



EUREF SYMPOSIUM, BRATISLAVA, SLOVAKIA, JUNE 02-05, 2004

NATIONAL REPORT OF BULGARIA

G. Milev, K. Vassileva, T. Beljashki, G. Petrov, G. Valev, M. Minchev, T. Bochev

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1. General

Development of the EUREF and the main related activities with the Bulgarian participation after the EUREF symposium in Toledo, Spain can be outlined in several aspects.

- **Further realisation of the EUREF on the territory of Bulgaria;**
- **Participation and integration within the framework of the European and IAG projects and activities;**
- **Specific EUREF activities.**

2. Permanent stations, regulations, national GPS network

2.1. Permanent stations

- **Permanent Station SOFI has operated as an EPN/IGS control and operation station since 19.05.1997;**
- **For about of 7 years of operation of the station SOFI systematic changes in position (north and east) of about 20 mm have been occurred and in height (up) – within 30 mm for a period of 1 year**
- **Establishment of two more permanent stations on the territory of Bulgaria in 2004 according to the program of the CERGOP-2 project.**

2.2. Regulations

- **Implementation of EUREF in Bulgaria is regulated by an Act of the Council of Ministers**
- **Bulgarian Geodetic System 2000 (BGS2000) materialised by a network of geodetic points**
- **Creation and maintainance of the cadastre map of the country;**
- **Introducing of regulations for application BGS2000**
- **Law for the classified information in 2002.**

2.3. National (control, state) GPS network

- **15 EUREF – BULREF points (fig. 2) have been adopted as a zero order control network of the country;**
- **Improvement of the for the National GPS network**
- **Realisation of the project in two stages:**
- **First stage - establishment of 110 points;**
- **Second stage - the network points will be increased up to 370.**



Fig. 2: EUREF points on the territory of Bulgaria

1. Stability analysis of BULREF

- **The assessment of the EUREF point stability in Bulgaria is achieved by activities on other projects.**
- **15 BULREF stations were included in the GPS CEGRN03 in 200.**
- **Permanent stations at the University of Thessalonike at the University of Belgrade were included as well during the time of the CEGRN03 campaign**
- **4 Bulgarian CERGOP stations were involved in the CEGRN03 GPS campaign. They have been connected to outside reference GPS IGS stations (fig. 3).**
- **Preliminary obtained coordinates (table 2) by Bernese software, V 4.2.**

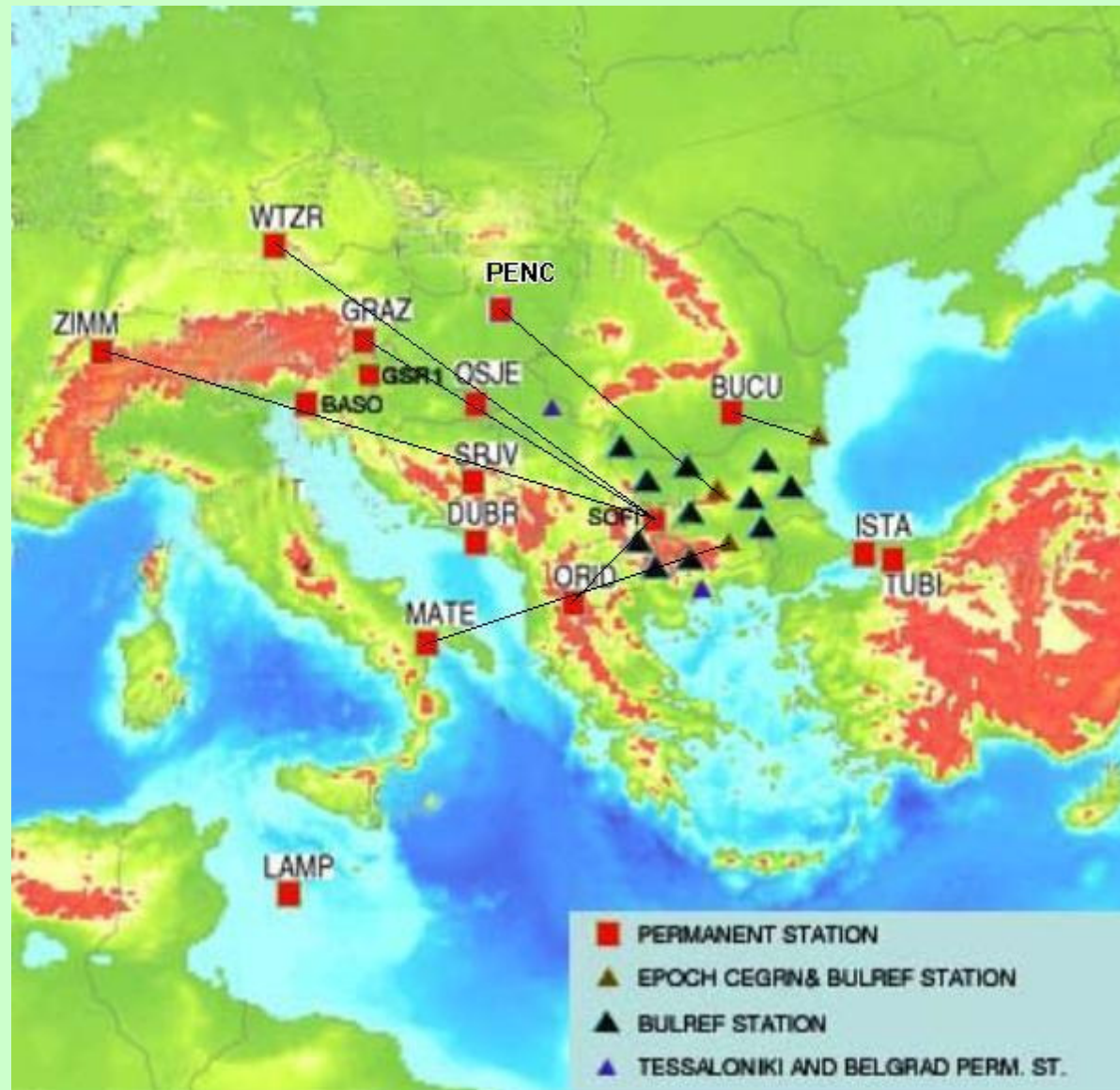


Fig. 3. Connection of BULREF03 to the outside IGS Permanent Stations

**Table 2: ITRF2000 coordinates, epoch 2003.46 of CEGRN03-BG
and BULREF03 points**

No	STATION NAME	ITRF2000 COORDINATES, EPOCH 2003.46		
		X (M)	Y (M)	Z (M)
1	SOFI	4319372.1120	1868687.7536	4292063.9101
2	KAVA	4083131.3038	2205288.9878	4361084.3101
3	BURG	4168849.6177	2164801.0940	4300556.5824
4	GABR	4227589.7382	1996278.4463	4324909.6957
5	GULI	4203554.2249	1931470.8204	4376301.9150
6	KERM	4220205.2483	2088014.4250	4288433.5952
7	HARM	4280049.8303	2073328.4380	4236244.8867
8	PANA	4291702.7809	1925107.0433	4295520.0964
9	BERK	4289512.4960	1832981.7195	4337413.3765
10	SAPA	4342939.5981	1865518.9626	4269392.1713
11	VIDI	4233068.3310	1773730.1036	4414410.5358
12	SHUM	4139915.3225	2084445.7004	4367224.3467
13	MAMA	4230987.5236	2135869.7126	4254451.2118
14	PETR	4402938.8373	1880255.0774	4201276.2735
15	SATO	4367373.4365	1936491.7194	4212946.0551

4. European combined geodetic network (ECGN) and Bulgarian participation

- **Concept for a combined network on the territory of Europe on the base of collocation of GPS stations, absolute gravity stations and levelling benchmarks has been also accepted by Bulgaria and it declares its participation.**
- **Project for realisation of ECGN is presented in the fig. 4;**
- **ECGN in Bulgaria - result from the integration of works on the projects EUPOS, CERGOP-2 and National Gravity System in Bulgaria;**
- **Works on the organisation and realisation of ECGN in Bulgaria are in progress.**



Fig. 4. ECGN points in Bulgaria

4. DGNSS - EUPOS in Bulgaria

- Multifunctional differential GPS systems (DNSS) have been introduced in many countries in the world and especially in Europe;
- Satellite system for position determination in Germany SAPOS[®] (Satellite Positioning Service);
- Since 2002, with active participation of Bulgaria the project *EUPOS* (*European Position Determination System*) has been developed.
- *EUPOS* is a regional extension of SAPOS[®] for Europe;
- *EUPOS* project is an initiative of 13 central and eastern European countries for establishment a unified DGNSS base infrastructure for Central and Eastern Europe;
- Networks of active reference stations will be established on the base of common reference system ETRS89; unified data formats and international standards;
- *EUPOS* will provide an accuracy of 1-3 m up to 2 cm in real time and higher accuracy in post processing;
- Several pilot projects are in process of realisation.

4. European vertical system and connection of Bulgaria

**Bulgaria became the 26th European country which was connected to the UELN .
The main stages of accomplishment of this connection are as follows:**

- ♦ **Identifying of benchmarks from the Romanian levelling network used in the height realisation between Bulgaria and Romania.**
- ♦ **Transformation of heights of the identified border Romanian benchmarks into the Bulgarian height system and determination of height differences.**
- ♦ **Determination of geopotential numbers of the State levelling 1st order benchmarks.**
- ♦ **Adjustment of the Bulgarian State levelling 1st order network in geopotential system based on the fundamental underground point No28 (Varna) and analysis of the obtained parameters.**
- ♦ **Incorporation of the Bulgarian State levelling network to the UELN by six levelling connections with Romania.**
- ♦ **Adjustment of the incorporated Bulgarian Levelling network to the UELN in geopotential system and in normal heights system Amsterdam tide gauge is used as reference.**
- ♦ **Obtained the heights of nodal points.**
- ♦ **Calculation of the heights of all benchmarks from the Bulgarian State levelling 1st order network.**
- **A posteriori mean standard deviation of the Bulgarian levelling network from the adjustment of the united European network is 1.18 mm/km, what makes it 12-th in the accuracy range of the participated 24 levelling networks.**

7. Activities related to EUREF

- **Bulgaria participates actively in the work carried out within the framework of IAG Section V “Geodynamics”;**
- **Central European Regional Geodynamic project financially supported by the FP5 of the EU under the name CERGOP–2 started on the 01.04.2003;**
- **Work groups created within the framework of the project for the geotectonic analysis of the region of Central Europe;**
- **New special group – Geodynamics of the Balkan Peninsula.**
- **Participation of Bulgaria in this project is based on four points from the EUREF – BULREF system;**
- **During the period June 16-21, 2003 the first GPS CEGRN03 campaign of the CERGOP-2 was carried out;**
- **All BULREF stations were measured and a preliminary processing was accomplished;**
- **A special processing strategy is accepted for the measurements in Bulgaria and in the neighboring countries**
- **First activity of the mentioned group was the Special symposium “Geodynamics of the Balkan Peninsula” within the framework of the 3rd Balkan Geophysical Congress 24-28 2002, Sofia, Bulgaria;**
- **Generalised picture of the geodynamics of the Balkans will be presented as a generalised study – monograph.**

7. Activities related to EUREF – con't

- **Three absolute gravity stations have been established on the UNIGRACE projects of the COPRNICUS program of EC where the gravity values have been determined;**
- **Geopotential numbers of the points included in the EUVN have been also determined;**
- **Absolute gravity measurements are foreseen for the ECGN points and for new points related to the project “National Gravity System of Bulgaria” this year;**
- **Works on the project for the cadastre and the property register of the Republic of Bulgaria with the support of the World Bank are going on;**
- **Activities related to the reinstate of the property, geodynamic investigations in selected regions of the country, GPS in engineering surveying and many others;**
- **Preparation for printing of the monograph “European reference system in Bulgaria” is at the last stage. It is expected the publishing of it to be realised this year.**

8. Conclusion

Bulgaria participates actively in the realisation of EUREF on the territory of Bulgaria, in the further development of EUREF and in the main activities related to it, in the integration within the framework of European and IAG projects and activities, and other projects and activities of EUREF.

THANK YOU FOR YOUR ATTENTION !