The Second Field Campaign of the Russian Reference Frame Creation

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Introduction

Federal Service of Geodesy and Cartography of Russia have begun to create the new geodetic reference frame using GPS technology in 1999. The structure of the Russian Geodetic Reference Frame was described in (Demianov, Kaftan, Zubinsky, 1999) The first fragment of the new network of 15 points was observed at the Central European part of Russia (Demianov et al., 2000). The Central Research Institute of Geodesy, Aerial Surveying and Cartography have carried out the scientific provisions of the project and participation in the First Field Campaign. The Second Field Campaign was brought of in September 2000. Nine Regional Divisions of the Federal Service of Geodesy and Cartography took part in the field work.
Now the constructed part of the network, shown in Fig.1, consists of 66 points. Eight of them are the fiducial astro-geodetic (FAGN) stations and the others are the points of the Precise Geodetic Network. The observation results are under processing now.

Used Equipment

Different models of GPS equipment were used in the field observation. Long term observation at the FAGN and PGN stations was carried out by the use of dual frequency receivers of JPS, Trimble and Ashtech manufacturers. Local ties of the new GPS points to points of the classic State Astro-Geodetic Network of the 1st and the 2nd orders and benchmarks of the Main Vertical Reference Frame were executed using Wild System 200 and Trimble SST equipment. All types of GPS receivers and antennas are presented in Table.

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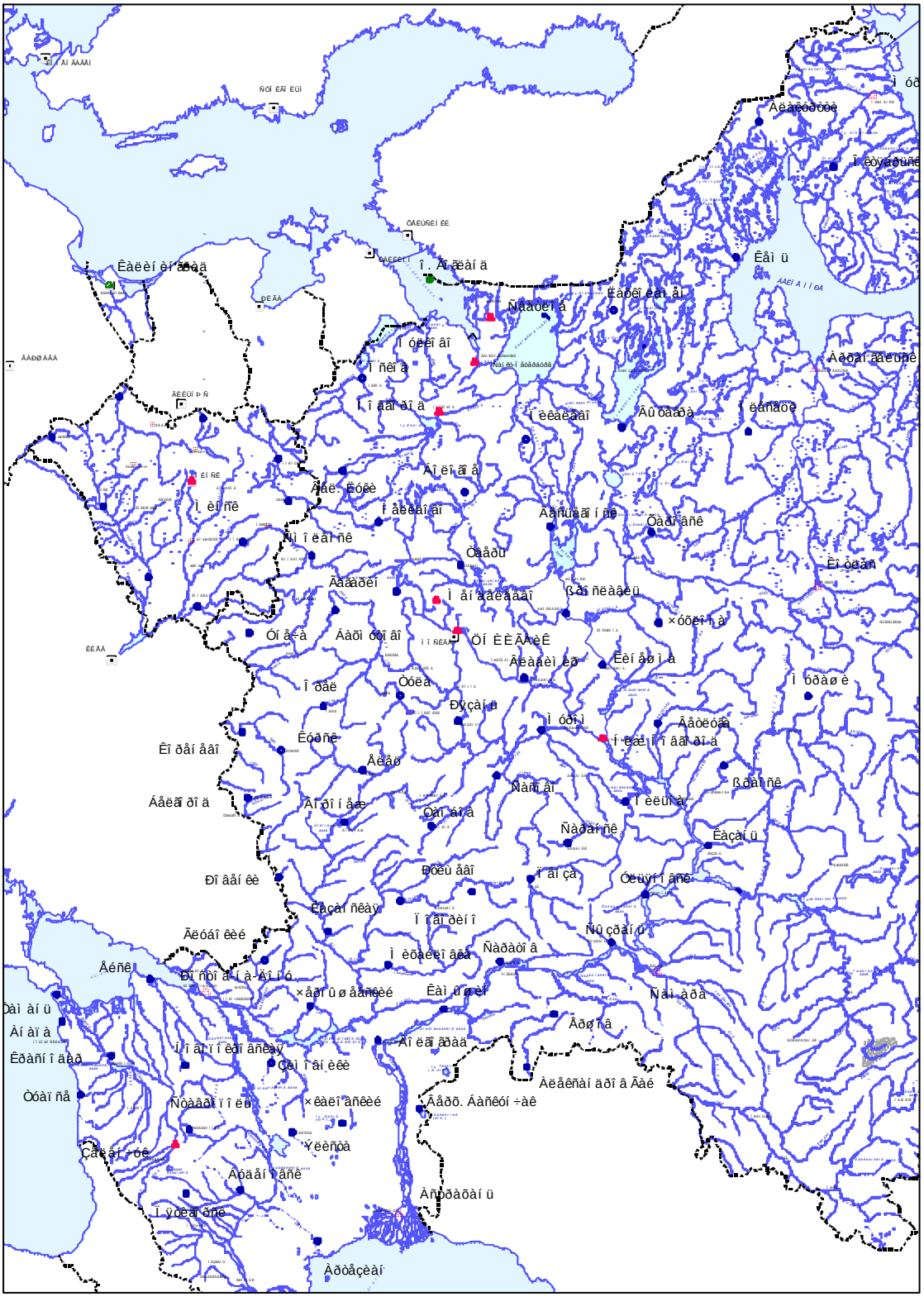

Fig. 1. Russian Reference Frame for the European territory (red points - fiducial GPS stations, blue and named dots - created points of the Precise Geodetic Network (PGN), green dots - planned points of PGN)

GPS equipment used in the Second Field Campaign of the Russian Reference Frame construction

Manufacturer	Receiver type	Antenna type	Number of units	Aim of the use
Topcon Positioning Systems	JPS Legacy	Regant_SD	5	Main baselines 100-350 km
	JPS Legacy	Legant	1	Main baselines 100-350 km
	Legacy-E GGD	Regant_SD	4	Main baselines 100-350 km
Trimble	Trimble 4000SSE	4000ST/SSE L1/L2 Geod	6	Main baselines 100-350 km
	Trimble 4000SSE	Compact L1/L2	3	Main baselines 100-350 km
	Trimble 4000SSi	Compact L1/L2	3	Main baselines 100-350 km
	Trimble 4000SSi	Choke Ring	1	Main baselines 100-350 km
	Trimble 4000SST	4000ST/SSE L1/L2 Geod	1	Local ties <30 km
	Trimble 4000SE	Compact Dome	2	Local ties <30 km
Ashtech	Z-XII	Ashtech Geodetic III Whopper	3	Main baselines 100-350 km
Leica	WILD GPS - System 200	Sensor Wild SR299	7	Local ties <30 km

Necessary calibration procedures (Kaftan, Tatevian, 2000) were performed before the field observation for the antennas used at the FAGN and PGN stations.

The transportable absolute ballistic laser garvimeter GBL-P was used for the gravity determination at the fiducial FAGN stations.

Measurement Technique

As it is mentioned above the Second Field Campaign was performed in 2000. Sixteen field teams consisting of 4-5 members took part in the field observation. It is necessary to remark that colleagues from Belorussia participated in a one session of GPS observation simultaneously with Russia teams. The network of the Second Field Campaign was connected to the margin points of the first PGN fragment observed in 1999. GPS observation

at the fiducial stations was run for about a month. This time interval covered three PGN observation sessions going on from 3 to 8 days. Each day GPS signals at FAGN and PGN points were recorded from 10:00 to 9:50 MT with 30s intervals. Elevation mask was established to 10^0.

The centers of the FAGN stations are the special monuments build into roofs of town buildings. These centers have been tied to special earth placed centers providing the control of stability of the main observation monuments.

The PGN centers were predominantly the benchmarks of the 1st or the 2nd order leveling. In rare cases it were the pillars of the astro-geodetic or gravimetric points.

Each FAGN main center was tied to two 1st or 2nd order leveling benchmarks and to two astro-geodetic points of the classic national geodetic network.

PGN centers were usually tied to one leveling benchmark and to two astro-geodetic points. These local ties were performed using two 1-4 hour GPS sessions for which GPS antennas were fixed at different heights above the marks of the pillars.

Preliminary Results and Future Plans

Now the GPS observations are under processing. GAMIT, GPSurvey and Pinnacle software is used for this purpose. The nearest permanent IGS and EUREF GPS stations are used in processing simultaneously with the new FAGN and PGN points. ITRF97 coordinates of the seven permanent stations were fixed in the whole adjustment. Preliminary results of the adjustment have shown the accuracy of the FAGN and PGN point position about 0.5 cm in a plane and 1-2 cm in a heght.

Absolute gravity measurements were performed at Samara and Nizhniy Novgorod FAGN stations. The analysis of repeatabilities between 60 drops has shown the rout mean square variations of about 2-2.5 microGals for the both stations.

After adjustment of the created GPS network a precise ITRS coordinates will be determined. A computation of the transformations between ITRS and the Russian State Geodetic Reference System of 1995 (SGRS95) will be the next step of the work under the project. Thus it will be possible to obtain the SGRS95-ETRS89 transformation too. The obtained values of geodetic and normal heights will allow us to make more precise geoid and to use GPS observation for the developing of the normal height system.

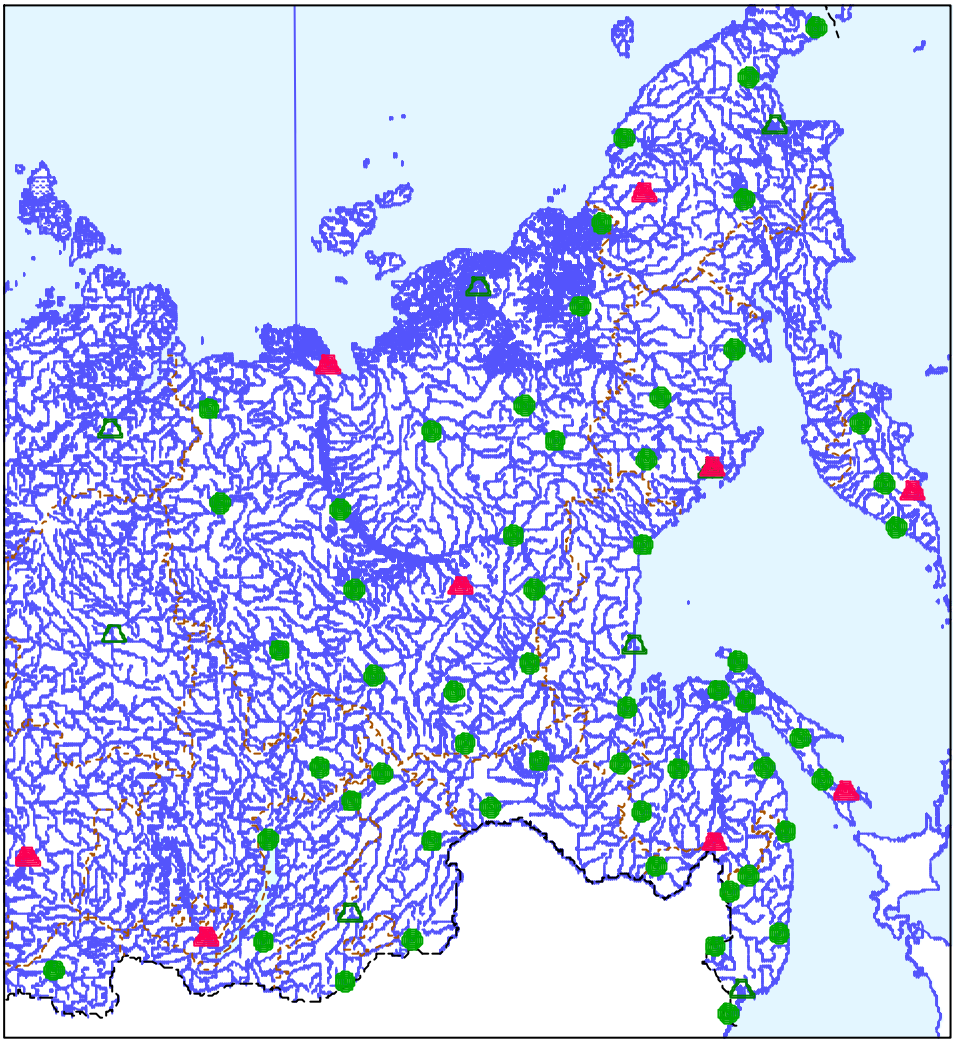

Fig. 2. Planned FAGN and PGN fragments (red - FAGN station, green dots - PGN points)

The third field campaign is intended to be in the Far East region of Russia. The chart of the planned network fragment is presented at the Fig.2. But another variant is probable too. It can be extension of the European fragment to the Ural region. The choice of the variants depends on the economical conditions.

Reference

Demianov G.V., Kaftan V.I., Makarenko N.L., Zabnev V.I., Zoubinsky V.I. (2000), New Russian Reference Frame: Status and development, *International Association of Geodesy, Section I – Positioning, Commission X – Global and Regional Geodetic Networks, Sub-Commission for Europe (EUREF), Publication No. 9*, 293-300

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