DGFI part of project PN 5
Status report

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DFG Forschergruppe Referenzsysteme

DGFI

CGE Centre of Geodetic Earth System Research

Work packages and schedule

Work Packages	1st Project Year				2nd Project Year				3rd Project Year			
	I	II	III	IV	I	II	III	IV	I	II	III	IV
WP5300	***Development of refined combination strategies (NEQ level)***											
WP5310									Long-term comb.			
WP5320									Non-linear motions			
WP5330									Epoch combination			
WP5400	***Homogeneously processed observation time series***											
WP5410											Definition	
WP5420											VLBI	
WP5430											SLR	
WP5600	***Computation of long-term (LRF) and epoch reference frames (ERF)***											
WP5610											LRF	
WP5620											ERF	
WP5700	***Analysis and interpretation of results***											
WP5700												

GPS solutions

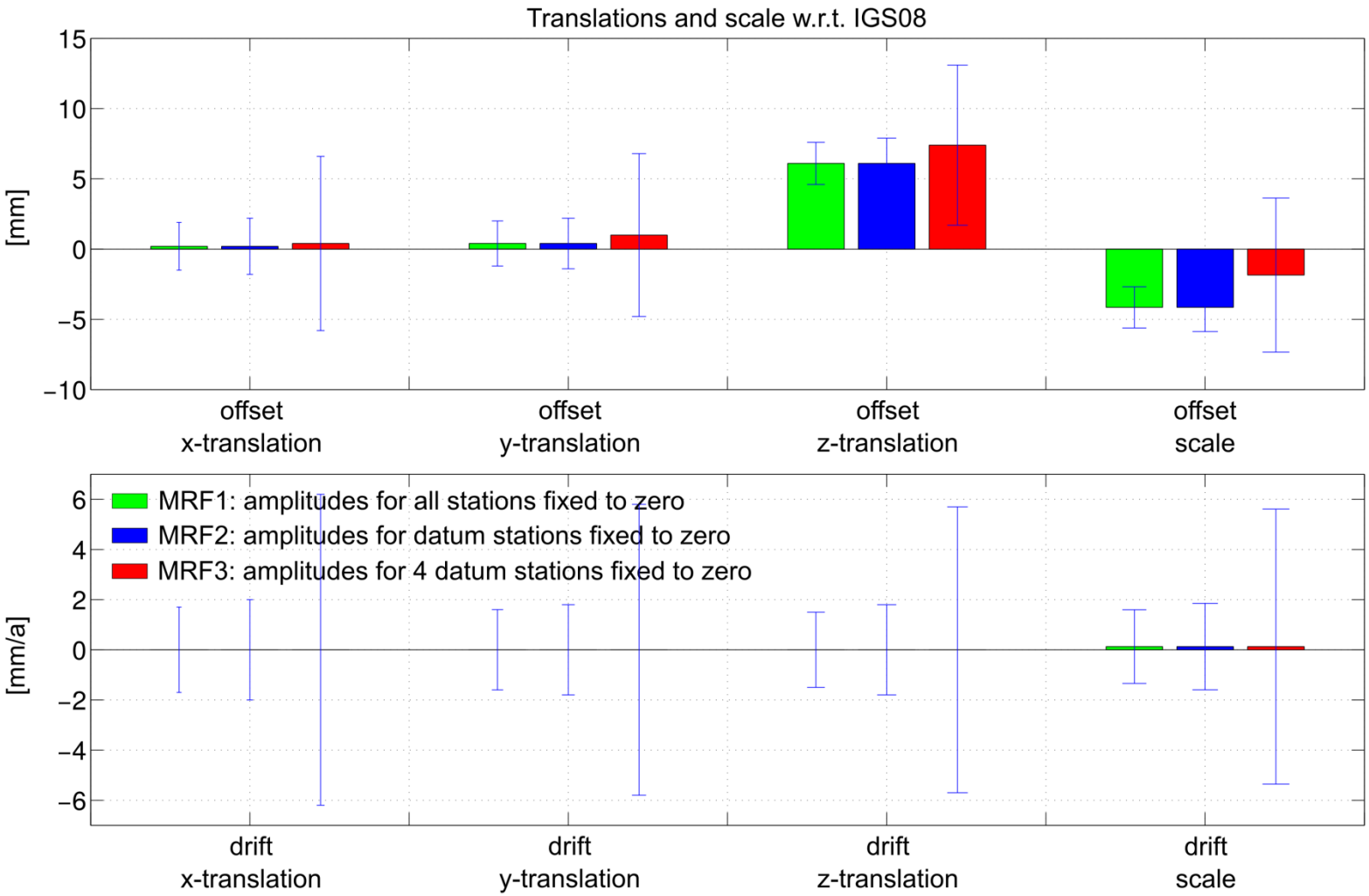
- time span: 5 years (2006.0 until 2011.0)
- stations: more than 300 (66 datum stations)
- estimated: station coordinates, velocities and **sine/cosine amplitudes** (see below!), pole coordinates
- datum realized via NNR/NNT/NNS conditions w.r.t. IGS08
- different types:
  - **daily**/epoch solutions
  - **multi-year** solutions (MRFs):
    - zero amplitudes for all stations (standard solution)
    - zero amplitudes for datum stations, non-zero for others
    - zero amplitudes for only 4/3/2 datum stations (globally distributed)
    - *non-zero amplitudes for all stations*

Datum defect due to seasonal station variations

No. of stations with amplitudes fixed to zero	RMS of the transformation w.r.t. IGS08
> 300	8.8 mm
> 60	10.3 mm
4	32.6 mm
3	33.5 mm
2	**334.2 mm**

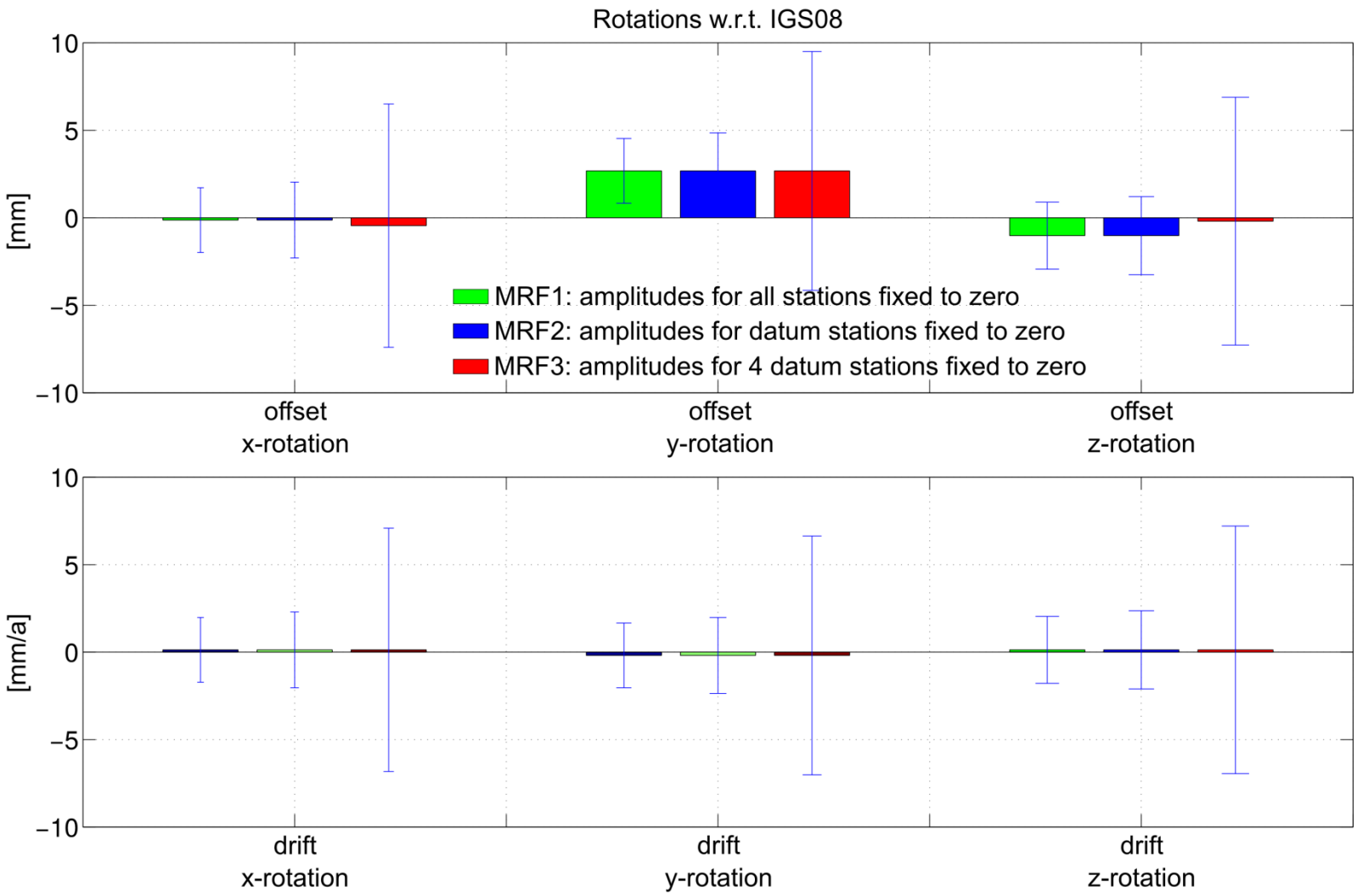
No datum defect, if at least 3 stations are prevented from seasonal variations

Validation of the multi-year solutions w.r.t. IGS08 (1)



Increasing standard deviations with increasing number of datum stations varying seasonally

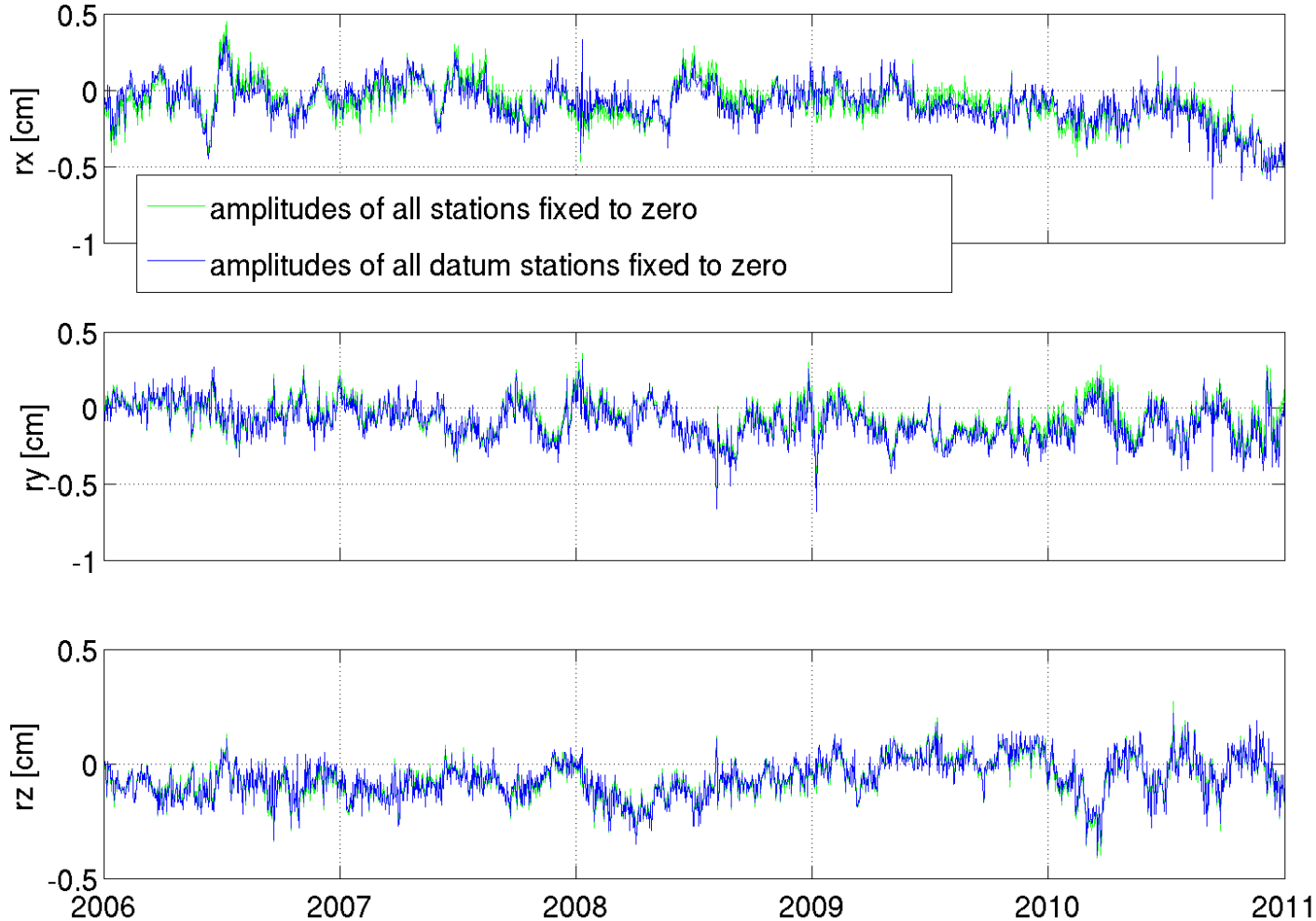
Validation of the multi-year solutions w.r.t. IGS08 (2)



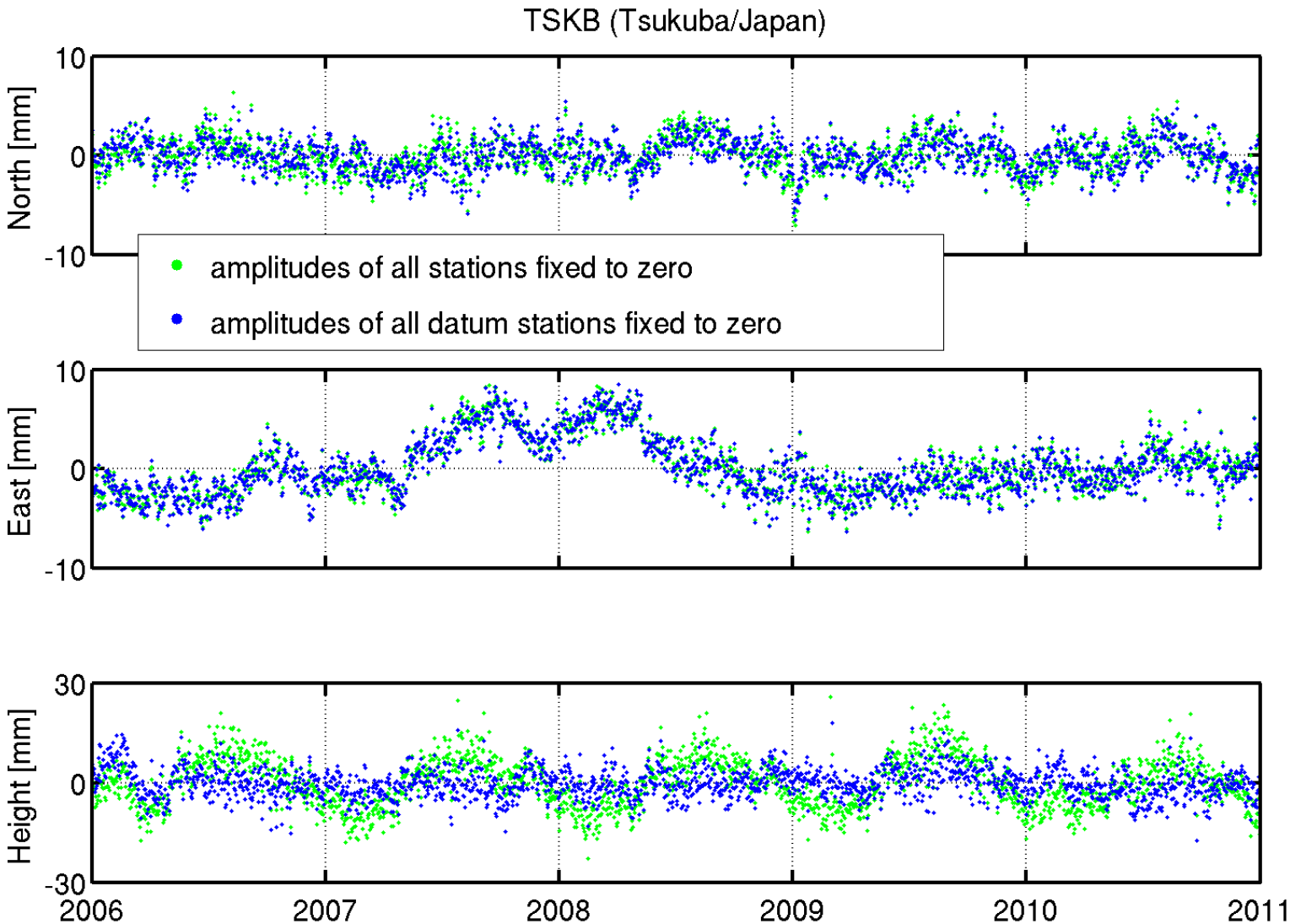
Datum of multi-year solutions comparable to IGS08

Validation of the multi-year w.r.t. epoch solutions

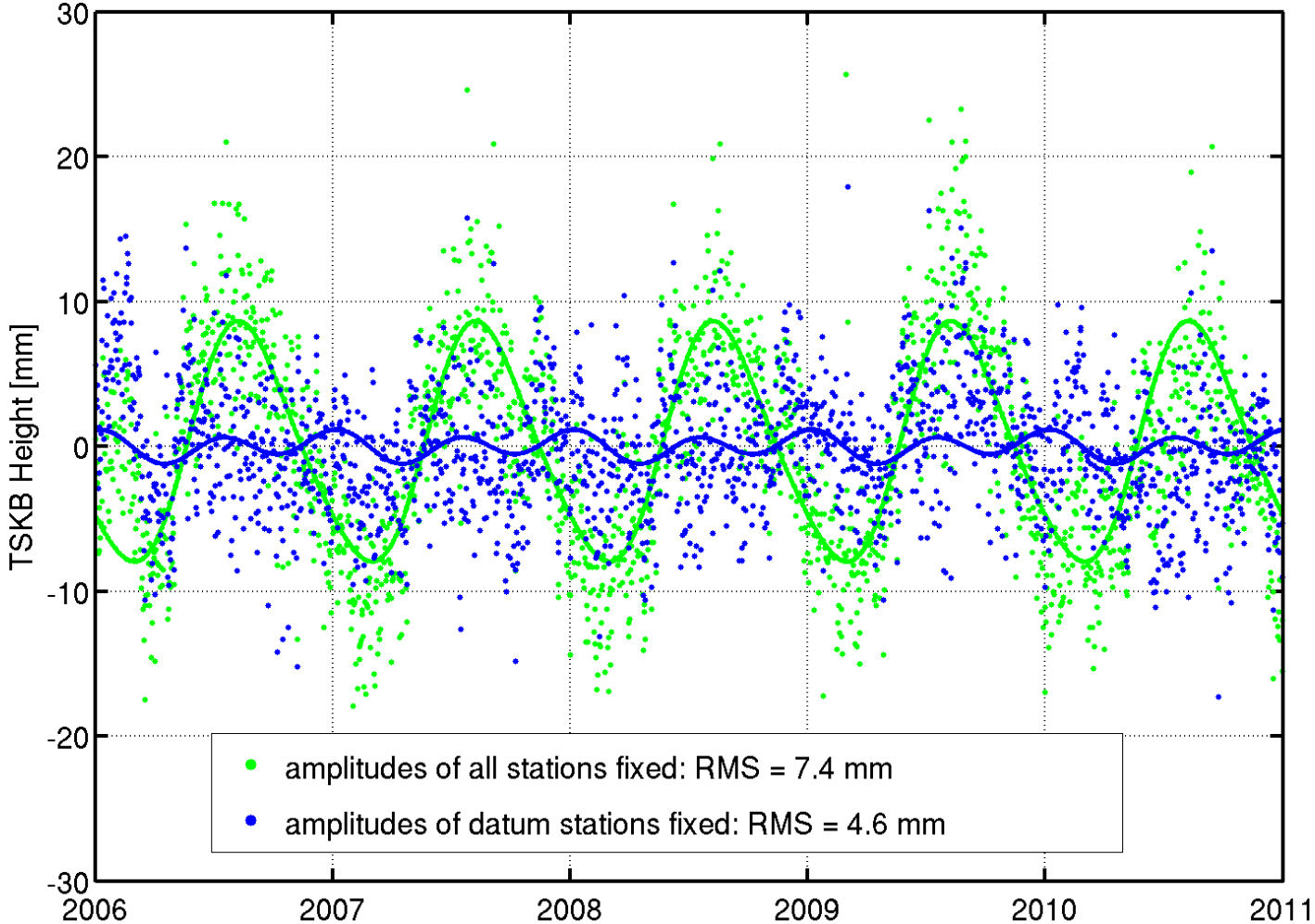
Epoch-wise rotation parameters w.r.t. two different multi-year solutions:



Impact of seasonal variations on station residuals (1)

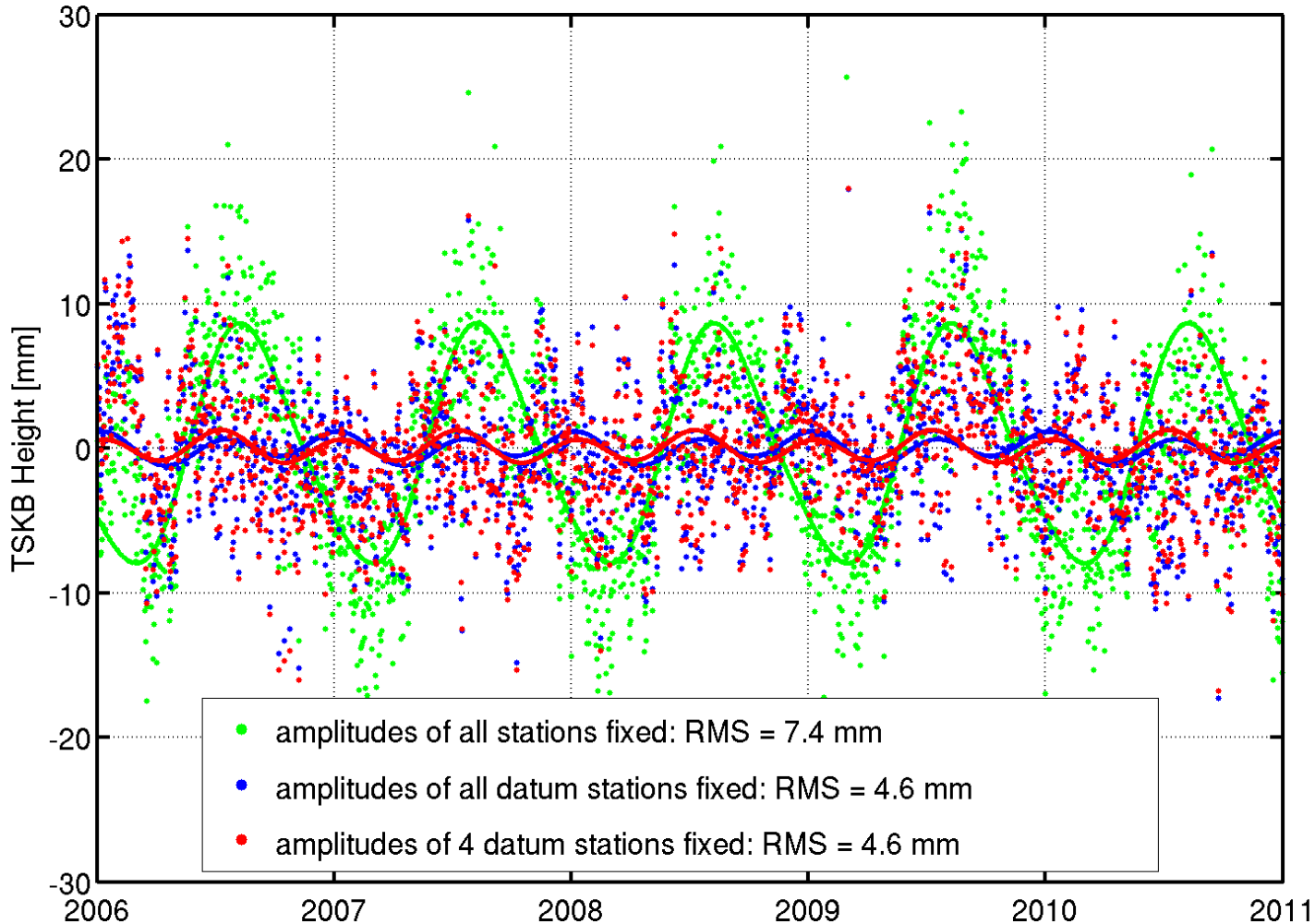


Impact of seasonal variations on station residuals (2)



Semiannual signal remains (not yet estimated with DOGS-CS)

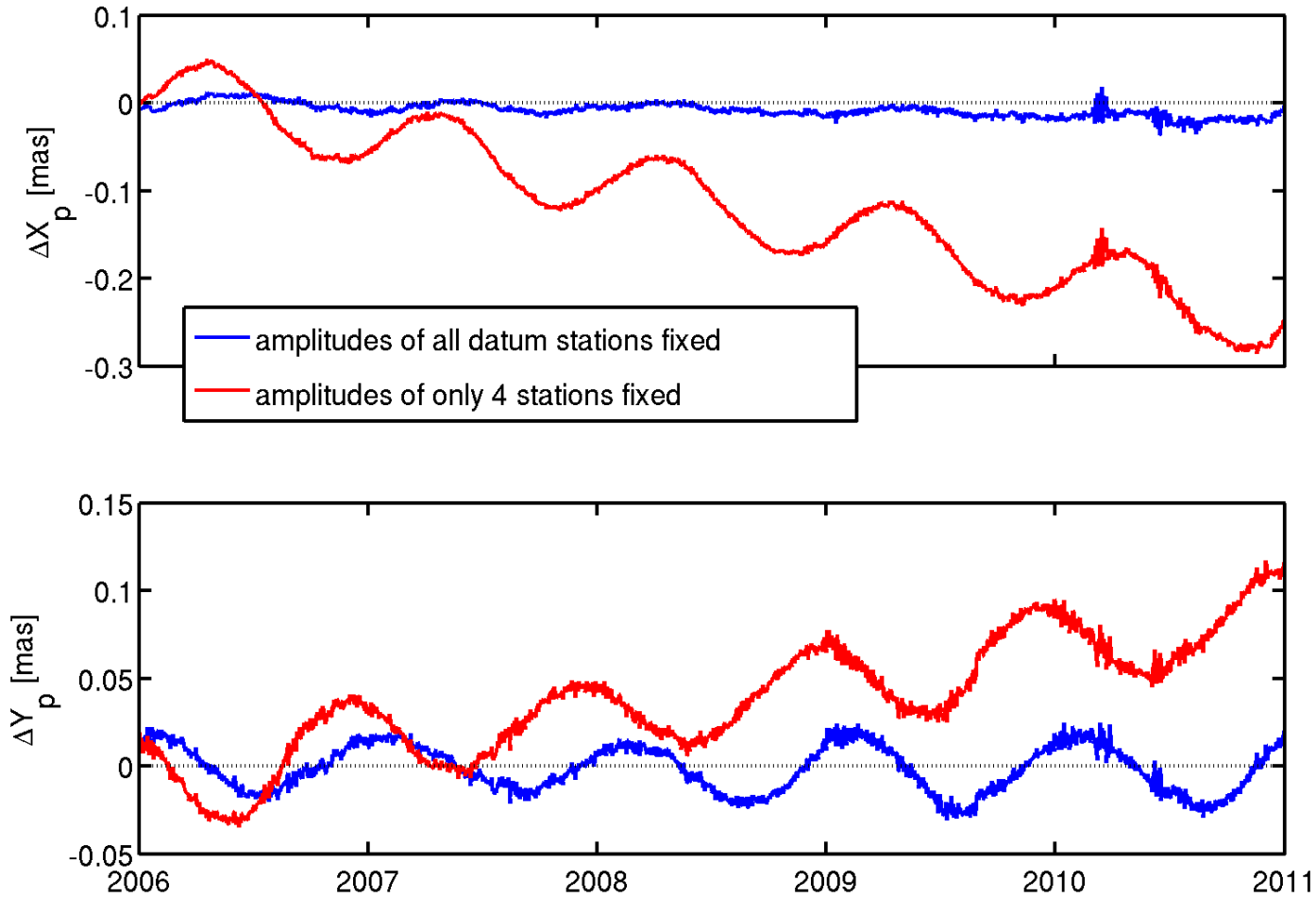
Impact of seasonal variations on station residuals (3)



Similar results, if seasonal variations allowed for more stations

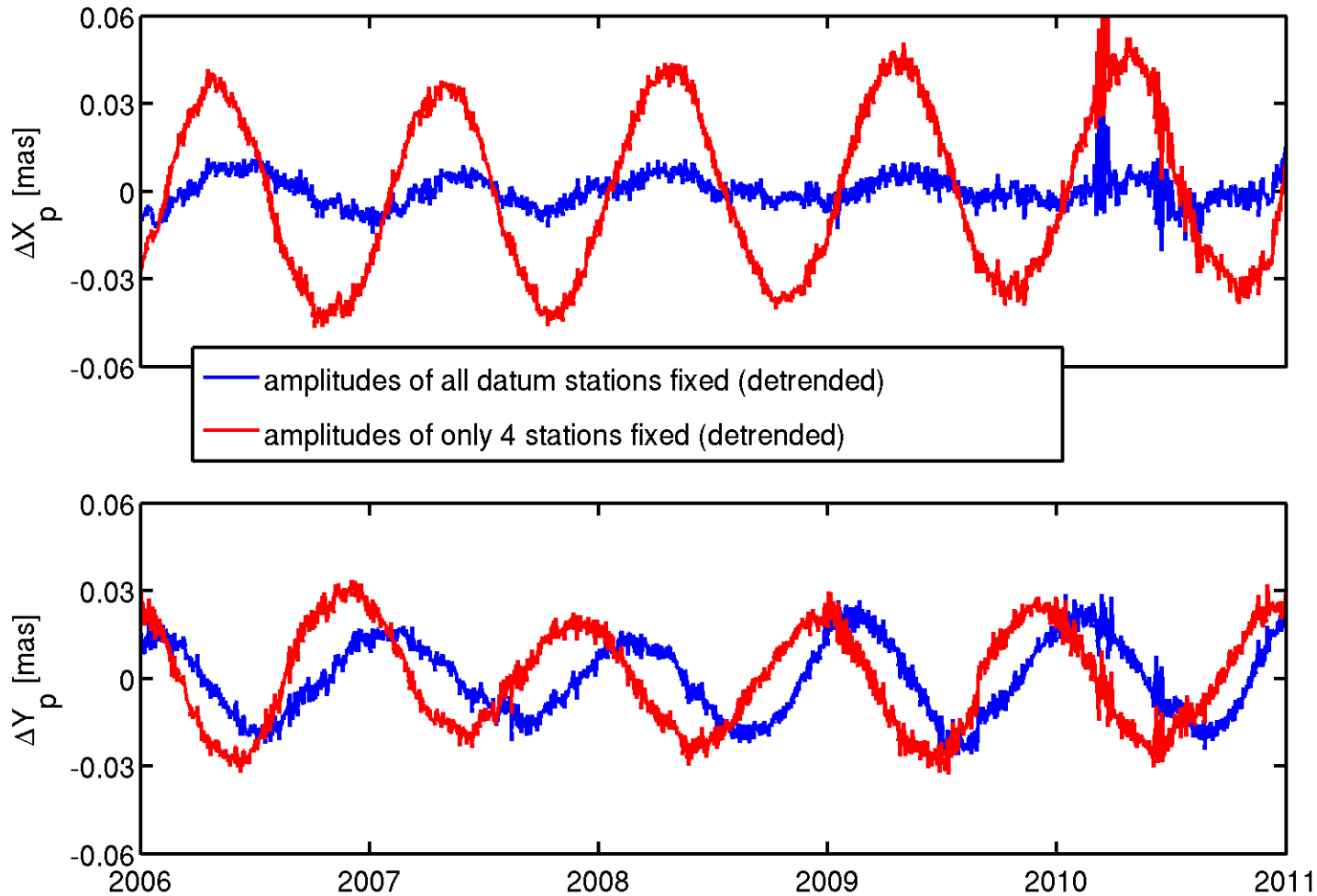
Impact of seasonal variations on pole coordinates (1)

ERP differences w.r.t. standard solution (w/o annual signals):



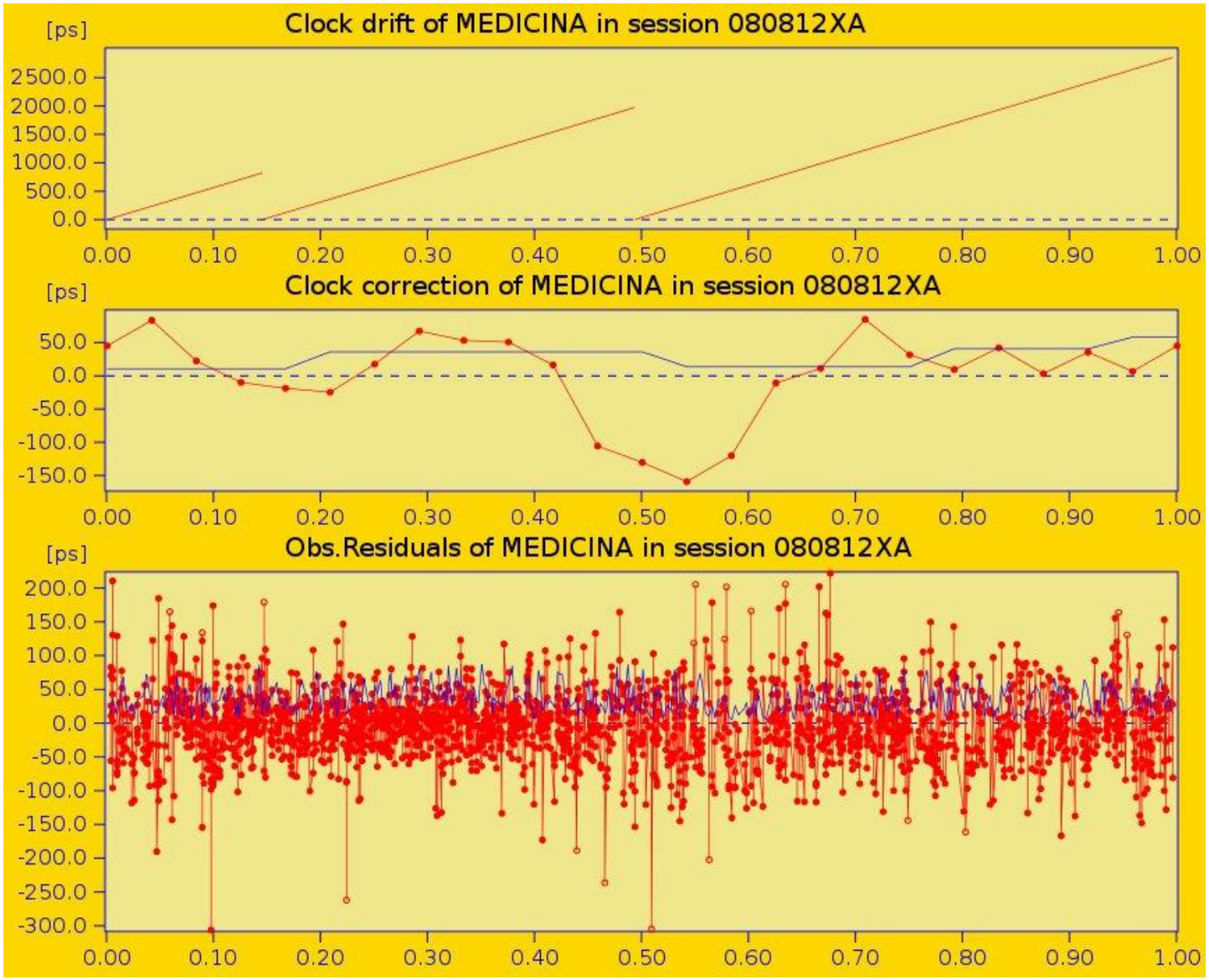
Earth rotation parameter (ERP) trends indicate that fixing amplitudes for a small subset of stations to zero is not sufficient

Impact of seasonal variations on pole coordinates (2)



Pole coordinates from standard solution are affected by suppressed non-linear station variations (Bloßfeld et al., 2014)

New VLBI processing software DOGS-RI



Current problem: Correlations between ERP and Nutation, possibly related to clock modeling

VLBI reprocessing

- reprocessing necessary to include **radio source coordinates**
- as DOGS-RI not available yet, “outdated” OCCAM version is used to do the preprocessing: identification of clock jumps, check of the quality of the cable calibration, detection of outliers
- final processing applying DOGS-RI will be necessary using the **OCCAM preprocessing options**
- current status: consistent set of solutions from September 2009 until April 2014 available
- validation of the session solutions via the official IVS combination (rapid and quarterly solutions)
- goal: consistent time series from **January 2009 until December 2013** (5 years of data)

PN5-related publications

- Angermann D., Seitz M., Drewes H.: Global terrestrial reference systems and their realizations. In: Xu G. (ed.) Sciences of Geodesy II - Innovations and Future Developments, 97-132, Springer, DOI:10.1007/978-3-642-28000-9_3, 2013
- Bloßfeld M., Seitz M., Angermann D.: Non-linear station motions in epoch and multi-year reference frames. J Geod 88(1): 45-63, DOI:10.1007/s00190-013-0668-6, 2014
- Bloßfeld M., Seitz M., Angermann D.: Epoch reference frames as short-term realizations of the ITRS - Datum stability versus sampling. IAG Symposia (in press)
- Bloßfeld M., Stefka V., Müller H., Gerstl M.: Satellite laser ranging - A tool to realize GGOS? IAG Symposia (in press)
- Schmid R., Gerstl M., Seitz M., Angermann D.: DGFI Analysis Center report 2013, IVS Annual Report 2013, NASA, 2014 (in press)
- Seitz M., Steigenberger P., Artz T.: Consistent realization of ITRS and ICRS. In: Behrend D., Baver K.D. (eds.) IVS 2012 General Meeting Proceedings, NASA/CP-2012-217504, 2012
- Seitz M., Angermann D., Drewes H.: Accuracy assessment of the ITRS 2008 realization of DGFI: DTRF2008. In: Altamimi Z., Collilieux X. (eds.) Reference Frames for Applications in Geosciences, IAG Symposia 138: 87-93, DOI:10.1007/978-3-642-32998-2_15, 2013
- Seitz M., Steigenberger P., Artz T.: Consistent adjustment of combined terrestrial and celestial reference frames. In: Rizos C., Willis P. (eds.) Earth on the Edge: Science for a Sustainable Planet, IAG Symposia 139: 215-221, DOI:10.1007/978-3-642-37222-3_28, 2014

Summary

- **estimation of sine/cosine amplitudes** possible with DOGS-CS
- datum defect can be overcome by fixing the amplitudes of at least three stations to zero
- **equation of condition** to constrain amplitudes necessary to avoid trends (and phase shift?) in pole coordinates
- impact of seasonal variations on station velocities has to be investigated
- estimation of semiannual in addition to annual amplitudes?
- **pole coordinate results benefit** from the consideration of seasonal station variations
- consistent VLBI time series including radio source coordinates envisaged for time span of 5 years (2009-2013)