NATIONAL REPORT
OF POLAND
TO EUREF 2009

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Outline

Main geodetic activities at the national level in Poland since 2006

- maintenance of the national gravity control
- operational work of permanent IGS/EUREF stations
- data processing at Local Analysis Centre at WUT
- GNSS for meteorology
- monitoring of ionosphere
- the ASG-EUPOS network in Poland
- modelling a cm geoid model in Poland
- Galileo project
- Earth tides monitoring
- activity in SLR
Maintenance of national gravity control (1)

Continuation of

1. densification of 1st order absolute gravity network in Poland

2. modernization of gravimetric calibration baselines
   • absolute gravity survey with FG5 230 of WUT
   • relative gravity survey with a set of L&R of IGiK
     - interconnection of absolute gravity points
     - link with gravity control

3. monitoring non-tidal gravity changes at
   • Jozefoslaw Astrogeodetic Observatory of WUT
   • 4 other absolute gravity stations in Poland
Maintenance of national gravity control (2)

Since September 2008
the A-10 No 20 absolute ballistic portable gravimeter
at the Institute of Geodesy and Cartography

First measurements with A-10 at the Borowa Gora Observatory
Operational work of permanent IGS/EUREF stations

**EPN stations in Poland**
- Biała Podlaska (BPDL)
- Borowa Gora (BOGI)
- Borowa Gora (BOGO)
- Borowiec (BOR1)
- Bydgoszcz (BYDG)
- Gorzow Wielkopolski (GWWL)
- Jozefoslaw (JOZE)
- Jozefoslaw (JOZ2)
- Katowice (KATO)
- Krakow (KRAW)
- Lamkowko (LAMA)
- Lodz (LODZ)
- Redzikowo (REDZ)
- Suwalki (SWKI)
- Ustrzyki Dolne (USDL)
- Wroclaw (WROC)
- Zywiec (ZYWI)

**Stations participating in EUREF-IP project:**
- BOGI
- BOR1
- JOZE
- JOZ2
- LAMA
- WROC

Symposium of the IAG Subcommission for Europe
European Reference Frame – EUREF 2009
Florence, Italy, 27-30 May 2009
Data processing at LAC at WUT

Data from 71 EPN stations - routinely processed
GPS for meteorology

Dramatic decrease of ZTD differences between individual LAC solutions in 2007 (solutions after GPS week 1400 showing best conformity since the year 2003)

IPW values coming from GPS (different EPN solutions and combination) are reliable as compared with routinely derived water vapour data from
• radiosoundings,
• sun photometer, and
• input data of numerical prediction model

Simple model of daily IPW values series (sinusoid + constant) derived from IGS CODE ZTD solution for JOZE 1997-2001
Monitoring ionosphere

Study the ionosphere and its changes with the use of GNSS signals
• methodology for TEC changes monitoring with 5-minute temporal and 150-250 km spatial resolution during severe ionospheric storms,
• new index describing ionospheric disturbances
• application of high resolution ionospheric TEC maps to studying the ionosphere during eclipses
• mid-latitude ionospheric trough over Europe
• ionospheric precursors of the earthquakes
• application of several complementary observing techniques to improvement of the ionosphere models derived from satellite data

Studies on the improvement of GNSS precise positioning
• methodology algorithms for application of predicted, local ionosphere model to support RTK GNSS positioning over long ranges
• methodology concerned application of weighted ionospheric corrections for rapid-static GNSS positioning over long ranges
Reference stations of ASG-EUPOS network
- 98 of the Polish part
- 20 foreign

Stations of ASG-EUPOS
- Biała Podlaska (BPDL)
- Bydgoszcz (BYDG)
- Gorzow Wielkopolski (GWWL)
- Lodz (LODZ)
- Redzikowo (REDZ)
- Suwalki (SWKI)
- Ustrzyki Dolne (USDL)

became fully operational as EPN stations in May 2008

Services of ASG-EUPOS are realized in ETRS89
ASG-EUPOS network in Poland (2)

2820 registered users of the ASG-EUPOS system at the end of 2008

ASG-EUPOS system usage in its first operational year

NAWGEO – an RTK service for highest precision real-time measurements most popular among real-time services the
The EPN solutions are used in the ASG-EUPOS system to monitor the stability of the reference frame realized by the ASG-EUPOS stations.

The ETRF2000 epoch 2005.0 datum has been used in Poland for permanent stations of the ASG-EUPOS network as the best realization of ETRF.

Coordinates of the stations have been determined in common adjustment for all ASG-EUPOS stations using the Bernese software. The EPN stations: BOR1, WTZR, METS, POTS, ONSA were included into adjustment as reference points (ETRF 2000 PL solutions).

The official coordinates of EPN stations in Poland were compared with the coordinates published by EUREF in December 2008 (due to short period of permanent observations the coordinates of some stations could not been determined by EPN).

EUREF coordinates were calculated for the epoch 2005 using EPN published velocities.
ASG-EUPOS network in Poland (4)

Difference between
and
PL solution ETRF2000 (epoch 2005.0)

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Modelling a cm geoid for Poland

Quasigeoid determination with LS collocation using:
- gravity data
- deflections of the vertical, and
- DTM

Effect of uncertainty of:
- height
- position
- DTM

of gravity stations

on the accuracy of terrain corrections
- analytical formulae
- numerical estimation
Galileo Project

GESS+ in Warsaw - station of the global Galileo ground control network
Earth tides monitoring (1)

Earth tides monitored in the Astrogeodetic Observatory of WUT in Jozefoslaw using L&R ET-26 gravimeter since January 2002

- create new model of the gravimetric Earth tides for Jozefoslaw Observatory
- monitoring of environmental effects - continuation
- calibration of L&R ET-26 with FG5 230
- studies of the modulation of tidal waves
- application of wavelet transform for the analysis tidal record
Non-tidal signal observed by long water-tube tiltmeter in period 2004-2007

Plumbline variations from long water-tube measurements in 26 December 2004
Satellite Laser Ranging

Borowiec station operates within ILRS and EURULAS

in 2008:

• ~208 successful passes of 16 SLR satellites with the normal point precision of 3 mm and accuracy of 20 mm

• modernization of the hardware and software of the SLR system

• comparison of positions and velocities of all SLR stations in 1993-2004 determined with GPS and SLR

• determination of positions and velocities of all SLR stations from Starlette, STELLA, and Ajisai as well as CHAMP and Larets