



EPN Special Project „Real-Time Analysis“ – Status Report

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- **Real-time Data Dissemination concept**
- **Transformation approach (BKG Ntrip Server (BNS))**
- **BKG Ntrip Client (BNC) PPP examples**
- **Summary and outlook**



- **EPN Special Project „Real-Time Analysis“ started end of 2008 (follow-up of EUREF-IP)**
- **Three main topics:**
 - **Re-dissemination of GNSS real-time data and products in Europe via NTRIP Broadcasters**
 - **Validation of clock and orbit correctors to Broadcast Ephemeris**
 - **Backup for all critical real-time service components**



- **Status at the end of EUREF_IP was: one Ntrip Broadcaster (www.euref-ip.net) uploading all EPN RT data streams**
- **Status in development: three Regional broadcasters are pulling RT data from various Local Broadcasters for further dissemination**



Reference stations



Top level caster

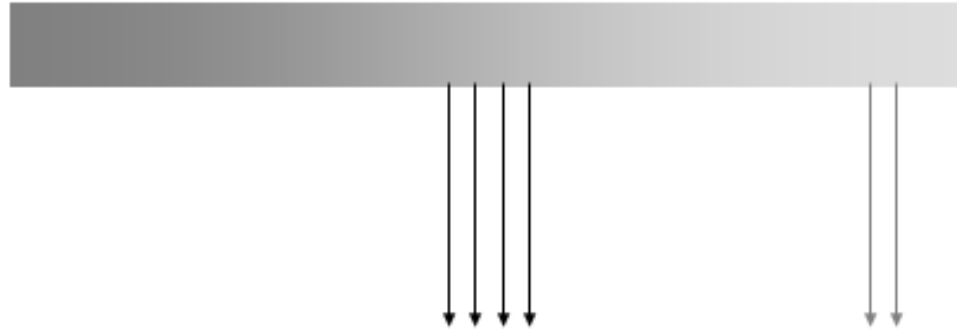


Relay caster

Relay caster



Reference stations



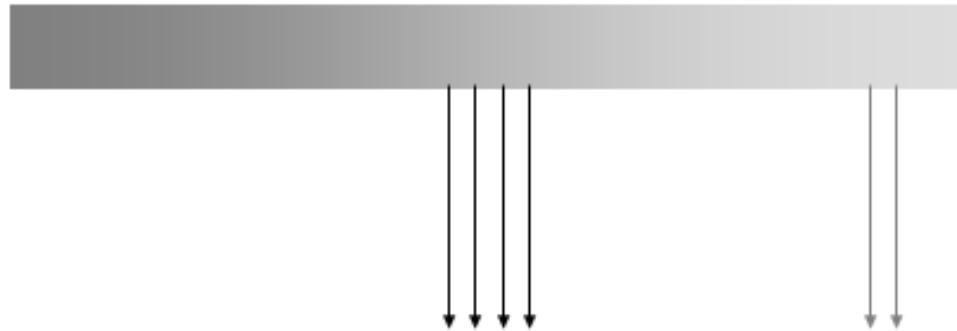
Top level caster

Relay caster

Relay caster



Reference stations



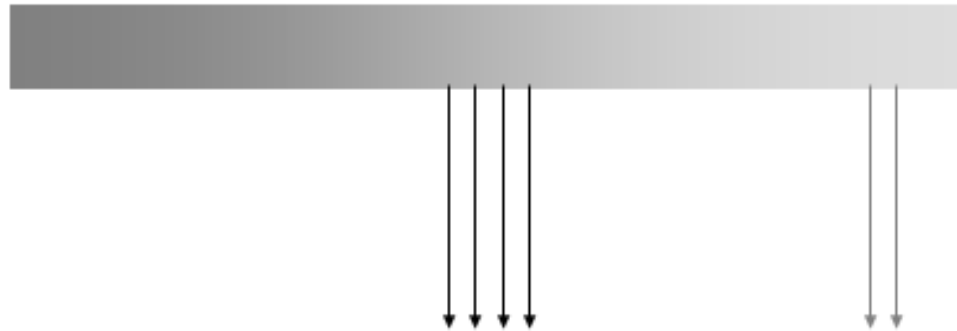
Top level caster

Relay caster

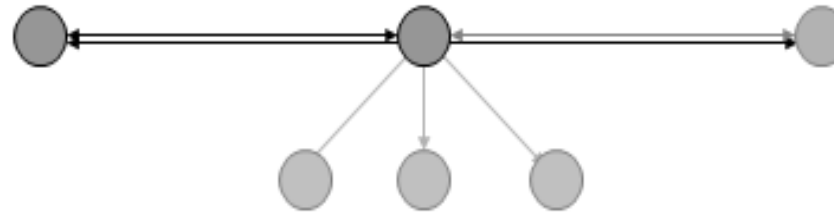
Relay caster



Reference stations

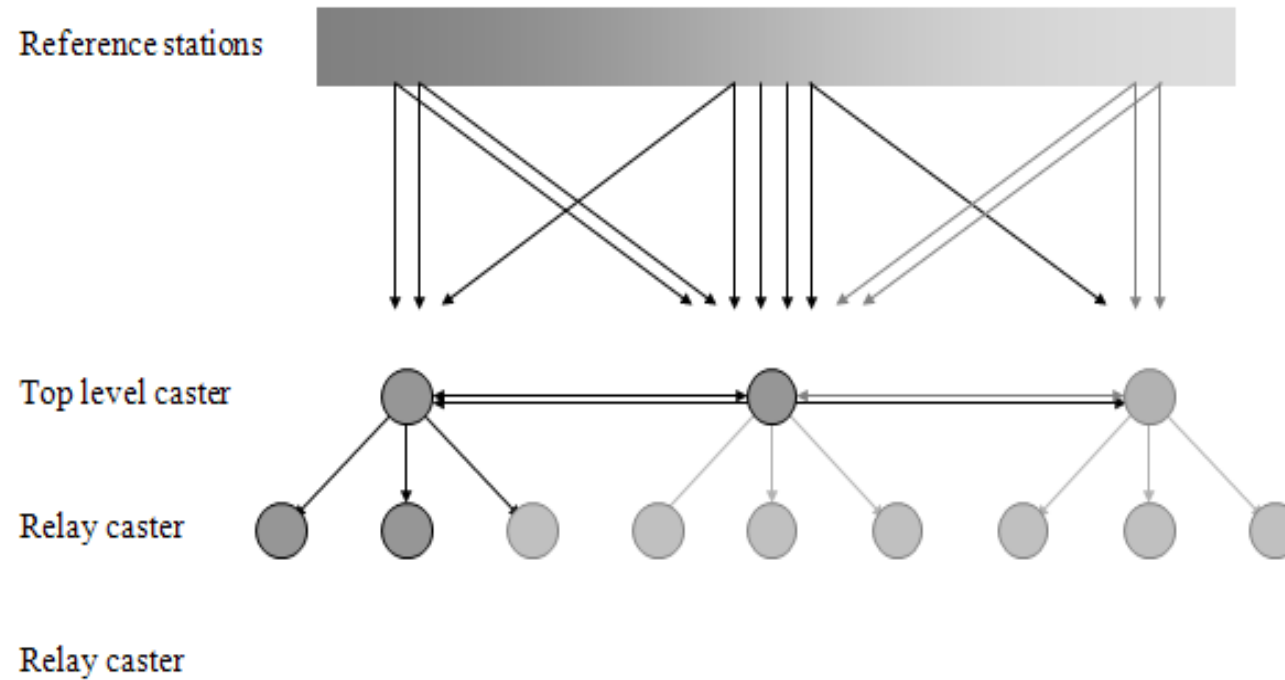


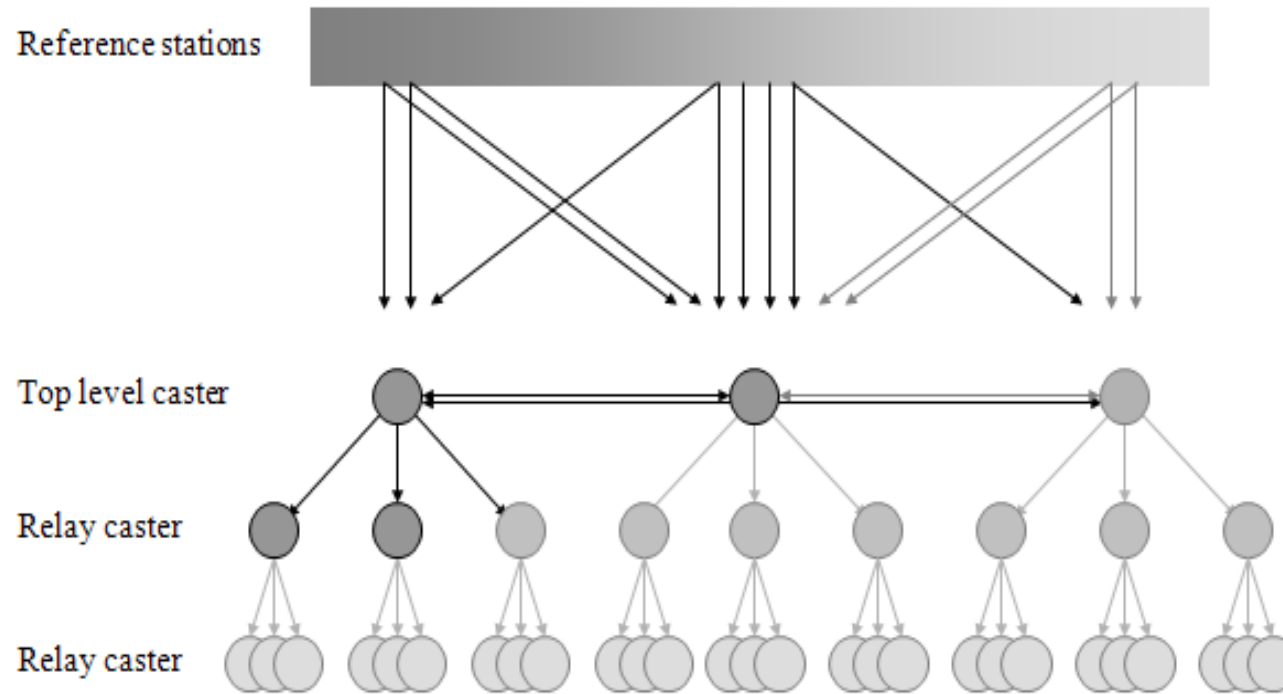
Top level caster



Relay caster

Relay caster







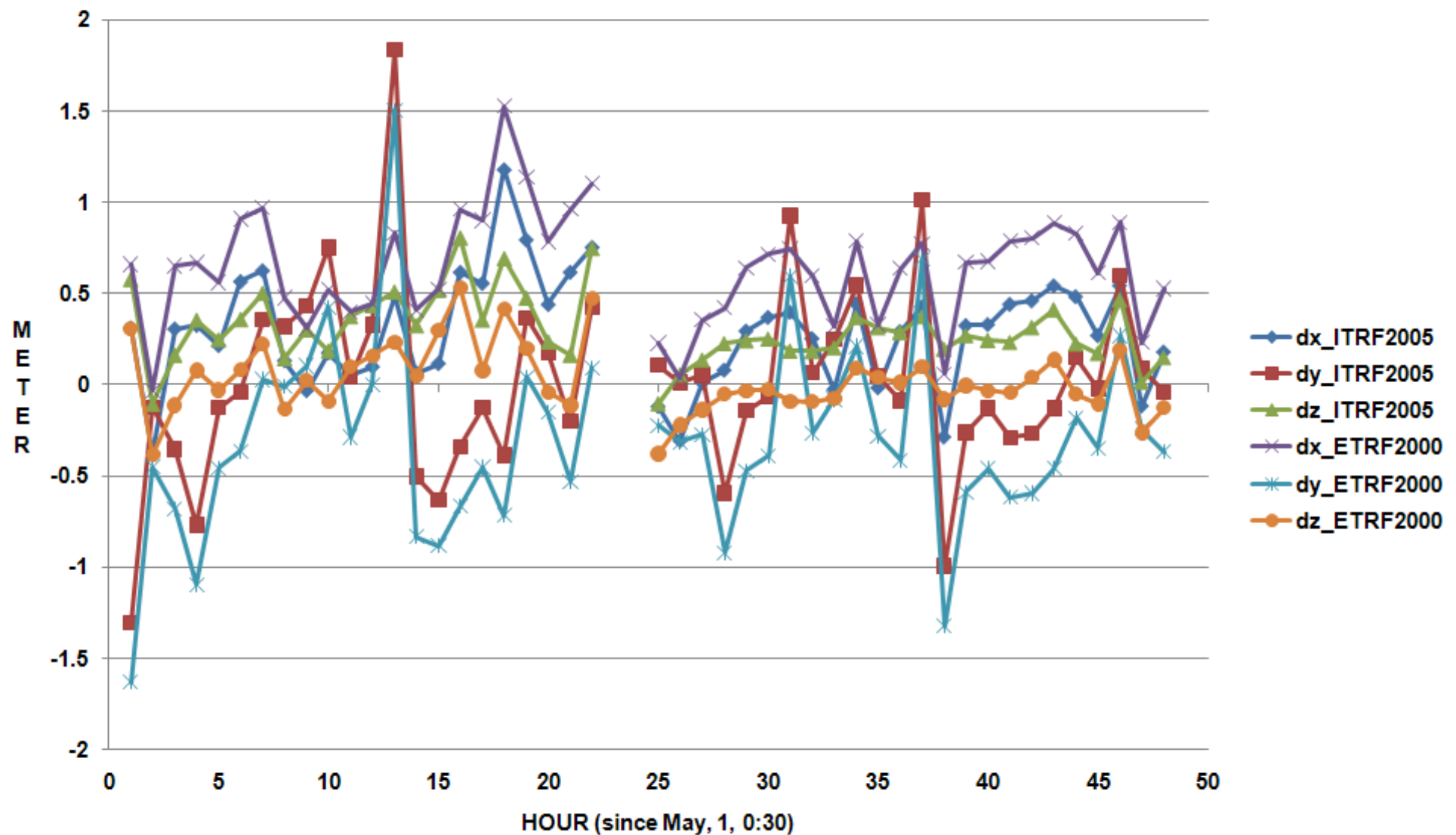
- **Motivation: user should have advantage of using orbit and clock corrections directly in its specific reference frame**
- **Solution:**
 - implementation of transformation formulae (14 parameters transformation) and parameters in BNS
 - transformation of the satellite positions
- **Currently, available (hard-coded) for ETRS89, GDA94, NAD83, and SIRGAS2000 (input of individual – max. 14 – parameters possible)**

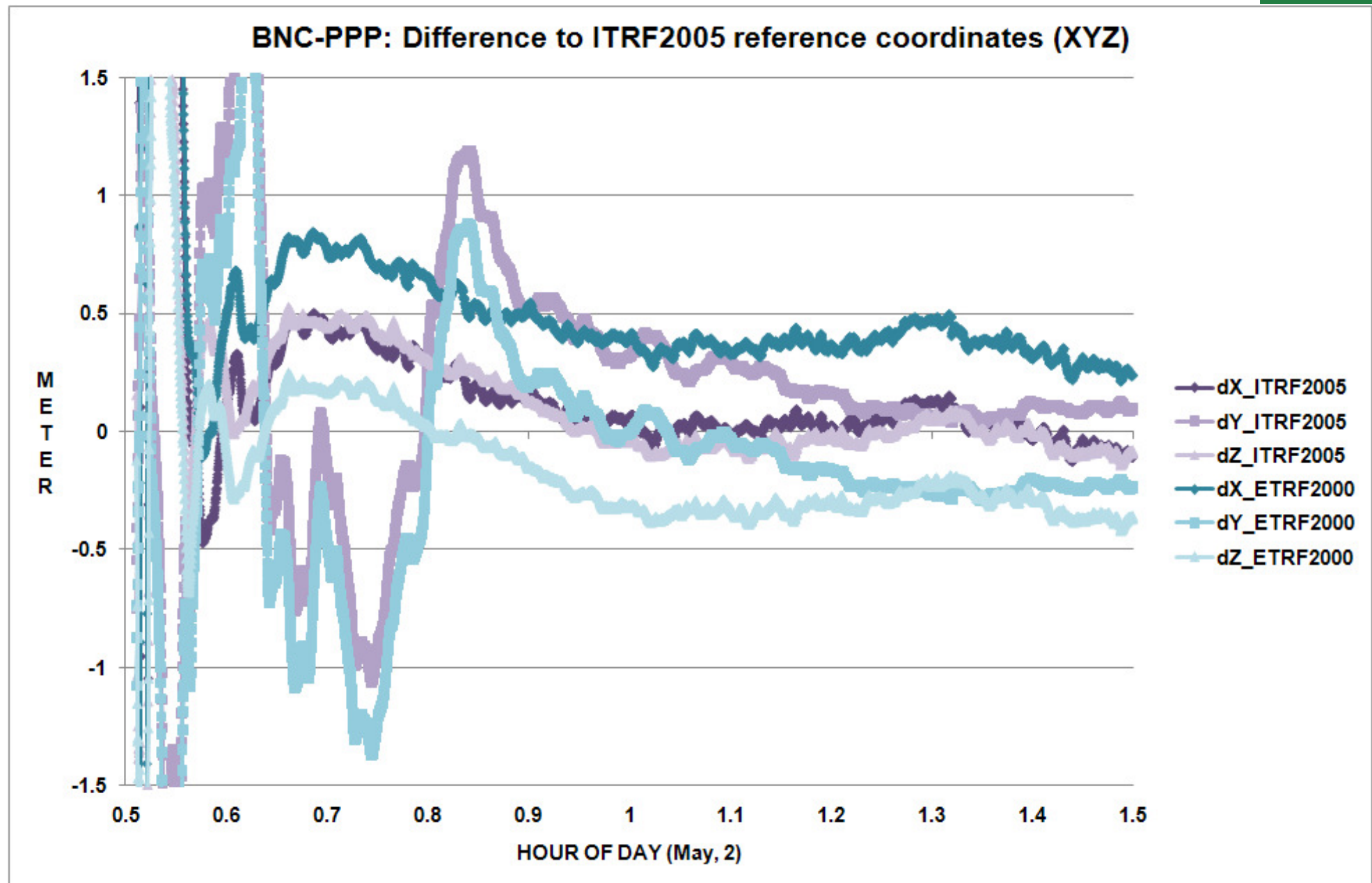


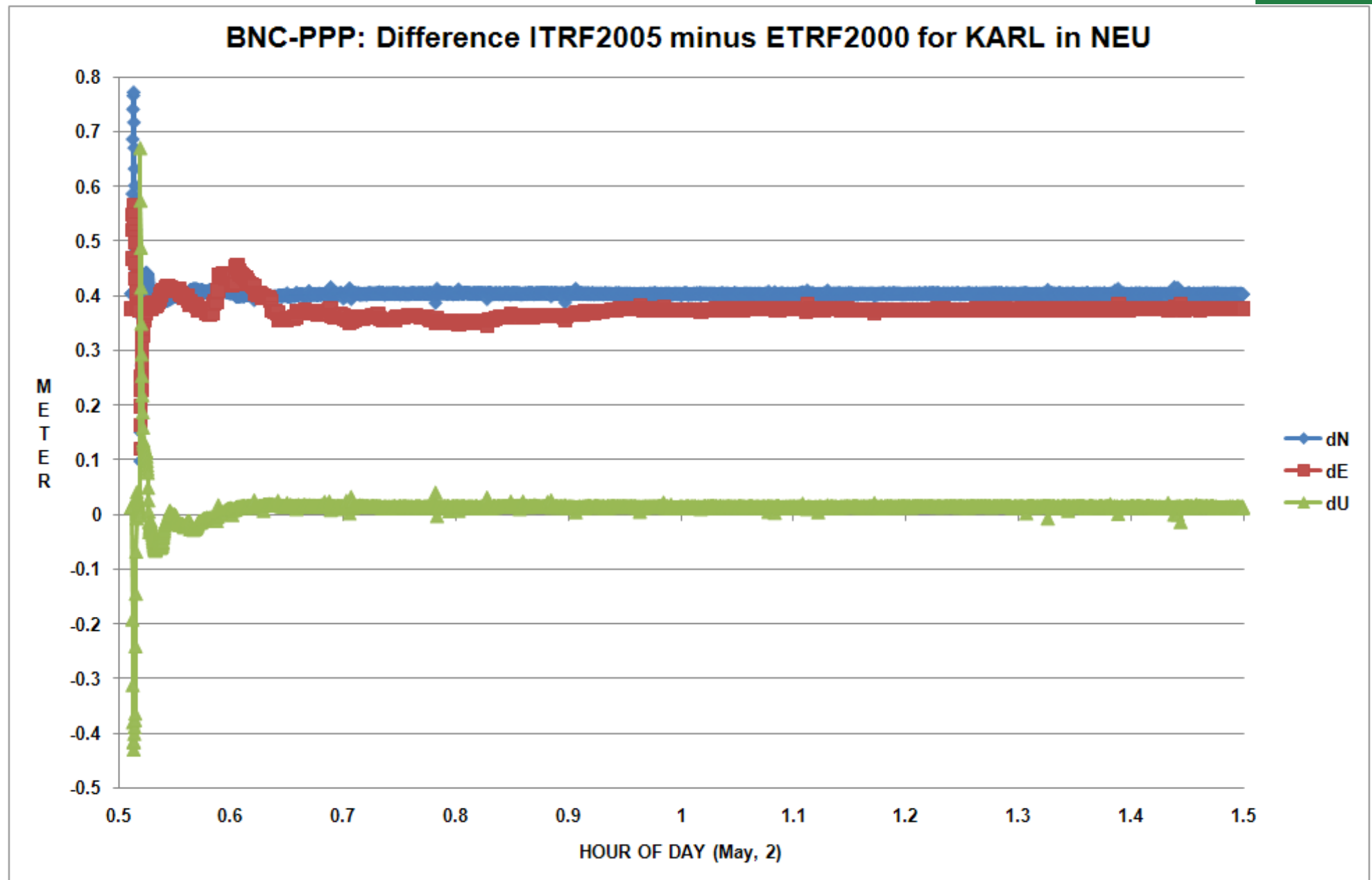
- **Proof: using of orbit & clock correction streams within the BKG Ntrip Client (BNC)**
- **Starting with version 2.0 PPP option implemented (→ G. Weber et al.)**
- **Test: running two (three) BNC jobs in parallel with the different corrections (ITRF2005 vs. ETRF2000)**
 - **May, 1, 00:30 – May 3, 2010 (48 hours)**
May, 8, 13:00 – May 10, 2010 (60 hours)
 - **Duration of each BNC job: 1 hour**
 - **EPN mountpoint used: KARL1 (GPS part only)**
 - **Clock correction streams used:**
CLK11 (ITRF2005) vs. CLK41 (ETRF2000)
CLK11 (ITRF2005) vs. CLK41 (ETRF2000) vs. CLK10 (ITRF2005)

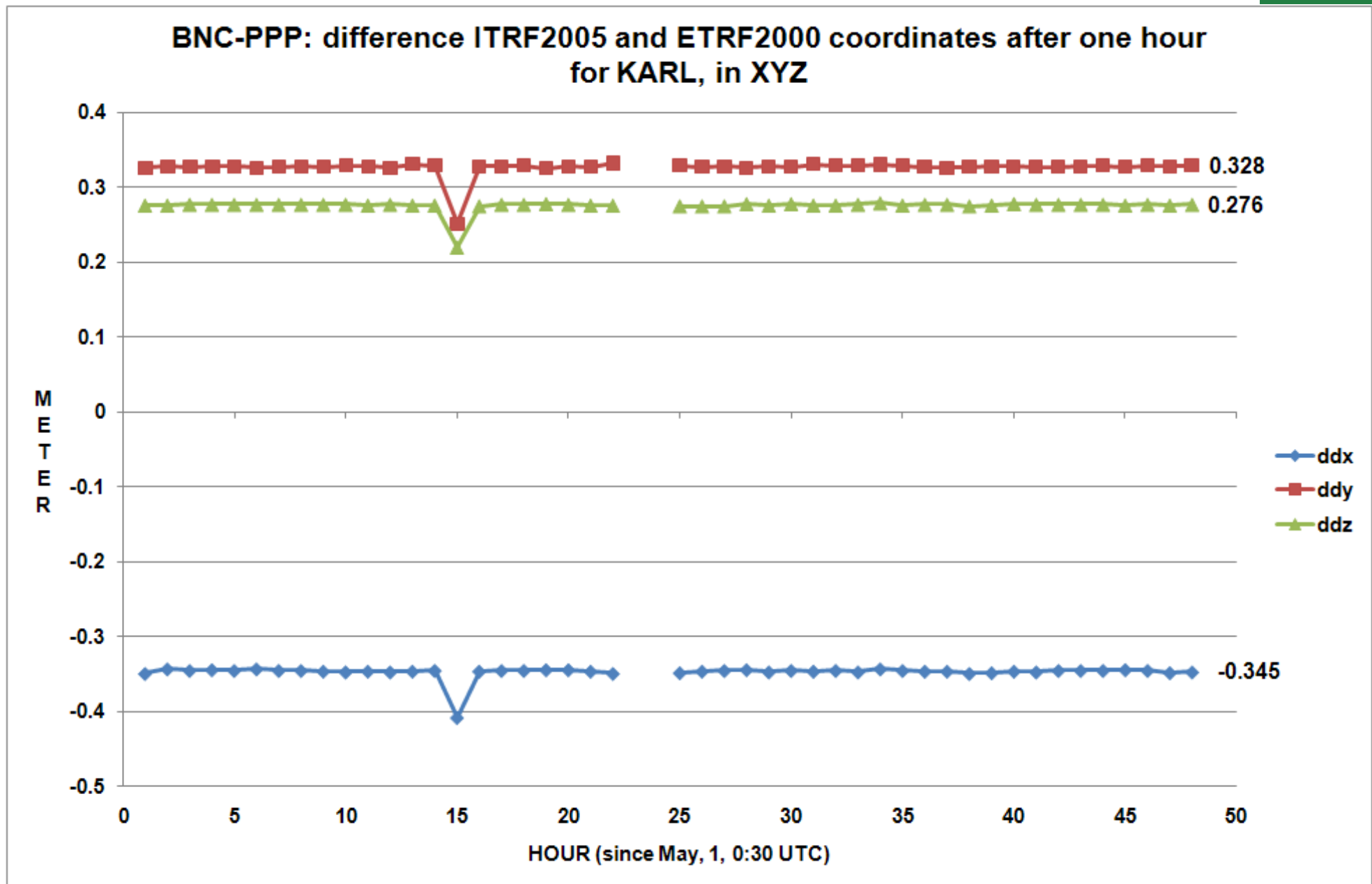


BNC-PPP: differences to reference coordinates (IGS05) for KARL after one hour in XYZ









EUREF Permanent GNSS Network > Tracking Network > Station Coordinates for > SMarkerName - Windows Internet Explorer

http://www.epncb.oma.be/_trackingnetwork/coordinates/stationcoordinates4onestation.php?station=KARL

Datei Bearbeiten Ansicht Favoriten Extras ?

Konvertieren Auswählen

EUREF Permanent GNSS Network > Tracking Network ...

1. POSITIONS/VELOCITIES PUBLISHED BY EUREF

EUREF has classified KARL (Karlsruhe, Germany) as a **class A station** which means that it can be used as fiducial station for EUREF densifications.

Latest release
EPN_A_ETRF2000_C1570.SSC - EPN_A_ITSF2005_C1570.SSC (March 23, 2010)

ETRF2000	epoch t_0	Position (m)			Velocity (m/y)		
		X	Y	Z	V_X	V_Y	V_Z
309/2006 - 044/2010	001/2005	4146524.653 ± 0.001	613137.832 ± 0.001	4791516.971 ± 0.001	0.0002 ± 0.0001	-0.0003 ± 0.0000	0.0003 ± 0.0001
188/2002 - 308/2006	001/2005	4146524.653 ± 0.001	613137.832 ± 0.001	4791516.972 ± 0.001	0.0002 ± 0.0001	-0.0003 ± 0.0000	0.0003 ± 0.0001
133/2001 - 187/2002	001/2005	4146524.658 ± 0.001	613137.826 ± 0.001	4791516.975 ± 0.001	0.0002 ± 0.0001	-0.0003 ± 0.0000	0.0003 ± 0.0001
277/1998 - 125/2001	001/2005	4146524.635 ± 0.001	613137.823 ± 0.001	4791516.945 ± 0.001	0.0002 ± 0.0001	-0.0003 ± 0.0000	0.0003 ± 0.0001

ITSF2005	epoch t_0	Position (m)			Velocity (m/y)		
		X	Y	Z	V_X	V_Y	V_Z
309/2006 - 044/2010	001/2005	4146524.377 ± 0.001	613138.066 ± 0.001	4791517.184 ± 0.001	0.0136 ± 0.0001	0.0173 ± 0.0000	0.0114 ± 0.0001
188/2002 - 308/2006	001/2005	4146524.378 ± 0.001	613138.062 ± 0.001	4791517.185 ± 0.001	-0.0136 ± 0.0001	0.0174 ± 0.0000	0.0114 ± 0.0001
133/2001 - 187/2002	001/2005	4146524.382 ± 0.001	613138.060 ± 0.001	4791517.187 ± 0.001	-0.0136 ± 0.0001	0.0173 ± 0.0000	0.0114 ± 0.0001
277/1998 - 125/2001	001/2005	4146524.358 ± 0.001	613138.056 ± 0.001	4791517.158 ± 0.001	-0.0136 ± 0.0001	0.0173 ± 0.0000	0.0114 ± 0.0001

[Previous releases](#)

2. POSITIONS/VELOCITIES PUBLISHED BY THE IERS

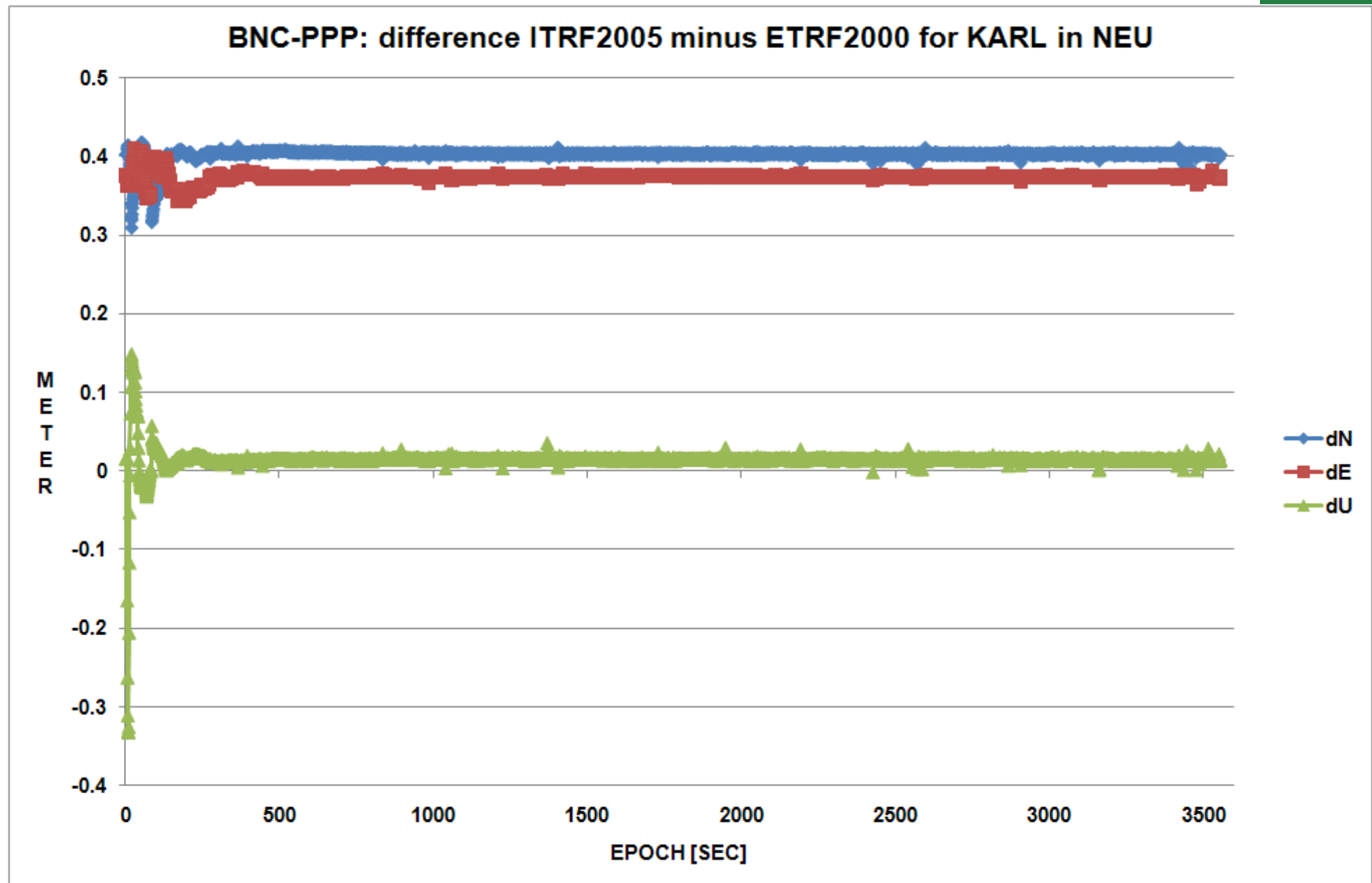
IGS05	epoch t_0	Position (m)			Velocity (m/y)		
		X	Y	Z	V_X	V_Y	V_Z
087/2010 - 093/2010	090/2010	4146524.302 ± 0.000	613138.154 ± 0.000	4791517.240 ± 0.000	NA	NA	NA

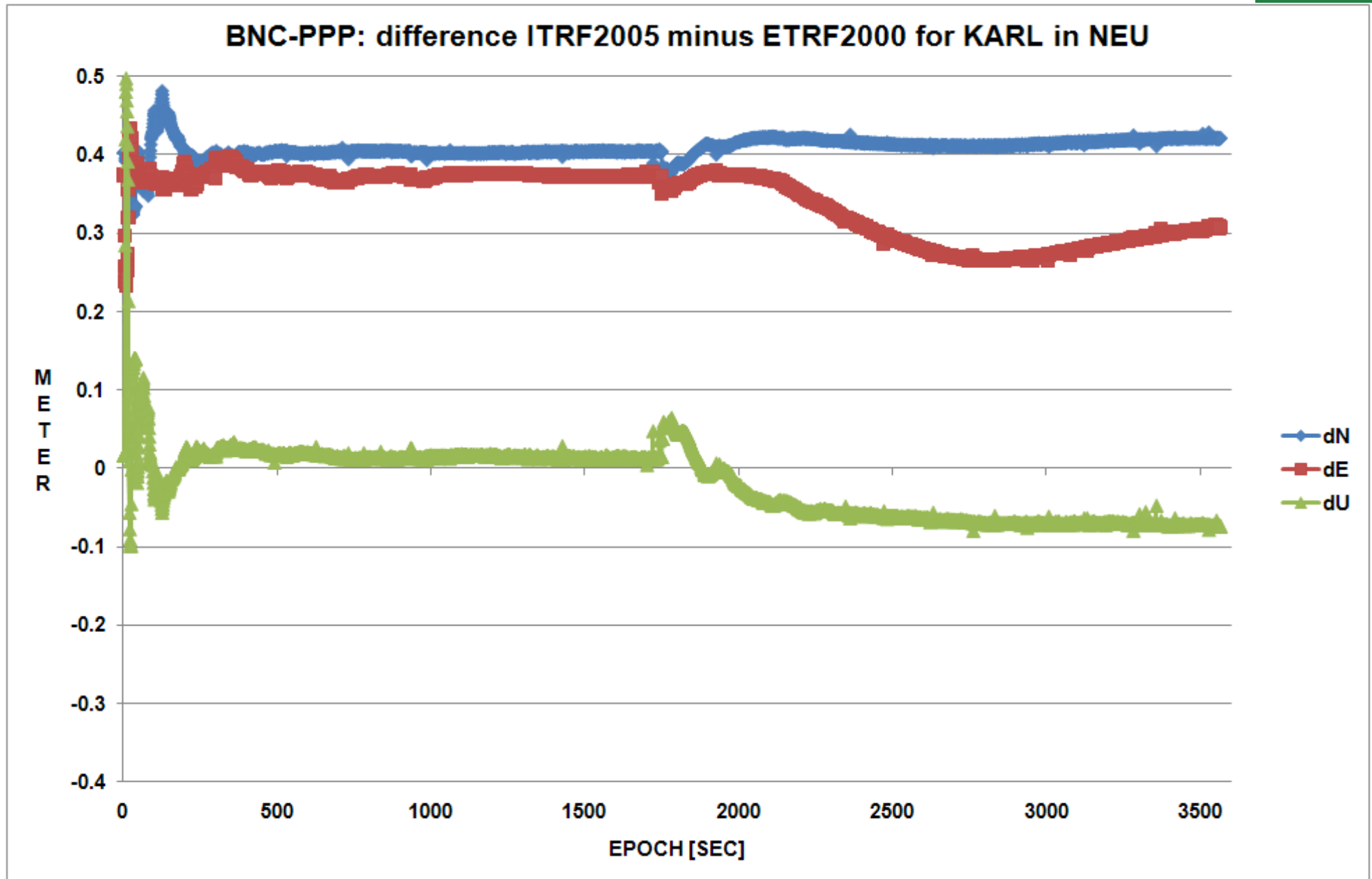
EPN Central Bureau - Royal Observatory of Belgium Disclaimer and Copyright Feb 08, 2010

Internet 100%

Table [X/Y/Z, in m]

ITRF2005	524.304	138.159	517.245
ETRF2000	524.653	137.832	516.971
Difference	-0.349	+0.327	+0.274







```
soehne@fs073:~/Decoder/BNC21A - Shell - Konsole
Session Edit View Bookmarks Settings Help

10-05-01 14:59:50 KARL1: NEU 14:59:49.0 7    0.941  -0.817  -0.641
10-05-01 14:59:51 KARL1: Received message type 1004
10-05-01 14:59:51 KARL1: Received message type 1012
10-05-01 14:59:51 KARL1: Received message type 1006
10-05-01 14:59:51 KARL1: Received message type 1007
10-05-01 14:59:51 KARL1: Antenna descriptor TRM29659.00    NONE
10-05-01 14:59:51 KARL1: ARP (ITRF) X 4146524.7412 m
10-05-01 14:59:51 KARL1: ARP (ITRF) Y 613137.8452 m
10-05-01 14:59:51 KARL1: ARP (ITRF) Z 4791517.0670 m
10-05-01 14:59:51 KARL1: Antenna height above marker 0.0649 m
10-05-01 14:59:51 KARL1: PPP 14:59:50.0 7    4146523.300 +- 0.050    613137.187 +- 0.040    4791517.367 +- 0.032
10-05-01 14:59:51
residuals code -2.181 9.999 7.002 1.162 -0.155 -1.648 0.512
residuals phase 0.014 0.011 0.008 -0.009 -0.009 0.011 -0.010

clk = 23109.890 +- 0.188
amb G05 = 5.673 +- 0.185
amb G10 = 0.050 +- 0.185
amb G15 = -4.815 +- 0.186
amb G27 = -1.349 +- 0.188
amb G28 = 6.813 +- 0.186
amb G08 = 11.592 +- 0.187
amb G09 = 12.356 +- 0.189

10-05-01 14:59:51 KARL1: NEU 14:59:50.0 7    0.943  -0.816  -0.651
10-05-01 14:59:52 KARL1: Received message type 1004
10-05-01 14:59:53 KARL1: Received message type 1012
10-05-01 14:59:53 KARL1: PPP 14:59:51.0 7    4146523.290 +- 0.050    613137.188 +- 0.040    4791517.373 +- 0.032
10-05-01 14:59:53
residuals code -2.913 9.850 5.773 1.224 -0.133 -1.289 0.521
residuals phase 0.012 0.008 -0.006 -0.011 -0.014 0.014 -0.003

clk = 23098.206 +- 0.188
amb G05 = 5.672 +- 0.185
amb G10 = 0.049 +- 0.185
amb G15 = -4.817 +- 0.185
amb G27 = -1.352 +- 0.188
amb G28 = 6.812 +- 0.186
amb G08 = 11.591 +- 0.187
amb G09 = 12.353 +- 0.189

10-05-01 14:59:53 KARL1: NEU 14:59:51.0 7    0.954  -0.813  -0.652
10-05-01 14:59:53 KARL1: Received message type 1004
10-05-01 14:59:53 KARL1: Received message type 1012
10-05-01 14:59:53 KARL1: PPP 14:59:52.0 7    4146523.291 +- 0.050    613137.189 +- 0.040    4791517.374 +- 0.032

30793,1 47%
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```
10-05-01 14:59:50 KARL1: NEU 14:59:49.0 7 0.537 -1.190 -0.655
10-05-01 14:59:51 KARL1: Received message type 1004
10-05-01 14:59:51 KARL1: Received message type 1012
10-05-01 14:59:51 KARL1: Received message type 1006
10-05-01 14:59:51 KARL1: Received message type 1007
10-05-01 14:59:51 KARL1: Antenna descriptor TRM29659.00 NONE
10-05-01 14:59:51 KARL1: ARP (ITRF) X 4146524.7412 m
10-05-01 14:59:51 KARL1: ARP (ITRF) Y 613137.8452 m
10-05-01 14:59:51 KARL1: ARP (ITRF) Z 4791517.0670 m
10-05-01 14:59:51 KARL1: Antenna height above marker 0.0649 m
10-05-01 14:59:51 KARL1: PPP 14:59:50.0 6 4146523.610 +- 0.072 613136.878 +- 0.042 4791517.090 +- 0.036
10-05-01 14:59:51
residuals code -2.131 10.000 0.999 1.162 -0.156 -1.650 0.514
residuals phase 0.014 0.011 -0.008 -0.009 -0.009 0.011 -0.010
Outlier Code G08 10.000
residuals code -2.142 7.007 1.168 -0.154 -1.654 0.529
residuals phase 0.001 -0.001 -0.005 -0.008 0.007 0.004

clk = 23109.840 +- 0.193
amb G05 = 5.674 +- 0.185
amb G10 = 0.051 +- 0.185
amb G15 = -4.815 +- 0.186
amb G27 = -1.351 +- 0.188
amb G28 = 6.815 +- 0.186
amb G09 = 12.354 +- 0.189

10-05-01 14:59:51 KARL1: NEU 14:59:50.0 6 0.564 -1.167 -0.688
10-05-01 14:59:52 KARL1: Received message type 1004
10-05-01 14:59:53 KARL1: Received message type 1012
10-05-01 14:59:53 KARL1: PPP 14:59:51.0 7 4146523.594 +- 0.072 613136.874 +- 0.042 4791517.084 +- 0.036
10-05-01 14:59:53
residuals code -2.921 9.881 5.776 1.228 -0.133 -1.292 0.533
residuals phase 0.003 0.000 -0.002 -0.008 -0.014 0.013 0.008

clk = 23098.140 +- 0.193
amb G05 = 5.672 +- 0.185
amb G10 = 0.050 +- 0.185
amb G15 = -4.817 +- 0.185
amb G27 = -1.353 +- 0.188
amb G28 = 6.814 +- 0.186
amb G09 = 12.352 +- 0.189
amb G08 = 11.631 +- 0.192

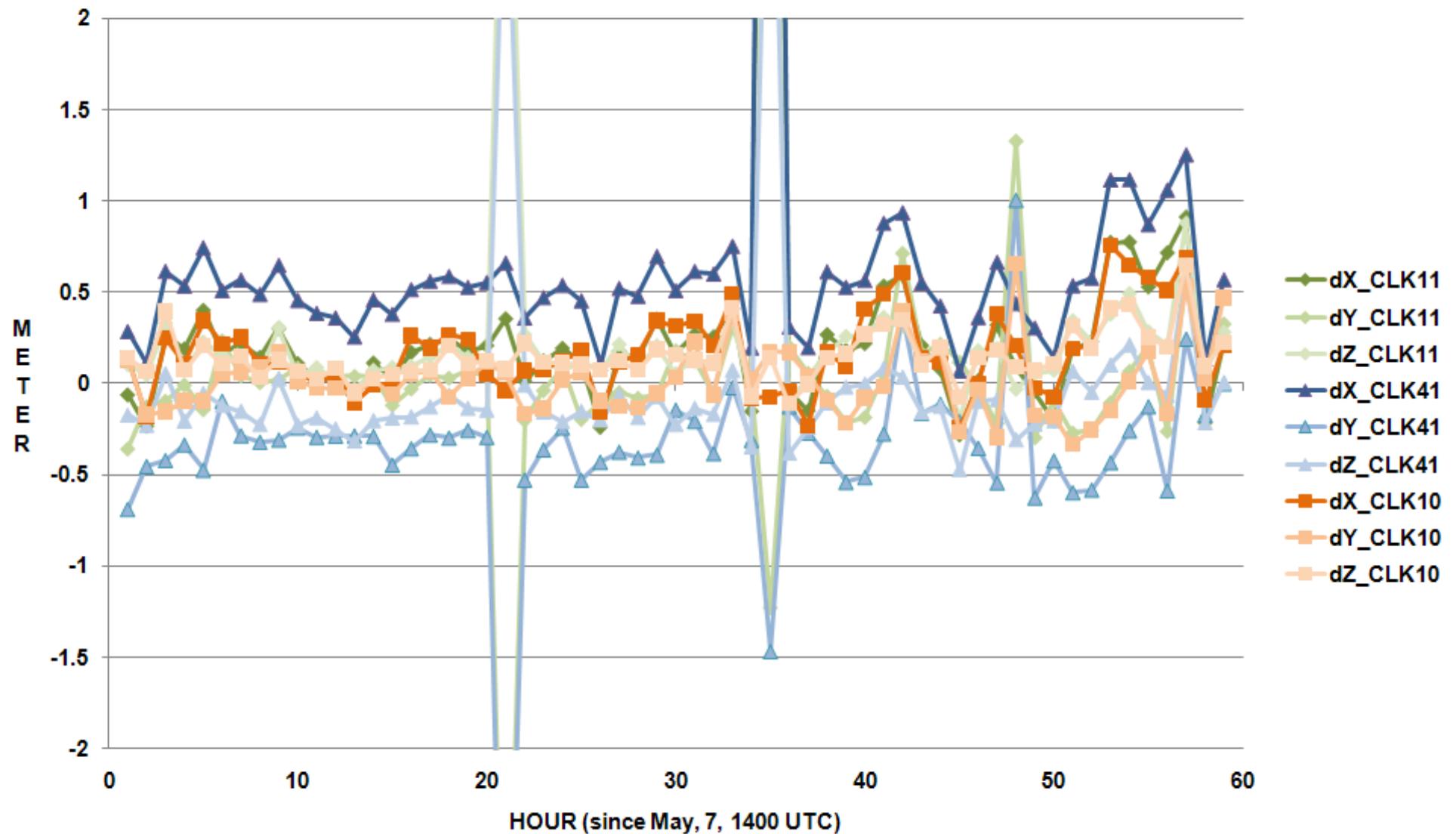
10-05-01 14:59:53 KARL1: NEU 14:59:51.0 7 0.572 -1.169 -0.704
10-05-01 14:59:53 KARL1: Received message type 1004
```

30794,4

47%



BNC-PPP: differences to reference coordinates (IGS05) for the three different solutions after one hour for KARL in XYZ

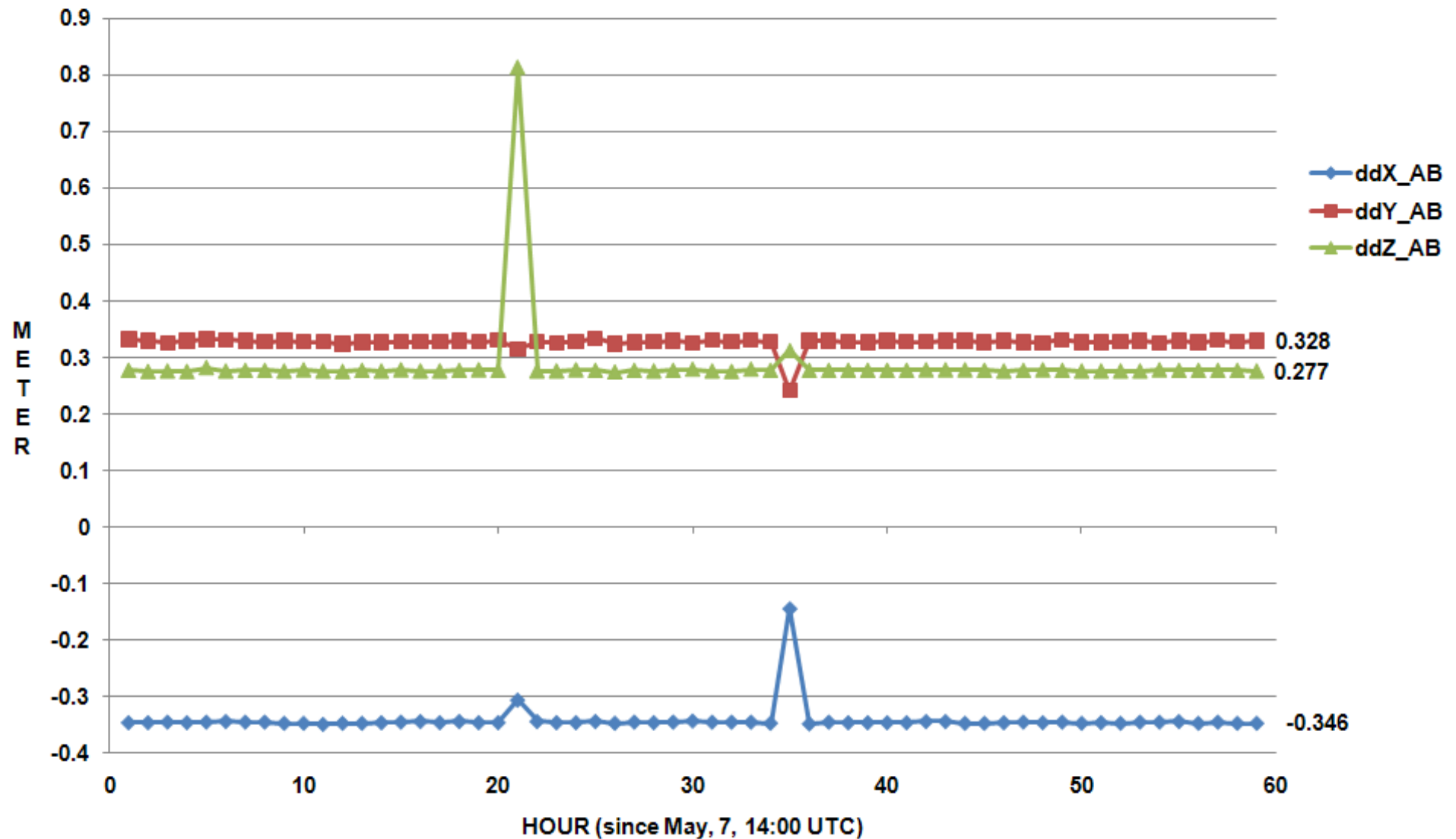


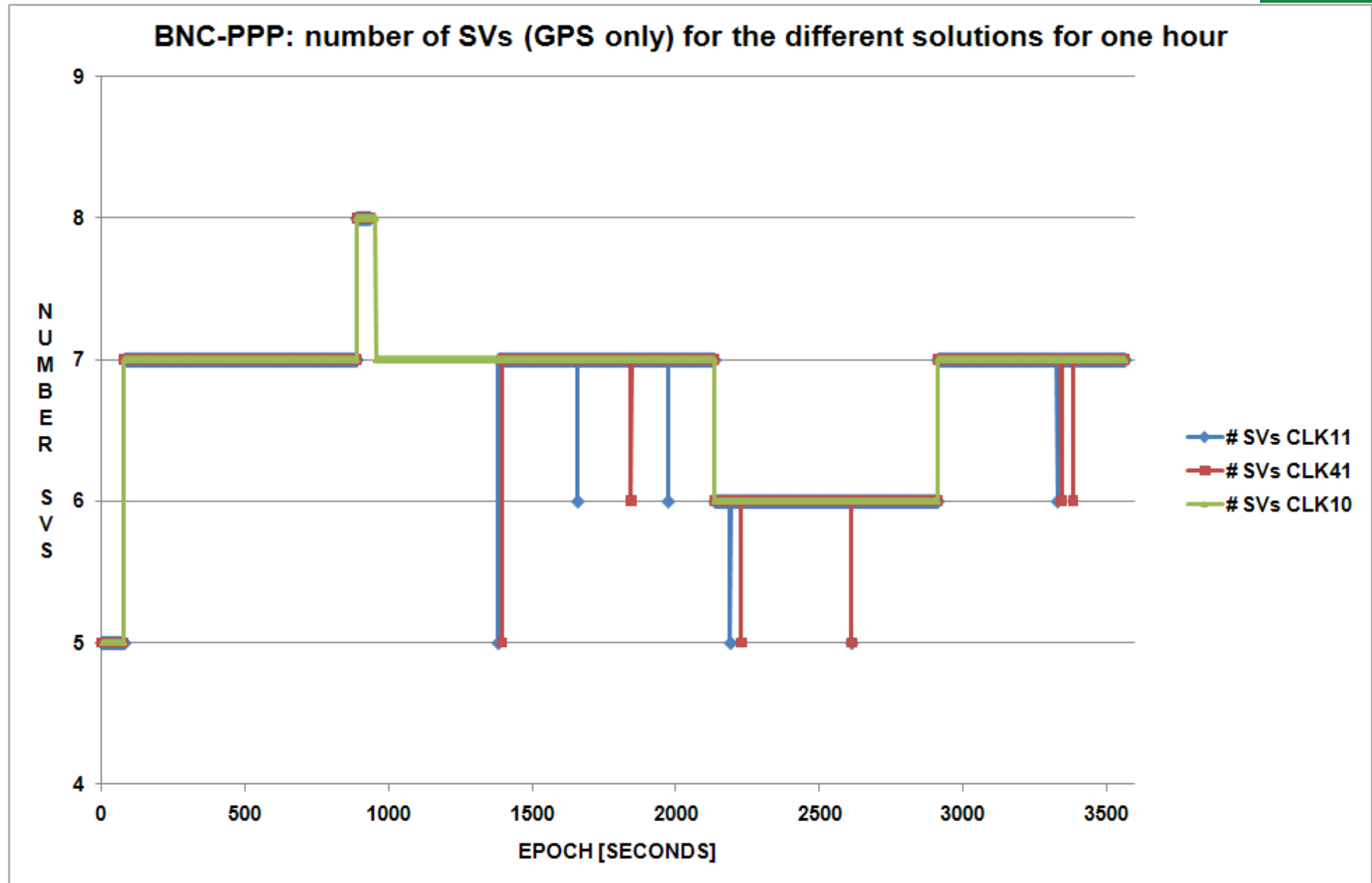
Mean differences w.r.t. ITRF2005 coordinates [N/E/U, in m]

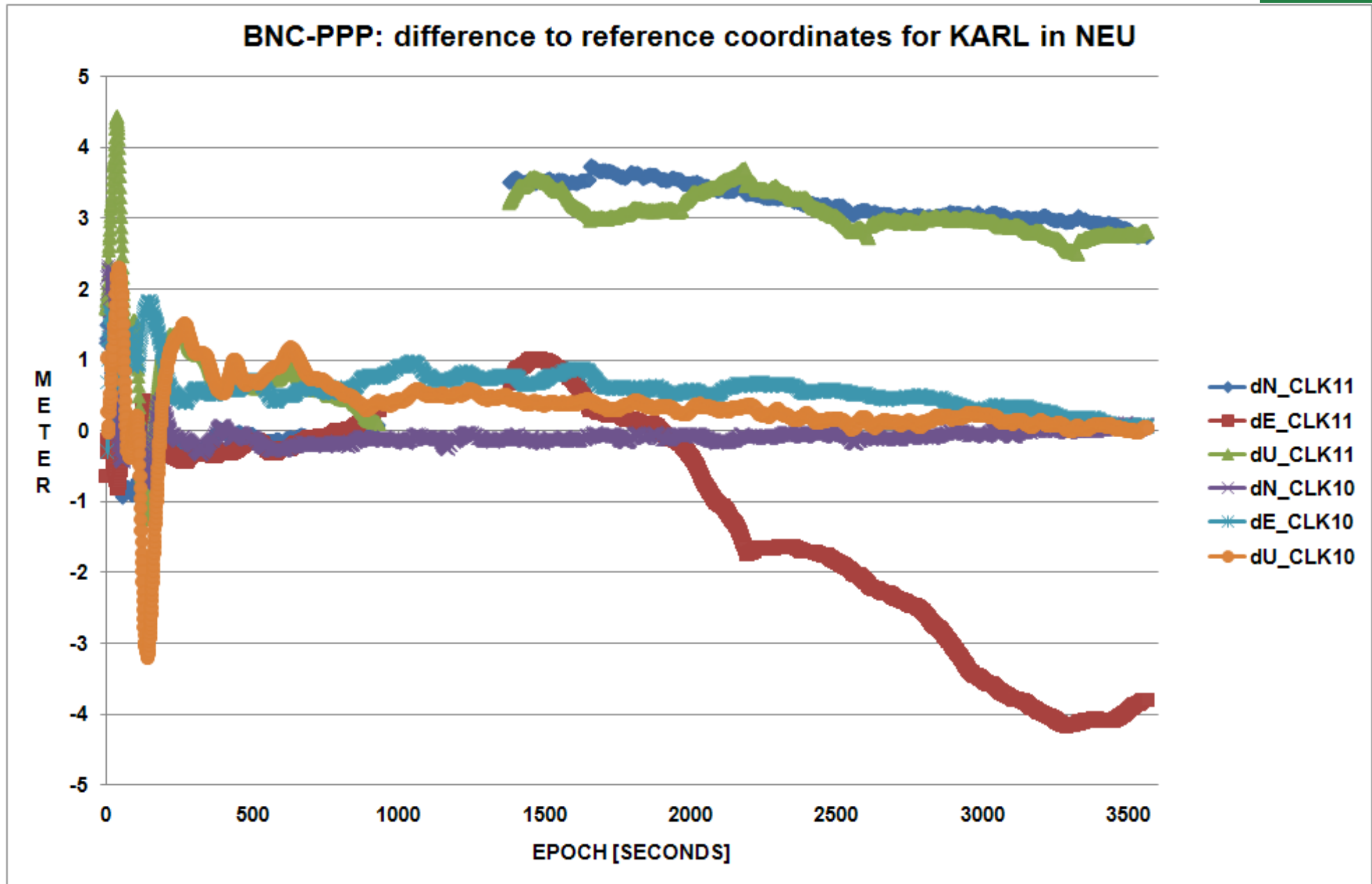
CLK11 (ITRF2005)	-0.03 ± 0.13 / $+0.00 \pm 0.25$ / $+0.24 \pm 0.28$
CLK41 (ETRF2000)	-0.43 ± 0.13 / -0.37 ± 0.25 / $+0.22 \pm 0.28$
CLK10 (ITRF2005)	-0.03 ± 0.12 / -0.02 ± 0.19 / $+0.23 \pm 0.24$



**BNC-PPP: difference between ITRF2005 and ETRF2000 solutions for KARL
after one hour in XYZ**









- **All 115 EPN real-time data streams available from three Regional Broadcasters**
- **44 of them are pulled independently, others to follow soon**
- **Station managers are encouraged to install local or national Ntrip broadcasters to support the EPN dissemination concept**
- **Users are encouraged to use the new Regional Broadcasters of the EPN**
- **EUREF provides ETRF2000 orbit and clock corrections in real-time**