National report of Croatia

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Abstract. This national report gives brief layout of the fundamental geodetic works in the Republic of Croatia having been carried out since the last EUREF meeting. Also in paper some future activities concerning fundamental geodetic works and CROPOS system were presented.

Keywords. CROPOS, HTRS96, HVRS71, unique transformation model T7D, TTG

1 Introduction

CROPOS system has become in just two years of operation an inevitable positioning service in the performance of the daily tasks of geodetic and cadastral system. The reason is high reliability and quality of services enabling the user to perform field survey in a simpler and more economical way. On January 3^{rd} 2011 State Geodetic Administration was introduced new on-line transformation service of CROPOS system - CROPOS VRS HTRS96 with the main objective to distribute the data to the users in the new official systems directly from CROPOS measurements. In that way is enabled usage of new official height datum HVRS71 (with implementation of new geoid model HRG2009), and at the same time new official plane cartographic projection HTRS96/TM. From March 31^{st} 2011, upon the decision by the Director-General, has been implemented new uniform transformation model T7D into official usage and currently is in testing phase integration of the transformation model into the CROPOS system that will be realized through the new CROPOS service CROPOS VRS HDKS. With the main goal to familiarize the geodetic and wider public with the implementation of the new, official geodetic datums and plane cartographic projections of Republic of Croatia that are enabled through the CROPOS, as well as introduction of application of new official unique transformation model T7D, State Geodetic Administration and the Faculty of Geodesy of the University of Zagreb, in cooperation with the Croatian Chamber of Licensed Geodetic Engineers and Croatian Geodetic Society, organized the 2nd CROPOS Conference on the Faculty of Geodesy in Zagreb on April 8^{th} 2011.

2 New official transformation model T7D

One of the most important tasks in Program of implementation of official geodetic datum and map projections is development of a unique transformation model T7D that would provide

a simple and for all users uniform procedure for the transformation of data of state survey, cartographic and cadastral data made in the historical reference system - HDKS into the new official geodetic references system – HTRS96 and vice versa.

The model is based on the grid transformation for the entire state territory. It includes 7-parameter transformation of the datum and implementation of the grid of distortions in the regular 60 x 90 seconds raster of predicted values, separately in position and height. For prediction of distortion 5034 identical points with the known coordinates in both reference systems were used covering the entire state territory.

From March 31st 2011 is in official usage new transformation model T7D and computer programme that provides positional and vertical accuracy of the transformation of ± 0.10 m (in both directions) for the whole state area. New HRG2009 geoid model and the height transformation model Trst-HVRS71 are integrated in the programme for the transformation of heights (Figure 1).

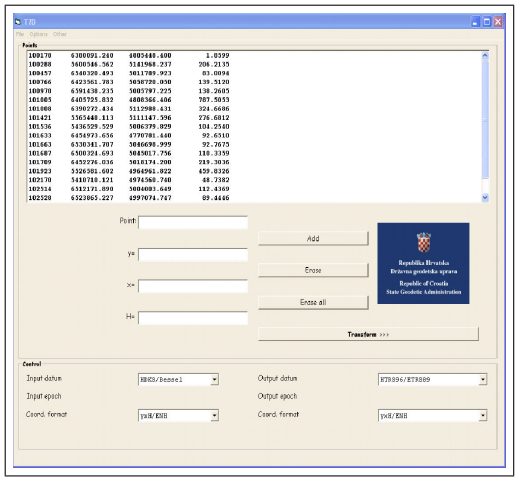

Fig. 1: T7D computer programme

3 Upgrade of CROPOS with new transformation services

Till the April 2011, the number of registered CROPOS users amounted to 348 companies. In total, 897 user licenses were issued for three CROPOS services: DPS, VPPS and GPPS. The greatest number of licenses (478) was issued for the VPPS service, as can be seen from the fact that the users are using the system up to 8,000 hours a month.

In the aim of providing simple and efficient field measurements for users directly in projected system and official height system we started the process of integrating new geoid model HRG2009 and unique transformation model T7D into CROPOS during the year 2009 for the purpose of establishing on-line transformation services. The usage of new services demands from the user rovers to have the possibility of receiving RTCM 3.1 format messages (the usage of transformation messages 1021 and 1023), i.e. the possibility of applying the emitted RTCM within the user rover. Within the frame of new CROPOS VRS HTRS96 service there are transmitted the geoid undulations N of the new geoid model HRG2009 in the official height system HVRS71, in that way ellipsoidal heights h are transformed into orthometric heights H in real time ($H = h–N$).

Testing of CROPOS VRS HTRS96 service was performed from September till December 2010 on 604 control points by comparing the on-line results with post-processing transformation model T7D using geoid undulations of HRG2009 (Figure 2). The differences of the obtained orthometric heights are of accidental character (0 mm, +1 mm or -1 mm), which is completely satisfactory for the practical application. Control points that are measured with CROPOS in new HTRS96/TM system are used for calculation of the external accuracy of the new transformation model T7D. About 450 trigonometric points over the whole state territory, that were not included in the creation

of the transformation model, were included in calculation of 2D accuracy and was achieved standard deviation of ± 0.105 m.

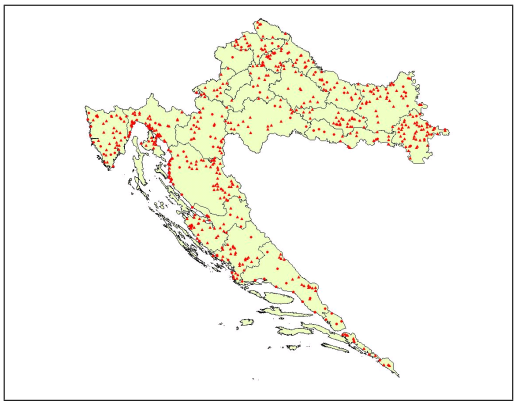

Fig. 2: Testing of CROPOS VRS HTRS96 service on control points

Since the old reference system HDKS (Croatian coordinate system) is still in practical usage in Croatia, by means of RTCM 3.1 format the transformation parameters (Message 1021: TX, TY, TZ, dM, RX, RY, RZ) and the values of distortion corrections (Message 1023: $\delta\varphi$, $\delta\lambda$, δN), needed to perform the datum transformation in real time, are emitted, as well as the geoid undulations that refer to the old height system (Trieste) and by which the ellipsoid heights h are computed into orthometric heights H in real time. CROPOS VRS HDKS service was implemented into CROPOS at the beginning of March 2011 as the first test measurements were also made. Next phase is test measurements on about 1000 points equally distributed on the entire state territory and comparison of the obtained results (on-line vs. post-processing transformation). First results show deviations in the amount of ± 0.013 m. We intend to start using the service officially at the beginning of July 2011.

4 Web application of geodetic point database

One of SGA's responsibilities is to ensure useful and reliable geodetic point database so that field measurements can be done at any time. Maintenance of geodetic points consists of field revision of geodetic points, displacement and renovation of geodetic points and keeping up-to-date register about condition of points in database of geodetic points. State geodetic administration was established database of geodetic points, as well as web application for registered users. Web application enables to users access and ordering geodetic point descriptions and coordinates through the internet. From September 13^{th} 2010, upon the decision by the Director-General geodetic point database has been implemented into official usage (Figure 3).

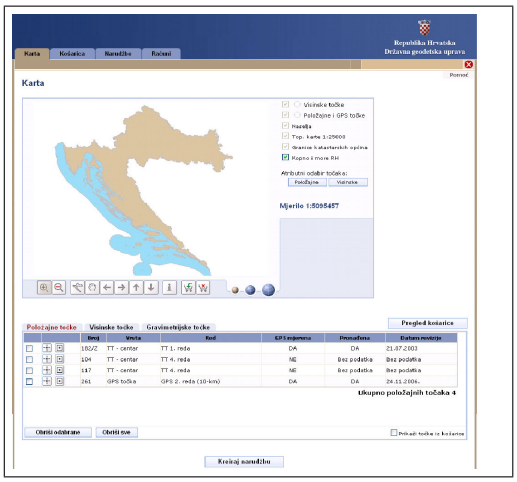

Fig. 3: Web application of geodetic point database

5 Levelling and gravity network

Croatian Geodetic Institute was during 2010 completed the project preparation for the new high precision levelling network of the Republic

of Croatia (III. NVT). Renewal of the fundamental vertical network will include additional marking of destroyed benchmarks, designing new lines of leveling figures for the purpose of adjusting the configuration to the state territory, estimation of adequate methods of vertical survey, and a systematic gravimetric survey of the entire network.

After establishment and gravity measurements of 1^{st} order gravimetric network points on Croatian islands, one of the main tasks is connections to the nearest benchmarks. In year 2010 trigonometric leveling measurements were carried out in the aim of connection of south Croatian islands with the mainland in unique vertical system (Mainland – Veliki Drvenik – Šolta – Brač – Mainland, Mainland – Hvar – Brač – Mainland, Pelješac – Korčula). These works will together with first two phases, as a result, have independent quality control of accuracy of new geoid model HRG2009 on Adriatic islands.

From 2007 CGI has been performed establishment of the gravimetric network of II. order. In 2010 CGI has been prepared and realized III. and IV. phase of project that include field revision, stabilization, positional and height measurement on the points and also gravimetric measurements. Phase III includes regions of Podravina, Slavonija and Posavina with 22 new established gravimetric points of II. order. During 2011 preparation and realization of V. phase is planned that will include positional and levelling measurements, as well as gravimetric measurements in the area of Zagreb city (microgravimetric network) and in the part from Zagreb city to Ogulin and Plitvice lakes.

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