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Status report of the EPN Special Project „Troposphere Parameter Estimation“

W. Söhne, G. Weber

Bundesamt für Kartographie und Geodäsie

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  - Options (Dry/Wet Niell; gradients)
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- Conclusions

Content

Overview

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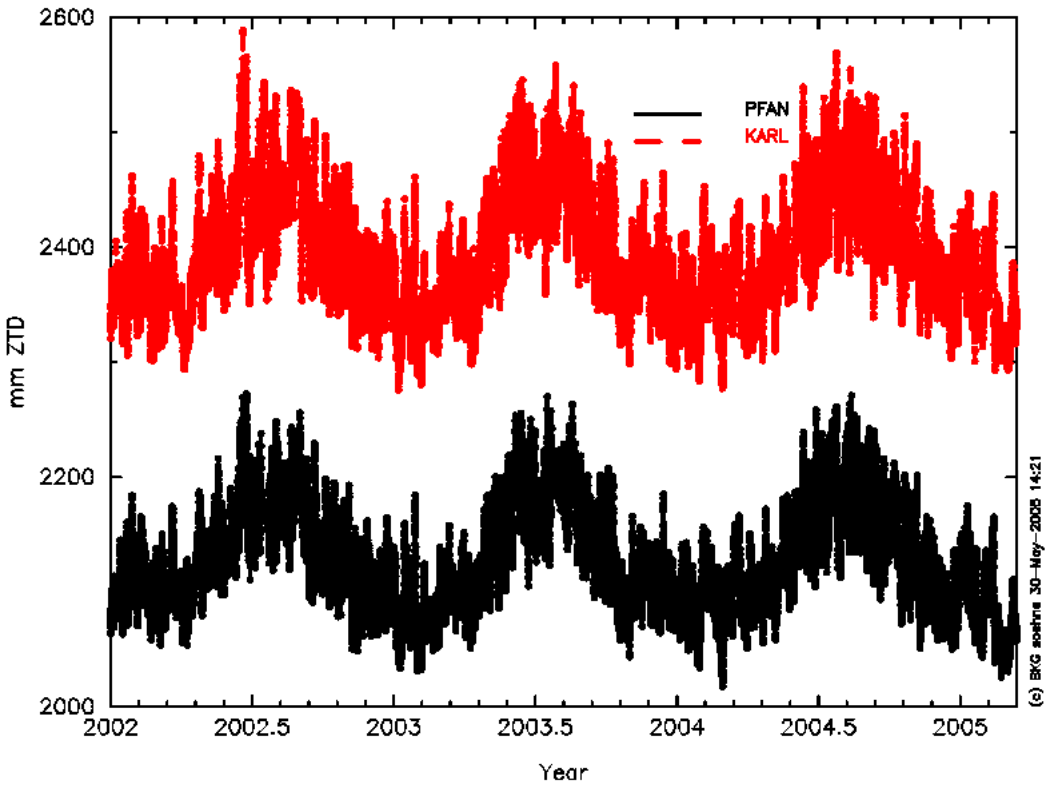
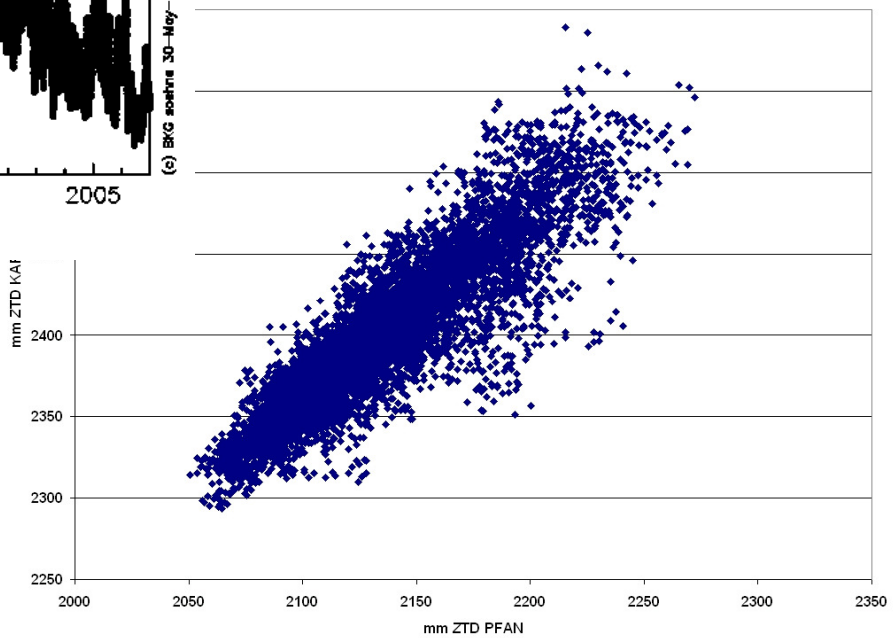
Overview



$\Delta ZTD = -264.7 \pm 22.9$ mm

$\Delta H = 907$ m

$\Rightarrow$ 1 m $\Delta H \approx$ -0.29 mm ZTD



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Overview

Chronology of the project:

- GPS week 1108: first solutions
- GPS week 1110: Contribution of 4 LACs: ASI, BKG, COE, UPA
- GPS week 1111: Contribution of IGN and LPT
- GPS week 1112: Contribution of OLG
- GPS week 1113: Contribution of WUT
- GPS week 1114: Contribution of NKG
- GPS week 1115: Contribution of GOP
- GPS week 1120: Contribution of BEK
- GPS week 1126: Contribution of IGE
- GPS week 1130: New EUREF processing options
  Contribution of DEO and ROB
- GPS week 1143: Switch to new reference frame ITRF 2000
  Contribution of SGO
- GPS week 1143: COE using Wet Niell, switching to (unofficial) 5.0
- GPS week 1185: Contribution of SUT as 16th LAC

Overview

Chronology of the project (cont'd):

- GPS week 1203: Contribution of EPN troposphere solution to IGS combination of ZTD
- GPS week 1307: GFZ stops EPN combination (IGS troposphere combination is changing from GFZ to JPL)
- GPS week 1317: LPT switching to 5.0, Wet Niell (EUREF mail 2360)
- GPS week 1318: WUT switching to 5.0, Wet Niell (EUREF mail 2363)
- GPS week 1319: BKG switching to 5.0, Wet Niell (EPN LAC mail 490)
- GPS week 1320: GOP switching to 5.0, Dry Niell? (EPN LAC mail 508)
- GPS week 1321: NKG switching to 5.0, Wet Niell (EPN LAC mail 505)
- …

Content

Changes in analysis: Options (Dry/Wet Niell; gradients)

Changes in analysis: options

- Actual:

- no a priori troposphere modeling, estimated ZTD parameters with DRY NIELL mapping function
- no horizontal gradient parameters

- Bernese 5.0 (RNX2SNX):

- a priori troposphere modeling DRY NIELL, estimated ZTD parameters WET NIELL

Changes in analysis: options

Slant Total Delay

$STD = mf_h * ZHD_0 + mf_w * ZWD'$

mf_h mapping function for hydrostatic delay
mf_w mapping function for wet delay
ZHD_0 approximated value for the zenith hydrostatic delay
ZWD' estimated zenith wet delay

(from COST 716 Final Report 2004)

Changes in analysis: options

- Case study: local (Germany, 31 sites) and regional (Europe, 17 sites) network

Changes in analysis: options

Comparison

- NONE / DRY NIELL vs.
- DRY NIELL / WET NIELL

Differences in ZTD:

Regional: +1.52 mm ± 0.45 mm (max. +2.60 mm)

Local: +1.76 mm ± 0.17 mm (max. +2.22 mm)

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Changes in analysis: options

Comparison

- NONE / DRY NIELL vs.
- DRY NIELL / WET NIELL

But all coordinates fixed to the same set

Differences in ZTD:

Regional: +0.78 mm ± 0.24 mm (max. +1.10 mm)

Local: +1.72 mm ± 0.13 mm (max. +2.08 mm)

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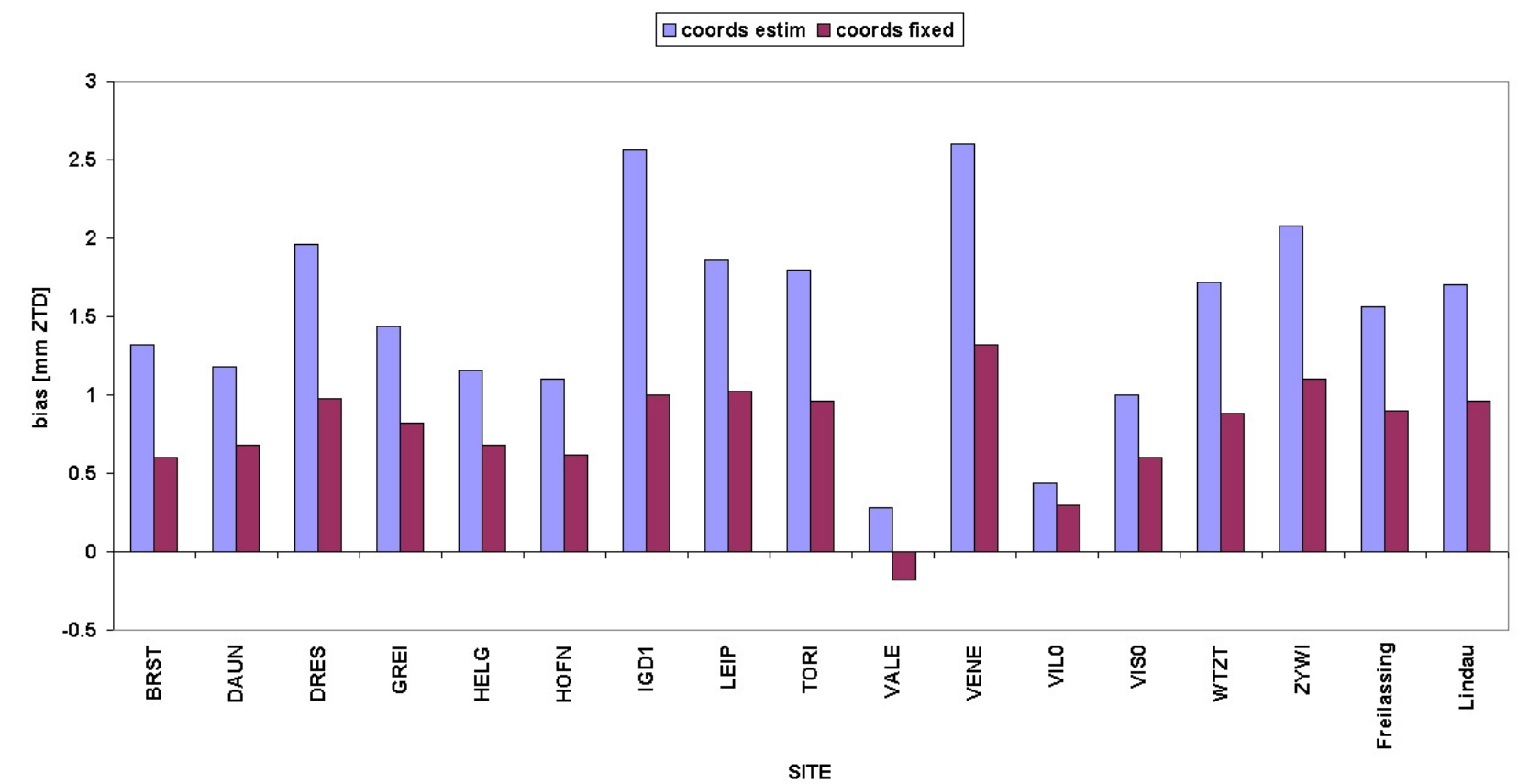
NONE/DRY NIELL vs. DRY NIELL/WET NIELL



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Changes in analysis: options

Comparison

- DRY NIELL / WET NIELL w/o gradients vs.
- DRY NIELL / WET NIELL with horizontal gradient parameters (TILTING, 1 per 24 hrs in NS and EW)

Differences in ZTD:

Regional: -1.88 mm ± 1.27 mm (max. -5.46 mm)

Local: +5.90 mm ± 0.40 mm (max. +7.50 mm)

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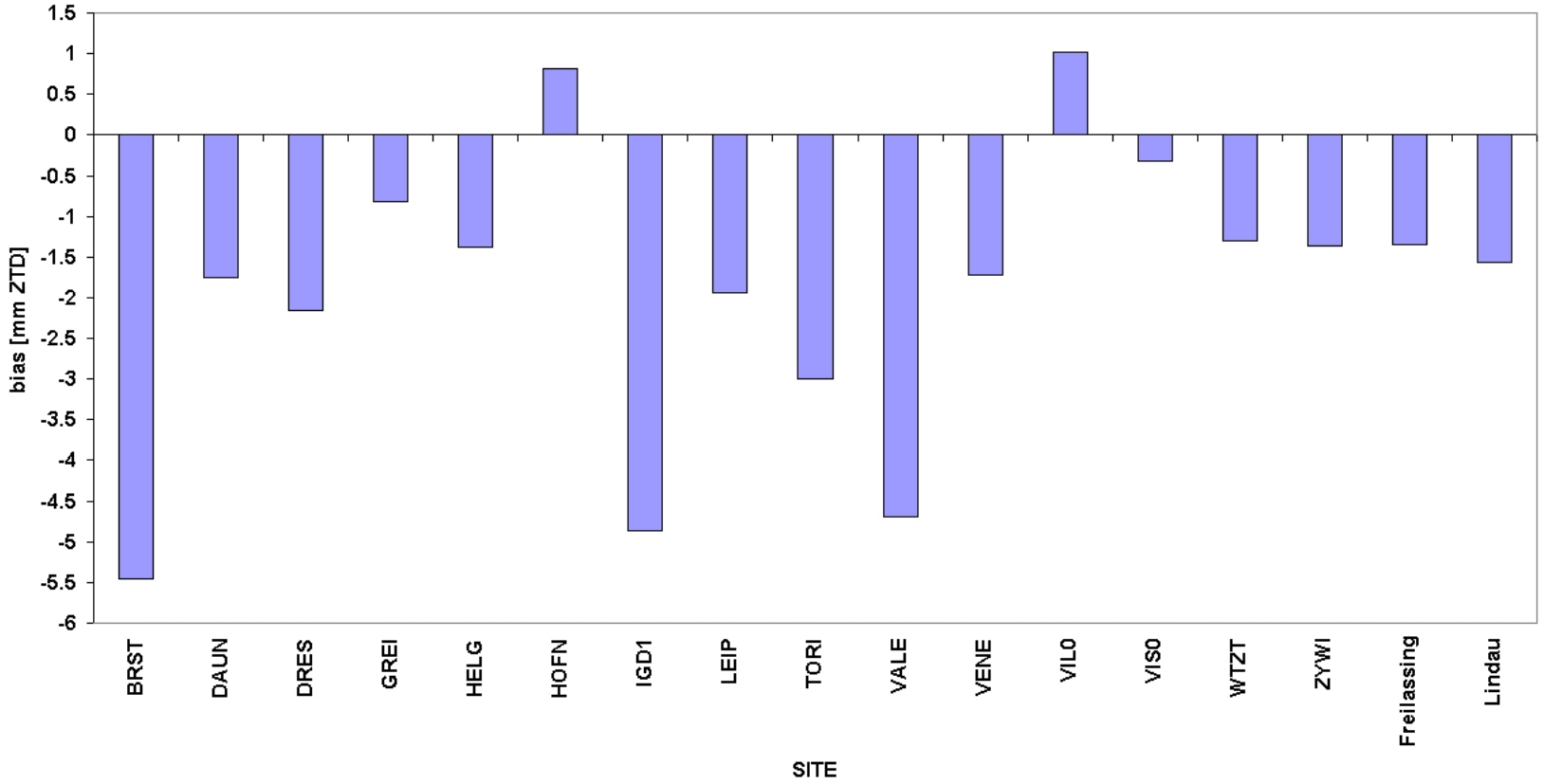
No gradients vs. Gradients (TILTING)



Changes in analysis: options

Comparison

- DRY NIELL / WET NIELL with coordinates estimated vs.
- DRY NIELL / WET NIELL with coordinates fixed to a priori values

Differences in ZTD:

Regional: - 1.36 mm ± 1.91 mm (max. -6.30 mm)

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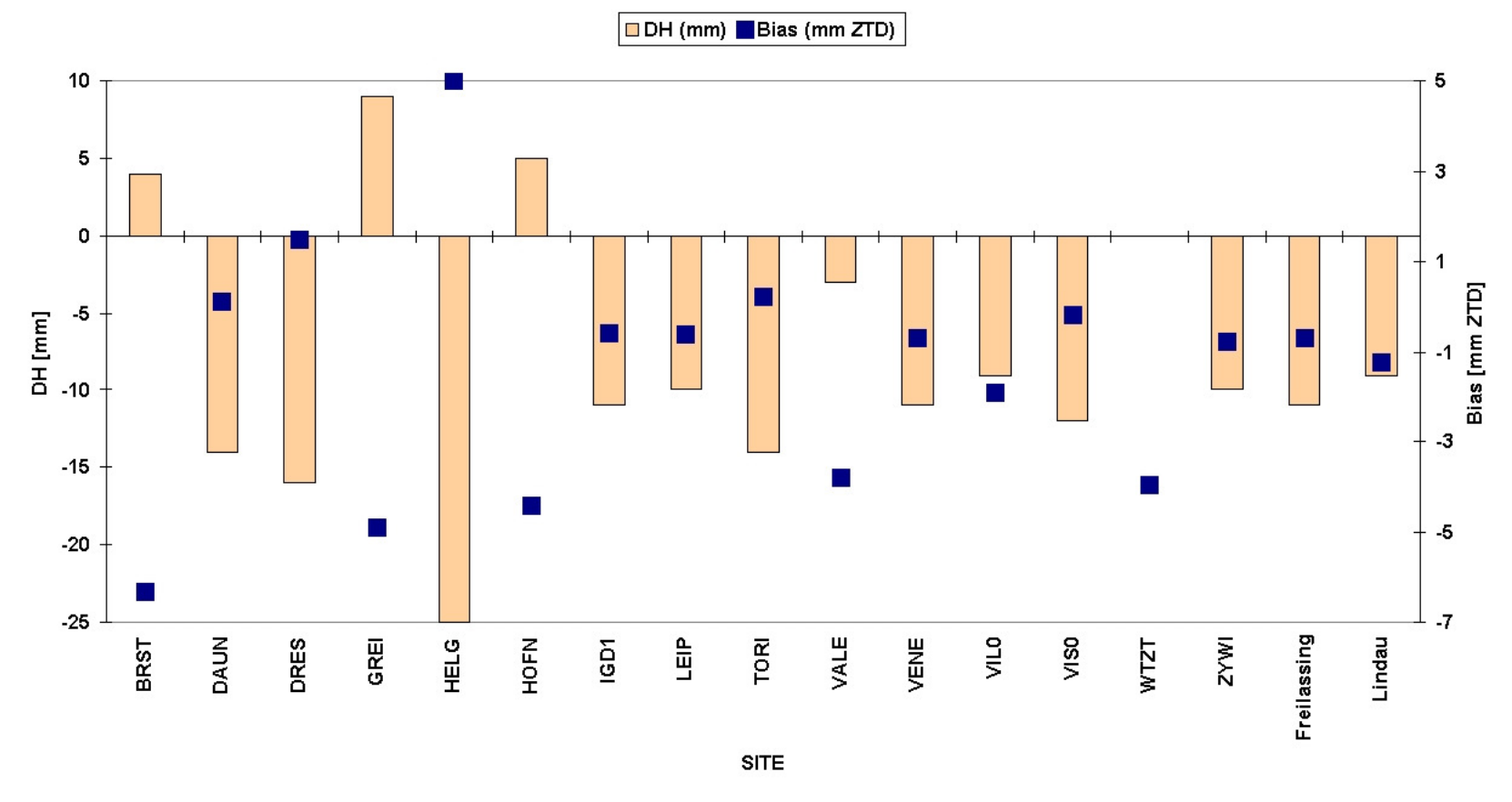
Estimated vs. fixed coordinates



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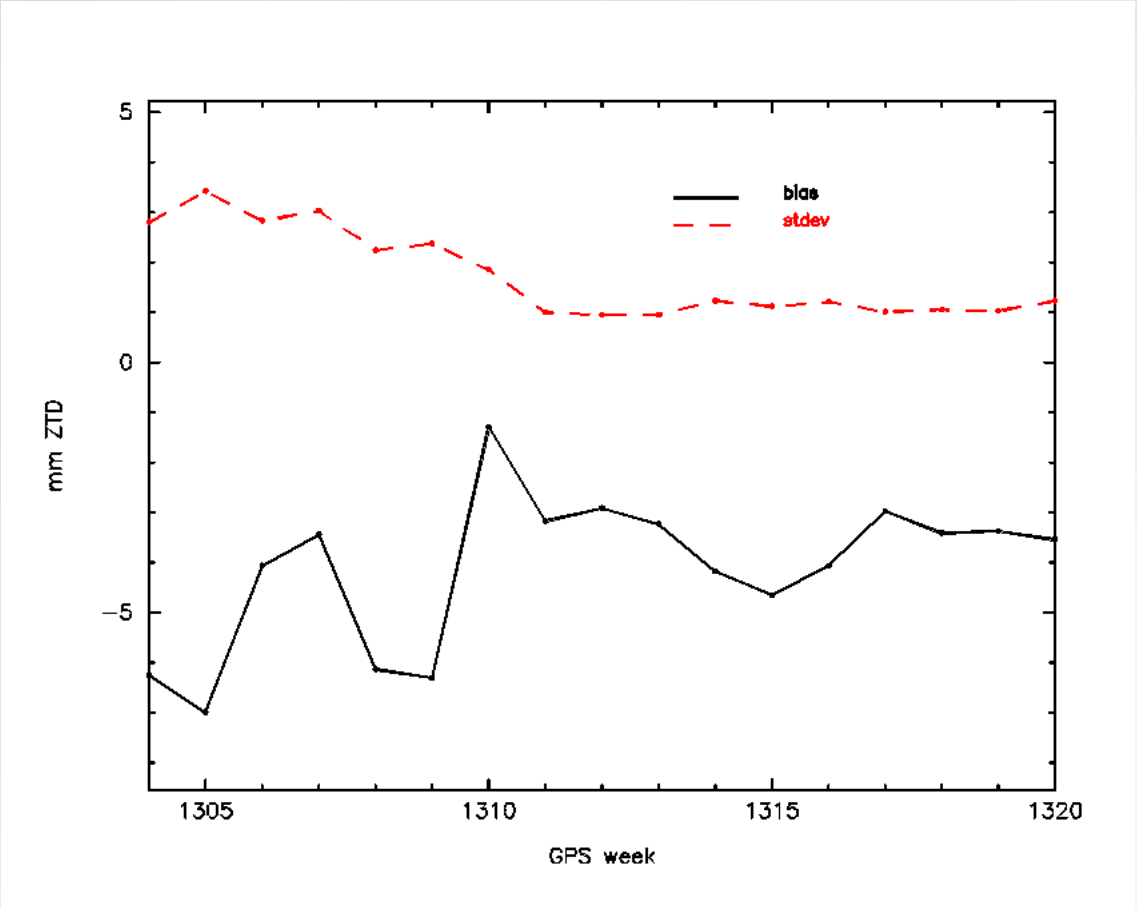
Changes in analysis: example BKG

ZTD weekly mean bias and its st. dev. between BSW „4.2“ and „5.0“



analyses by P. Franke, BKG

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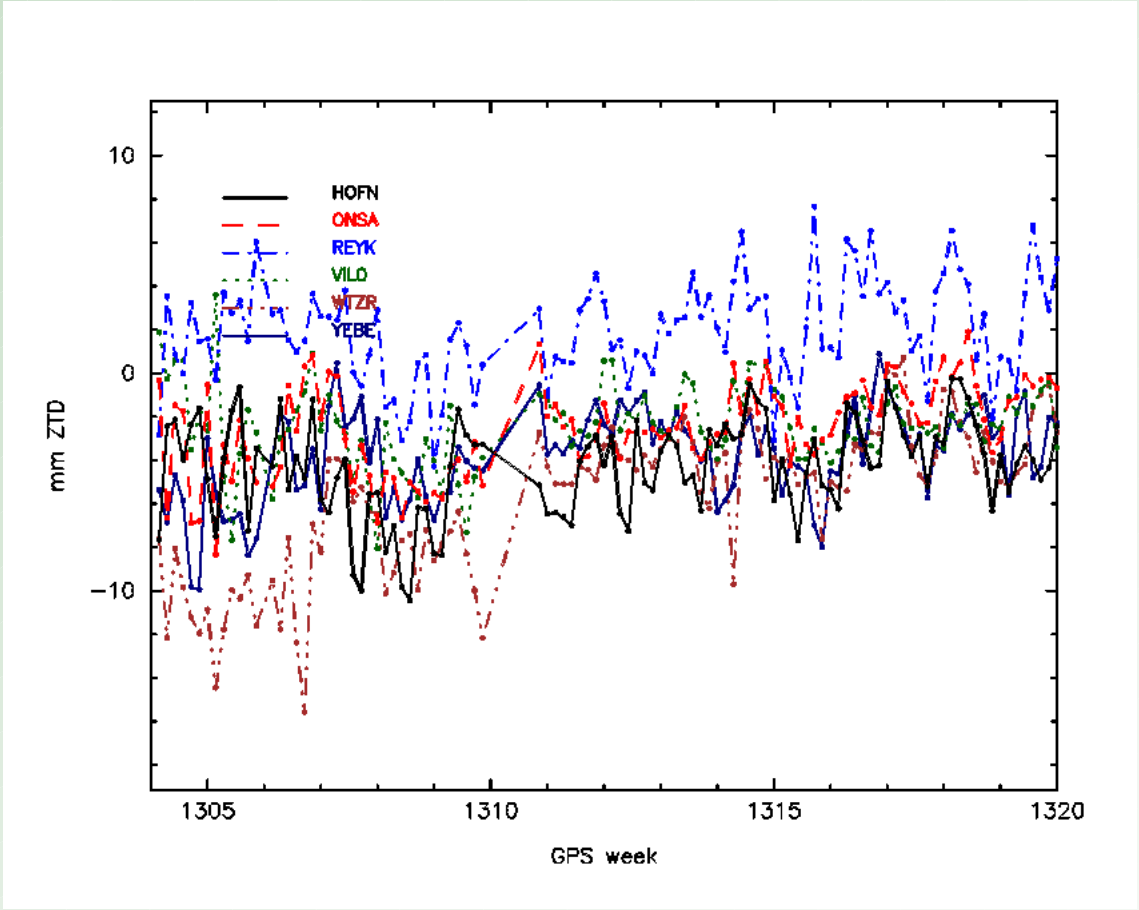
Changes in analysis: example BKG

Weekly mean bias between „4.2“ and „5.0“ – individual sites



For comparison: L. Jivall, NKG (EPN LAC mail 505): bias –1.8 - –2.2 mm ZTD, rms 0.5 – 3.4 mm

Content

Changes in analysis: Parameter (e.g. OTL)

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Changes in analysis: OTL parameter

Comparison

- 11 EPN sites with GOT00.2 model vs.
- 9 EPN sites with GOT00.2 model and BRST, HOFN with CSR4 model

Differences

ZTD: - 0.04 mm ± 0.08 mm (~ -0.08 mm systematic for all sites except HOFN: +0.28 mm)

Coordinates: ± 0.1 mm for all sites and components except HOFN: -1.8 mm in height)

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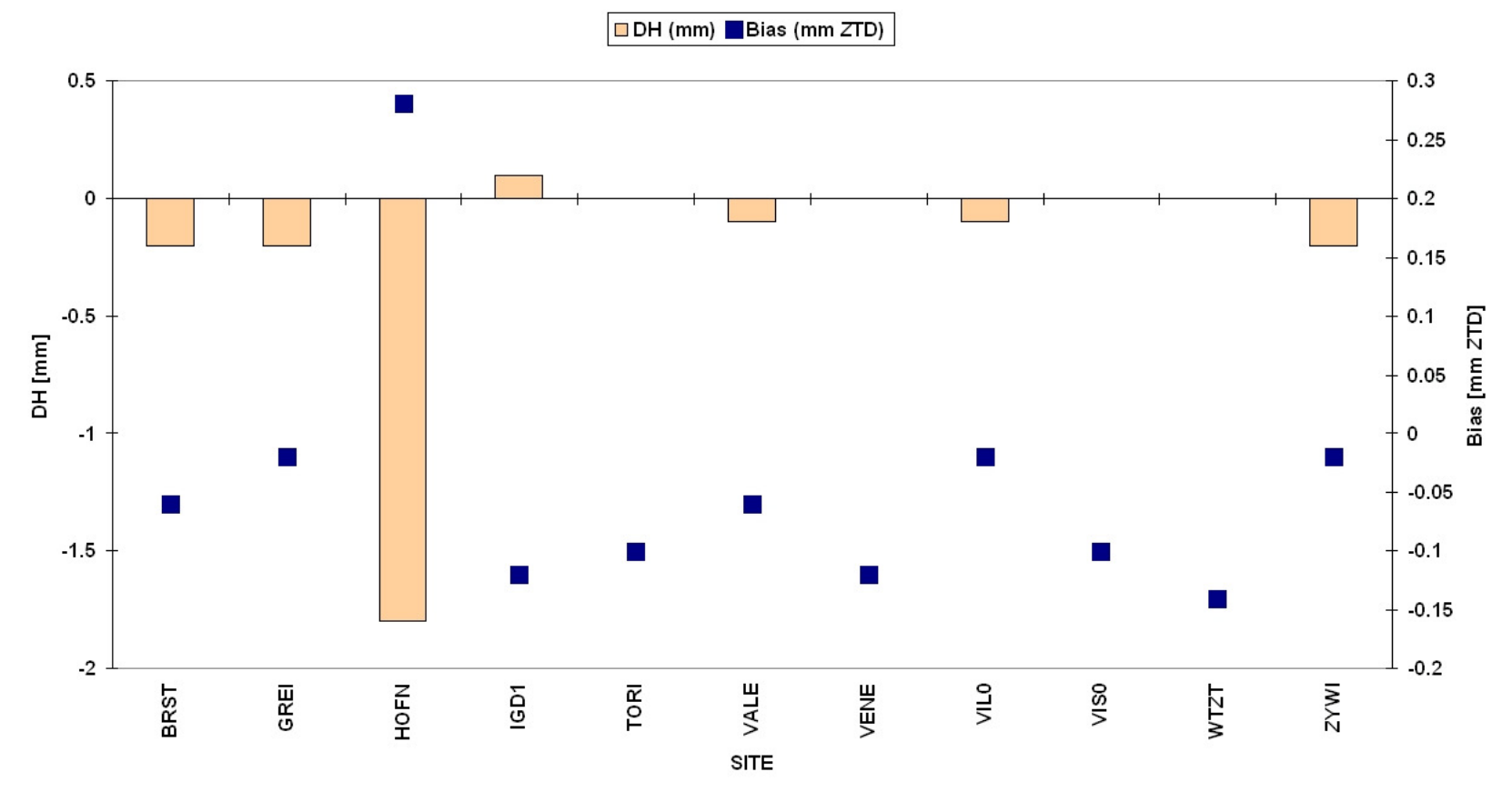
Changes in analysis: OTL parameter



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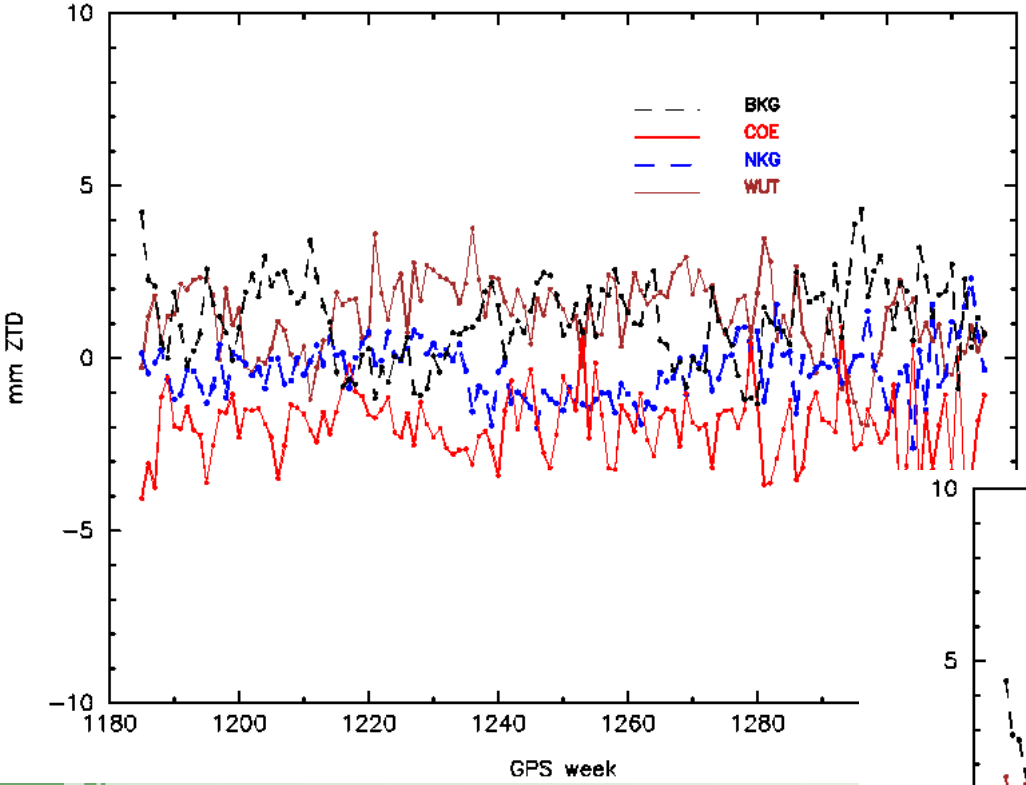
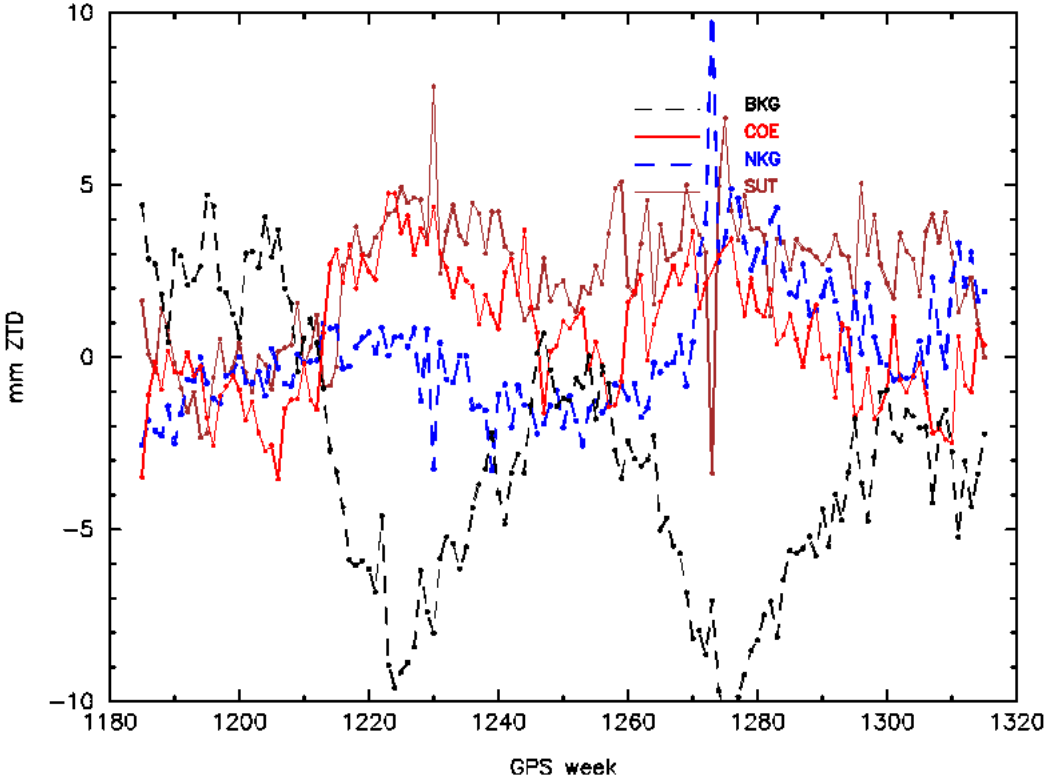
Changes in analysis: parameter



← HOFN



REYK →

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Changes in analysis: parameter

- Comparison of two LACs at a time
- Sites which are analysed by at least 4 LACs
- Two or more sites which are analysed by identical set of LACs
- Time span GPS weeks 1185 - 1315

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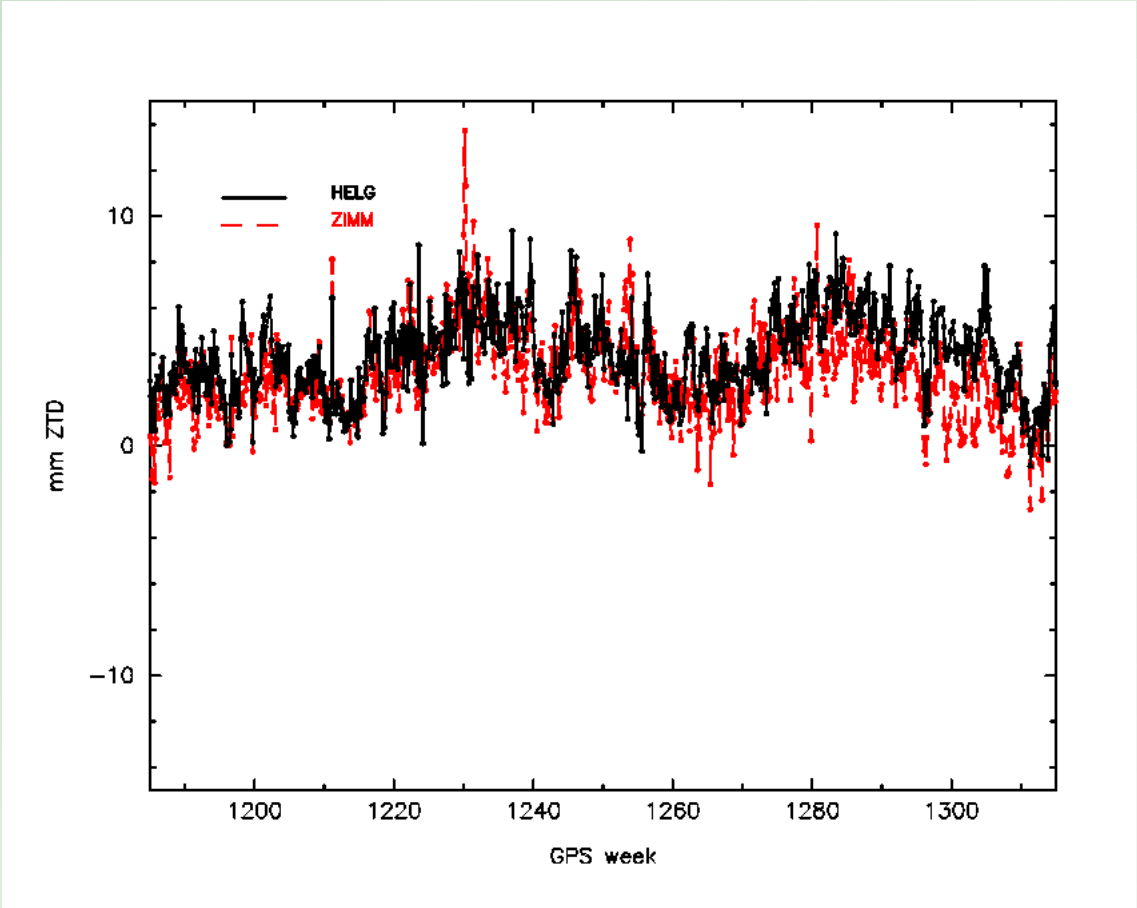
Combination results: BKG vs. COE



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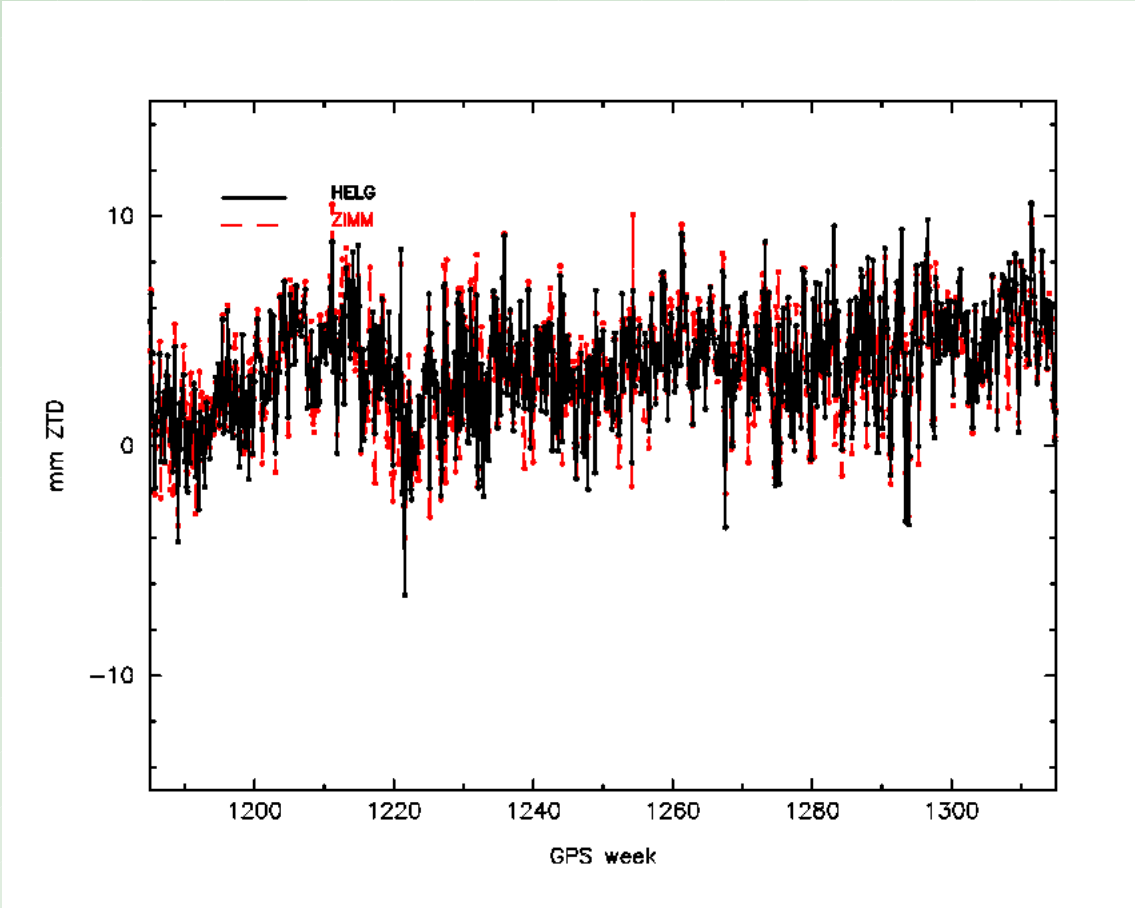
Combination results: BKG vs. LPT



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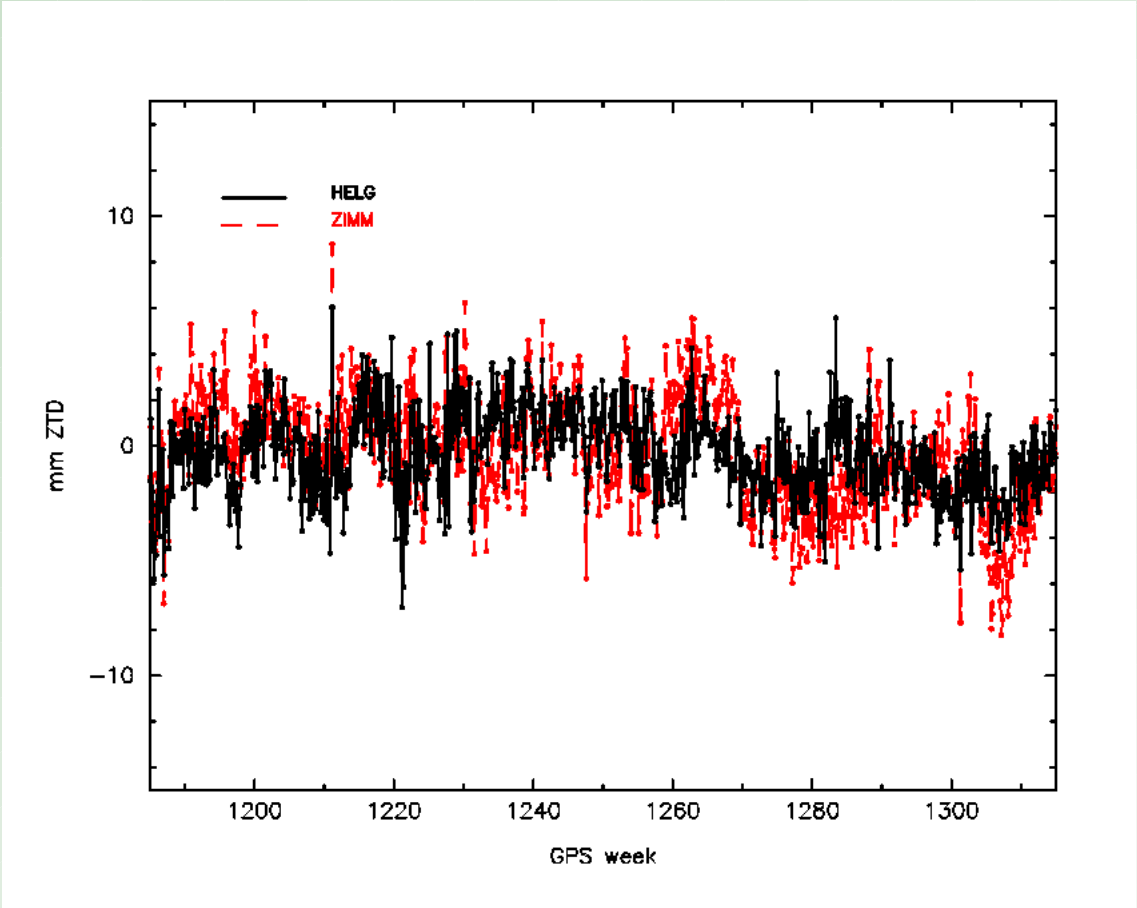
Combination results: BKG vs. SUT



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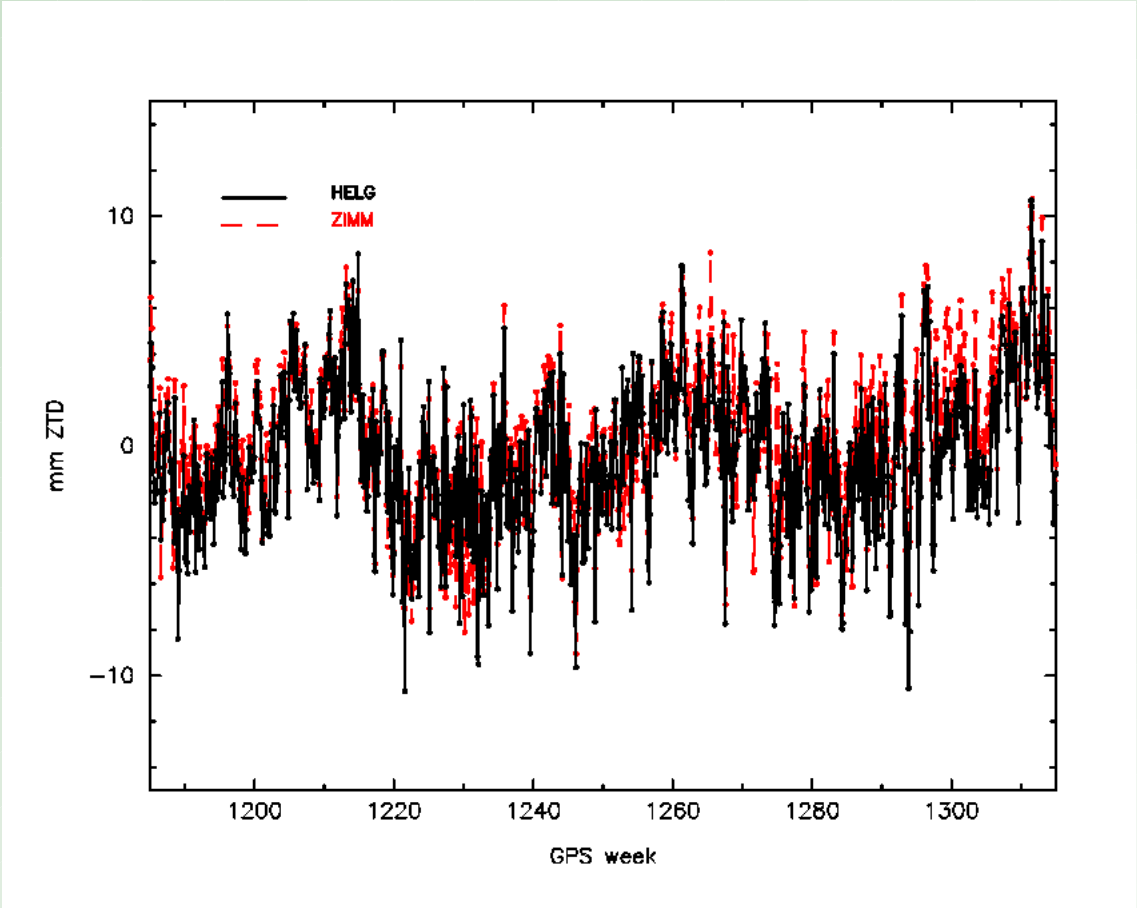
Combination results: COE vs. LPT



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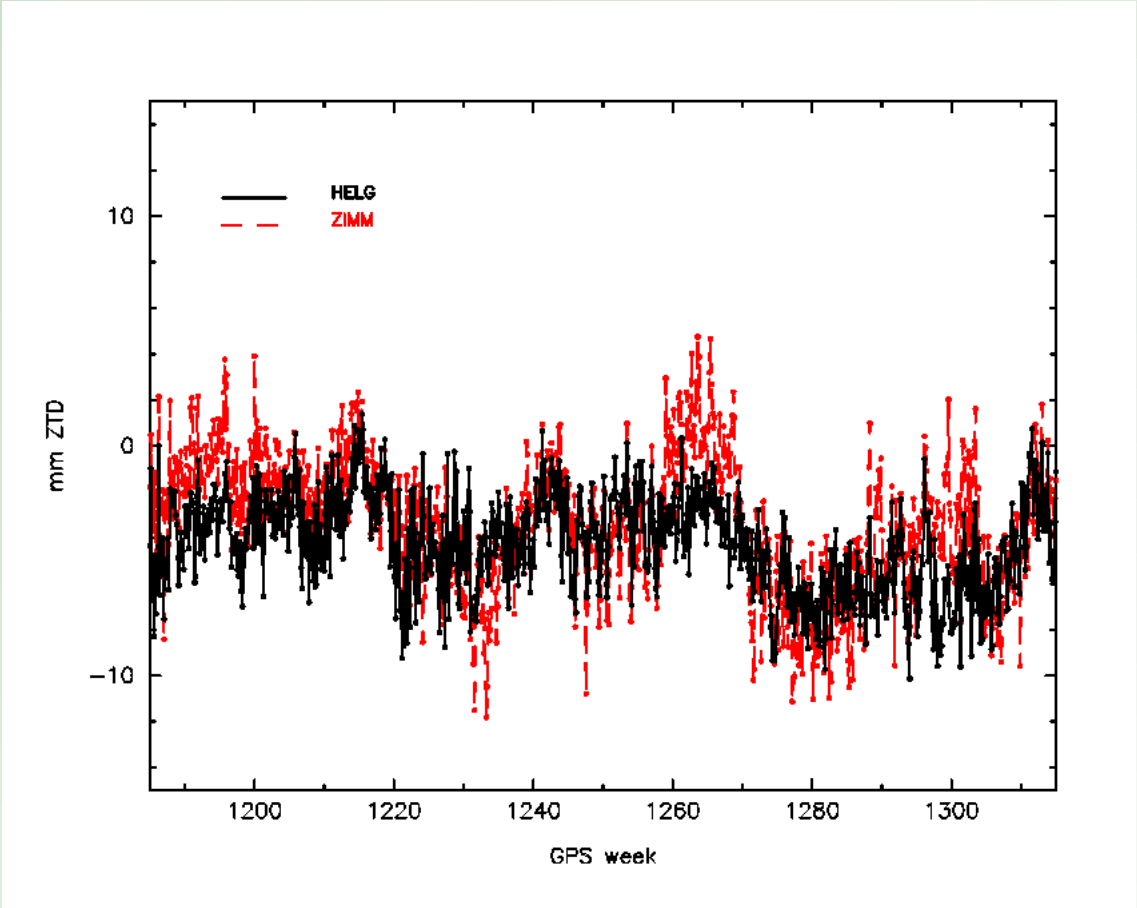
Combination results: COE vs. SUT



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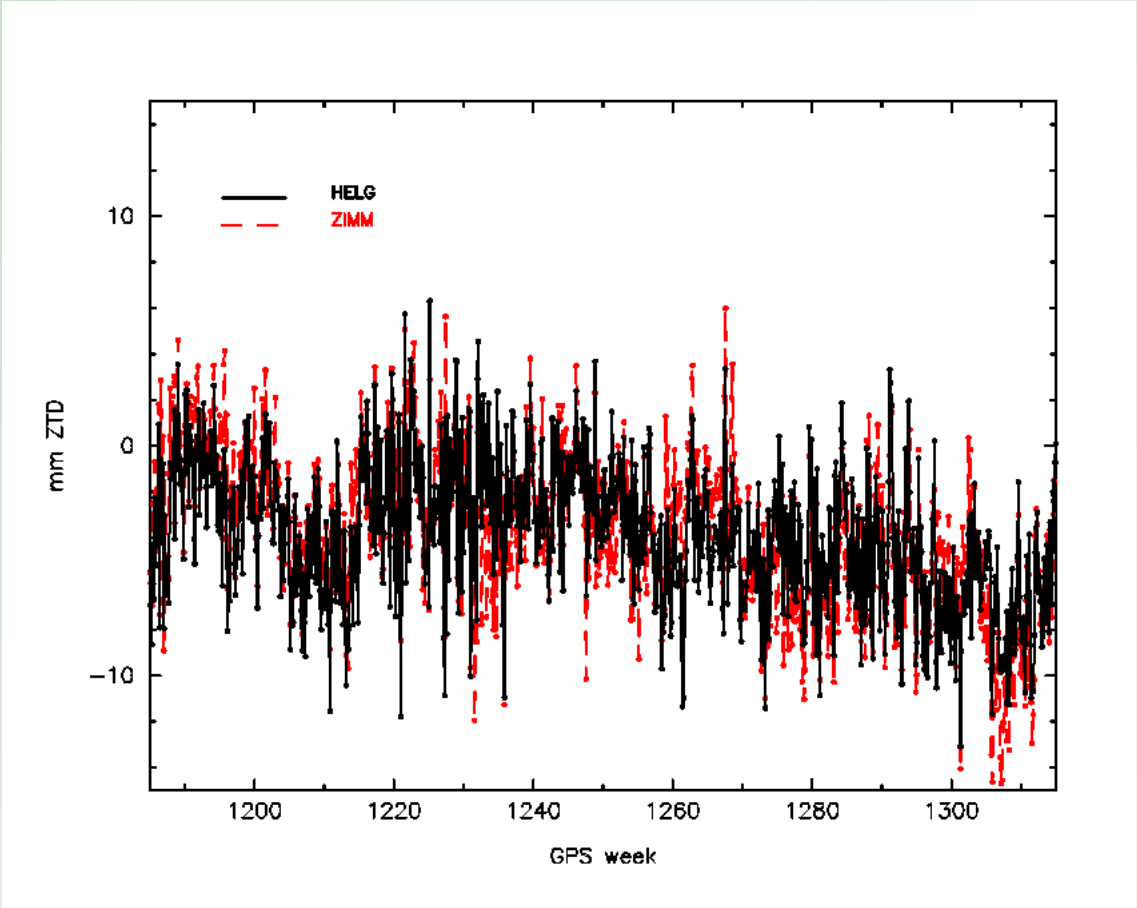
Combination results: LPT vs. SUT



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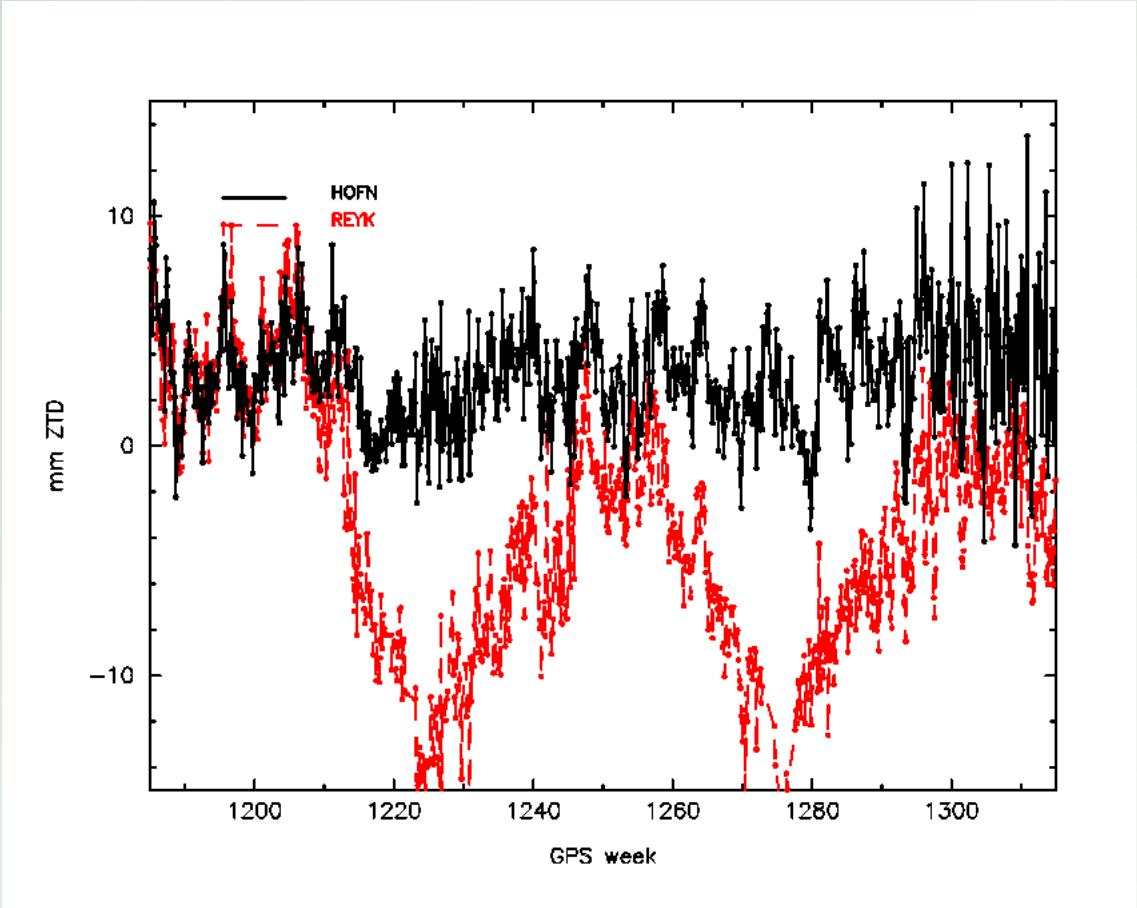
Combination results: BKG vs. COE



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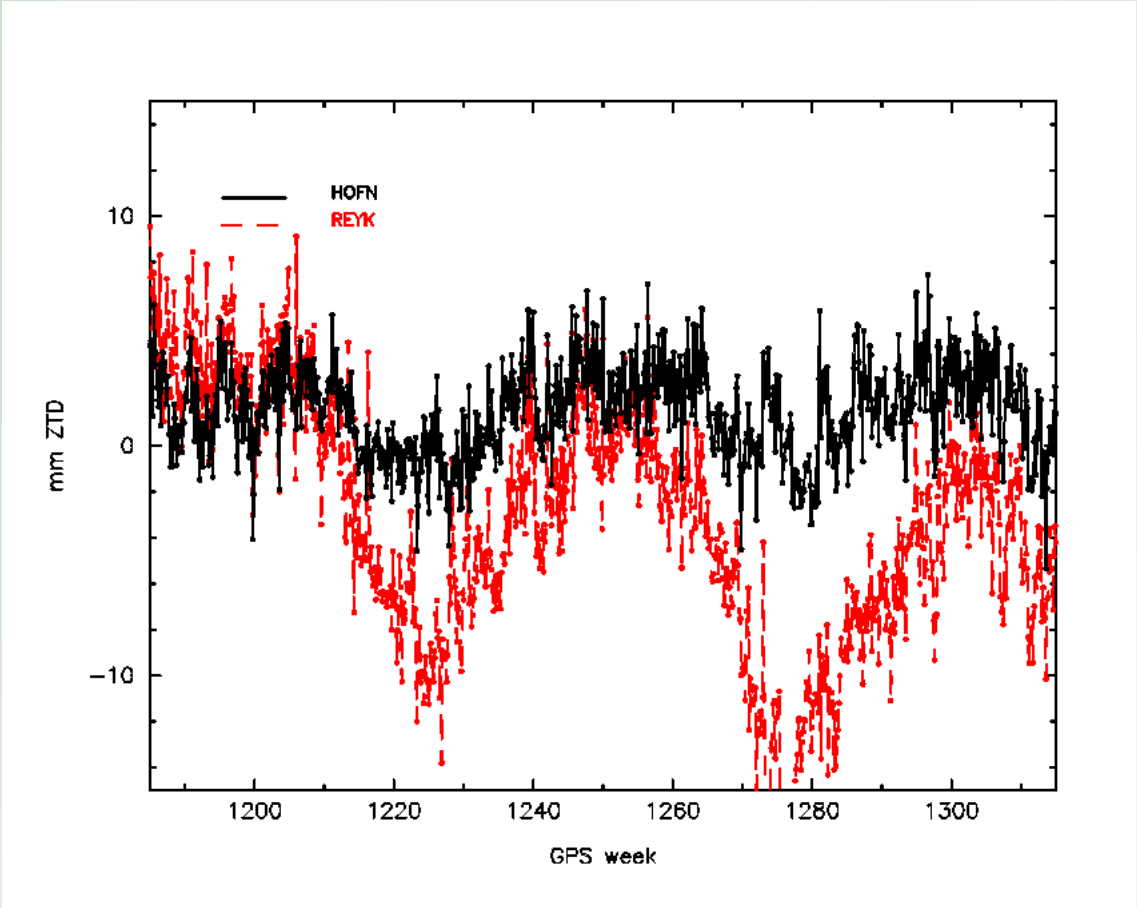
Combination results: BKG vs. NKG



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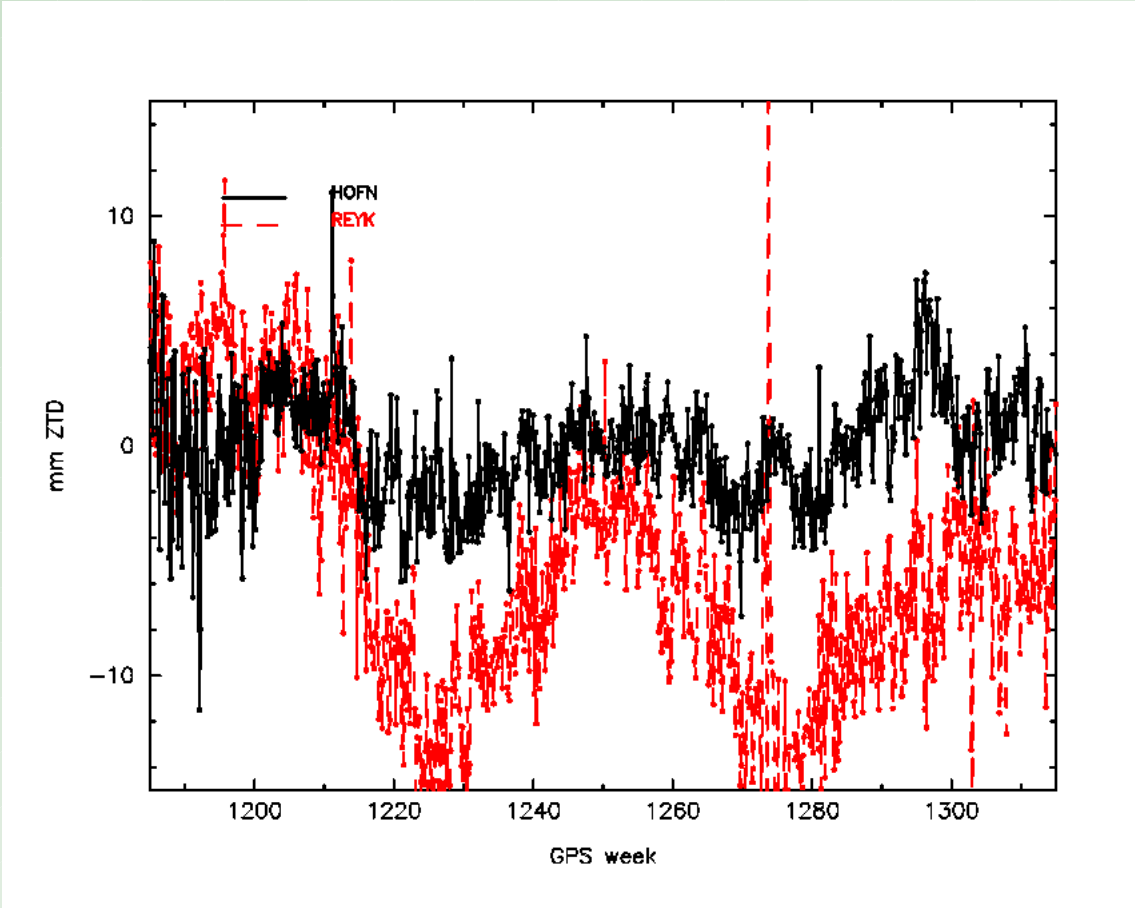
Combination results: BKG vs. SUT/WUT



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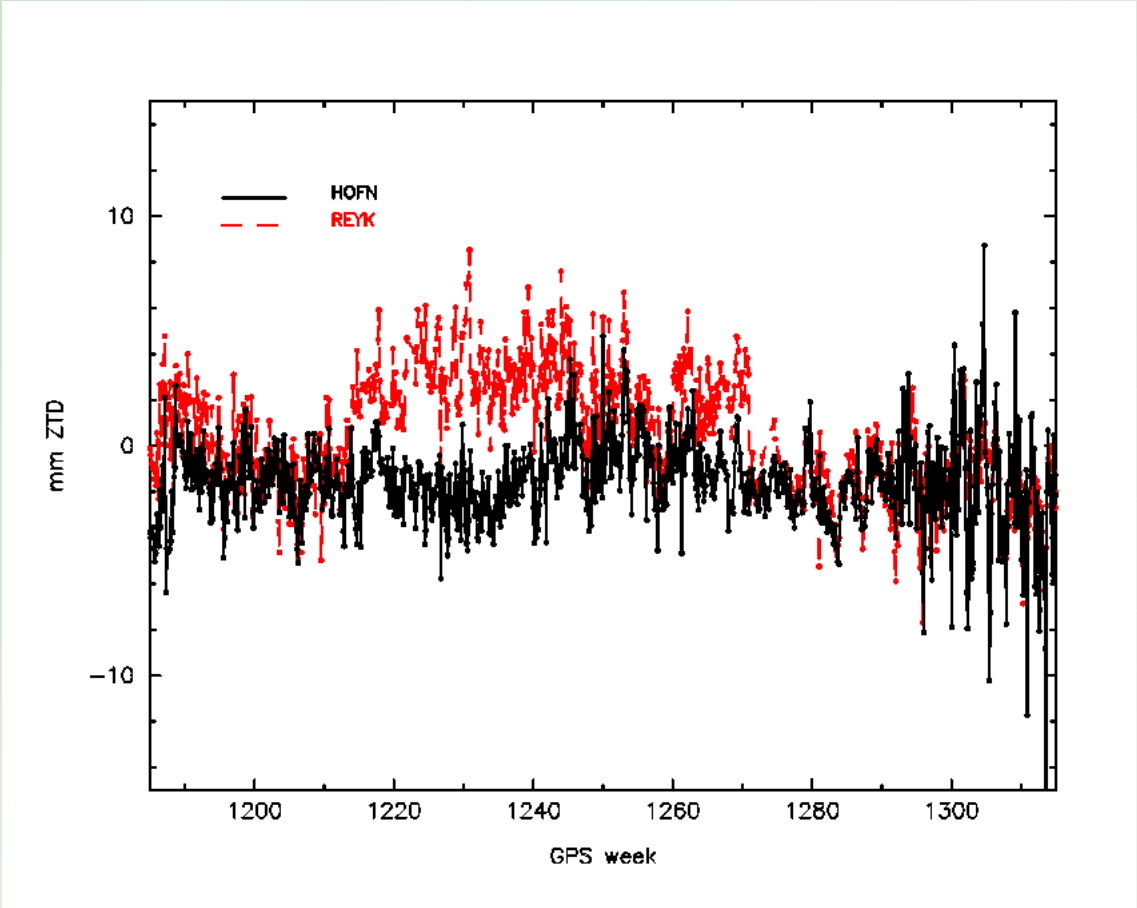
Combination results: COE vs. NKG



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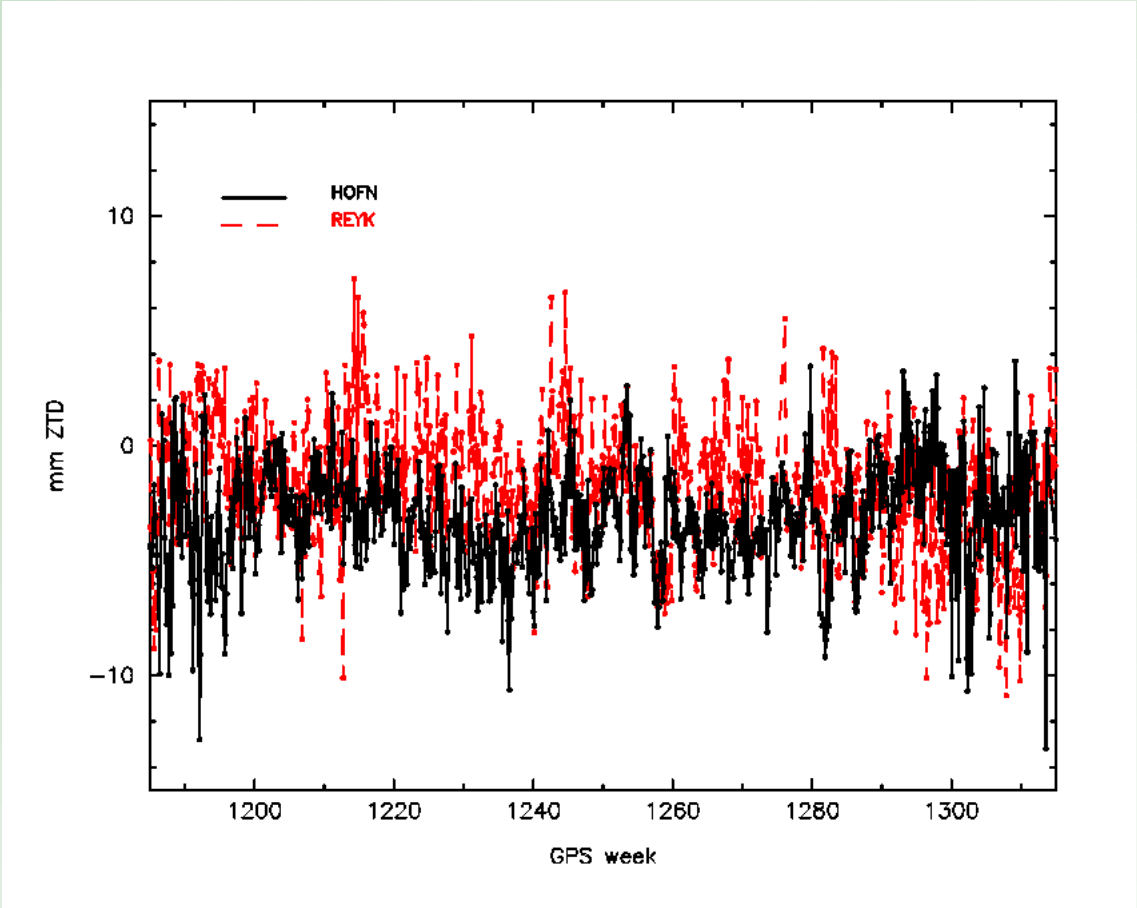
Combination results: COE vs. SUT/WUT



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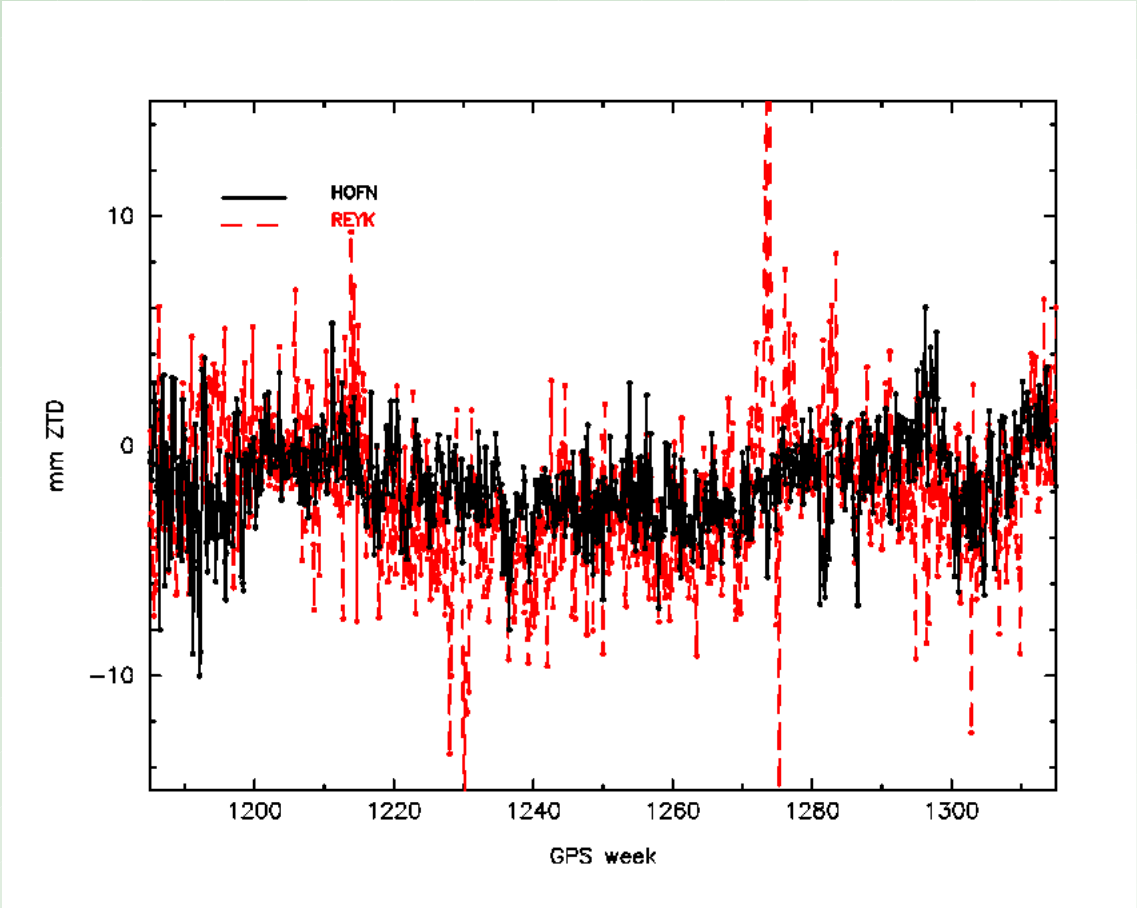
Combination results: NKG vs. SUT/WUT



Combination results: HOFN, REYK

- Seasonal signal for REYK analysis by BKG, but not for HOFN

- Ocean Tide Loading? – No, same model for both sites; impact of OTL small in general

- → Reference station! REYK fixed by BKG from GPS week 1200 on

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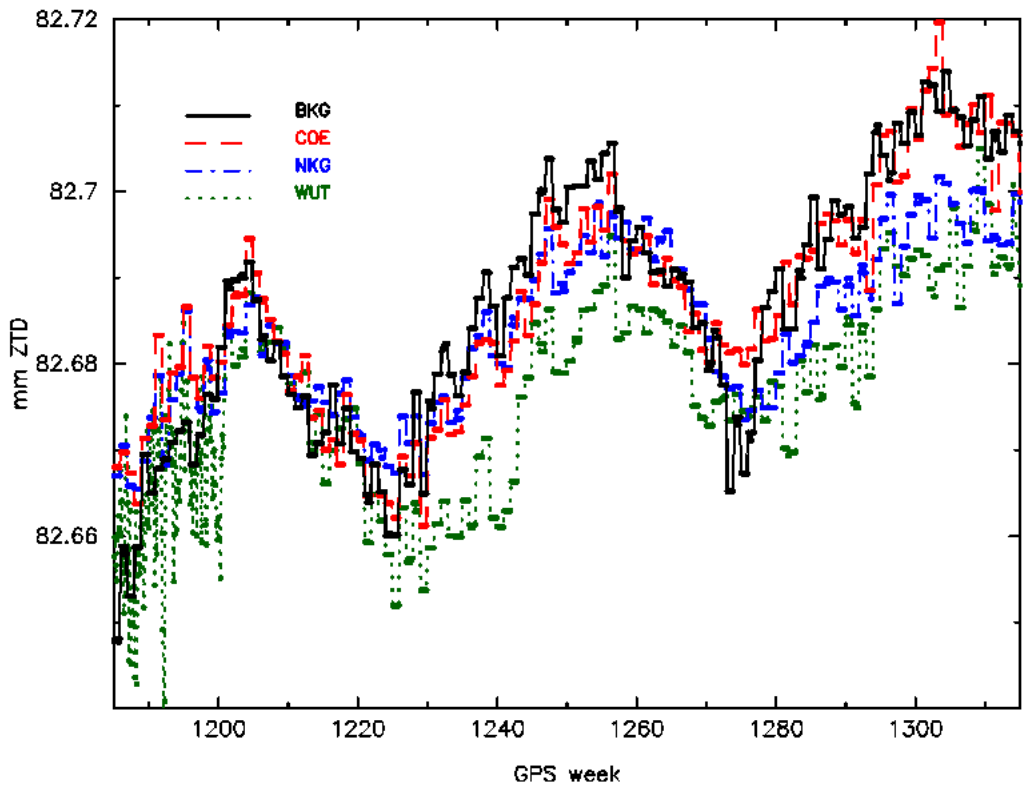
Ellipsoidal height HOFN



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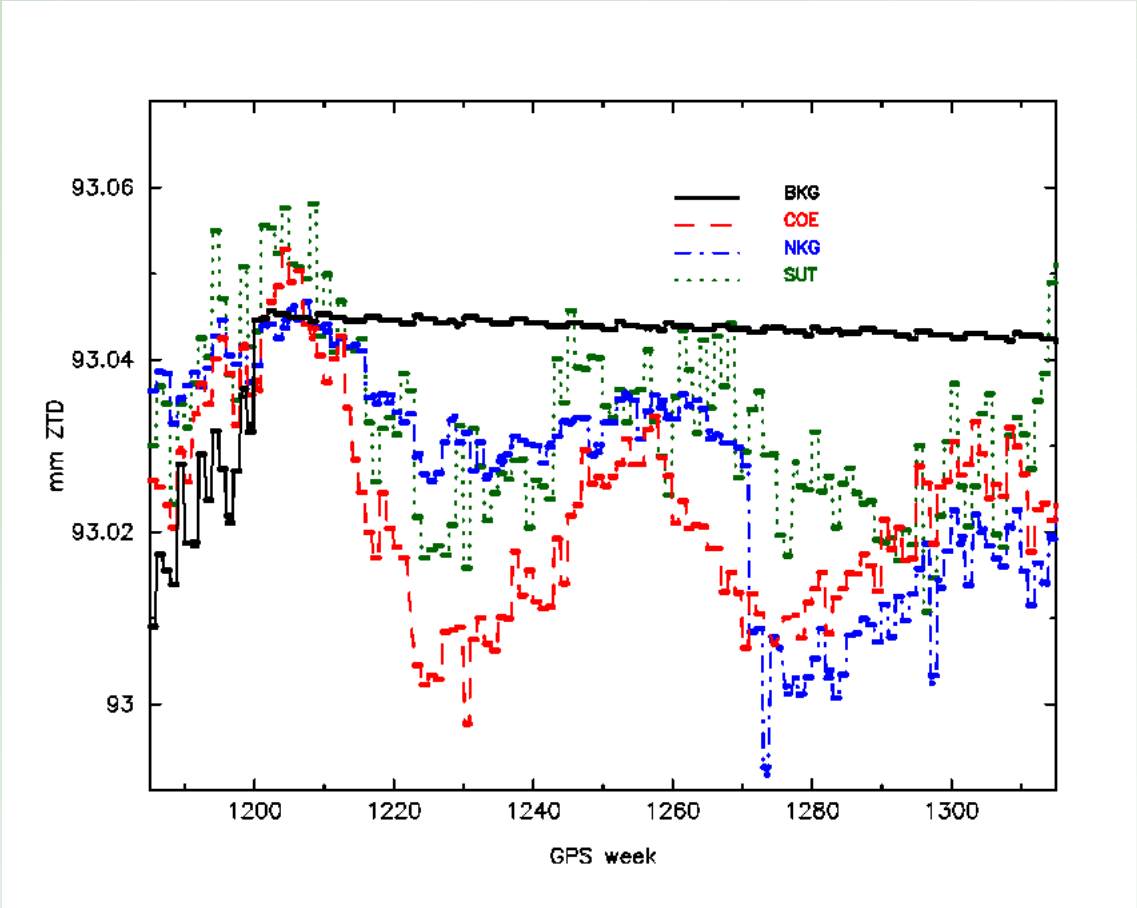
Ellipsoidal height REYK



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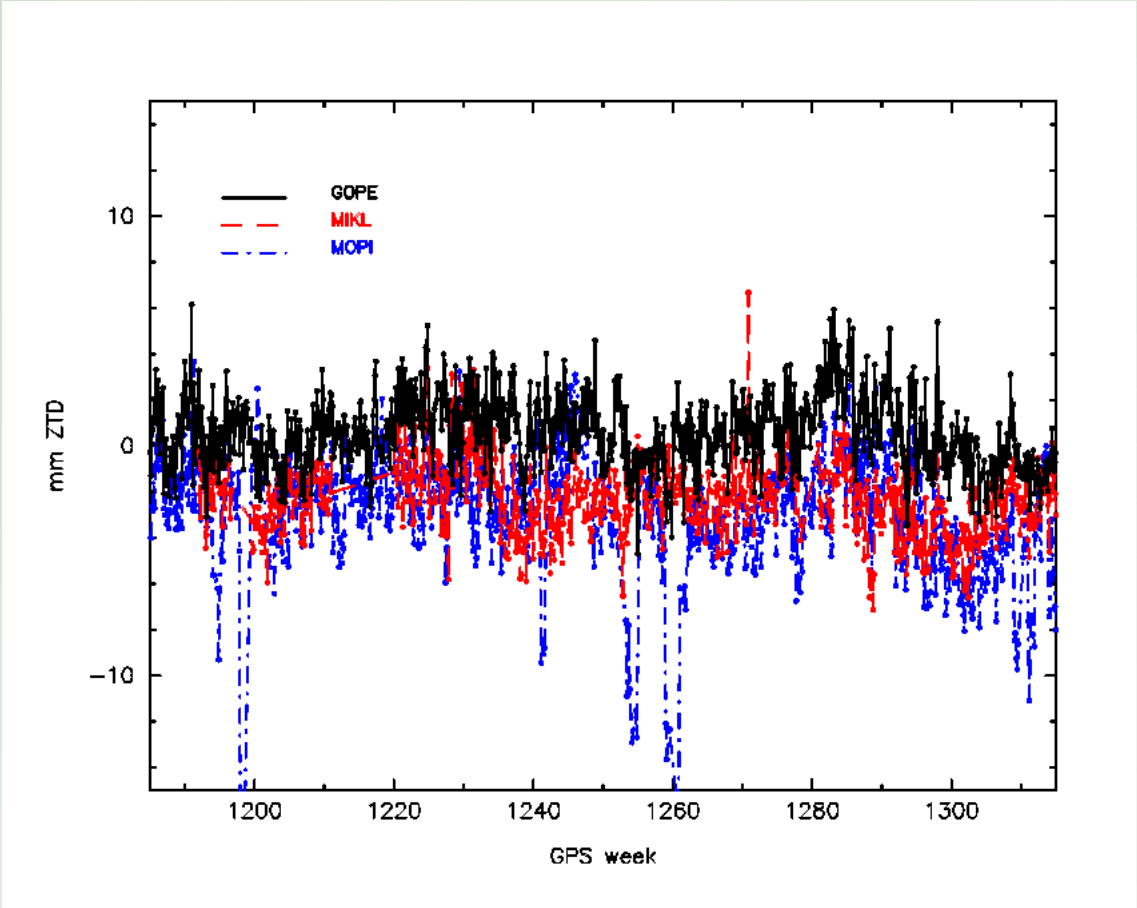
Combination results: GOP vs. OLG



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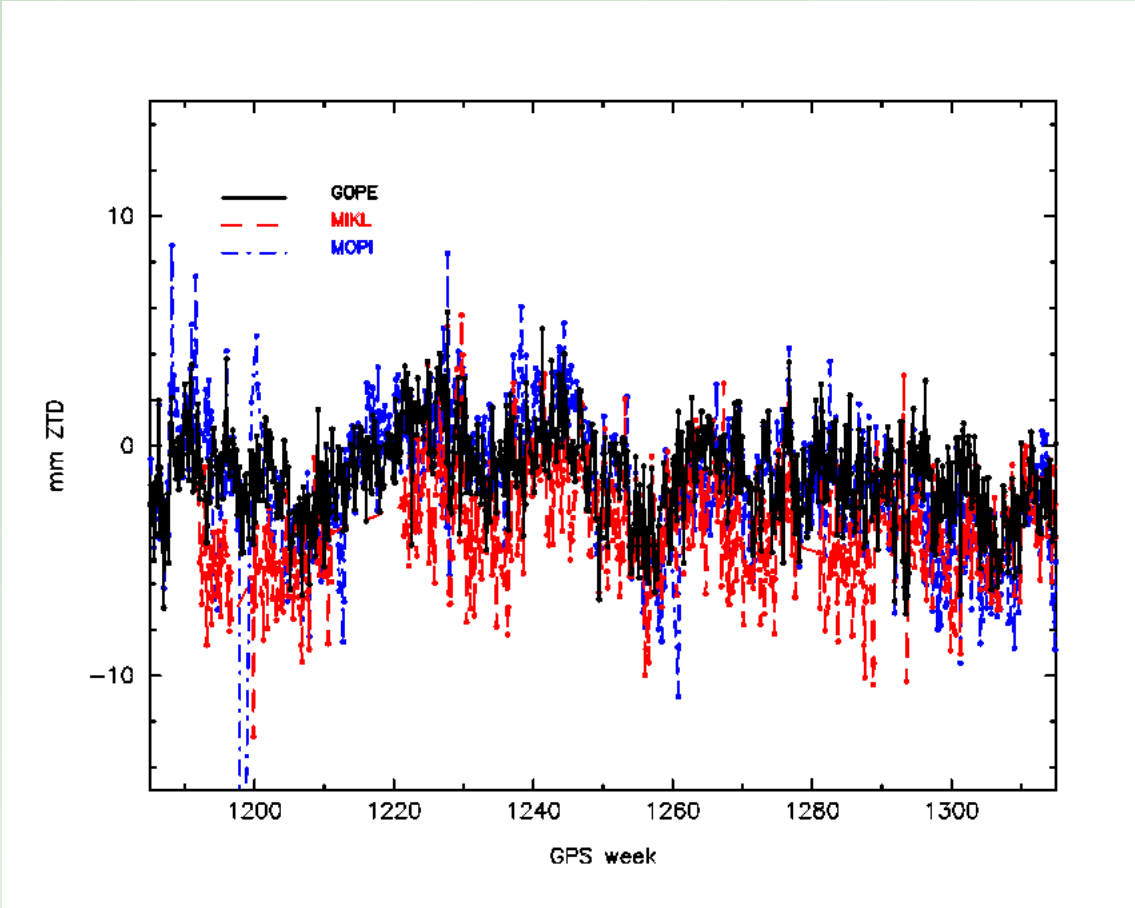
Combination results: GOP vs. SUT



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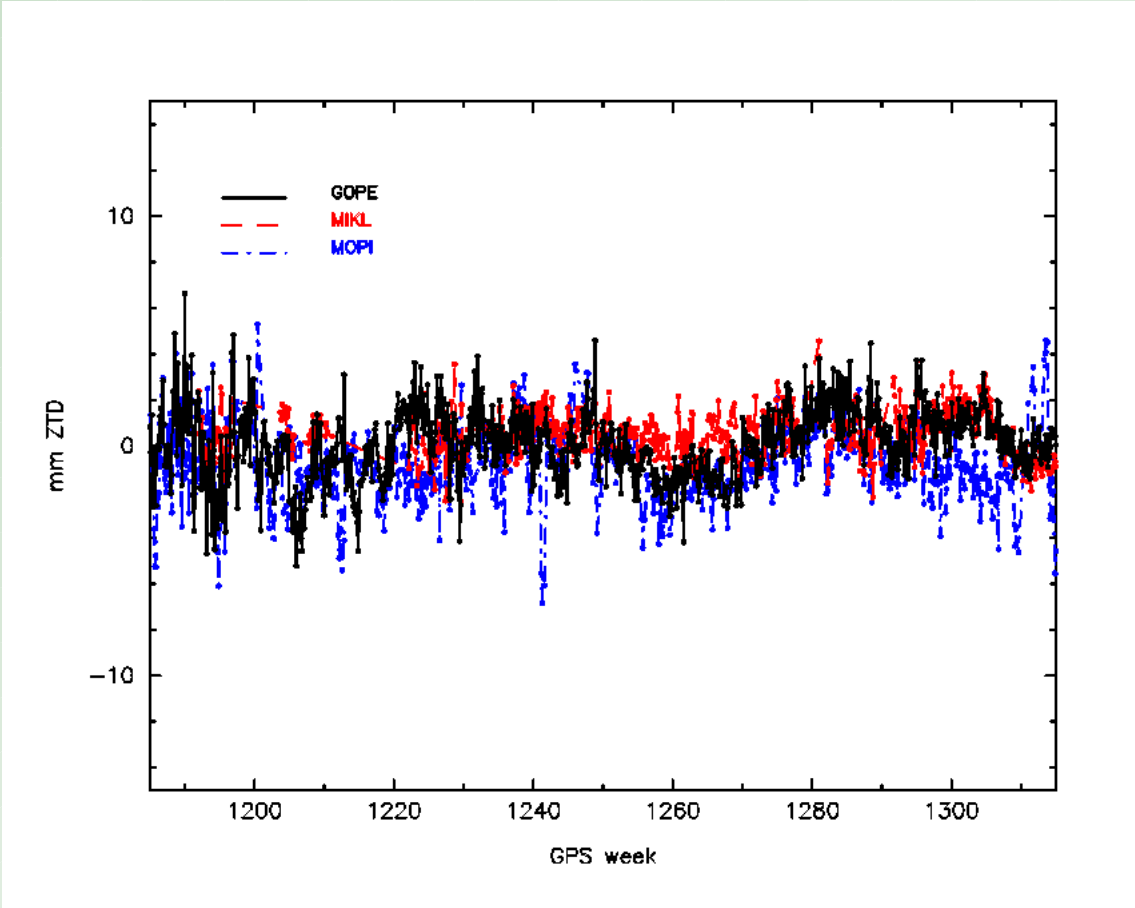
Combination results: GOP vs. WUT



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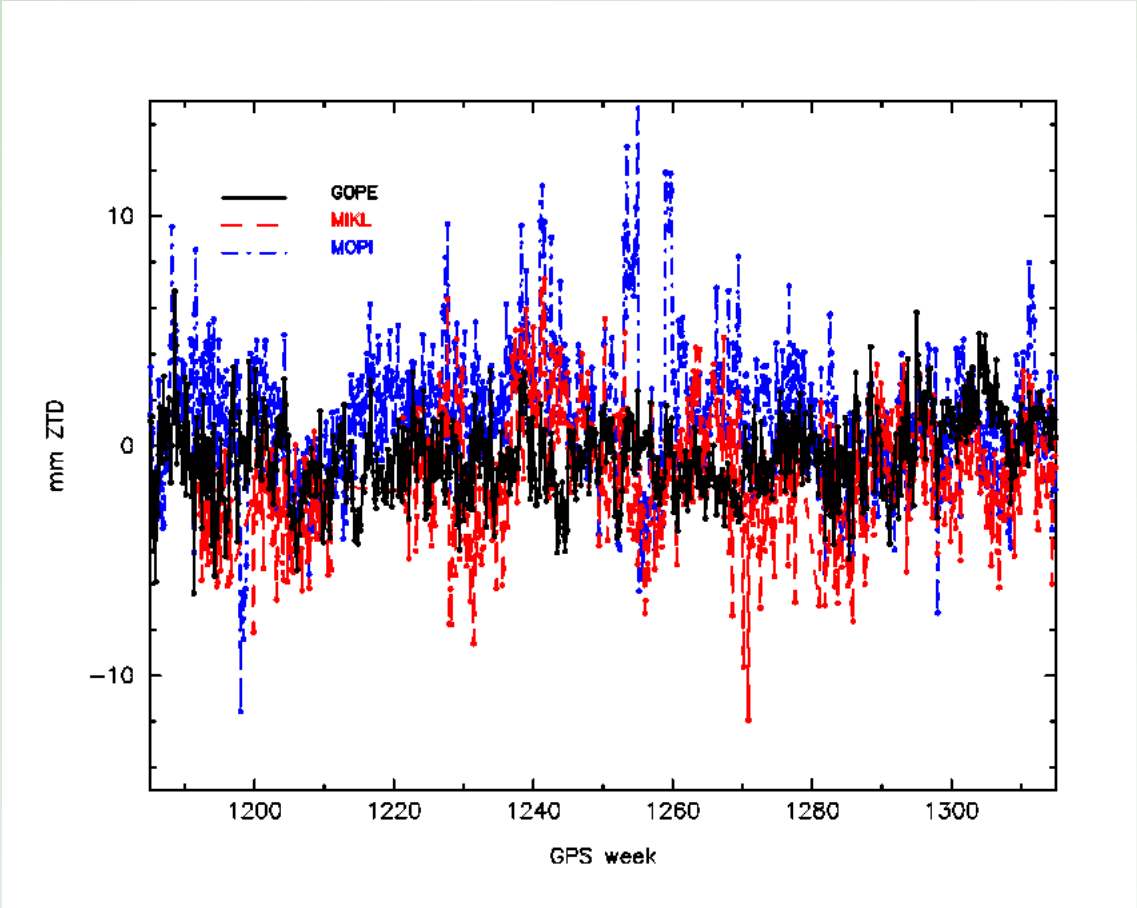
Combination results: OLG vs. SUT



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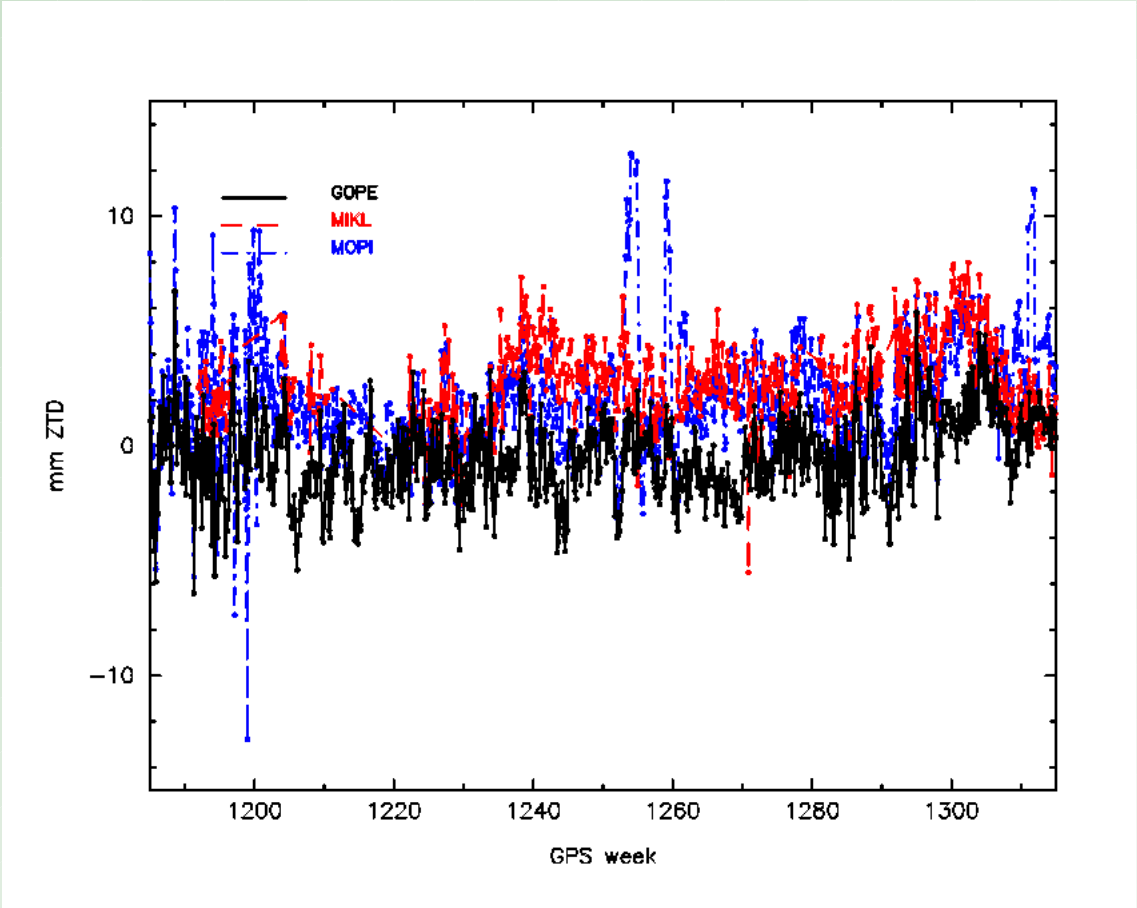
Combination results: OLG vs. WUT



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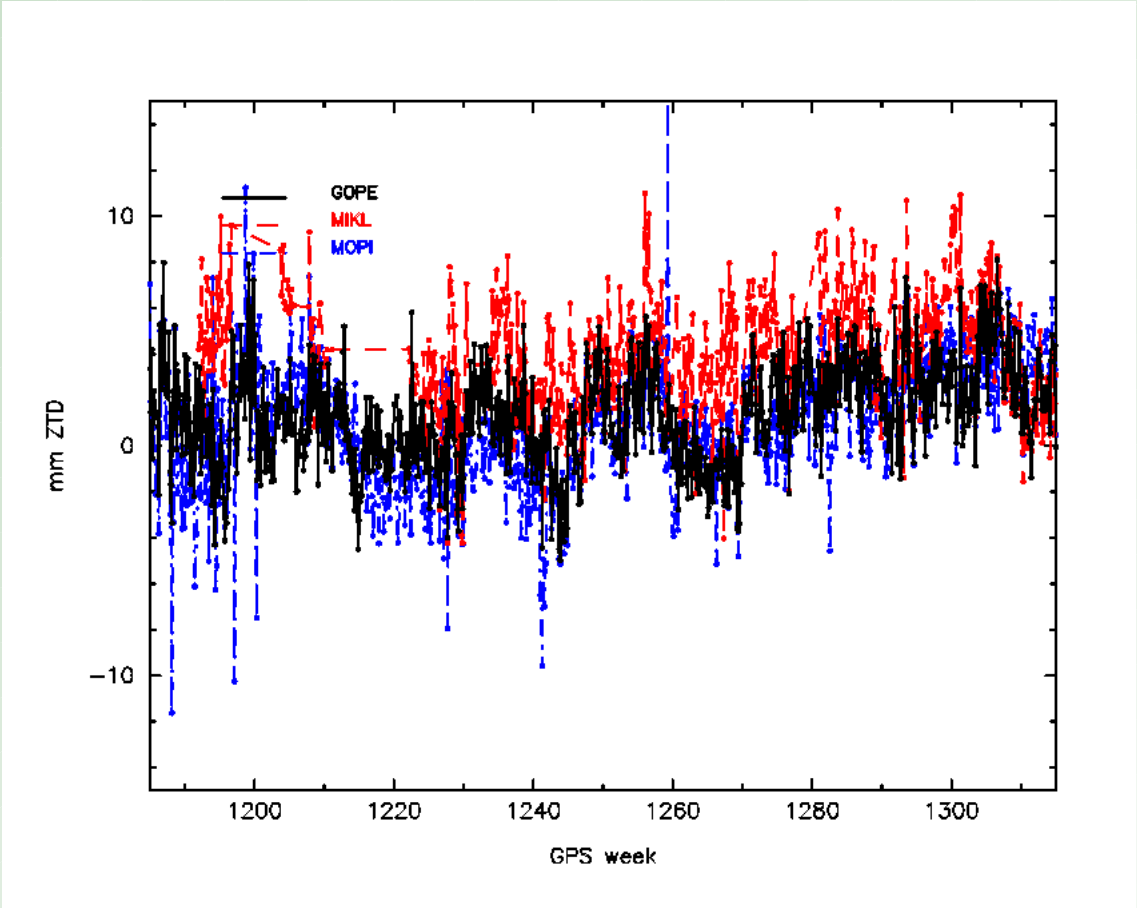
Combination results: SUT vs. WUT



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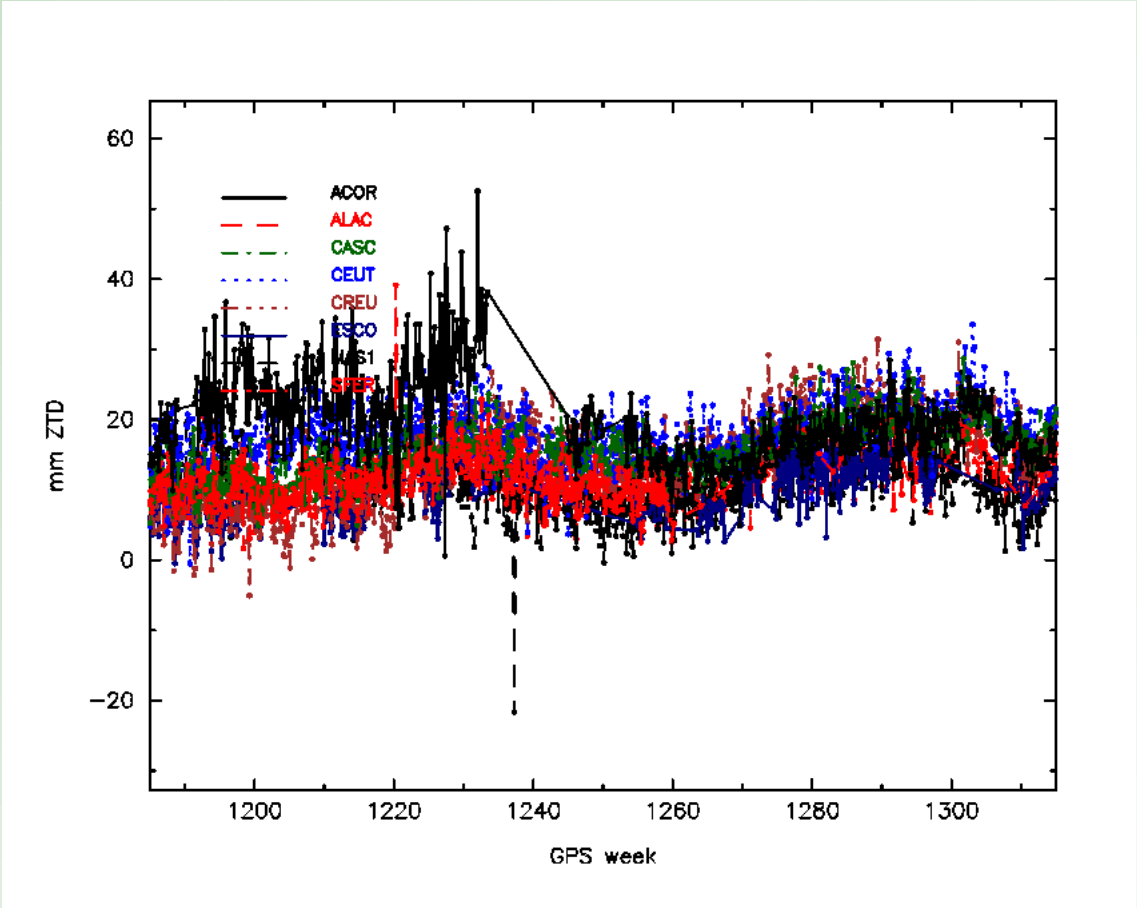
Combination results: BEK vs. DEO



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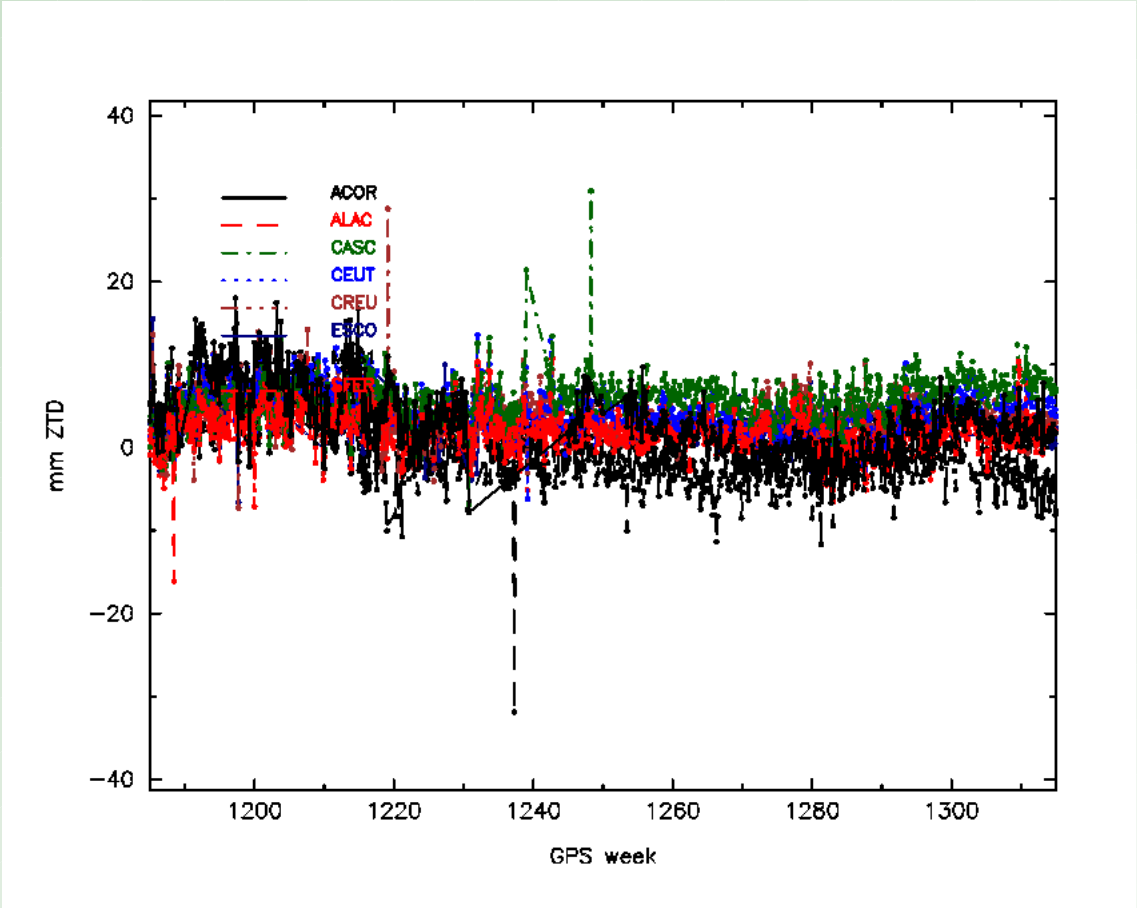
Combination results: BEK vs. IGE



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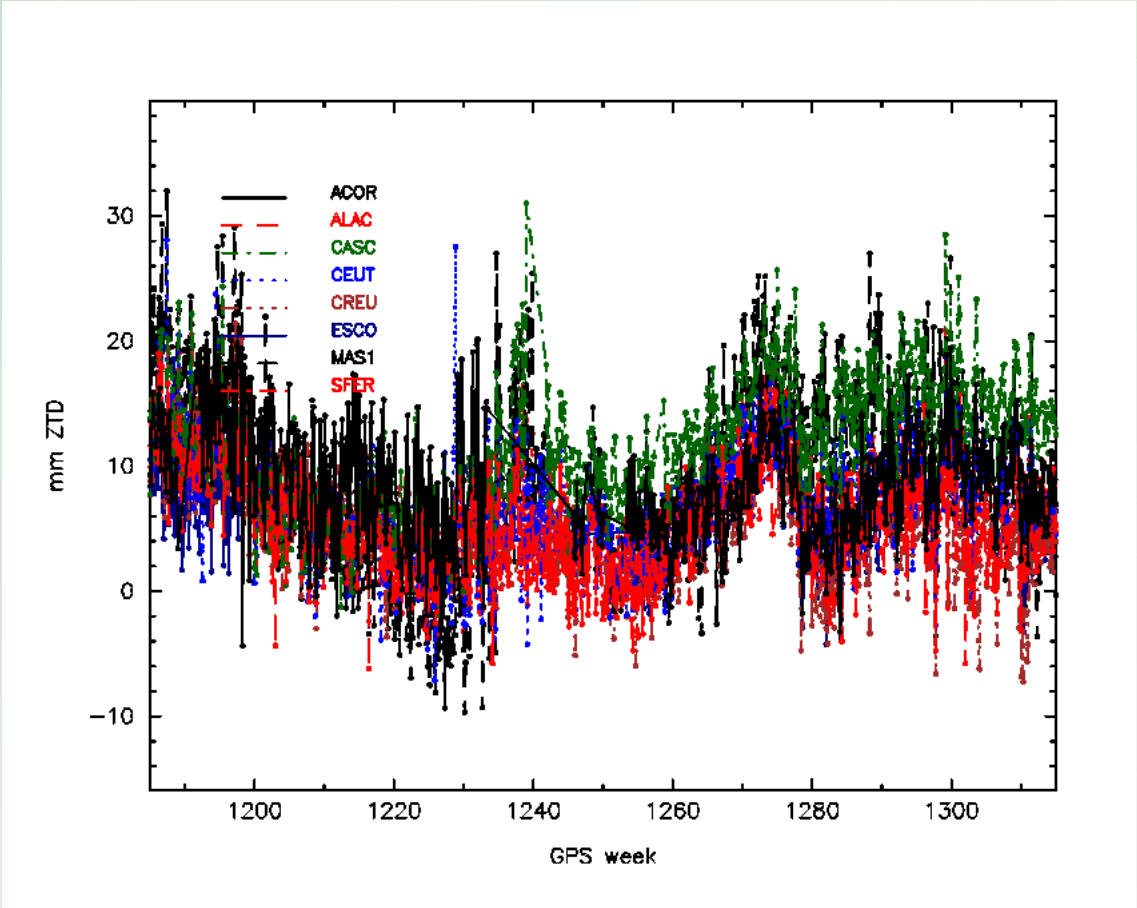
Combination results: BEK vs. IGN



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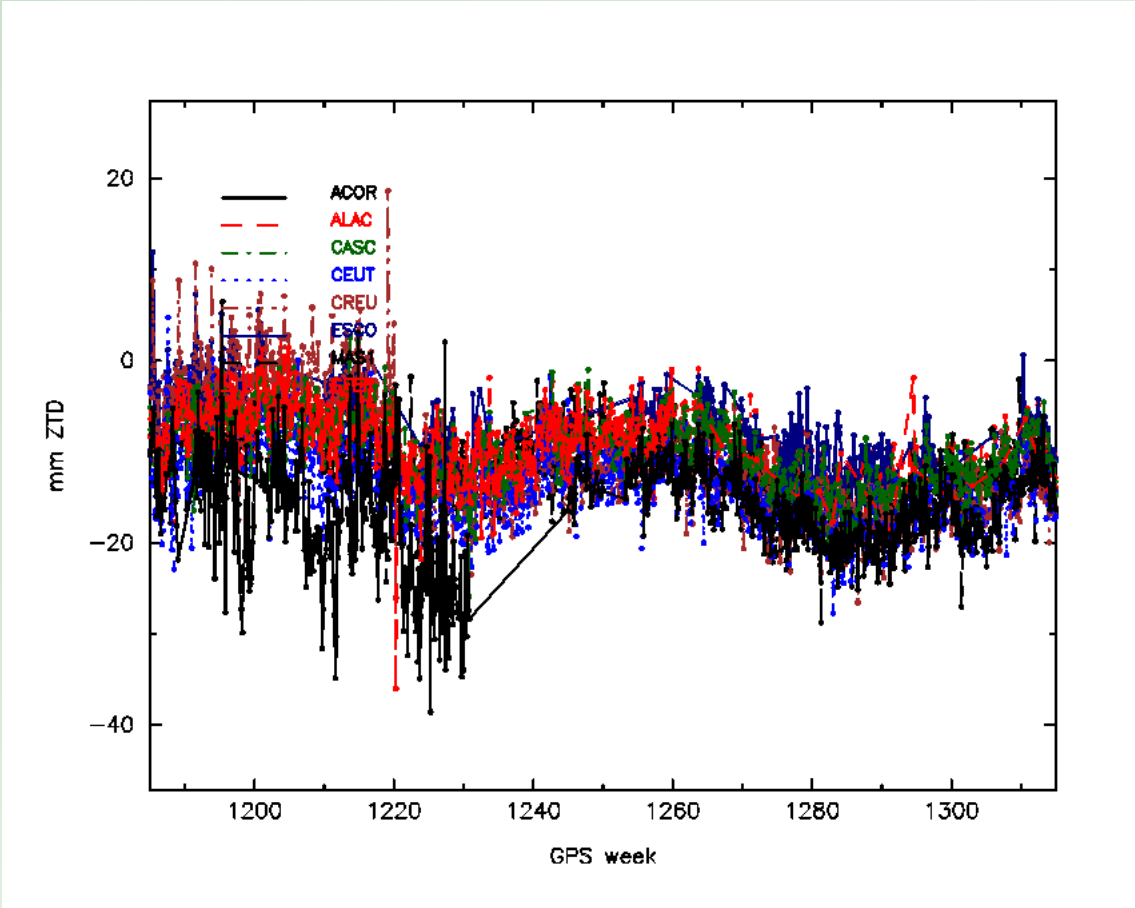
Combination results: DEO vs. IGE



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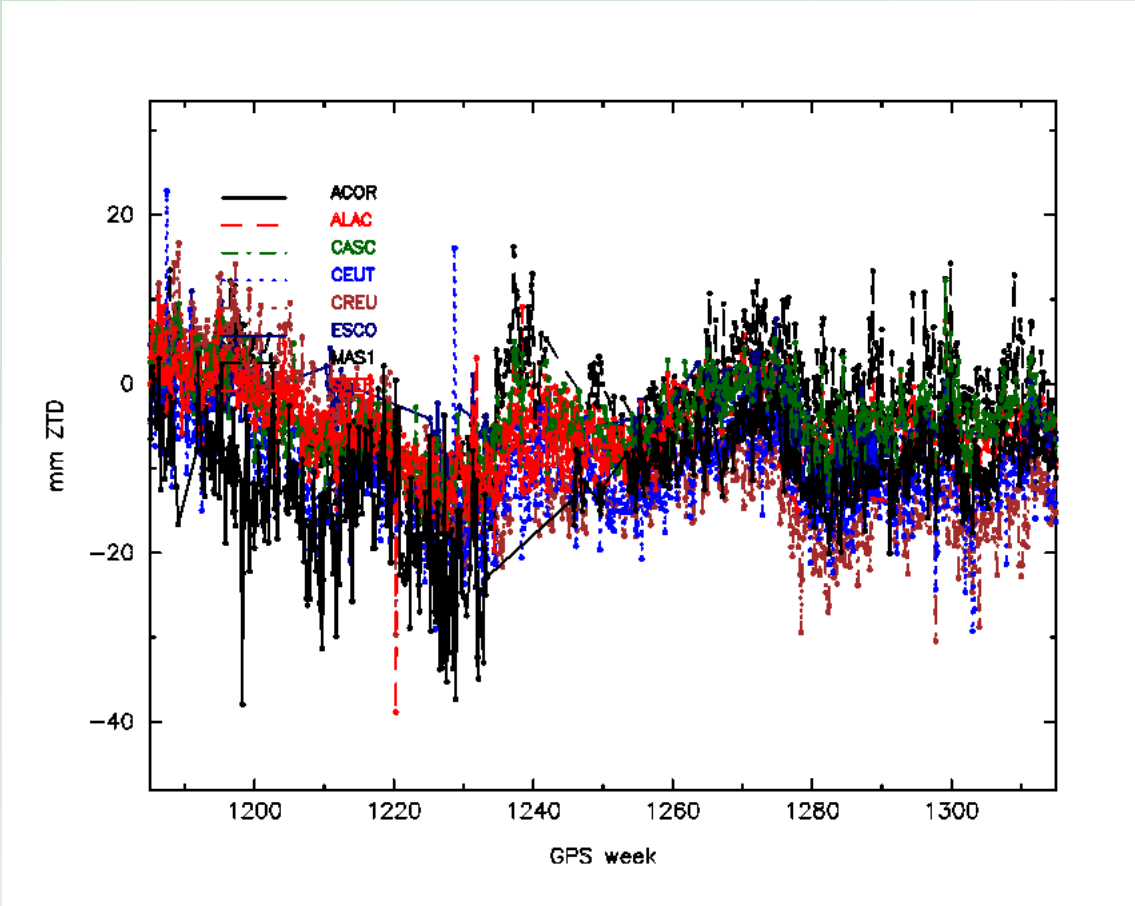
Combination results: DEO vs. IGN



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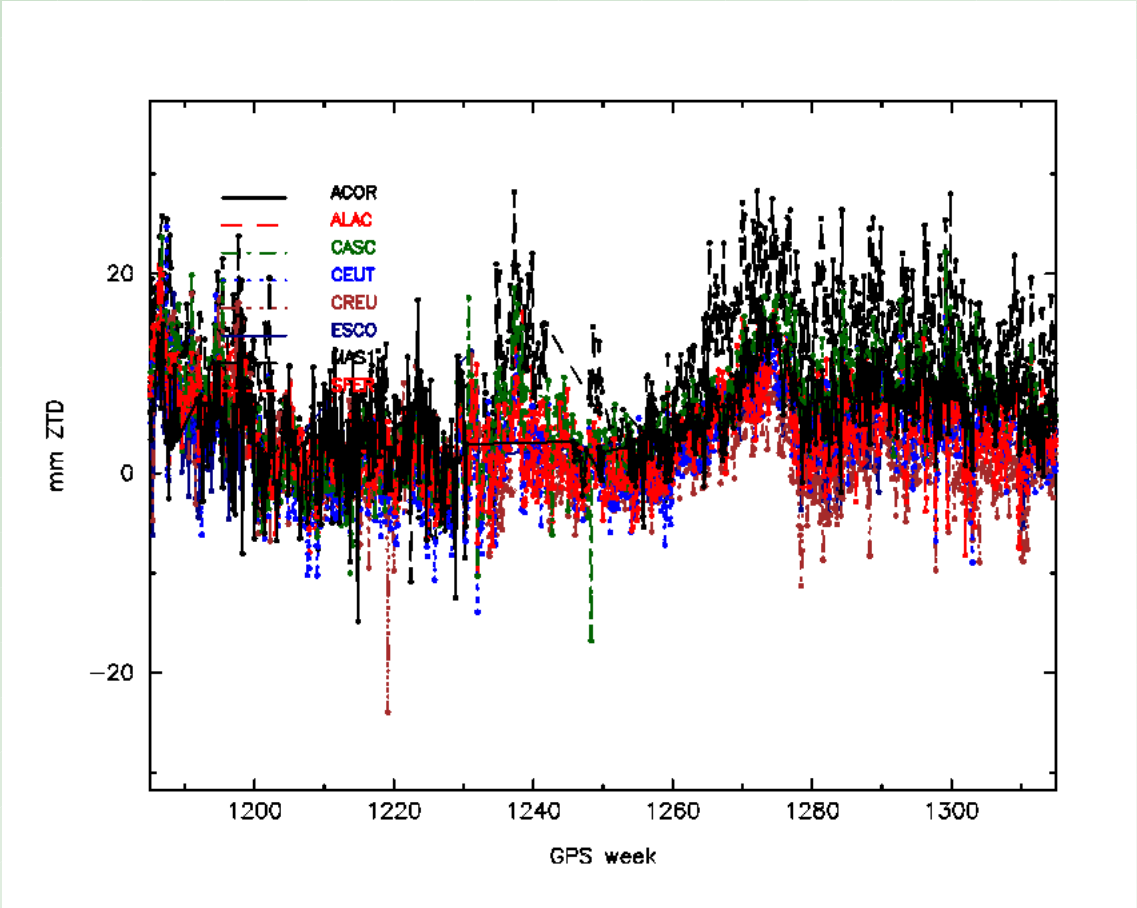
Combination results: IGE vs. IGN



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Conclusions

- Change from Bernese version 4.2 to 5.0 gives systematic but small biases; too many changes at a time to separate impacts
- A priori troposphere modeling DRY NIELL and estimated ZTD parameters WET NIELL recommended
- Horizontal gradient parameters: impact on ZTD solution to be estimated
- „Re-substitution“: not really necessary
- Identical set of Ocean Tide Loading parameters → EPN LAC mails 487, 488