Royal Observatory
of Belgium

New EPN web pages and tools

C. Bruyninx

Updates

Necessary because of

- Galileo added to site log
- RINEX V3 data
- EPN-REPRO1 results
- New cumulative solution, IGS08

- Facilitate management

- Additional info

EUREF Permanent Network

WELCOME !

EUREF Permanent Network

The European Terrestrial Reference System 89 (ETRS89) is used as the standard precise GPS coordinate system throughout Europe. Supported by EuroGeographics and endorsed by the EU, this reference system forms the backbone for all geographic and geodynamic projects on the European territory both on a national as on an international level.

The ETRS89 is maintained by the IAG sub-commission EUREF and it is accessed through the EUREF Permanent Network (EPN), a science-driven network of continuously operating GPS reference stations with precisely known coordinates in the ETRS89.

All contributions to the EPN are voluntary, with more than 100 European agencies/universities involved, and the reliability of the network is based on redundancy and extensive guidelines guaranteeing the quality of the raw GPS data to the resulting station positons. Next to its key role in the maintenance of the ETRS89, the EPN data are also used for a wide range of scientific applications such as the monitoring of ground deformations, sea level, space weather and numerical weather prediction.

Download EPN flyer.

EPN Central Bureau

This web site is part of the EPN Central Bureau Information System, providing both EPN member organizations and the public with information about the EPN organization, the EPN network of stations, and EPN data & products.

Whenever your use of EPN data or products results in a publication, please include a citation.

The Central Bureau is supported by the Solar Terrestrial Centre of Excellence (STCE) and managed by the Royal Observatory of Belgium.

Quick Link to Site Information

(select a station)

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More ...

News

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More ...

Job Opportunities

Open Positions for 3 Post-Doctoral Fellowships

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Assistant Professor in Geodesy & Surveying Engineering

Open Position in the Ionospheric and Atmospheric Remote Sensing Group at JPL

Next Meetings

AGU 2012 Fall Meeting
2012-12-03/2012-12-07
San Francisco, USA

FIG Commission 3 Workshop and Annual Meeting 2012
2012-12-10/2012-12-14
Athens, Greece

ION International Technical Meeting 2013
2013-01-28/2013-01-30

STATION LIST:
Galileo
and
RINEX V3 INFO ADDED

STATION LIST

As of 11 November 2012, 245 permanent GNSS tracking stations are part of the EUREF Permanent Network.

For a better understanding of the table, see the legend.

Site Identification	Site Location	Data	Receiver Information	Antenna Information	Meteorological Instrumentation	Additional Information
☑ Marker Name	☑ City	☑ Quality	☐ Type	☐ Type/Radome	☐ Meteo data	☐ Primary data centre
☑ Marker Number	☐ Country	☑ Availability	☑ Satellite system	☐ Serial number	☐ Humidity sensor	☐ Secondary data centre
☐ Site log	☐ Tectonic plate	☑ Latency	☐ Serial number	☐ Height	☐ Pressure sensor	☑ Networks
☐ Site name	☑ Lat, long, h		☐ Firmware version	☐ Reference point	☐ Temperature sensor	☑ RINEX 3 data available
	☐ X, Y, Z		☐ Frequency Standard		☐ Water vapor radiometer	☑ Remarks

Submit

Marker Name	Marker Number	City	Lat.	Long.	H.	DQ (%)		Availability (%)					Latency			Receiver Sat. System			Networks			RINEX 3 data available	Remarks
						0°	15°	Daily BKG	Daily OLG	Hourly BKG	Hourly OLG	RT	Hourly(%) BKG	Hourly(%) OLG	RT (s)	G	R	E	IGS	TOS	ECGN		
ACOR	13434M001	A Coruna	43.36	-8.40	67.0	85	93	100	100	100	100	99	99	97	1.4	✔	_	_	_	_	✔	_	
AJAC	10077M005	Ajaccio	41.93	8.76	99.0	89	97	100	100	100	100	98	96	29	0.8	✔	✔	_	✔	✔	_	_	
ALAC	13433M001	Alicante	38.34	-0.48	60.0	96	100	100	100	100	100	99	93	92	0.9	✔	✔	✔	_	_	✔	✔	
ALBA	13452M001	Albacete	38.98	-1.86	751.8	97	99	100	100	100	100	99	94	94	0.9	✔	✔	✔	_	_	_	✔	
ALCI	12371S001	Alchevsk/Mikhailovka	48.46	38.91	152.1	87	92	100	100	98	97	_	2	0	_	✔	_	_	_	_	_	_	
ALME	13437M001	Almeria	36.85	-2.46	127.0	84	97	100	100	100	100	99	96	96	2.0	✔	_	_	_	_	✔	_	
~~AMMN~~	~~22201M001~~	~~Amman~~	~~32.03~~	~~35.88~~	~~1055.8~~											✔	_	_	✔	_	_	_	*Former*
ANKR	20805M002	Ankara	39.89	32.76	974.8	89	97	100	100	100	100	_	98	0	_	✔	✔	_	✔	_	_	_	
AQUI	12757M001	L'Aquila	42.37	13.35	713.0	79	93	100	100	100	100	_	94	90	_	✔	_	_	_	_	_	_	
ARGI	10117M002	Argir, Tórshavn	62.00	-6.78	110.2	86	94	100	100	100	100	_	97	97	_	✔	✔	_	_	_	_	_	
AUT1	12619M002	Thessaloniki	40.57	23.00	150.0	82	93	100	96	100	100	99	96	94	1.4	✔	_	_	_	_	_	_	
AUTN	10080M001	Autun	46.95	4.29	353.0	87	97	100	100	100	100	_	97	32	_	✔	✔	_	_	_	_	_	
AXPV	10057M001	Aix En Provence	43.49	5.33	229.4	88	97	100	100	100	100	_	98	36	_	✔	✔	✔	_	_	_	✔	
BACA	11405M001	Bacau	46.56	26.91	219.2	80	93	93	93	89	89	_	89	88	_	✔	_	_	_	_	_	_	
BADH	14288M001	Bad Homburg	50.23	8.61	261.6	87	93	100	100	100	100	_	100	0	_	✔	✔	_	_	_	✔	_	
BAIA	11406M001	Baia Mare	47.65	23.56	271.0	77	92	100	100	99	99	_	93	97	_	✔	_	_	_	_	_	_	
BBYS	11514M001	Banska Bystrica	48.75	19.15	487.4	82	93	100	100	99	99	_	96	92	_	✔	✔	✔	_	_	_	✔	
BELF	13240M001	Belfast	54.58	-5.93	82.1	87	94	100	96	100	97	87	100	65	0.7	✔	✔	_	_	_	_	_	
BELL	13431M001	Bellmunt de Segarra	41.60	1.40	853.4	77	91	100	100	100	100	97	100	100	0.3	✔	✔	_	_	_	_	_	
BISK	11520M001	Zlate Hory	50.26	17.43	950.9	69	85	0	4	0	6		0	5		✔	✔	✔					

INFO on signals tracked
NEEDS UPDATE

Details on the GNSS signals included in the daily RINEX v2.11 data files available from the EPN data centres are given below. The GPS L1 signal is mandatory included in all GNSS data files and cannot be de-activated. When GLONASS is selected, the GLONASS L1 signal is also considered as mandatory (and cannot be de-activated).

Criteria selection

Date 2012-11-09

Observables mandatory in RINEX

☑ GPS
using the signals :
code : ☐ C1 ☐ C2 ☐ C5 ☐ P1 ☐ P2
phase : ☑ L1 ☐ L2 ☐ L5
not using the signals :
code : ☐ C1 ☐ C2 ☐ C5 ☐ P1 ☐ P2
phase : ☐ L1 ☐ L2 ☐ L5

☐ GLONASS
using the signals :
code : ☐ C1 ☐ C2 ☐ P1 ☐ P2
phase : ☐ L1 ☐ L2
not using the signals :
code : ☐ C1 ☐ C2 ☐ P1 ☐ P2
phase : ☐ L1 ☐ L2

Update map

Additional tracking information available

- from the University of Bern

Sites responding to the criteria on 09-11-2012

- Select a station -

NETWORK & DATA > **TRACKING STATUS**

Details on the GNSS signals included in the daily RINEX v2.11 data files available from the EPN data centres are given below. The GPS L1 signal is mandatory included in all GNSS data files and cannot be de-activated. When GLONASS is selected, the GLONASS L1 signal is also considered as mandatory (and cannot be de-activated).

Criteria selection

Date 2012-11-06

Observables mandatory in RINEX

☑ GPS
using the signals :
code : ☐ C1 ☐ C2 ☐ C5 ☐ P1 ☐ P2
phase : ☑ L1 ☐ L2 ☑ L5
not using the signals :
code : ☐ C1 ☐ C2 ☐ C5 ☐ P1 ☐ P2
phase : ☐ L1 ☐ L2 ☐ L5

☐ GLONASS
using the signals :
code : ☐ C1 ☐ C2 ☐ P1 ☐ P2
phase : ☐ L1 ☐ L2
not using the signals :
code : ☐ C1 ☐ C2 ☐ P1 ☐ P2
phase : ☐ L1 ☐ L2

Update map

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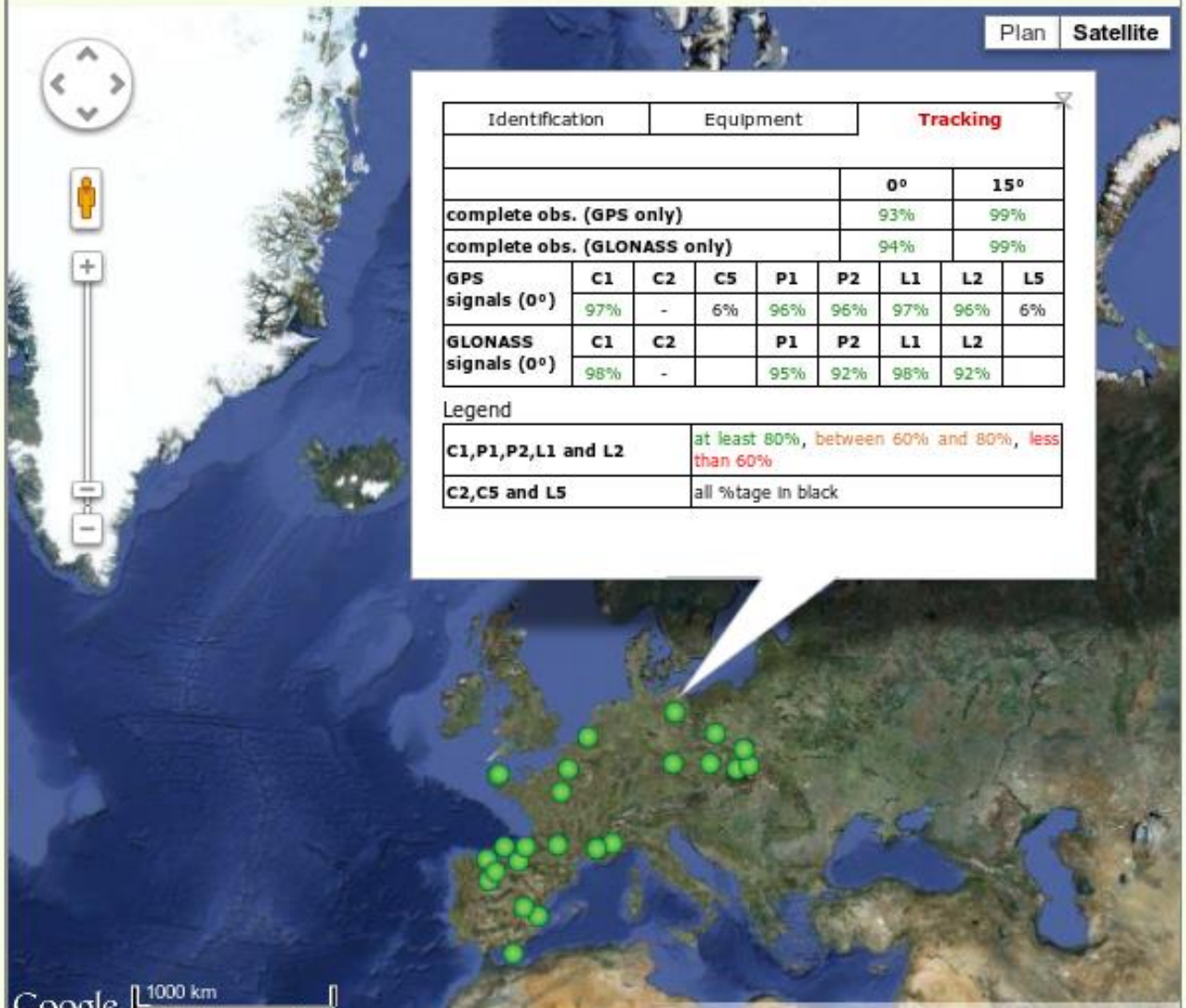
Sites responding to the criteria on 06-11-2012

POTS (Potsdam, Germany)



Identification	Equipment	Tracking					
					0°	15°	
complete obs. (GPS only)					93%	99%	
complete obs. (GLONASS only)					94%	99%	
GPS signals (0°)	**C1**	**C2**	**C5**	**P1**	**P2**	**L1**	**L2**	**L5**
	97%	-	6%	96%	96%	97%	96%	6%
GLONASS signals (0°)	**C1**	**C2**		**P1**	**P2**	**L1**	**L2**	
	98%	-		95%	92%	98%	92%	

Legend

C1,P1,P2,L1 and L2	at least 80%, between 60% and 80%, less than 60%
C2,C5 and L5	all %tage in black

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2013-01-28/2013-01-30

Added original individual antenna calibration file (all signals)

Site Descr

sels, Belgium

LOG FILE	brux_20120924.log (current) View
PICTURES	
OPERATIONAL CENTRE	ROB
OTHER NETWORKS	IGS, ~~TOS~~, ~~ECGN~~
EPN INCLUSION	Since 071/2012 (GPSweek No 1679).
INACTIVITY PERIODS	None
COORDINATES	Published positions/velocities in ITRS and ETRS89
INDIVIDUAL ANTENNA CALIBRATIONS	• ASH701945C_M/NONE (SN: CR620002301) from 2008-03-19 to 2008-06-17, from 2008-06-17 to 2008-09-02, from 2008-09-02 to 2008-09-22, from 2008-10-20 to 2011-03-07 : - BONN (freq: G01,G02,G05,R01,R02,E01,E05,E06,E07,E08, date: 2010-08-23) • JAVRINGANT_DM/NONE (SN: 00464) from 2011-03-07 to now : - BONN (freq: G01,G02,G05,R01,R02,E01,E05,E06,E07,E08, date: 2011-02-01)

Added info on availability of RINEX v3 data files

GNSS Data (RINEX, RTCM, ...)

DAILY

FORMAT : RINEX V2.11, 30 sec, Hatanaka compressed
ACCESS : free

FORMAT : RINEX V3.02, 30 sec, Hatanaka compressed
(unvalidated data - download from here - , only for test purposes!)

DOWNLOAD DATA

<<	<	November 2012				>	>>
Wk No	Sun	Mon	Tue	Wed	Thu	Fri	Sat
1712					01 (306)	02 (307)	03 (308)
1713	04 (309)	05 (310)	06 (311)	07 (312)	08 (313)	09 (314)	10 (315)
1714	11 (316)	12 (317)	13 (318)	14 (319)	15 (320)	16 (321)	17 (322)
1715	18 (323)	19 (324)	20 (325)	21 (326)	22 (327)	23 (328)	24 (329)
1716	25 (330)	26 (331)	27 (332)	28 (333)	29 (334)	30 (335)	

Data available from the historical EPN data centre
Data available from a Regional data centre
Data only available from a Local data centre
Data only available from a Global IGS data centre

META DATA ERRORS

Header of the RINEX observation files

DATA CENTRES STATUS

EPN (historical)	Online. No data detected for BRUX since 2012/122 (190 days).
BKGI (secondary)	Online.
OLG	Online.
ROB (primary)	Online.
CDDIS	Online.
IGNI	Online.

HOURLY

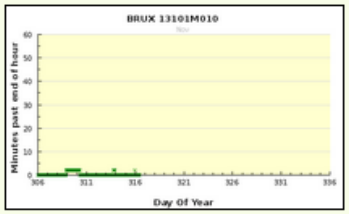
FORMAT : RINEX V2.11, 30 sec, Hatanaka compressed
ACCESS : free

AVAILABLE FROM

BKGI
CDDIS
GOP
IGNI
OLG
ROB

FORMAT : RINEX V3.02, 30 sec, Hatanaka compressed
(unvalidated data - download from here - , only for test purposes!)

DATA LATENCY



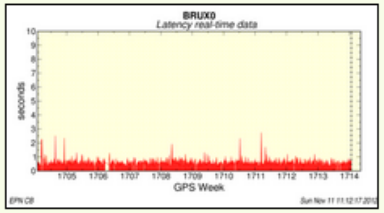
REAL-TIME

ACCESS : free, using Ntrip

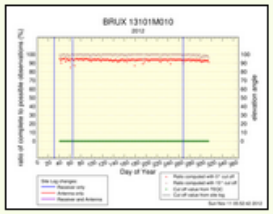
AVAILABLE FROM

BKG (broadcaster, registration)
BRUX0 : RTCM 3.0 (1004(1),1006(10),1008(10),1012(1))
ROB (broadcaster, registration)
BRUX7 : RTCM 3.0 (1019(1),1020(1),1033(1),1077(1),1087(1),1097(1),1107(1))
BRUX0 : RTCM 3.0 (1004(1),1006(10),1008(10),1012(1))
BRUX1 : RAW (SBF(1))

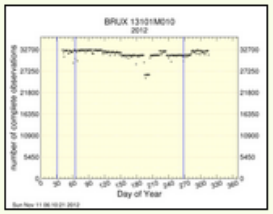
DATA LATENCY



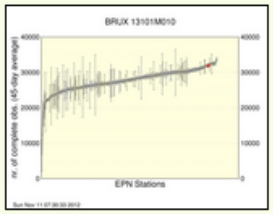
QUALITY PLOTS



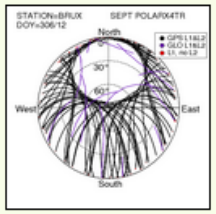
Ratio observed/predicted number of observations



Yearly tracking performance (TEQC)



Tracking performance (TEQC) compared to other EPN stations



Snapshots of satellite tracking

MORE INFORMATION

METEO DATA : none

SATELLITE SYSTEM : GPS+GLO+GAL

NETWORK & DATA > STATION LIST > BRUX 13101M010 > **RATIO OBSERVED/PREDICTED NUMBER OF OBSERVATIONS**

This plots displays the long-term tracking performance of a station, based on the daily percentage of each constellation tracked by the station. This percentage corresponds to the ratio of the number of complete observations (both the L1 and L2 frequencies are observed) with respect to the number of predicted observations. Input are the daily RINEX observation file and the RINEX navigation message, needed to compute the predicted observations.

The percentage, given in brown, is computed for a fixed elevation cut off angle of 15°. The percentage, given in red, is computed for a fixed elevation cut off angle of 0°. The EPN guidelines request that a station has a clear horizon above 5° which means that it is expected that the 15° value is close to 100%.

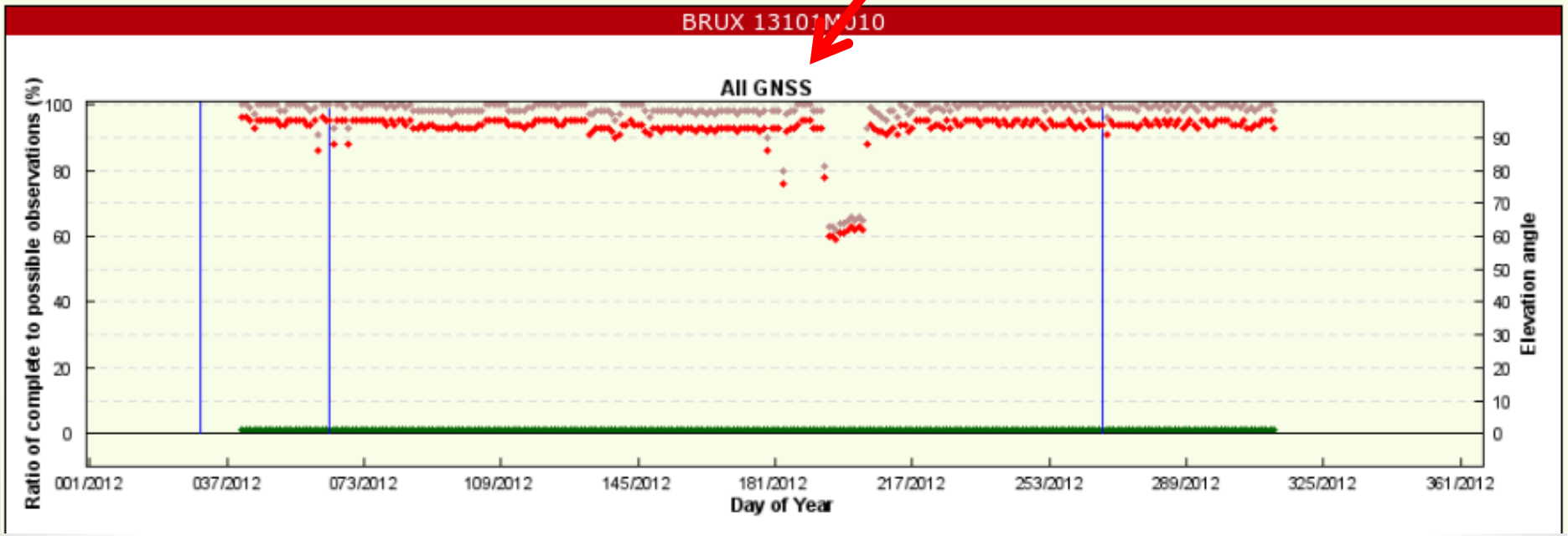
The black line on each plot is the elevation cut off angle as set in the station log file. The value in green is the elevation cut off angle as observed in the RINEX observation file, given by the lowest elevation at which satellite are seen.

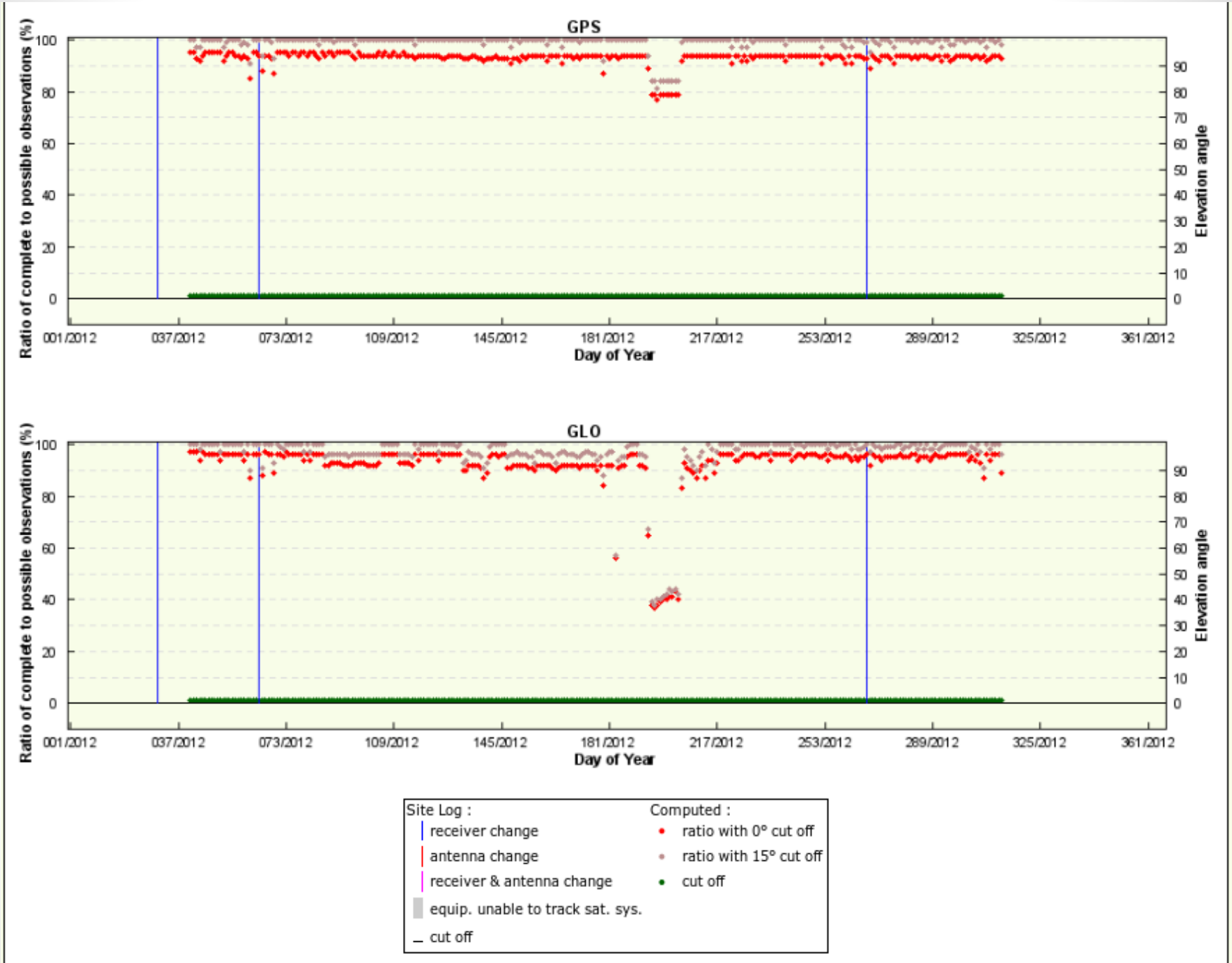
Other periods:

From : 2012 / 001 to : 2012 / 366

View

The quality checks are presently still running on the historical EPN data.
Consequently, the plots below may not yet display results for the full time span of the station.




GPS
Ratio of complete to possible observations (%)
Elevation angle
Day of Year
001/2012
037/2012
073/2012
109/2012
145/2012
181/2012
217/2012
253/2012
289/2012
325/2012
361/2012
GLO
Ratio of complete to possible observations (%)
Elevation angle
Day of Year
Site Log :
receiver change
antenna change
receiver & antenna change
equip. unable to track sat. sys.
cut off
Computed :
ratio with 0° cut off
ratio with 15° cut off
cut off

Position time series & Tropospheric products updated to include EPN-REPRO1 results

	From (GPSweek)	To (GPSweek)
ASI	0834	now
BKG	0834	now
COE	1400	now
GOP	1603	now
NKG	0834	now
WUT	0834	now

COMBINED SOLUTIONS

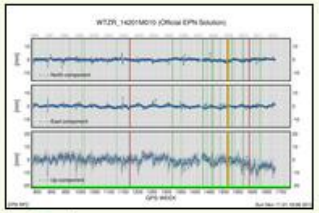
EXCLUSION PERIODS

- 341/2003 (GPSweek No 1248) - 347/2003 (GPSweek No 1248) : too large residual in comparison between LACs.

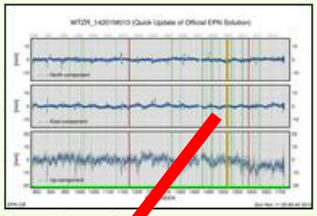
POSITION TIME SERIES

New results including EPN-REPRO1 available!!

Cumulative EPN Solution

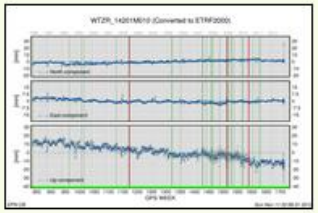


Official



Quick update

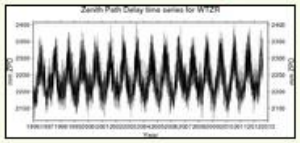
Weekly EPN Solution wrt mean



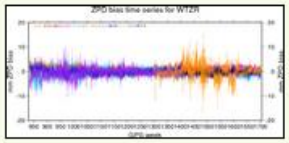
ETRS89

TROPOSPHERE

New results including EPN-REPRO1 available!!

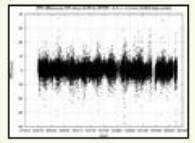


Zenith path delay time series. Monthly mean ZPD parameters

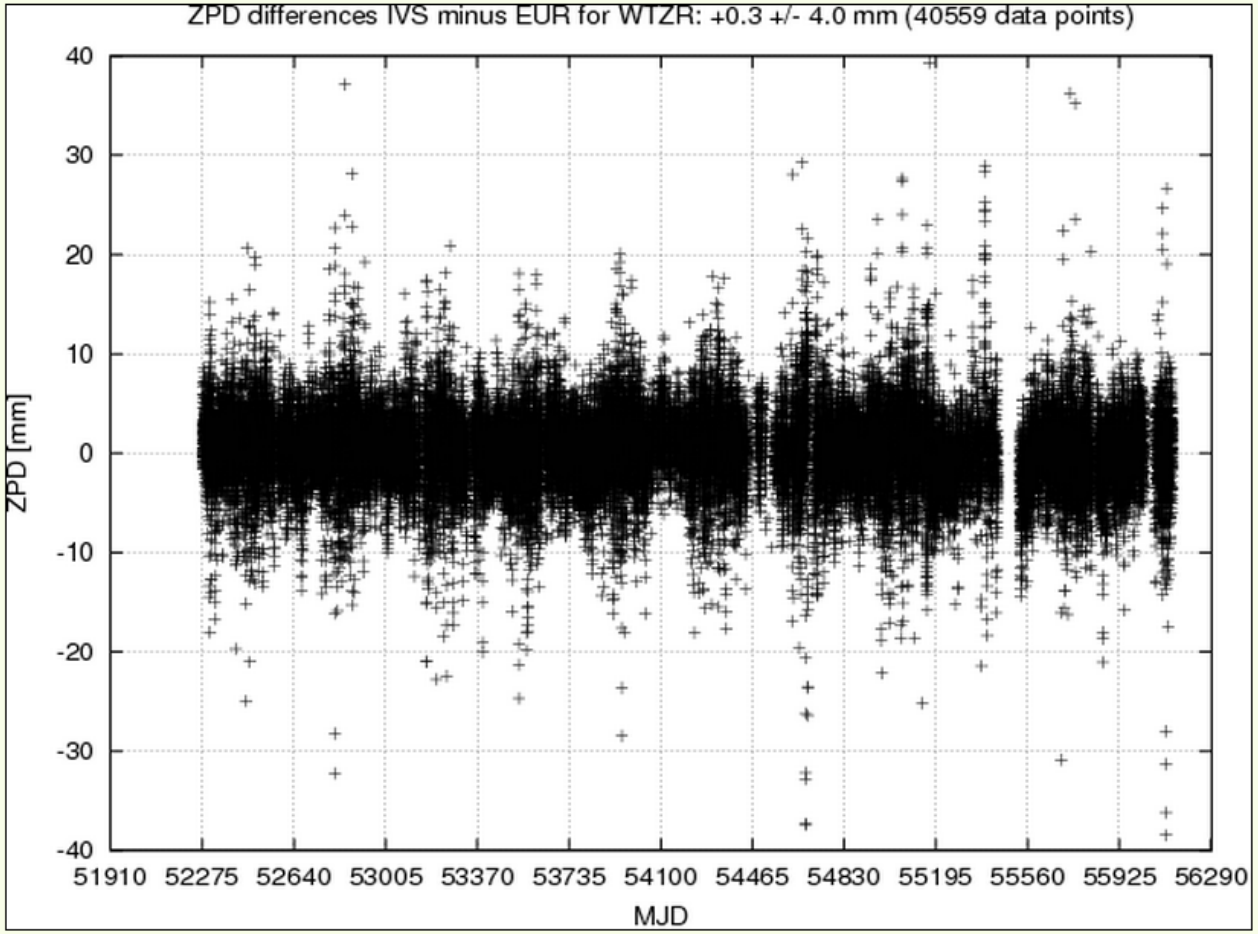


Daily ZPD biases from EUREF combination

ZPD radiosonde biases : not yet available.



Comparison with VLBI ZPD



Purpose

- Validate EUREF combined Zenith Path Delay (ZPD) parameters with ZPD derived from Very Long Baseline Interferometry (VLBI) data at co-located sites
- Variations and differences are influenced by the distance between the two stations
- Time series of differences reflect differences and changes in analysis strategy

Procedure

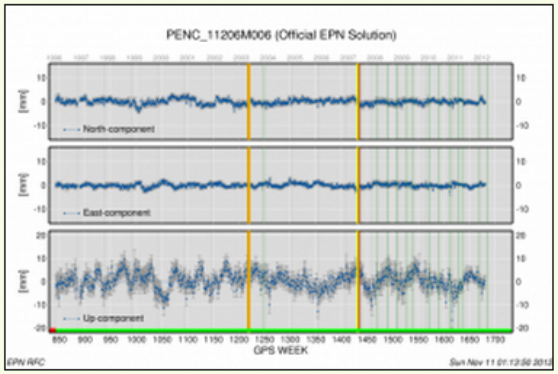
- Download of VLBI ZPD parameters, provided by the International VLBI Service (IVS)
- Combination of tropospheric estimates by R. Heinkelmann, Deutsches Geodätisches Forschungsinstitut (DGFI)
- Height difference at the co-located site is not taken into account
- Differences at co-located sites for identical points in time (interpolation)

EPN station position time series:
(select a station)

Other residual position time series: ITRF2008

MULTI-YEAR EPN SOLUTION

Official, solutions included up to March 18, 2012 (GPS wk 1680)



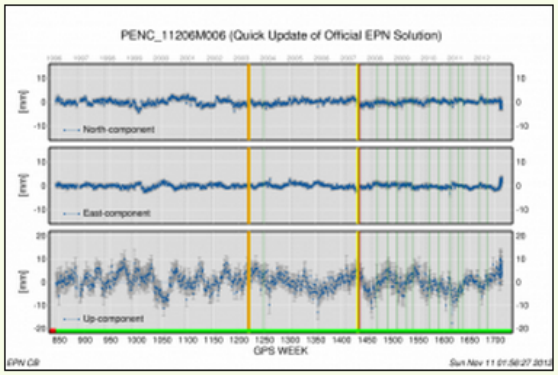
Residual position time series of the cumulative EPN solution (tied to IGS08) with as input:

1. the reprocessed weekly EPN solutions up to GPS week 1408 (corrected to be in accordance with the epn_08.atx antenna calibration model)
2. the weekly (routine) EPN solutions from GPS week 1409 till 1631 (corrected to be in accordance with the epn_08.atx antenna calibration model)
3. the weekly (routine) EPN solutions from GPS week 1632 till 1680

The North, East, Up-components are the position residuals with respect to the estimated station positions and velocities. During the estimation, position outliers have been eliminated and discontinuities have been introduced.

Display outliers eliminated from combination: 0885-0889
Display estimated position shifts

Extended, solutions included up to November 09, 2012 (GPS wk 1713 dow 5)



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Parts 1), 2) and 3) correspond to the latest official EPN solution and have been corrected for outliers and discontinuities.

WEEKLY EPN SOLUTIONS

Extracted positions in ITRS/ETRS89

Positions extracted from the following EPN SINEX solutions:

1. the reprocessed weekly EPN solutions up to GPS week 1408
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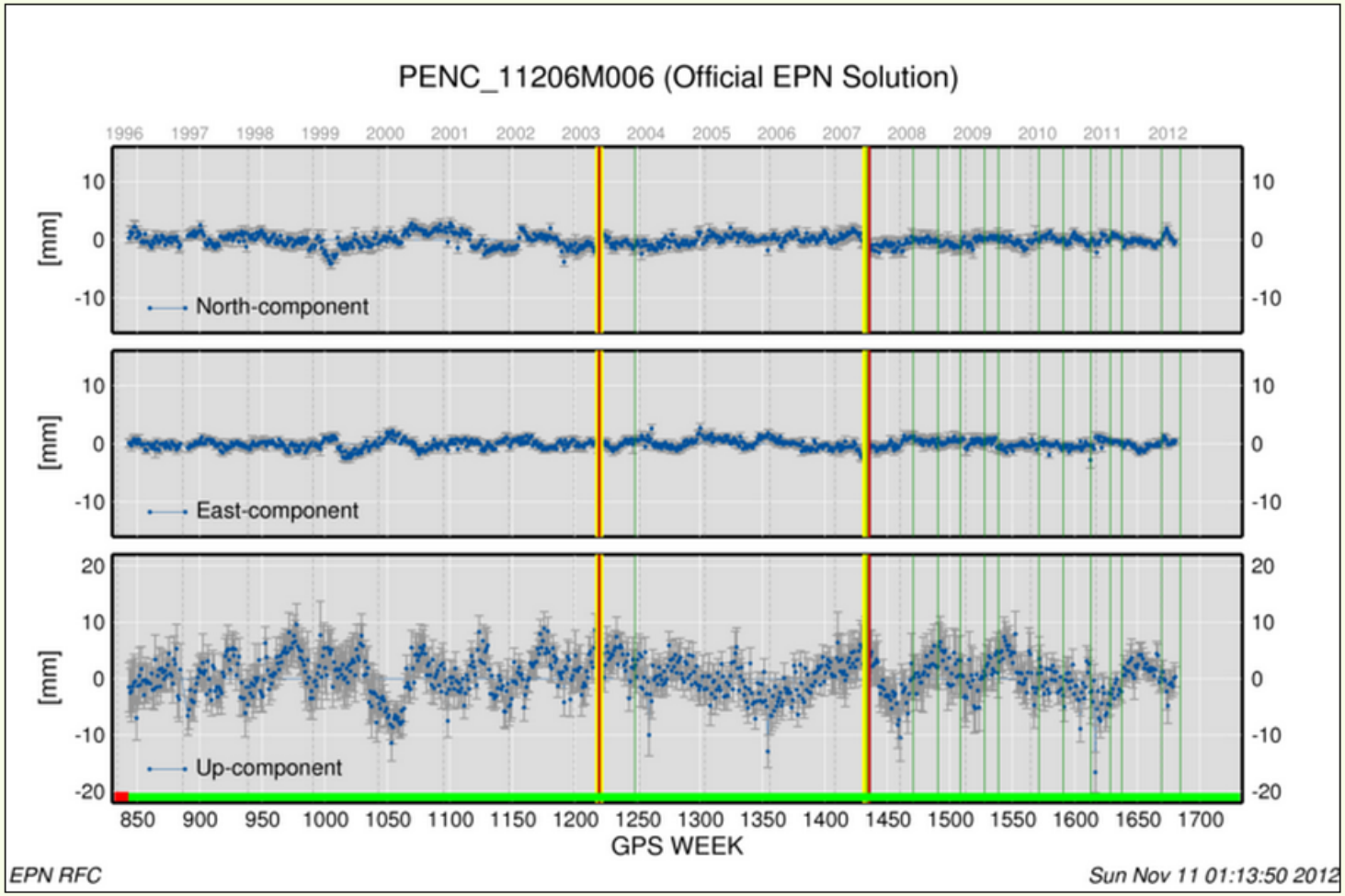
MULTI-YEAR EPN SOLUTION

Official, solutions included up to March 18, 2012 (GPS wk 1680)



Status within EPN :

- included
- not included
- temporarily excluded

Equipment changes :

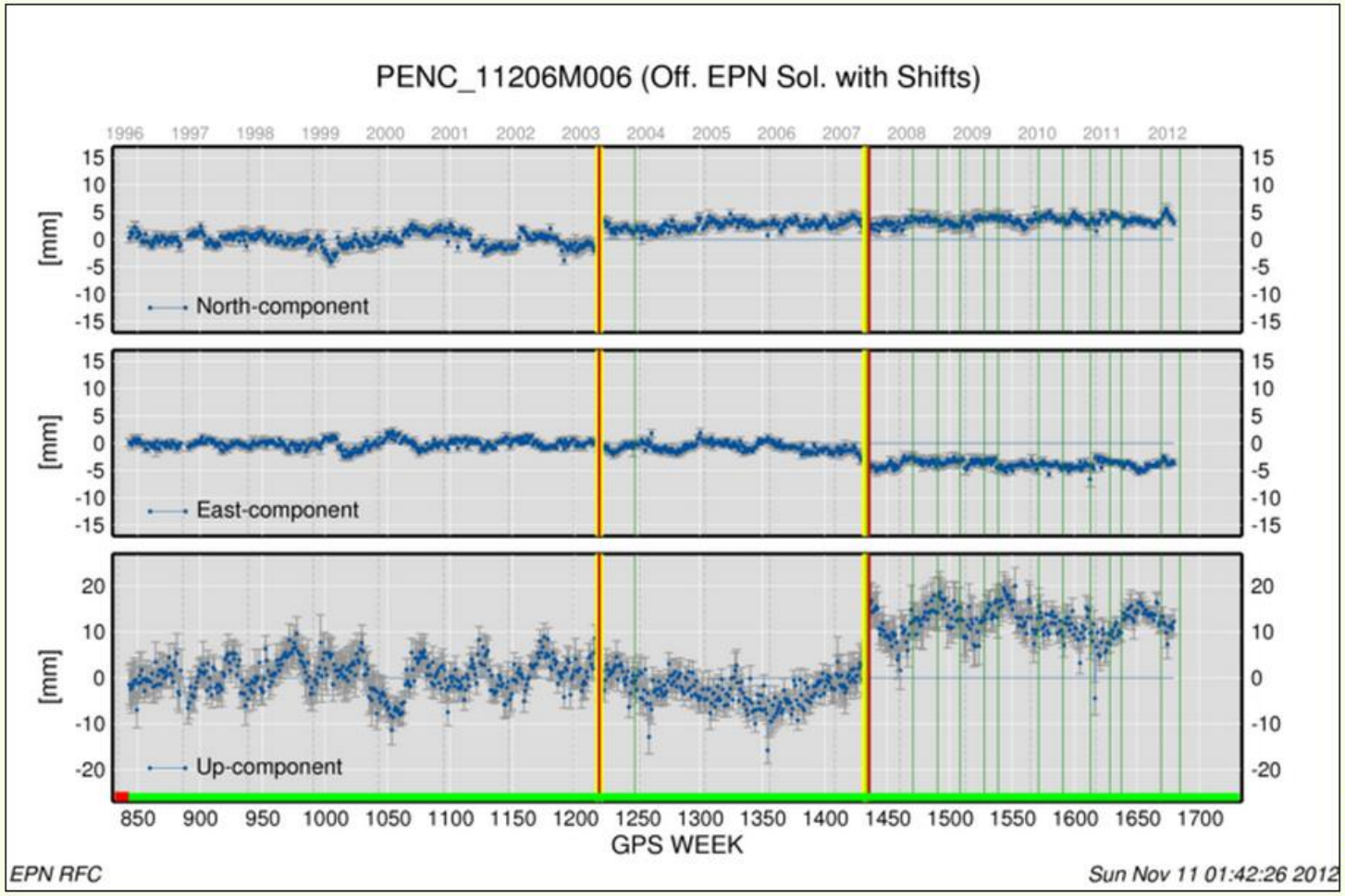
- antenna/radome change (site log)
- receiver change

[Display outliers](#) eliminated from combination: 0885-0889

[Display estimated position shifts](#)

MULTI-YEAR EPN SOLUTION

Official, solutions included up to March 18, 2012 (GPS wk 1680)



Status within EPN :

- included
- not included
- temporarily excluded

Equipment changes :

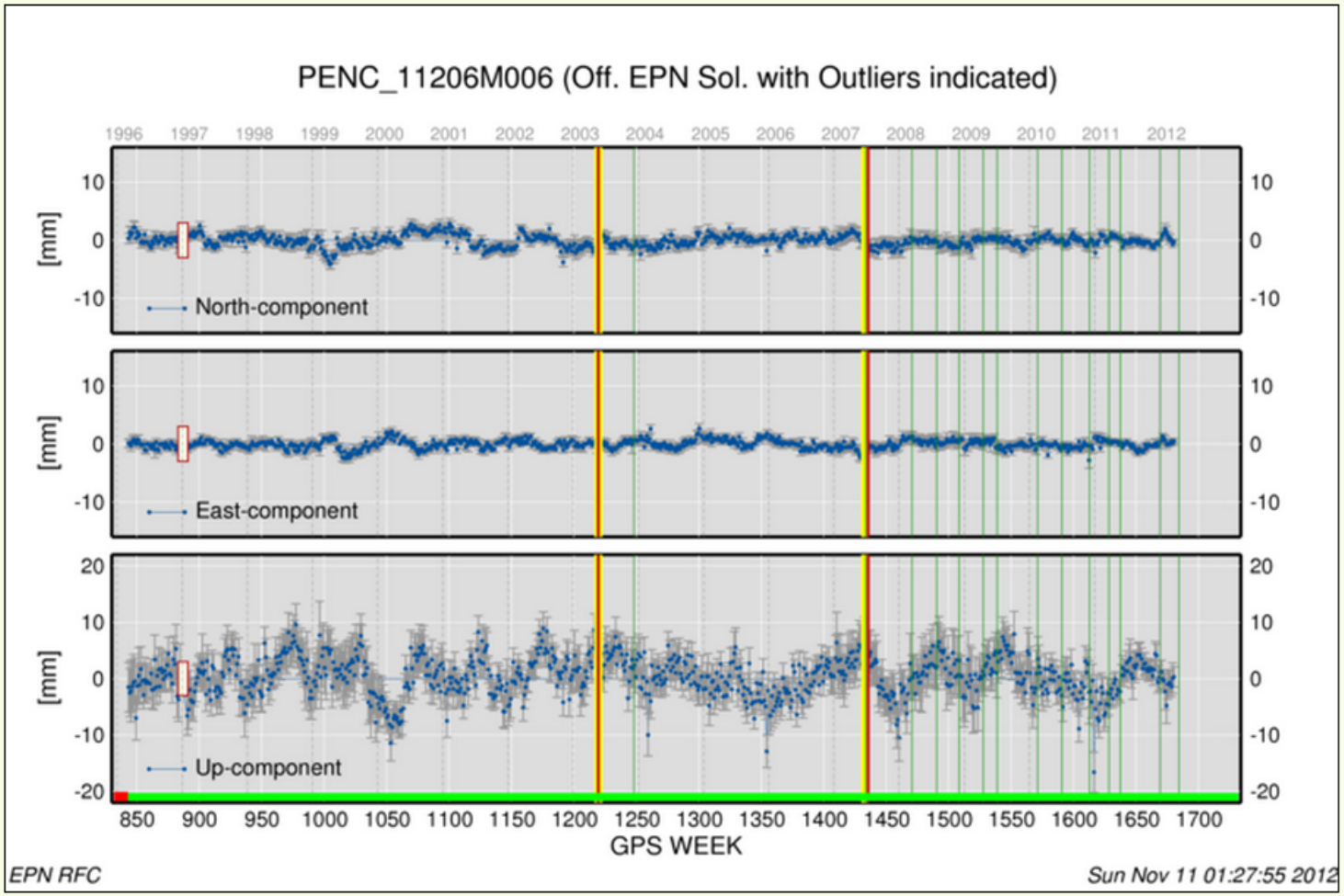
- antenna/radome change (site log)
- receiver change

Display plot without outliers and shifts

Display plot with outliers (and without shifts)

MULTI-YEAR EPN SOLUTION

Official, solutions included up to March 18, 2012 (GPS wk 1680)



Status within EPN :

- included
- not included
- temporarily excluded

Equipment changes :

- antenna/radome change (site log)
- receiver change

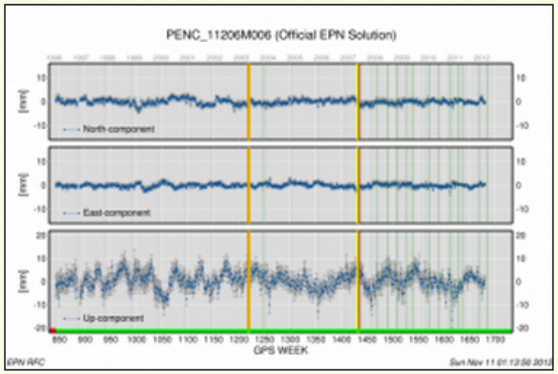
[Display plot without outliers](#)
[Display estimated position shifts](#)

EPN station position time series:
(select a station)

Other residual position time series: ITRF2008

MULTI-YEAR EPN SOLUTION

Official, solutions included up to March 18, 2012 (GPS wk 1680)



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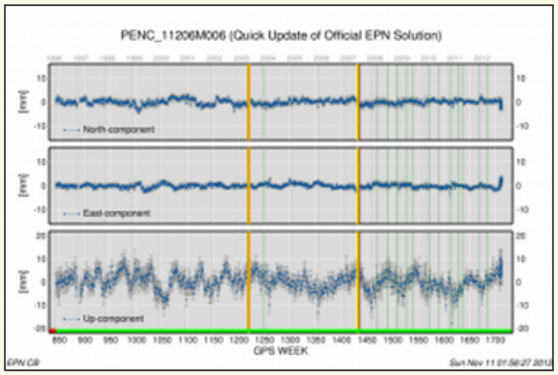
The North, East, Up-components are the position residuals with respect to the estimated station positions and velocities. During the estimation, position outliers have been eliminated and discontinuities have been introduced.

Display outliers eliminated from combination: 0885-0889
Display estimated position shifts

Extended, solutions included up to November 09, 2012 (GPS wk 1713 dow 5)



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WEEKLY EPN SOLUTIONS

Extracted positions in ITRS/ETRS89

Positions extracted from the following EPN SINEX solutions:

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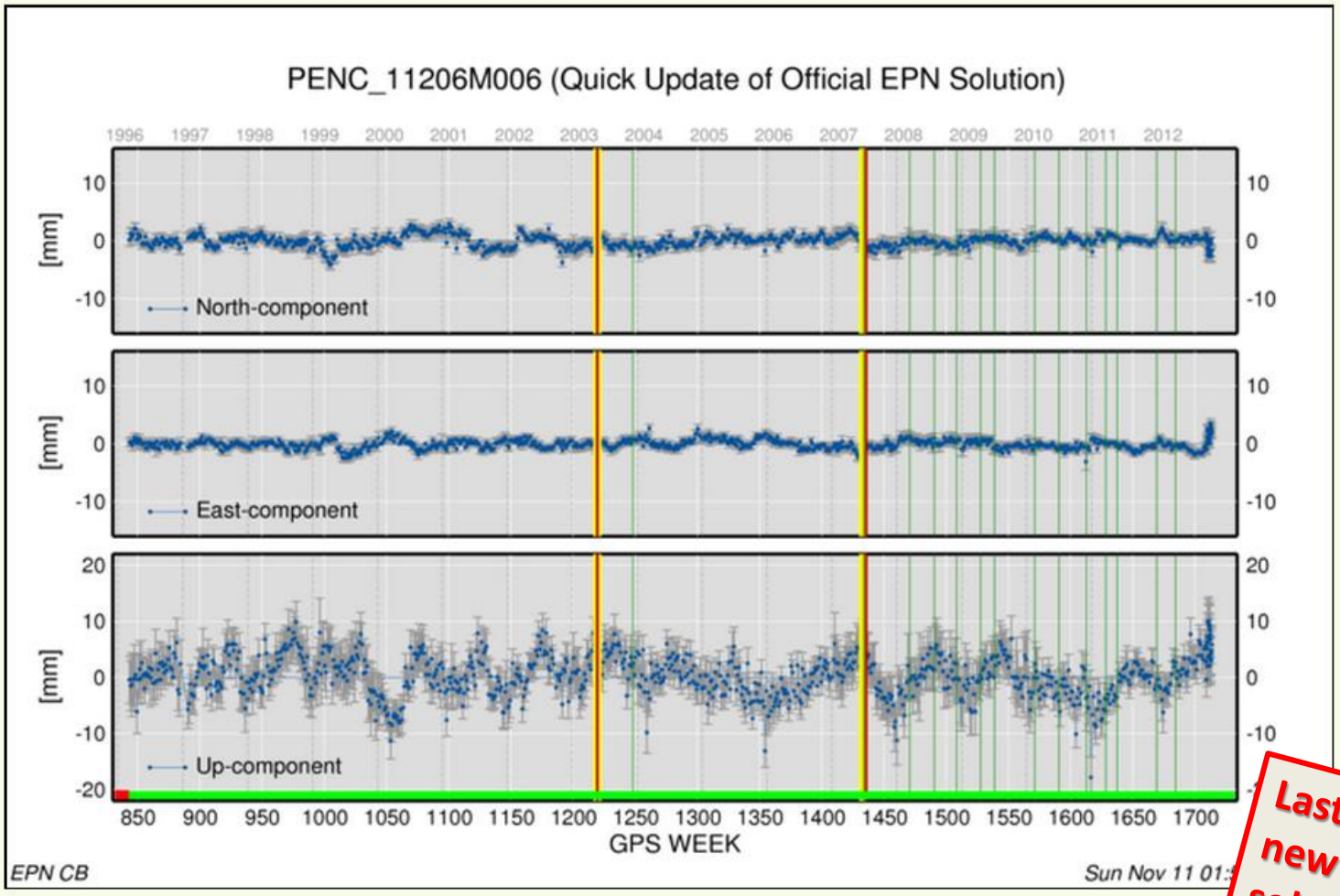
Extended, solutions included up to November 09, 2012 (GPS wk 1713 dow 5)



Status within EPN :
- included
- not included
- temporarily excluded

Equipment changes :
- antenna/radome change (site log)
- receiver change

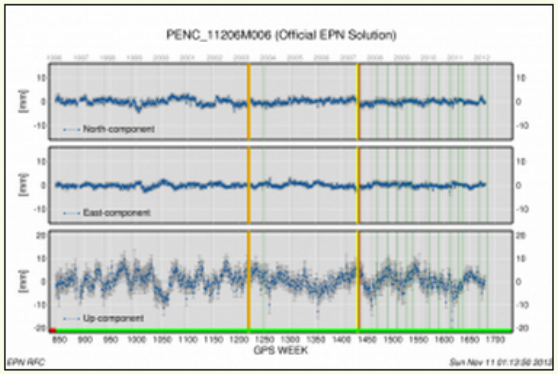
Last 'official solution' + new weekly + daily solutions

EPN station position time series:
(select a station)

Other residual position time series: ITRF2008

MULTI-YEAR EPN SOLUTION

Official, solutions included up to March 18, 2012 (GPS wk 1680)



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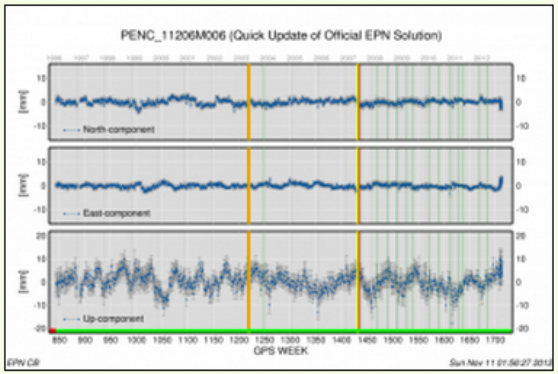
Display outliers eliminated from combination: 0885-0889
Display estimated position shifts

Extended, solutions included up to November 09, 2012 (GPS wk 1713 dow 5)



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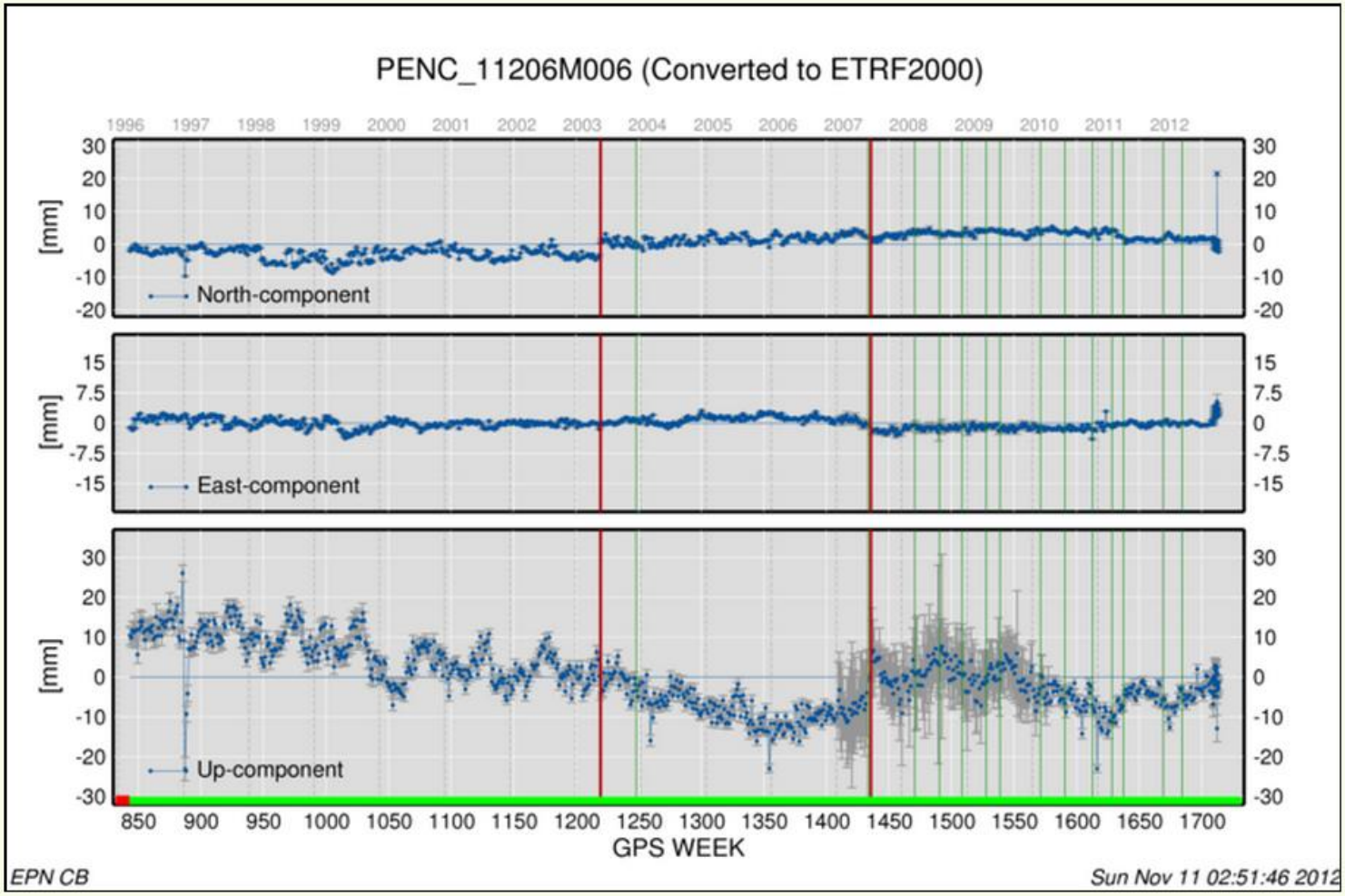
WEEKLY EPN SOLUTIONS

Extracted positions in ITRS/ETRS89



Status within EPN :

- included
- not included
- temporarily excluded

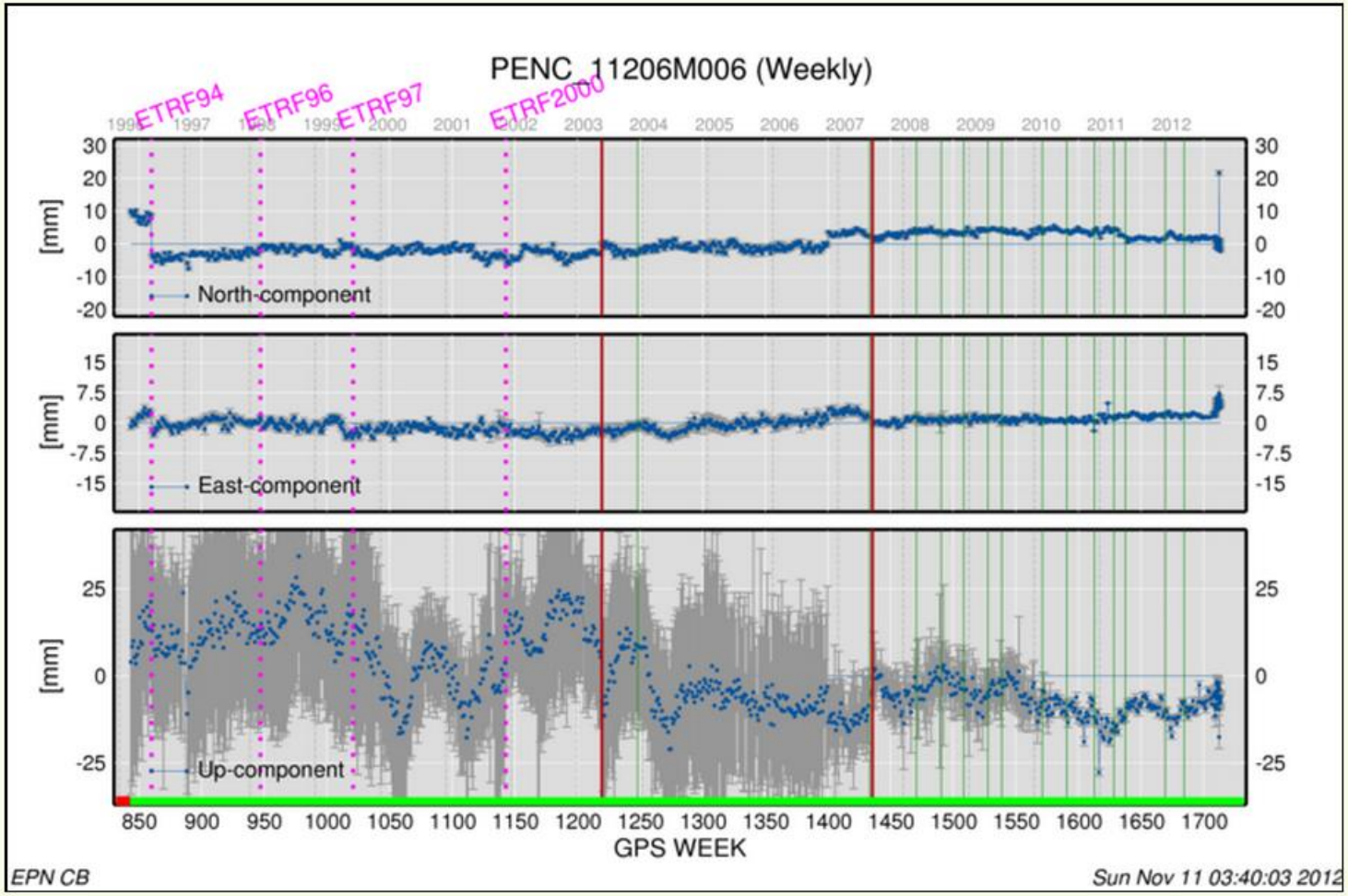
Equipment changes :

- antenna/radome change (site log)
- receiver change

Display in ITRS (non-repro, repro)
Display in ETRS89 (non-repro, repro)

WEEKLY EPN SOLUTIONS

Extracted positions in ITRS/ETRS89



Status within EPN :
- included
- not included
- temporarily excluded

Equipment changes :
- antenna/radome change (site log)
- receiver change

Display in ITRS (non-repro, repro)
Display in ETRS89 (non-repro, repro)

New results including EPN-REPRO1 available!!

The most accurate and up-to-date EPN site positions and velocities are derived from a multi-year adjustment of the EPN weekly SINEX product. The cumulative solution is used for the realisation of the regional densification of the ITRFyy/IGSyy between two releases and also for the maintenance of the ETRS89. The multi-year adjustment comprises weekly SINEX files from GPSweek 834 up to the most recent solutions involving the EPN_REPRO1 results and the routine weekly EPN product. The multi-year solution is updated each 15 weeks in order to provide up-to-date coordinates and velocities.

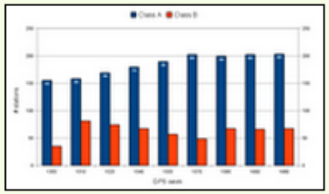
EPN station positions and velocities:

(select a station)

Based on the series of the regularly updated EPN multi-year position and velocity solution, the EPN stations are categorized taking the station quality and the length of the available observation time span into account (Kenyeres, 2009):

- **Class A**: station positions have a 1 cm accuracy at all epochs of the time span of the used observations
- **Class B**: station positions have a 1 cm accuracy at the epoch of minimal variance of each station

Categorization of the EPN stations



Station categorization history

Only Class A stations are suitable as fiducial stations for the densification of the ETRS89. The associated files can be downloaded from the EPN Central Bureau; the most recent realization is available through the links:

In the ITRS (IGS08 realization) :

- EPN_A_IGS08.SSC, table with site positions (at epoch 2005.0) and velocities
- EPN_A_IGS08.SNX.Z, solution in SINEX format

In the ETRS89 (ETRF2000 realization) :

- EPN_A_ETRF2000(R08).SSC, table with site positions (at epoch 2005.0) and velocities
- EPN_A_ETRF2000(R08).SNX.Z, solution in SINEX format

More details about the usage of the Class A stations for EUREF densifications are available from "Guidelines for EUREF Densifications" by Bruyninx et al.

For ***Class B*** stations, EUREF provides only position estimates (EPN_B_IGS08.SSC, EPN_B_ETRF2000(R08).SSC) at the epoch of minimal variance while the velocity estimates are not released because of their limited accuracy (caused by e.g. the short observation period of the station, or lower data quality).

The EPN cumulative solution is maintained by the EPN Reference Frame Coordinator (A. Kenyeres).

Description and additional information about the EPN multi-year solution :

- Description
- Map of the multi-year EPN positions and velocities.
- EPN station discontuities, fully harmonized with the IGS/ITRF discontinuity table.
- List of rejected outliers.
- Residual position time series.
- Miscellaneous plots

Introduction

Many EPN stations provide GNSS data in real-time. Disseminating their streams via NTRIP became an EPN routine operation. The aim of this Special Project is the processing of these data to derive and disseminate new real-time GNSS products while gaining experience with the real-time analysis in general.
Objectives of the SP are

- Processing and analysis of real-time GNSS data for
    - the extension or modification of existing EPN products
    - the development of new EPN products in order to improve positioning in Europe (regional products)
- Stable dissemination of real-time GNSS data and products with an elaborated backup system

More details about the concept and goals can be found here.

Increasing the GNSS Stream Dissemination Capacity (concept; last updated: July 16, 2009).

Satellite Clock and Orbit Corrections

A minimum service for the real-time PPP support is provided via estimating real-time precise satellite clock and orbit corrections with respect to the navigation messages. As satellite clock and orbit determination needs access to global resources, this Special Project cooperates with and contributes to the Real-time IGS (RTIGS) Pilot Project which is dedicated to the same subject.

The first approach which consists in producing real-time clock and orbit correctors to Broadcast Ephemeris of GPS and GLONASS satellites is described in detail in the clocks and orbits computation section.

Precise Point Positioning

Within the Precise Point Positioning (PPP) approach only observations from a single rover receiver are used. Since error sources are not eliminated in the PPP, which is based on undifferenced observations, they must be properly modeled or corrected. The most important and at the same time minimum corrections are provided through real-time precise orbits and clocks using so-called "State Space Representation" (SSR) approach (Schmitz, 2012, Wübbena, 2012). Details of the potential of modern PPP algorithms can be found in, e.g., Wübbena et al., 2005 and Mervart et al., 2008.

The goal of this part of the work is to evaluate the PPP accuracy reachable in real-time: A sole EUREF and IGS based service shall allow real-time decimeter-level satellite positioning everywhere on the European continent when using a dual frequency GNSS receiver.

Monitoring

Incoming real-time GNSS observations from the EPN network as well as derived clocks and orbits are continuously monitored. Monitor results describing completeness and latency of observations are derived in the context of converting RTCM streams to 1sec/15min RINEX files.

Standardization

Except for the scientific community, real-time GNSS products like satellite clocks and orbits remain of marginal value unless they come in a standardized format supported by receiver firmware. The Special Project therefore supports the standardization under development in the State Space Working Group of RTCM SC-104. The tools used so far for clock and orbit correction processing and dissemination (see here) follow RTCM Recommended Standards and proposals documented in RTCM working papers. Encoding/decoding routines used in this Special Project will be updated when new RTCM proposals become available.

Regional-based Products

Estimating satellite clocks and orbits from EUREF and IGS sources is understood as a first and minimum step in real-time GNSS support for user-end PPP applications. Deriving other real-time products mainly focused on ionosphere and troposphere products or hardware bias estimation in order to support PPP regional ambiguity resolution and finally aimed for regional augmentations with instantaneous ambiguity resolution on user-side (i.e., PPP-RTK providing an alternative to RTK) should be main objective for future developments within European real-time activities.

Background

To step forwards from real-time single point positioning (SPP - code-only analysis, with position precision of the meter level and below) to precise point positioning (PPP - code+phase analysis, with position precision of the dm or even cm level) it is necessary to have real-time access to several correction streams allowing to take full advantage of the high precision phase observables. An example of such corrections are real-time corrections to the GPS and GLONASS broadcast ephemeris enabling availability to high precision satellite orbit and clock information in real-time. In 2009 the IGS launched a pilot project to estimate and distribute such corrections in real-time, see IGS Real-Time Pilot Project (IGS-RT PP) for more details. Whereas IGS is currently focusing on satellite orbit and clock corrections for GPS which are related to ITRF2008 (or its IGS08 realization), EUREF is distributing corrections for GPS and GLONASS which are related to ETRS89.

Procedure

The IGS-RT PP Analysis Centres (AC) are estimating GPS and partly also GPS & GLONASS satellite orbit and clock corrections. These corrections are uploaded to the IGS NTRIP broadcaster. The IGS-RT PP Analysis Coordinator is then combining the individual contributions to make available a clearly specified product to the users. These corrections are referred to the IGS realization of ITRF2008.

For EUREF, a clearly specified product is made available as well. 14 parameter transformations between ITRF2008 and various regional datums are introduced in the program BNC to additionally derive the corrections related to these regional datums. For EUREF, the values for the transformation between ITRF2008 and ETRF2000, epoch 2000.0, are introduced using the values from http://etrs89.ensg.ign.fr/memo-V8.pdf and extrapolated to the current epoch.

Note that in the current version of BNC only the satellite orbits are transformed. With regard to the large number of possible transformations, only a few transformations are hard-coded in the software, whereas individual ("custom") parameters could be introduced by the user.

Access

The EUREF real-time product streams can be accessed using so-called mountpoints from one of the three regional Ntrip broadcasters. To get free access to the broadcasters you simply have to register, use column Operator & Registration Link for the details.

It is planned to establish unambiguous mountpoints for the EUREF-related corrections streams. Currently, the following mountpoints are opened or will be established in near future for the ETRS89-related orbit & clock corrections:

- mountpoint EUREF01 is the combined solution including GPS-only (currently the combination of the individual contributions CLK11, CLK21, CLK70, CLK80 and CLK91 - may be subject of change);
- mountpoint EUREF02 is the combined solution including GPS & GLONASS (currently the combination of the individual contributions CLK11, CLK21, CLK80 and CLK91 - may be subject of change);
- mountpoint EUREF03 is planned to be the solution including GPS & GLONASS & Galileo IOV (not available yet);

Other mountpoints with individual solutions, e.g. mountpoint CLK41 as the individual GPS & GLONASS solution of BKG/CTU, are still available as well.

Note that the correction streams given here are related to the antenna phase centre (APC) reference point because of in order to provide the necessary consistency between orbits and clocks required by the PPP procedure they will be used for.

Tools

One of the open source programs to analyze GNSS real-time data is BNC, an NTRIP client for precise point positioning. For a complete list of various corrections you may go to Broadcast Ephemeris Corrections to see the details.

Performance

The accuracy of the IGS real-time clock corrections is well below 0.3 ns with respect to the IGS rapid clocks. Using the IGS real-time orbit and clock correctors in the PPP gives accuracies of a few decimeters after 20 to 30 minutes convergence time. Permanent positioning using the various individual and combined clock & orbit corrections can be found on the real-time PPP monitoring page. Tests showed that the coordinate differences between the two sets of coordinates using either the transformed orbits & clocks or using the original orbits & clocks and transforming the coordinates afterwards below one centimeter for the ETRS89 transformation (Söhne, 2010).

NETWORK & DATA > SITE PICTURE SUBMISSION > **WARE (operated by ROB)**

NEW PICTURES

Browse... Add new picture

Pictures upload conditions :

- the only file extension allowed is jpg. If you encounter any problem to convert your original picture format file, please contact the EPN central Bureau.
- the maximum size of the picture file is 1Mb.

LOCATION, MONUMENTATION AND ENVIRONMENT

	Snapshot date	Related log sections	Description	
	0000-00-00	1		Edit
	0000-00-00	1		Edit

Pictures showing :

- the site location (commented map),
- the GNSS monument (monument and marker description, pole, foundation, ...) and its surroundings (in all directions),
- the local ongoing conditions possibly affecting the computed position (radio interferences, multipath sources, signal obstructions) and
- the local episodic effects possibly affecting data quality (tree clearing, construction, ...)

are more than welcome and need detailled description.

ANTENNA

	Snapshot date	Related log sections	Description	
	0000-00-00	4.3 (2003-01-23/CCYY-MM-DD)	ASH701945E_M antenna without radome	Edit

Pictures showing :

- the antenna (type, radome, cable),

are more than welcome and need detailled description.

VER AND FREQUENCY

Pictures showing :

- the receiver (type),
- the rack, the power supply, the emergency power system, the temperature stabilization system, the external frequency, ...

are more than welcome and need detailled description.

COLLOCATED AND METEOROLOGICAL INSTRUMENTS

Site pictures submission similar to Site log submission

Under development