Results of the GNSS re-processing effort at GOP

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Outline

- GOP-repro1 effort evolution
- Brief strategy description
- Basic solution runs (1st, 2nd, Benchmark, ..)
- Raw coordinate time-series (daily solutions)
- Assessment of EPN densification datum definition
- Long-term combination – clean time-series
- Troposphere evaluation
- Summary

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GOP1 effort evolution

- Reprocessing system setup (Sep, 2010)
- 1st run completed (Sep-Oct, 2010)
  - Initial checks for the routine settings, data and products availability, solution stability
  - Some problems resolved
  - First raw daily time-series
- 2nd run completed (Nov-Dec, 2010)
  - Improved RINEX data handling according to minimize data removal (problem using old version of teqc software)
  - Weekly solution implemented and provided, submitted
- Benchmark campaign (Jan, 2011)
  - Processed daily, weekly for CRD+TRP, submitted
- 2nd run (a) weekly re-combination (Mar, 2011)
  - Fixed outlier rejection in weekly combination, re-submitted
- Long-term combination – crd+vel (Mar, 2011)
- 3rd run expected (Apr-May, 2011 ?)
  - Some 'historical' stations with short-term period included
  - Considering a full EPN or globally referenced solution

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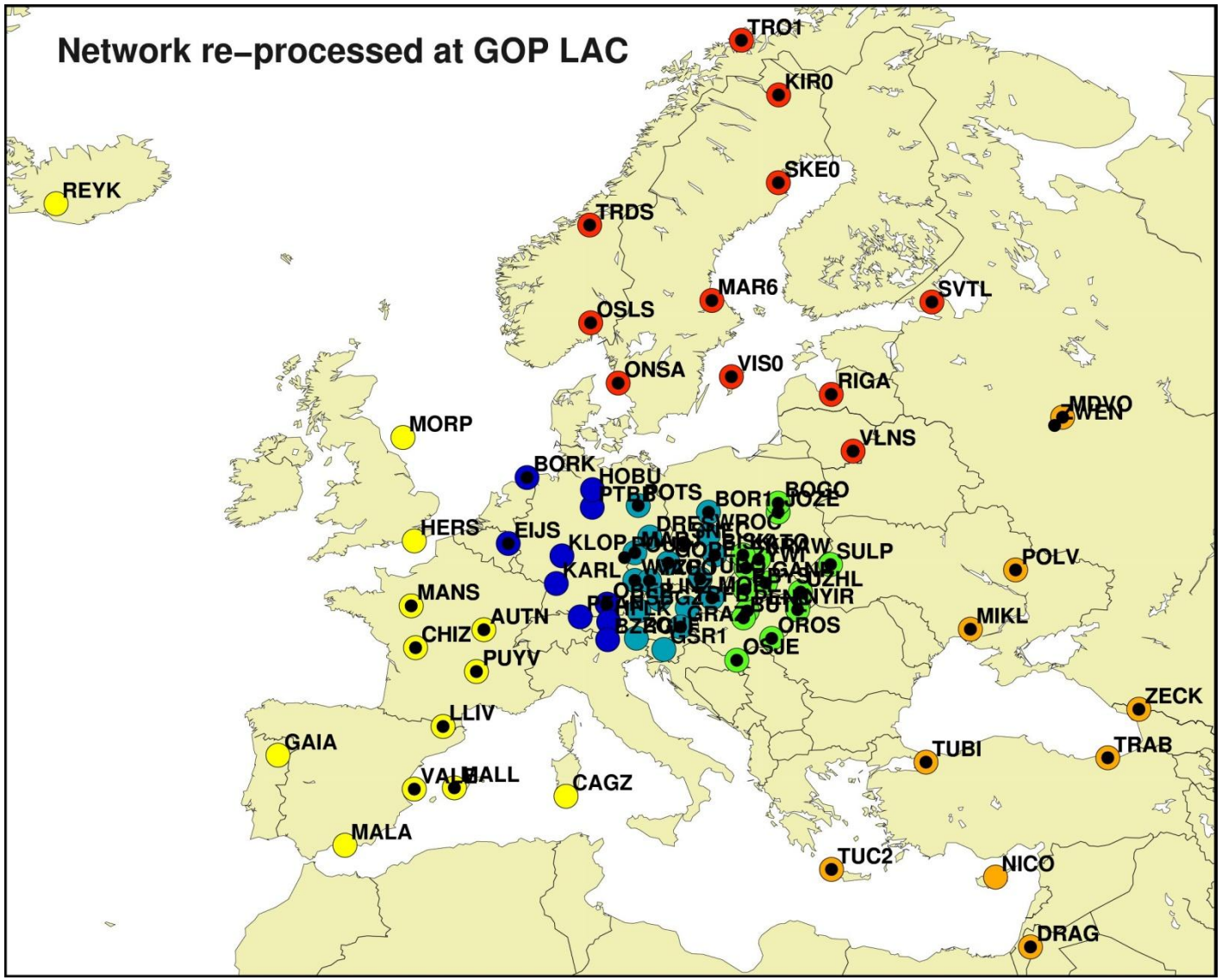
Reprocessed network for GOP



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Processing strategy

- Based on IGS repro1 orbits and ERPs
- All currently used models consistent with the existing GOP routine for EUREF network
- Basic strategy consistent with standard weekly GOP contribution to the EPN
- Extensive parallelization for 4-7cores with adaptable cluster definition
- Robust procedure with a possibility of re-iteration after identifying problems with individual satellite or station
- Datum definition on a daily basis for the estimation of ETRS89 coordinates used for the draft time-series plots

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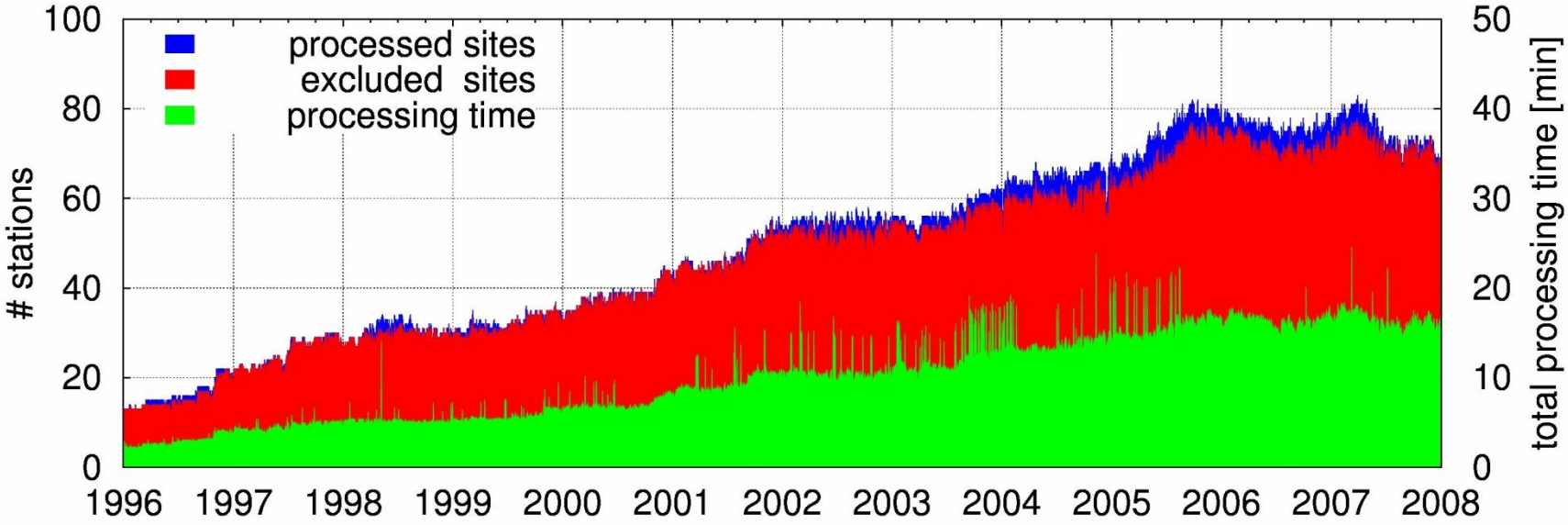
Additional characteristics

- Excluded stations with less than 12h data
- Number of all stations 17-75
- Processing time from 4-18 min
- 4× increase in total number of stations -> 4× processing time



Fixed common problems

1999:266

- More than 50% observations removed
- IG1 orbits (1028:4) – irrelevant drift in clocks
- Fixed by using broadcast orbits

2004:101

- RXOB3 setup wavelength factor 2/1 instead of 1/1 for G10
- Crashed at MAUPRP for GRAZ
- Fixed by removing erroneous at the end of GRAZ RINEX file

2nd run:

- Weekly solution: daily outliers not correctly excluded
- Fixed and 2a run reprocessed and resend to BKG

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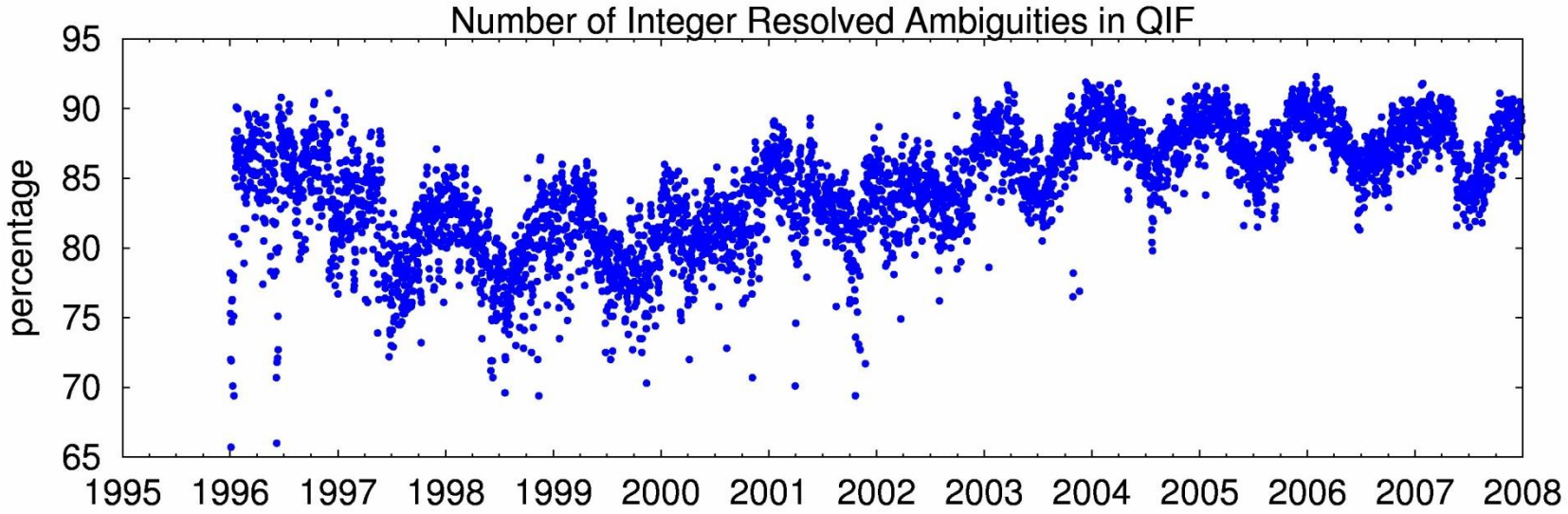
Ambiguity resolution

- QIF strategy only used
- 85% ambiguities resolved in average
- Improved performance after 2003 !
- Seasonal variation – higher success rates at winters
- CODE Ionosphere model applied (instead of internal)



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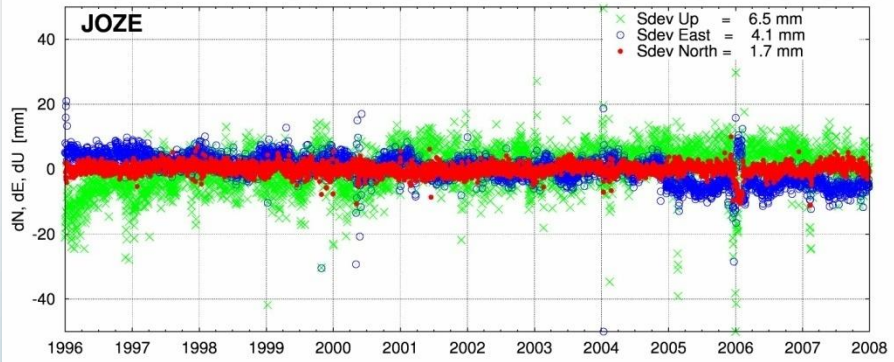
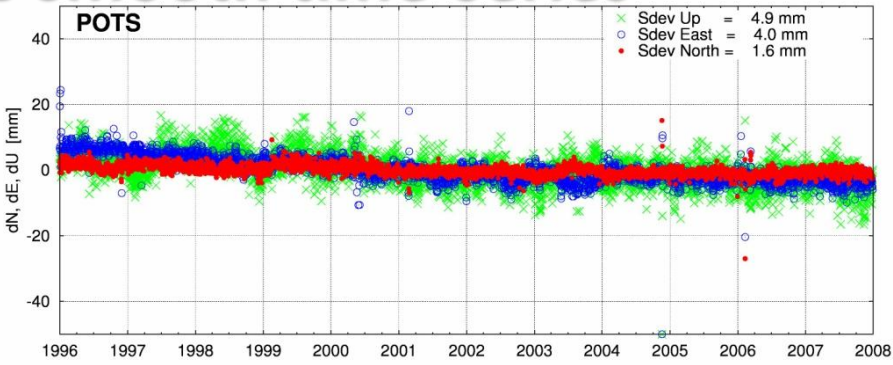
Raw ETRS time-series (1)

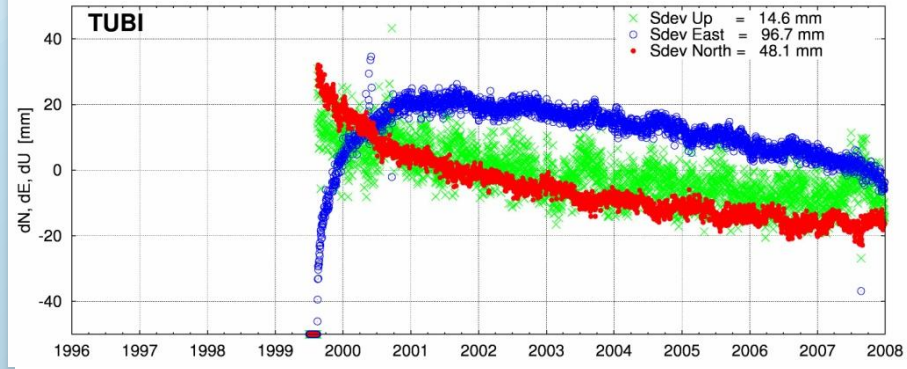
For daily solution, GOP applies iterative datum definition, thus daily raw coordinate time-series clearly reveals all the issues

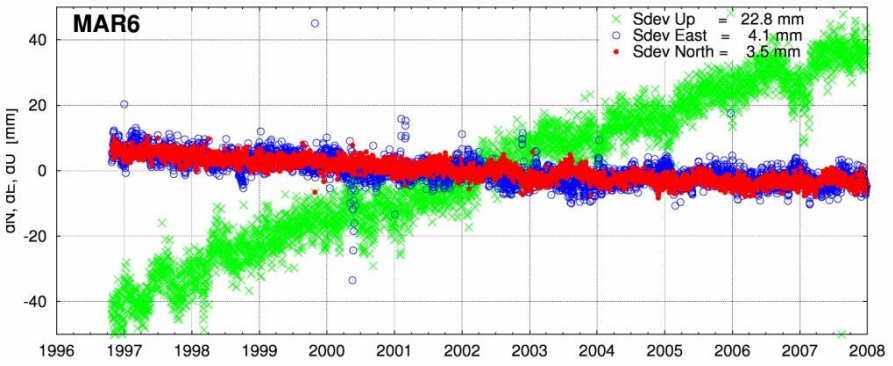
- **JOZE & POTS – continuous smooth time-series**





- **TUBI – postseismic movement, MAR6 – postglacial uplift**

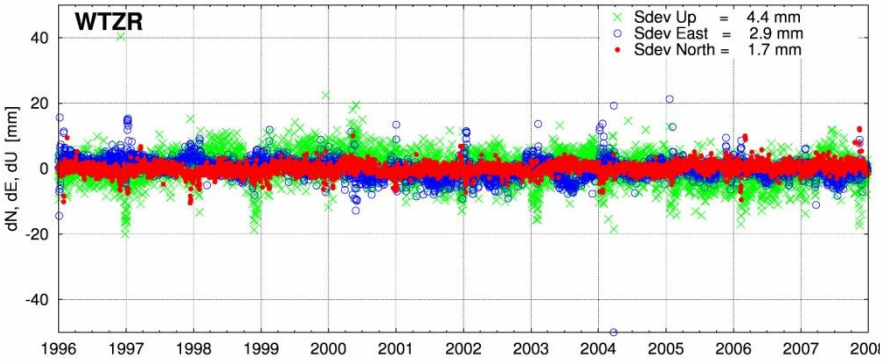


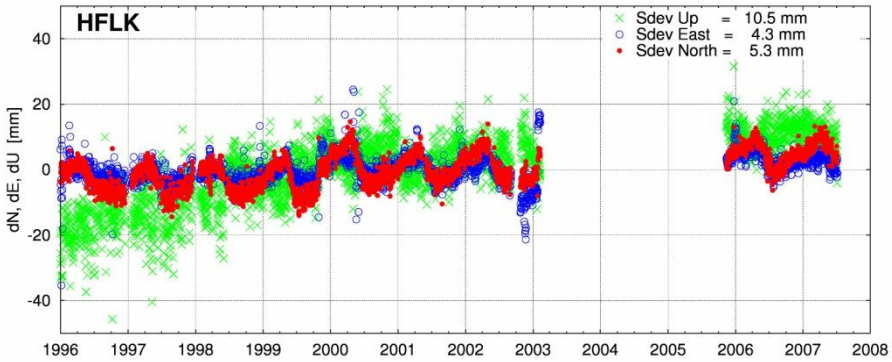


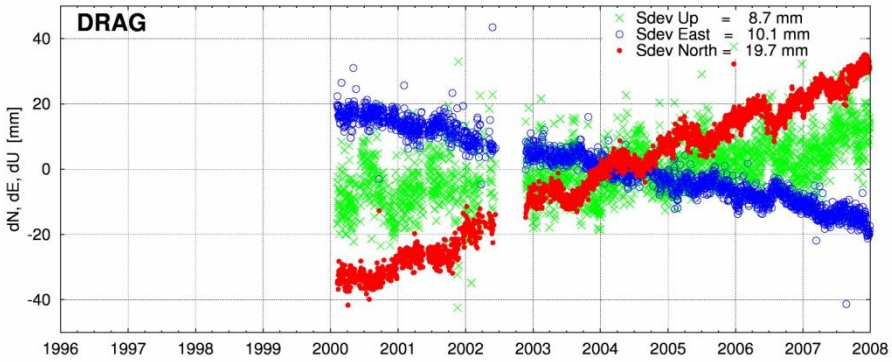
Raw ETRS time-series (2)

HFLK,WTZR – snow/ice problem

DRAG – other seasonal problem

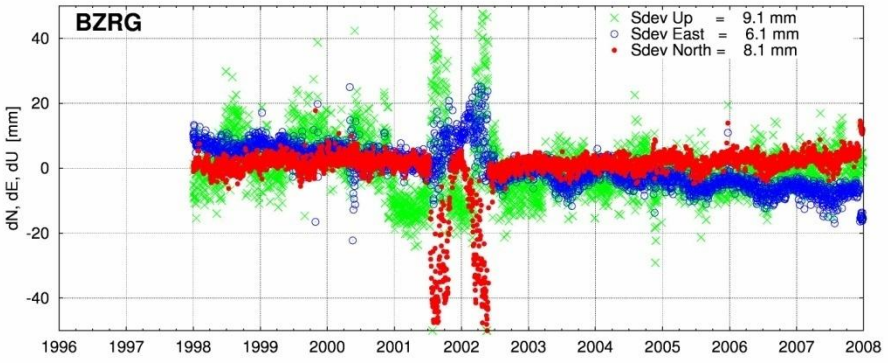


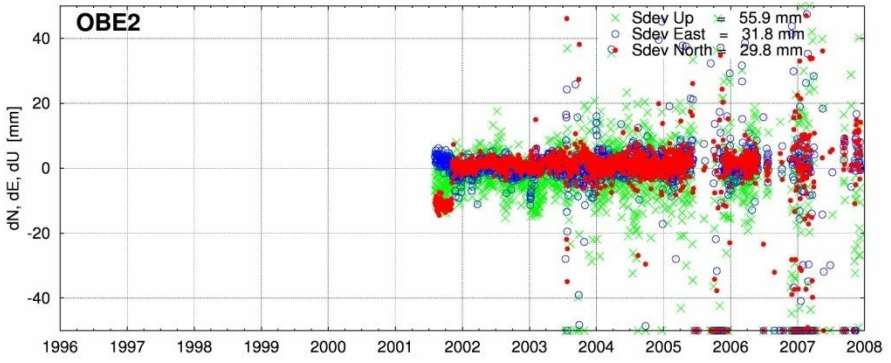




BZRG – occasional data problem

OBE2 – low quality data





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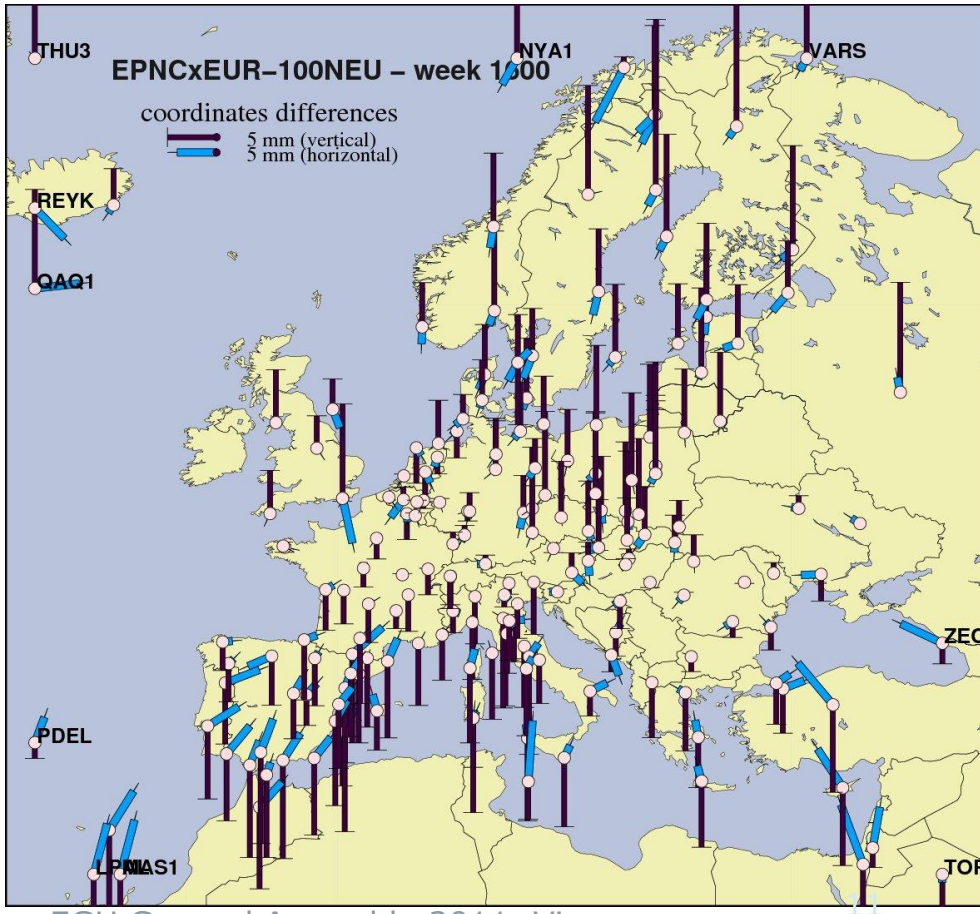
Testing EPN datum definition

- Observed N-S tilt between recent EUREF AC weekly combinations (or EUREF campaigns) and the EPN cumulative solution
- GOP repro-1 provides a 'homogenious' weekly results to look into history
- Compared CRD on weekly basis:
  - 1a-set EPNC_1300 (CRD+VEL)
  - 1b-set EPNC_1600 (CRD+VEL)
  - 1b-set ITRF2005 (CRD+VEL)
  - 1c-set ITRF2008 (CRD+VEL)
  - 2a-set EUREF AC (CRD)
  - 2b-set GOP repro1 (CRD)
- Helmert transformations:
  - NEU or XYZ
  - 3-TRA or 3-TRA + 3-ROT + 1-SCL
- Datum definition assessed by:
  - All common stations set as fiducial
  - Iteratively select the 'consistent' set
  - Solution numbers per sites applied



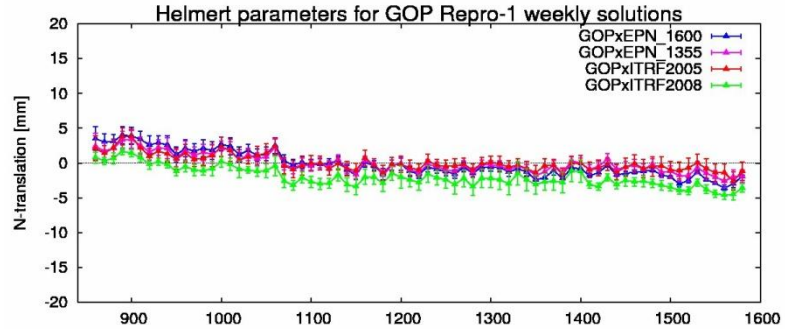
Helmert parameters

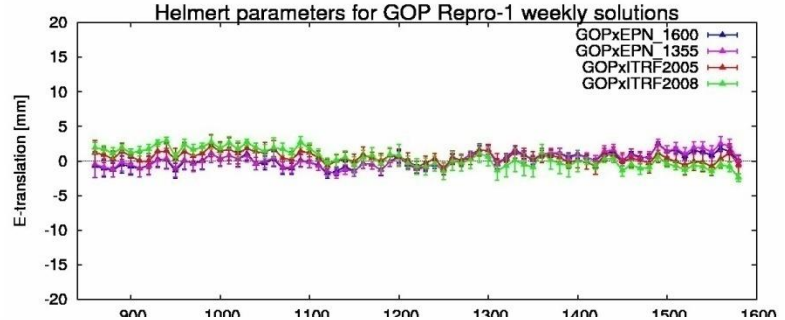
GOP-repro1

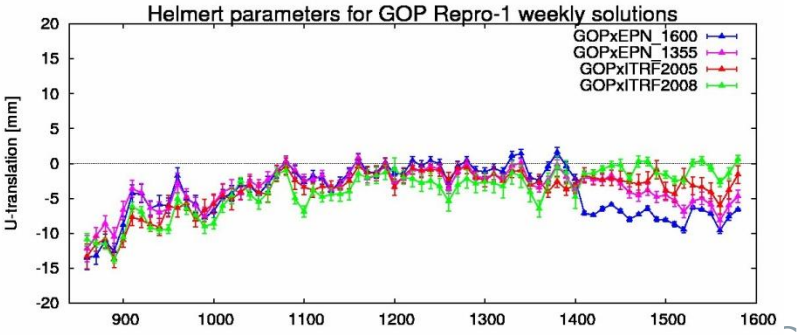
x

EPN_1600, EPN_1355, ITRF2005, ITRF2008

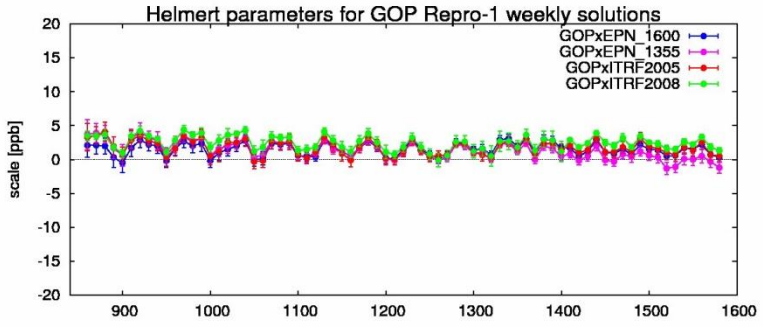
N, E, U - translations

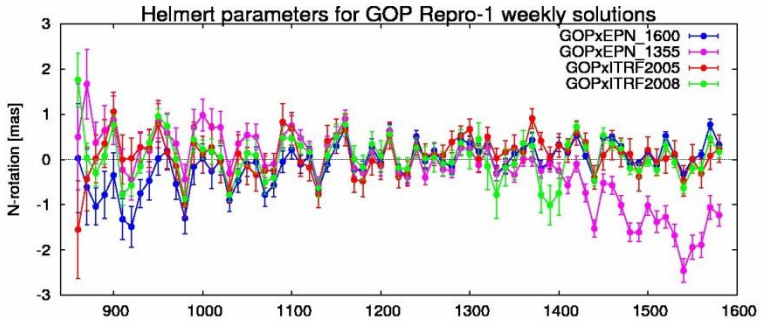


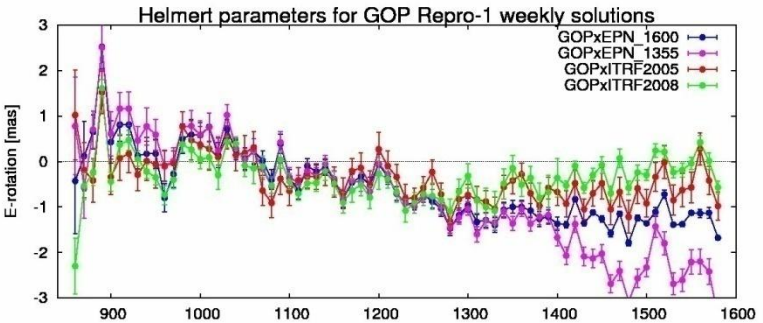


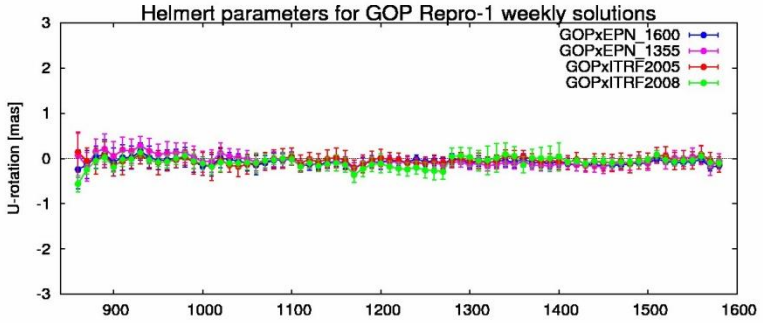


N, E, U, rotations + scale

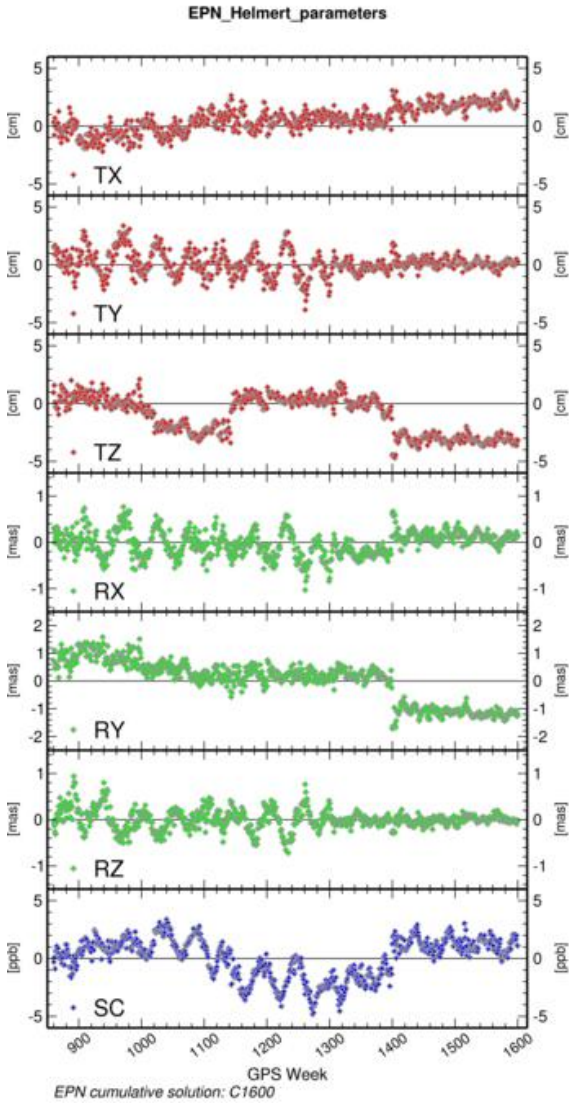


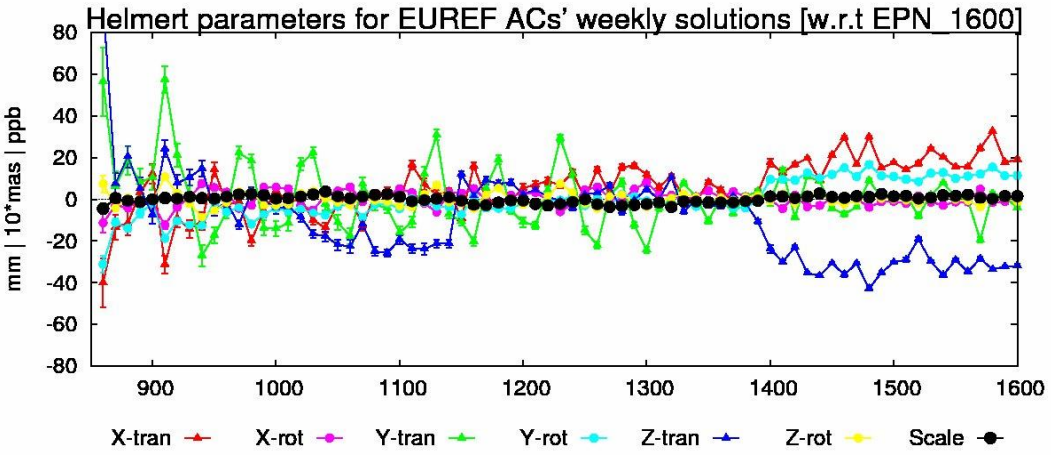


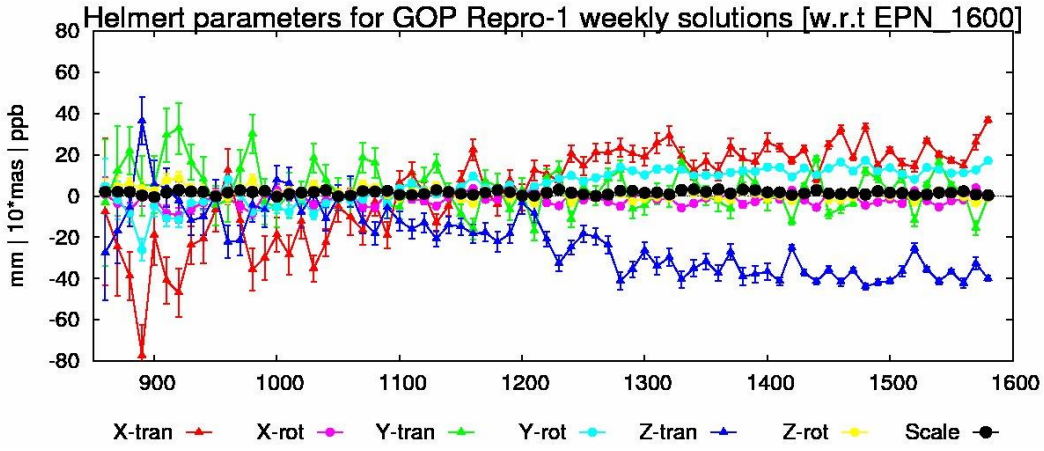




Helmert parameters (XYZ)

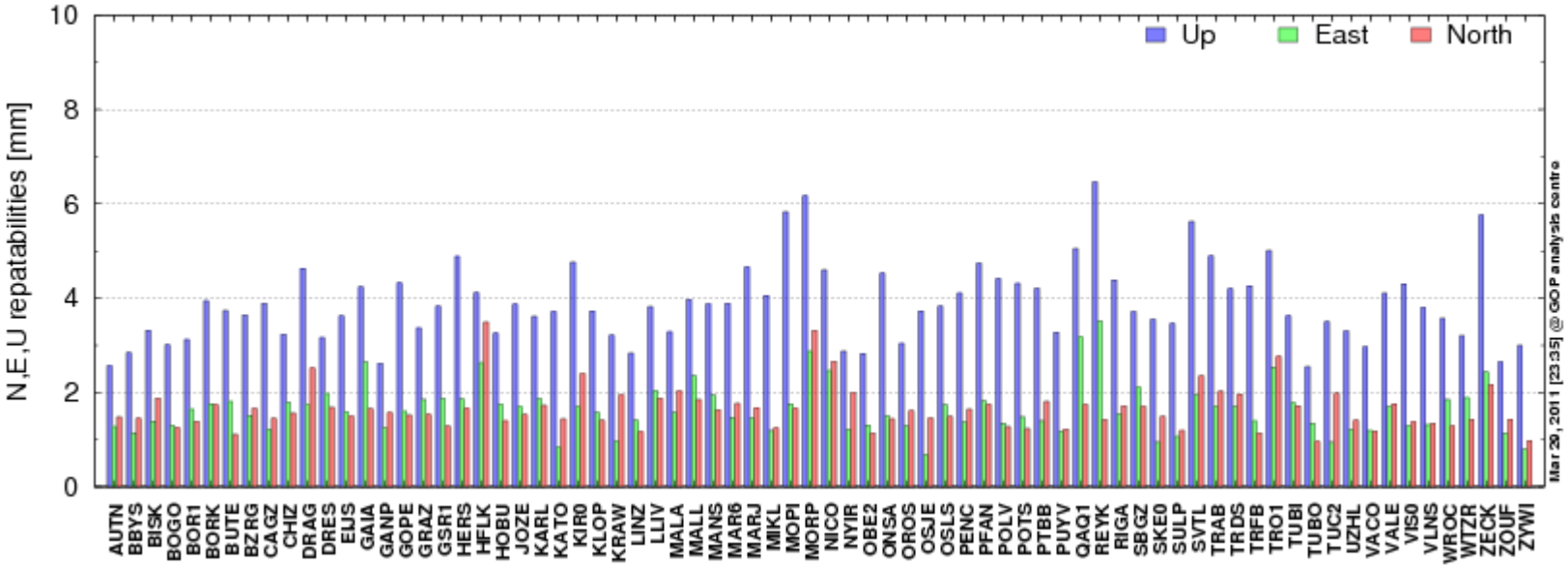






Long-term combination

- Combination based on weekly solutions
- NNT condition for 17 fiducial stations [w.r.t. ITRF2005]
- Weekly outlier rejection for specific site (very few)
- Setup of coordinate/velocity intervals
- Generate clean time-series of the coordinate residuals
- Plot velocities and residuals after Helmert transformation



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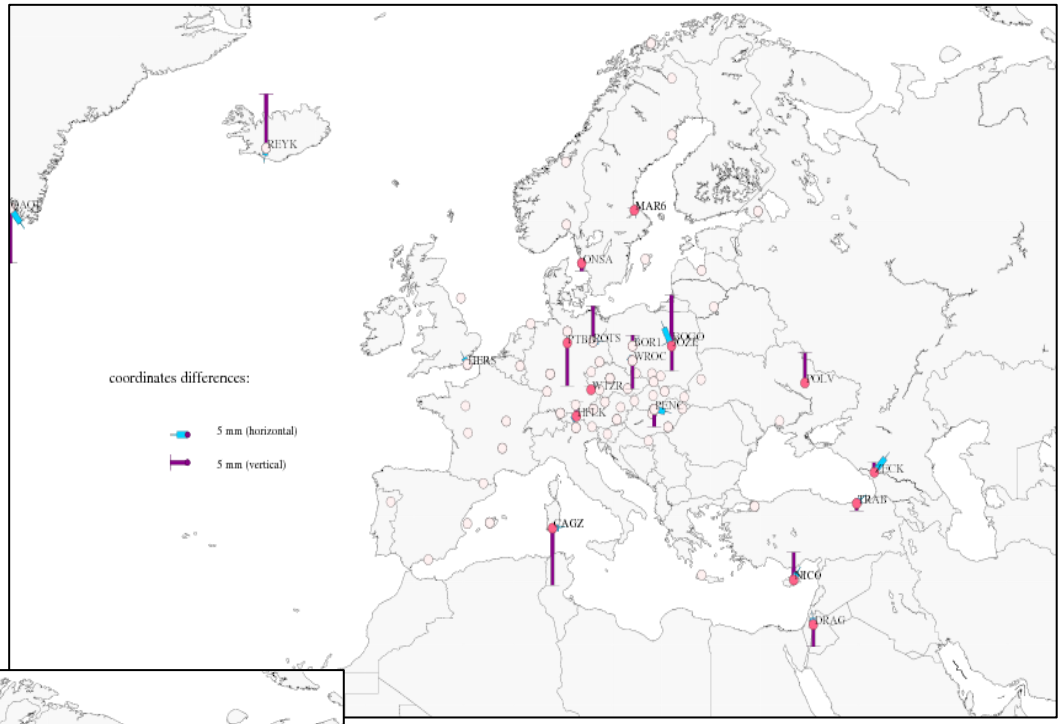
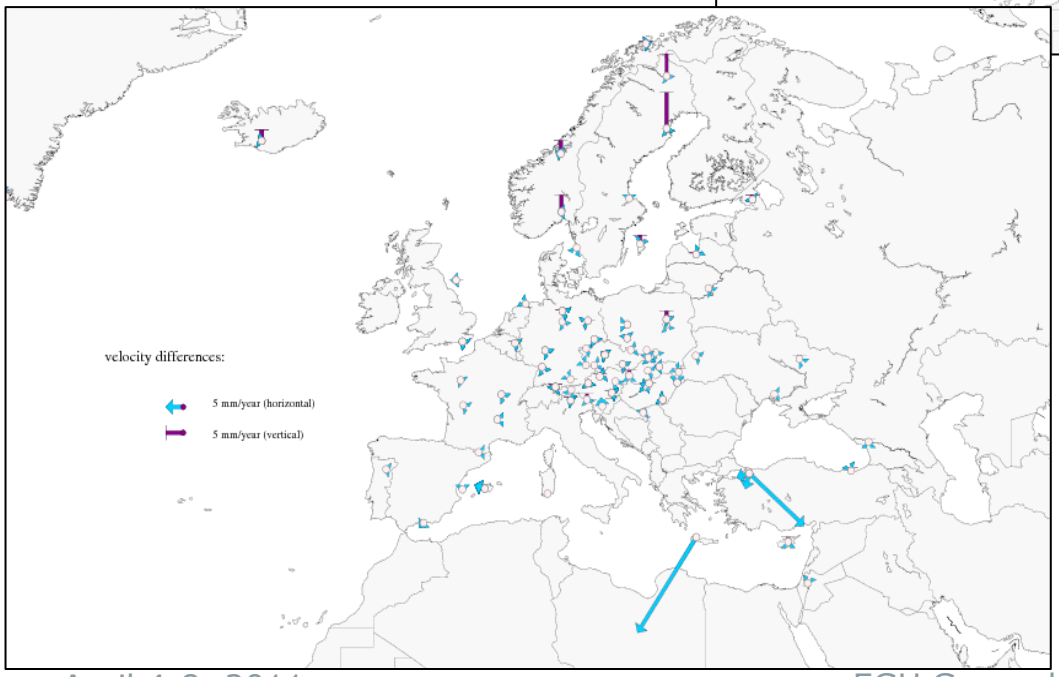
Combination

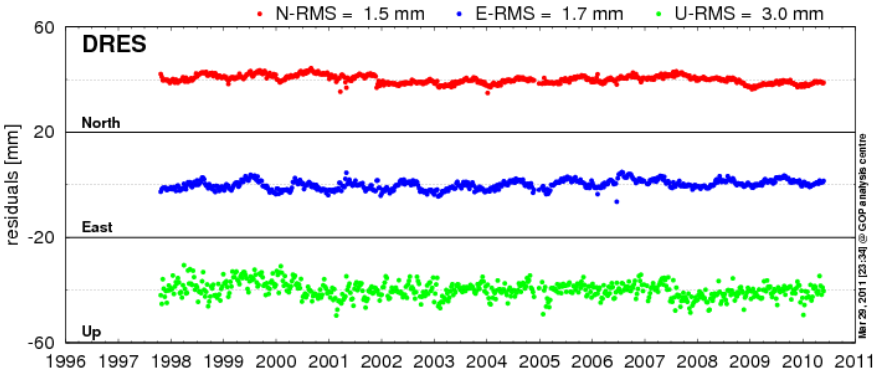
NEU residuals from the Helmert tranformation
3 translations [mm] ->
17 fiducial stations

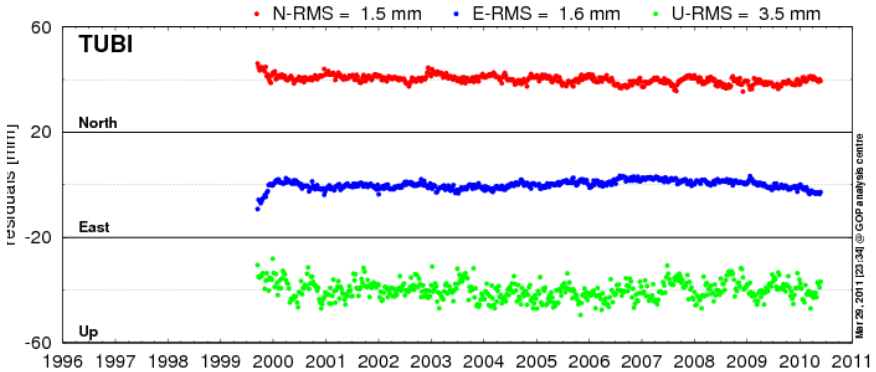


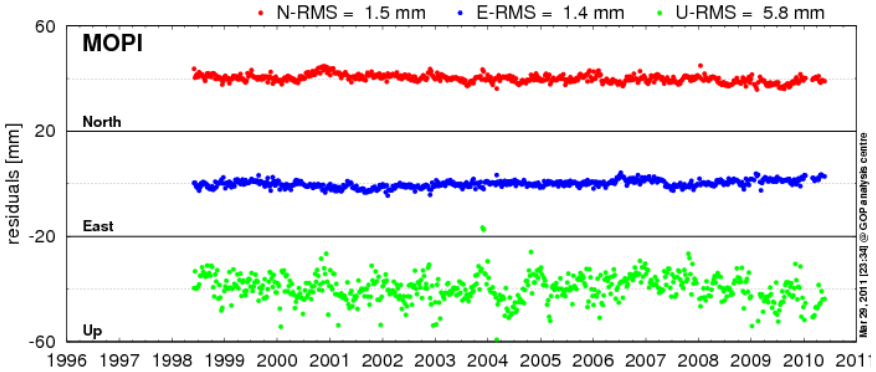


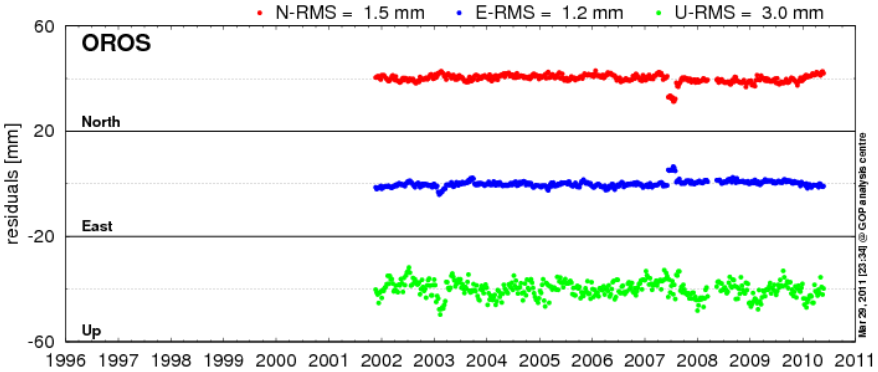
<- estimated horizontal and vertical velocities w.r.t. ITRF2005 [mm/year]

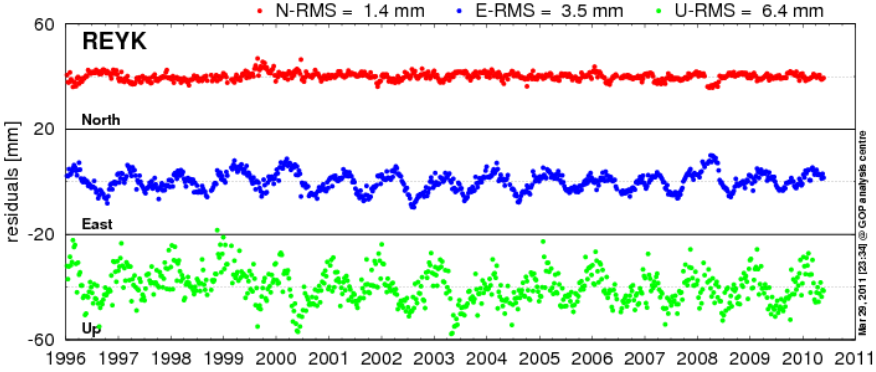
Combination – CRD time-series

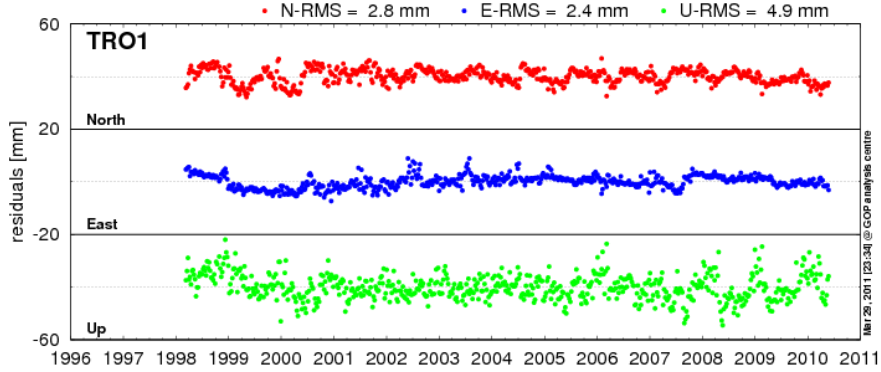












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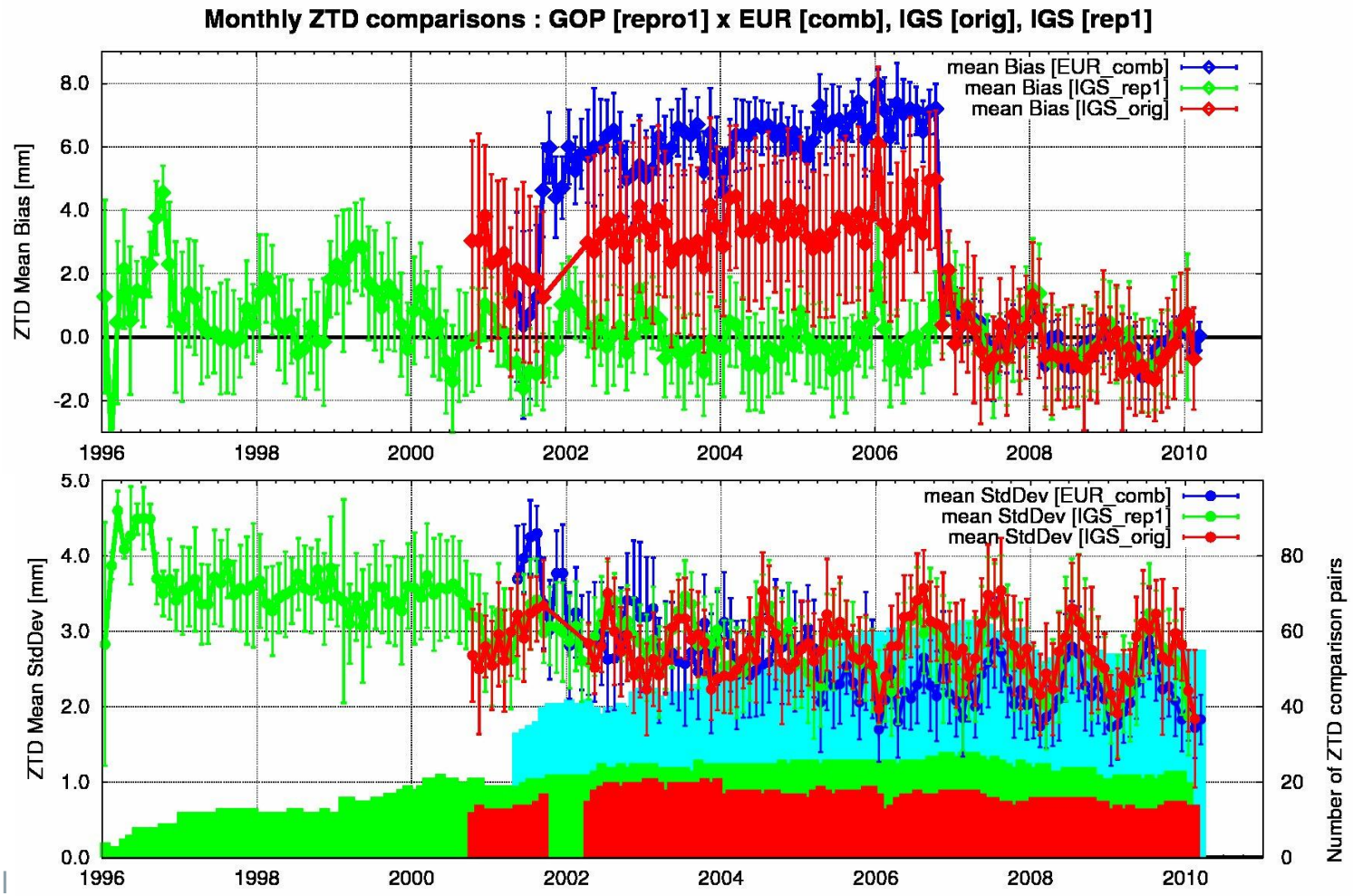
GOP-rep1 ZTD comparisons (1)

- 1996-2010 – GOP repro-1 x IGS original, new, EUREF original
- yearly, monthly, weekly bias and std-deviation



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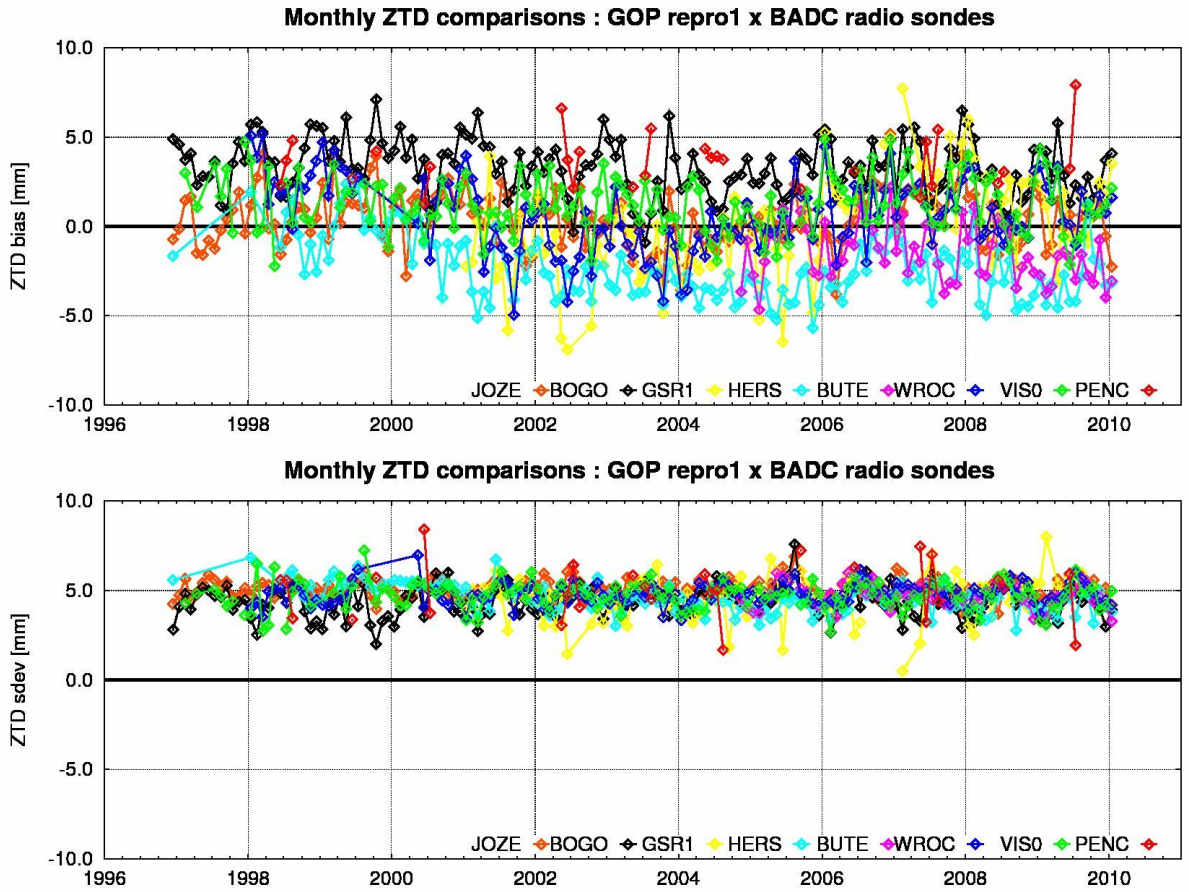
GOP-rep1 ZTD comparisons (2)

- 1996-2010 – GOP repro-1 x radio sondes [BADC]
- JOZE, BOGO, GSR1, HERS, BUTE, WROC, VIS0, PENC



Conclusion

- GOP EPN repro-1 solution developed and data processed
- Some additional stations added on request of coordinator
- 1st, 2nd,2a run completed, 3rd run scheduled
- Benchmark dataset processed
- Weekly SNX+SUM and daily SNX+TRO uploaded to BKG
- Long-term combination completed (coord+vel)
- Clean time-series repeatability: N,E (<2mm), U(<4-6mm)
- Troposphere compared to IGS/EUR and radiosondes
- GOP repro-1 used for the assessment of the EPN cumulative solution reference datum

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