Impact of different phase center correction values on GNSS-based positioning and frequency transfer

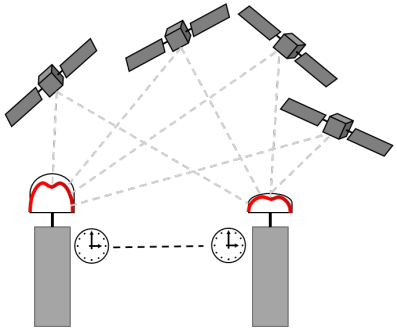
- IUGG 2023 -

G05g – Multi-signal positioning, Remote Sensing and Applications

Institut für Erdmessung

Gottfried Wilhelm Leibniz Universität Hannover

Motivation



- Highly precise & accurate positioning, navigation and frequency transfer with GNSS: Phase Center Corrections (PCC) are mandatory
- Generally, two methods exist to determine PCC:
  (1) chamber calibration
  (2) robot calibration
- PCC differences (ΔPCC) between methods, resolutions as well as individual & type-mean calibrations

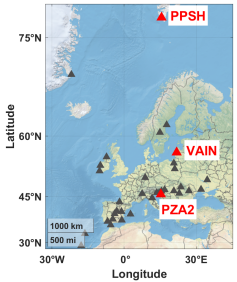
→ **How do ΔPCC impact geodetic parameters and GNSS-based frequency transfer?**

Data selection

Impact on geodetic parameters

Analysis of ΔPCC at 3 EPN stations equipped with LEIAR20 LEIM antennas:

$$\Delta\mathrm{PCC} = \mathrm{PCC}_{\mathtt{INDIV}} - \mathrm{PCC}_{\mathtt{TYPE}}$$



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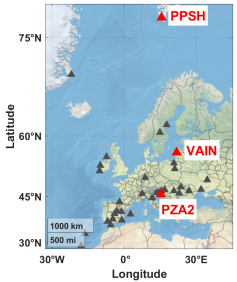
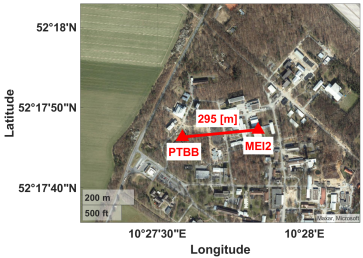


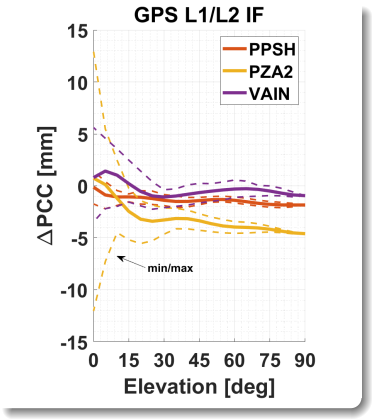
Impact on GNSS-based frequency transfer

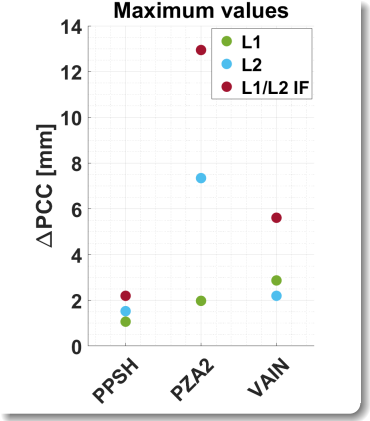
Analysis of differential receiver clock time series using PPP and single differences (SD) approaches:

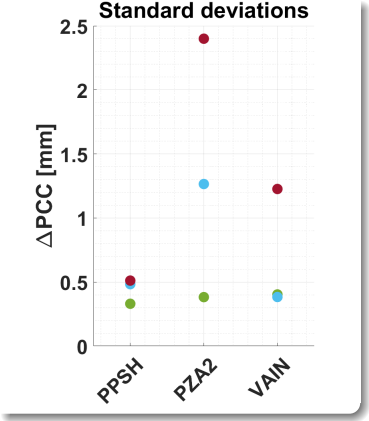
$$\Delta\mathrm{PCC} = \mathrm{PCC}_{\mathtt{LEIAR25.R4\ LEIT}} - \mathrm{PCC}_{\mathtt{LEIAR20\ LEIM}}$$



Impact on geodetic parameters: differences at pattern level (LEIAR20 LEIM antenna)

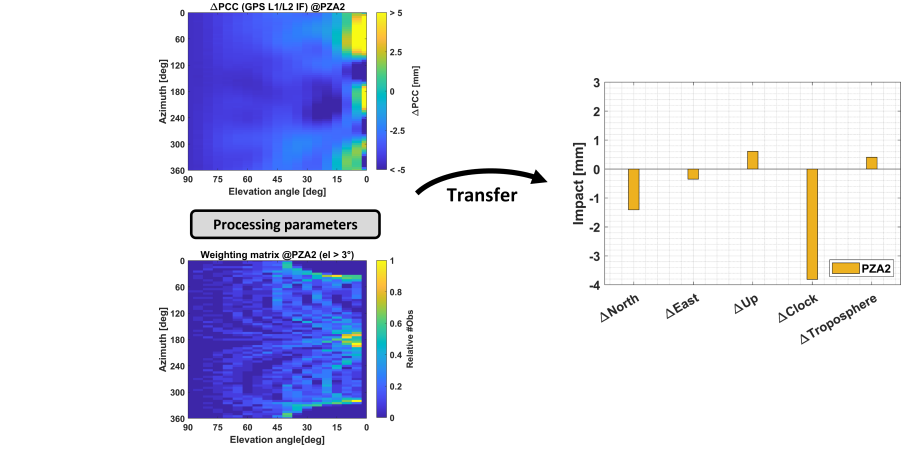






Kersten et al. (2022): Comparison concept and quality metrics for GNSS antenna calibrations, Journal of Geodesy, DOI: 10.1007/s00190-022-01635-8

Impact on geodetic parameters: results for May, 1st 2023 (24 h, Δt = 30 s)



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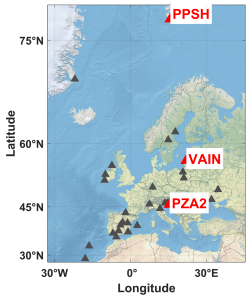
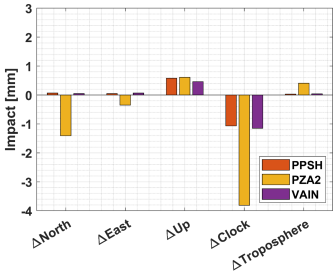


Processing parameters

Transfer



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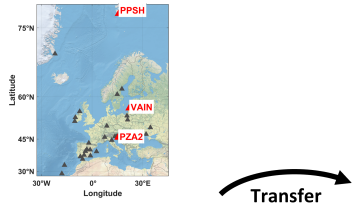

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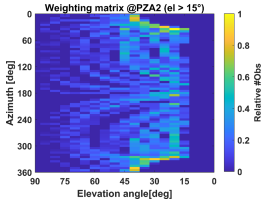
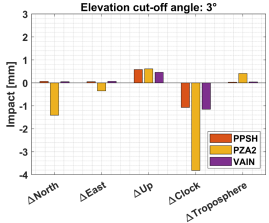
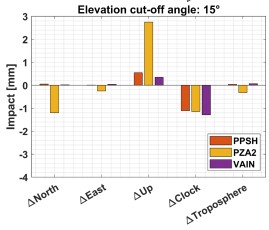
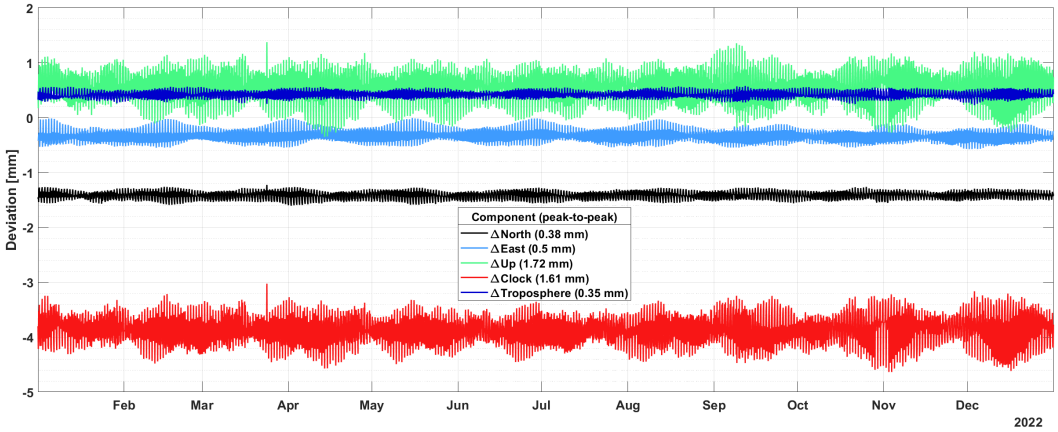






Kröger et al. (2022): How Do Different Phase Center Correction Values Impact GNSS Reference Frame Stations, REFAG

Impact on geodetic parameters: results for one year (station PZA2, estimation every 3 h, Δt = 5 min)



Impact on frequency transfer: experiment set-up

Data set

- Common-clock, short baseline set-up [1]
- Use of 5 different PCC sets at MEI2 (LEIAR20 LEIM antenna):

(1) type-mean calibration (robot)

(2) indiv. calibration (IfE), 5° resolution

(3) indiv. calibration (IfE), 1° resolution

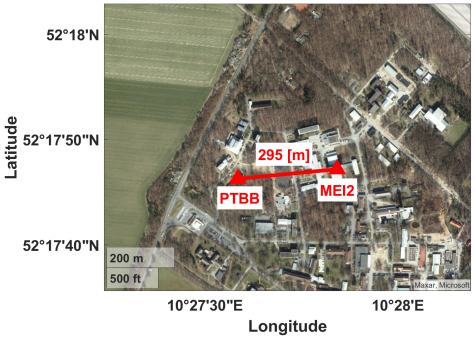
(4) indiv. calibration (IfE), method `COEFF`

(5) type-mean calibration (chamber)

- PCC values for LEIAR25.R4 LEIT at PTBB not changed (indiv. chamber calibration)

[1] Krawinkel et al. (2022): Exploring the Technical Limits of GNSS-based Frequency Transfer, PTTI proceedings, DOI: 10.33012/2022.18288

Location



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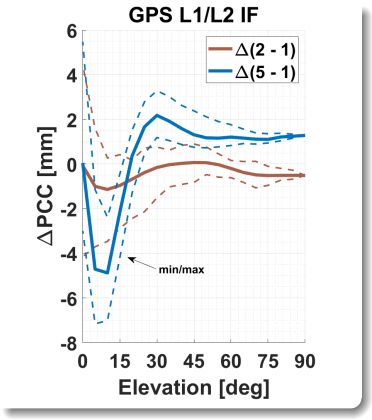
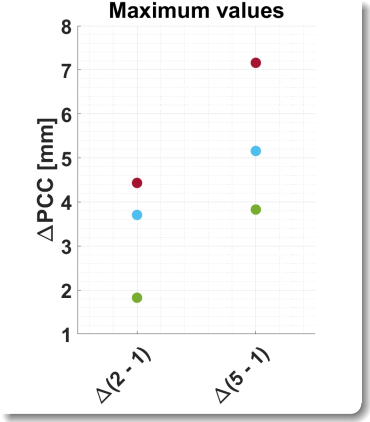
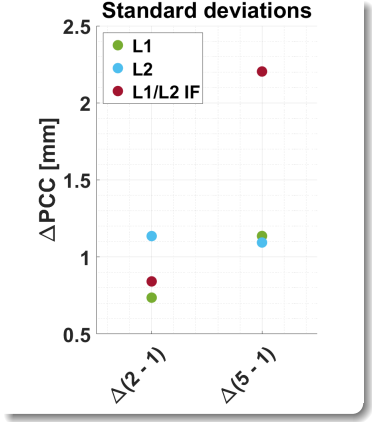
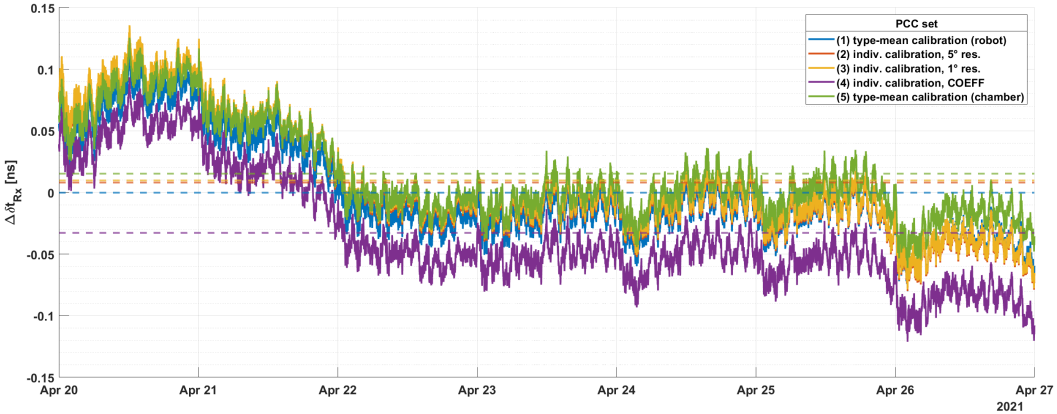




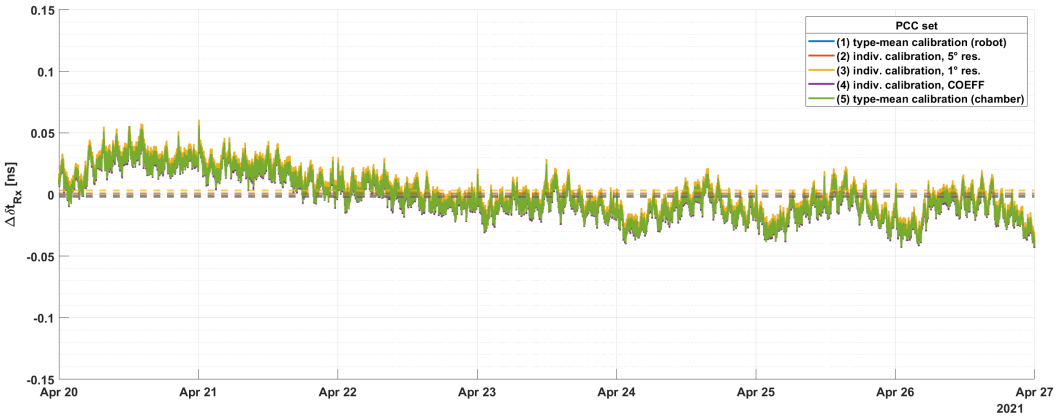


(1) type-mean calibration robot | (2) indiv. calibration (IfE), 5° resolution | (5) type-mean calibration chamber

Impact on frequency transfer: PPP approach (GPS L1/L2 IF)

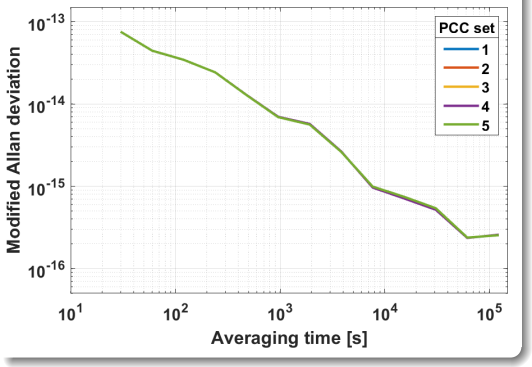


Impact on frequency transfer: SD approach (GPS L1)

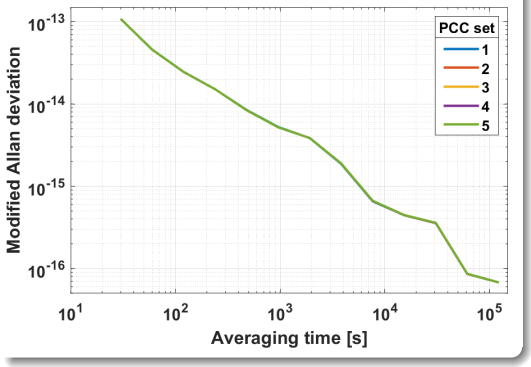


Impact on frequency transfer: frequency stability

PPP approach (GPS L1/L2 IF)



SD approach (GPS L1)



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