Polish National Report on EUREF related activities in 1998 – 1999

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1. Polish geodynamic Network

Polish geodynamic network was completed in 1998 (DOBRZYCKA et al., 1998). It consists of 36 stations; most of them belong to the primary geodetic control (EUREF-POL and POLREF sites). The stations are nearly evenly spread all over Poland and comprise all main and secondary geological block structures (Fig. 1).

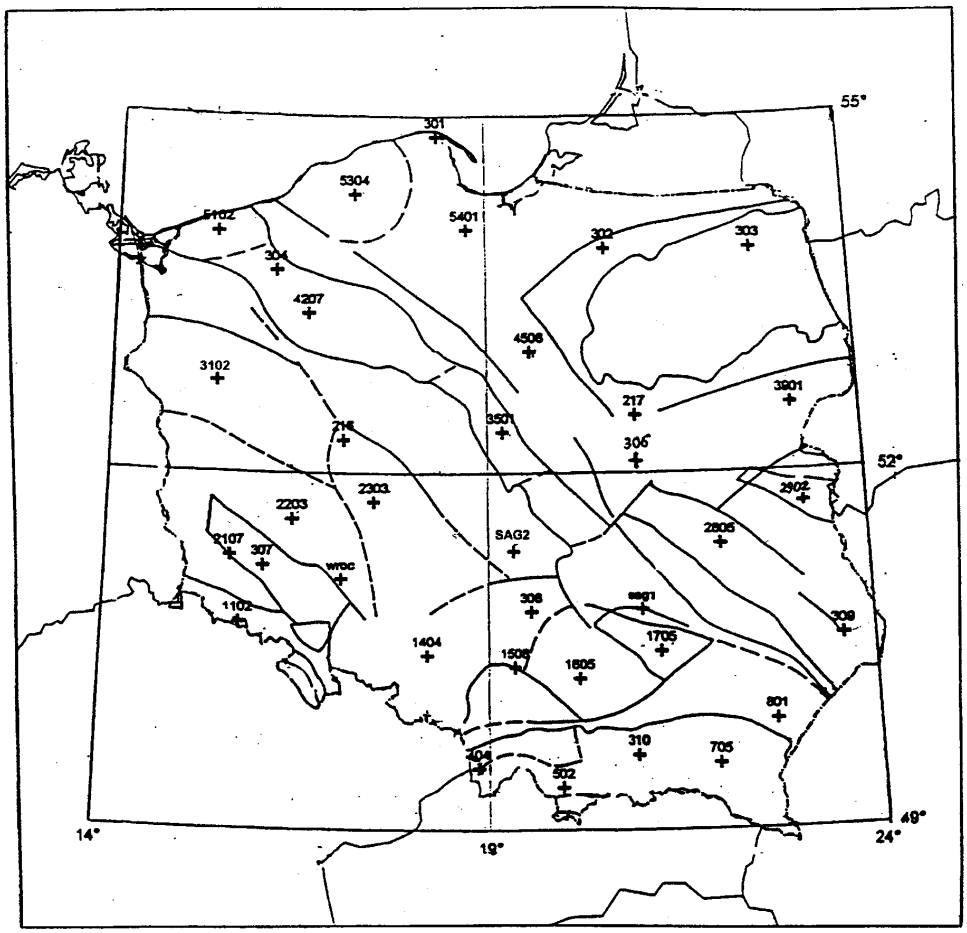

Fig.1: Polish Geodynamic Network

The GPS observations were conducted in two campaigns. The data were collected in 3-day sessions (6 day sessions at joining points) and were processed using Bernese version 4.0 software according to the standards. The obtained results show a distinct bias as compared to the data of the primary geodetic control. Steadily improving, different ITRF frame parameters used as well as different versions of processing software, methods of adjustment and ties selection could contribute to the estimated bias. Special attention was also paid to the antenna phase centre offsets used in both former

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GPS campaigns and geodynamic network campaign. The project concerning the comparison of the GPS antenna offsets for different antenna types was conducted. GPS data from the observational campaign performed at the pillars of the precise metrological national calibration baseline in Warsaw were processed.

2. Local Geodynamic Networks

Institute of Geodesy and Geodetic Astronomy, Warsaw University of Technology (WUT) took part in a GPS campaign organized in the frame of the Polish-Slovak regional project *Geodynamics of the Tatra Mountains*. In 1999 a session of three-full-day GPS observations at three Polish and six Slovak stations situated in the Tatra Mts. was performed (SLEDZINSKI, 1999).

Another GPS and gravimetric measurements aimed at determination of a geoid profile near Tatra Mts. were performed in 1999 by Institute of Geodesy and Cartography (IGC) in Warsaw.

In the western part of Poland the GPS observation campaign of the joint Polish and Czech geodynamic network of Eastern Sudety Mts. was organized by University of Agriculture in Wroclaw (UAW) on 11-12 September 1999. The work is being performed with the Czech scientists as coincidence of two projects: Polish project GEOSUD and the Czech Project SILESIA. In 1997 the GEOSUD network was integrated with the SILESIA network in the northern part of Morava into the new network named SUDETEN (SHENK et al., 1998).

3. Activity of the permanent GPS EUREF stations

Five permanent GPS stations operate in Poland. They are: Borowa Gora (Ashtech Z-12), Borowiec (Turbo Rogue SNR8000), Jozefoslaw (Trimble 4000SSE and Turbo Rogue SNR80000), Lamkowko (Ashtech Z-12 and Turbo Rogue SNR8000), Wroclaw (Ashtech Z-12). Three of them are incorporated to the International GPS Service (Borowiec, Jozefoslaw, Lamkowko). In September 1998 Borowiec station started to carry out permanent double frequency P-code observations of GLONASS satellites in the frame of IGEX (International GLONASS Experiment) Campaign. The observations are carried out with six-channel 3S Navigation receiver, equipped with choke ring, temperature stabilized antenna (BARAN, 1999).

The stations Borowiec and Borowa Gora work in the system of the hourly download data transmission. At the station Borowiec on August 11, 1999 a special one-day campaign was performed for investigation of the solar eclipse effects in the ionosphere (SLEDZINSKI, 1999).

It is to be pointed out that a heavy thunderstorm on 19 July 1999 damaged the antenna, the receiver and a computer network of the station Wroclaw. Permanent observations will be restarted after installation of a new GPS/GLONASS receiver Ashtech Z-18.

4. Local area DGPS/RTK network in Poland

It is known from our previous National Report (BARAN, ZIELINSKI, 1999), that first DGPS stations in Poland (ROZEWIE and DZIWNOW) were created in 1996. They are located on the southern Baltic seashore.

Since 1997 Institute of Geodesy of the WM University in Olsztyn (WMU) has been engaged in experimental works on application of DGPS Service for the needs of Gdansk agglomeration (BARAN, OSZCZAK, 1999). Three multi functional DGPS and RTK reference stations were established in Gdansk, Sopot and Gdynia. The link between reference stations and user receivers will be held using radio waves at frequency of about 450 MHz, power of transmission will be of 10W. It is foreseen that the system should be fully operational in 2001 (OSZCZAK et al.).

The system will be widely used in the field of navigation as well as geodesy. In the field of navigation it will fulfil the following tasks:

- augmentation of emergency and civil town services (police, fire brigades, first aid ambulance services, transportation etc.),
- real-time positioning and navigation (land, maritime),
- bathymetric measurements, maritime navigation signs, etc.

On the other hand, in the field of geodesy it will enable:

- data acquisition for GIS/LIS,
- measurements of geodetic detailed networks, augmentation of Total Station instruments in land details surveying for digital mapping purposes, engineering surveying etc.
- easier modernization of cadastre.

DGPS network was established at the Space Research Centre (SRC) of the Polish Academy of Sciences. The network consists of:

- base station, located at SRC building,
- remote station established in mobile GPS laboratory,
- local UHF telemetry link,
- test bed, prepared for two kinds of measurements i.e. static and kinematic.

The base station works as a permanent DGPS reference station. The differential corrections are broadcasted once a day during one-hour period. The operational range of the network depends on radio propagation conditions and reaches about 3 to 5 km away from the base.

Station Borowa Gora maintains the DGPS service based on the Ashtech Z-12 GPS receiver generating DGPS RTCM corrections and on mobile phone system GSM. In October 1999 in the centre of city of Warsaw there was installed another reference DGPS RTK station equipped with the receiver Z-12 and a software NAVI; also the mobile phone system Plus GSM is used.

Station Jozefoslaw installed Trimble Community Base Station and mobile phone in NMT 450i analogue system for distribution of DGPS corrections in RTCM 104 format for limited number of users (SLEDZINSKI, 1999).

Nowadays Head Office of Geodesy and Cartography is working on the concept for CORS (Continuously Operating Reference Station) Network in Poland. First stage should satisfy the needs for surveying on 2-centimetre level for horizontal values and 5-centimetre level for vertical values (relative accuracy). First phase should include existing permanent stations. During a pilot project more detailed specifications and standards should be checked and developed. The idea is to use CORS by ordinary surveyors (private individuals) with L1 receivers and not expensive equipment and software (i.e. post-processing instead real-time).

5. Densification of the polish part of EUVN

On the request of the Head Office of Geodesy and Cartography the WUT has realized a project on densification of the Polish part of the European Unified Vertical Network (EUVN). Fifty two new stations coinciding with Polish first order levelling bench-marks plus another seven EUVN stations existing on the Polish territory were measured in September 1999. Every station was observed in two independent one-full-day GPS sessions. Sixteen Trimble receivers 4000SSE/SSi/4700 were engaged. For data processing and adjustment there were also used four EUREF permanent Polish stations as well as six permanent stations of neighbouring countries.

6. Troposphere and ionosphere studies

The activities concerning troposphere and ionosphere were conducted mainly at the Warsaw University of Technology and WM University in Olsztyn.

The research on ionospheric delay to determine Total Electron Content (TEC) and to investigate the influence of TEC changes on the precision of positioning started in WMU in 1995. GPS observations from IGS and EUREF permanent stations were used. The study carried out at minimum solar activity shows that dual frequency GPS observations are useful for monitoring periodical (daily and seasonal) changes of TEC and for monitoring TEC during solar storms periods (BARAN, SHAGIMURATOV, 1998). Solar storms have considerable influence on the accuracy determination of the vectors coordinates. The changing conditions of ionosphere influence mainly the height determination. The height differences obtained under quiet and disturbed ionosphere reach 30 mm even for the 250 km length vectors (BARAN et al., 2000).

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