DETERMINATION OF VELOCITY OF COORINATES CHANGE OF THE PERMANENT GPS STATIONS ON THE TERRITORY OF UKRAINE

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1. INTRODUCTION

The EUREF Permanent Network (EPN) consists of 137 permanent stations. With increase of amount of the permanent stations and accordingly by more prolonged temporal series, the use of EUREF network for the study of tectonic deformations and other geodynamics processes on the territory of Europe became possible. The last is very important, as allows at the on-line operation to use the ITRF solutions for the decision of various tasks, including for development of the national reference coordinate system.

2. ABOUT EPN "SPECIAL PROJECT"

Because of environmental effects, equipment replacement, changes in the observation/processing strategy, receiver/antenna problems, which introduce temporary, sudden or periodical disturbances into the station coordinate time series, EPN – stations are not always suitable for reliable geodynamic interpretation.
These features in the combined solutions of the permanent stations of network EPN can be caused by the change of the reference system, method of the data processing with the hard fixing of support stations' coordinates and other factors. In 2000 the special project "EPN time series monitoring" was created, the task of which above all was monitoring of the weekly combined solutions and analysis of temporal series of coordinates with the purpose of grant to the EPN stations proper kinematics' information. The so called "CLEANED" time series, by means which velocity of coordinates' change of the permanent stations of network EPN are determined, are the finished product of the given special EPN - project.

3. CALCULATION OF VELOCITY OF COORDINATES' CHANGE

For the Ukrainian permanent stations (on territory of Ukraine there are six EPN-stations), which are included to EPN network, the value of velocity of coordinates' change can be got on an official site EPN. The primary purpose of the given work was determination of velocity of coordinates' change of the Ukrainian permanent stations, which are not the constituents of EPN network and are not engaged in a project, which the estimate of movement of the stations.

The value of velocity can be defined for the stations after the NNR-NUVEL-1A geophysical model of the movements of tectonic plates:

$$\begin{aligned} V_X &= \omega_{(Y)} Z_o - \omega_{(Z)} Y_o, \\ V_Y &= \omega_{(Z)} X_o - \omega_{(X)} Z_o, \\ V_Z &= \omega_{(X)} Y_o - \omega_{(Y)} X_o, \end{aligned} \quad \textbf{(1)}$$

where X_o, Y_o, Z_o - geocentric coordinates of point, the rate of movement of which is determined;
$\omega_{(X)}$, $\omega_{(Y)}$, $\omega_{(Z)}$ - the components of Euler vectors, which value for the given model are shown at Table 1.

Table 1. Coefficients of NNR-NUVEL-1A geophysical model of the movements of tectonic plates

Name of model	$\omega_{(X)}$, рад/Ma	$\omega_{(Y)}$, рад/Ma	$\omega_{(Z)}$,рад/Ma
NNR-NUVEL-1A	-0,00981	-0,002395	0,003153

Received value of velocity after the model NNR-NUVEL-1A ($V_м$) will differ from received EPN (V) on certain value:

$$\Delta V = a_1 + a_2 (B_i - B_o) + a_3 (L_i - L_o) \cos B_i + a_4 (L_i - L_o) \cos B (B_i - B_o). \quad \textbf{(2)}$$

We will receive the probable value of velocity of coordinates' change of the stations, entering the corrections to the value of the velocity calculated after the NNR-NUVEL-1A model. The approximate value of velocity of coordinates' change, obtained by means of the model NNR-NUVEL-1A was used in the calculations. The most probable values of velocities are calculated for six Ukrainian permanent stations (SULP, CRAO, GLSV, POLV, UZHL, MIKL) by the EPN centers of analysis and for 17 stations which operate on the territories of neighboring countries (Figure). The values of calculated velocities for given permanent stations are shown at Table 2.

Fig. 1. Ukrainian permanent stations and stations which operate on the territories of neighboring countries

Table 2. The velocity of coordinates' change of Ukrainian permanent network

№	Name of station	Velocities after given project, mm/year			Velocities after the NNR-NUVEL-1A model, mm/year		
		V_x	V_y	V_z	V_x	V_y	V_z
1	ALCH	-18.20	17.99	4.99	-19.74	15.04	5.29
2	CHER	-15.83	19.01	8.21	-17.22	16.71	7.33
3	GUGK	-16.99	18.37	6.65	-18.26	15.84	6.35
4	KACH	-17.08	18.71	6.54	-18.69	16.04	6.37
5	KIRO	-17.08	18.57	6.65	-18.52	15.95	6.35
6	LVIV	-15.63	18.80	8.06	-16.90	16.62	7.37
7	MARI	-17.82	18.31	5.37	-19.48	15.45	5.68
8	MIKO	-16.82	18.82	6.96	-18.39	16.21	6.59
9	ODES	-16.55	18.97	7.36	-18.13	16.42	6.83
10	POLT	-17.58	18.25	6.03	-18.96	15.52	5.89
11	SHAT	-15.79	18.51	7.48	-16.97	16.36	7.14
12	SHEP	-16.27	18.62	7.40	-17.54	16.28	6.91

13	**SIME**	**-16.84**	**18.96**	**6.57**	**-18.68**	**16.29**	**6.56**
14	**SUMY**	**-17.79**	**18.04**	**5.83**	**-19.04**	**15.28**	**5.68**
15	**UZHD**	**-15.16**	**19.12**	**8.90**	**-16.49**	**16.99**	**7.78**
16	**VAPN**	**-16.37**	**18.82**	**7.53**	**-17.76**	**16.39**	**6.92**
17	**GLSV**	**-16.95**	**18.40**	**6.70**	**-18.23**	**15.87**	**6.38**
18	**CRAO**	**-16.84**	**18.96**	**6.57**	**-18.68**	**16.29**	**6.56**
19	**POLV**	**-17.61**	**18.24**	**6.00**	**-18.98**	**15.50**	**5.87**
20	**SULP**	**-15.64**	**18.82**	**8.08**	**-16.91**	**16.63**	**7.37**
21	**UZHL**	**-15.14**	**19.11**	**8.91**	**-16.46**	**16.99**	**7.79**

CONCLUSION

Our researches showed a practical possibility of determination of velocity of coordinates' change of the station by means of the geophysical model of tectonic plate movement with precision 1-2 mm.

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