

Development of the EUREF GNSS Services and Reference Networks

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- 
- Services under development
 - Active services
 - Backbone of services
 - Reference Networks



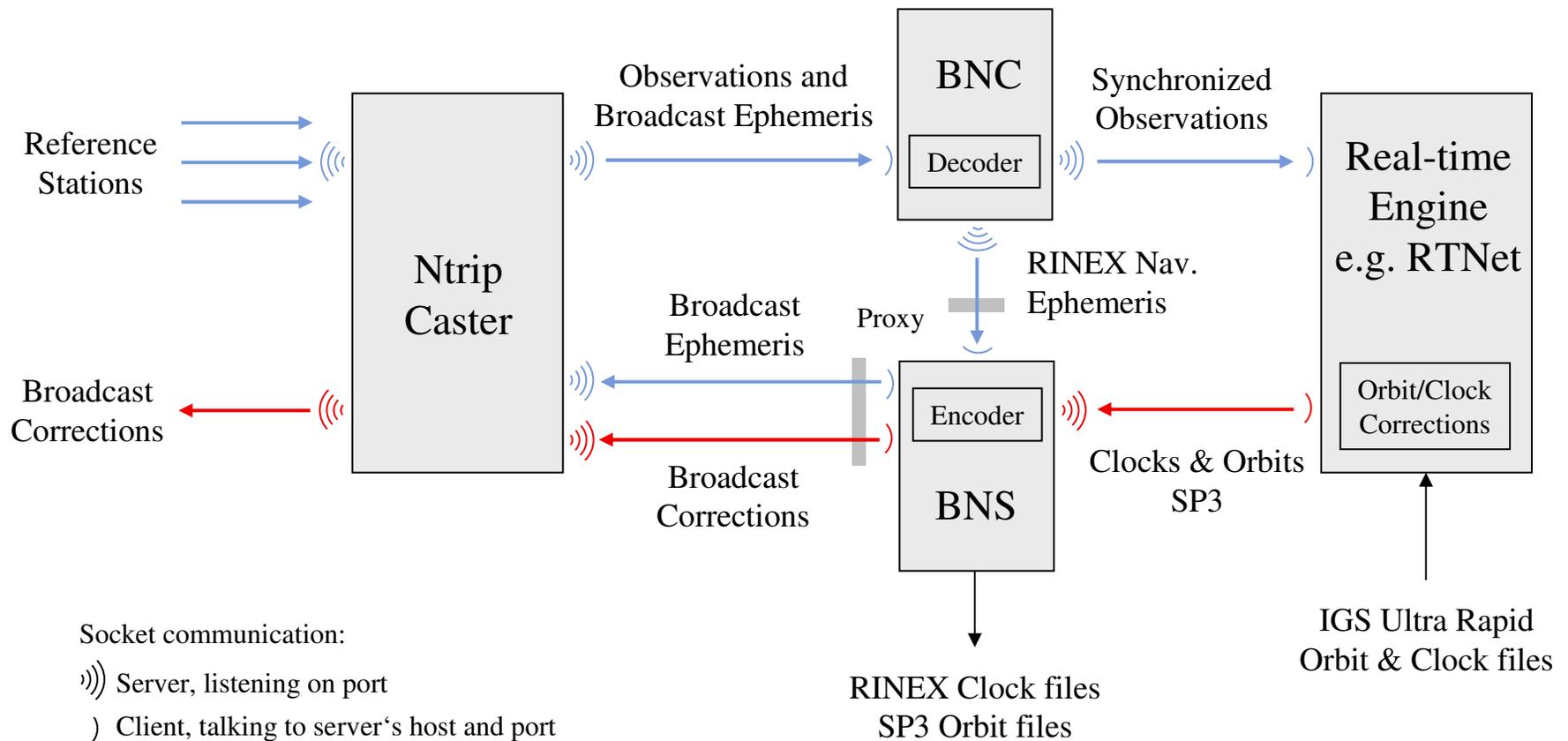
EUREF Real-Time Analysis - Satellite Clock and Orbit Corrections -

- Based on active service of real-time transmission of tracking data
- Real-time estimation and dissemination of GNSS clocks and orbits
- For regional or global high-precision satellite positioning services
- Real-time clock and orbit corrections w.r.t. broadcast ephemerides of GPS and GLONASS satellites
- Software components:
 - **BNC**, an NTRIP Client for stream retrieval and decoding,
 - **RTNet**, a real-time GNSS processing engine by GPS Solutions Inc. for satellite clock and orbit determination,
 - **BNS**, an NTRIP Server for stream encoding and upload



EUREF Real-Time Analysis - Satellite Clock and Orbit Corrections -

Flow Chart - BKG Ntrip State Space Server (BNS), Version 1.1, January 2009





Ultra Rapid Orbits and RTNet Clocks - Recommended for now-

Ultra Rapid Orbit of CODE (GPS+GLONASS)
(Center for Orbit Determination in Europe)

24h estimated + 24h predicted = 48h

Interval: 15 Min.

Update in 12h (Note: 6 h for IGS
Ultra-Rapid)

Clock Corrections from RTNET (CLK11)

CLK11 = GPS + GLONASS

RTCM Messages: 1059,1060, 1065,1066

Orbits: CODE Ultra Rapid

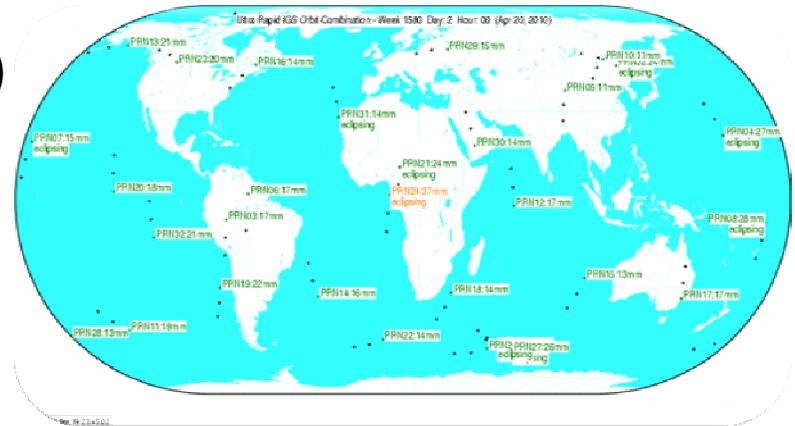
Reference Frame: ITRF2005 (GPS Time)

Processing Center: BKG / RTNet + BNS

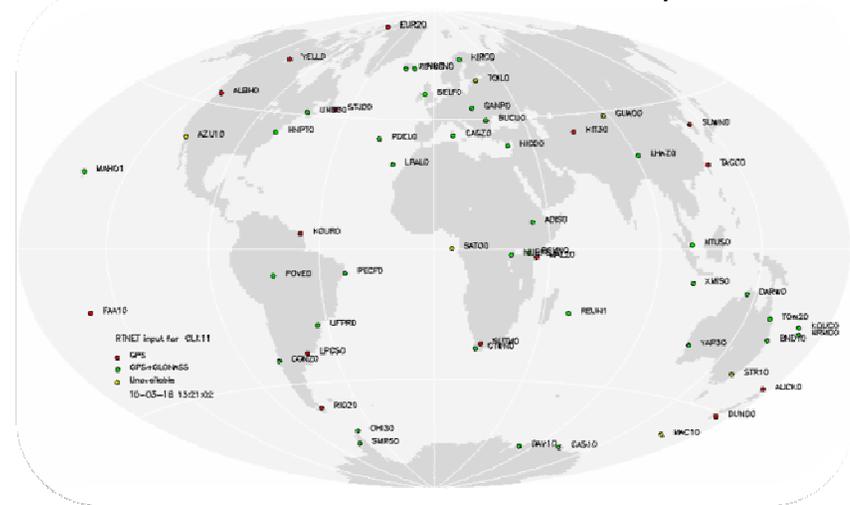
Interval:10 Sec.

➤consistent orbit + clock data stream

Ultra Rapid Orbit Station Network, April 2010



> 50 Stations in RTNet Real-Time Analysis

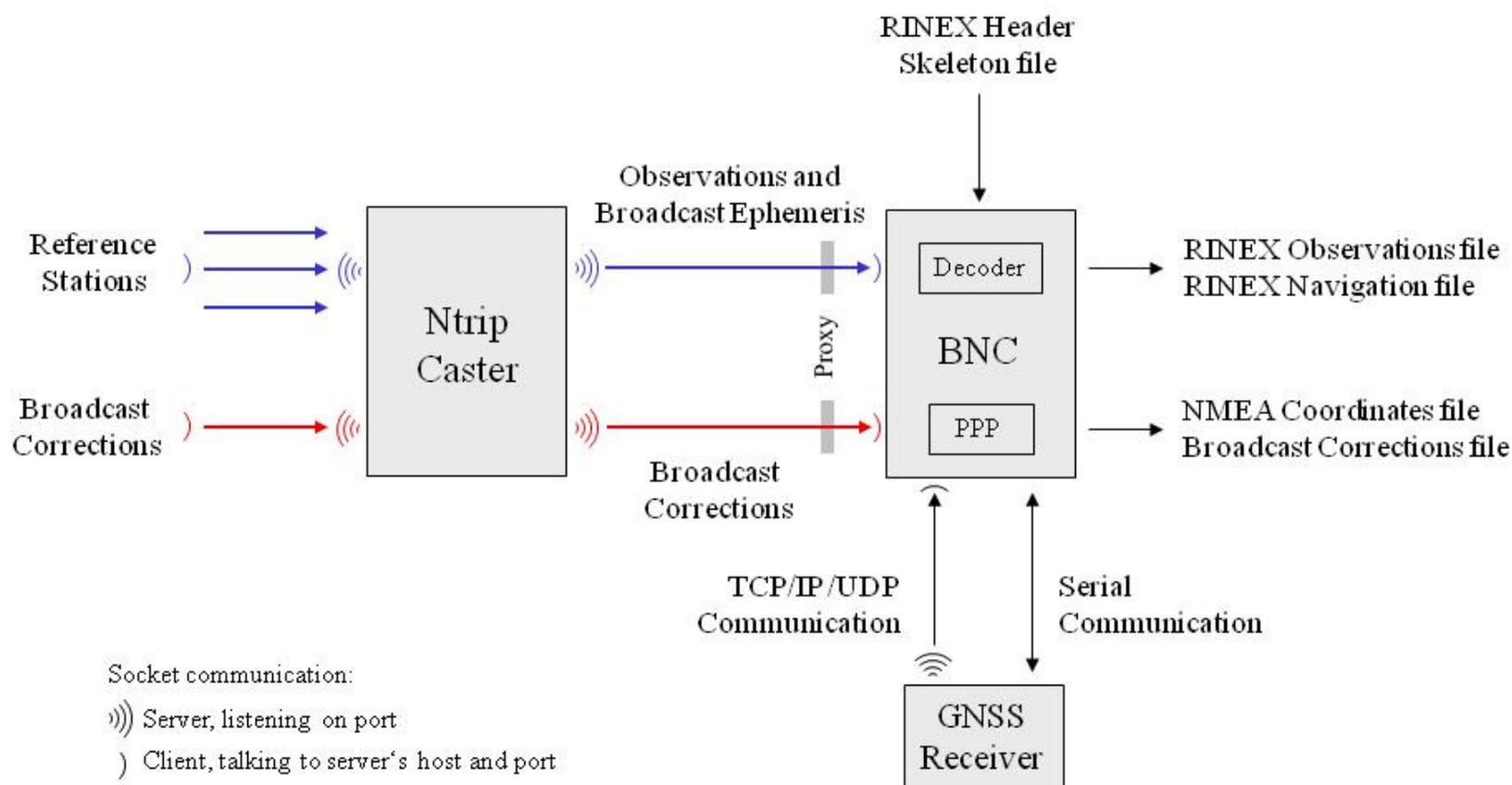


EUREF Real-Time Analysis

- Clock and Orbit User -

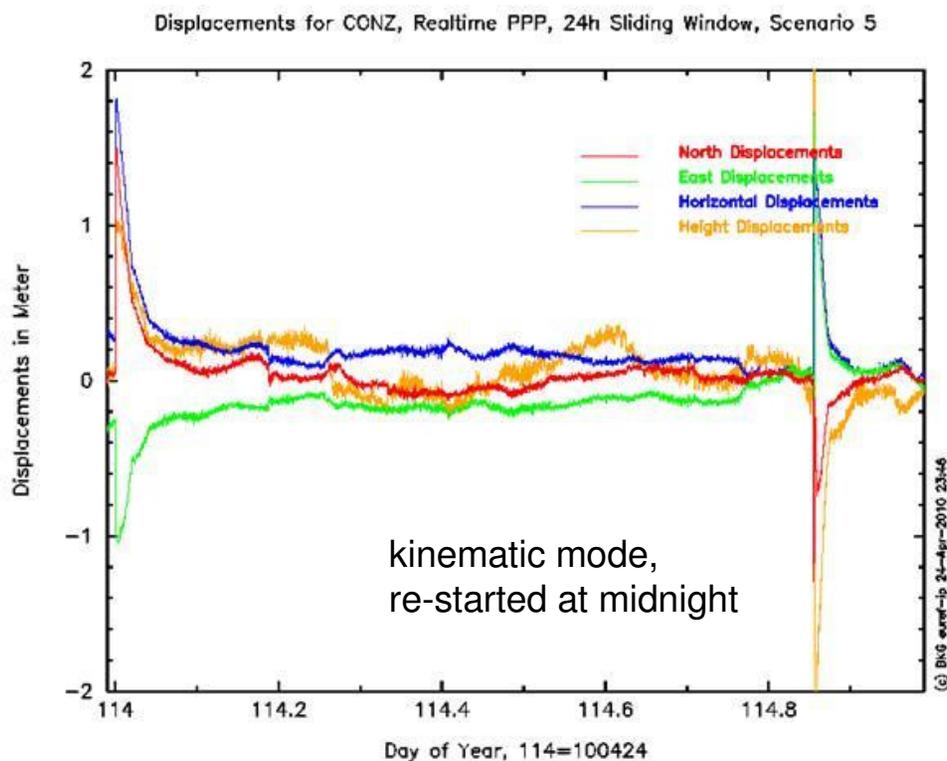
BKG Ntrip Client (BNC) Flow Chart

Version 2.0 February 2009



EUREF Real-Time Analysis - Precise Point Positioning -

- Evaluate the PPP accuracy reachable in real-time
- Real-time decimeter-level satellite positioning everywhere on the European continent when using a dual frequency GNSS receiver
- BKG Ntrip Client (BNC) software development



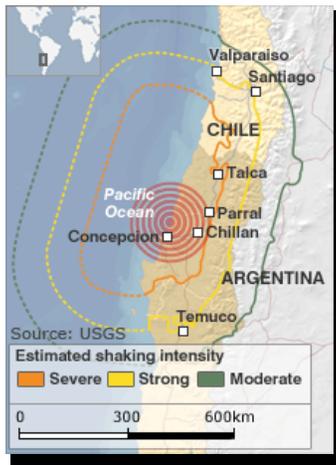


Example: Post-Processed PPP, RTNet - 1 Hz Data and IGS Final Orbit -

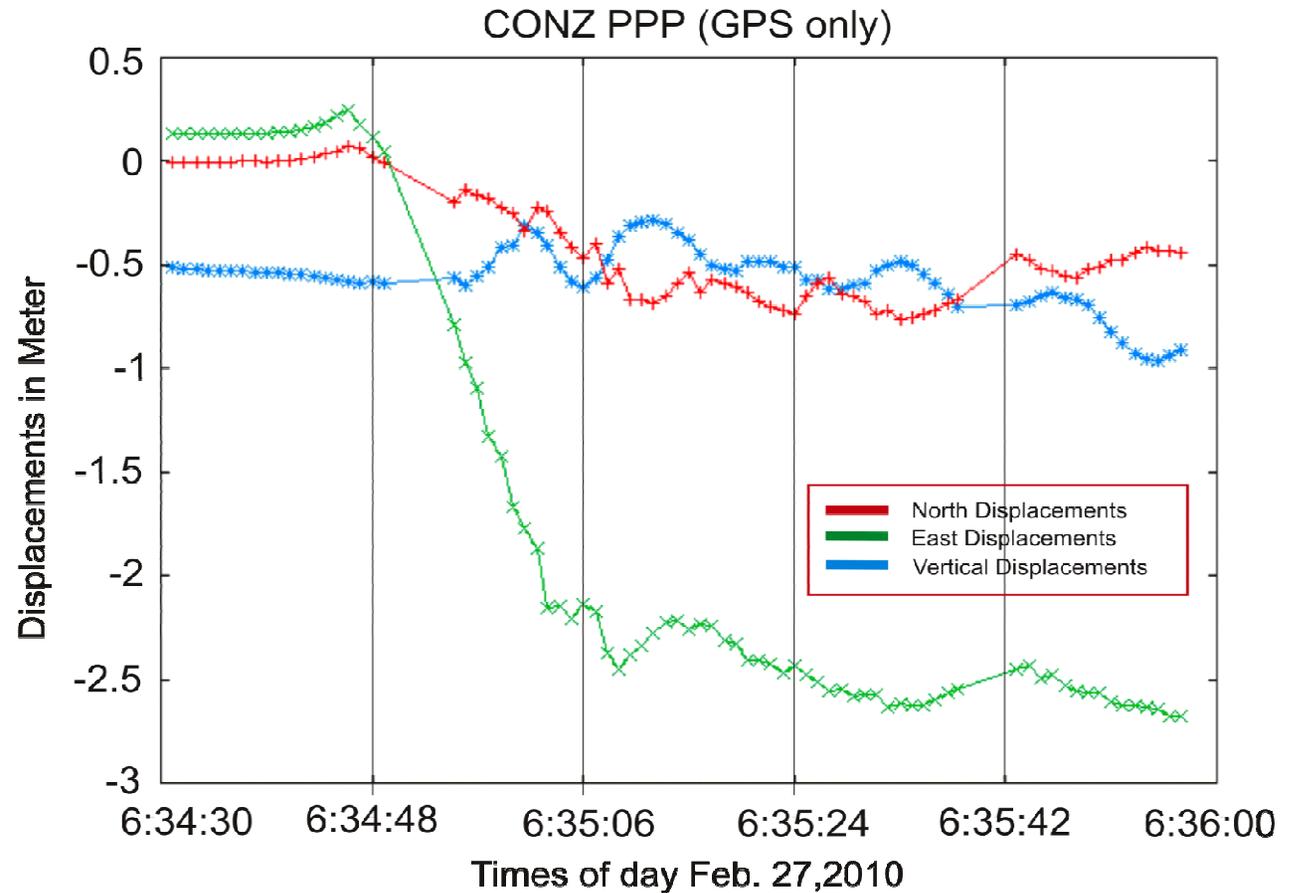
Pillar after the earthquake



LEICA
GRX1200GGPRO
TPSCR3_GGD(CONE)

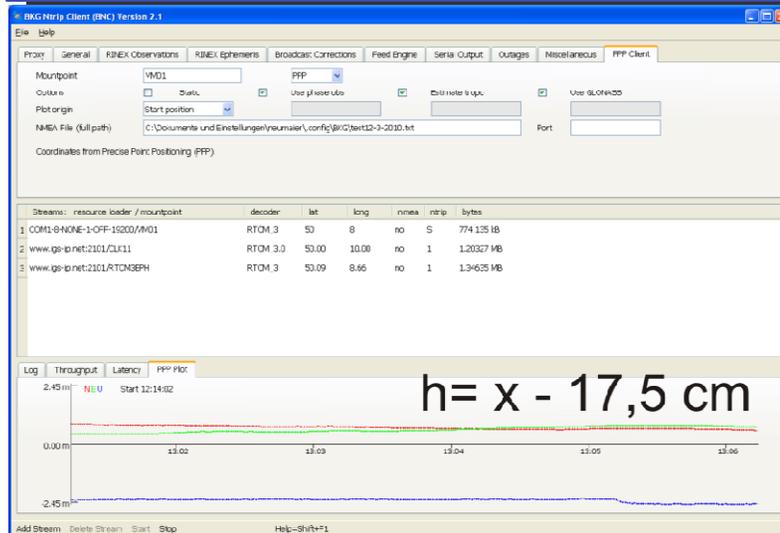
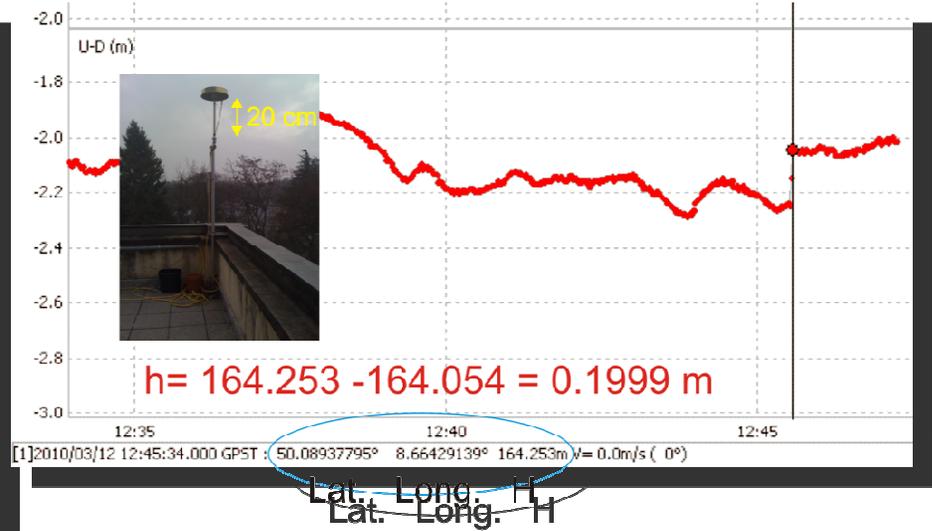
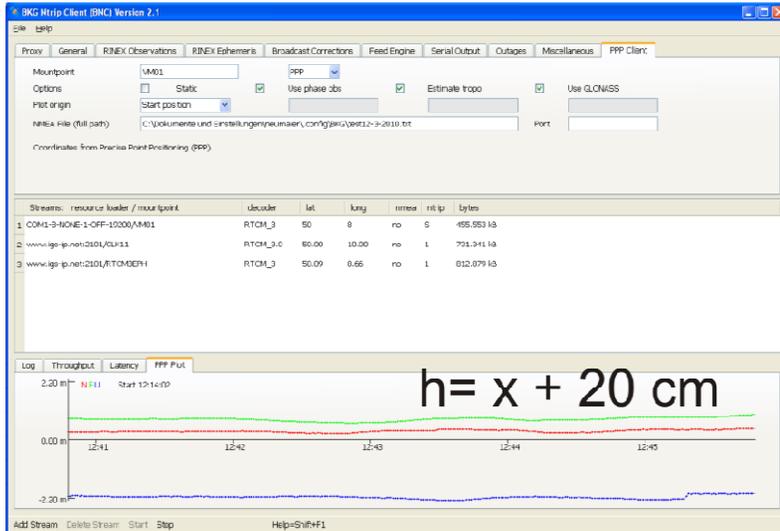
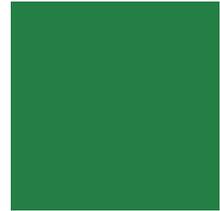


<http://news.bbc.co.uk/2/hi/americas/8540625.stm>





Monitoring Simulation - Manual Change of Antenna Height -

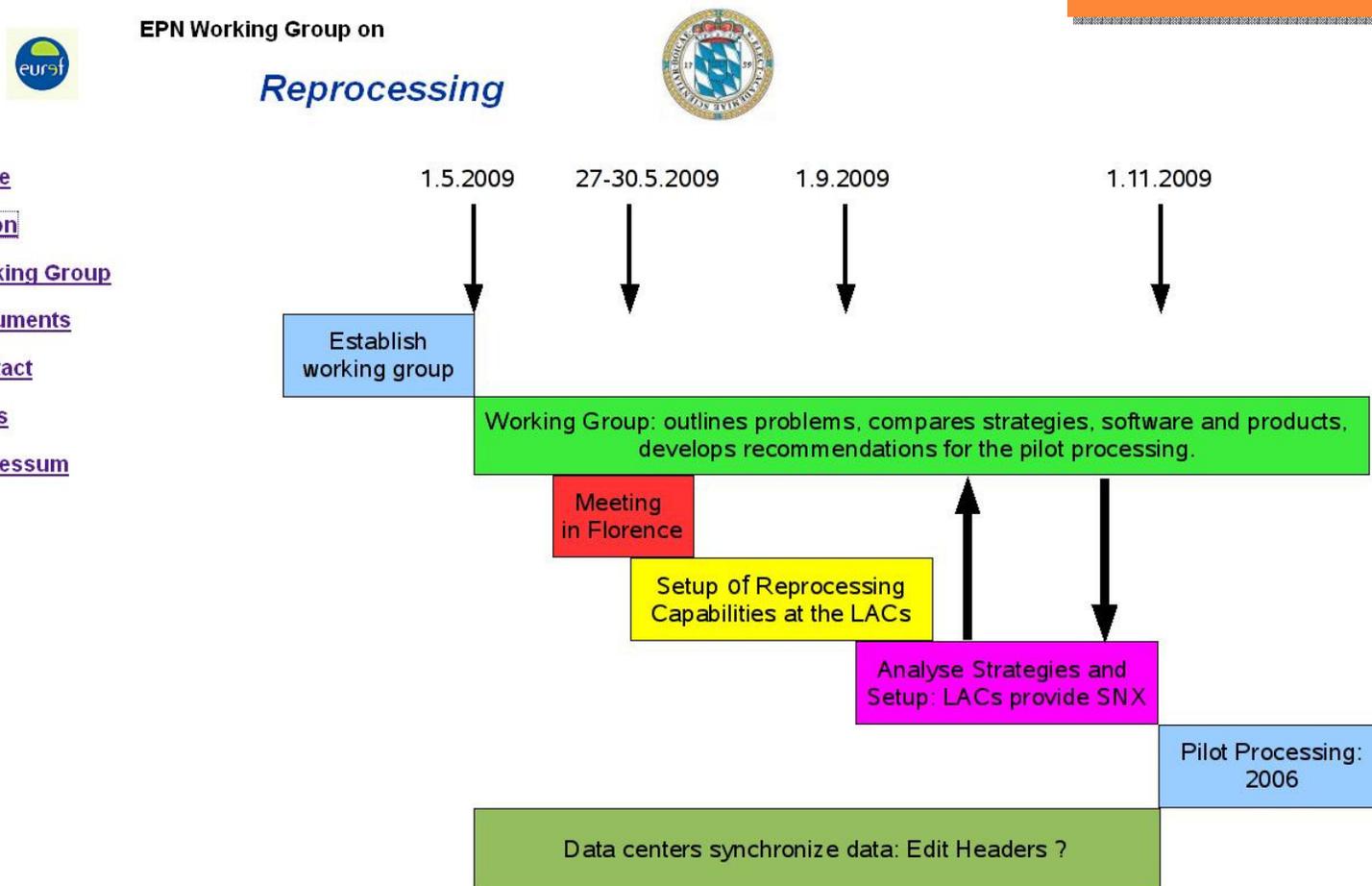




- EUREF supports the standardization under development in State Space Working Group of RTCM SC-104

- Website <http://epn-repro.bek.badw.de/>

- Improved analysis models
- Consistent solution



- [Home](#)
- [Action](#)
- [Working Group](#)
- [Documents](#)
- [Contact](#)
- [Links](#)
- [Impressum](#)

C. Völksen, 2009



■ Wiki: Project development platform

The screenshot shows a Wiki page titled "Network" with a navigation menu on the left and a main content area. The navigation menu includes sections for "navigation", "concept", "analysis", and "local analysis centers". The main content area contains a section titled "Network distribution:" followed by a paragraph of text and a map of Europe. The map shows the occurrence of each site in different networks analyzed by LACs, with a legend titled "Station Occurrence" indicating the number of sites per LAC.

Navigation:

- Main Page
- Community portal
- Current events
- Recent changes
- Random page
- Help

Concept:

- Mission
- Future
- Working Group

Analysis:

- Network
- Data
- Antenna Calibration
- Troposphere
- Combination
- Orbits+ERP
- Results

Local analysis centers:

- ASI
- BEB
- DEO
- GOP
- IGE
- IGN
- LPT
- MUT
- NKG
- OLG
- ROB
- SGO
- SUT
- UPA
- WUT

Network distribution:

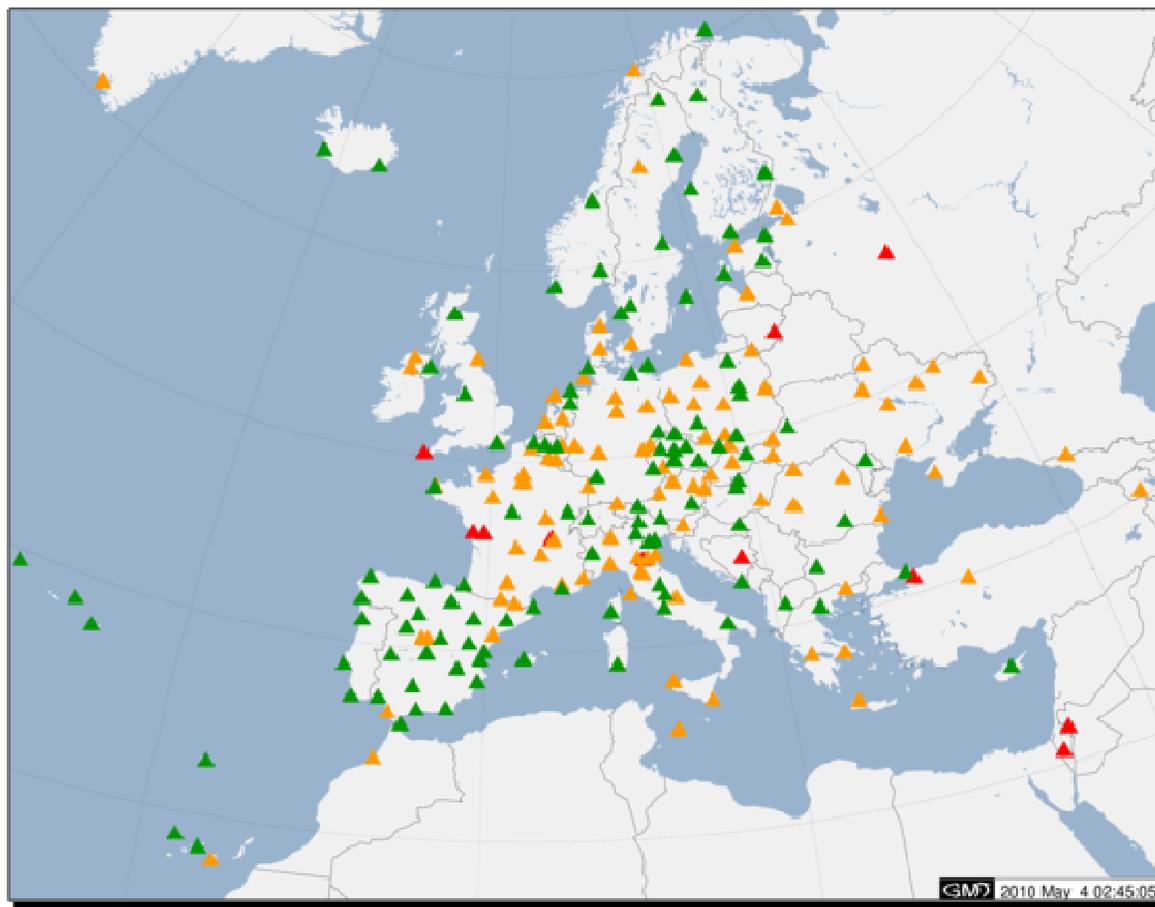
It is a goal to arrange a distributed processing of the entire EPN. Therefore at the minimum three LACs shall be appointed to process each site. A redistribution of sites will be necessary, since not all LACs will contribute in the same extent as they do in the weekly analysis of the EPN. Therefore each LAC shall compile a list of sites that it intends to reprocess. That will be the basis for redistribution of the sites to other LACs. There is the option to include additional global sites into the EPN reprocessing for purpose of datum definition. The appointment of such global sites to individual LACs needs to be discussed.

The following figure shows the occurrence of each site in the different networks analysed by the LACs. Apparently it is necessary to distribute still a number of sites, which are shown in dark red, orange and purple. Obviously a number sites from the northern part of the network need to be assigned to different LACs.

Station Occurrence Legend:

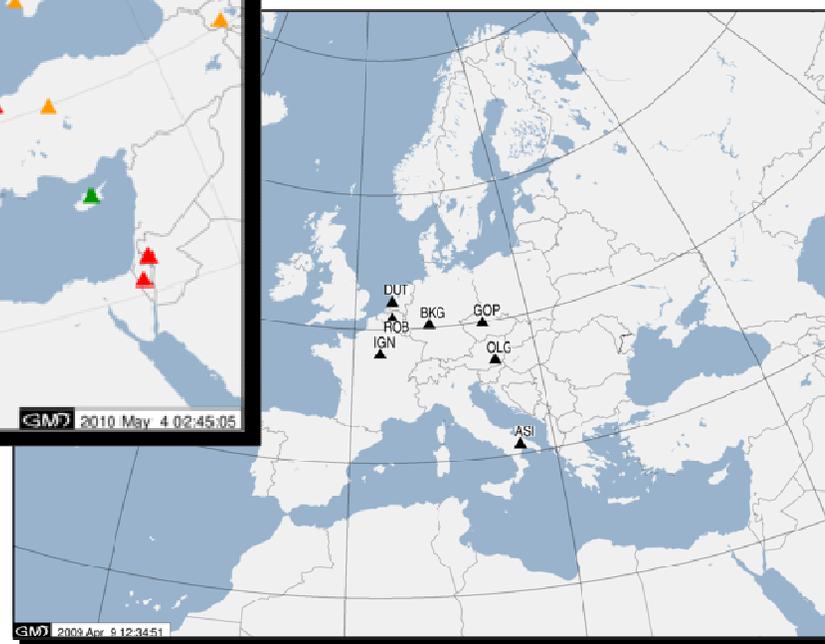
- > 5 (Green)
- = 4 (Light Green)
- = 3 (Yellow)
- = 2 (Purple)
- = 1 (Orange)
- = 0 (Dark Red)

Data Access - Active Service -



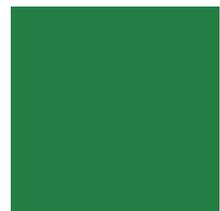
Permanent GNSS Stations

Data Centres

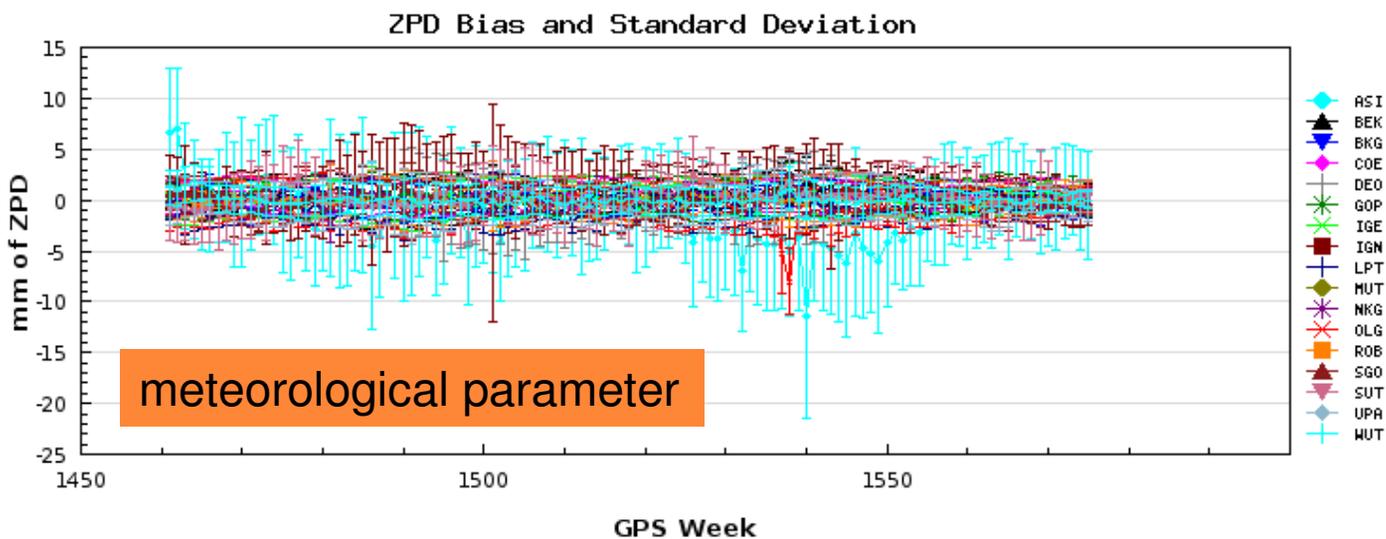
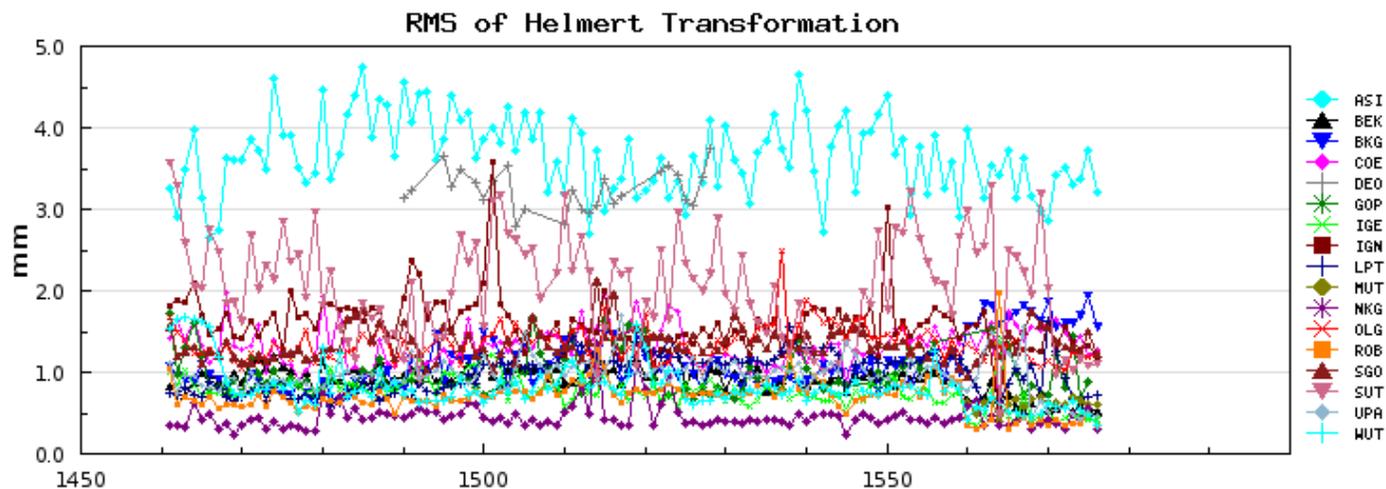
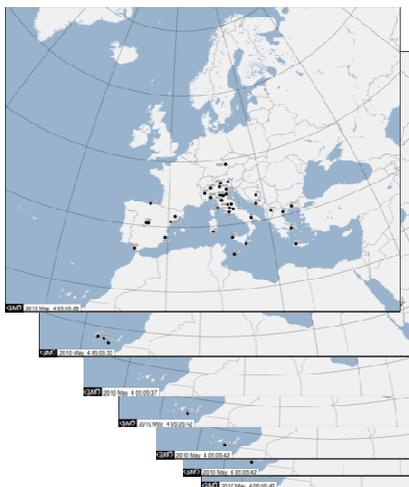


orange: stations delivering hourly data
red: stations delivering daily data
green: stations delivering real-time data

<http://www.epncb.oma.be>



17 Sub-Networks



Station Coordinates and Velocities - Active Service -

Chisinau, Republic of Moldova (IGEO)

1. POSITIONS/VELOCITIES PUBLISHED BY EUREF

EUREF has classified IGEO_15101M001 (Chisinau, Republic of Moldova) 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_ITRF2005_C1570.SSC (March 23, 2010)

ETRF2000	epoch t_0	Position (m)			Velocity (m/y)		
		X	Y	Z	V_x	V_y	V_z
217/2007 - 044/2010	001/2005	3814975.640 ± 0.001	2101074.955 ± 0.000	4644143.786 ± 0.001	0.0002 ± 0.0002	-0.0009 ± 0.0001	-0.0001 ± 0.0002

ITRF2005	epoch t_0	Position (m)			Velocity (m/y)		
		X	Y	Z	V_x	V_y	V_z
217/2007 - 044/2010	001/2005	3814975.278 ± 0.001	2101075.166 ± 0.000	4644143.977 ± 0.001	-0.0190 ± 0.0002	0.0153 ± 0.0001	0.0096 ± 0.0002

Click [HERE](#) to see a plot of how the station positions between successive cumulative solutions agree with each other.

+ Previous releases

2. POSITIONS/VELOCITIES PUBLISHED BY THE IERS

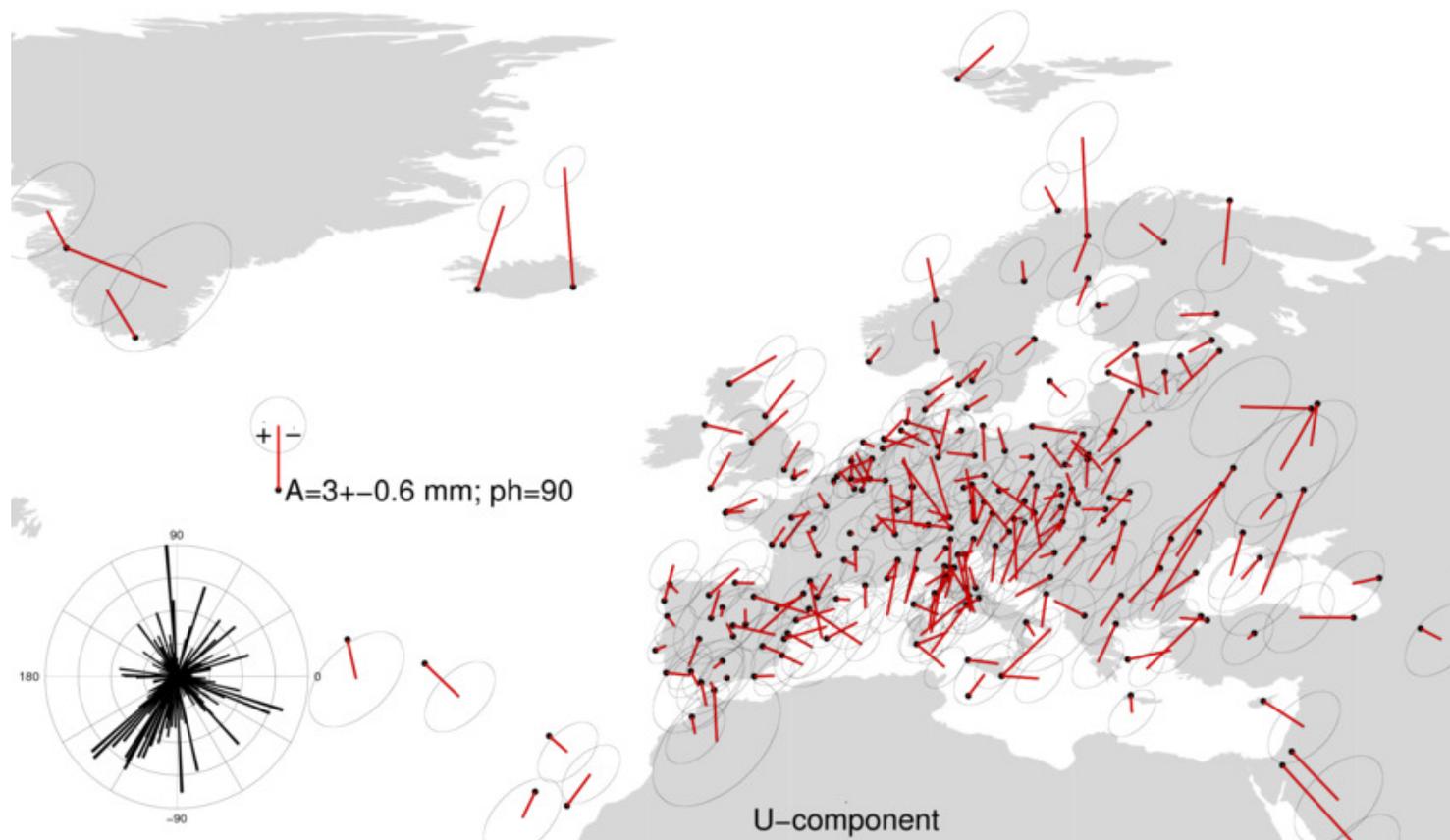
IERS has not yet released coordinates for IGEO_15101M001 (Chisinau, Republic of Moldova).

3. POSITION PUBLISHED WEEKLY IN THE EPN COMBINED SOLUTION

IGS05	epoch t_0	Position (m)			Velocity (m/y)		
		X	Y	Z	V_x	V_y	V_z
066/2010 - 072/2010	069/2010	3814975.177 ± 0.000	2101075.241 ± 0.000	4644144.017 ± 0.000	NA	NA	NA



Amplitude and phase lag of annual signal
(global effects not visible in regional network ?)



The length of the sticks corresponds to the amplitude and the direction to the phase lag



■ “Global to Regional” Online Transformation @ EPN-CB

ETRS89/ITRS TRANSFORMATION

The following tool allows to transform coordinates (position and velocity) from any ETRFxx to any ITRFyy (or ITRFyy to ETRFxx). In case input and output coordinates are requested at different epochs, then site velocities are mandatory.

Input

Frame :

Format:

Epoch :

```
# Example with velocity - StationName(no space character) X[m] Y[m] Z[m] VX[m/yr] VY[m/yr] VZ[m/yr] :  
IGEO_15101M001 3814975.1755 2101075.2432 4644144.0204 -0.0177 0.0166 0.0071
```

Output

Frame :

Epoch :

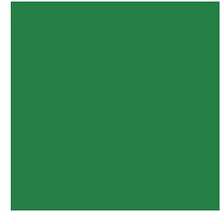
```
IGEO_15101M001 3814975.6404 2101074.9450 4644143.7776 0.0015 0.0004 -0.0026
```

show intermediate steps

Reference <http://etrs89.ensg.ign.fr/memo-V7.pdf>



Coordinate Transformation - Active Service -

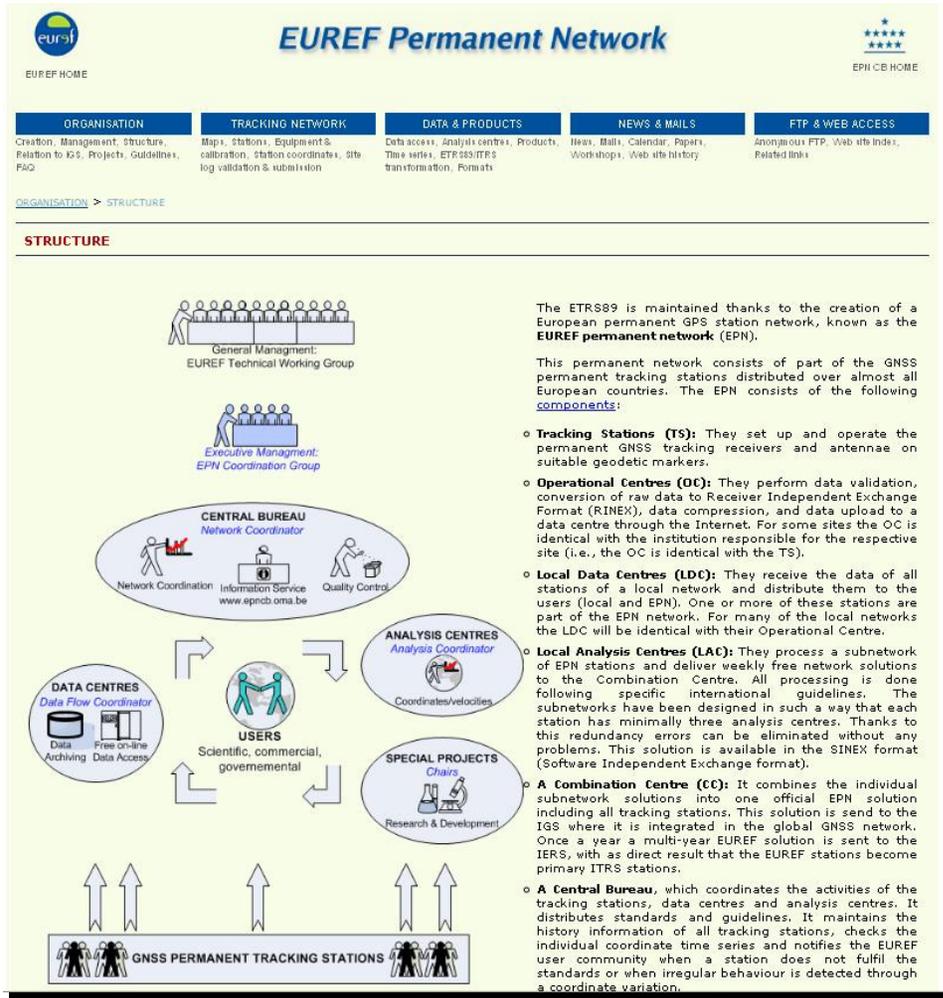
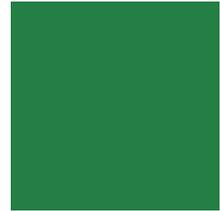


■ “Regional to National” Online Transformation @ CRS

The screenshot displays the 'CRSEU' website interface. The main header reads 'Coordinate Reference Systems in Europe'. The left sidebar contains navigation links: Home, News, CRS Overview, CRS Description, References, Links, Service (Sitemap, Contact, Imprint), national CRS, pan-European CRS, and another Service section. The main content area is titled 'Information and Service System for European Coordinate Reference Systems' and includes logos for the Bundesamt für Kartographie und Geodäsie, eurogeographics, and EUREF. Below this, a form titled 'DE_DHDN (North) to ETRS89' is shown, divided into 'Source' and 'Target' sections. The 'Source' section includes fields for 'GK_3 [m]', 'X / Hochwert', 'Y / Rechtswert', 'ellip. height', 'ellipsoidal coordinates [DMS / m]' (Latitude: dd mm ss.sss, Longitude: dd mm ss.sss, ellip. height: hhhh.hhh), and 'cartesian coordinates [m]' (X, Y, Z). The 'Target' section includes fields for 'ETRS-TM xx [m]', 'North', 'East', 'ellip. height', 'ellipsoidal coordinates [DMS / m]' (Latitude, Longitude, ellip. height), and 'cartesian coordinates [m]' (X, Y, Z). To the right of the form is a map of Europe with red dots indicating national CRS locations, accompanied by a list of countries: Latvia, Lithuania, Luxembourg, Macedonia, Malta, Netherlands, Northern Ireland, Norway, Poland, Portugal, Romania, Russia, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey, and Ukraine. A 'to the top' link is at the bottom right. A red box at the bottom of the screenshot contains the URL 'http://www.crs-geo.eu'.



EPN Central Bureau - The “triple-M” -



<http://www.epncb.oma.be/>

Management



Maintenance

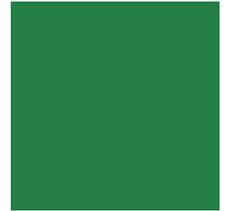


Monitoring





- EUREF Technical Working Group (general management responsibility) established the
 - Working Group on Future Development of ETRS89**
 - dedicated to the ETRS89 future development, realization and its target users
 - , e.g., measured “time evolution” of network vs. user requested “stability”
- Linkage and densification of new global reference networks, e.g., upcoming ITRF2008, to Europe
 - transform to ETRS89, thus fixed to the European tectonic plate
 - fill the gap in between two successive ITRF realizations
- Access to European reference network in real-time



- EUREF provides the reference frame for Europe through operating various services
 - real-time
 - long-term scale (decades)
- EUREF is a sub-commission of IAG and supports IAG services (IGS, GGOS, ...)
- Considering user needs
 - national mapping agencies
 - others (feedback welcome)

