National report of Belgium

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1. The national map projection system

As reported in the Belgian national reports presented during the Euref symposia of 2006 (Riga) and 2007 (London) the NGI (National Geographical Institute) adopted a new national mapping system, the Lambert 2005 projection. The aim was to introduce plane coordinates which are directly developed from the ETRS89 coordinates in order to avoid datum transformation and according loss of accuracy.
Several surveyors and GIS-experts expressed their concern about possible confusion with the Lambert 1972 coordinates, the older map projection system, which will, at least for a couple of years, co-exist with Lambert 2005. They stated that the mean difference of about 1 km in as well x as in y is too small.
The NGI decided to augment considerably the false easting and northing and to change the name from Lambert 2005 to Lambert 2008. The parameters of the new projection are given in table 1.

Lambert 2008		
Ellipsoid	Id	GRS80
	½ major axis (a)	6.378.137,0 m
	Flattening (f)	1 / 298,257222101
Standard parallels	φ_1	49° 50’ N
	φ_2	51° 10’ N
Origin	Latitude	50° 47’ 52” 134 N
	Central meridian	4° 21’ 33” 177 E
False easting	x_0	649.328,0 m
False northing	y_0	665.262,0 m

Table 1: parameters of the Belgian Lambert 2008 map projection

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2. Activities related to EPN

The ROB (Royal Observatory of Belgium) is heavily involved in the EPN (EUREF Permanent Network) and is processing GNSS observations from the EPN since February 1996. Nowadays, the errors due to the reference setting and the atmosphere still remain the main limiting factors when performing high accuracy GNSS positioning. In that frame, the ROB carries a long-term research program that aims to better understand these error sources, to improve their mitigation in the GNSS data processing and to provide specific products for the scientific community.

2.1. Ongoing Research based on the EPN

2.1.1. Reference frame definition

The ROB carries out a study in order to quantify the impact of using a regional network instead of a global network to determine station positions and velocities. We show that different regional position solutions present biases with respect to each other which can reach the centimetre level (Fig 1). These differences depend on the set of fiducial stations as well as the frame (IGS05 [Ferland, 2006] or ITRF2005 [Altamimi et al., 2007]) to which the solution is tied [Legrand and Bruyninx, in press]. A new study on the influence of the reference frame on the velocity estimation is in progress.

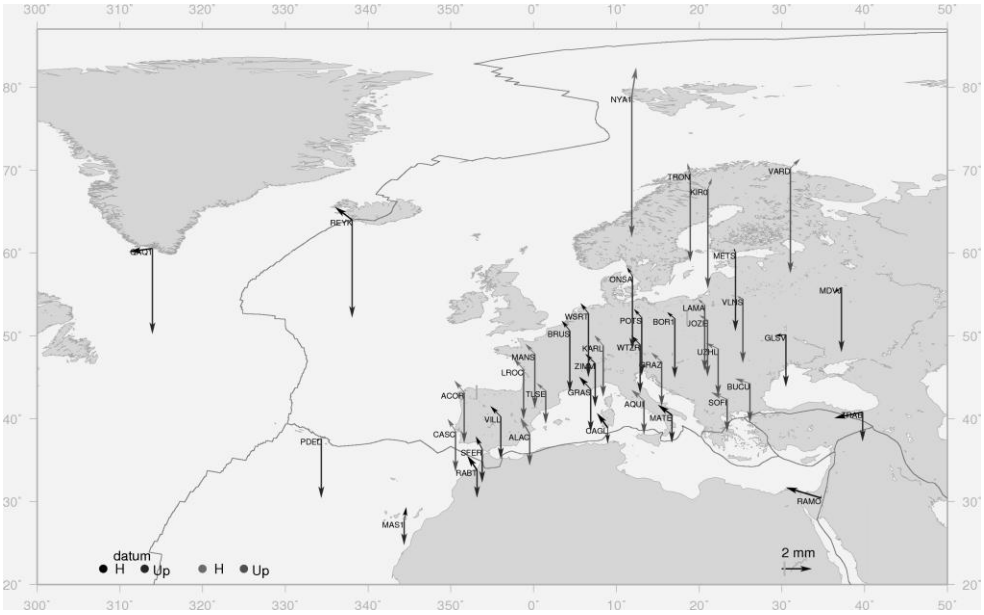

Figure 1: Differences in positions between the global cumulative solution in IGS05 and the regional cumulative solution in IGS05.

2.1.2. Atmospheric refraction

In the frame of the atmospheric refraction, the Royal Observatory of Belgium carries a long-term research program that aims to improve the mitigation of the atmospheric refraction error source in the GNSS data processing. The atmospheric refraction study can be divided into two main parts: the refraction due to the ionosphere and the one due to the troposphere components.

- Ionospheric refraction

The study of the ionosphere over Europe has applications for geophysics, space weather research, or radio system transmission. Moreover, GNSS errors due to the ionosphere may increase in the next few years due to the increase of the solar activity after the end of the 23rd sunspot cycle. To better understand the ionosphere and its effects on GNSS positioning, the ROB is developing an automatic monitoring to detect rapid and small variations in the ionosphere using the EPN data. In the present validation stage we compare our results with the IGS Analysis Centre CODE products [Bergeot et al., in press]: we computed TEC maps each hour on a 1°/1° grid over Europe. We focused on the 2003 29-31st October geomagnetic storm to produce Total Electron Content (TEC) map (Fig: 2).

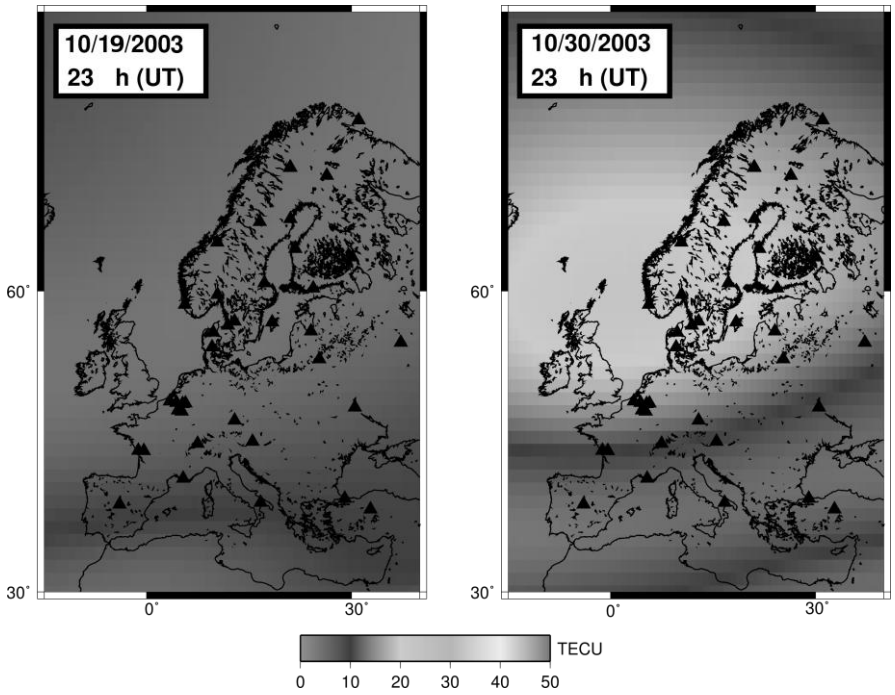

Figure 2: TEC map from ROB Analysis centre at 23h during normal ionosphere activity (left) and during the October, 2003 geomagnetic storm (right).

- Tropospheric refraction

Present models of the tropospheric refraction remain incomplete and remain an important limiting factor in positioning, particularly during periods of quiet ionospheric activity. The research carried out at the ROB in that domain aims to properly estimate this error source in order to better mitigate its impact on positioning. It also aims to be used as an important source of information in meteorological applications such as numerical weather prediction and nowcasting. Among the research topics that are currently ongoing at ROB, we can cite:

- GNSS Near Real-Time Zenith Path Delay Estimations at ROB: Methodology and Quality Monitoring [Pottiaux (a),in press]
- Impact of Reference Frame Definition on GNSS-based Tropospheric Zenith Path Delay Estimations [Pottiaux et al. (d), in press]
- Detecting Small-Scale Tropospheric Phenomena Using GNSS Observations from Dense National Networks [Pottiaux (b), in press]

2.2. Service and products based on the EPN

2.2.1 EPN Reprocessing at ROB

Since the start of the EPN in 1996, considerable improvements in the processing strategies and modelling of the GPS solutions were done. Currently, the ROB is reprocessing the whole EPN using the Bernese 5.0 software [Dach et al., 2007] and the EPN standard analysis procedure used today within the EPN [Kenyeres et al., in press] in order to reduce the uncertainties on the EPN stations positions and velocities.

2.2.2 E-GVAP Analysis Centre

The ROB participates as an official analysis centre within the EUMETNET GPS Water Vapour Program (E-GVAP) [Pottiaux, 2008c]. In that frame, the ROB provides near real-time Zenith Tropospheric Delay (ZTD) estimations of a regional network that covers the whole of Europe (Figure 3). At the present time, this network includes about 150 sites, most of them are EPN and IGS GNSS stations. Moreover, some of these sites are co-located with other instruments such as radiosondes, water vapour radiometers ... This co-location allows the ROB to validate its ZTD estimates by cross-technique comparisons [Pottiaux et al. (e), in press].

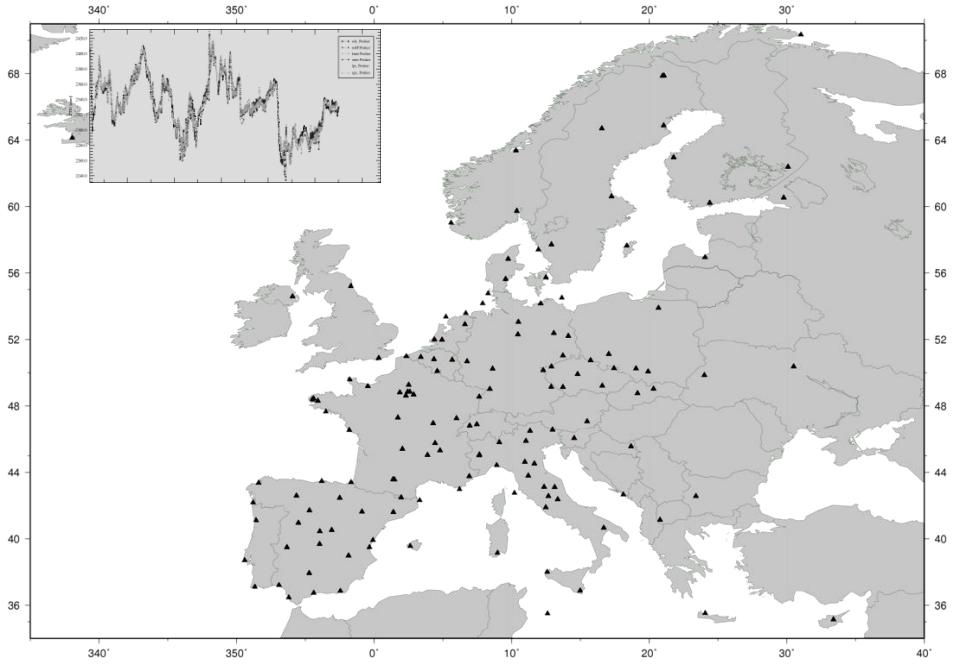

Figure 3: EPN and IGS GNSS sites processed by the ROB for near real-time ZTD estimations (example of ZTD estimations for BRUS station at the top).

2.3 Contribution to the EPN

The ROB contributes to the EPN with:

- 4 permanent tracking stations (all submitting hourly data) : BRUS, DENT, DOUR and WARE ; BRUS is streaming real-time data
- An EPN Local Data Centre (ftp://epncb.oma.be/gps_rob/data/rinex)
- An EPN Local Analysis Centre processing an EPN sub network located around the Benelux (see http://epncb.oma.be/_dataproducts/analysiscentres/subnetwork.php?lac=ROB).

In addition, the ROB hosts the EPN Central Bureau (http://www.epncb.oma.be/). For details we refer the interested reader to the paper *"Status and Performance of the EUREF Permanent Tracking Network"* by Bruyninx et al. (in this volume)

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