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National Report of Albania

Developments on establishing of the Albanian Satellite Positioning System (ALBPOS)

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Content:

Introduction

Development last years of the Albanian Satellite Positioning System is considered as the most important development according to the interest of EUREF. To present and complete this development, through this report is underline a brief history of the surveying and geodetic development in the past as well as the development after ’90, especially during last years. Also a scenario of all other activities are presented with the idea to argue the need for institutional developments in coming years.

Brief History of surveying and geodetic developments in Albania

1860 –1873: First triangulation Network;
Established from Military Geographic Institute of Vienna;
Purpose: for mapping at 1:75 000 scale in Albania;

1927-1934: Second and New Triangulation Network in four orders;
Coordinative system based on Bessel ellipsoid, Bonn Projection, Central meridian with $\lambda_0=20$;
A Leveling Net was established, too;
Established from Military Geographic Institute of Florence;

1970-1985: New Albanian Net (Triangulation & Leveling) was designed, measured and adjusted;
It was based on Krassovsky Ellipsoid, Gauss- Kruger (TM) Projection, Central Meridian with $\lambda 0=21$;
Height (leveling) System was an approximate orthometric height
Established from Military Topographic Institute of Albania;

After ’90….:

October 1994: First GPS Campaigne;
It was carried out from MIT of Albania in collaboration with US Defense Mapping Agency and Aerospace Center (today NIMA);
Purpose: To establish World Geodetic System1984 (WGS84);
It was based on 35 existing stations from Astro- Geodetic network, where:5 stations from astro-geodetic network, 18 stations from horizontal control network and 12 stations were from vertical control network;
Accuracy: ± 1 m for each station;

February 1998: Second GPS campaigne:
In Collaboration with Wisconsin University / US;
Purpose: Connect ALB86 with ITRF;
Obtained the final coordinates are referenced to ITRF 96, Epoch 1998.0; final WGS84 coordinates (φλH) were obtained;

September 1998: GPS observations;
It was carried out in collaboration with BKG/ Frankfurt within EUREF 98, at 9 new stations;
Purpose: Connect Albania with ETRS 98 network;
Final coordinates are given in ETRF96, epoch 1998.7 and then transformed to the ETRS 89;
Standard deviations: ± 2mm in North and ± 6.5mm in East.

Albanian Positioning System 2009 (ALBPOS)

INSTITUTIONAL DATA on the Project

- Project is initiated by EURALIUS(An European Mission for the Law Reform in Albania, under the Ministry of Justice);

– Project was argued to support primary the Land and Property Registration System of IPRS (Immovable Property Registration Office).

- Project idea was launched in 2005;

- During 2007- 2008 was carried out the set up and establishing project;

- During the year 2008, project:
  - *took approval;
  - *gain financing by EU;
  - *an Albanian Institution Consortium was establish in order to manage and use project and system;

- Trimble Company(branch of Europe is determined to execute the project in collaboration with Consortium in Albania);

- Currently have start the phase of installations of the receiver GNSS stations;

Albanian Positioning System 2009 (ALBPOS)

Fig. 1 Albanian Positioning System (ALBPOS)

PROJECT DATA

- Comprises 16 new receivers stations distributed throughout Albania;
- 1 Control center;
- mostly of GNSS receivers (13) are foreseen to be positioned and install in the IPRO buildings:
- 6 GPS receivers currently operate under the Seismology Institute of Albania;

Transformation parameters from ETRF2000 into ALB86 System

September 2007 – April 2008

IGM of Firenze, Italy in collaboration with IGUS of Albania calculated Transformation Parameters between:

International/ Europe Terrestrial Reference System **(ITRS/ETRS)** into Albania Coordinative System **(ALB86)**.

To perform this task, Albanian Geodetic Coordinative network was divided in two levels:

I. A GPS dynamic Network configured by the GPS Permanent Stations (RDN);
II. A GPS static Network (RGN);

Transformation parameters from ETRF2000 into ALB86 System

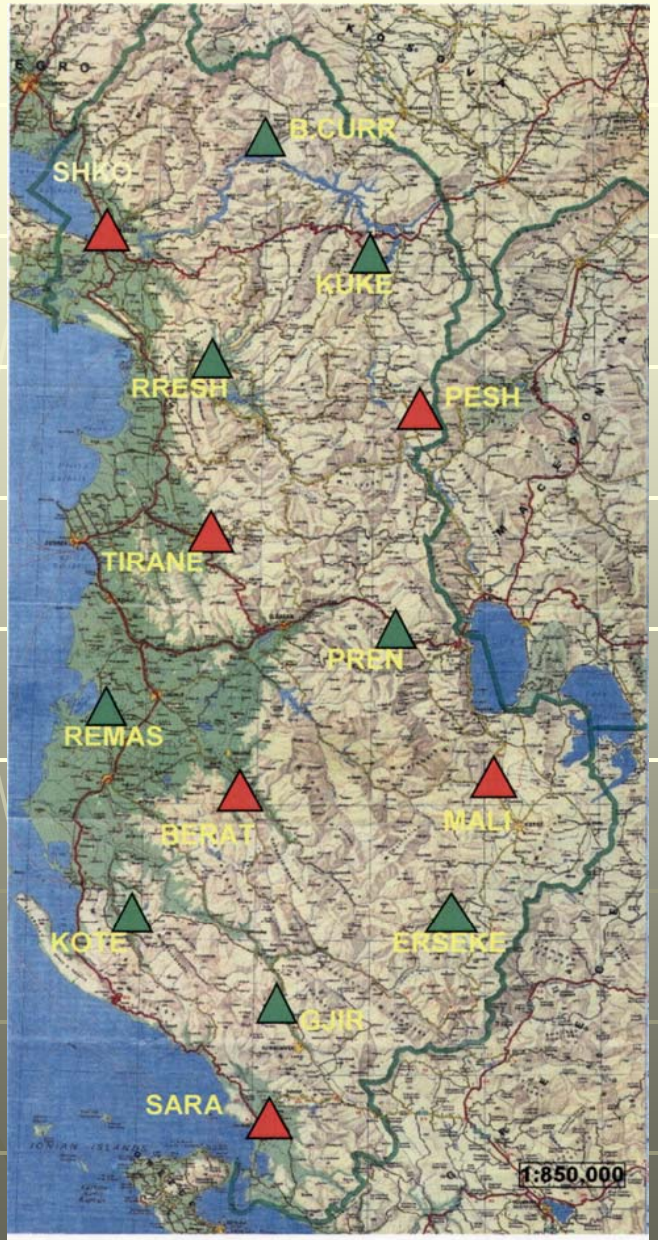

Fig. 2 GPS Dinamic Network (RDN)

GPS Dynamic Network (RGN)

was configured by:

- 14 Permanent Stations;
- 6 of them are existing (red color), established and installed by Albanian Seismologic Survey;
- 8 others (green color) are new and are installed based on the criteria of homogeneity and interdistances.

Transformation parameters from ETRF2000 into ALB86 System

Fig. 3 GPS Static Network (RGN)

GPS Static Network was configured by:

- 150 Geodetic Points by applied an average interdistance 35-40 km between the points;
- GP were selected from National Triangulation Network as well as from National Leveling Network.

- GPS Measurements were performed by using:
  - Leica System 500 (IGUS)
  - Leica system 1200 (IGM)

In RGN network (II) were used:

- GPS Trimble SSE,
- Trimble SSI,
- Trimble 4700

with 5 hours observing time.

Transformation parameters from ETRF2000 into ALB86 System

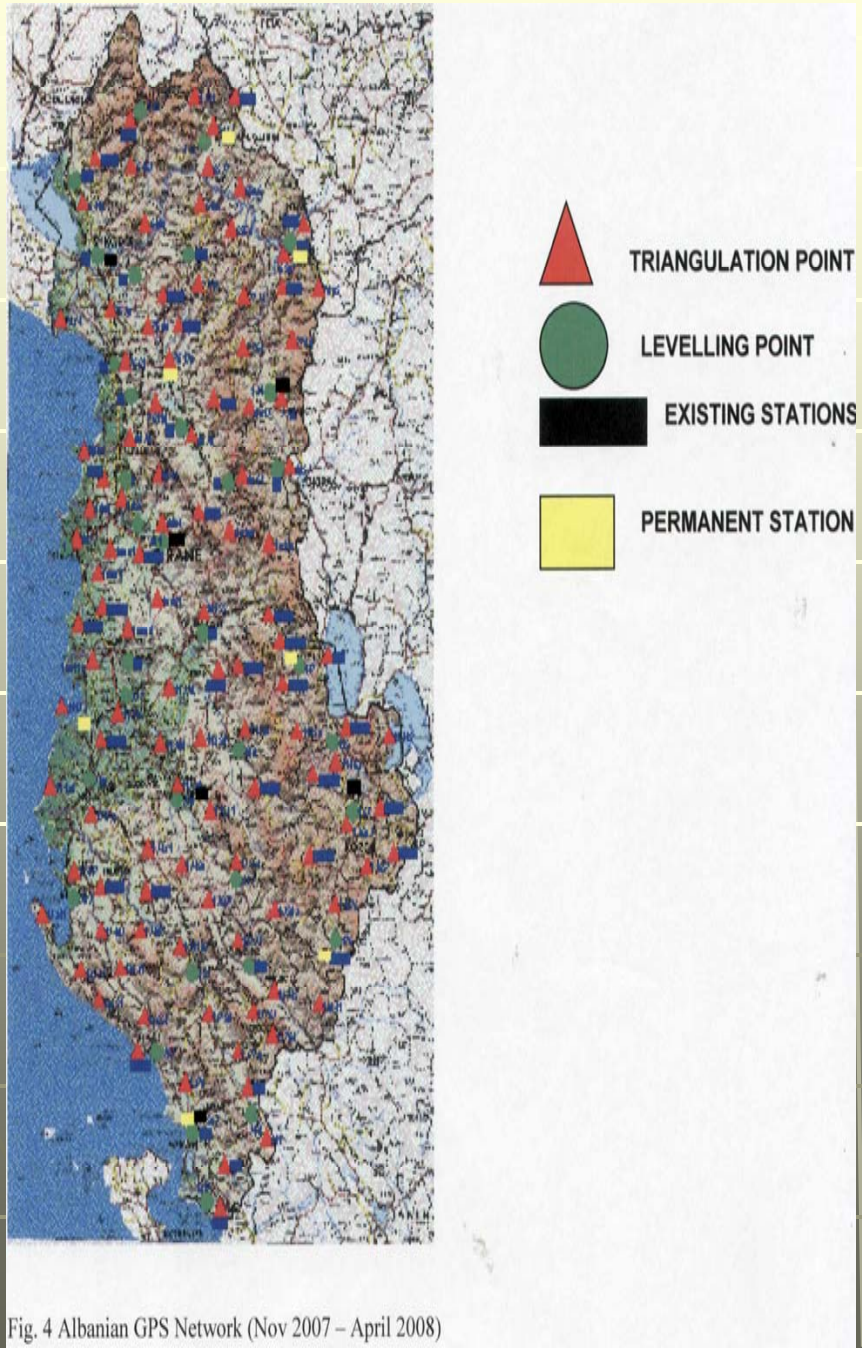

Fig. 4 Albanian GPS Network (Nov 2007 – April 2008)

Transformation parameters by IGM

- Calculation of Stable Station Network is referred ETRF2000, Epocha2008.0;
- For transformation between ITRF2005 and ETRF2000, **EUREF** gives the proper and accurate parameters for application;
- The Coordinates of Permanent Stations, reported in ITRF2005, Epoch 2000.0 (IGS2005) are updated at Epoch 2008.0 as related in following:

$$X^{I}_{05}(2008.0) = X^{I}_{05}(2000.0) + \dot{X}^{I}_{05}(2000.0) \cdot (2008.0 - 2000.0)$$

- Processing of observation is performed by Bernese 5.0Software and results are reported in ITRF2005, Epocha2008.0;
- Transformation of coordinates from ITRF2005 into ETRF2000were done in two phases:

  -First: from ITRF 2005 into ITRF2000;

  -Second: from ITRF2000 intoETRF2000;

Transformation parameters from ETRF2000 into ALB86 System

- Static Network contains 135 points;
- Baselines are calculated with TGO Trimble, by using precise ephemerides.
- Square Average Error per weight unit resulted 20 mm;
- Relative Average Errors were less then 2cm in plan and less then 3 cm in heights;
- ALBAGEO3 Software for all Albanian territory by using GPS measurements gives the geodetic heights with an error valuated at range of 20cm - 1σ with the secure level of 68%, those with error till 40 cm with secure level of 95%;
- By ALBACO Software was performed the transformation from Local System (Alb86) into ETRF2000 (2008.0);
- After the transformation 7-P Helmert parameters are reported as follows:

Tx = 44.183m, Ty = 0.58m, Tz = 38.489m,
Rx = 2.3867'', Ry = 2.7072'', Rz = - 3.5196'',
S = 8.2703 ppm

Transformation parameters from ETRF2000 into ALB86 System

II. Transformation Parameters calculated by Department of Geodesy

Also, Department of Geodesy in Polytechnic University of Tirana have calculated the same transformation parameters by using a limited number of points (18), applying the:

1. By using in ITRF96, epoch 1998.1 and of 18 points, it was calculated:

a) the Parameters of Transformation by Burša-Wolf Model

Tx= 35.758m, Ty=11.676 m, Tz=41.135m,

Rx=2.21863332 '', Ry=2.47261534 '', Rz= -3.12334734 '',

S = 8.3855334 ppm, RMS = 0.2965 m;

b) the Parameters of Transformation by Mollodjensk - Badeká Model calculating the bari-centers of both systems (**WGS84** and **ALB86**), and the coordinative differences respectively, gave the shifting components of the system's centers after calculations as:

Tx= -77.09m, Ty=111.25m, Tz=42.50m,

Transformation parameters from ETRF2000 into ALB86 System

II. Transformation Parameters calculated by Department of Geodesy

After the final solution by using the two steps above transformation parameters are obtained as follows:

Tx = -77.09 m, Ty = 111.25 m, Tz = 42.50 m,
Rx = 2.22273223 '', Ry = 2.47463712 '', Rz = - 3.12801692 '',
S = 8.38446554 ppm RMS = 0.2965 m

It should be underlined

- that ellipsoidal heights of points in ALB86 are approximate;
- calculations of parameters are done with iterative transformation software SEVENPAR;
- Number of iterations was 20;
- parameters of this transformation are real values of center's shifts to the ellipsoid WGS84 and Krassowsky;

Transformation parameters from ETRF2000 into ALB86 System

II. Transformation Parameters calculated by Department of Geodesy

Calculations of Ellipsoidal heights

A Polynomial for interpolation of heights of the three range with three variables was used to calculate the ellipsoidal heights. Its form is:

$$H_{ALB86} = h_{WGS84} + C_0 + C_1\Delta\varphi + C_2\Delta\lambda + C_3\Delta h + C_4\Delta\varphi^2 + C_5\Delta\varphi\Delta\lambda + C_6\Delta\varphi\Delta h + C_7\Delta\varphi^2\Delta\lambda + C_8\Delta\varphi^2\Delta h$$

$$+C_9\Delta\varphi^3 + C_{10}\Delta\lambda^2\Delta\varphi + C_{11}\Delta\lambda^2\Delta h + C_{12}\Delta\lambda^3 + C_{13}\Delta h^2\Delta\varphi + C_{14}\Delta h^2\Delta\lambda + C_{15}\Delta h^3$$

where: *HAlb* – height in the ALB86 System and *hWGS84* – ellipsoidal heights in WGS84.

- Square average deviation of heigts's transformation of common points refere new operator is: 0.39 m. Statistics in percentage of the new and used operator for heights transformation are as follows:

-Till to 10cm are 38.5% of points, till to 20cm are 69.2% of points, till to30cm are 79.9% of points, till to 40cm are 88.5% of points and till to 50cm are 96.2%.

Comments and conclusions

Situation and surveying and geodetic developments in Albania after ’90.

- economic changes;
- ownership and private sector;
- modern developments in geodetic and surveying technology;
- Urban and infrastructure development in Albania;
- High school and education;
-Situation and Institutional developments;

Conclusions:

- Albania is doing progress with the establishing of ALBPOS;
- This system will improve the situation in Registration of Immovable Property System;
- Improvements will effect even the other aspects like urban, infrastructure, education and scientific developments;
- It is necessary to develop the institutions and standards to serve and support the surveying and geodetic developments;
- Geodetic education need to improve the teaching program referring the Bologna process;
- It is necessary to increase the relations with regional and European institution;

Thank You!