National Report of Republic of Moldova

Establishment of a National Geodetic Frame

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Summary

In March 1999, the Government of Moldova adopted a Decision to introduce in the Republic of Moldova the World Geodetic System 1984 (WGS 84), to replace the System of Coordinate 1942 (SC-42). At the national level the focus was set on:

- defining the fundamental principles and
- establishing a GPS National Geodetic Frame.

Regulations on the National Geodetic Frame

The Regulation on the National Geodetic Frame is the basic normative document regulating the introduction on the territory of the Republic of Moldova of a new geodetic system. It defines the *coordinate system* for the present period, specifies the structure and general principles of establishing a National Geodetic Network in the Republic of Moldova, methods of mathematical processing of geodetic measurements, cataloguing and storage of geodetic information. This document shall become the basis for developing instructions on the National Geodetic and Gravimetric Networks and also for production of catalogues containing point coordinates of the National Geodetic Frame.

The National Geodetic Frame comprises geodetic points of the 0, 1st, and 2nd Order.

Coordinate and time reference systems

The National Geodetic Frame (NGF) establishes the reference system on the whole territory of the country. The position of NGF points is determined in two systems of coordinates: global and reference. A univalent connection is established between the two systems determined by parameters of mutual transfer.

The World Geodetic System WGS 84 is adopted as the global geodetic system. The European Terrestrial Reference System 1989 (ETRS 89) is adopted as the reference coordinate system.

The position of NGF points within the reference systems is determined:

- through the geocentric Cartesian coordinates X, Y, Z, where the origin is the center of reference ellipsoid, axis X lies on the zero meridian plane, axis Y completes the system within the plane of the equator, and the direction of axis *Z* coincides with the rotation axis of reference ellipsoid; geodetic coordinates: geodetic latitude – *B*, geodetic longitude – *L,* geodetic height – *H*;
- plane rectangular coordinates x (N), y (E) and normal height h.

For the purpose of small scale mapping the plane rectangular coordinate x (N), y (E) *y* are computed on the plane in the Universal Transversal Mercator (UTM) projection within six-degree zones.

To perform topographic and cadastral surveying at scale 1:10 000 and larger, the flat rectangular coordinates x (N), y (E) are computed in the Transversal Mercator (TM) projection with the following parameters:

- geodetic longitude of axial meridian: L_o = 28°24¢
- scale coefficient on the axial meridian: k_o = 0.99994
- conventional x-axis: x_o = -5000 000 m
- conventional y-axis: y_o = 200 000 m

Geodetic heights of NGF points are determined either directly from satellite measurements, or as the summation of normal height and the height of quasigeoid above the reference ellipsoid. The normal heights of NGF points are determined in the Baltic Heights System. To determine the heights of quasigeoid above the reference ellipsoid, global continental and local geopotential models shall be used.

Structure of the national geodetic network

Points of the National Geodetic Frame of 0-Order (NGF-0), located at a reciprocal distance of 80-150 km in the country, are determined using GPS surveying and EUREF permanent stations as well as points of the National Geodetic Networks of neighbouring countries. The fundamental NGF-0 points represent the foundation for establishing the National Geodetic Frame and for ensuring increased accuracy within the long-term EUREF program.

The coordinate system, established through the NGF-0 points that are connected with EUREF points, coincides with an adequate accuracy with the European Reference

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System ETRS 89 implementing the World Geodetic System WGS 84 in the country.

Coordinates of NGF-0 points are determined using GPS surveying which ensures an accuracy for the reciprocal position of neighbouring points of 3 – 6 mm for plane coordinates, and 10 – 20 mm for geodetic heights.

Establishment of GPS National Geodetic Frame

The new GPS National Geodetic Frame is being established in the Republic of Moldova (Fig. 1). The 5 points of 0-order determined by combined measurement campaigns on several EUREF points in European countries became basis for this Frame. The network includes 8 IGS stations, 5 new points in Moldova and 3 points of Ukrainian frame.

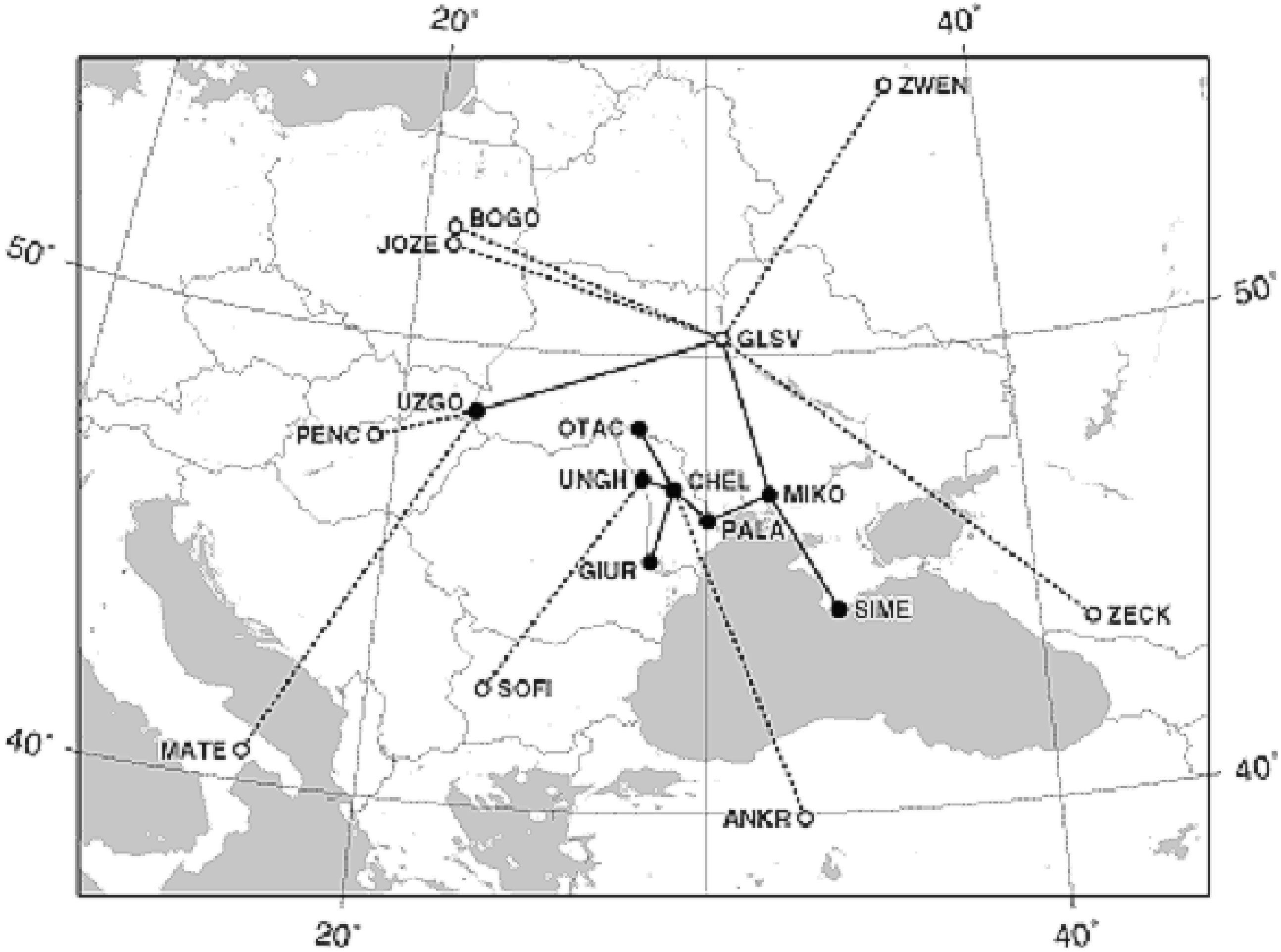

Figure 1. 0-order National Geodetic Frame.

The 5 points of the National Geodetic Network have been incorporated into the EUREF system, and these points were accepted as class B standard. Detailed information about technical conditions of measurements is provided in Tab. 1.

Processing of data in accordance with EUREF standards was made at the Astronomical Institute of the University in Bern (AIUB). The network of the MOLDREF 99 campaign was successfully measured and processed using *Bernese GPS Software V4.2*.

Internal consistency (RMS repeatability) of coordinates for 5 new points in Moldova: *1 – 2 mm* for horizontal position and *3 – 6 mm* for height**.**

The final coordinates were obtained using comparison of IGS station with their coordinates in ITRF 97, epoch of May 27, 1999. At the final stage these works were transformed in ETRF 97 Reference Frame in the European Reference System 89 (ETRS-89), epoch of May 27, 1999, using standard transformation parameters. In such a way in Moldova the coordinates of 5 basic points of New Geodetic Frame were determined in the EUREF system and the connection of the National Geodetic Frame with the European Geodetic Frame was thus ensured.

Table 1. Measurements.

Abbr		Station	State	Receiver	Antenna
CHEL		Cheltuitorul	Moldavia	LEICA SR9500	LEIAT202-GP
GIUR		Giurgiulesti	"	LEICA SR9500	LEIAT202-GP
OTAC		Otaci	"	LEICA SR9500	LEIAT202-GP
PALA		Palanca	"	LEICA SR9500	LEIAT202-GP
UNGH		Ungheni	"	LEICA SR9500	LEIAT202-GP
MIKO		Mikolaev	Ukraina	TRIMBLE 4000SSE	TRM14532.0
SIME		Simeiz	"	TRIMBLE 4000SSE	TRM14532.0
UZHD		Uzgorod	"	TRIMBLE 4000SSE	TRM14532.0
ANKR	20805M002	Ankara	Turkey	ROGUE SNR-8000	AOAD/M_T
BOGO	12207M002	Borowa Gora	Poland	ASHTECH Z-XII3	ASH7009366A_M
GLSV	12356M001	Kijev	Ukraina	TRIMBLE 4000SSI	TRM29659.00
JOZE	12204M001	Jozefoslav	Poland	TRIMBLE 4000SSE	TRM14532.0
MATE	12734M008	Matera	Italy	ROGUE SNR-8100	AOAD/M_T
PENC	11206M006	Penc	Hungary	TRIMBLE 4000SSE	TRM14532.0
SOFI	11101M002	Sofia	Bulgaria	ROGUE SNR-8000	AOAD/M_T
ZECK	12351M001	Zelenchukskaya	Russia	ROGUE SNR-8000	AOAD/M_T
ZWEN	12330M001	Zwenigorod	Russia	ROGUE SNR-8000	AOAD/M_T

Station	RMS (mm)			Range (mm)		
	N	E	U	N	E	U
GIUR	18	1.3	2.8	49	31	6.7
OTAC	22	1.4	3.6	5.4	2.9	8.7
PALA	24	2.5	4.9	5.7	6.1	12.2
UNGH	13	2.5	2.6	3.5	6.0	6.1
GLSV	27	2.0	5.6	7.0	4.4	14.9
MIKO	19	2.5	2.8	5.0	5.9	7.7
SIME	50	1.9	9.0	10.4	4.1	23.2
UZHD	20	1.7	6.7	4.8	4.3	18.6

Table 2. Coordinates in ETRS-89, epoch May 27, 1999

Station	Coordinate X (m)	Coordinate Y (m)	Coordinate Z (m)
Cheltuitorul Nou	3807536.8863	2104493.7134	4648842.5106
Giurgiulesti	3946301.6832	2117866.1349	4526149.1514
Otaci	3754452.4455	1976193.2053	4746725.1406
Palanca	3814919.6255	2204325.9237	4596482.2443
Ungheni	3829765.1988	2029340.2125	4663860.2028

Development of national geodetic frame

For continuation of works on establishment of the geodetic network the measurements and mathematical processing of first and second order points was carried out (Fig. 2).

As a result a geodetic network with average density of 1 point per 60 square kilometers was created in Moldova. This ensures execution of any types of works in an unified coordinate system.

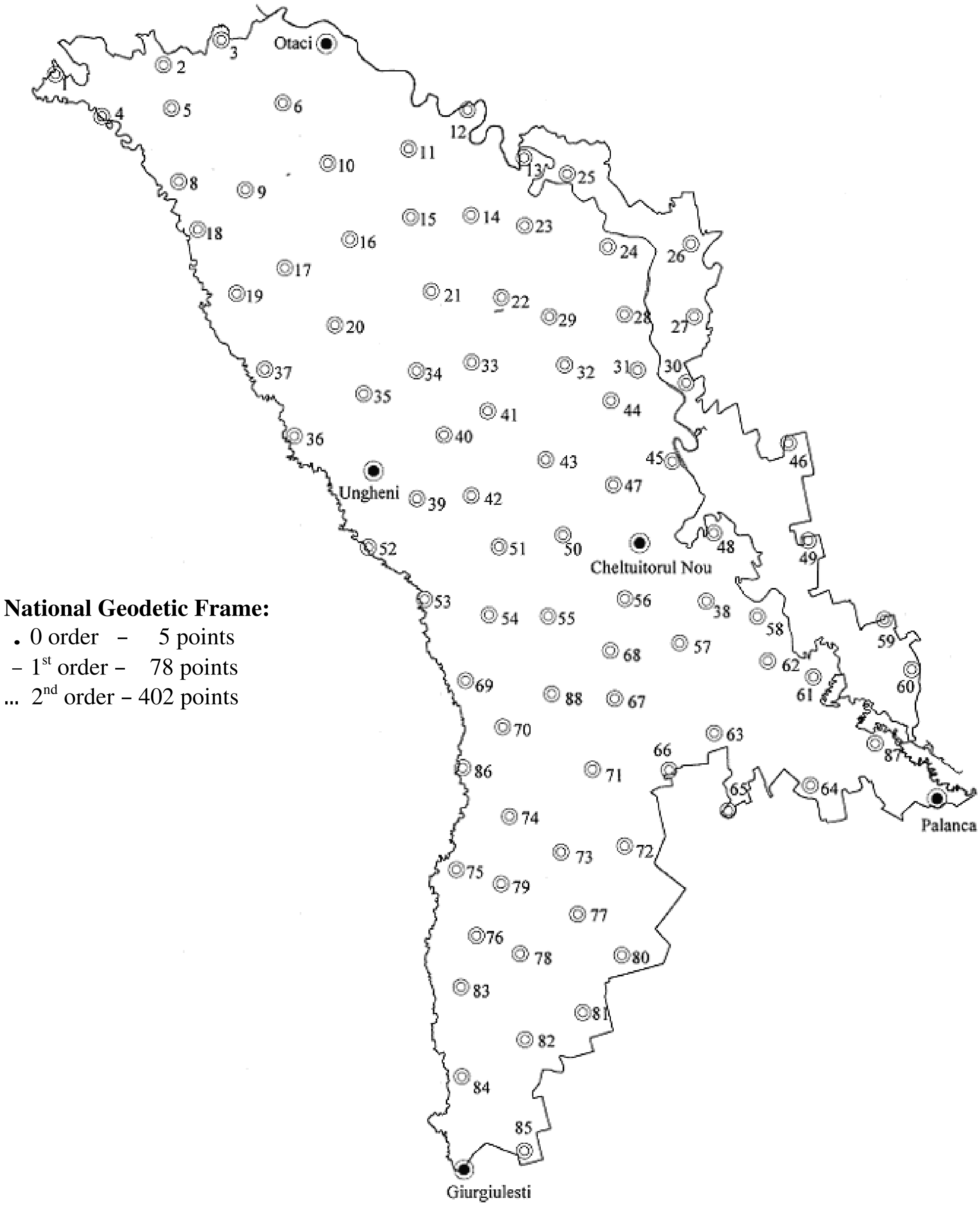

Figure 2. Densification of the National Geodetic Frame.

Acknowledgment

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