

National Report of Ukraine

The fundamental GPS network establishment in Ukraine

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Introduction.

The State Service of Geodesy, Cartography and Cadastre has focused his effort during last two year on the technological development in Geodesy and continue the policy of EUREF implementation in Ukraine. The main efforts were concentrated on the further development of Permanent GPS Network as well as on the establishment of connection between the GPS network and the traditional State Geodetic Network and calculation of precise transformation parameters between ETRF and State Coordinate System. These activities

and the GPS technology application for the Geodetic Survey of Boryspol Airport are discussed in this paper.

1. Permanent GPS network development in Ukraine.

The first efforts to develop the Permanent GPS Network in Ukraine started in 1995 with the first GPS campaign. The actual status of Ukrainian GPS Permanent Network is shown in fig.1.

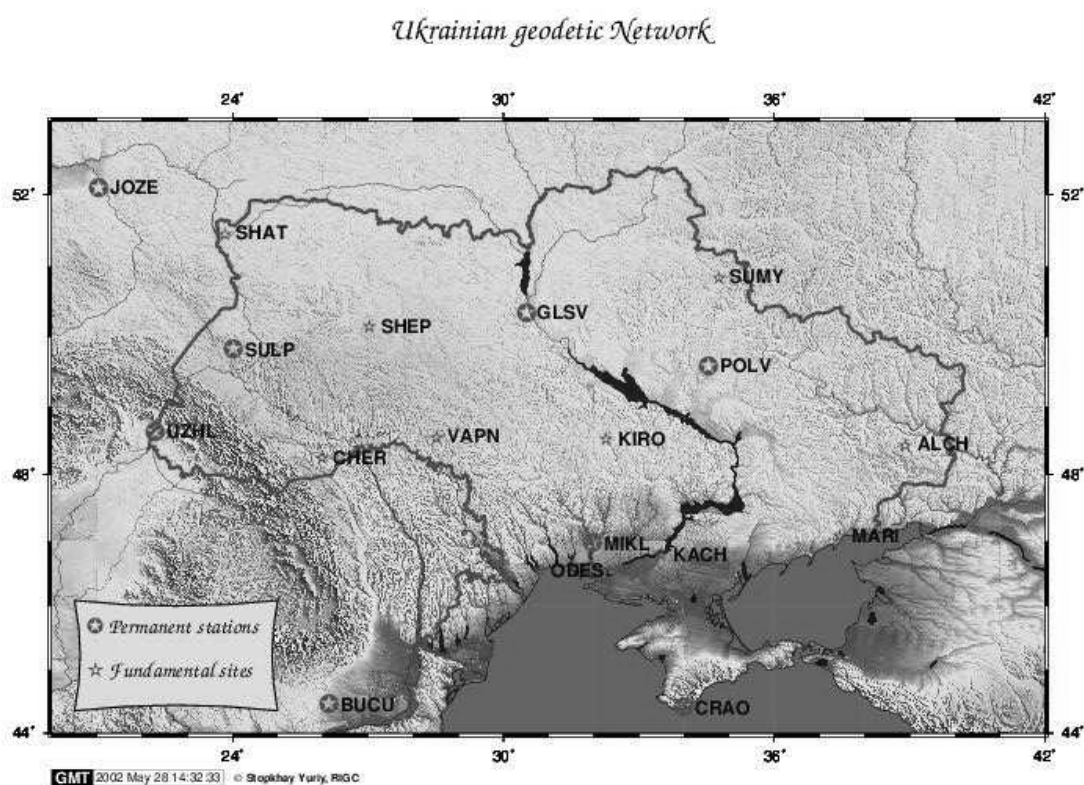


Figure 1. Actual status of Ukrainian GPS Network.

There are 7 permanent stations in Ukraine now:

GLSV	Golosiiv	North of Ukraine
UZHL	Uzhgorod	West of Ukraine
EVPA	Evpatoria	South of Ukraine, Crimea
CRAO	Simeiz	South of Ukraine, Southern Crimea

POLV	Poltava	Central Ukraine
SULP	Lviv	West of Ukraine
MIKL	Mykolaiv	South of Ukraine

Three of them (GLSV, UZHL, EVPA) are established and managed by the Main Astronomical Observatory (MAO)

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of National Academy of Sciences of Ukraine. Sites GLSV and UZHL are the IGS-stations and EPN-stations. The site EVPA will be included in these networks after setting up Internet connection.

These stations are equipped with Trimble 4000SSI GPS receivers and TRM29659.00 (Choke Ring) antennas. The receiver on station GLSV has RTCM oOutput option, so it can be used as a base DGPS-station. Operation of receivers is fully automated using Golosiev GPS software developed by Dr.O. KHODA (MAO) using advantage of OS Linux, R-utilities of Trimble and TEQC software (ESTEY, 1998).

Permanent GPS station CRAO is installed by the Massachusetts Institute of Technology (MIT) as permanent station of Mediterranean GPS Network. Site is equipped with GPS-receiver ROGUE SNR-8000 and antenna AOAD/M_T.

Observations on this station are available on ftp-sites at UNAVCO—archive.unavco.ucar.edu/pub/ps_out/<year>/<DOY> and at MAO ftp.mao.kiev.ua/pub/gps/archive/<year>/CRAO.

Last three stations (POLV, SULP, MIKL) were installed by Research Institute of Geodesy and Cartography of the State Service of Geodesy, Cartography and Cadastre of Ukraine.

These stations are equipped with Trimble 4700 CORS receivers and TRM41249.00 (Zephyr) antennas, except the station POLV, where the TRM29659.00 (Choke Ring) antenna is used. Trimble Reference Station (TRS) software is used to operate the receivers at stations POLV and SULP. Both stations are registered as EPN/IGS stations. GGPS software is used to operate the receiver and manage data at the station MIKL. MIKL will be soon proposed to including in EPN/IGS networks.

According to the requirements of IGS (IGS, 1997) and EUREF (GURTNER, 1997) observations on sites are organized with following parameters: session start at 00:00 UTC daily; session end at 23:59 UTC daily; measurement rate: 30 sec beginning from 0 sec; elevation mask: +5°.



Figure 2. IGS/EPN station POLV (Poltava)

Hourly data is available at the station SULP.

Next step of Research Institute of Geodesy and Cartography will be the installation of permanent stations in Alchevsk (Eastern Ukraine) and Kharkiv (Eastern Ukraine).

These stations will be available for international community. The view to the permanent station POLV is shown on fig. 2.

2. Connection between the State Geodetic Network and Fundamental GPS Network.

The observation campaign on 16 sites of Fundamental GPS Network and on 48 the first-order points first-ordered sites of State Geodetic Network was carried out in August 2000. Sites of the State Geodetic Network were chosen in such manner that allows to observe the pare of astronomic (Laplace) points of the State Geodetic Network.



Figure 3. Observation at the SHEP – site of Fundamental GPS Network.

In June 2001 the re-observation of Fundamental GPS Network (16 sites) was carried out. re-observation of Fundamental GPS Network (16 sites). One of these stations is shown at fig. 3. The software GAMIT was used for processing and analyzing both campaigns. As a result of this campaign precise coordinates and velocities of Fundamental GPS Network stations in ITRF97 and ETRS89, and coordinates of 1-ordered sites of State Geodetic Network in ITRF97, ETRS89 and WGS-84 were obtained. Using the results of the campaign the Helmert transformation parameters between ITRF97 (WGS-84) and old Soviet Coordinate system SK-1942 for Ukrainian territory were also calculated. The accuracy of parameters obtained (the MSE) is around better than 0,1 m..

3. Vertical network and EUVN

In 1997 Ukraine took part in EUVN97 observation campaign. The Ddata from four stations (Mykolaiv, Simeiz, Uzhgorod and Kiev) was sent to Data Center. Responding to resolution No 4 of Dubrovnik Symposia and resolution No 3 of Tromso Symposia, Ukraine additionally can provide data for:

Lviv	(SULP or LVIV)
Poltava	(POLV)
Kiev	(GLSV)
Mikolaiv	(MIKL)
Simeiz	(SIME or CRAO)

All these sites are equipped with permanent stations and the Mmean distance between these points is separation is within 300–400 km. There are the permanent GPS stations. Coordinates of all this station were calculated at Research Institute of Geodesy and Cartography using GAMIT software with sub-centimeter accuracy in ITRF97 (ETRS89).

These sites are connected to the State Vertical Network using the 1-order leveling was leveled as 1-order with approximately accuracy ± 0.15 mm

Geopotential numbers now are available for GLSV, MIKL, SIME (CRAO). In the future plans are to perform The gravimetric measurement on all permanent and fundamental sites of Ukraine measurements on all permanent and fundamental sites of Ukraine are in the plans for a nearest future.

The precise levelling of Permanent/Fundamental sites and part of 1-order network points will be carried out during this year.

4. Gravimetric network

Absolute gravimetric measurements are complete at seven sites (or near sites) of Fundamental /and Permanent networks: Lviv, UZHL, GLSV, KHAR (Kharkiv), Rivne (fig. 4).

Geopotential numbers were passed to sites using the methods relative gravimetric measurements. The accuracy of absolute measurements is within 0.05 mGal, methods (absolute or relative – 0.04-0.06 mGal etc.)

It is planned also to perform gravimetric measurements at all sites of this Permanent and Fundamental networks.

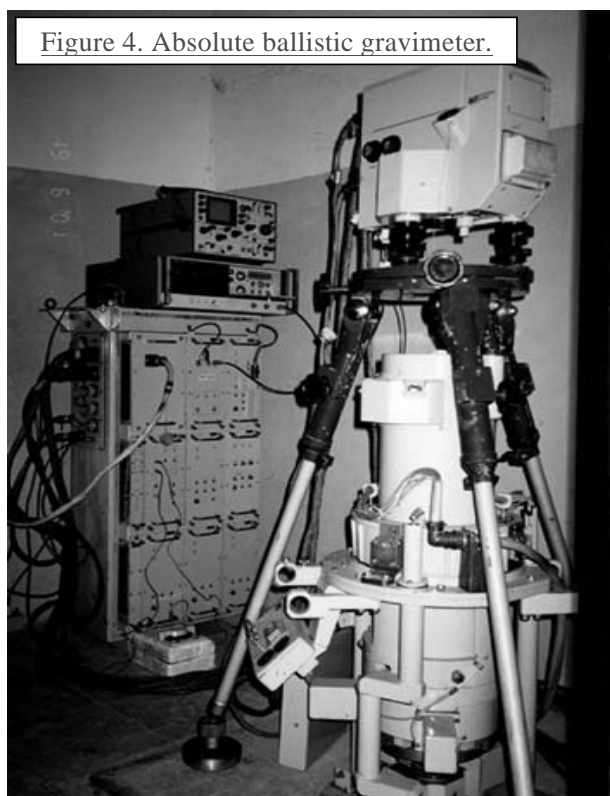


Figure 4. Absolute ballistic gravimeter.

5. Geodetic survey of Borispol International Airport and WGS-84 introduction

In 2000-2001 geodetic survey in Borispol International Airport was performed by the Research Institute of Geodesy and Cartography to provide the airport with WGS-84 coordinates according the ICAO requirements.

The main goal of the survey was to collect the data and air navigation information that can be present to the European Organization for the Safety of Air Navigation (EUROCONTROL) according the ICAO requirements.

The survey includes:

- creation of precision base geodetic network in WGS-84, using GPS technique;
- densification of base network using GPS technique;
- determination of coordinates of all navigation points in WGS-84;
- leveling and gravimetric observation on the territory of Airport;
- modeling of geoid for the territory of Airport;
- calculation of Helmert transformation parameters on the territory of Airport.

All work was performed according to the ICAO requirements.

Conclusions.

According to the plans of the SSGCC during next year are expected the following activities:

- establishment of two more permanent stations;
- creating of 1-st order GPS network to establish connection of national Coordinate System (State Geodetic Network) and ETRS89.
- connection of all permanent stations to the State Vertical Network of the 1-st or the 2-nd orders.
- establishment of connection between State Vertical Network and UELN/EUVN.
- Participate in European projects connected with UEGN2002 and the development European Gravimetric Geoid.