European Geosciences Union
General Assembly 2012
Vienna, Austria, 22-27 April, 2012

IMPROVED ACCURACY OF THE REFERENCE NETWORK OF BOSNIA AND HERZEGOVINA

Medžida Mulić[1] & Asim Bilajbegović[2]

EGU2012-13406/Z222

ABSTRACT

Availability of the reprocessed IGS05 precise orbits opened the door to the possibilities of the re-processing of two GPS campaigns in the Bosnia and Herzegovina, organized in the year 2000 and 2005. The data of the GPS observations processed using the Bernese software, version 5.0. Results were in the IGS05 reference frame. Corrections for the delays of GPS signals passing through the troposphere were estimated for every 2 hours, and their projection on the horizon at the height of the observed stations was calculated using wet Neill mapping functions, but horizontal gradients were estimated for every 4 hours. Results of reprocessing shows improved accuracy.
It could be generally said that the accuracy of the all three components of the positions were within the 10 mm and accuracy of the velocities for the identical stations were about 1mm/year, which were evaluated in the combined campaign. Coordinates of the stations from combined campaign were transformed to ETRF2000.

1. INTRODUCTION

In its effort to keep pace with contemporary developments in Europe, Geodetic administrations in Bosnia and Herzegovina organized GPS campaign to densify the EUREF network observed in year 1998. The campaign is called BIHREF2000 (B&H Reference Frame), and lasted five days, when more than 20 new GPS stations were observed for the two daily sessions, and data were processed using the Bernese software. The resulting coordinates in ITRF97 and ITRF2000 were transformed into ETRS89 coordinate system. The accuracy of the coordinates was not satisfying the required accuracy of 1 cm for all three components of the position for all stations. In the meantime, the campaign CEGRN05 (Central European Geodynamic Reference Network) organized in the framework of the geodynamical project CERGOP2/Environment (Central European Regional Geodynamical Project), when 14 stations were observed in Bosnia and Herzegovina. Among observed stations, there were 8 same stations from the BIHREF2000 campaign. Availability of the daily observations for B&H networks is shown in the Table 1.
Availability of the reprocessed IGS05 precise orbits (IG1) opened the door to the possibilities of the re-processing of GPS campaigns in the Bosnia and Herzegovina in order to improve resulting parameters accuracy, ie. to achieve the required accuracy of 1 cm for all three components of the stations. Distribution of the GPS stations in B&H is shown at Figure 1.

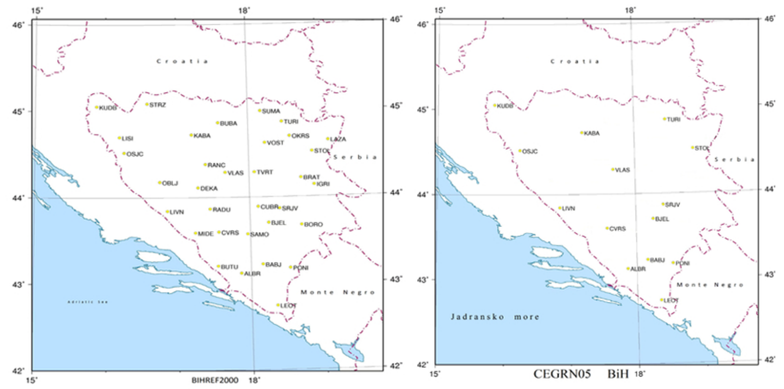

Fig. 1: Bosnian GPS stations in BIHREF 2000 and CEGRN2005 campaigns

2. PROCESSING STRATEGY

The data of both campaigns were evaluated at IGS05 separately. In order to get an accurate ambiguity solution for each campaign, the improvement of a priori coordinates was repeated so long, until the difference between the estimated and introduced a priori coordinates reached a value less than 3 cm for each coordinate component. Fig. 2 gives a general description to the strategy of data processing applied for both campaigns using Bernese software, version 5.0. Selected IGS reference stations showed at Figure 3. Table 2 shows summary of data evaluation giving parameters used for data processing.

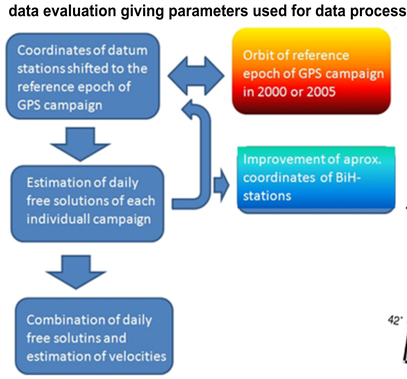

Fig. 2: Strategy for data processing

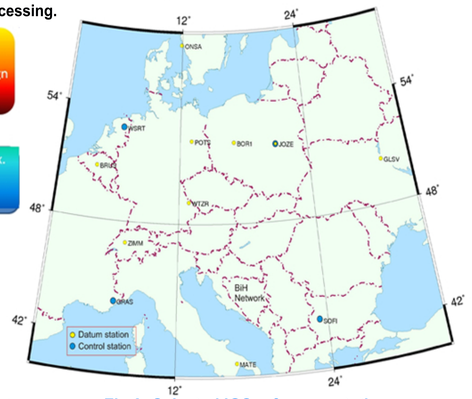

Fig.3: Selected IGS reference stations

Table 2: Parameters applied in the processing within both campaigns.

Parameter	Processing model and algorithms
Cut of angle	10°
Sampling rate	30 s
Orbit	IGS05
Earth's rotation parameter	Per day
Ocean loading model	FES2000
Tidal effects	IERS Conventions 2000
Precesion-Nutation model	IAU2000
Gravity Field	EGM96
Third-Body	JPL Planetary ephemeris DE200
Earth shadow model	Penumbra
Eccentricities of antennas	ARP eccentricities from RINEX files of data
PCV	Phase center variations of antennas from GPS week 1627
Pseudo distances	For detection of clocks of satellites and receivers for each epoch
Carrier phase data	For formation of double differences
Ambiguity solution	Quasi ionosphere-free model
Signal delay in the troposphere	Computation of a priory delay in the troposphere using the model of Saastamoinen, and projection to the height of stations with the Neill mapping function; Estimation of troposphere parameters using model Neill. Linear estimation the wet part of the troposphere delay for each hour, gradients per 4 hours.
Daily free solutions	Ionosphere-free linear combination L3 applying a standard deviation for each component of coordinates of 1.0 m.
Datum of estimated station coordinates	Weighting of coordinates of 8 IGS stations (BOR1, BRUS, GLSV, MATE, ONSA, POTS, WTZR, and ZIMM) at the epoch of the individual campaign considering a standard deviation of 0.1 mm for each component of coordinates of selected datum stations.

3. RESULTS

3.1. Daily solutions

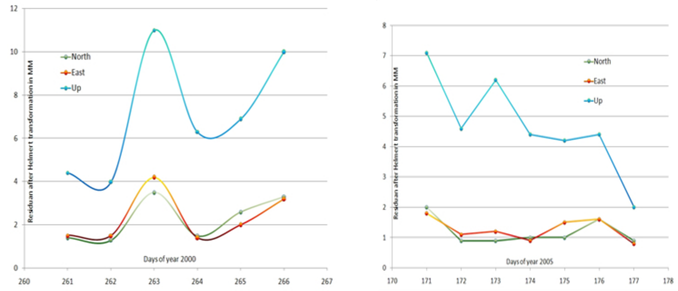

Fig. 4: Daily reputability of BIHREF2000 and CEGRN2005 in BiH.

3.2. Quality of datum stations

After the transformation of the reference coordinate of the selected 9 datum stations from IGS05 into ITRF2005 for the epoch of the combined (daily) solutions, it was detected that the datum station JOZE has a large residuals. This station was excluded from the list of datum stations and a new conversion from the realization IGS05 into the realization ITRF2005 was conducted with the other 8 datum stations.

3.3. Accuracy of the estimated coordinates in IGS05

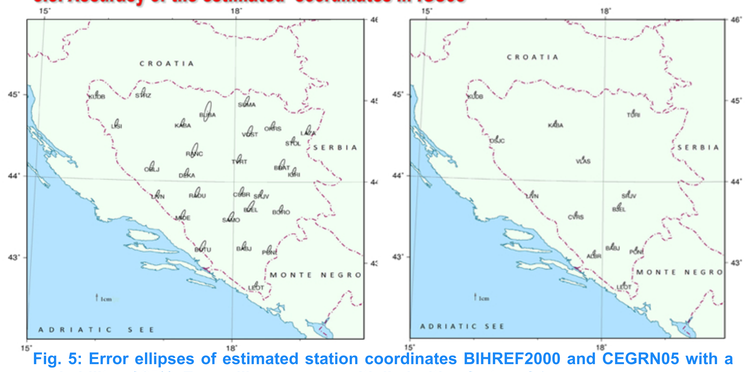

Fig. 5: Error ellipses of estimated station coordinates BIHREF2000 and CEGRN05 with a probability of 95%. Error ellipses were multiplied with a factor of 4.

3.4 Combined campaign

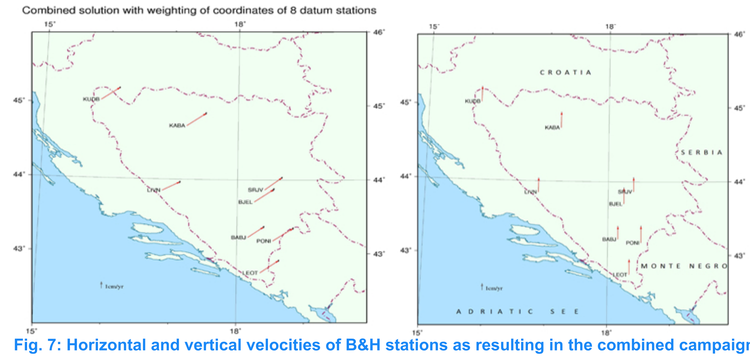

Fig. 7: Horizontal and vertical velocities of B&H stations as resulting in the combined campaign

[1]University of Sarajevo-Faculty of Civil Engineering-Department of Geodesy
e mail: medzida_mulic@gf.unsa.ba; medzida_mulic@yahoo.com
[2]Fakulät Geoinformation Dresden (bilajbegovic@htw-dresden.de)

Acknowledgments

Sincere thanks from first author goes to IGG TU Vienna and to Prof. Dr. Harald Schuh for the grate support and warm hospitality.
Special gratitude goes to Prof. Dr. Robert Weber for his time and scientific supervision during my stay at IGG.

Bibliography

Mulić, M. (2012): Istraživanja uticaja ITRF realizacija na koordinate, njihovu tačnost i određivanje vektora brzina GPS tačaka na području BiH, Građevinski fakultet Sarajevo.

4. CONCLUSION

Benefit of the availability of the reprocessed IGS05 orbits (IG1) used for re-processing of the B&H campaigns resulted in the improved accuracy of the realization of the geodetic reference network of Bosnia and Herzegovina. It could be generally said that the accuracy of the all three components of the positions were within the 10 mm and accuracy of the

Expectation

We expect further improvements in the accuracy that can be achieved through re-processing same data, which can be possible when IGS08 reprocessed orbit would be published. Also, we expect that the application of new achievements in the troposphere modeling, ie. using pressure and temperature from Global Pressure and Temperature Model (GPT) and projection to the horizon of the height of observed stations with the Global Mapping Function.