

Activities and New Initiatives of the EUREF Technical Working Group

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1 INTRODUCTION

The EUREF sub-commission was created at the IUGG (International Union of Geodesy and Geophysics) General Assembly held in Vancouver in 1987 in order to deal with these future needs of precise basic reference networks for both practical and scientific applications. EUREF was created under the umbrella of the IAG (International Association of Geodesy) and today, as can be seen from Figure 1, EUREF is embedded in IAG sub-commission 1.3 on “Regional Reference Frames”. The EUREF activities are coordinated by the EUREF Technical Working Group (TWG) which brings together representatives from both research agencies and mapping agencies. The TWG 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 3 one-day meetings a year: a spring meeting, a meeting just before the EUREF symposium (May-June) and a fall meeting. During these meetings, in addition to the general EUREF policy and its implementation, also technical issues related to the ETRS89 (European Terrestrial Reference System), EVRS (European Vertical Reference System), etc... are discussed. More information on the meetings of the EUREF Technical Working Group is available from http://www.euref.eu/html/twg_meetings_documentation.html.

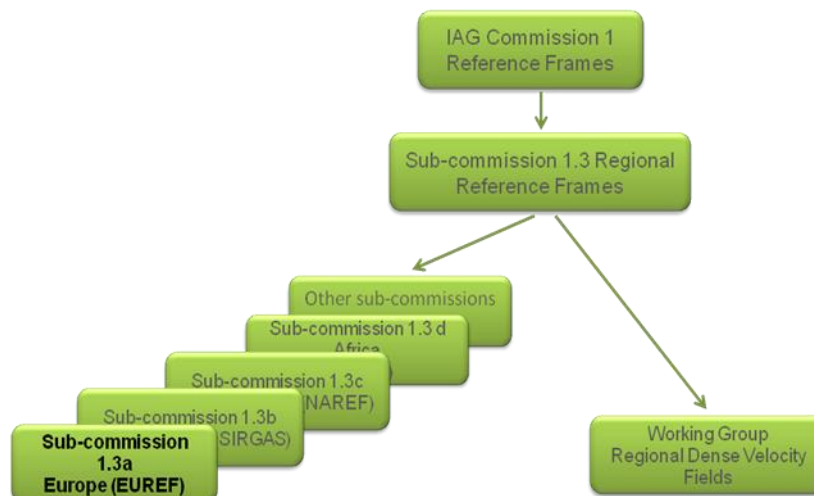


Figure 1: Structure of IAG sub-commission 1 on “Regional Reference Frames”

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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 Geofísico D. Luis	Portugal

Table 1: EUREF TWG member list (status May 2009)

2 COOPERATIONS

To achieve its objectives, EUREF closely collaborates with different organizations:

- In June 2007, a Memorandum of Understanding was signed between EUREF and EUMETNET (Network of European Meteorological Services) enabling the usage of the EPN (EUREF Permanent GNSS Network) RINEX data by the meteorological agencies and the usage of meteorological data by EUREF.
- In August 2007, a Memorandum of Understanding was signed between EUREF and EuroGeographics providing the necessary framework to work on common projects like e.g. INSPIRE (see 3.8).
- Within the frame of the EPN, EUREF is also closely working together with the International GNSS Service (IGS). In a spirit of cross-fertilization, EUREF members are participating to the IGS real-time Pilot Project, the IGS GNSS Working Group, the IGS antenna calibration Working Group and the IGS Infrastructure Committee. In addition, IGS standards are used for the routine EPN operations.

3 RECENT ACTIVITIES

EUREF has been developing activities related to the establishment and maintenance of the ETRS89 and the EVRS. The ETRS89 provides a geocentric, three-dimensional homogeneous reference system for the whole of Europe while the EVRS does the same for the height. The following gives an (incomplete) overview of the major activities of the EUREF Technical Working Group since the last EUREF symposium held in Brussels, June 2008.

3.1 Conventional frame ETRF2000

The ETRS89 is linked to the International Terrestrial Reference System (ITRS): to each ITRS realization (i.e. ITRF_y) corresponds an ETRS89 realization (ETRF_y) and the relation between the two systems is given in the Memo of Boucher and Altamimi which is updated at each ITRF release. When the ITRF2005 was released, the associated ETRF2005 coordinates showed in Europe a cm-level coordinate shift with

respect to coordinates in the ETRF2000. For more details in the origin of these coordinate shifts we refer to (Altamimi, 2009). To remedy these coordinate shifts, the EUREF Technical Working Group proposed at its annual symposium held in Brussels, June 2008, to the EUREF user community not to use the ETRF2005, but instead to use the ETRF2000 as the conventional frame for the ETRS89. In practice this means that instead of converting each ITRFyy to its associated ETRFyy, the TWG recommends to convert it to ETRF2000. For example, it is recommended to convert the ITRF2005 (as well as future ITRFyy releases) to ETRF2000. This mathematical transformation can be done in a two-step approach using two successive Helmert transformations (ITRFyy \rightarrow ITRF2000 followed by ITRF2000 \rightarrow ETRF2000), but can also be done by one single 14-parameter transformation (directly from ITRFyy \rightarrow ETRF2000). The parameters of all these transformations are available from the Memo by Boucher and Altamimi, 2008 which was updated on Nov. 24, 2008.

3.2 ETRS89 Working Group

As mentioned before, the EUREF TWG is the platform where technical discussions related to EUREF are held. These discussions have lately shown the need for a clarification of, and education on, the definition of the ETRS89 as well as its usage within the EUREF community. Within that frame, the importance to map the ETRS89 user community was emphasized. The Working Group on “Future Development of ETRS89” has been created at the EUREF Technical Working Group Meeting held in Budapest, February 26-27, 2009. The WG is chaired by M. Lidberg and has two main objectives:

- Clarify the definition of ETRS89 and its target groups,
- Propose to the TWG approaches for the long-term maintenance of the ETRS89.

More information on the ETRS89 WG is available from (Lidberg et al, 2009).

3.3 Up-to-date ITRS/ETRS89 Coordinates of EPN Stations

To take full advantage of the EPN and its most recent GNSS observation data, the EUREF TWG decided at its meeting of Nov. 3-4, 2008 in Munich, to release regular official updates of the ITRS/ETRS89 coordinates/velocities of the EPN stations. A first step in this process consisted in a densification of the ITRF2005 using all EPN data up to Dec. 2005 (the same observation period as covered by the ITRF2005). This release (Kenyeris, 2008) has been distributed to the EUREF community through EUREF mail 4142 on Dec. 12, 2008. The second step, is consisting in updating each 15 weeks the original densification by a new EUREF realization of the ITRF. The advantage of regularly updating the realization is that the most recent EPN results are taken as much as possible into account. The update rate of 25 weeks has been decided at the EUREF TWG meeting in Florence, May 26, 2009. In order to provide the most reliable products, the EUREF TWG also decided to categorize the EPN stations taking into account the station quality (Kenyeris, 2009):

- 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

The coordinates are available from http://www.epncb.oma.be/_trackingnetwork/coordinates/.

3.4 Guidelines for EUREF Densifications

A first set of guidelines describing how to compute EUREF densifications (also known as “EUREF Campaign Guidelines”) using IGS products was presented at the 1994 EUREF symposium in Warsaw (Gurtner, 1994). In 1997, these guidelines were updated (Gurtner et al, 1997) in order to make full use of the IGS network and its European densification. Last year, it has become clear that the previous guidelines for EUREF densifications needed updating. Firstly, the minimal constraints (now widely accepted as the optimal method to define the datum of a geodetic network while preserving the original

characteristics of the solution) are not mentioned in the original guidelines. Secondly, the original guidelines mainly use ITRF sites as reference stations for datum definition. Today, reliable and up-to-date coordinates for the EPN stations are available (see 3.2) and allow using the EPN stations as reference stations. The new “Guidelines for EUREF Densifications” have been endorsed by the EUREF TWG at its meeting in Florence on May 26, 2009 and are available from ftp://epncb.oma.be/pub/general/Guidelines_for_EUREF_Densifications.pdf. The document outlines the procedure recommended for computing station coordinates in the ETRS89, in particular in the framework of national densifications of the ETRS89. In addition, it also describes how to proceed to request a EUREF validation of the densification.

3.5 EUREF Permanent Network

The EUREF TWG has continued to manage the EUREF Permanent Network. Since last year, 14 new EPN stations joined the EPN bringing the total number of EPN stations to 223. The EPN tracking network is slowly preparing for multi-GNSS tracking with a 15% increase of the number of GPS+GLONASS tracking stations within the last year. Also the number of EPN stations equipped with antenna/radome pairs with absolute calibrations is growing, demonstrating the importance of strategic guidelines aiming at slowly upgrading the EPN. Recent upgrades to the EPN Central Bureau monitoring system include dedicated web pages with the comparison of the LAC solutions with respect to the combined EPN solution, a new on-line site log submission tool and a data centre dedicated to reprocessing (Bruyninx et al, 2009).

Taking into account that already 47% of the EPN stations are streaming real-time GNSS data, the EUREF TWG decided at its meeting in Munich, 3-4 Nov. 2008, to create a new EPN Special Project (SP) on “Real-time Analysis”, chaired by W. Söhne. This new SP focuses on the processing of the EPN real-time data to derive and disseminate new (or extended) real-time GNSS products. At the same time the SP aims at increasing the reliability of the EPN real-time data flow and decreasing the workload on today’s EPN broadcasters. More information of the EPN “Real-time Analysis” Special Project is available from http://www.epncb.oma.be/_organisation/projects/RT_analysis/ and Söhne, 2009.

A pilot reprocessing of the complete EPN has been done in 2008 by the MUT (Warsaw) and ROB (Brussels) analysis centres clearly demonstrating an improvement of the EPN time series which were previously inconsistent due to the analysis and modeling changes. In order to coordinate the reprocessing of the full EPN between all EPN Local Analysis Centres a new EPN Special Project was created at the EUREF Technical Working Group meeting held in Budapest on Feb. 26-27, 2009. The Special Project is chaired by C. Völksen. More information on the objectives of this Special Project as well as its work plan is available from <http://epn-repro.bek.badw.de/> and (Völksen, 2009).

3.6 National ETRS89 Coordinates of EPN Stations

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 (see 3.4). These national ETRS89 coordinates adopted by the different countries can differ from each other due to differences in datum definition: they are often based on different ETRFyy frames and each of them refers to different observation times. To have an idea of the agreement between the different national ETRS89 realizations, the EUREF TWG came up with the idea to compare these coordinates with the regularly updated ETRS89 coordinates of the EPN stations (see 3.2) which provide today a homogeneous set of ETRS89 coordinates.

The results of an initial comparison, using just 15 countries, were presented at the EUREF symposium in Florence, May 27-30, 2009 by Brockmann (Brockmann, 2009) and show an agreement of a few cm. The next step will be to extend this comparison to all European countries using the ETRS89 and to make the results of the comparison available through the web site of the EPN Central Bureau.

3.6 EUVN_DA

The EUVN densification action (EUVN_DA) created, in cooperation with EGGP (European Gravity and Geoid Project) and with the support of the European mapping agencies, a regional GNSS/leveling database including 1505 GNSS/leveling points. The submitted data were carefully tested and transformed to common reference frames (ETRS89/GRS80 for the GNSS and EVRS2007/UELN for the leveling data). The transformation of all data into the zero-tidal system already allowed eliminating part of the systematic differences between several countries. However, the most recent analysis of the EUVN_DA data still reveals several problems and inconsistencies. The greatest challenge of the EUVN_DA project is now to understand these problems which will require a close cooperation of all related partners. More details are available from (Kenyeris et al, 2009).

3.7 EVRF2007

Resolution No.3 of the 2008 EUREF symposium in Brussels recommended the adoption of EVRF2007 as new realization of the European Vertical Reference System and proposed to recommend to the EC the EVRF2007 as the vertical reference for pan-European geo-information. Following an agreement between all involved the countries (except one), the EVRF2007 results (adjusted heights and coordinates, but no observation data) have since then been delivered to these countries. This progress marks an important step towards a common high precise vertical system for the European continent.

3.8 INSPIRE

The European Commission launched in 2005 a Call for Expression of Interest for the development of INSPIRE, the Infrastructure for Spatial Information in the European Community. The goal of INSPIRE is to deliver to users from different communities an interoperable and integrated European spatial information service. Because the definition of a common geodetic reference system for Europe is a basis for a European geo-spatial infrastructure, the EUREF TWG decided to register as a SDIC (Spatial Data Interested Community) within INSPIRE and nominated two experts for the development of the Draft Implementing Rules (DIR) related to Coordinate Reference Systems. INSPIRE was adopted in March 2007 by the Directive 2007/2/EC of the European Parliament and the Council. The Directive defined the Themes and grouped them in three Annexes. Two of the themes within Annex I “Coordinate Reference Systems” (CRS) and “Geographical Grids Systems” (GGS) were of concern to EUREF. As INSPIRE asked for experts to work on the development of the Implementing Rules (IR) of these themes, at the TWG meeting of March 31- April 1, 2008 in Helsinki, the EUREF TWG asked the same experts to continue, and another J. Torres from the EUREF TWG was invited as facilitator (coordinator). The EUREF experts reported their work at following TWG meetings and got suggestions of the TWG for the improvement of the IR. In this way the reference systems adopted by EUREF are incorporated in the INSPIRE Implementing Rules and will become a law in the Member States of the European Union. More details on this topic are available from (Torres et al, 2009).

OUTLOOK

The EUREF TWG is builds on continuous work performed by TWG members with the support of the complete EUREF community. Next to the continuation of the EUREF core tasks outlined in this paper, future plans of the EUREF TWG will concentrate on the development of an implementation plan to respond to the rising need for more outreach and education on EUREF products. The new ETRS89 WG, the planned modernization of the EUREF web site, and the development of a new on-line (web-based) EUREF campaign data base, are already first steps in that direction.

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