EUREF 2015 NATIONAL REPORT OF BELGIUM

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1. Contribution to the EPN

1.1 EPN Central Bureau

The Royal Observatory of Belgium (ROB) hosts the EPN Central Bureau (http://www.epncb.oma.be/ & ftp://epncb.oma.be). In 2014, the EPN CB web site and ftp site received more than resp. 2 and 10 million hits.

The EPN CB is performing:

- daily data quality checks of the daily RINEX v2 data of the EPN stations;
- daily checks of the meta-data of the daily RINEX v2/3 data of the EPN stations;
- 2-hourly checks of the meta-data and latency of the real-time EPN data streams;
- daily checks of the latency and availability of the hourly and daily RINEX v2 data of the EPN stations;
- daily update of the residual position time series of the EPN stations;
- regular updates of several EPN meta-data files (station site logs, antenna calibrations, ocean loading parameters, site coordinates, …) in support of EPN data analysis.

In addition, during the last year, we

- reviewed and redesigned in collaboration with several EPN coordinators, the pages related to the combined EPN products, the tropospheric products and the complete part of the web site related to ‘organization’;
- created a new monitoring of the EPN real-time data streams allowing to compare the streams provided by the three regional EPN broadcasters (BKG, ROB, ASI);
- adapted the EPN site log submission for allowing the submission of station logs from EPN densification stations;
- started to prepare the switch from 4-char. station names to the long station names as required by the new RINEX v3 format;
- developed new tools to evaluate the conformity of RINEX v3 observations data files to the RINEX v3 format description. Station managers were notified in case of errors.

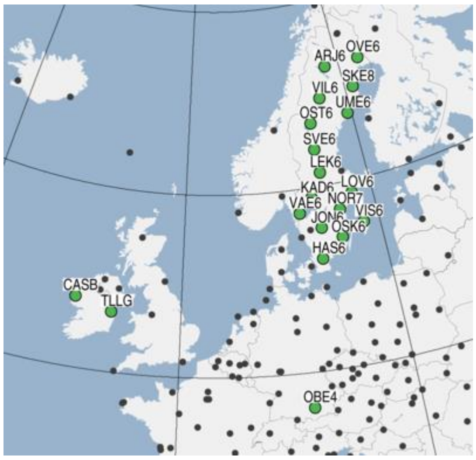

Figure 1: New stations added to the EPN since June 2014.

Since June 2014, 19 new stations have been included in the EPN (see Figure 1) and the “Guidelines for EPN data centres” have been converted into “Guidelines for EPN data centers & EPN broadcasters”.

1.2 EPN Tracking Stations

ROB operates four permanent GNSS tracking stations included in the EPN: BRUX, DENT, DOUR and WARE. In 2014, all stations have been upgraded with SEPT POLARX4 receivers (tracking

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GPS/GLONASS/Galileo on L1/L2/L5). In BRUX, a multi-GNSS antenna is already in operation, but in the other stations the antenna will be upgraded to a multi-GNSS antenna in 2015-16.

1.3 EPN Data Centers and Regional Broadcaster

ROB maintains an historical EPN data center, providing access to all historical EPN RINEX v2 data (ftp://epncb.oma.be/ftp/obs/). This historical data center is used for EPN reprocessing activities. Typically updates are done once a month or upon a site log upgrade (which affects data in the data center) and the headers of the RINEX data are updated to agree with the site log. The historical data center does not contain RINEX data for the last three months.

ROB's EPN regional NTRIP broadcaster (www.euref-ip.be:2101) makes available the data from all real-time EPN stations. Users can apply for an account by filling in the web form on http://www.gnss.be/data.php#NTRIPaccess.

1.4 Data Analysis

ROBs EPN Local Analysis Center is processing an EPN sub-network located around the Benelux (see http://epncb.oma.be/_dataproducts/analysiscentres/subnetwork.php?lac=ROB).
Since June 2014, 9 new EPN stations were added to this routine data analysis (7 in Sweden and 2 in Ireland).

2. Services and Products Based on the EPN

2.1 Ionospheric Products and Space Weather impacts

The ROB-IONO software, based on the analysis of real-time GNSS data from the EPN, demonstrated its capability to detect in near real-time abnormal ionospheric behavior over Europe (Bergeot et al. 2014). The ROB-TEC products are freely available through the ftp server (ftp://gnss.oma.be) in real-time and in the IONEX format. Additionally, ROB is maintaining a public data base with identified ionospheric events since 2012. For 2014, 3 events of abnormal ionospheric activity have been reported at www.gnss.be.

Additionally, the impact of solar radio bursts on GNSS carrier to noise density from 2001 until 2013 was investigated using GPS and GLONASS data of the EPN. A method was developed to detect such GNSS signal degradations in a near real-time approach.

2.2 Tropospheric Products and E-GVAP Analysis Centre

The ROB continued develops and maintains a GNSS analysis centre participating to the E-GVAP program (see Pottiaux, 2014) to provide the European meteorological institutes with near real-time (NRT) GPS-based tropospheric Zenith Path Delay (ZPD) estimates for assimilation in the Numerical Weather Prediction (NWP) models.

3. EPOS

2014 saw the end of the EPOS[3] Preparatory Phase, followed by the start of the preparation of its Implementation Phase (IP). ROB contributed to the elaboration of the final version of the GNSS Thematic Core Services (TCS), as part of the Preparatory Phase, including the selection of the GNSS TCS that should be realized during the Implementation Phase. Following its experience with GSAC (see Baire and Bruyninx, 2014), ROB designed, together with the GNSS meta data working group of EPOS, the scheme of a prototype database for GNSS station meta-data. The finalization of the database scheme will be done during the Implementation Phase of EPOS which will start in the Fall of 2015.

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[3] EPOS = European Plate Observing System, ESFRI whose implementation phase will start in 2015.

4. Research Activities

4.1 IAG Working Group 'Integration of Dense Velocity Fields in the ITRF'

ROB is chairing the IAG Working Group "Integration of dense velocities fields in the ITRF". The Working Group is a collaborative effort between the different IAG regional reference frame sub-commissions who are submitting solutions for the GNSS permanent tracking stations installed in their continent to the Working Group with the goal to create a homogenous global velocity field (see Figures 2 and 3). The network now counts about 2600 stations having more than 3 years of data. The working group is ending this year.

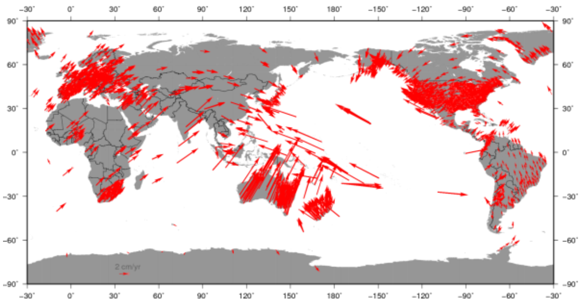

Figure 2: Horizontal velocity field

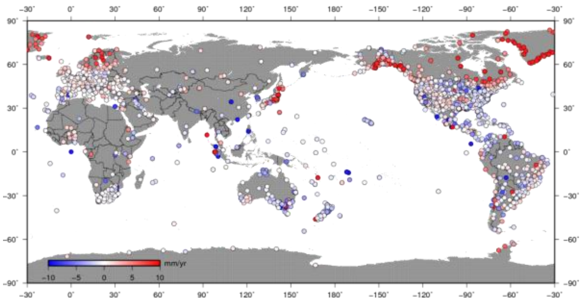

Figure 3: Vertical velocity field

4.2 Long-term Stability of GNSS-based Tropospheric Zenith Path Delays

ROB continued its collaboration with the Royal Meteorological Institute of Belgium and the Belgian Institute of Space Aeronomy on the inter-comparison of atmospheric water vapour observed by several ground-based (GNSS, sun-photometers), in-situ (radiosondes) and satellite-based (GOME/GOME2/SCHIAMACHY/AIRS) techniques (Van Malderen et al, 2014).

4.3 COST Action ES1206 (GNSS4SWEC) on GNSS, severe weather and climate

ROB co-chairs Working Group 2 of the E.U. COST Action ES1206 "Advanced GNSS Tropospheric Products for monitoring Severe Weather Events and Climate" (GNSS4SWEC) and contributed to the Action by focussing on using real-time GNSS observations and orbit and clock products to provide real-time troposphere estimates in support of severe weather forecasting/nowcasting (see Pottiaux et al., 2015).

More information on the activities of the GNSS research group of the Royal Observatory of Belgium can be found at http://www.gnss.be/.

5. Update of a part of the national levelling network

In some regions of Belgium where coal was excavated during the second part of the twentieth century, signs of land uplift were noticed. Long term GPS observations from permanent stations showed clearly an uplift during the last decade. This was already mentioned in our national reports to the EUREF subcommission of last year and 2013. During 2014, NGI performed spirit levelling observations in the region of Charleroi, in order to update the levelling benchmarks.

In figure 4, which gives an overview of the levelling results, one can clearly see the height changes in the former mining area. Several peaks of land uplift show up, but on the other hand there is also a small region where slight subsidence has been noted.

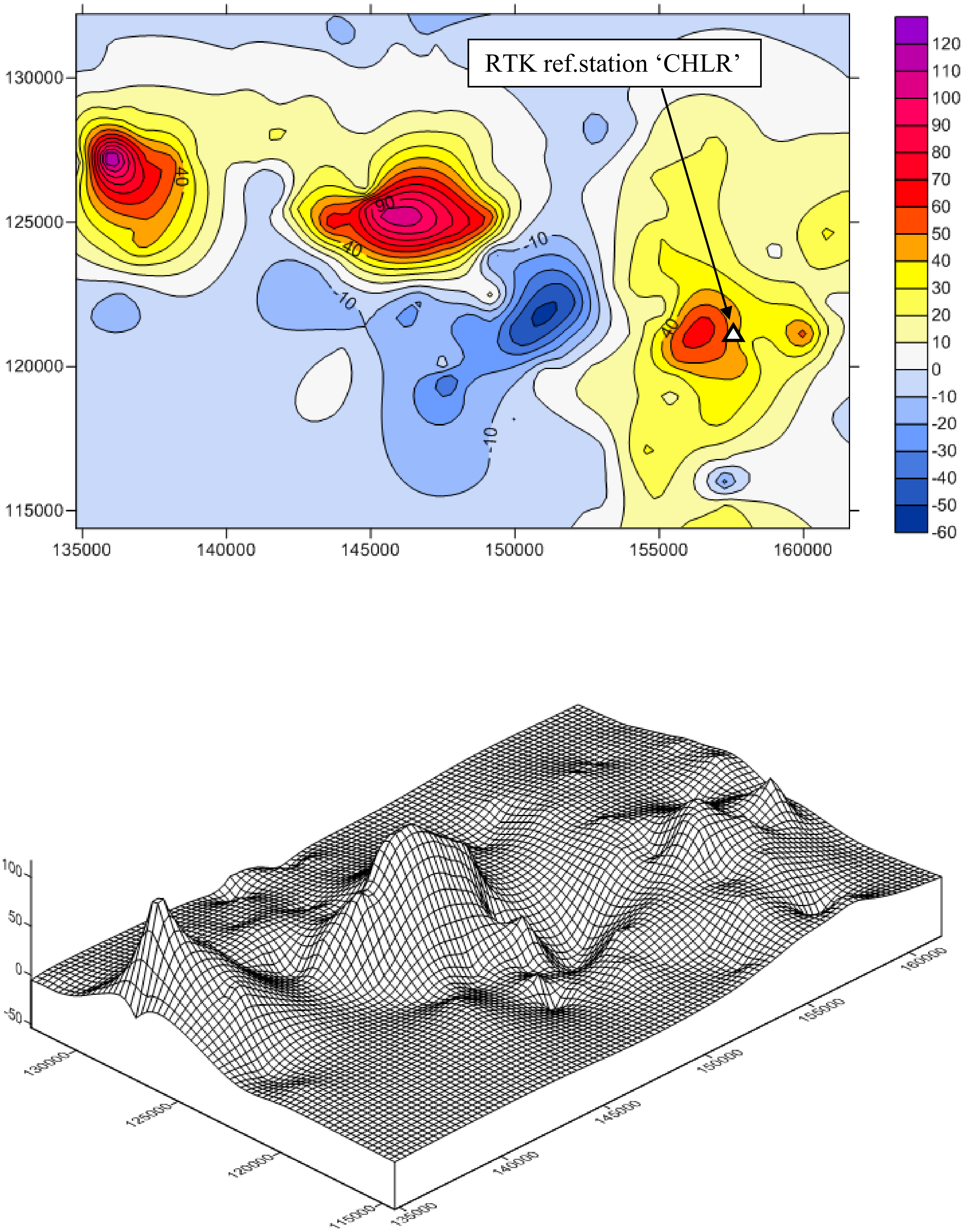

Figure 4: Height change (2D and 3D) expressed in mm between successive levelling campaigns (2014 minus 1994)

Nowadays the Belgian levelling network is not maintained systematically. Local levelling campaigns are set up only for the regions where we have strong indications of height change. In this case the time series for the up-component of the permanent station ‘CHLR’, which is situated in the former mining zone near the town Charleroi, was the trigger (figure 5).

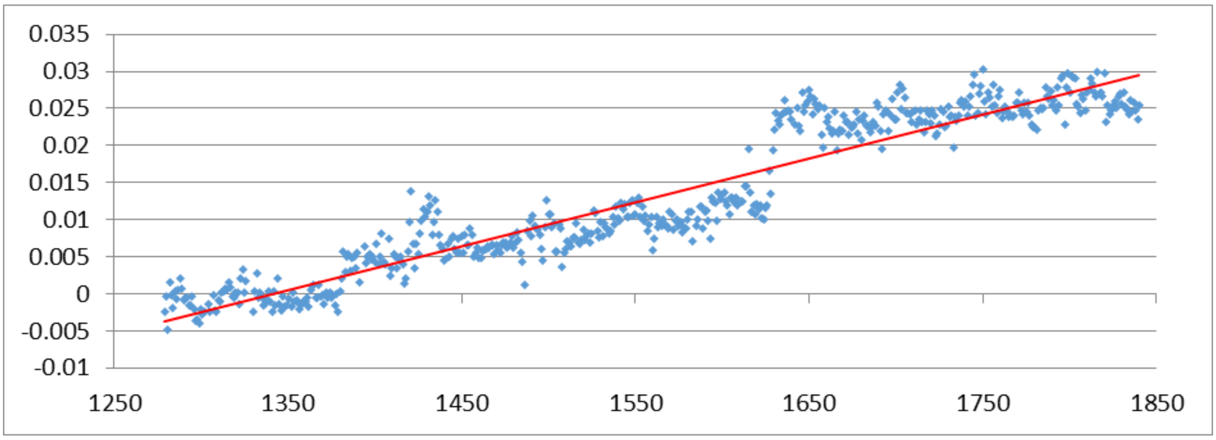

Figure 5: Permanent station 'CHLR' time series of the up component (ETRS89) expressed in m for the period july 2004 – april 2015 (GPSweeks 1249 – 1840)

Acknowledgements

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