Activities and New Initiatives of the EUREF Technical Working Group

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Abstract. The IAG Sub-commission 1.3a EUREF is a joint effort of research agencies and National Mapping and Cartographic Agencies with the goal to define, realize and maintain the European Reference Frame. The EUREF key infrastructures are the EPN (EUREF Permanent Network) and the UELN (United European Levelling Network). The EUREF activities are coordinated by the EUREF Technical Working Group (TWG). This paper describes the main activities of the TWG during the last year.

Keywords. EUREF, ETRS89, EVRS, EPN

1 Introduction

The EUREF activities are coordinated by the EUREF Technical Working Group (TWG) which brings together representatives from both European research agencies as national mapping agencies. The TWG was created at the EUREF symposium in Bern, 1992, and its current member list is given in Table 1. The EUREF TWG is constituted by members elected by the plenary, ex-officio members, honorary members and members in charge of specific tasks. The positions of elected members are filled for terms of 4 years, which are renewable once (see EUREF Terms of Reference, http://www.euref.eu/Overview_of_EUREF/Terms_of_reference/EUREF-ToR-2008.pdf).
Typically, the TWG has three one-day meetings a year: a spring meeting, a meeting just before each annual EUREF symposium (May-June) and a fall meeting. During these meetings, the EUREF goals and their implementation are discussed. These EUREF goals are to define, realize, maintain, provide access and promote the adoption of ETRS89 (European Terrestrial Reference System) and the EVRS (European Vertical Reference System).

The minutes of the TWG meetings are published in the EUREF proceedings, but are also available on-line at the EUREF web site from http://www.euref.eu/euref_twg_meetings.html.

Table 1. Members of the EUREF Technical Working Group.

Members	Agency	Country
Z. Altamimi	IGN/ENSG	France
E. Brockmann	SwissTopo	Switzerland
C. Bruyninx	Royal Observatory of Belgium	Belgium
A. Caporali	University of Padua	Italy
J. Dousa	Geodetic Observatory Pecny	Czech Republic
R. Fernandes	UBI,CGUL, IDL	Portugal
H. Habrich	Bundesamt für Kartographie und Geodäsie	Germany
H. Hornik	Deutsche Geodaetische Kommission	Germany
J. Ihde	Bundesamt für Kartographie und Geodäsie	Germany
A. Kenyeres	FÖMI Satellite Observatory	Hungary
M. Lidberg	Lantmäteriverket	Sweden
J. Mäkinen	Finish Geodetic Institute	Finland
M. Poutanen	Finish Geodetic Institute	Finland
W. Söhne	Bundesamt für Kartographie und Geodäsie	Germany
G. Stangl	Institut für Weltraumforschung	Austria
J. Torres	SPUIAGG, Instituto Geofisico D. Luis	Portugal

2 Recent Activities

The following gives a non-exhaustive overview of the major activities of the EUREF Technical Working Group since the last EUREF symposium held in Gävle, June 2010.

2.1 2.1 Definition and Realisation of the ETRS89

With the goal to have “stable” coordinates, EUREF defined in 1990 the ETRS89 to be coincident with the ITRS (International Terrestrial Reference System) at the epoch 1989.0 and fixed to the stable part of the Eurasian plate. However, in practice ETRS89 coordinates

have been subject to variations. A first type of variations is due to reference frame changes. Indeed, each new realization of the ITRS (i.e. ITRFyy) is followed by a new realization of the ETRS89 (i.e. ETRFyy), and could cause coordinate jumps in the ETRS89. In order to remedy to this, from ITRF2005 on, the TWG decided to use the ETRF2000 as the conventional realization of the ETRS89. The ETRF2000 is thus also adopted in conjunction with the latest release of the ITRS, ITRF2008 (released May 2010, see http://itrf.ign.fr/ITRF_solutions/2008/ for more information).

The mathematical transformation from any ITRFyy to ETRF2000 can be done in a two-step approach using two successive Helmert transformations (ITRFyy → ITRF2000 followed by ITRF2000 → ETRF2000), or can be done by one single 14-parameter transformation (directly ITRFyy → ETRF2000), (Altamimi, 2011). The parameters of all these transformations are available from the Memo by Boucher and Altamimi (2011). To help users to perform the necessary transformations, an on-line transformation tool, which allows transforming between any ITRS/ITRS, ITRS/ETRS89 and ETRS89/ETRS89 realization has been put on-line at http://epncb.oma.be/_dataproducts/coord_trans This tool was updated recently to include transformations to and from the ITRF2008.

A second reason why ETRS89 coordinates may change in time are local geodynamics. A preliminary study of the influence of these geodynamics on the lifetime of ETRS89 coordinates has been performed by the TWG. First results are given in (Caporali et al., 2011).

2.2 Access to the ETRS89

The primary way to access to the ETRS89 is through the EUREF Permanent Network (EPN) managed by EUREF (see Figure 1). Within the last year, 5 new continuously observing GNSS stations joined the EPN bringing the total number of EPN stations to 247. The EPN tracking network is now a multi-GNSS tracking network with 59% of the EPN stations observing both GPS as GLONASS signals; more details are given in (Bruyninx et al, 2011) and at the web site of the EPN Central Bureau (http://epncb.oma.be). The EPN provides full access to the ETRS89 through its publicly available GNSS observation data and the regularly updated ETRS89 coordinates of its stations (http://epncb.oma.be/_trackingnetwork/coordinates/).

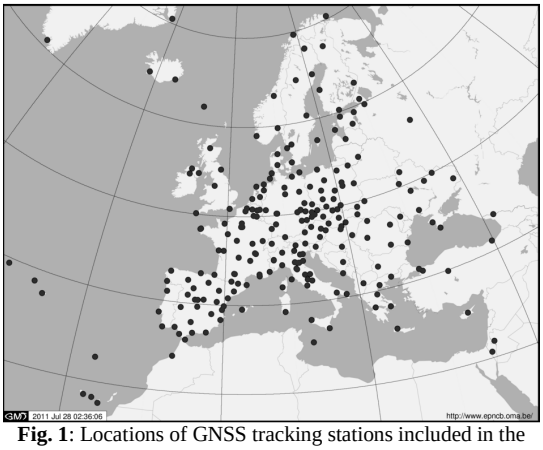

Fig. 1: Locations of GNSS tracking stations included in the EUREF Permanent Network (status May 2011)

Using the 15-weekly updates of the EPN site coordinates, the EPN sites are classified in two classes :

- Class A stations with positions at the 1 cm accuracy at all epochs of the time span of the used observations
- Class B stations with positions at the 1 cm accuracy at the epoch of minimal variance of each station

Following the "Guidelines for EUREF Densifications" (Bruyninx et al, 2010), only Class A EPN stations can be used for densifications of the ETRS89. Today 202 EPN stations are classified as Class A and the generation of new updates is postponed until a final solution based on a reprocessed EPN solution (see section 2.5) can be generated (expected for the fall of 2011). A first preliminary cumulative solution based on the first results of the EPN reprocessing has been presented in Kenyeres (2011).

2.3 Promotion of Adoption of the ETRS89

Since 1989, many European countries have defined their national reference frames in (or closely aligned to) ETRS89 by calculating national ETRS89 coordinates following the EUREF guidelines. EUREF recently send out a new questionnaire to the NMCA on the usage of the ETRS89 and EUREF products in their country and the first results have been presented in Ihde et al. (2011). Up to now, 60% of the contacted countries replied to the questionnaire and about 85% stated that they adopted the ETRS89 in their country. 10% were still in the process of adopting it.

The national ETRS89 coordinates, adopted by the different countries, can differ from each other due to differences in datum definition: they are often

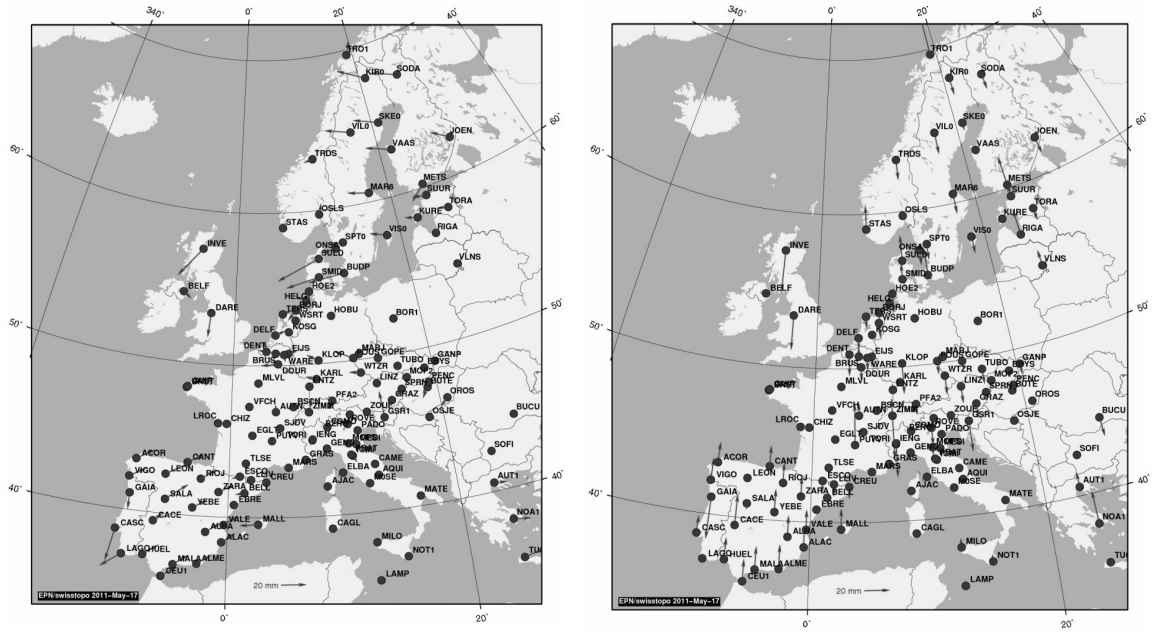

Fig. 2: Difference between ETRS89 coordinates adopted in the different countries and the latest EPN cumulative coordinate solution.

based on different ETRFyy frames and each of them refers to different observation times.

The differences between the ETRS89 adopted in each of the different countries wrt the most recent estimates of the ETRS89 coordinates of the EPN stations is monitored on a regular basis by EUREF (Brockmann, 2010). Since 2010, Bulgaria, Romania and Lithuania have included their ETRS89 coordinates in the data base and the information for the Netherlands and Sweden has been updated. The results of the comparison show an agreement of a few cm (see Figure 2) and are available from http://www.epncb.oma.be/_trackingnetwork/coordinates/stationcoordinates4onestation.php?station=XXXX (with XXX=4-char identification of the EPN station).

2.4 EPN Real-time Analysis Project

The EPN Project on "Real-time Analysis" (http://epncb.oma.be/_organisation/projects/RT_analysis) focuses on the processing of the EPN real-time data (almost half of the EPN stations) to derive and disseminate new (or extended) real-time GNSS products. Since some months, the EPN regional broadcaster at BKG (http://www.euref-ip.net) is now also broadcasting satellite orbits in the ETRS89 (ETRF2000 frame). Using these orbits, users can directly derive in real-time coordinates in the ETRS89 at the few dm-level. More details are given in (Söhne, 2011).

2.5 EPN Reprocessing Project

The aim of the EPN reprocessing project is to obtain improved station coordinates, residual position time series and tropospheric parameters for the EPN stations. The EPN Local Analysis Centers (LAC) participating to this project use different software packages like BERNESE, GIPSY, and GAMIT. A first preliminary version of the reprocessing has been finalized (Habrich, 2011 and Völksen, 2011) and the stacking has been performed using CATREF (Kenyeres, 2011). Final results of the EPN first reprocessing (REPRO1) are expected for the fall of 2011.
More information the EPN reprocessing is available from http://epn-repro.bek.badw.de/.

2.6 New EUREF Campaigns

Three EUREF densification campaigns have been validated by the TWG in the last year; they concern Serbia (EUREF Serbia 2010, Veljkovic et al., 2011), the Republic of Macedonia (EUREF MAKPOS 2010, Dimenski et al., 2011) and the Faroe Islands (EUREF Faroe Islands 2008, Khan et al. 2011).

2.7 EVRF2007

The European Vertical Reference Frame EVRF2007 is the common European height reference, as recommended by INSPIRE. The

EVRF2007 is based on the geopotential numbers and normal heights provided by 27 European countries. 13 well-distributed datum points have been used to fit the EVRF2007 to the level of the EVRF2000. The EVRF2007 has been distributed to the National Mapping Agencies in the contributing countries in 2010 together with the transformations between the EVRF2007 and the national height systems. The countries have been asked to check their transformation and if the values for their countries can be made publically available together with the on-line transformation to EVRF2007. The result is available at http://www.crs-geo.eu (more details in Sacher et al., 2011).

Future developments of the EVRF2007 focus on the inclusion of the first order leveling network of Russia, new networks from Spain, Ukraine and Latvia, and the improvement of the closing of the Baltic Ring.

2.8 EUREF Partnership with CERGOP

In addition to the already existing partnerships with EUMETNET and EuroGeographics, EUREF and CERGOP (Central European GPS Geodynamic Network Consortium) signed a new Memorandum of Understanding (MoU) at EUREF symposium at Chisinau, Moldova. The general goal of this MoU is to create the conditions to facilitate the data exchange and to promote the increase in the co-operation between EUREF and CERGOP to contribute to the densification of the European GNSS network for reference frame definition and geokinematical applications, and to support the ECGN (European Combined Geodetic Network) project.

2.9 New EUREF web site

The EUREF web site, accessible through http://www.euref.eu/, has been completely restyled and updated.

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