EPN Past and Future

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EPN Central Bureau
Royal Observatory of Belgium

EPN TRACKING NETWORK

223 permanent GNSS stations

Since June 2008:

14 new EPN stations

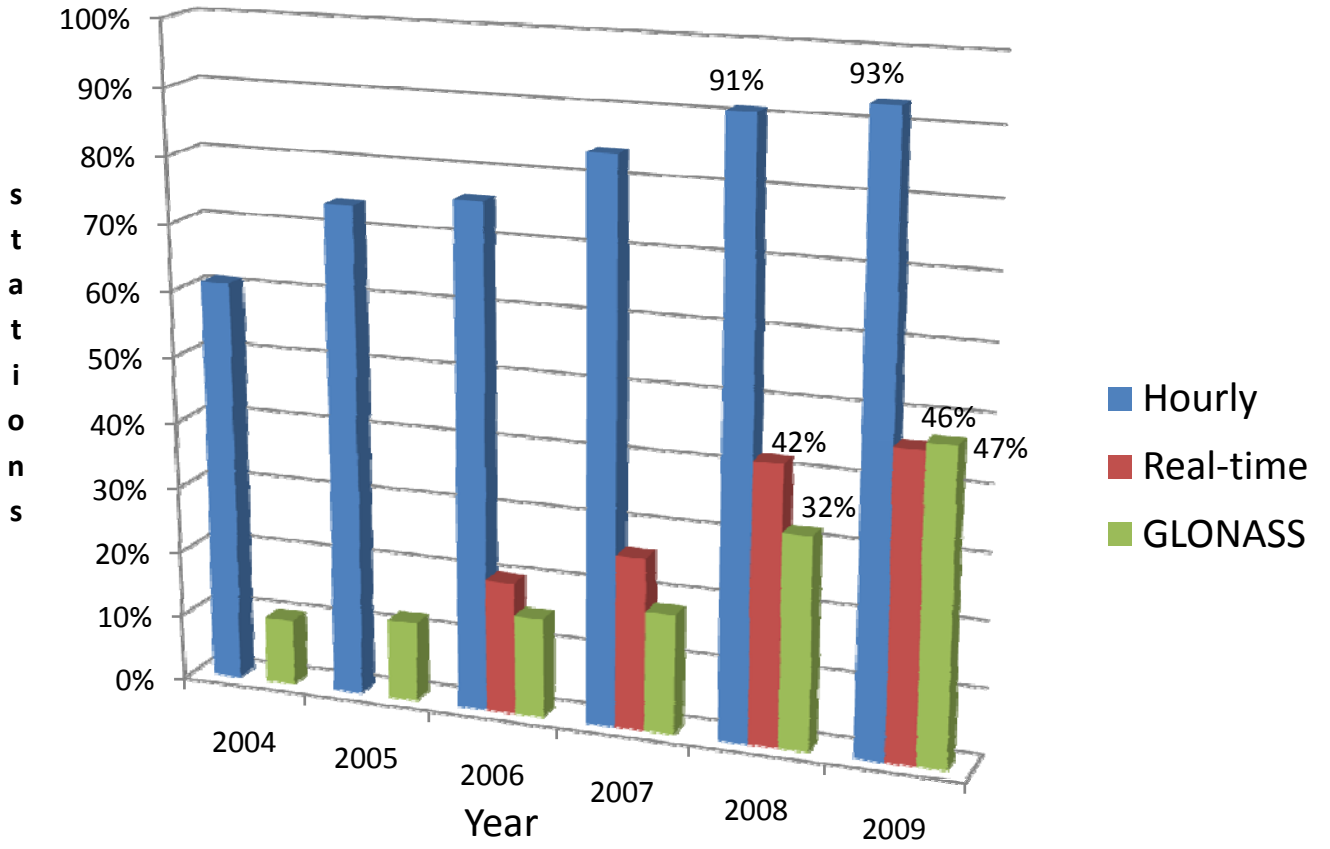
1 station removed from network

NEW EPN STATIONS

ROB

4-CHAR ID	LOCATION	FUNCTION		CALIB	FROM
FUNC	Funchal, Portugal	RT	GLO	Type	06/07/2008
MOP2	Modra-Piesok, Slovak Republic		GLO	Indiv.	24/08/2008
FLRS	Santa Cruz das Flores, Portugal	RT	GLO	Type	31/08/2008
TERU	Teruel, Spain	RT	GLO	Type	28/09/2008
HFL2	Innsbruck, Austria	RT		Indiv.	05/10/2008
PFA2	Bregenz, Austria	RT	GLO	Indiv.	05/10/2008
SBG2	Salzburg, Austria	RT	GLO	Type	05/10/2008
TRF2	Pernitz, Austria	RT	GLO	Indiv.	05/10/2008
IZAN	Guimar, Spain	RT	GLO	Type	18/01/2009
DUTH	Xanthi, Greece		GLO	Type	22/02/2009
ENIS	Enniskillen, UK	RT	GLO	Type	15/03/2009
FOYL	Londonderry, UK	RT	GLO	Type	15/03/2009
ALCI	Alchevsk, Ukraine	RT	GLO	Type	19/04/2009
INVR	Inverness, UK	RT	GLO	Type	19/04/2009

EVOLUTION OF EPN TRACKING NETWORK



EPN ANTENNA CALIBRATIONS

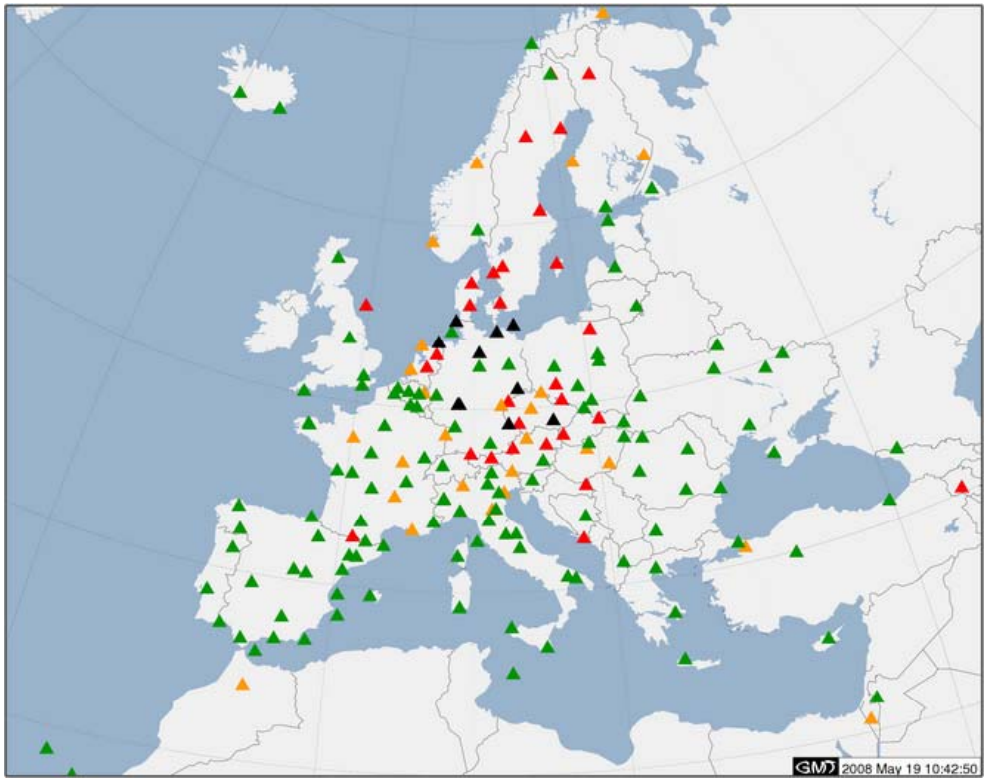
ROB

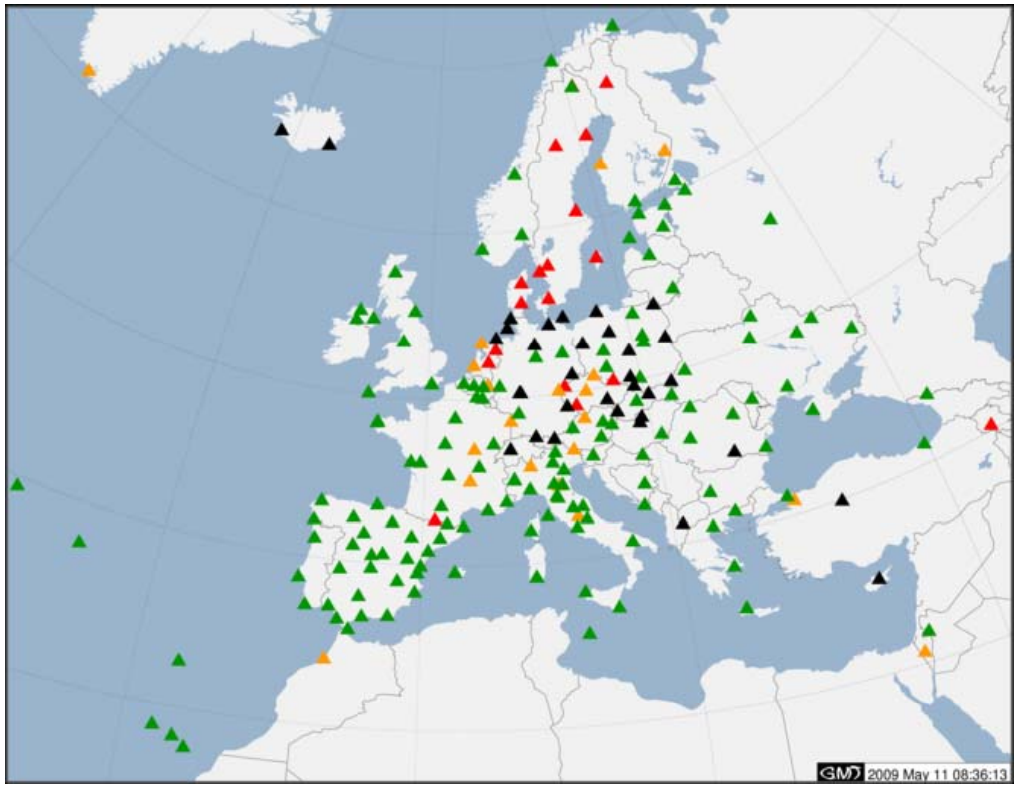
Dec. 2006

Indiv. abs. calib.	5 %	
True abs.calib	64 %	69%
Abs. calib. from field	14 %	
No calib.	17 %	

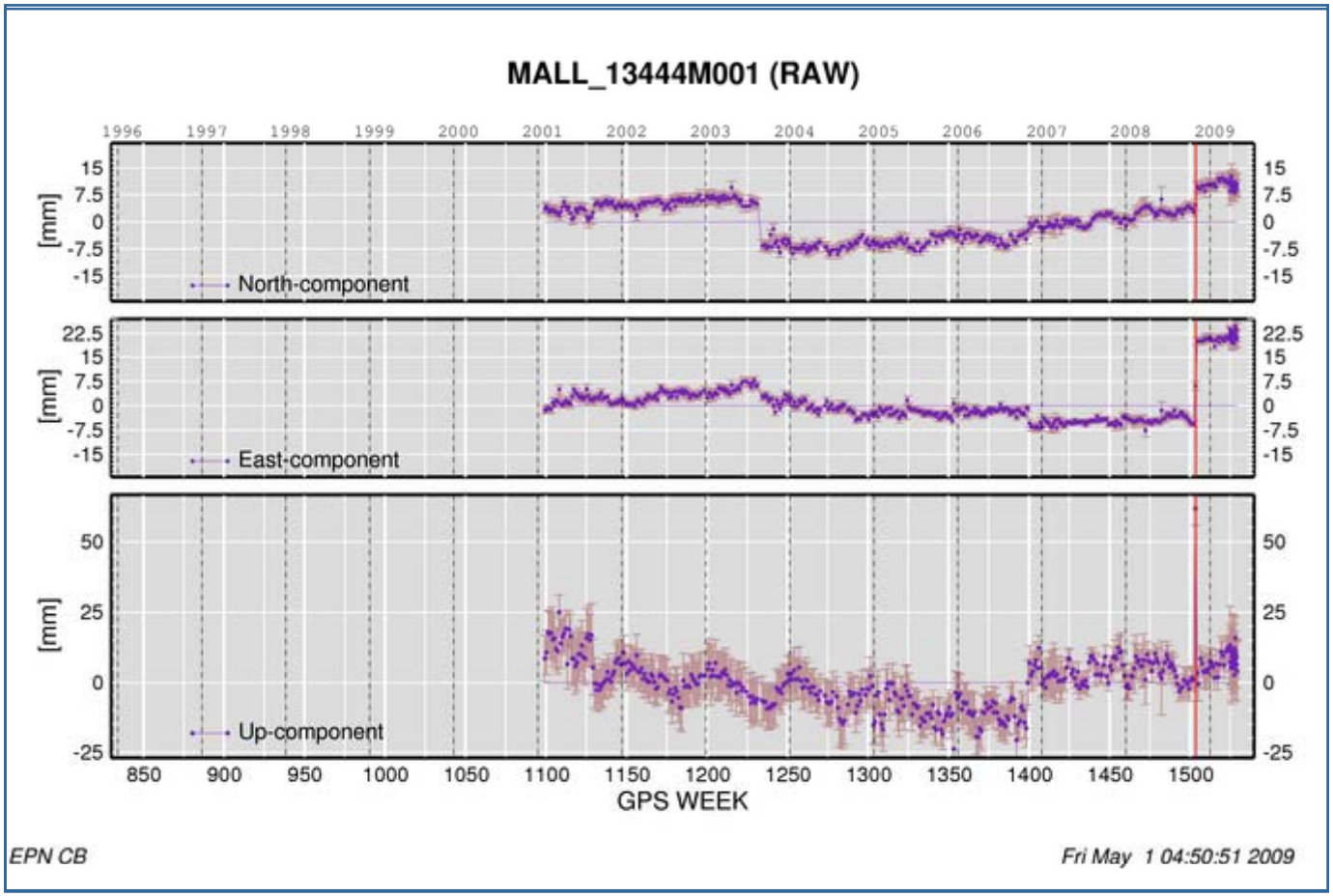
May 2009

Indiv. abs. calib	15 %	
True abs. calib	66 %	81%
Abs. calib. from field	9,5%	
No calib.	9,5%	





EPN ANTENNA REPLACEMENTS



Antenna+radome with true absolute calibrations before and after switch

EPN ANTENNA REPLACEMENTS

ROB

31 antenna replacements (including new stations)

(18 with radome!)

GPS	GPS/GLONASS	GPS/GLONASS/GALILEO
1 AOA/M_T	17 LEIAT504GG	3 LEIAR25
1 ASH701945E_M	1 NOV702GG	3 TPSCR.3G
1 ASH700936E	1 TPSSCR3_GGD	1 TRM59800.00
	2 TRM55971.00	
3	21	7

EPN ANTENNA REPLACEMENTS

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- Significant discontinuities associated with antenna changes
- Majority of antenna replacements today : multi-GNSS antenna

Strong recommendation:

use multi-GNSS antenna (GPS/GLONASS/GALILEO)

for EPN antenna replacements or when introducing new stations in EPN

… be ready for introduction of new EPN guideline …!

PERFORMANCE OF LAC SOLUTIONS

ROB

http://www.epncb.oma.be/_dataproducts/analysiscentres/LACreports.php

ANALYSIS CENTRES

In order to optimize the data processing within the EUREF Permanent Network, the principle of distributed processing is used. In this approach the EPN is divided in subnetworks which are separately processed by different EPN Local Analysis Centres (LACs).
The below mentionned EPN LACs all process a subnetwork out of the EPN following the rules and guidelines set up by the International GPS Service and supplemented by the EUREF Technical Working Group. They submit weekly free-network solutions (SINEX format) to the EPN Regional Data Centre BKG (availability).

The EPN Combination Centre is responsible for combining the EPN subnetwork solutions into one European solution submitted to IGS. Until GPS week nr 1019, CODE, located at the Astronomical Institute of the University of Bern (Switzerland), was acting as Combination Centre. Since GPS week nr 1020, the Bundesamt für Kartographie und Geodäsie (BKG), located at Frankfurt (Germany), took over this responsability.

The resulting free-network solutions (= *official combined EPN solution*) are made available as SINEX files to the IGS Global Network Associate Analysis Centers (GNAAC).

The coordination of the subnetwork definition is performed by the EPN Network Coordinator, Carine Bruyninx. The combined EPN solution is computed by the EPN Analysis Coordinator, Heinz Habrich of the BKG analysis centre.

Statistics on the agreement of the LAC solutions with the combined EPN solution are available from here.

	EPN Local Analysis Centres (EPN LAC)	LAC file	Network
ASI	**Centro di Geodesia Spaziale G. Colombo, Matera - Italy** The Centro di Geodesia Spaziale processes a European subnetwork comprising IGS and EPN stations in the South of Europe. Their solutions are incorporated in EUREF since September 1996.	Yes	available
BEK	**Bayerische Kommission für die Internationale Erdmessung of the Bavaria Academy of Science, Munich - Germany** The Bayerische Kommission für die Internationale Erdmessung of the Bavarian Academy of Science in Munich has been the Computing Center for the computation of the unified European Triangulation Network RETrig. It was also involved in the computation of the EUREF-89 GPS campaign. Since end of 1995, BEK has been producing weekly solutions of a EPN subnetwork.	Yes	available
BKG	**Bundesamt für Kartographie und Geodäsie - Germany** BKG has acquired the capacity to routinely process permanent IGS networks. Since early 1996 it has been processing part of the European Network on a weekly basis.	Yes	available
COE	**Centre for Orbit Determination in Europe, Astronomical Institute of the University of Bern - Swizerland** CODE is processing almost the complete European Permanent Network in order to create a reference solution which is used as a comparison for the solutions of the other EPN Local Analysis Centres. The Center for Orbit Determination in Europe is a joint operation of the four institutions : • Astronomisches Institut (AIUB), Universität Bern, Switzerland • Bundesamt für Landestopographie (L+T), Wabern, Switzerland	Yes	available

PERFORMANCE OF LAC SOLUTIONS

ROB

http://www.epncb.oma.be/_dataproducts/analysiscentres/LACreports.php

DATA & PRODUCTS > ANALYSIS CENTRES > ANALYIS REPORTS

ANALYSIS REPORTS

The EPN Local Analysis Centres (LAC) compute permanently the positions of the EPN stations as well as the tropospheric zenith path delays at the EPN stations. Each week these computed station positions (in SINEX format) and tropospheric parameters are combined by the EPN Analysis Coordinator (H. Habrich) and the coordinator of the EPN troposphere product (W. Sohne) to generate the weekly EPN final position and troposphere products.

During the combination process, the solutions from the individual analysis centres are compared against the combined product and associated statistics on the agreement between the solutions of the individual analysis centres and the combined solution are generated :

- General agreement between analysis centres

  showing the time evolution of the

  1. RMS of the Helmert transformation between each weekly LAC position solution and the combined EPN solution. Also the values of the Helmert transformation parameters are available. In all cases a priori values (before outlier rejection) and final values (after outlier rejection) are provided.
  2. tropospheric biases (as well as their standard deviation) of each weekly LAC troposphere solution with respect to the combined solution.

- Agreement between analysis centres - zoom into an EPN station

  showing for each EPN station the time evolution of the

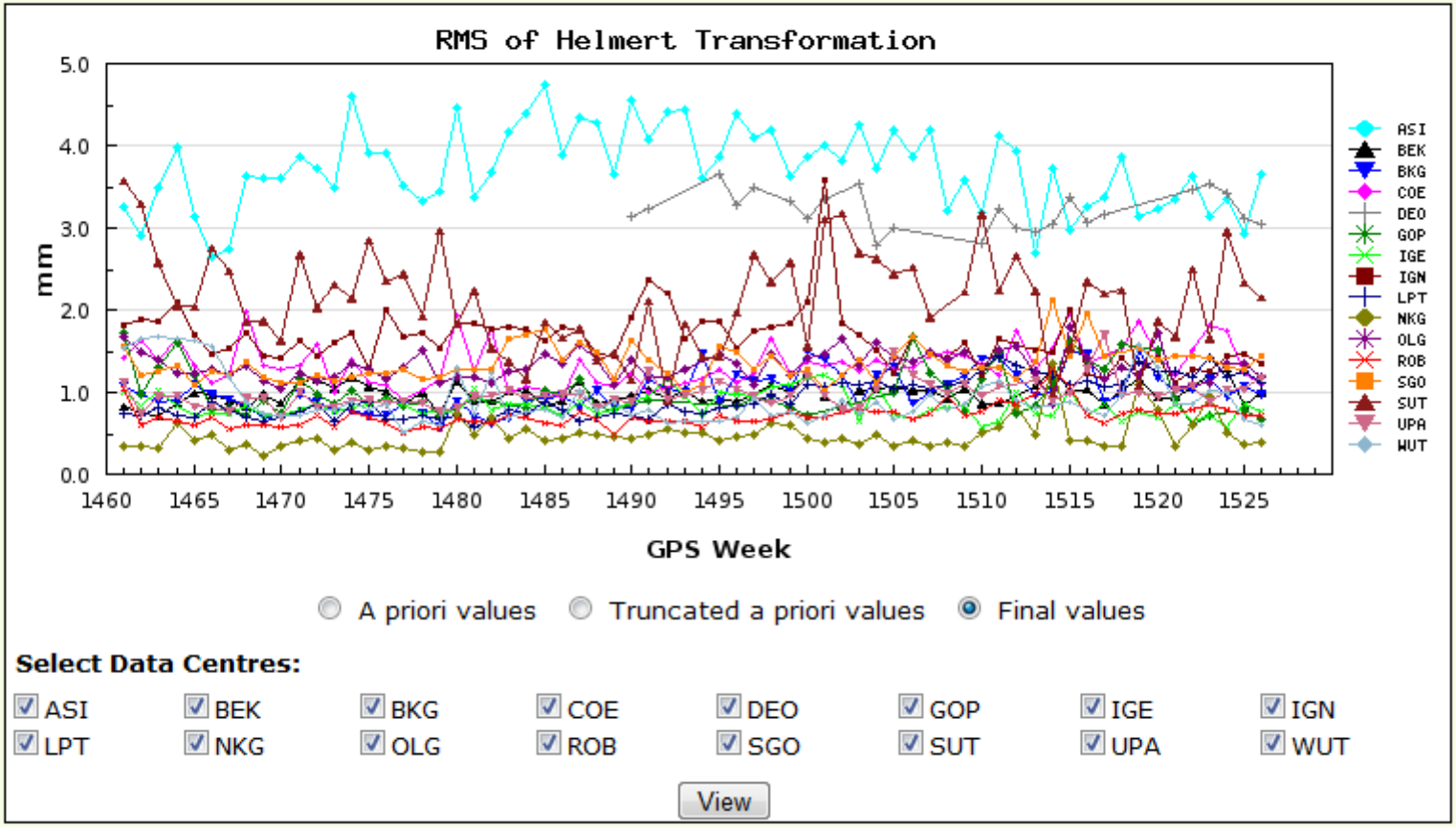
  1. RMS and Helmert differences of the position estimates of each LAC with respect to the combined EPN solution, a priori values (before outlier rejection) and final values (after outlier rejection) are provided.
  2. tropospheric biases (as well as their standard deviation) of each weekly LAC solution with respect to the combined solution.

PERFORMANCE OF LAC SOLUTIONS

ROB

http://www.epncb.oma.be/_dataproducts/analysiscentres/LACreports.php

A. RMS of the Helmert transformation (values of Helmert parameters) between each weekly LAC position estimates and the combined EPN solution. A priori values (before outlier rejection) and final values (after outlier rejection) are provided.

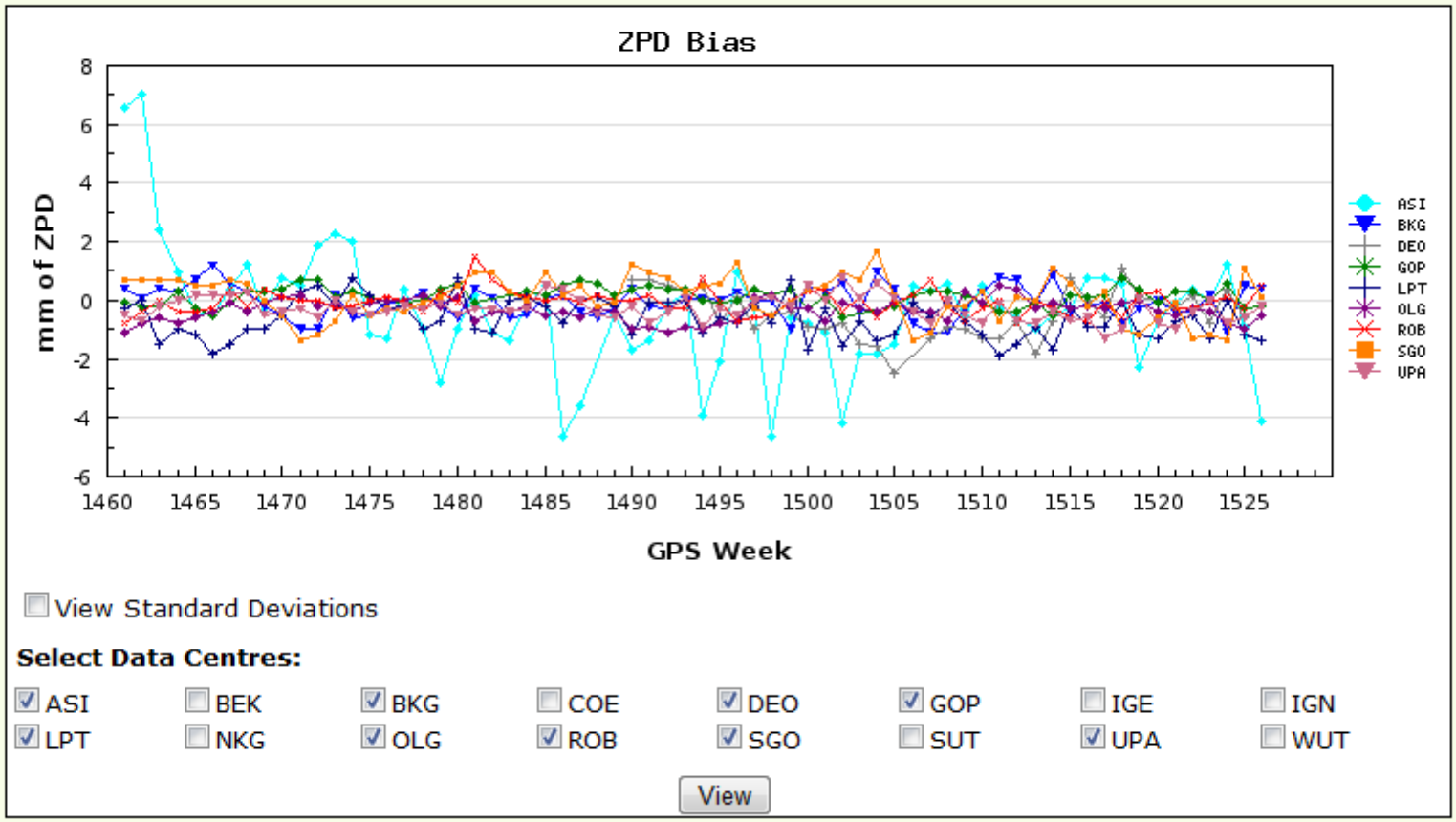


PERFORMANCE OF LAC SOLUTIONS

ROB

http://www.epncb.oma.be/_dataproducts/analysiscentres/LACreports.php

B. Mean bias (and Standard Deviation) of the Tropospheric Zenith Path Delay (ZPD) estimations by each LAC with respect to the combined EPN tropospheric ZPD solution.



PERFORMANCE OF LAC SOLUTIONS

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ANALYSIS REPORTS

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  2. tropospheric biases (as well as their standard deviation) of each weekly LAC troposphere solution with respect to the combined solution.

- Agreement between analysis centres - zoom into an EPN station

  showing for each EPN station the time evolution of the

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  2. tropospheric biases (as well as their standard deviation) of each weekly LAC solution with respect to the combined solution.

PERFORMANCE OF LAC SOLUTIONS
ZOOM ON STATION

ROB

http://www.epncb.oma.be/_dataproducts/analysiscentres/LACreports.php

The information below is extracted from the weekly EUREF AC REPORTS and EUREF TROPOSPHERE COMBINATION REPORTS distributed through LAC mail.

Select Station: Select a Station

A. RMS of the differences (after a Helmert transformation) between the weekly positions estimated by the LACs and the position from the weekly combined EPN solution. A priori values (before outlier rejection) and final values (after outlier rejection - available since GPS week 1526) are provided.

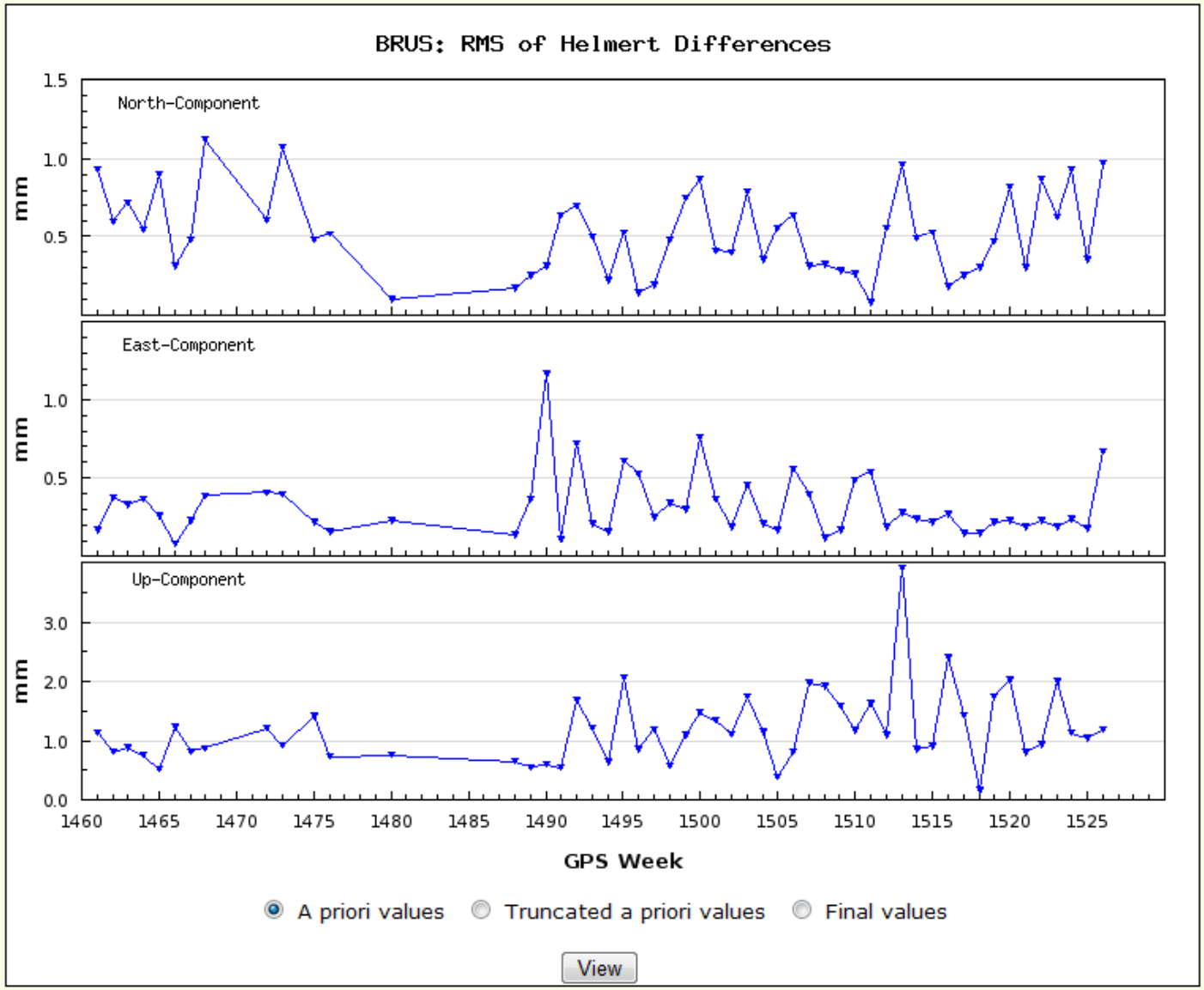
B. Differences (after a Helmert transformation) between the weekly position estimated by each LAC and the position from the weekly combined EPN solution. A priori values (before outlier rejection) and final values (after outlier rejection - available since GPS week 1526) are provided.

C. Biases and standard deviations between the Tropospheric Zenith Path Delays (ZPD) estimated by each LAC and the combined EPN tropospheric ZPD solution.

ZOOM ON STATION

ROB

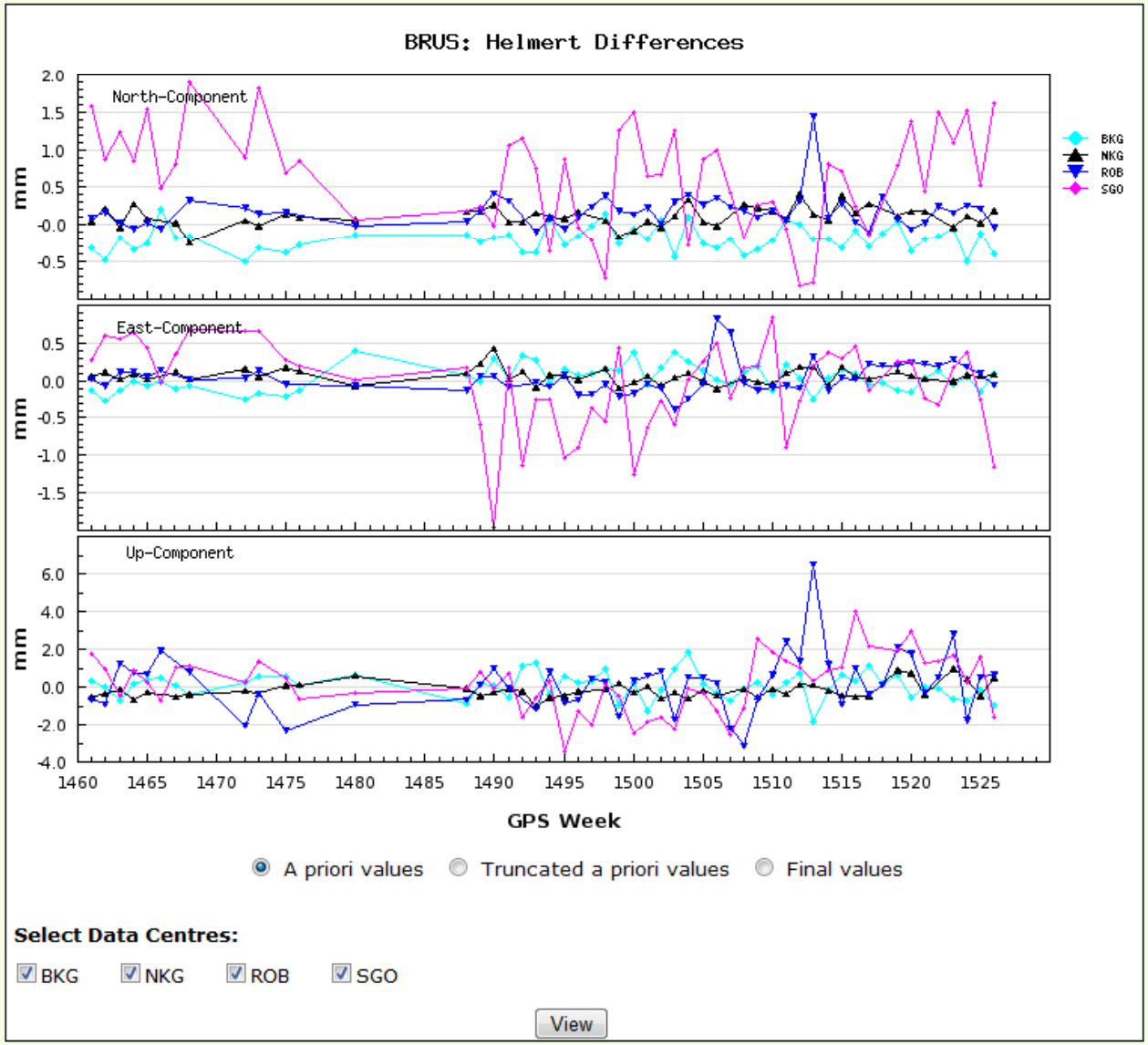
A. RMS of the differences (after a Helmert transformation) between the weekly positions for BRUS estimated by the LACs and the position of BRUS from the weekly combined EPN solution. A priori values (before outlier rejection) and final values (after outlier rejection - available since GPS week 1526) are provided.



ZOOM ON STATION

ROB

B. Differences (after a Helmert transformation) between the weekly position estimated for BRUS by each LAC and the position of BRUS from the weekly combined EPN solution. A priori values (before outlier rejection) and final values (after outlier rejection - available since GPS week 1526) are provided.

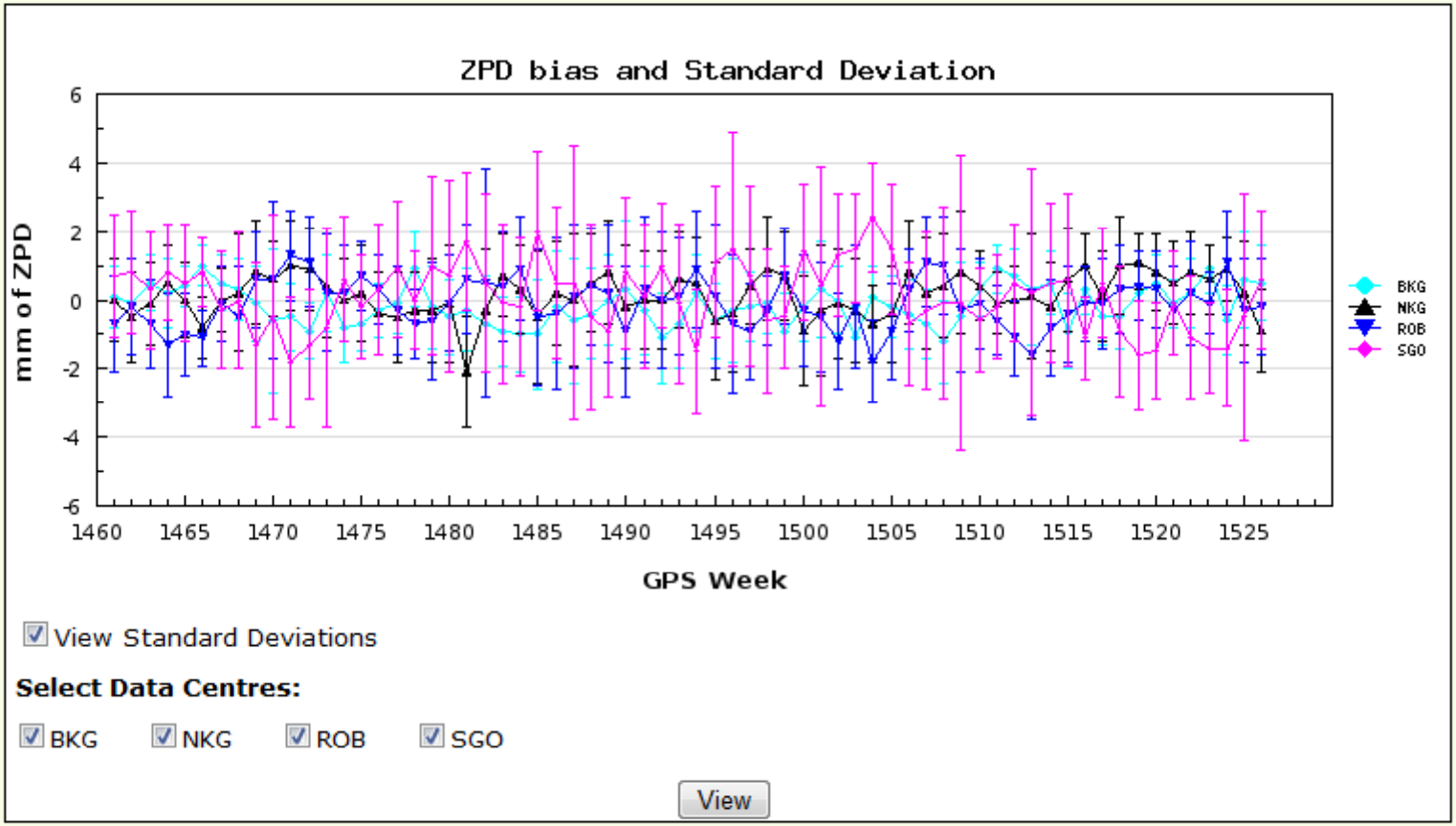


PERFORMANCE OF LAC SOLUTIONS
ZOOM ON STATION

ROB

http://www.epncb.oma.be/_dataproducts/analysiscentres/LACreports.php

C. Biases and standard deviations between the Tropospheric Zenith Path Delays (ZPD) estimated for BRUS by each LAC and the combined EPN tropospheric ZPD solution for BRUS.

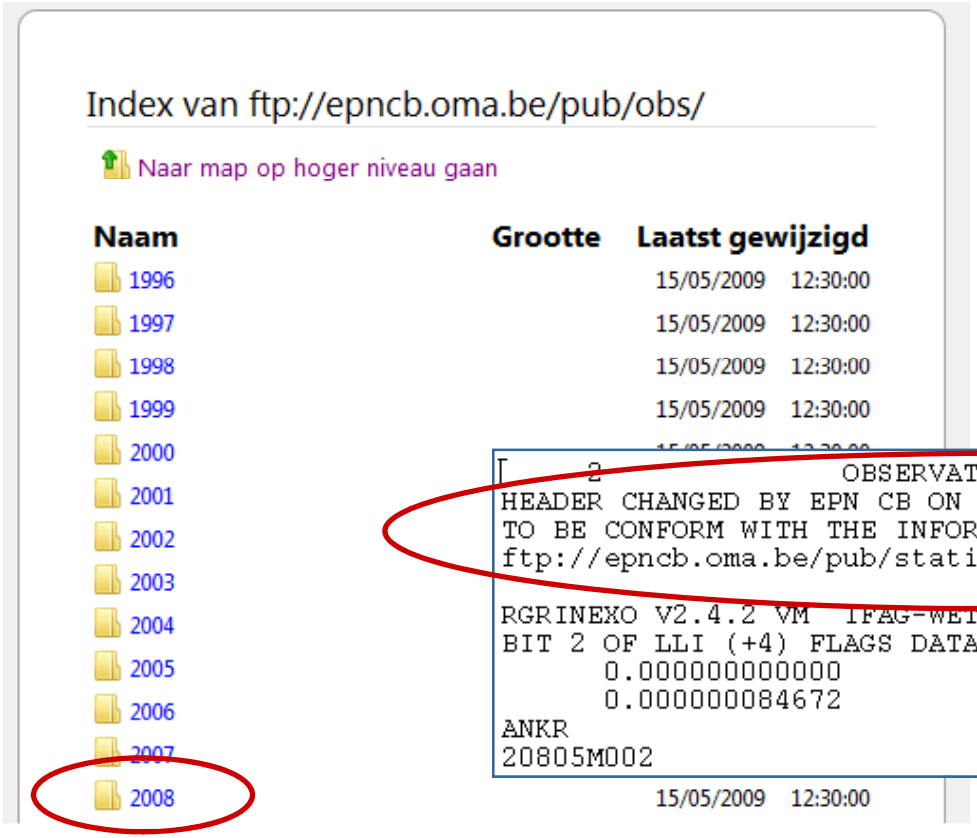


REPROCESSING DATA CENTER

ROB

ftp://epncb.oma.be/pub/obs

- All daily EPN data, presently only active stations, 1996 → 2008
- hatanaka compressed RINEX
- RINEX headers corrected following site logs




```
     2                    OBSERVATION DATA    G (GPS)             RINEX VERSION / TYPE
HEADER CHANGED BY EPN CB ON 2009-05-18                           COMMENT
TO BE CONFORM WITH THE INFORMATION IN                            COMMENT
ftp://epncb.oma.be/pub/station/log/ankr_20080509.log             COMMENT
                                                                 COMMENT
RGRINEXO V2.4.2 VM  IFAG-WETTZELL       04-JAN-96 10:12      PGM / RUN BY / DATE
BIT 2 OF LLI (+4) FLAGS DATA COLLECTED UNDER "AS" CONDITION      COMMENT
      0.000000000000          HARDWARE CALIBRATION (S)           COMMENT
      0.000000084672          CLOCK OFFSET (S)                   COMMENT
ANKR                                                             MARKER NAME
20805M002                                                        MARKER NUMBER
```

SUMMARY & FUTURE PLANS

- Antenna replacements continue to be a problem
- Prepare for upgrade to multi-GNSS tracking
- New tools at EPN CB
  - On-line site log submission
  - LAC performance
- EPN Data Center in support of reprocessing
- Future:
  - Update of EPN guidelines?
  - Archives of station pictures