NATIONAL REPORT OF POLAND TO EUREF 2006

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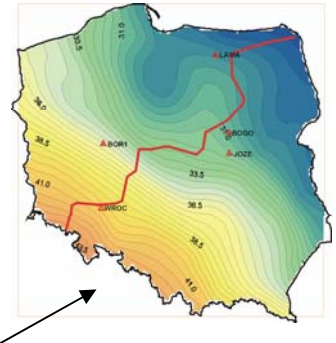
Outline

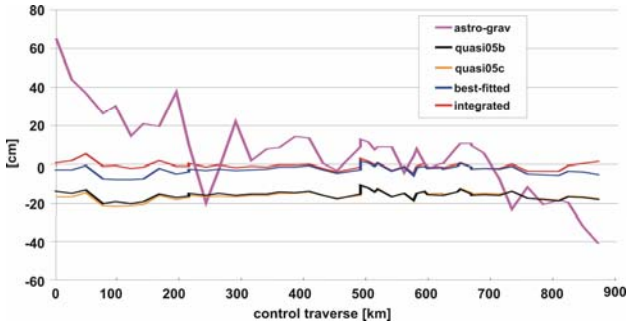
Main geodetic activities at the national level in Poland since 2004

- modelling a **cm geoid model** in Poland,
- maintenance of the national **gravity control**,
- adjustment of re-levelled **1st order vertical control**,
- re-processing of **EUREF-POL, POLREF and EUVN camp.**,
- operational work of **permanent IGS/EUREF stations**,
- data processing at **Local Analysis Centre at WUT**,
- activity within **EUREF-IP project**,
- GNSS **antenna calibration**,
- monitoring of **ionosphere** and ionopheric storms,
- the **ASG/EUPOS** network in Poland,
- activities concerning **Galileo**,
- activity within **ESEAS-RI Project**,
- activity in **SLR**.

Modelling a cm geoid for Poland

- most suitable geopotential model
- DTM – resolution and accuracy
- terrain corrections – methodology and calculation
- mean gravity anomalies – methodology and calculation
- processing of data from control GPS/levelling traverse
- astro-gravimetric geoid, gravimetric quasigeoid, best-fitted quasigeod, integrated quasigeoid
- accuracy estimation of quasigeoid models





Maintenance of national gravity control

- **link of the absolute gravity stations of the Polish gravity control network with long spans with the 3 absolute gravity stations in Czech Republic and 3 absolute gravity stations in Germany**

- **monumentation of 3 intermediate gravity stations along vertical gravity calibration baseline Zakopane - Kasprowy Wierch, link with relative gravity survey with national gravity control and survey of gravity gradients**

- **test measurements and developed**

  a couple of projects on employing the ballistic gravimeter FG5 purchased in 2005

Adjustment of 1st order vertical control

1999-2002 levelling campaign

382 levelling lines
- **total length 17 516 km**
- **average length ~46 km**

16 150 sections
- **average length 1.1 km**

135 loops

245 nodal points

rms of levelling ±0.278 mm/km$^{1/2}$

random error of ±0.264 mm/km$^{1/2}$

systematic error of levelling ±0.080 mm/km

σ of unit weight to ±0.088 mm/km

Adjustment as a free-network with 1 fixed point Warszawa-Wola in Krostadt2006 system.

Normal height of that point - obtained using the constraint of zeroing mean difference between heights in Krostadt2006 system and the respective ones in Kronstadt86 at secular stations of the network (differences at secular stations vary from –19 mm in northern Poland to 22 mm in southern Poland)

Re-processing of EUREF-POL, POLREF and EUVN campaigns

Re-processing of raw data from EUREF-POL, POLREF and EUVN campaigns using unified EPN standards

- verification of raw data
- ITRF2000
- new antenna models
- referencing all campaigns to the same permanent stations

Standard deviations of station coordinates of the POLREF sites from the 2005 solution are substantially larger than those from the solution of 1996.

The fit of the POLREF sites coordinates calculated using data from control survey to those from reprocessing the POLREF campaign in 2005 is twice better than to those from the 1996 solution.

Mean errors of adjusted coordinates of the EUREF-POL, POLREF and EUVN sites in the ITRF

	ITRF	N [mm]	E [mm]	U [mm]
POLREF 1994	ITRF2000	3.09	5.70	9.13
	ITRF92	3.94	6.49	9.67
POLREF 1995	ITRF2000	2.25	2.29	8.28
	ITRF93	2.55	2.46	8.38
EUREF-POL 2001	ITRF2000	1.13	0.81	2.28
EUREF-POL 1992	ITRF2000	2.71	3.92	5.89
	ITRF91	3.31	4.78	6.58
(EUREF-POL 1994)	ITRF2000	1.76	2.39	4.35
	ITRF92	2.76	3.99	6.07
(EUREF-POL 1995)	ITRF2000	1.86	2.23	6.49
	ITRF93	1.98	2.28	8.90
EUVN 1997	ITRF2000	0.92	0.86	2.63
	ITRF97	1.44	1.10	3.70
EUVN 1999	ITRF2000	2.09	2.55	3.35
	ITRF97	2.08	2.56	3.37

Operational work of permanent IGS/EUREF stations

EPN stations in Poland (2005):

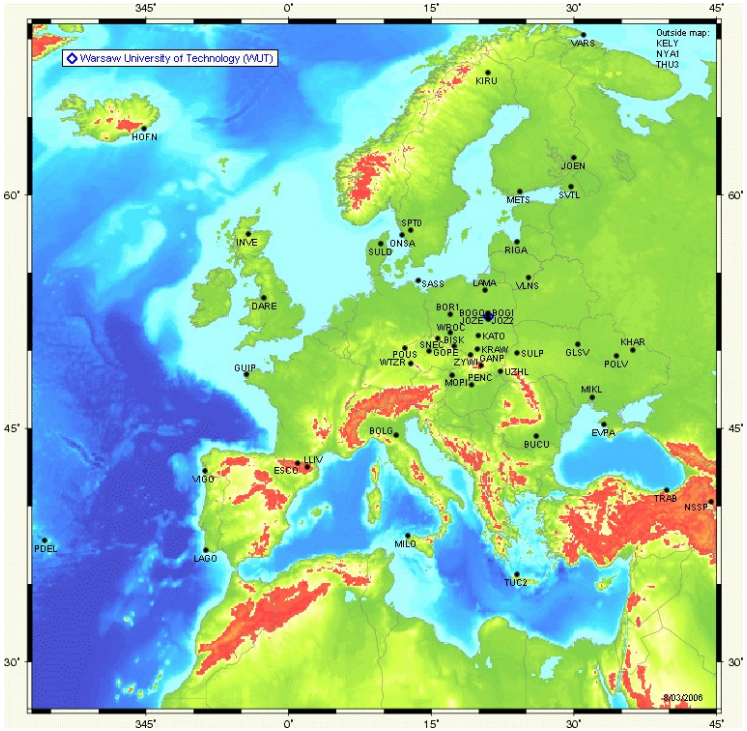
- Borowa Gora (BOGI)
- Borowa Gora (BOGO)
- Borowiec (BOR1)
- Jozefoslaw (JOZE)
- Jozefoslaw (JOZ2)
- Katowice (KATO)
- Cracow (KRAW)
- Lamkowko (LAMA)
- Wroclaw (WROC)
- Zywiec (ZYWI)

Stations participating in IGLOS-PP program:

- Borowa Gora (BOGO)
- Borowiec (BOR1)
- Jozefoslaw (JOZE)
- Wroclaw (WROC)

Data processing at LAC at WUT

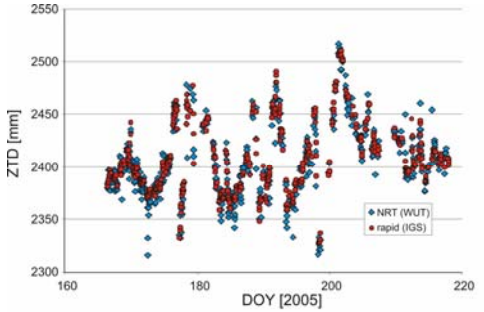
Data from 53 EPN stations
- routinely processed



Fully automatic system for ZTD estimation in NRT
- **successfully set up**
- **operates since November 2005**

test NRT campaign stations

WUT NRT solution vs IGS rapid tropospheric product for station HOFN



OGPSP system of on line GPS data processing for individual users is accessible by
http://ogpsp.gik.pw.edu.pl
since November 2005

Activity within EUREF-IP Project

Stations participating in EUREF IP pilot project:

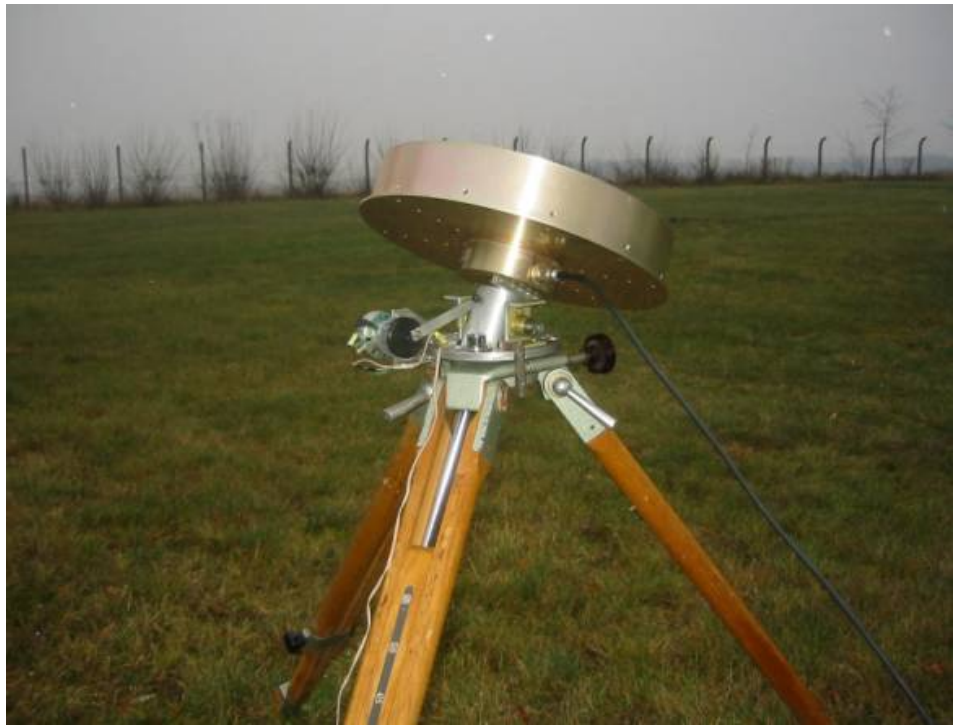
Borowa Gora (BOGI)
Jozefoslaw (JOZE)
Cracow (KRAW)

RTCM Client software developed at Warsaw University of Technology
- stable
- easy for the client

System of GPRS Teletransmission for DGPS/RTK Station Network in Warmia and Mazury region, developed at the University of Warmia and Mazury

GNSS antenna calibration

The prototype of antenna calibration device tested in Borowa Gora
(*Institute of Geodesy and Cartography, Warsaw; Institute "Metrologia", Kharkiv***)**

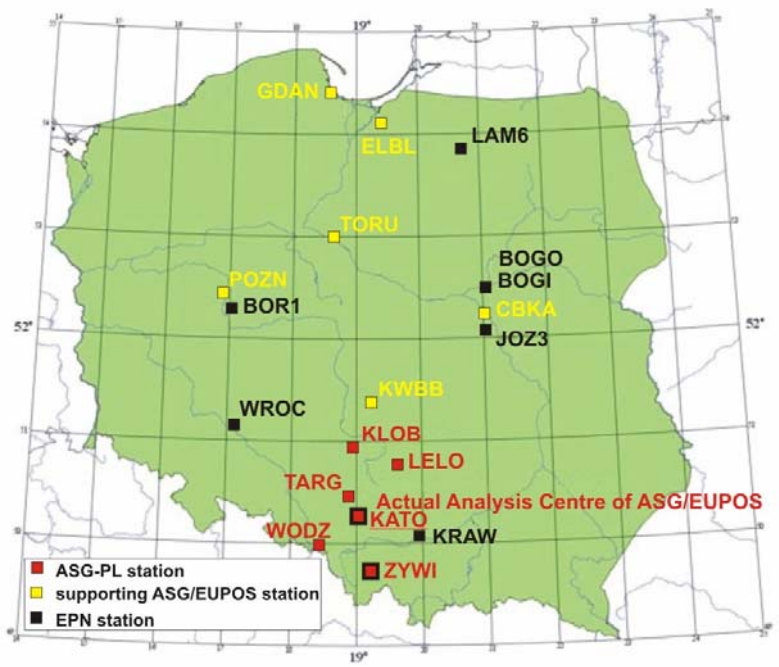


Test measurements in
- **Borowa Gora**
- **Lamkowko**
- **Ukrainian Antarctic station "Akademik Vernadsky"**

Investigation of the effect of of coverage of GPS antenna with snow on the calculated position

ASG/EUPOS network in Poland

(fully operational in Silesian Voivodship – since December 2003)



6 permanent stations:

Ashtech μZ12 –CGRS receivers

ASH701945C_M SNOW antennas

link to 10 EPN stations + 6 other permanent GPS stations

continuous post-processing service in Processing Centre at Katowice via internet

DGPS & RTK in development

observations – 1 s – sampling rate

data available free of charge

at: *www.asg-pl.pl*

87 permanent EUPOS reference stations in Poland
- purchase of the receivers - 2006
- fully operational - September 2007

Galileo activities in Poland

- one of 34 Ranging and Integrity Monitoring Stations RIMS operates since September 2004 in the Space Research Centre PAS
- Galileo Information Point Poland established within the Space Research Centre PAS
- participation in Proddage project of 6th EU Framework Programme - University of Warmia and Mazury, Olsztyn
- participation in Galileo Time Service Provider - project of 6th EU Framework Programme - Astrogeodynamical Observatory SRC PAS

Activity within the ESEAS-RI Project

project completed in October 2005 (SRC PAS)

CGPS station in Wladyslawowo

- Ashtech uZ-CGRS with Ashtech Dorne-Magolin Choke Ring antenna
- data acquisition – 30 s rate since April 2003
- precise levelling of GPS marker and tide gauge sensor
- absolute gravity with FG5 – surveyed by FGI (Mäkinen) in 2004, 2005

Station in Darlowko

- two 5-days GPS campaigns
- precise levelling of GPS marker and tide gauge sensor

ESEAS Analysis Centre

- analysis of CGPS data (time series)
- determination of vertical crustal movements
- monitoring of absolute and relative sea level changes

need for further research and development!

Satellite Laser Ranging

Borowiec station operates within ILRS and EURULAS

in 2005:

- **~1000 successful passes of 16 SLR satellites with the normal point precision of 4 mm and accuracy of 15 mm**
- **construction of the transmitting system for Galileo satellites laser ranging**
- **determination of the positions and velocities of all SLR stations for 1999-2003**
- **determination of SLR station positions from Starlette and Stella satellites**
- **orbits calculation of the low satellites: Starlette, Stella and CHAMP**
- **movement of Tateyama SLR station due to crustal deformation**