

NATIONAL REPORT OF POLAND TO EUREF 2009

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Symposium of the IAG Subcommittee for Europe
European Reference Frame – **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**



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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



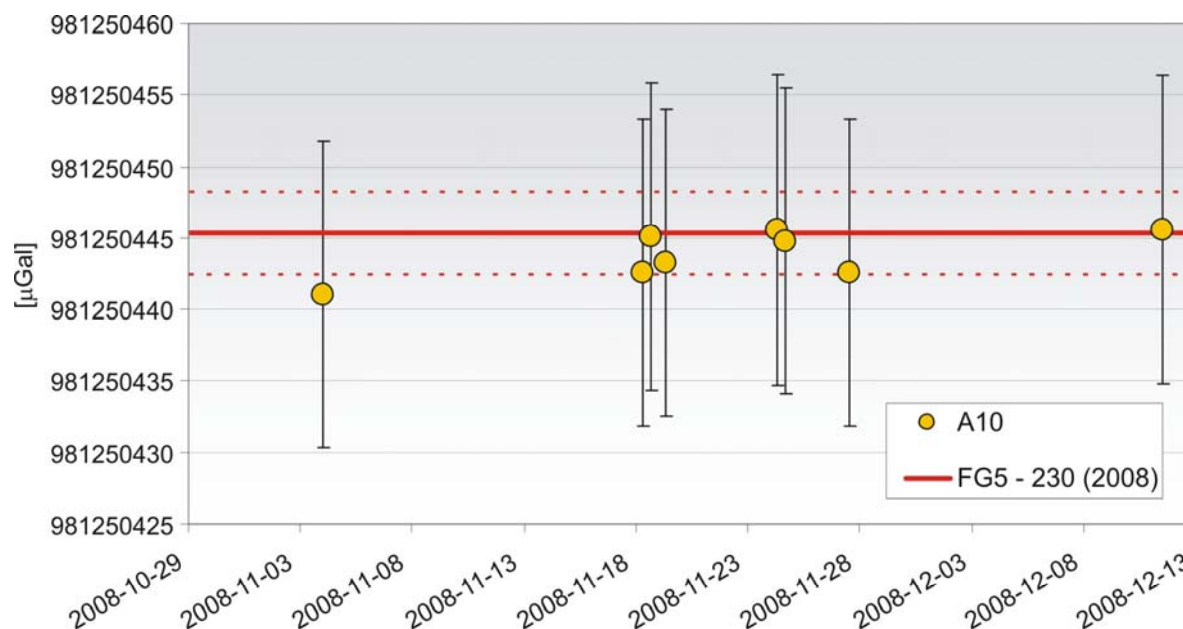
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Maintenance of national gravity control (2)

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

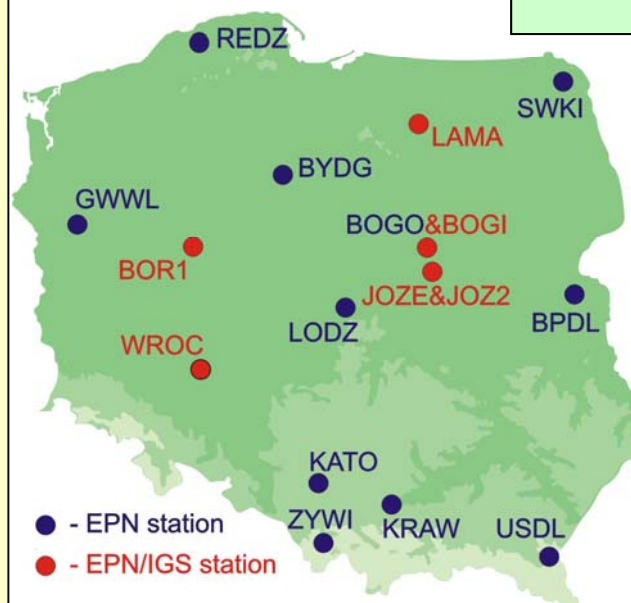


EPN stations in Poland

- Biala Podlaska (BPDŁ)
- Borowa Gora (BOGI)
- Borowa Gora (BOGO)
- Borowiec (BOR1)
- Bydgoszcz (BYDG)
- Gorzów Wielkopolski (GWWL)
- Józefosław (JOZE)
- Józefosław (JOZ2)
- Katowice (KATO)
- Kraków (KRAW)
- Łamkowo (LAMA)
- Łódź (ŁODZ)
- Redzikowo (REDZ)
- Suwałki (SWKI)
- Ustrzyki Dolne (USDL)
- Wrocław (WROC)
- Żywiec (ZYWI)

Stations participating in EUREF-IP project:

- ♥ BOGI
- ♥ BOR1
- ♥ JOZE
- ♥ JOZ2
- ♥ LAMA
- ♥ WROC



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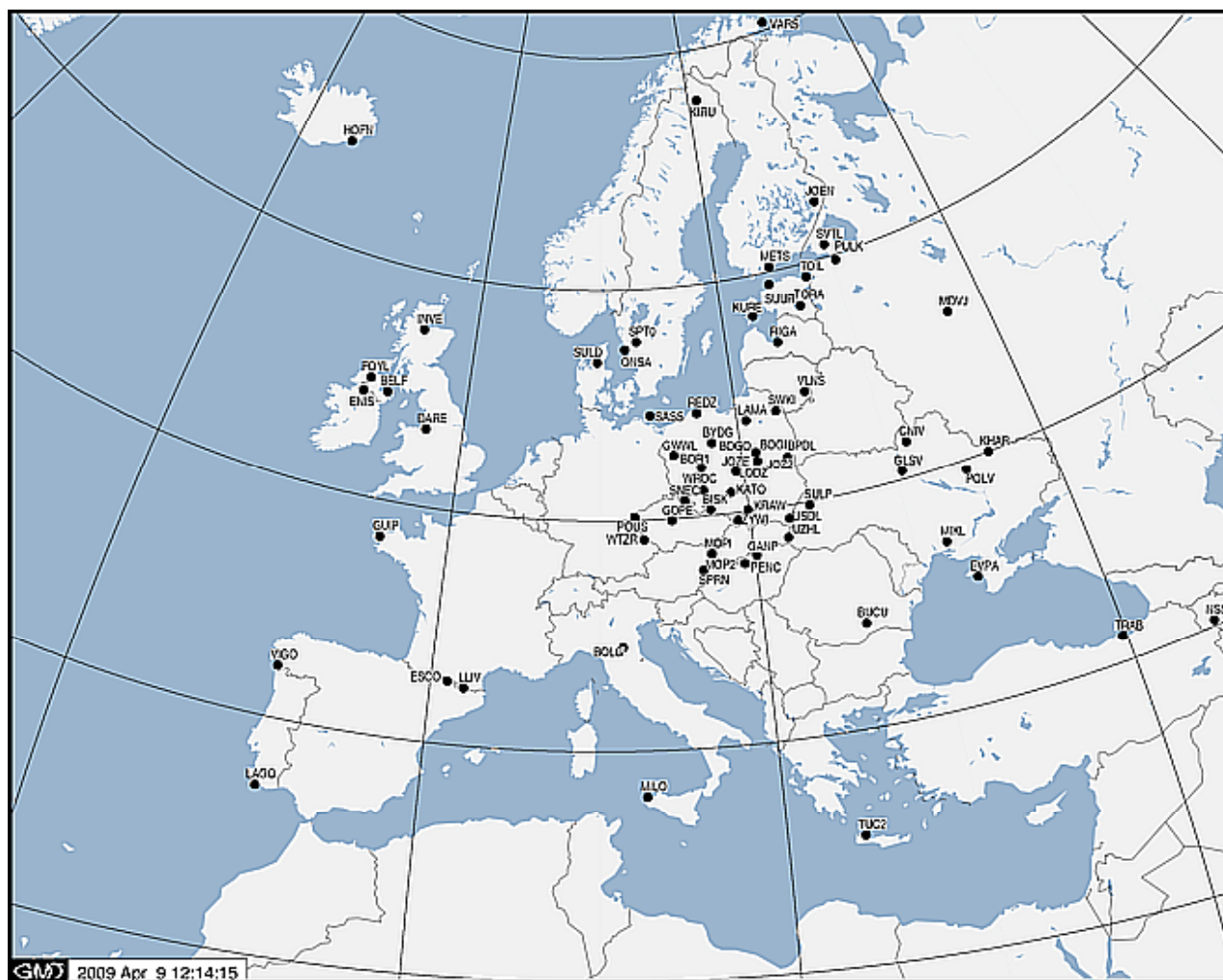




Data processing at LAC at WUT



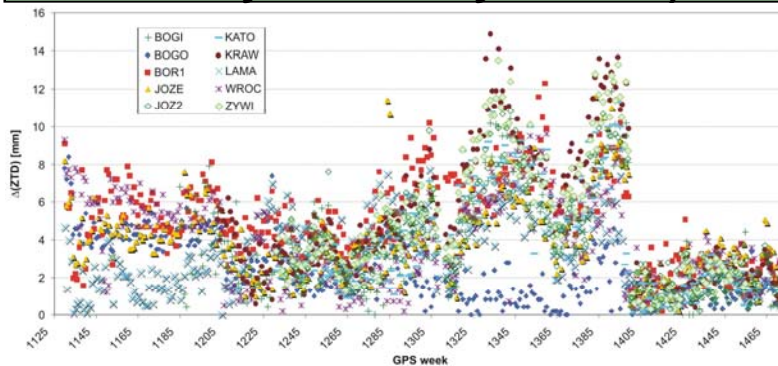
Data from **71 EPN** stations - routinely processed



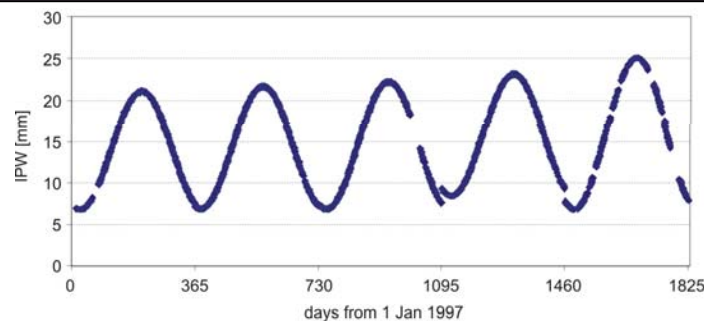
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Dramatic decrease of ZTD differences between individual LAC solutions in 2007 (solutions after GPS week 1400 showing best conformity since the year 2003)

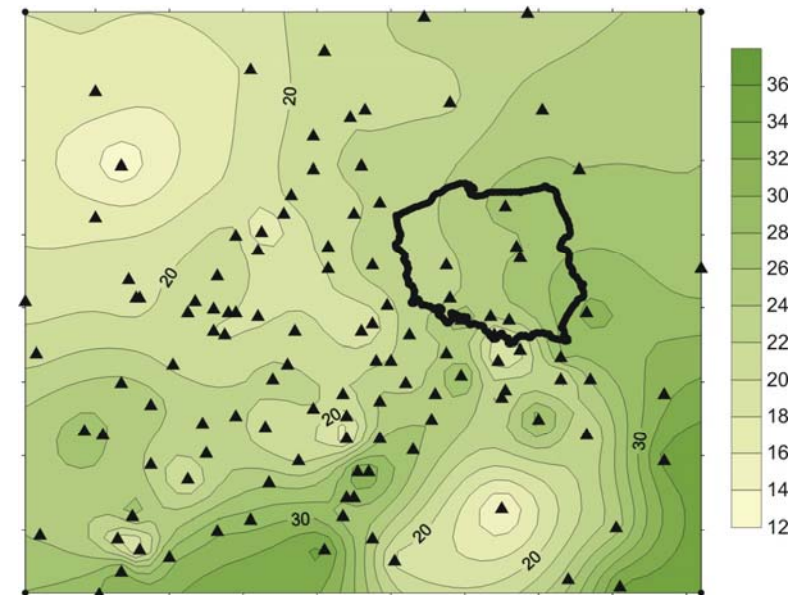


Simple model of daily IPW values series (sinusoid + constant) derived from IGS CODE ZTD solution for JOZE 1997-2001



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





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



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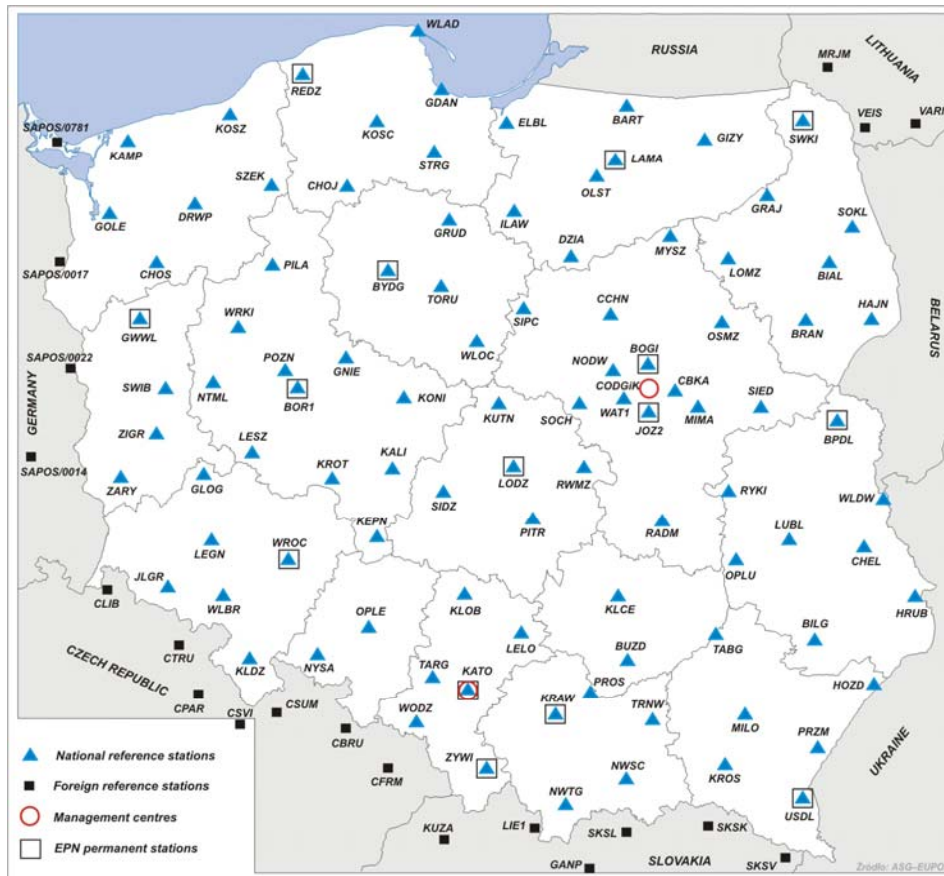




ASG-EUPOS network in Poland (1)

Reference stations of ASG-EUPOS network

- 98 of the **Polish part**
- 20 foreign



Stations of ASG-EUPOS

- Biała Podlaska (BPDŁ)
- Bydgoszcz (BYDG)
- Gorzów Wielkopolski (GWWL)
- Łódź (ŁODZ)
- Redzikowo (REDZ)
- Suwałki (SWKI)
- Ustrzyki Dolne (USDŁ)

became **fully operational**
as EPN stations
in May 2008

**Services of ASG-EUPOS
are realized in ETRS89**



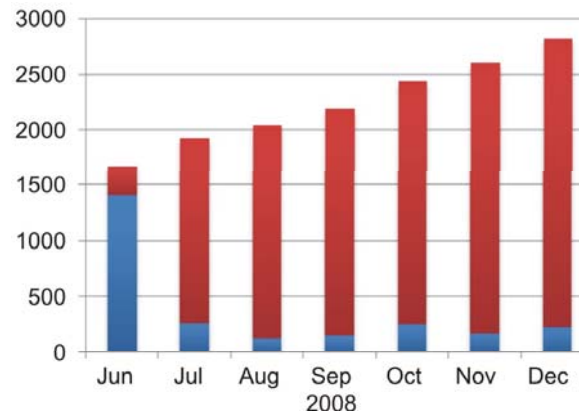
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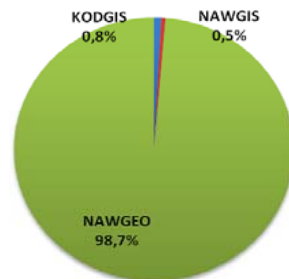


ASG-EUPOS network in Poland (2)

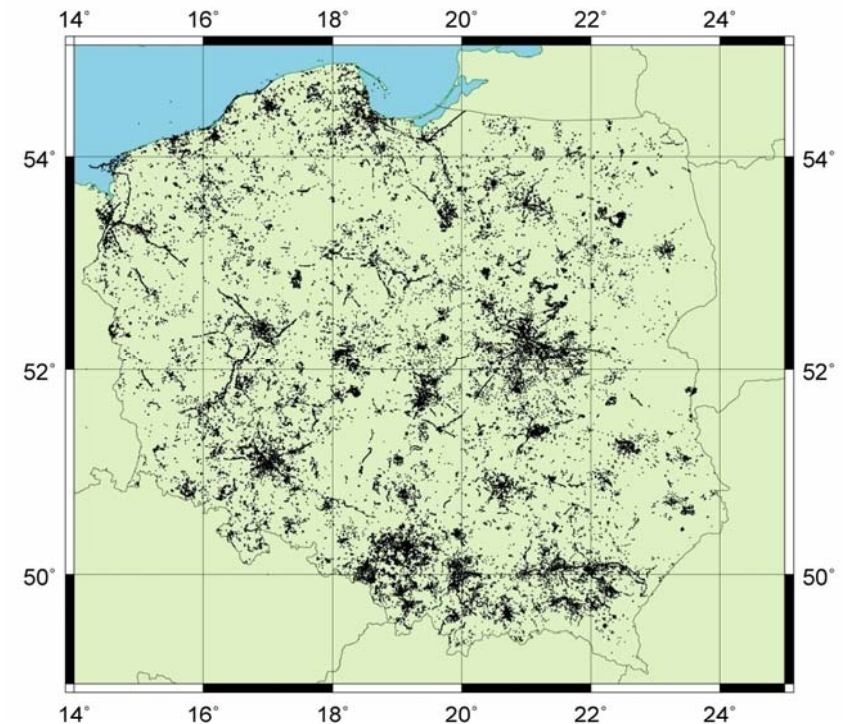
2820 registered users
of the ASG-EUPOS system
at the end of 2008



NAWGEO – an RTK **service** for highest precision real-time measurements **most popular** among real-time services the



ASG-EUPOS system usage in its first operational year



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ASG-EUPOS network in Poland (3)



- 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 be determined by EPN)
- EUREF coordinates were calculated for the **epoch 2005** using EPN published velocities



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ASG-EUPOS network in Poland (4)



Difference between
(EUREF solution (Dec. 2008) ETRF2000 epoch 2005.0)
and
PL solution ETRF2000 (epoch 2005.0)

Station ID	dX [m]	dY [m]	dZ [m]
BOGI	-0.005	0.001	-0.008
BOGO	-0.001	0.000	-0.002
BOR1	0.003	0.002	0.007
BPDL			
BYDG			
GWWL			
JOZ2	-0.007	0.007	-0.007
KATO	-0.015	-0.001	-0.010
KRAW	-0.008	0.001	-0.006
LAMA	0.002	0.005	0.002
LODZ			
REDZ			
SWKI			
USDL			
WROC	-0.010	-0.002	-0.004
ZYWI	-0.016	-0.002	-0.010



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Modelling a cm geoid for Poland



Quasigeoid determination
with LS collocation

using

- gravity data
- deflections of the vertical, and
- DTMs

Effect of uncertainty of

- height
 - position
 - DTM
- } of gravity stations

on the accuracy of terrain corrections

- analytical formulae
- numerical estimation



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Galileo Project

GESS+ in Warsaw - station of the global Galileo ground control network



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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**



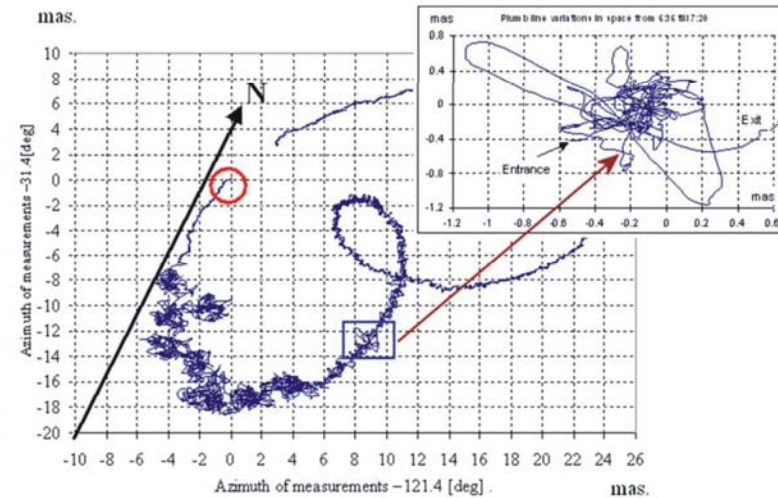
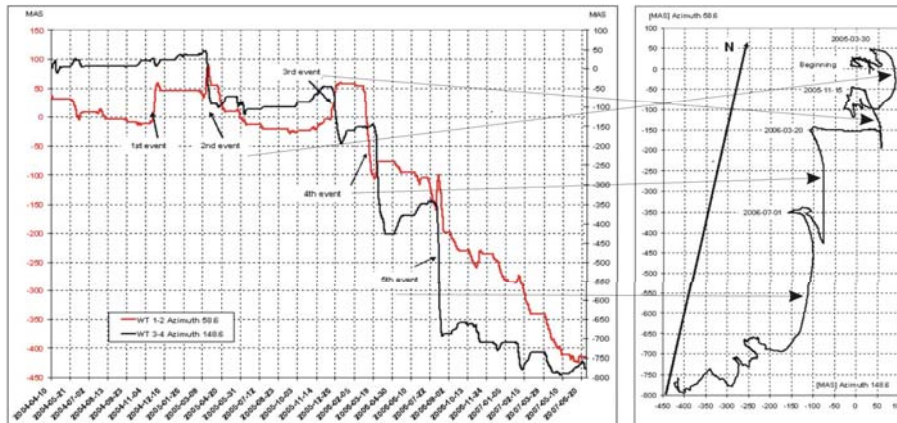
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Earth tides monitoring (2)

Geodynamic Laboratory of Space Research Centre PAS in Ksiaz in Sudeten Mountains

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



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