

EUREF National Report of Moldova

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1. Introduction

The Department of Geodesy and Cartography of the Agency for Land Relations and Cadastre is responsible for the realization of reference frames for horizontal and vertical control as well as for the establishment and maintenance of the gravity base network and determination of the local gravity field.

A decision on the new geodetic system and map projection for Moldova was taken by the Government in decision Nr. 48 dated January 2001, "On approval of Regulations regarding the national geodetic network". In order to implement the Government decision above was approved:

- Regulations on implementation of global and reference coordinate systems and corresponding map projection;
- Instructions regarding creation of national geodetic network;
- Instructions regarding creation of national gravimetric network.

Activities on establishment of National Geodetic Vertical Network (NGVN) are still going on.

2. National GPS Network

The establishments of Moldova National GPS Network consist of zero; first and second order networks (see fig.1).

2.1. Zero Order Network: 5 points.

The geodetic datum of MOLREF99 is given by the Zero Order Network with 5 points (so-called EUREF points) which were measured by GPS in May 1999 and linked to the European Terrestrial Reference System. This Zero Order Network will fix scale and orientation of MOLREF99 (see fig.2).

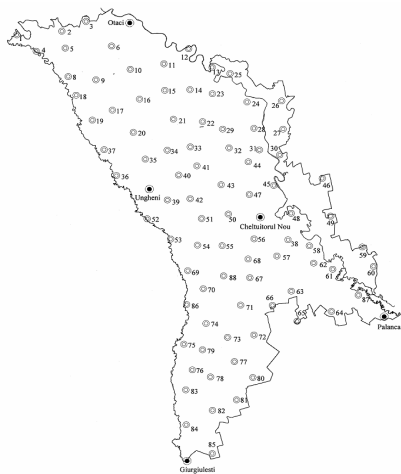


Fig. 1. National Geodetic Network

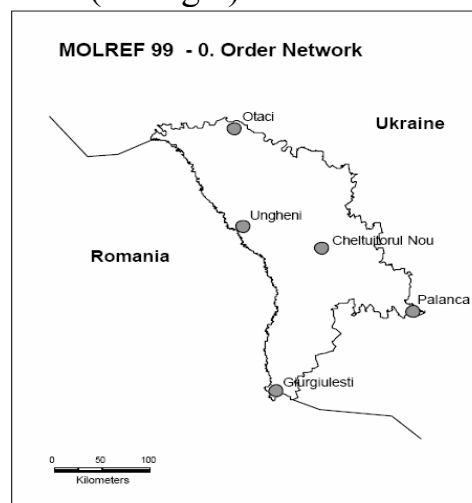


Fig. 2. Zero Order GPS network

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All baselines were processed by U. Hugentobler/W. Gurtner, Astronomical Institute University of Bern using Bernese GPS Software Version 4.2.(See Table 1).

	Cartesian			Geodetic						
	X	Y	Z	LAT		LON			Ell.Hgt.	
CHELTUIT NOU	3807536.8863	2104493.7134	4648842.5106	47	5	28.209257	28	55	48.768715	233.8325
GIURGIULESTI	3946301.6832	2117866.1349	4526149.1514	45	29	39.757786	28	13	16.213989	165.4376
OTACI	3754452.4455	1976193.2053	4746725.1406	48	23	58.856830	27	45	37.870486	302.8839
PALANCA	3814919.6255	2204325.9237	4596482.2443	46	24	16.119259	30	1	12.208704	162.1174
UNGHENI	3829765.1988	2029340.2125	4663860.2028	47	17	24.086241	27	55	6.617136	225.2305

Table 1: MOLDREF99-Geocentric Coordinates in ETRS-98

The network includes 8 IGS-stations (including Kiev/Ukraina), of which 5 new points in Moldova and 3 new points in Ukraina. The final coordinates were determined by constraining the IGS-stations to their ITRF97 coordinates. Finally these coordinates were transformed into the ETRF97 Reference Frame on the European Reference System 89 (ETRS-89), using the standard transformation parameters.

2.1.1. Point monumentation

Four new concrete pillars were built in Giurgiulesti, Otaci, Palanca, and Ungheni. For Cheltuitorul Nou the existing concrete pillar was used. All sites were checked in respect to their geological stability. All points have special metal adapters for an unconstrained centration and the pillars are painted with the national colours of Moldova (see figure 2).



Fig.3. Cheltuitorul Nou

2.2. First Order GPS Network

First Order GPS Network includes 78 points; average distance between the points is 25-35 km. GPS-measurements were observed in several campaigns. To strengthen the 1st Order Network two 24h-session were observed:

- 13.07.1999: 7 points in northern part: Cheltuitorul Nou, Ungheni, Otaci, 1, 13, 17 and 32.
- 03.08.1999: 6 points in southern part: Cheltuitorul Nou, Palanca, Giurgiulesti, 63, 80 and 86.

It was decided to process all 36 baselines (21 in the northern part and 15 in the southern part) and include them all in a constrained adjustment keeping the 5 EUREF-points fix.

In august 1997 a 1st GPS-baseline in Moldova was measured by the National Land Survey Sweden. The approx.25 km long baseline between NORDIC (=Cheltutorul Nou, 0.Order Point) and SUDIC (=38, 1.Order Point) was observed in 8 sessions each 12 h and processed according EUREF-standard with Bernese Software. The accuracy of resulting coordinates was estimated to approximately 15 mm.

GPS-measurements observed in several campaignns were used to process the 1st Order Network:

- 1st Order campaign 1999 in the period of July, 14-Aug.8.
- Additional measurements in 1999 Sept., 14-15.
- Additional measurements in 2001 April, 11, 18, 19.
- Pilot Project measurements in the areas of Chisinau in Oct.1998.

The baseline length is 25-30 km in average; the mission length varies between 4 and 5 hours. All points were observed twice at minimum. 221 baselines were used for the adjustment of 71 3Dcoordinates. 15 baselines were rejected from the final adjustment. Figure 4 and 5 show the baseline design and the resulting error ellipse (68% confidence level) [1].

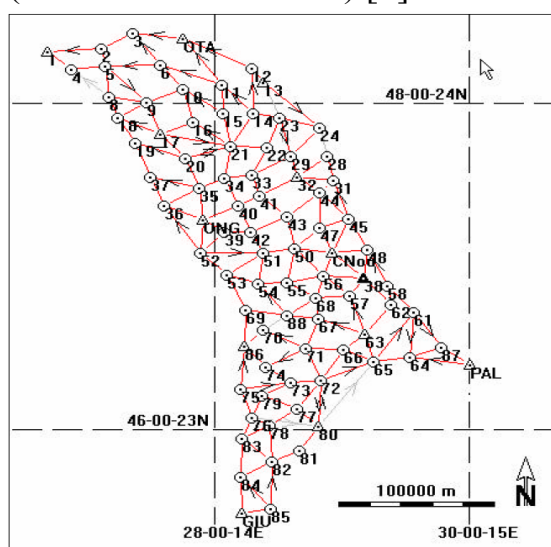


Fig 4: MOLREF99 - Network Design of 1st Order Network

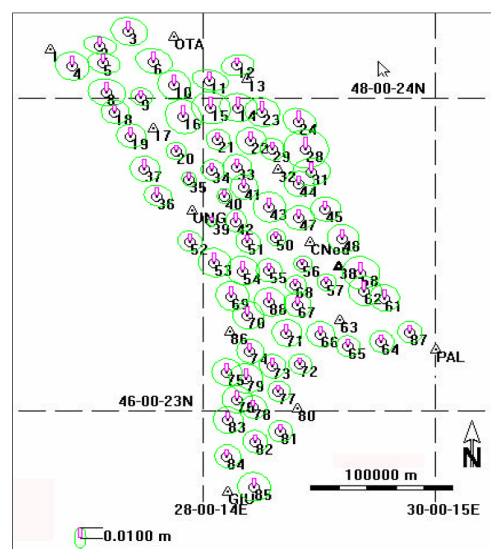


Fig.5. MOLDREF99-Results of Network Adjustment

2.3. Second Order GPS Network

Second order GPS network includes -398 points; average distance between the points is 10-15 km. Most of densification GPS network points are established in pairs for practical use for conventional surveying instruments directly from the GPS Network.

3. ETRS89/UTM

The Agency for Land Relations and Cadastre use the international reference system ETRS89/UTM at the national reference for all geodetic and mapping

applications in Moldova. Currently, the cartographic works are underway in the UTM projection, for small scales and TMM (Transversal Mercator for Moldova) with a non-standard zone $28^{\circ}24'$, $ko = 0, 99994$), for large scales.

5. The Moldovan Geoid

The project on the geoid in Moldova came into operational stage at the beginning of 2003. Its first step consists in the analysis of all available data, i.e. gravity data, GPS/leveling, altimetry, topographic data, crust densing. In 2005 we have got model with mean deviation $E = -0, 2$ cm, standard deviation $\sigma = 6, 9$ cm [2]. The project is in progress.

4. Gravity

The Gravity networks is important for the future development of the geodetic infrastructure in Moldova, e.g regarding improvement of the geoid model, and is important for the geological and geophysical mapping of the country, as well as scientific interest.

Regrettable Moldova has not gravimetric given on our territory, but called and studies have shown that the gravity system of the Republic of Moldova would be easily integrated into the EU gravity standard [3].

6. Conclusion

At present Moldova is the only country of EUREF members that has not permanent stations. The Network Project expects the creation 4 - 5 more constantly acting stations with possibility of the regional mode RTK (GSM) (fig.6). We are ready to receive any support to achieve this purpose. The activity of the realization of the EUREF is going on according to the possibilities of the country. Important activities related to the EUREF are also going on.

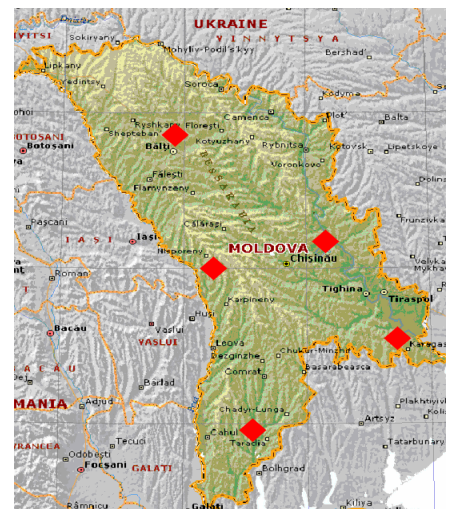


Fig. 6. Project to network base station

References

- [1] Dr. R.STENGELE (Swissphoto AG), MOLDREF99, 1st Order Network, Final Report, June 2001;
- [2] A. MARCHENKO, I. MONIN Regional quasigeoid solution for the Moldova area from GPS/levelling data;
- [3] BESUTIU L., NEAGA V., NICOLESCU A., LORINCZI J., ILIES I., BESUTIU G. Preliminary results in the achievement of the new gravity system of Republic of Moldova;