National Report of Slovakia

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1. Introduction

During the year 2000 the Conception of Geodetic Control Development for the years 2001-2005 was prepared [1]. The accepted Conception continues the building new geodetic control of the Slovak Republic and observes the EUREF subcommission recommendations. In addition to tasks in geodetic networks, in building the information system of geodesy and cartography, the Conception sets out also tasks in the field of geodynamics, metrology and legislation. New geodetic control makes up the field of integrated control points, which are determined by geodetic technologies in specialized networks in extreme precision. Updating of information and data on control points is provided by the Information System of Geodetic Control, which is being built in relation to the Automated Information System of Geodesy, Cartography and Cadastre. Control point positioning in space and time is determined by measurement in specialized geodetic networks, namely in:

- National Spatial Network - NSN (ETRS89),
- National Levelling Network - NLN (normal heights),
- National Gravimetric Network - NGN.

2. Geodetic networks

In order to provide for continual transition to the new geodetic control we have caried out overview of the points in the national trigonometric network, on the basis of which selection of the points that are suitable for National Spatial Net (NSN) is made .

2.1 National Spatial Coordinate Network

In the year 2000 we continued building a new 3D-network [2], using dual-frequency GPS instruments. In the first stage (years 2000-2002 - 1500 points) of the network building, with average distance of the points being 7 km, we have measured 340 points. Points in terrain are monumented by survey marks, set mainly to a stone prism of 20x20x80 cm dimensions as maximum; they are monumented in localities which can be reached by a vehicle. The national reference framework of the net is SLOVak GEodynamic REference NETwork (SLOVGERENET). Measurement on determined points was carried out in 6 hours long observation sessions. Distances among determined and reference points were to 25 km as maximum.

2.2 National Levelling Network

Since 1997 we have carried out measurement of the 1st order of the National Levelling Net (NLN) using precise digital levelling method. Before 2001 measurement season 2700 km out of 3400 km of levelling lines have been carried out and the measurement work on the 1st order is supposed to be completed in the measurement season of this year. Within the framework of the coordination of the work in specialized networks the selected points are included within NSN and NGN and in this way the normal set of integrated points is enlarging. Completion of measured work will allow to connect this epoch to UELN.

2.3 National Gravimetric Network

Within the UNIGRACE international project there was provided repeated measurement by means of two absolute gravimetric instruments JILA G6 - BEV Vienna and Axis FG5 - BG Frankfurt (Slovak Technical University Bratislava was the coordinator of the project) on the absolute point Modra-Piesok. Vertical gradients on absolute gravity points have been determined. Measuring work in connecting selected points to National Gravimetric Network (

NGN) was continued. On the basis of the work in NGN the project of creating Slovakia's quasi-geoid is being solved.

3. Information system of geodetic control

In the pilot project Catalogue of Control Points (CCP) graphic user's interface for the administration of geodetic control data is being solved. In the framework of partial tasks the datasets on control points are filled, while the format of the data sentence of individual specialized networks points is unified. From the data sets about 60 000 points have been exported so far. Graphic information, which is solved by scanning original topographies and their gradual replacemement by photo-video sequences which are made-out, is connected to the points. User' s interface uses the MicroStation/J software interlinked with the Access2000 database. Preparation for the measurement work was made using CCP.

4. Geodynamics

Solution is centred on repeated measurements by GPS instruments on special points included in the SLOVGERENET. In the year 2000 4 points were added to the net, which consists of 46 points as a whole. Out of these points only the MOPI point is a permanent station in the EUREF network so far; the station is run by the Department of Geodetic Control, STU Bratislava. In the year 2000 the Banska Bystrica (BBYS) point was built, on which the launch of the second permanent station is planned and which is to be run by Slovak Army. Until today the SLOVGERENET was measured in null stage in the year 1993 (17 points), in basic stage 1995 (42 points) and in the 1st repeated stage in 1999 (42 points). By effective connection of basic and the 1st repeated stage according to [7] the first information about motion activity - annual velocities of the points of this net has been obtained. They will serve for the transfer of the coordinates of its points to the epoch of connecting measurement in NSN building.

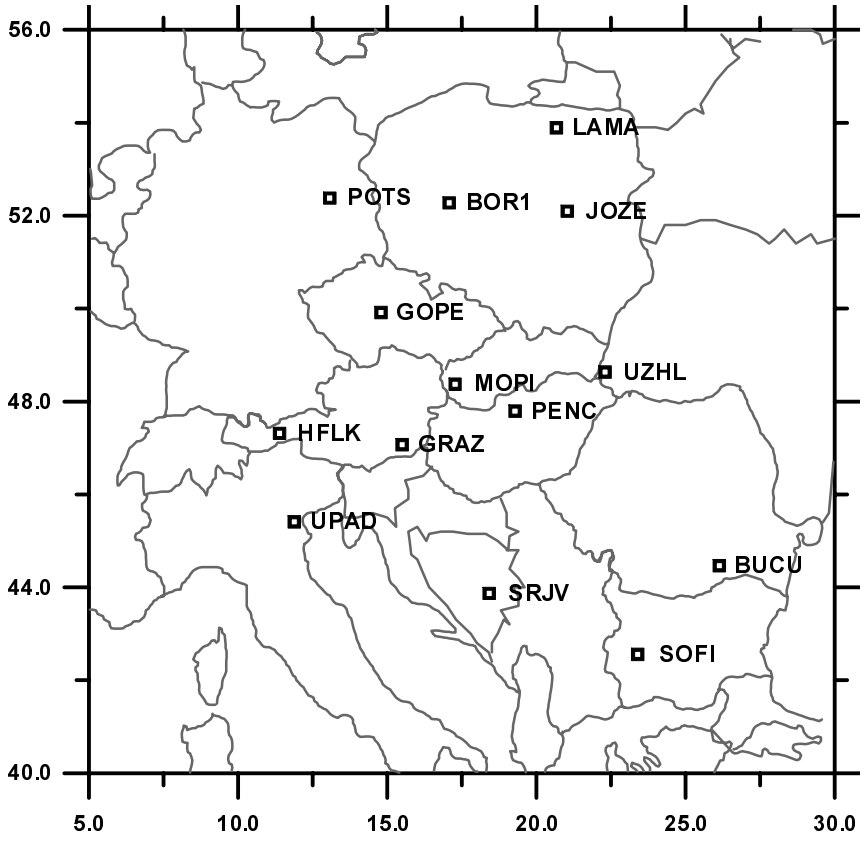
In the field of the monitoring of recent vertical movements after NLN 1st order levelling measurements completion it wil be possible to carry out analysis of above-mentioned movements on selected levelling points for the period from Csechoslovak United Leveling Network 1st order measurement from of years 1972 or 1962 until 2001.

In 1998 within the framework of Slovak-Polish international project, in order to monitor the geodynamics of the High Tatras locality, in Alpine environment a special local geodetic network The High Tatras [5] was established, in which repeated GPS measurements are carried out annually. By effective connection of measurement campaigns TATRY98, 99 and 2000 also information on the motion activity - annual velocities of this Alpine locality - has been obtained. Results confirmed the assumptions of geologists concerning the rise of this mountain range.

5. **Processing of permanent network of EUREF GPS stations in Central Europe**

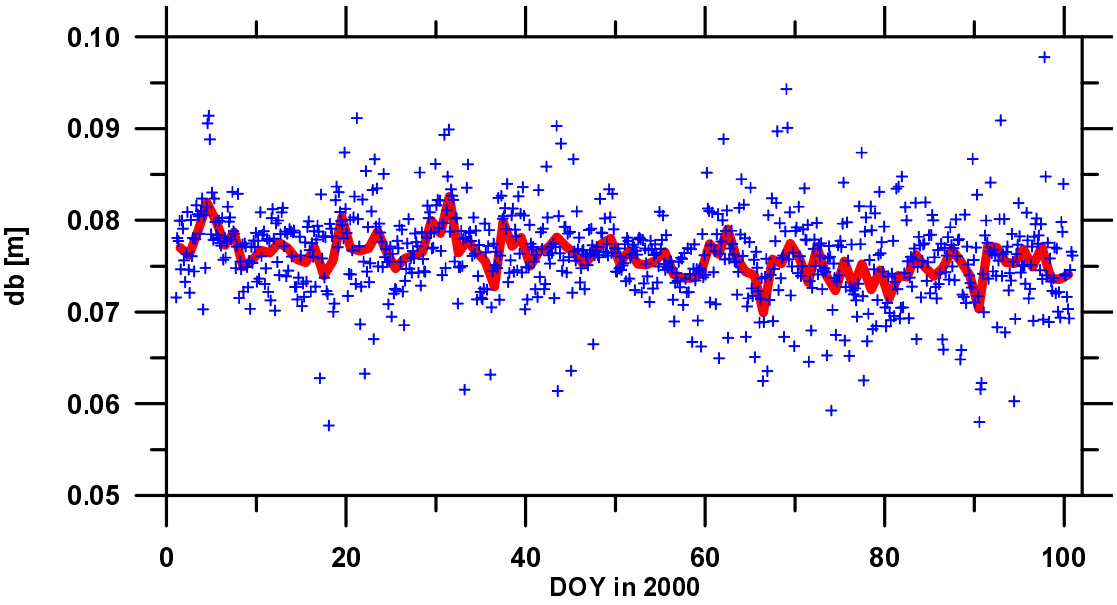
Analysis Centre: Slovak Technical University (STU), Bratislava.
Software: BSW42
Network processing and coordinate adjustment: 24 h and 3 h intervals.
Start of processing: 1.1.2000.
Output: coordinate time series of 15 stations with 24 h and 3 h resolution.
Objectives:

- analysis of short-period phenomena in permanent GPS time series,
- participation of STU in EPN Special project "Monitoring the EUREF permanent network to produce coordinate time series suitable for geokinematics".

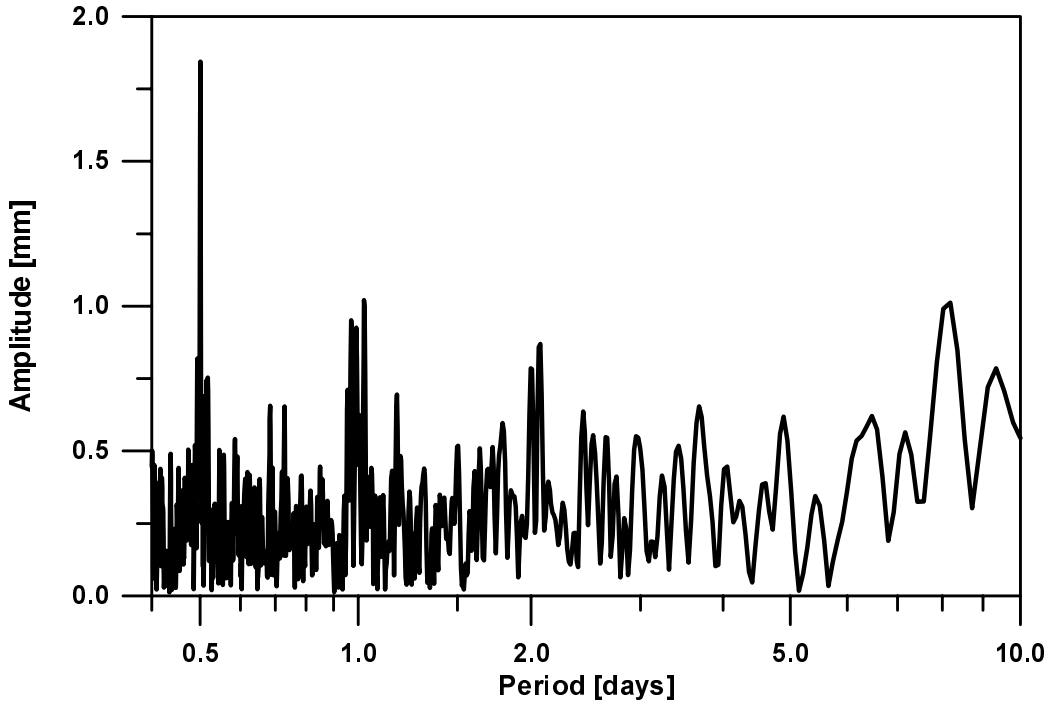


Network processed at STU Bratislava

Examples of results of processing of permanent network at STU



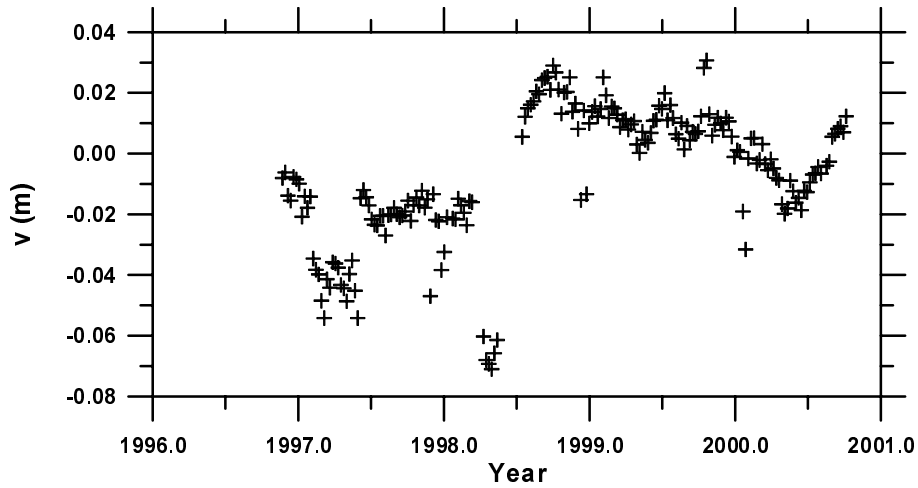
Baseline BOR1-GRAZ, b = 590 347.00 m + db. — results from 24 h intervals, + results from 3 h intervals



Amplitude spectrum of short-term variations of BOR1 – GRAZ baseline

6. Analysis of long-term stability of the EUREF permanent station Modra-Piesok (MOPI)

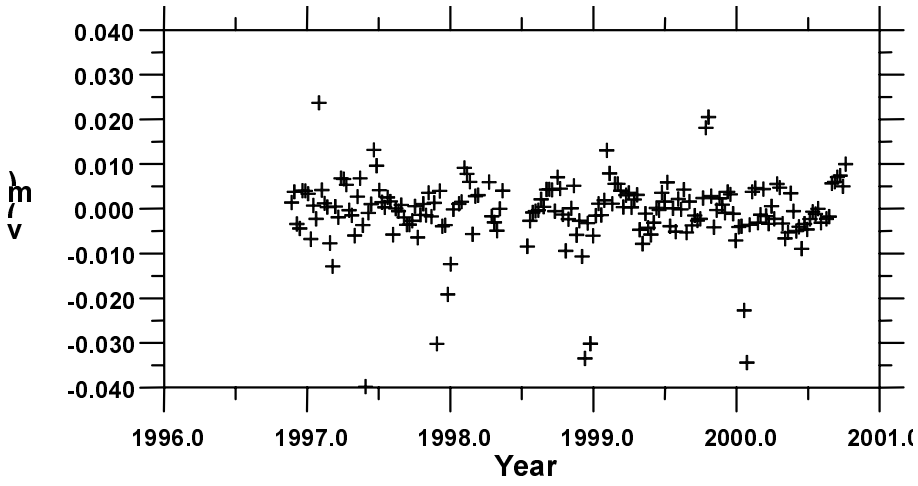
Determination of radome effects on variations of horizontal position and height



Evolution of the height component of MOPI from 1996.8 to 2000.8 (jumps are due to radome manipulations and reference frame changes)

Estimated local coordinates corrections to the initial position without radome. The changes are due to effects of radome installation and removing.

Period	*n* (mm)	*e* (mm)	*v* (mm)
1997.09 - 1997.42	4.2 ± 0.5	-1.5 ± 0.5	21.5 ± 2.2
1997.42 - 1997.46	3.6 ± 0.9	-3.3 ± 0.9	-5.5 ± 4.2
1997.46 - 1998.20	2.8 ± 0.6	-1.8 ± 0.6	10.3 ± 2.7
1998.20 - 1998.39	0.7 ± 0.9	-2.2 ± 0.9	48.2 ± 4.0
after 1998.39	-0.1 ± 1.1	-0.9 ± 1.1	-24.4 ± 4.6



Evolution of height component of MOPI after introduction correction due to radome manipulations

7. Metrology

In order to secure metrologic link-up and correctness of geodetic scales, the test geodetic base Modra-Piesok is systematically built, on which there are established:

- levelling test circle,
- gravimetric microbase with the absolute gravity point,
- latitude gravimetric base Modra-Piesok - Hurbanovo begins.

In addition, there are regularly used:

a) length base Hlohovec (calibration of distance meters),
b) vertical gravimetric base (Lomnický štít-destroyed), or Hochkar (Austria),
c) calibration base for positioning (of GPS antenna phase centre (Department of Geodetic Control STU, Geodetic and Cartographic Institute),
d) ephemerides of GPS satellites (international GPS geodynamic service) from Bern,
e) metrologic centre of TU Munich (calibration of levelling rods).

Before the season, at these places geodetic instruments used for the work in geodetic control are regularly calibrated and verified.

Literature:

[1] FERIANC, D. - PRIAM, Š. - KLOBUŠIAK, M.: Conception of the development of Slovakia s geodetic control for 2000 - 2005. Bratislava, Geodesy, Cartography and Cadstre Authority of the Slovak Republic 2001.

[2] FERIANC, D.: Principles of activities in NSN. [Internal regulation.] Bratislava, Geodetic and Cartographic Institute Bratislava 2000.

[3] MOJZEŠ, M.: Improvement of gravimetric quasi-geoid of the Slovak Republic. [Stage 4e) of a partial research project „Integrated geodetic network.“] Bratislava, Research Institute of Geodesy and Cartography in Bratislava 1999.

[4] KLOBUŠIAK, M. - LEITMANNOVÁ, K. - PRIAM, Š. –FERIANC, D. : Positioning of GPS receivers antenna phase centre on the temporary baseline.

[5] LEITMANNOVÁ, K. - KLOBUŠIAK, M. - PRIAM, Š: Determination of the heights of significant shields of The High Tatras using GPS. Geodetický a Kartografický obzor/Geodetic and cartographic review?, No. 11, 2000.

[6] Proceedings of Conference at the 50th anniversary of the Geodetic and Cartographic Institute foundation Bratislava. Bratislava, Geodetic and Cartographic Institute Bratislava 2000.

[7] KLOBUŠIAK, M.: Programs for simultaneous effective estimate of motion equations of control points and their coordinates, measured using GPS technology. [Final research report of the project: Integrated geodetic network, stage 4a]. Bratislava, VÚGK 1999, 15 pp, 11 appendices.