EPN Modernization and Introduction of ITRF2008/IGS08

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EPN Central Bureau
Royal Observatory of Belgium

OUTLINE

- Update on EPN Tracking Network
- EPN CB Support to LACs
- ITRF2008/IGS08
- Future & Summary

EPN TRACKING NETWORK

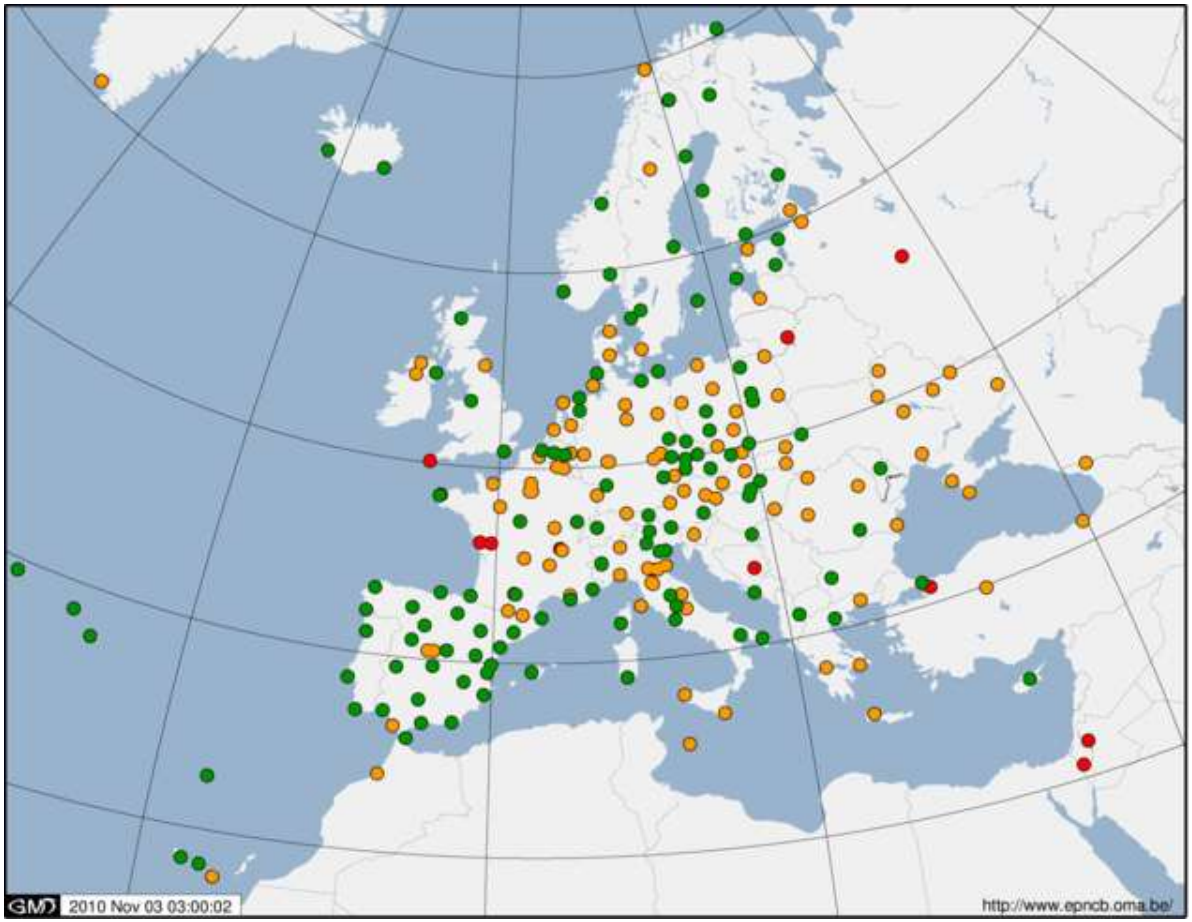
ROB

244 permanent GNSS stations

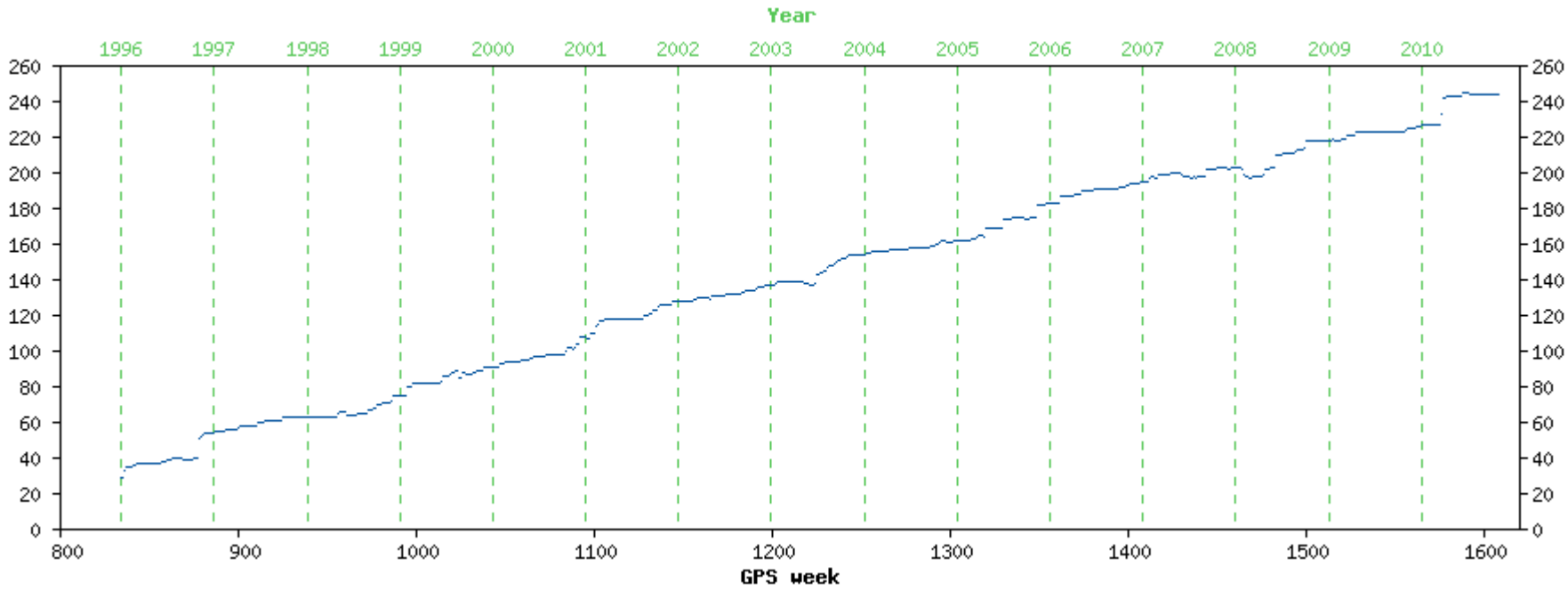
34 % IGS

94 % hourly

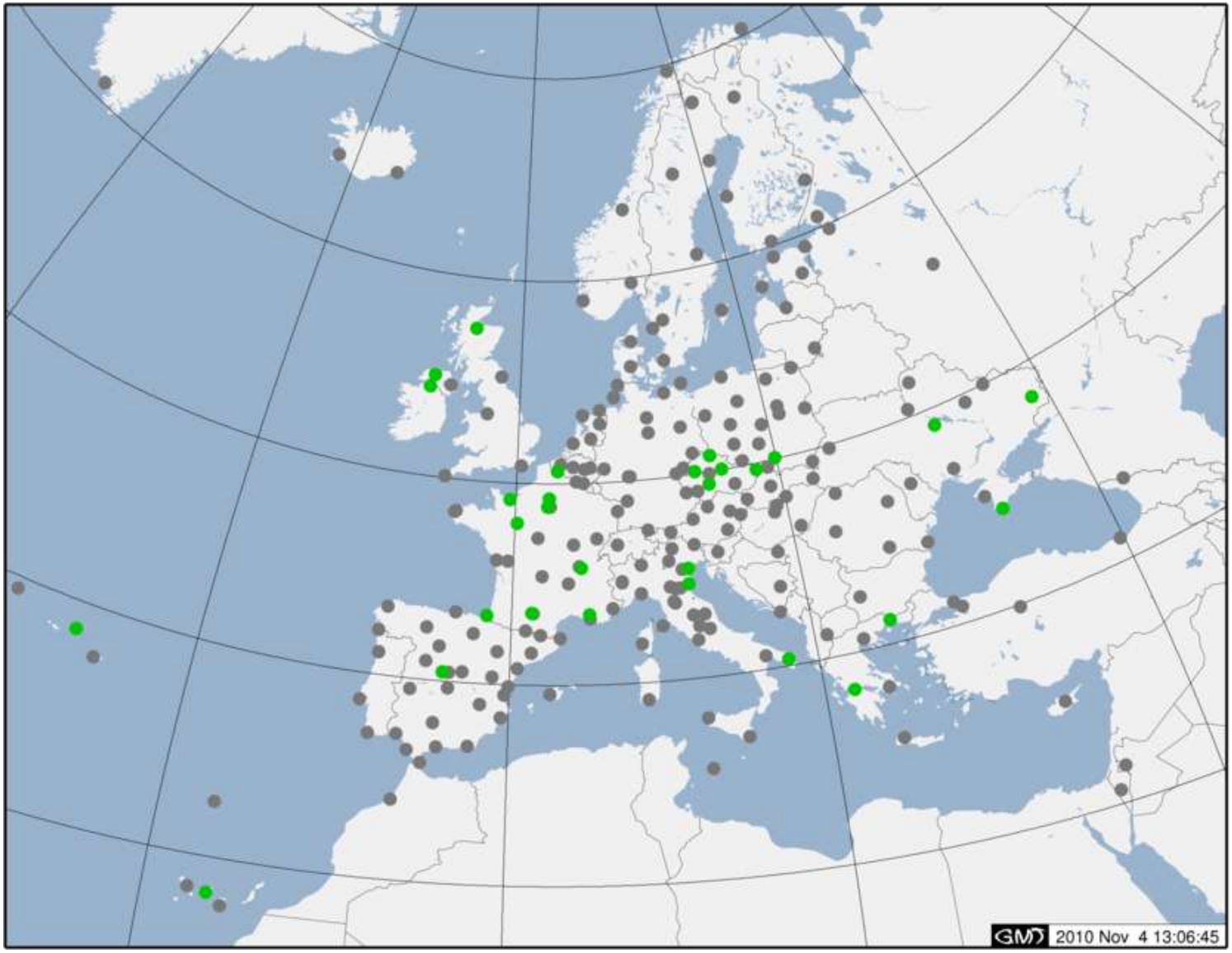
49 % real-time



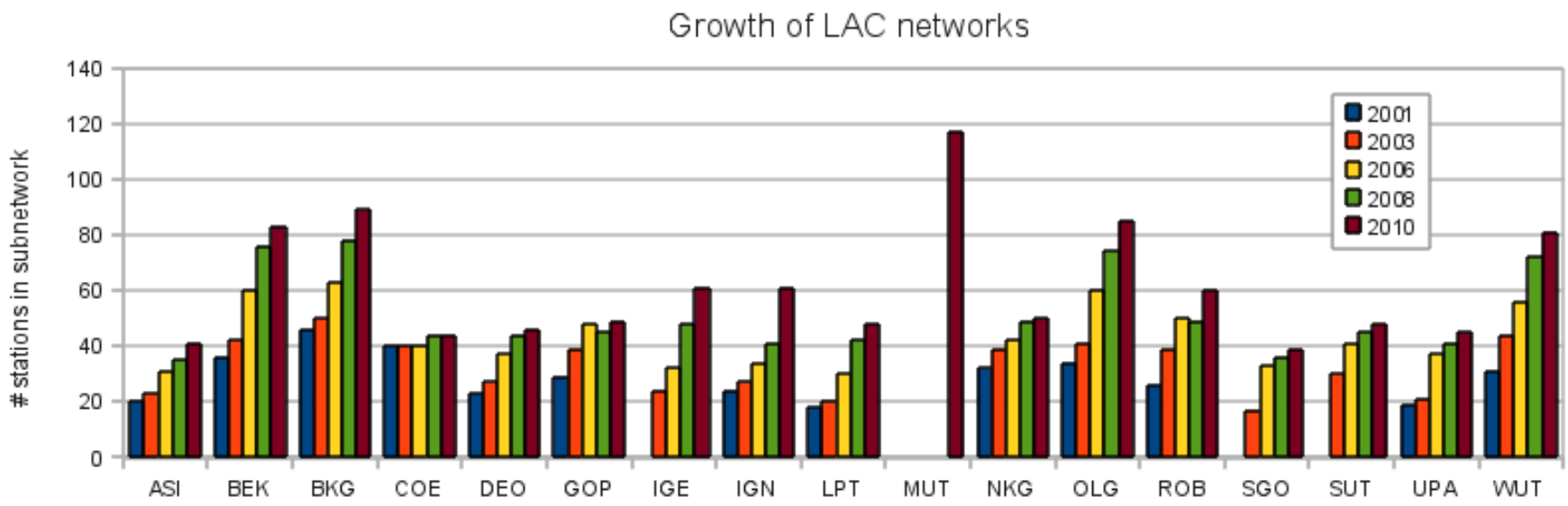
GROWTH OF EPN TRACKING NETWORK



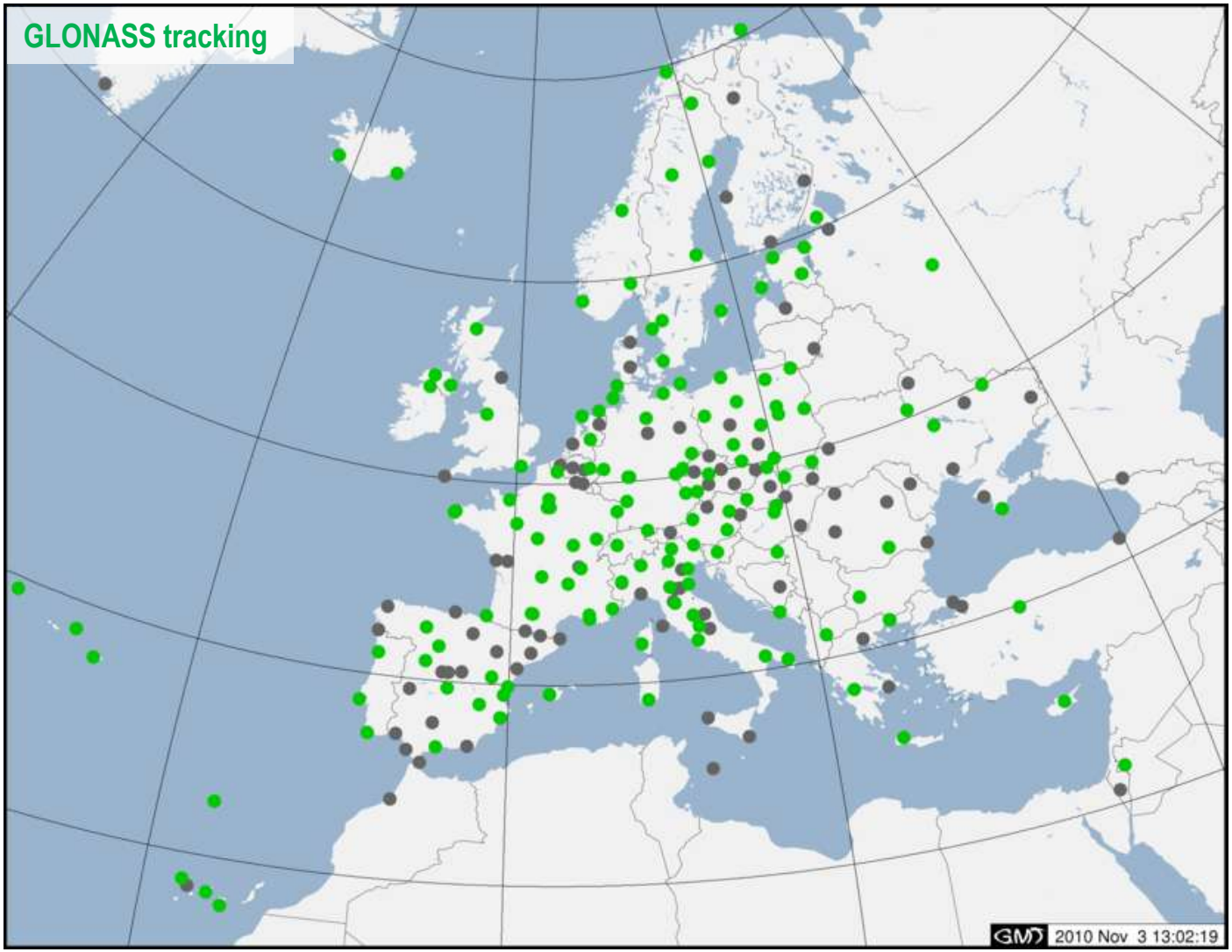
NEW EPN STATIONS SINCE LAST LAC WORKSHOP



GROWTH OF LAC NETWORKS



GLONASS TRACKING



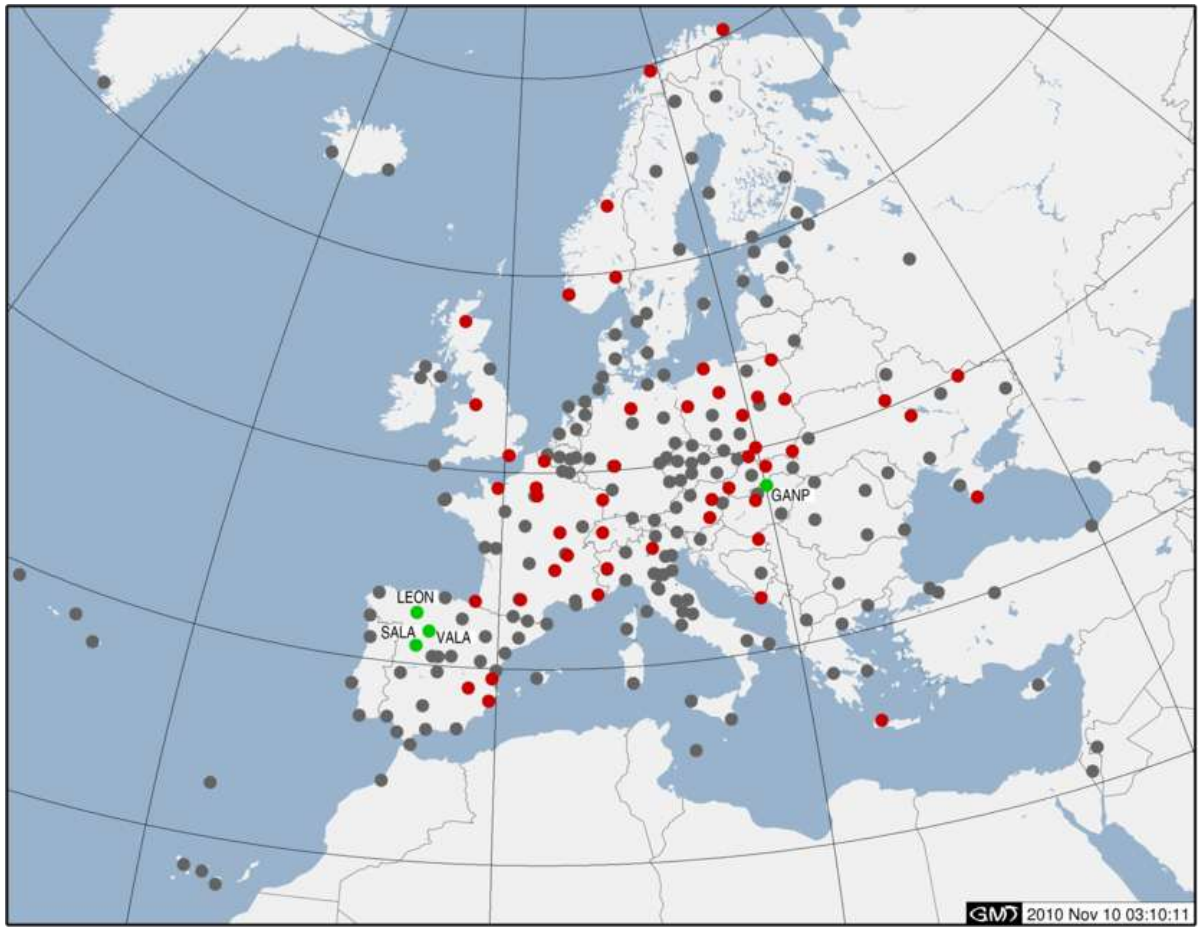
AC's PROCESSING

EPN Local Analysis Centre	GNSS Software	GLONASS capable	Galileo capable	GPS+GLONASS processing	GPS+GLONASS+ GALILEO processing
BEK	Bernese V5.0	yes	Yes, V5.1 update exp. 12/2010	yes	planned
BKG				planned, 2010	planned
GOP				planned	planned
IGE				TBD	TBD
IGN				planned, 2010	planned
NKG				planned, 2010	TBD
OLG				planned	planned
ROB				yes	planned
SGO				planned, 2010	planned
SUT				planned, 2010	planned
UPA				planned, 2010	planned
WUT				planned, 2010	planned
LPT	Bernese 5.0 ext.	yes	yes	yes	planned
COE	Bernese V5.1	yes	yes	yes	planned
ASI	MicroCosm software Vs. 2009.0	no	no	no	TBD
DEO	GIPSY 4.0	yes	no	no	TBD

Information based on LAC forms and pers. comm. Sept. 2009

GPS L5 TRACKING CAPABILITY

Capable of tracking GPS L5
Tracking GPS L5

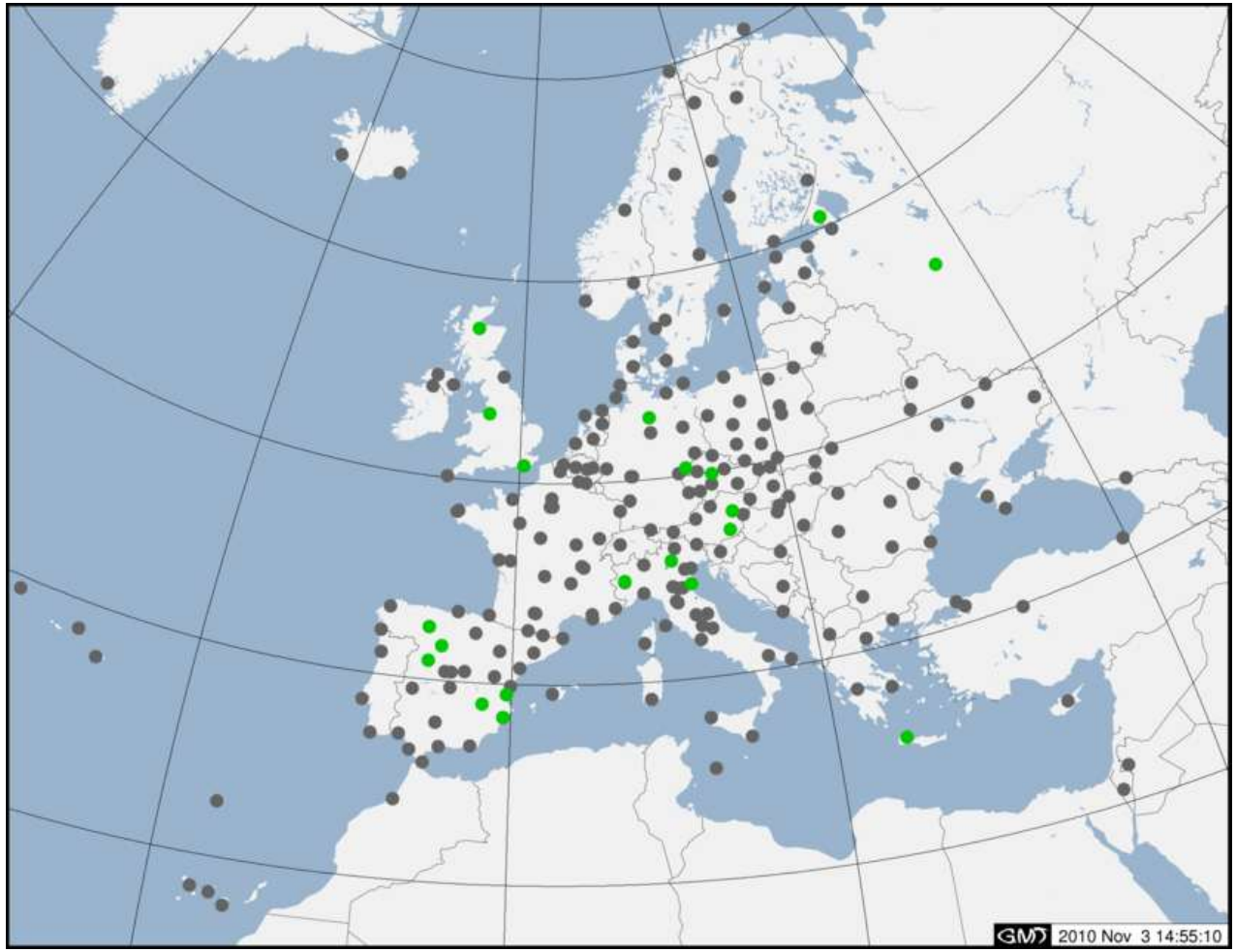


TRIMBLE NETR8	:	GANP LIL2 NYA1 OSLS STAS TRDS TRO1 VARS
TRIMBLE NETR5	:	AUTN BPDL BUTE BYDG CAEN CREI DUBR ENTZ GRAS GWWL KLOP KRA1 LODZ MDOR MLVL MOP2 OSJE PUYV REDZ SCOA SWKI TLSE USDL ZIM2 ZYWI
NOV OEMV3	:	GLSV KHAR KTVL SMLA
LEICA GRX1200+GNSS	:	DARE GRAZ HOBU INVR LEON ROVE SALA TORI TRF2 TUC2 VALA
SEPT POLARX3ETR	:	HERS
JAVAD TRE_G3T DELTA	:	BOGI
LEICA GR10	:	ALAC ALBA VALE

GALILEO CAPABLE

ROB

Receivers capable of tracking Galileo

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LEICA GR10          : ALAC ALBA VALE
LEICA GRX1200+GNSS  : DARE GRAZ HOBU INVR LEON ROVE SALA TORI TRF2 TUC2 VALA
SEPT POLARX3ETR     : HERS
TPS NETG3           : GARI GOPE MARJ MDVJ SVT
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EPN SUPPORT TO LAC

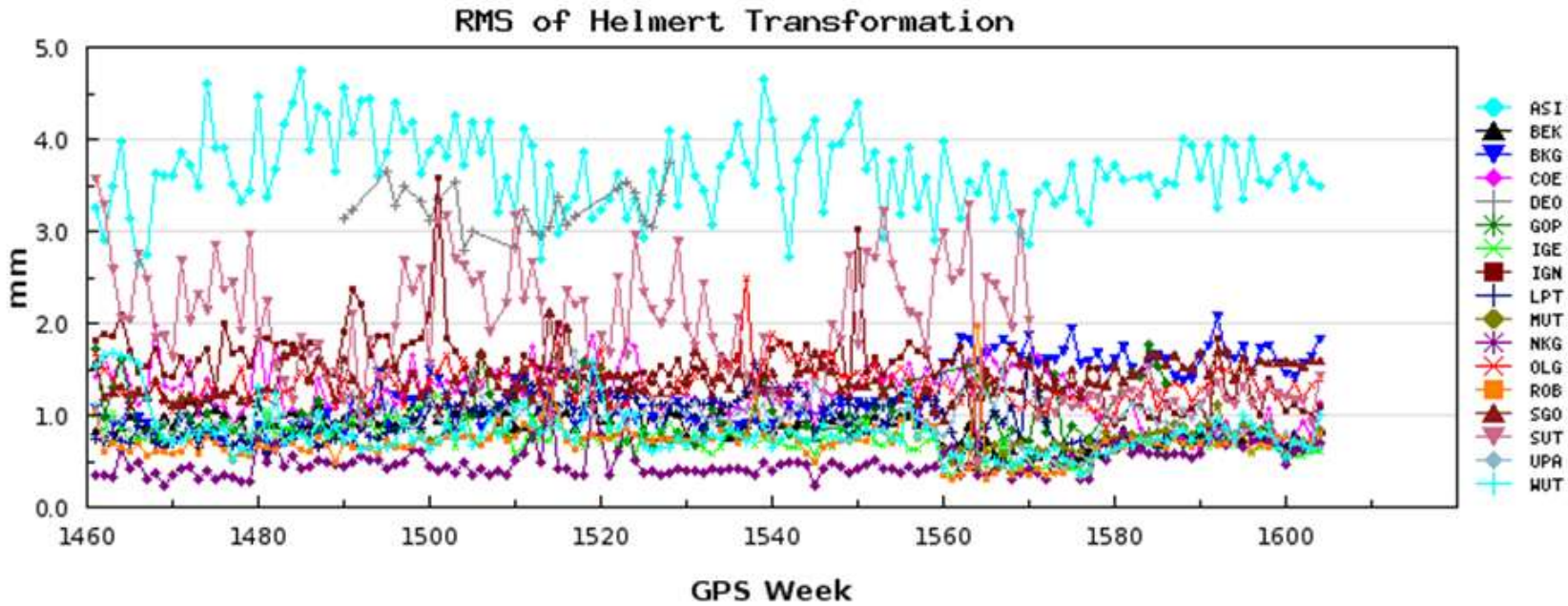
ROB

Dedicated Analysis Centres web page
http://www.epncb.oma.be/_dataproducts/analysiscentres/

- Subnetwork descriptions, processing options (need for update!)
- Archive of all LAC Mails sent to euref_ac@ifag.de
- Analysis reports in graphical form (based on reports from analysis coordinator and troposphere coordinator)
  - General agreement between LAC
    - RMS of agreement of the solution (after Helmert) with combined solution
    - Tropospheric biases
  - Agreement between LAC for a specific station

AGREEMENT BETWEEN LAC SOLUTIONS AND COMBINED SOLUTION

ROB



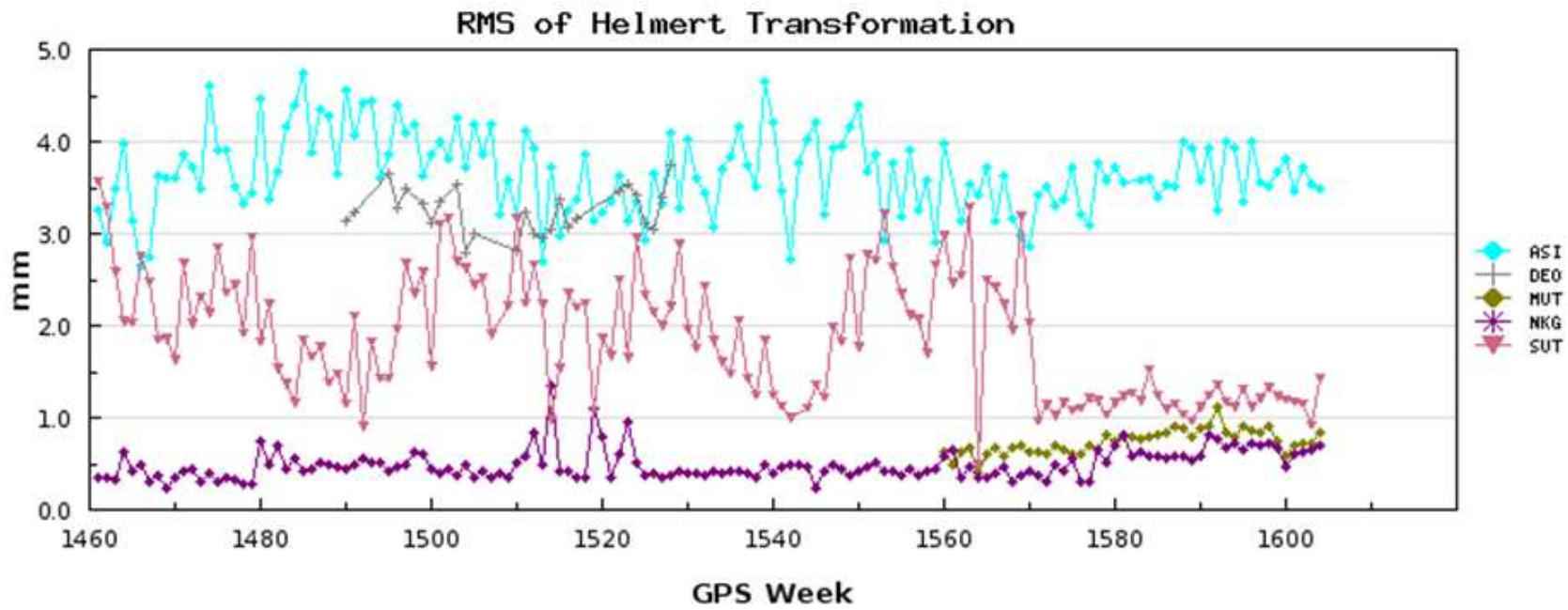
A priori values Truncated a priori values Final values

Select Analysis Centres:

☑ ASI ☑ BEK ☑ BKG ☑ COE ☑ DEO ☑ GOP ☑ IGE ☑ IGN
☑ LPT ☑ MUT ☑ NKG ☑ OLG ☑ ROB ☑ SGO ☑ SUT ☑ UPA
☑ WUT
☐ Select All

AGREEMENT BETWEEN LAC SOLUTIONS AND COMBINED SOLUTION

ROB

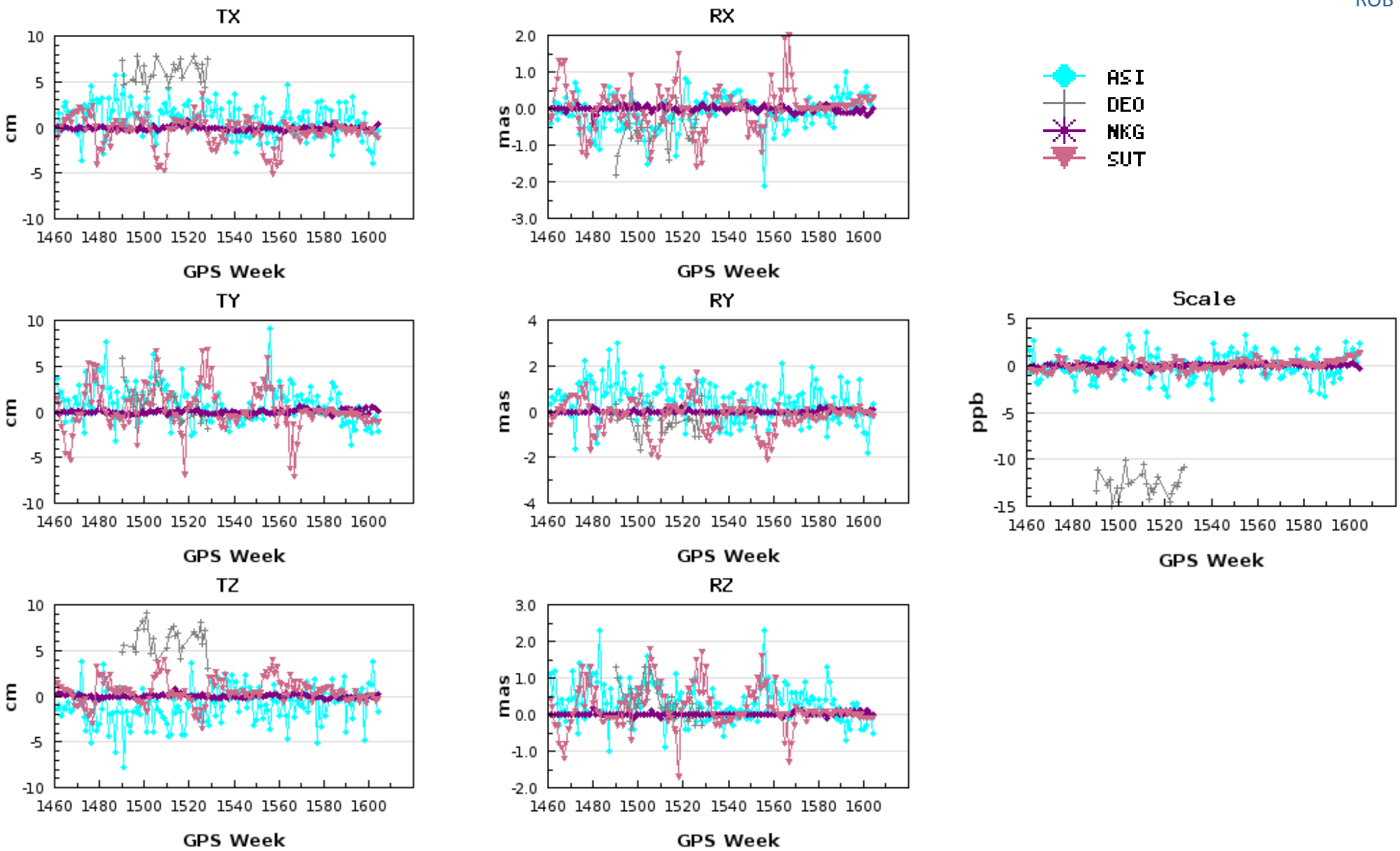


A priori values Truncated a priori values Final values

Select Analysis Centres:

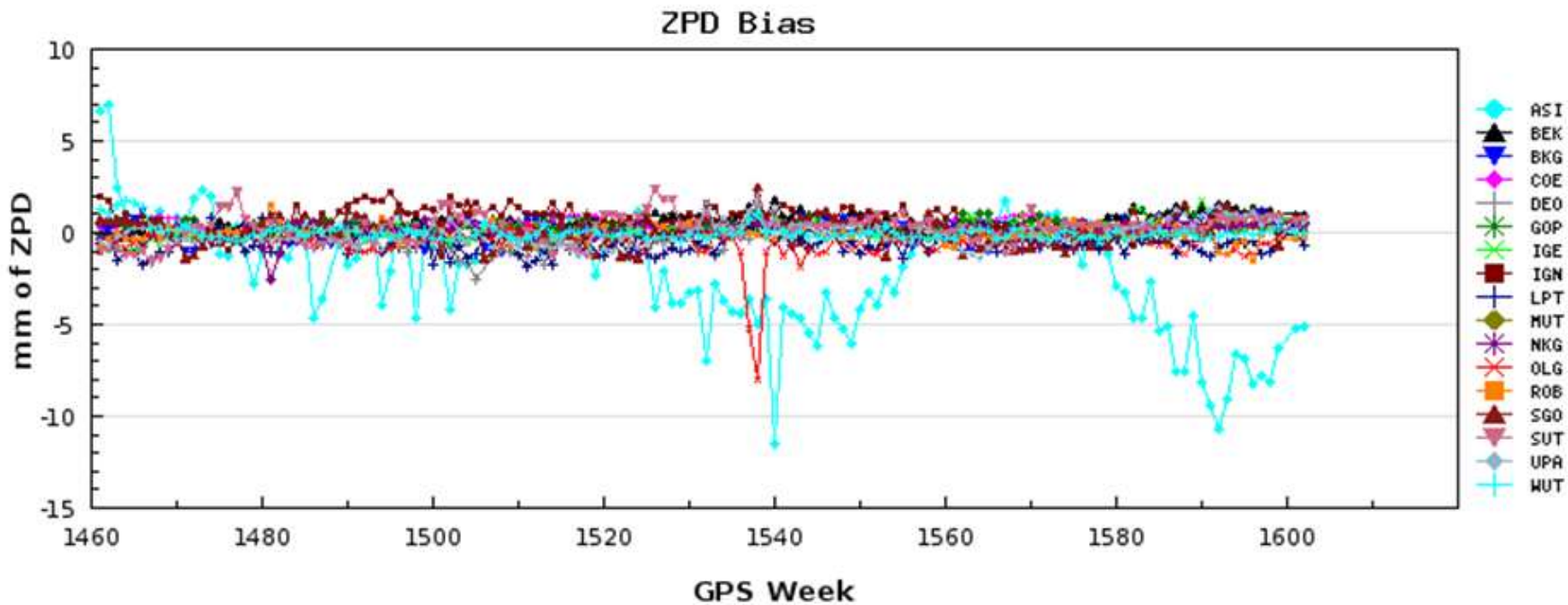
☑ ASI	☐ BEK	☐ BKG	☐ COE	☑ DEO	☐ GOP	☐ IGE	☐ IGN
☐ LPT	☑ MUT	☑ NKG	☐ OLG	☐ ROB	☐ SGO	☑ SUT	☐ UPA
☐ WUT							
☐ Select All							

PARAMETERS OF HELMERT TRANSFORMATION



BIAS BETWEEN LAC ZPD AND COMBINED ZPD

ROB



☐ View Standard Deviations

Select Analysis Centres:

☑ ASI ☑ BEK ☑ BKG ☑ COE ☑ DEO ☑ GOP ☑ IGE ☑ IGN
☑ LPT ☑ MUT ☑ NKG ☑ OLG ☑ ROB ☑ SGO ☑ SUT ☑ UPA
☑ WUT

☐ Select All

LATENCY OF LAC SOLUTIONS

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******* A B B C D G I I L M N O R S S U W
 SNX    S E K O E O G G P U K L O G U P U
******* I K G E O P E N T T G G B O T A T
1=7-13days; 2=14-20days; 3=21-27days...
****************** Last Update : 13-NOV-10
1609 -  . . . . . . . . . . . . . . . . .
1608 -  . . . . . . . . . . . . . . . . .
1607 -  . 1 . . . . . . . 2 . . . . . . .
1606 -  . 1 3 . . . 3 . 3 2 3 3 3 3 3 . 3
1605 -  . 1 3 4 . . 3 3 3 3 3 3 2 3 4 . 3
1604 -  3 2 3 4 . . 3 3 3 2 3 3 2 3 3 3 4 +
1603 -  3 2 3 4 . . 3 4 3 2 3 4 2 3 3 3 4 +
1602 -  3 2 2 4 4 . 3 5 3 2 3 4 3 3 3 3 4 +
1601 -  3 2 3 4 . . 3 3 3 2 3 3 3 3 3 3 4 +
1600 -  2 1 3 5 . . 3 3 3 2 3 3 2 3 3 3 5 +
1599 -  2 2 2 4 . . 3 4 3 2 4 3 3 3 3 3 4 +
1598 -  3 2 3 5 . . 3 3 3 2 3 3 3 4 3 4 3 +
1597 -  2 2 2 6 . . 3 3 3 2 3 3 4 3 3 4 4 +
1596 -  2 1 3 6 . . 3 4 3 2 3 3 2 3 3 3 3 +
1595 -  3 2 3 7 . . 3 4 3 4 3 3 2 3 4 3 2 +
1594 -  3 2 3 8 . . 3 3 3 2 3 3 2 3 5 3 2 +
1593 -  3 2 4 4 . . 3 3 3 2 3 3 2 3 5 2 4 +
1592 -  4 3 3 4 . . 3 3 3 2 2 3 2 3 3 3 3 +
1591 -  4 1 2 4 . . 3 3 3 2 3 3 3 3 3 3 3 +
1590 -  4 2 2 4 . . 3 4 3 2 3 3 4 3 3 2 2 +
1589 -  5 3 2 4 . . 3 3 3 2 3 3 2 3 3 3 3 +
1588 -  5 1 2 4 . . 3 3 3 2 4 3 3 3 3 3 2 +
1587 -  3 1 2 4 . . 3 3 3 2 4 3 4 3 3 4 2 +
1586 -  6 1 2 4 . 2 3 4 3 2 3 3 3 3 3 3 3 +
1585 -  3 2 3 4 . 2 3 4 3 3 3 3 4 3 3 3 2 +
1584 -  3 2 3 4 . 2 3 3 3 2 3 3 3 3 3 3 3 +
1583 -  4 1 2 4 . 3 3 3 3 2 3 3 2 3 3 2 3 +
1582 -  5 2 2 4 . 3 3 3 3 3 3 3 2 3 3 2 3 +
```

EPN SUPPORT TO LAC

ROB

ftp://epncb.oma.be/pub/station/general

- Ocean loading table (BLQ format): EPN_FES2004.BLQ
- Antenna calibrations (type+individual): epn_05.atx, since March 1, 2010 no password required anymore
- Meta-data files based on site logs: euref.snx (SINEX), EUREF.STA (Bernese)

ftp://epncb.oma.be/pub/station/general/excluded

- Stations to be excluded from weekly submission: excluded/excluded.wwww

ftp://epncb.oma.be/pub/station/general

- station coordinates in Bernese format (weekly): IGS05.CRD, updated weekly
- station coordinates in SSC format from cumulative EPN solution (A. Kenyeres)

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BACKGROUND : ITRF2005/IGS05

1. ITRF2005 released Oct. 2006
2. IGS contribution to ITRF2005 was based on IGS cumulative solution computed with relative antenna phase center (APC) models
3. ITRF2005 not consistent with absolute antenna calibrations
4. Absolute antenna calibrations to be introduced simultaneously with ITRF2005
5. Creation of IGS05: aligned to ITRF2005 and consistent with absolute antenna models

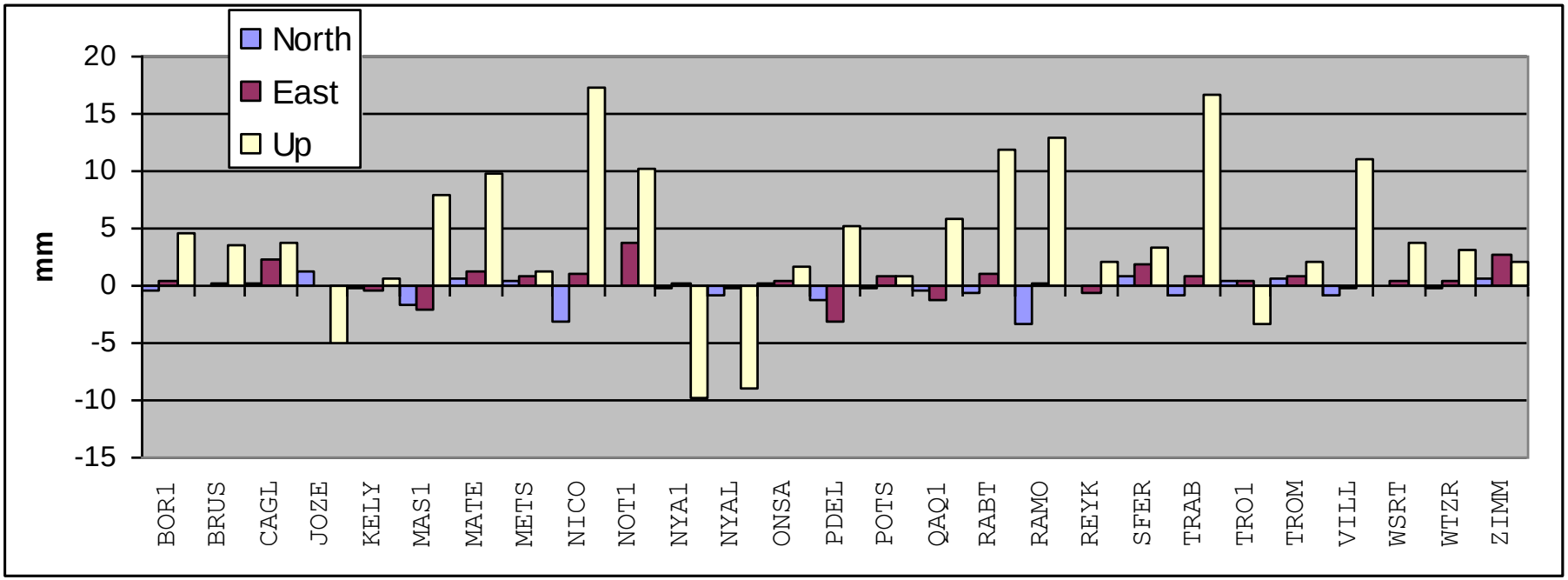
<u>Procedure (Ferland, IGS mail 5447, Oct 19, 2006):</u>

- ✓ Determine station-dependent coordinate correction for switch relative to absolute

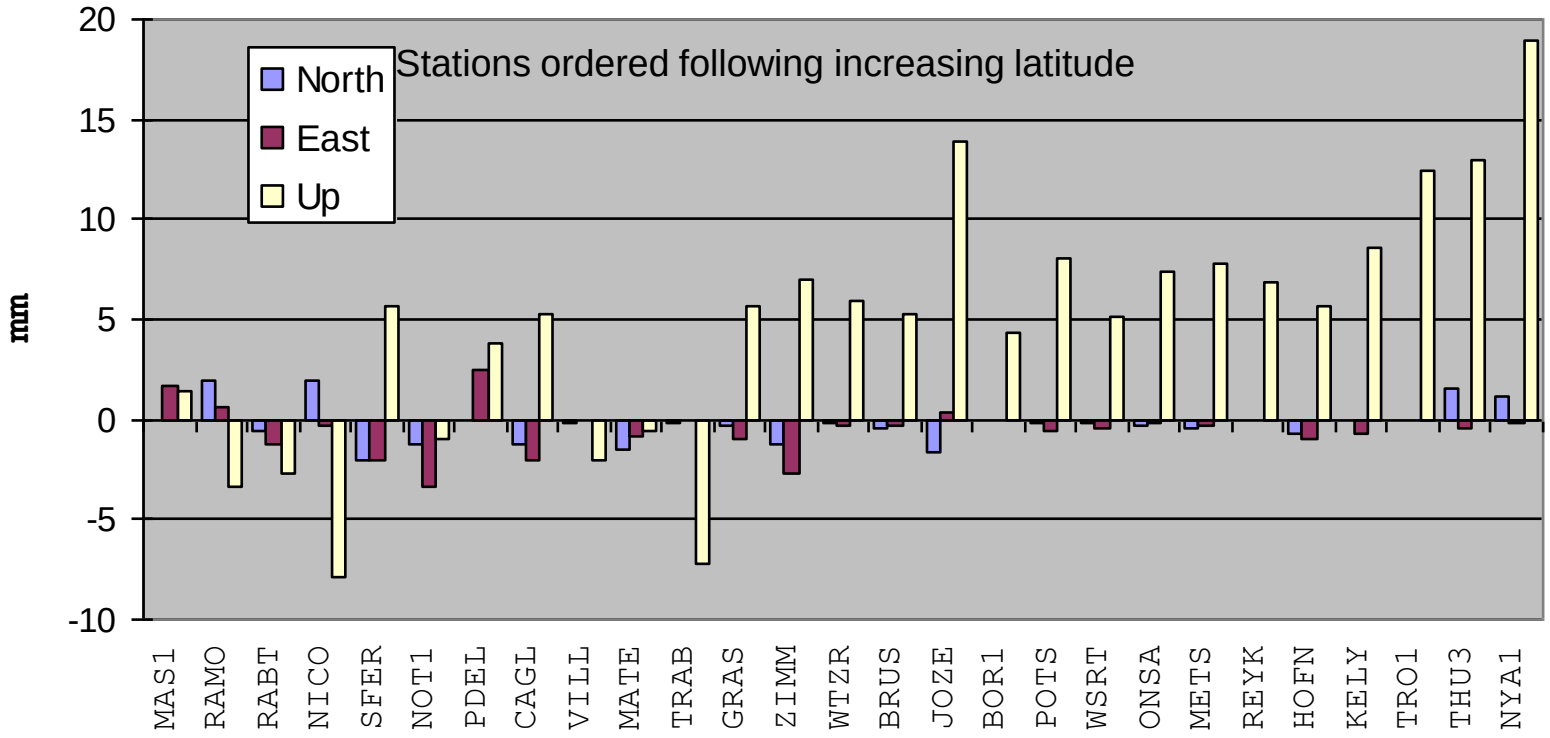
  Computation of two simultaneous solutions for 12 months by IGS AC
- ✓ Correct IGS cumulative solution (subset of IGS) for the station-dependent offset (rel.→ abs.)
- ✓ Align corrected cumulative IGS solution with ITRF2005 using 7 parameter Helmert transformation → IGS05 positions (IGS05 vel.=ITRF2005 vel.)

INTRODUCTION ABSOLUTE ANTENNA MODELS

Influence of introduction of absolute antenna phase center models on IGS reference frame stations - Extraction of EPN stations



Differences ITRF2005-IGS05



Mean differences:

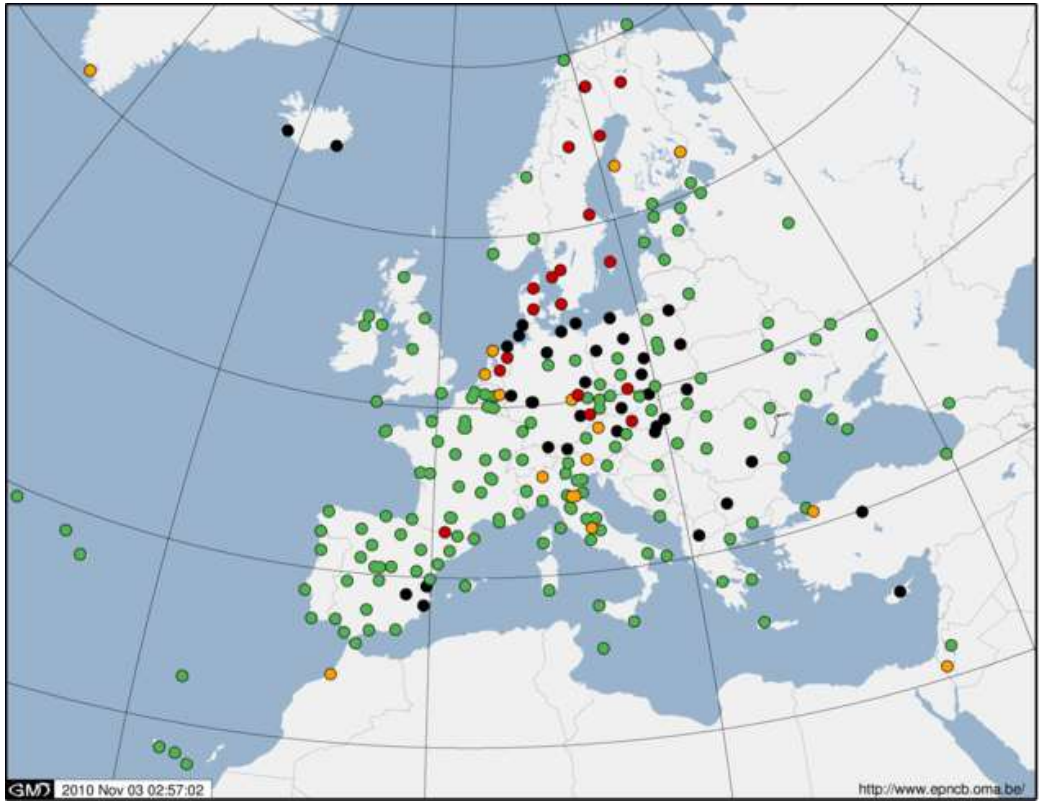
N= -0,2 mm ±1.0 mm E= -0,4 mm ± 1.4 mm U= 5.3 mm ± 6.5 mm

EPN ANTENNA CALIBRATIONS

ROB

Nov. 2010

Indiv. abs. calib	16%
True abs. calib	69 %
Calib. from field	7%
No calib.	8%



Identical to IGS calibrations, except for individual calibrations

Policy: do not change calibration values of antenna in operation within the network (jumps in coordinate time series)

igs05.atx / epn_05.atx does not contain most recent antenna calibrations

IGS08.ATX

- New available robot calibrations and updated robot calibrations
- Changed calibration values for AOAD/M_T (sub-mm):
  - Previously: 1 indiv. antenna with 42 calibration runs
  - Now: 2 indiv. antenna with 62 calibration runs

  change of all converted field calibrations

Switch IGS05.atx → IGS08.atx simultaneously with ITRF2005 → ITRF2008

Computed using IGS05.atx

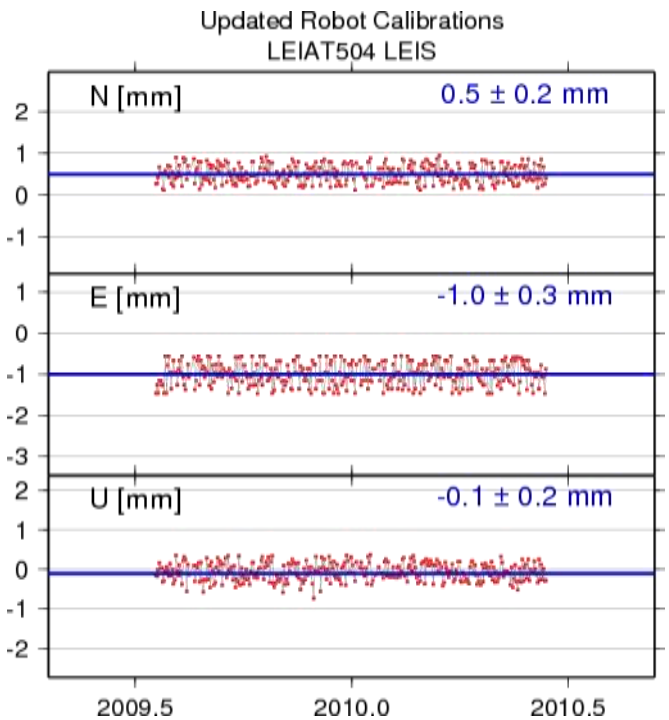
IGS procedure?

1. Evaluate differences in station coordinates IGS05.atx/IGS08.atx
2. Correct station positions?
3. Re-align to ITRF2008?

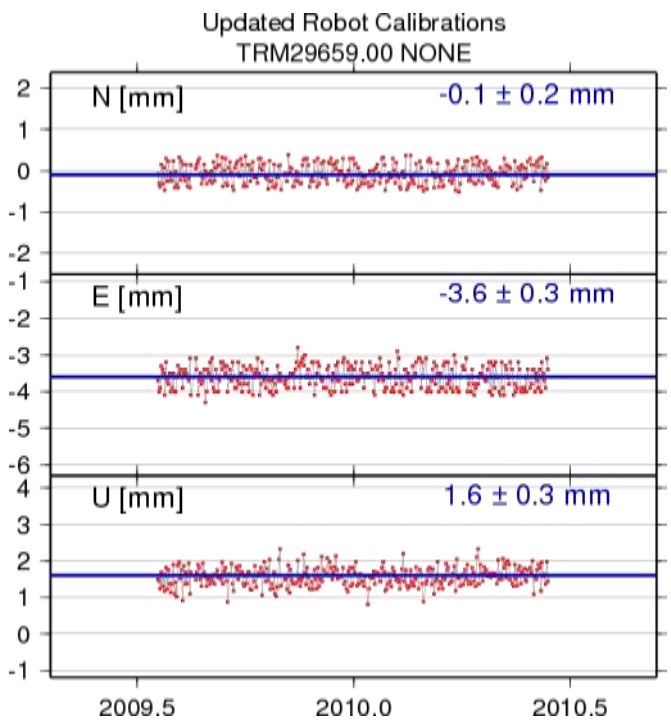
DIFFERENCE IGS05.ATX – IGS08.ATX

- Based on PPP analysis (Atomium): once with igs05.atx and one with igs08.atx (preliminary)
- 10 months of data → coordinate shift estimated with stdev of 0.3 mm (all three components)

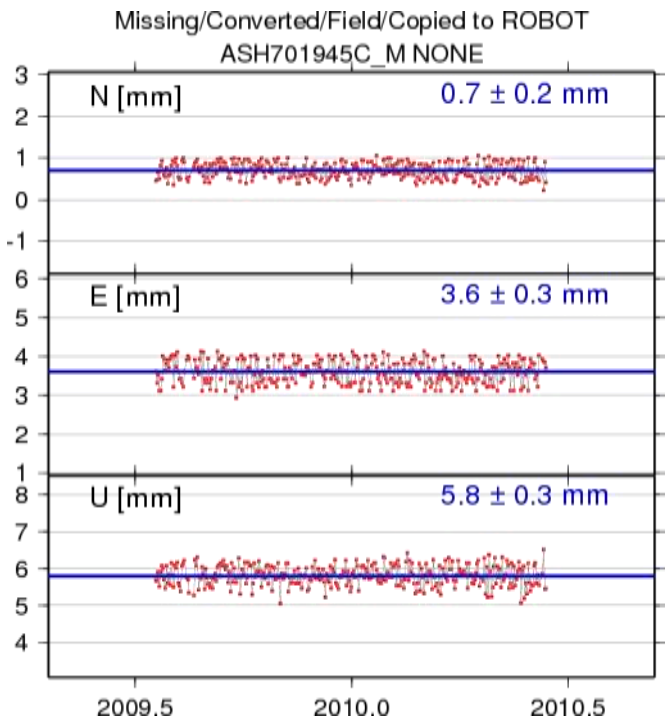
ACOR



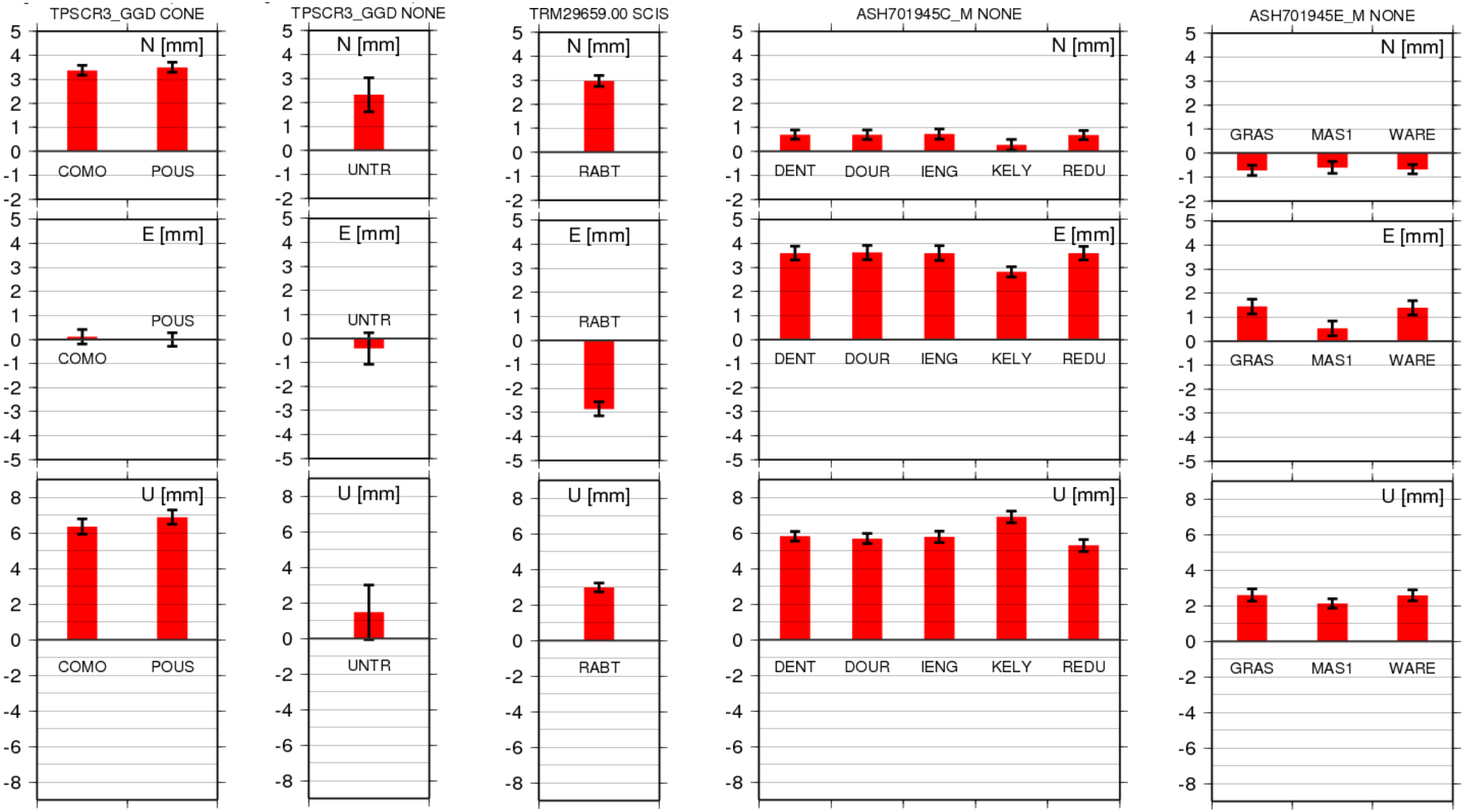
BORR



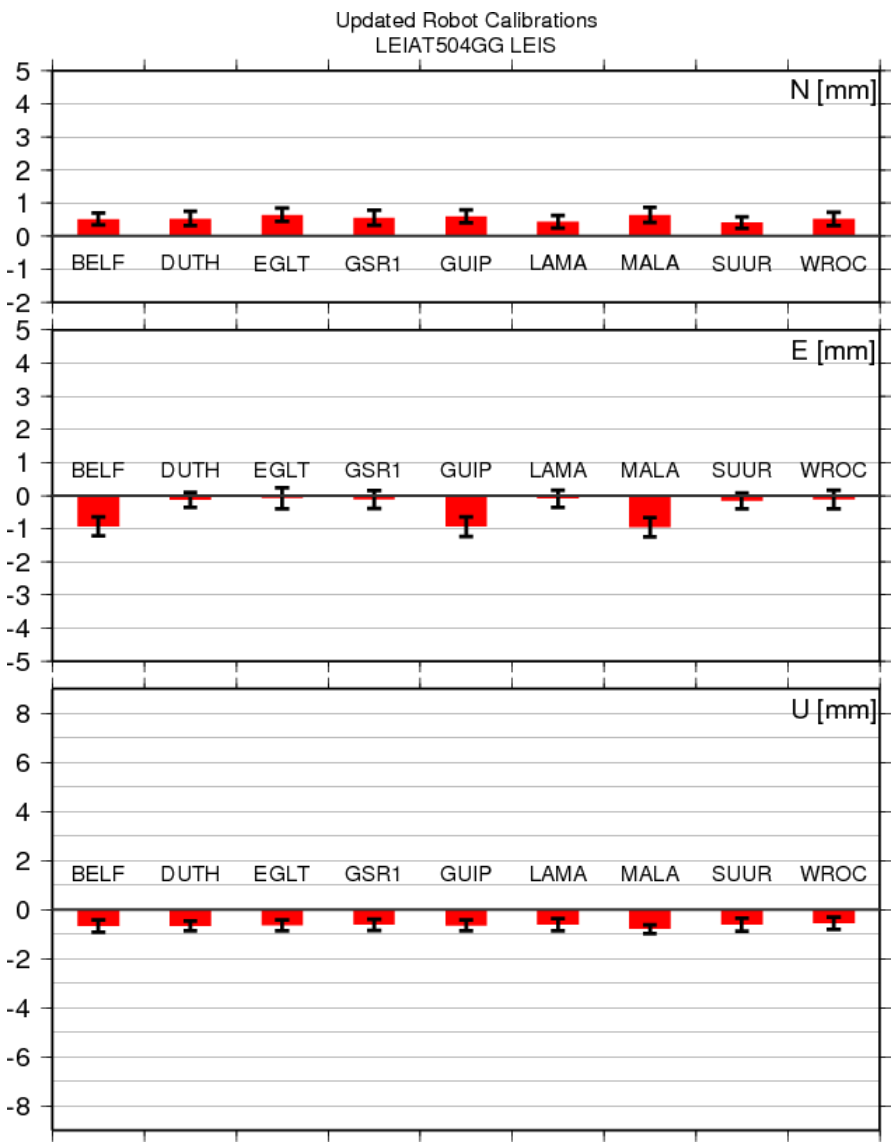
DENT

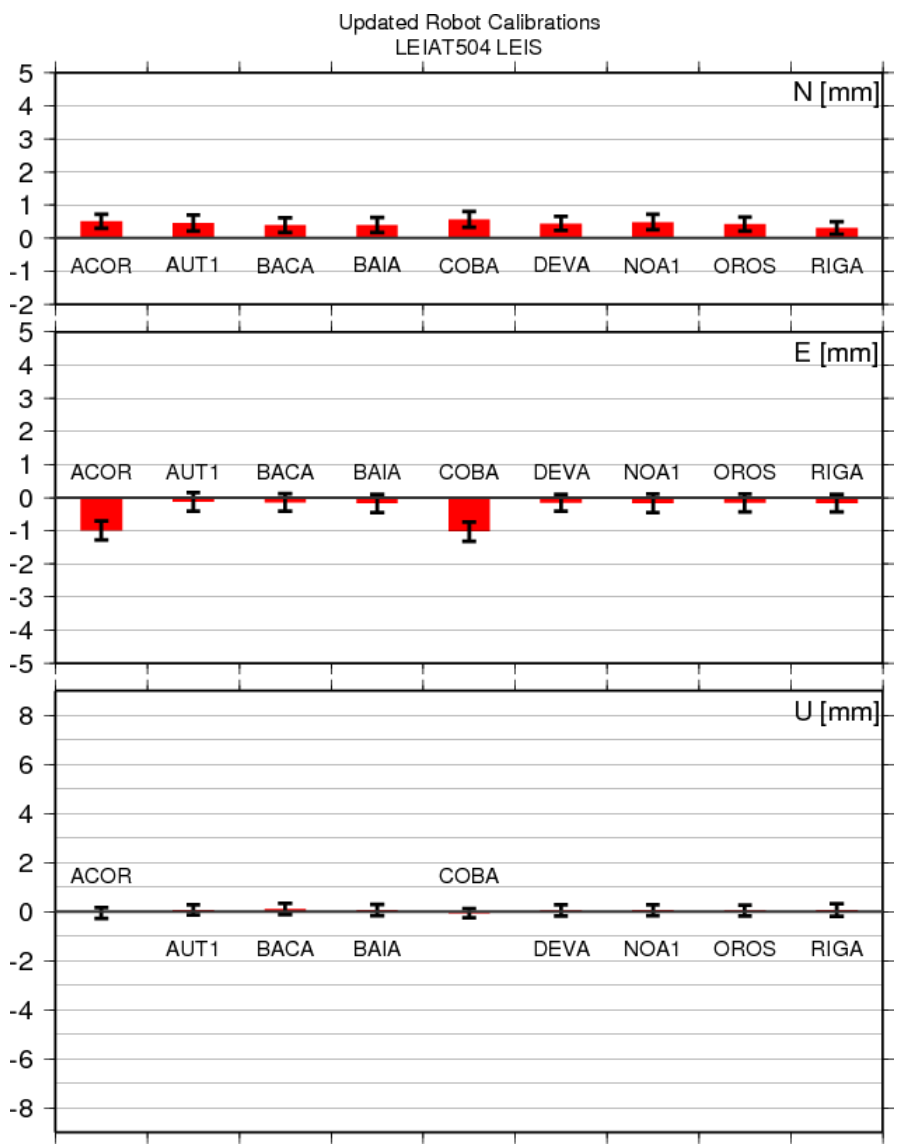


MISSING/CONVERTED/FIELD/COPIED to ROBOT

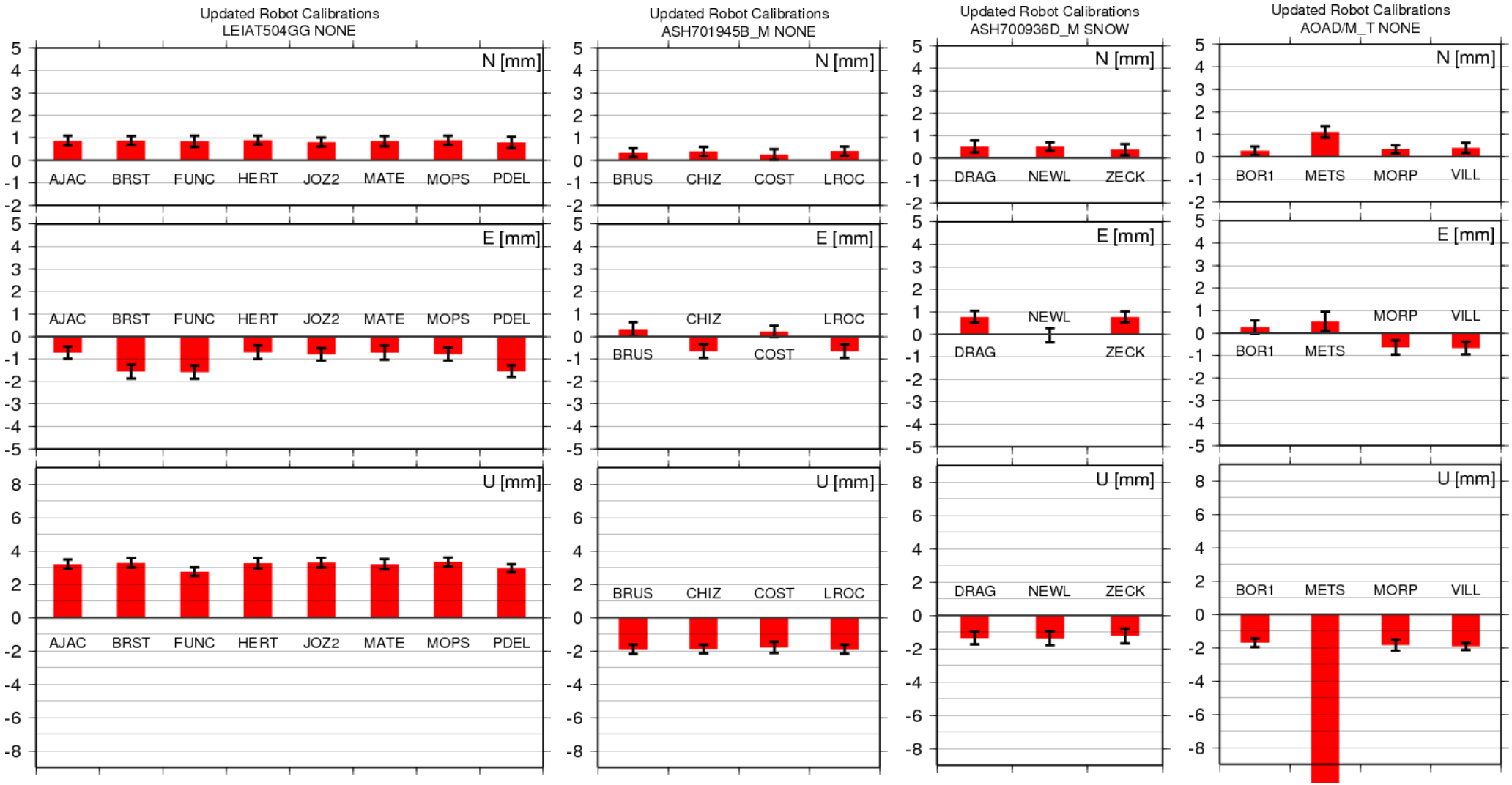


UPDATED ROBOT CALIBRATIONS

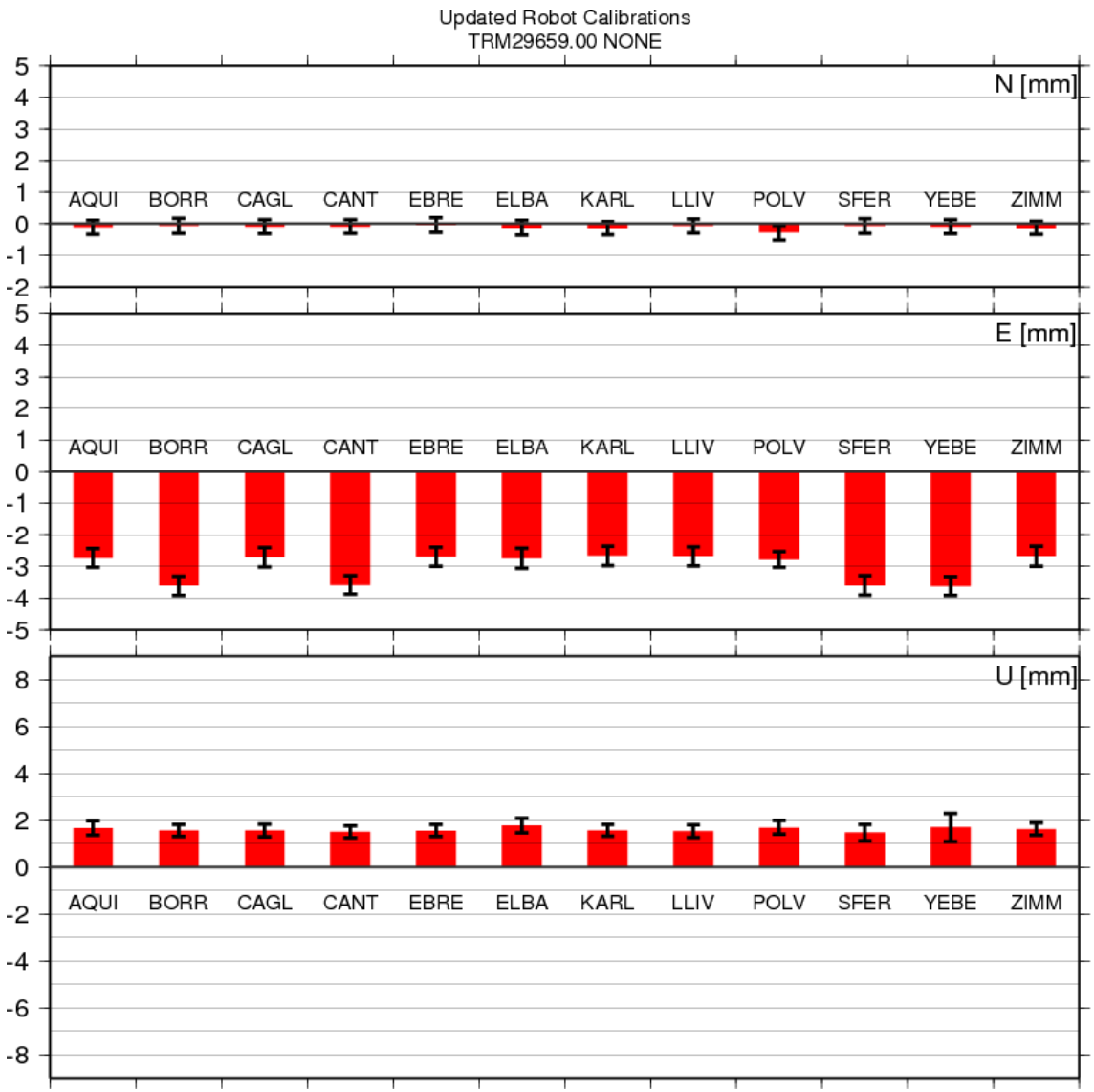


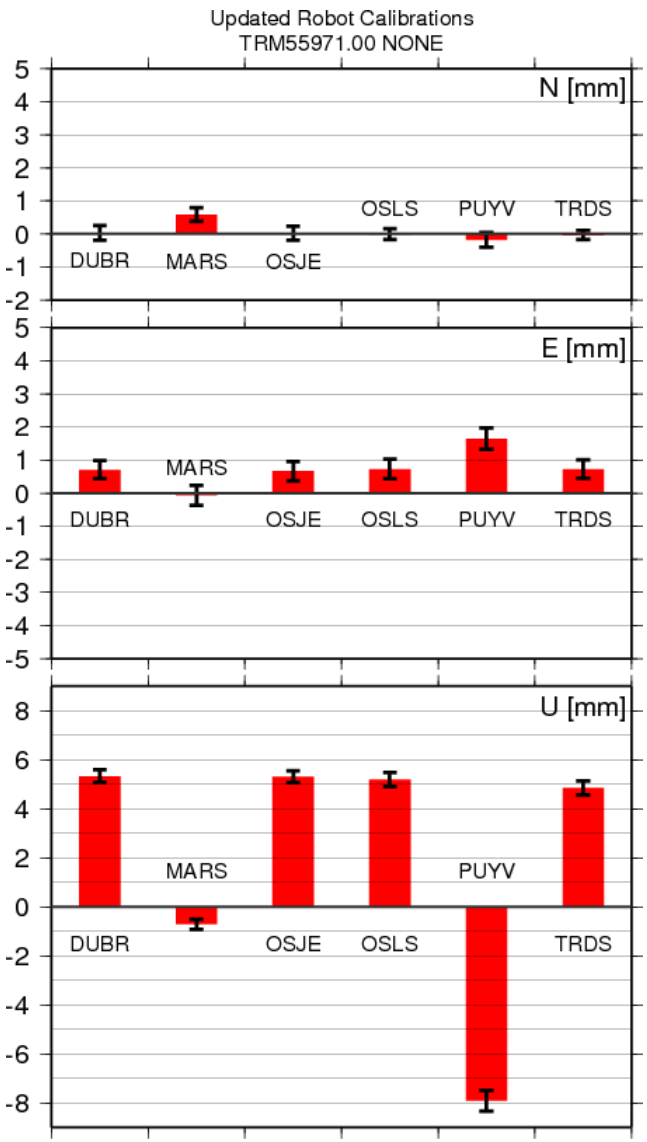


UPDATED ROBOT CALIBRATIONS



UPDATED ROBOT CALIBRATIONS





ANTENNA CALIBRATIONS

- igs05.atx → igs08.atx coordinate differences can reach up to 4 mm in horizontal and 8 mm in vertical
- Major differences igs05.atx/igs08.atx : introduction of robot calibrations
- Some updated robot calibrations (Trimble) also introduce significant coordinate offsets

Further investigations necessary

- Use latest release of igs08.atx
- Investigate outliers within a specific antenna/radome type (e.g. PUYV)
- Compare with IGS results (similar analysis done by different IGS AC & Bernese PPP)
- Study influence individual calibrations compared to type calibrations

Final values → IGS and discuss way to proceed

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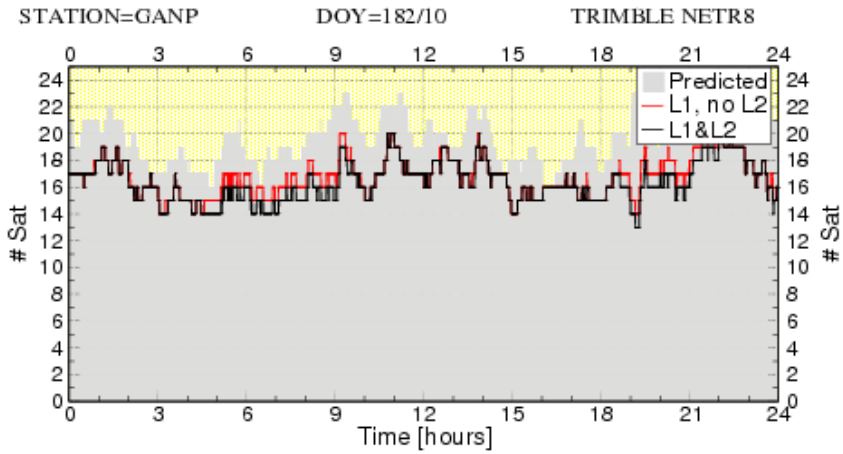
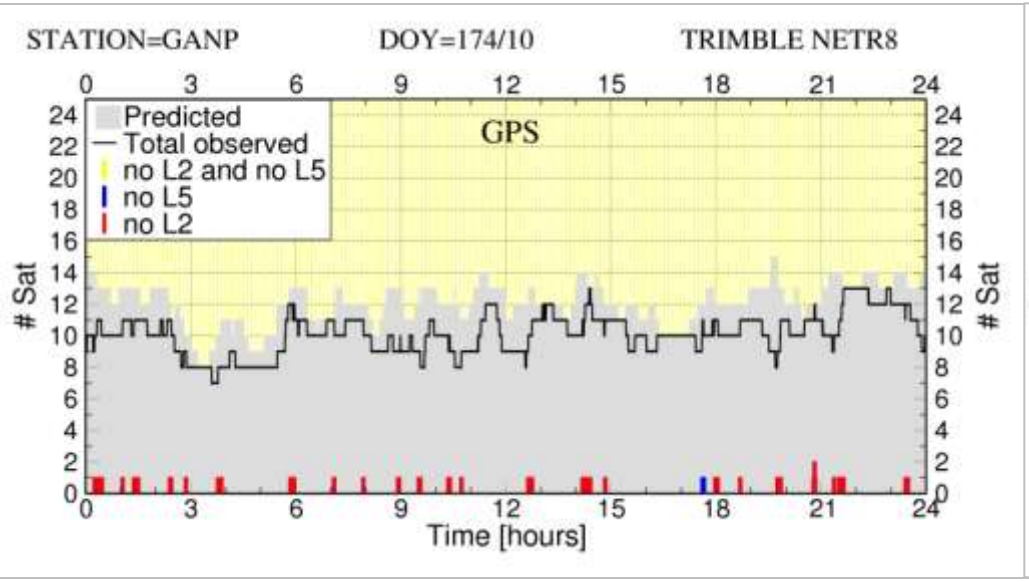
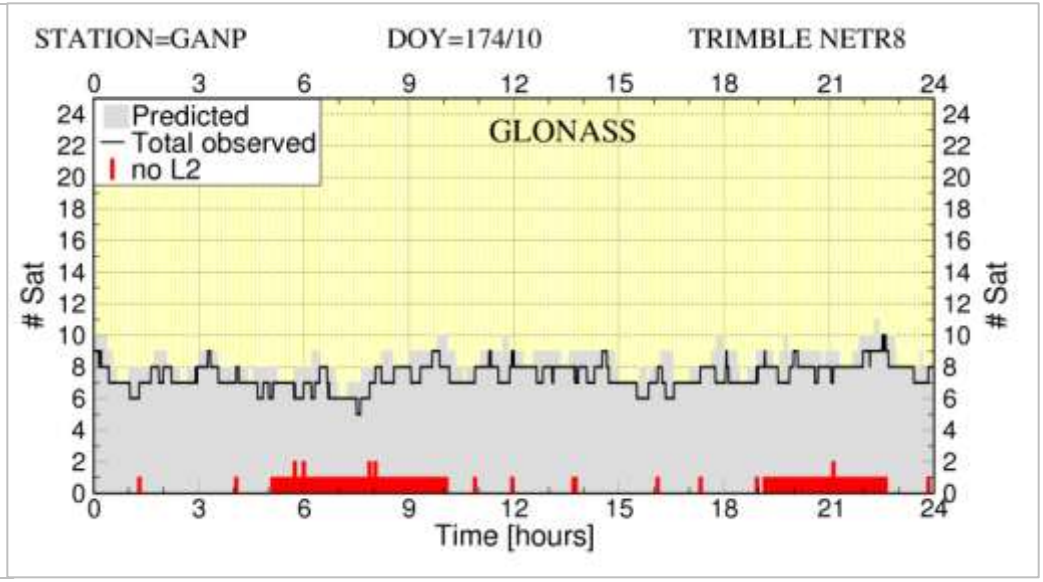
MULTI-GNSS DATA PLOTS

- Presently



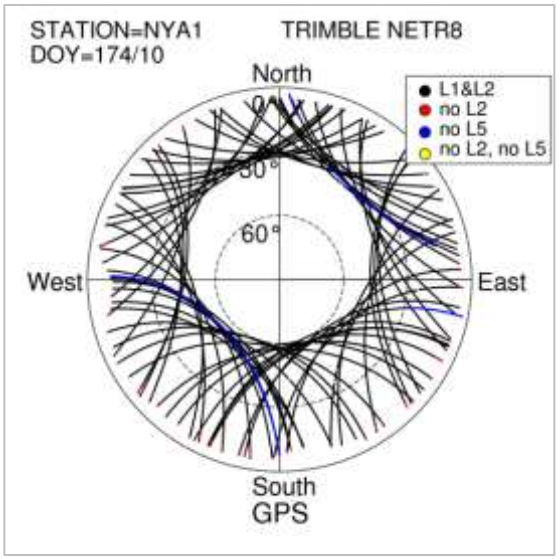
- Future



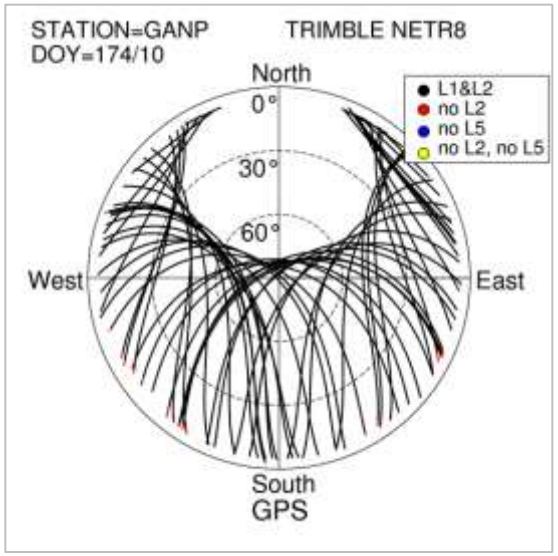


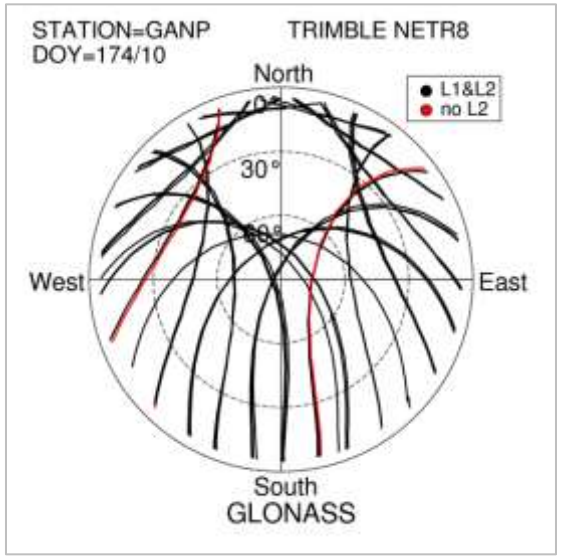
MULTI-GNSS DATA PLOTS

NAY1: GPS, L5 capable



GANP: GPS+GLONASS





SUMMARY

- More than half of EPN is tracking GLONASS, but LAC seem not to follow
- Information provided in reports of analysis and troposphere coordinator should be checked by LAC
- Prelminary comparisons of igs05.atx and igs08. atx show coordinate differences of up to 4 mm in horizontal and 8 mm in vertical
- igs08.atx calibrations should be used for reprocessing
- Generation of final results and evaluation of individual calibrations