSS+SLR (including LAGEOS satellites)



Conclusions

- SLR geocenter series are very clean for all 3 components
- GNSS geocenter series for X-, Y-component are very clean
- GNSS geocenter series for Z-component shows artifacts at periods related to the draconitic year
- These artifacts are reduced in combined GNSS-SLR solutions, but 3rd, 5th, 7th harmonics are still present
- Ignoring range biases and antenna offset corrections generates a shift and annual variations in Z-component of ~4 mm (partly also in Y-component)
- The negative impact of OPR parameters on geocenter cannot be fully avoided by the inclusion of SLR data

Impact of atmospheric loading



⇒ *See poster presentation by Sośnica et al.: Impact of atmospheric loading corrections on SLR and the consistency between GNSS and SLR solutions. Session G2.1, Thursday*