NATIONAL REPORT OF POLAND TO EUREF 2014

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Symposium of the IAG Subcommission for Europe
European Reference Frame – **EUREF 2014**
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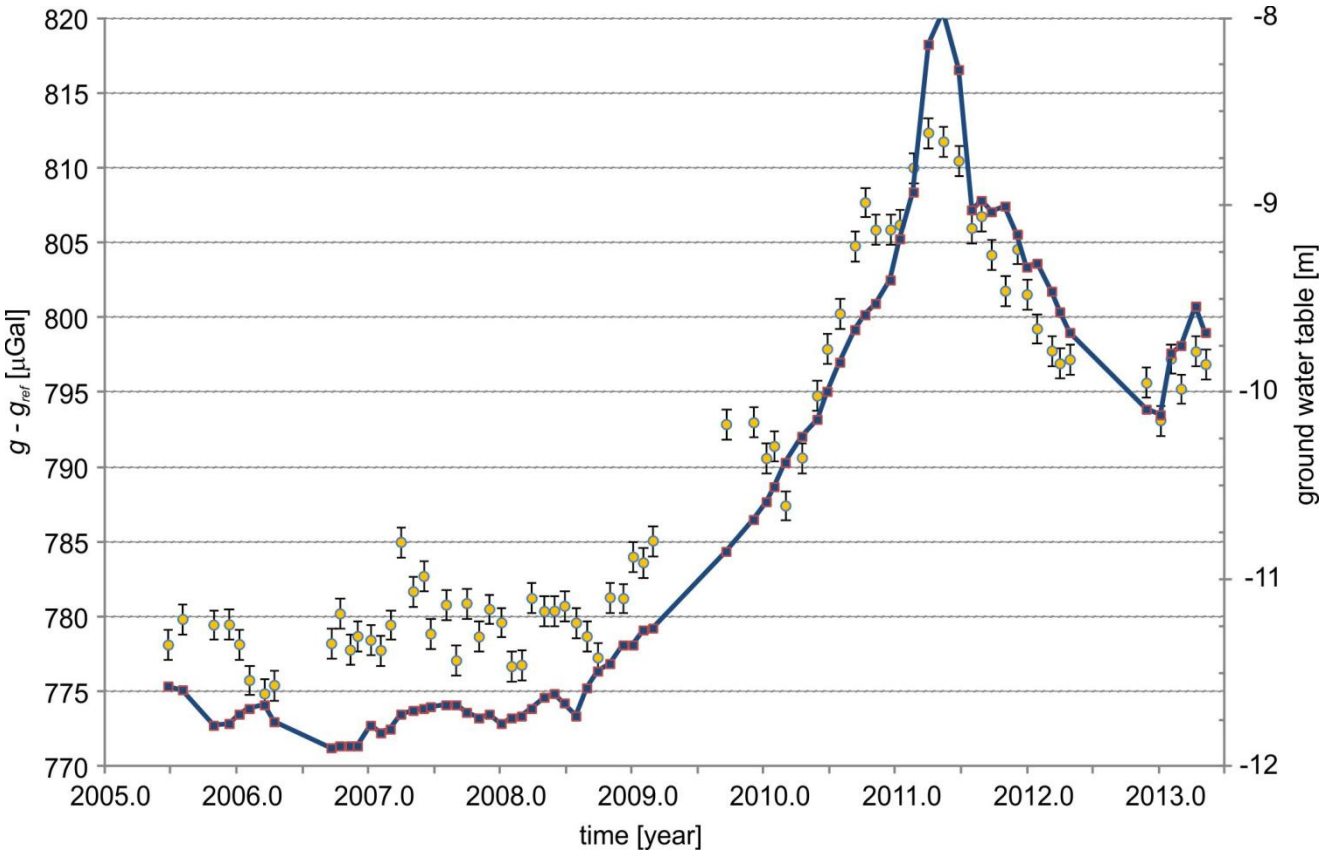
Main geodetic activities at the national level in Poland since 2012

- maintenance of the gravity control
- geodetic control point information system
- vertical control
- operational work of permanent EPN/IGS stations
- data processing at Local Analysis Centres at WUT and MUT
- MUT – WUT EPN Combination Centre
- GNSS for meteorology
- monitoring of ionosphere
- status of the ASG-EUPOS network in Poland
- local GNSS networks in Poland
- the use of data from satellite gravity missions
- Earth tides monitoring
- activity in SLR
- geodynamics

Maintenance of national gravity control (1)

Jozefoslaw Astrogeodetic Observatory of WUT

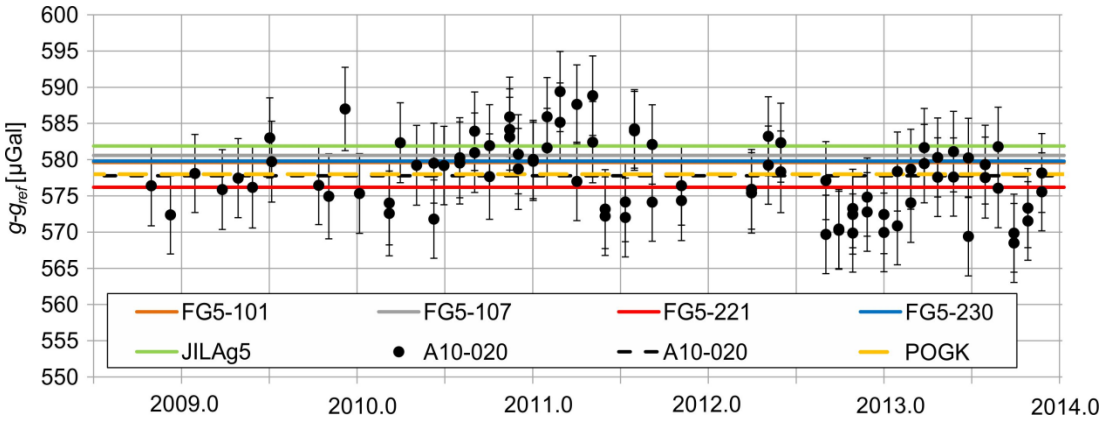
1. quasi-permanent absolute gravity measurements with FG5-230

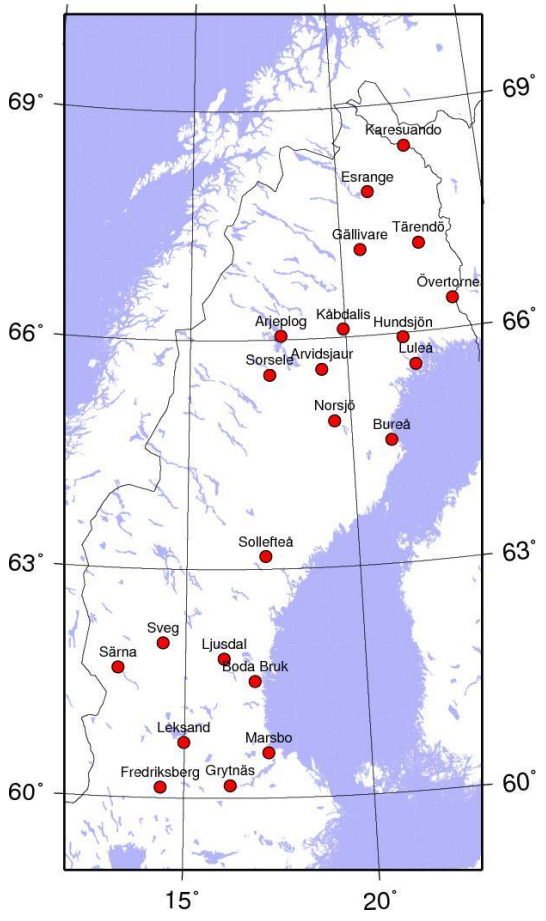


Maintenance of national gravity control (2)

Borowa Gora Geodetic-Geophysical Observatory of IGiK

1. quasi-permanent absolute gravity measurements with A10-020

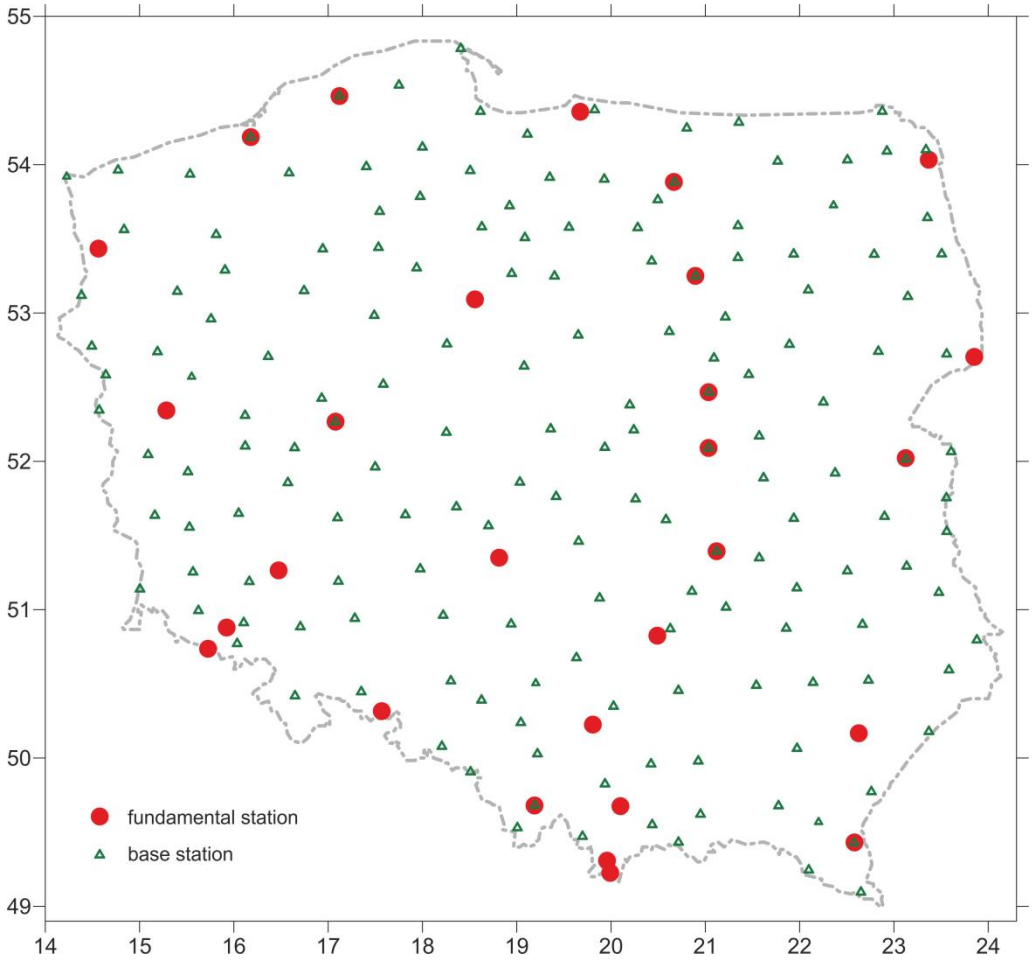




2. re-survey of the gravity network with A10-020 of IGiK in Sweden (22 stations in 2013)

Maintenance of national gravity control (3)

Modernization of the gravity control in Poland (WUT & IGiK) (2012-2014)



Project

Absolute gravity stations

27 – fundamental stations (FG5)

169 – base stations (A10)

87 – POGK

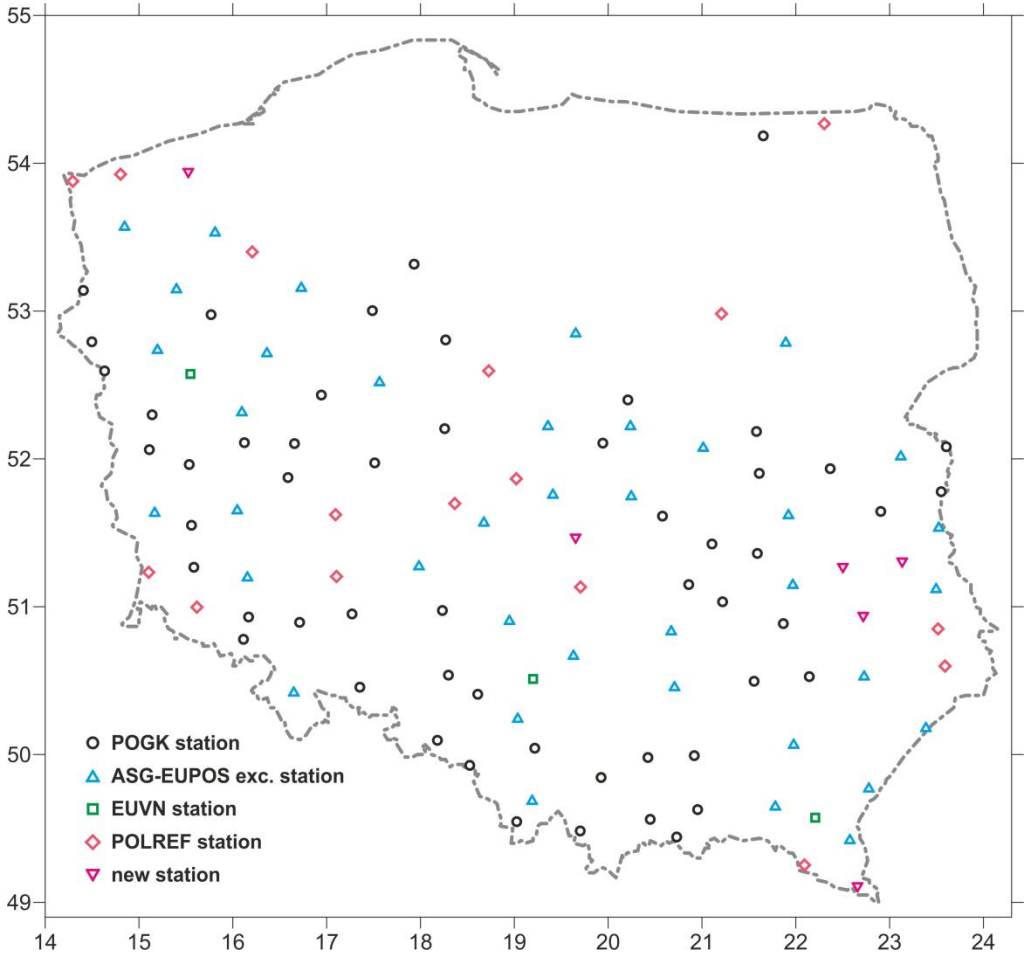
63 – ASG-EUPOS (exc)

9 – POLREF

5 – EUVN

Maintenance of national gravity control (4)

Modernization of the gravity control in Poland (IGiK) (2012-2014)



Realization in 2013

Absolute gravity stations

118 – base stations (A10-020)

118 – vertical gravity gradients

Geodetic control point information system (1)

In 2013 the Head Office of Geodesy and Cartography

- **established a state register of**
  - **geodetic,**
  - **gravimetric, and**
  - **magnetic**

  control network (PRPOG) which contains a database on
  - **horizontal,**
  - **vertical,**
  - **gravimetric, and**
  - **magnetic**

  fundamental network points

PRPOG provides the geo reference data through a standardised exchange interface

Geodetic control point information system (2)

In 2013 the Head Office of Geodesy and Cartography

- **released three geodetic data models**
  containing identical grid points
  on which differences of
  - coordinates, and
  - heights
  between horizontal as well as vertical datums in Poland are given

the models are publicly available at the home page of the Head Office of Geodesy and Cartography, Warsaw, and may be used for the purpose of a data transformation with centimetre accuracy

Vertical control (1)

Final adjustment of the 4th levelling campaign in Poland in 2013
(Head Office of Geodesy and Cartography)

1998-2003 - 1st order levelling network
(16 226 benchmarks and 17 516 km of 382 levelling lines)
2004-2012 - 2nd order levelling network
(25 868 benchmarks over 17 930 km of levelling lines
and adjusted in Kronstadt2006 datum

Final adjustment of both networks included
- **63 EUVN and EUVN DA points, and**
- **71 eccentric points of a network of ASG-EUPOS permanent stations**

The adjustment was performed in EVRF2007-NH vertical datum using 49 stable EUVN points as datum points

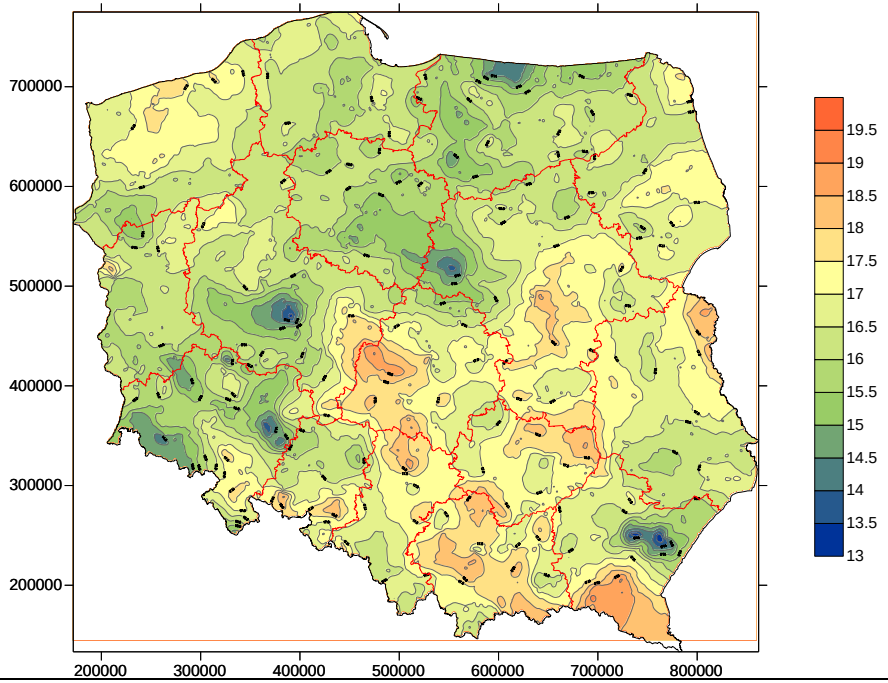
All heights were reduced to zero tidal system

Vertical control (2)

Final adjustment of the 4th levelling campaign in Poland in 2013
(Head Office of Geodesy and Cartography)

- **accuracy of levelling: 0.74 mm/km**
- **standard deviation of the height of a single benchmark: 3.5 mm**
- **maximum error of a single benchmark: 7.5 mm (at the state border).**

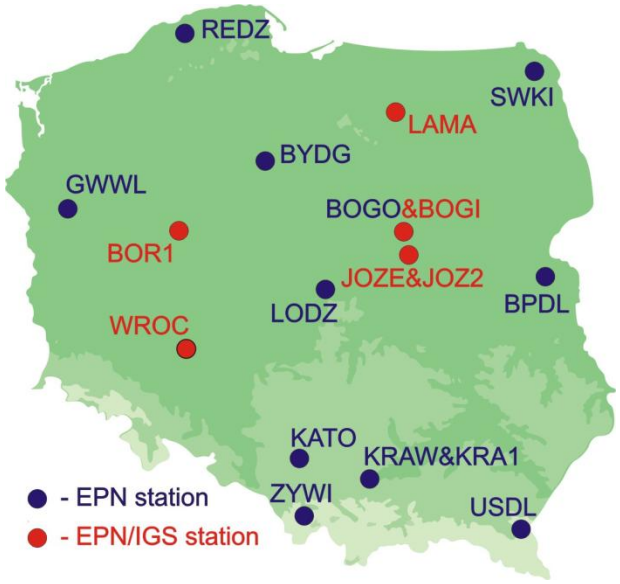
Differences between the heights in EVRF2007-NH and KRON86-NH datums [cm]



Operational work of permanent GNSS IGS/EUREF stations

EPN stations in Poland

- Biala Podlaska (BPDL)
- Borowa Gora (BOGI)
- Borowa Gora (BOGO)
- Borowiec (BOR1)
- Bydgoszcz (BYDG)
- Gorzow Wielkopolski (GWWL)
- Jozefoslaw (JOZE)
- Jozefoslaw (JOZ2)
- Katowice (KATO)
- Krakow (KRAW)
- Krakow (KRA1)
- Lamkowko (LAMA)
- Lodz (LODZ)
- Redzikowo (REDZ)
- Suwalki (SWKI)
- Ustrzyki Dolne (USDL)
- Wroclaw (WROC)
- Zywiec (ZYWI)



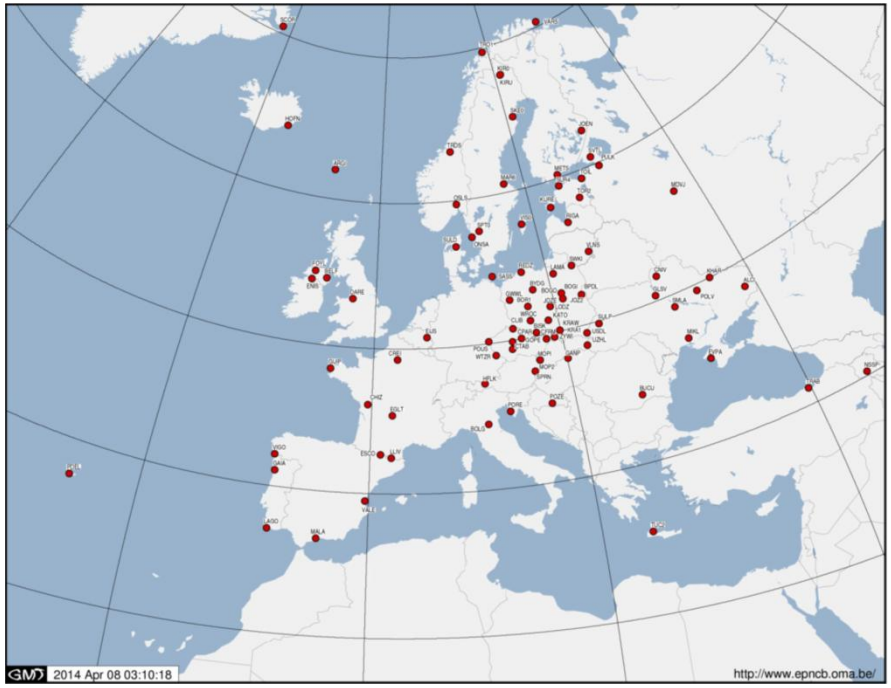
EPN Stations participating in EUREF-IP

- ♥ BOGI
- ♥ BOR1
- ♥ JOZ2
- ♥ KRA1
- ♥ KRAW
- ♥ LAMA
- ♥ WROC

Data processing at LACs

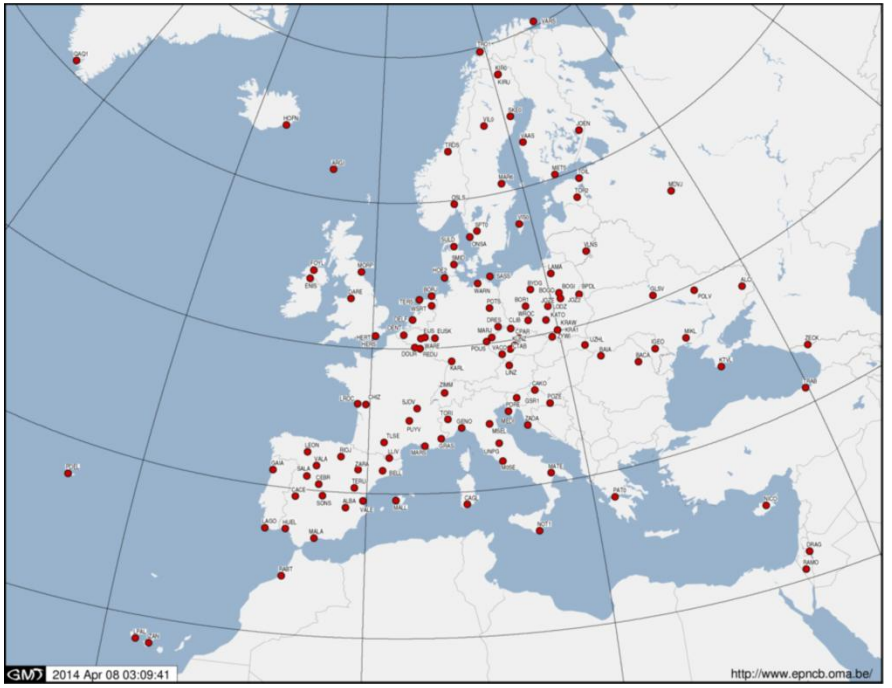
WUT

data from 93 EPN stations routinely processed



MUT

data from 130 EPN stations routinely processed



MUT – WUT EPN Combination Centre

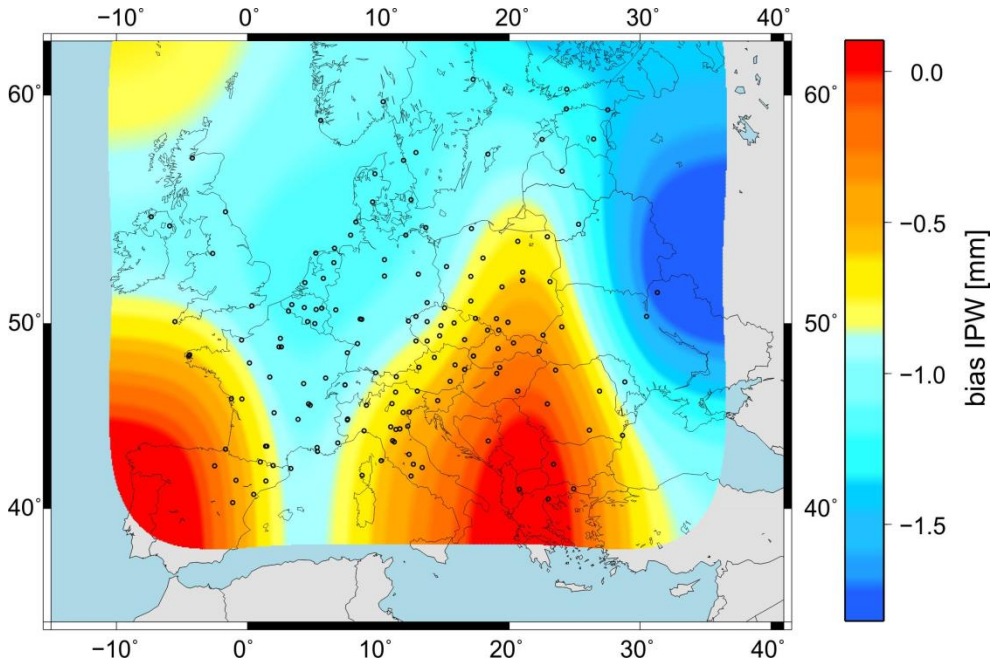
- new scripts for the combination of the solutions provided by the EPN LACs developed
- several tests concerning the selection of reference stations performed
- new set of IGS reference stations with coordinates expressed in igb08 used since GPS week 1788
- routine combinations provided from GPS week 1768 (beginning of 2014)
- daily combinations provided from GPS week 1788
- web page (http://www.epnacc.wat.edu.pl) of the new ACC developed
- several changes introduced into the “Guidelines for the EPN Analysis Centres”
- several processing options updated

GNSS for meteorology (1)

WUT

1. ZTD form WUT LAC solutions
2. IPW from GNSS, NWP and radiosounding

IPW difference (GNSS EUR tropospheric combination - COSMO-LM_14; annual average) map for 2011, meteo from COSMO model [mm]



GNSS for meteorology (2)

Wroclaw Univ. of Envir. & Life Sciences

NRT ZTD estimation service (125 stations)

Processing scheme	Processing time	Average from	ZTD bias [mm]	Std dev. [mm]	Gradient north component bias [mm]	Std dev. [mm]	Gradient east component bias [mm]	Std dev. [mm]
12 h without gradients	25 min	720 h	-1.11	7.27				
4 h without gradients	9 min	336 h	-1.84	7.67				
4 h with gradients	9 min	336 h	-1.11	11.20	-0.13	1.88	-0.15	1.81

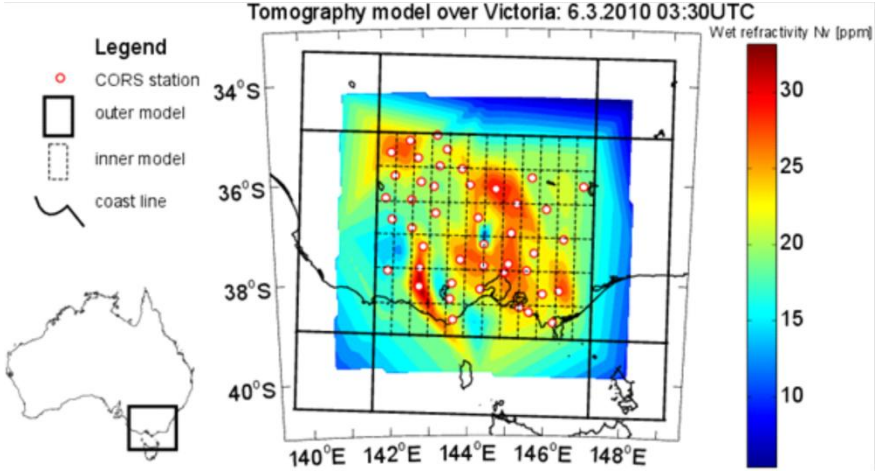
testing ZTD models IGGHZ-G and IGGHZ-M

Strategy	dN (m)	dE (m)	dU (m)	STD N (m)	STD E (m)	STD U (m)	AVSR (%)	AVF (%)
ASG (1)	−0.004	−0.003	**0.013**	0.009	0.005	**0.017**	83.3	2.1
IGGHZG (2)	−0.004	−0.003	**−0.007**	0.008	0.005	**0.021**	**89.6**	1.4
IGGHZM (3)	−0.005	−0.002	**−0.045**	0.009	0.005	**0.018**	83.3	1.4
UNB3m (4)	−0.003	−0.003	**−0.004**	0.009	0.005	**0.019**	84.0	2.1

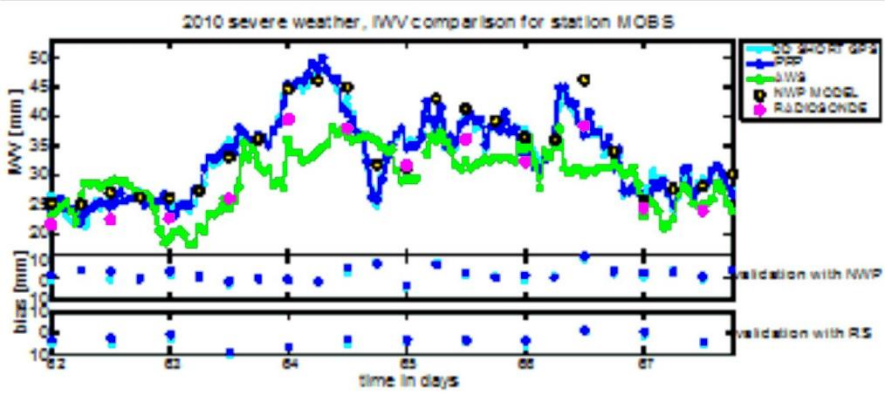
GNSS for meteorology (3)

Wroclaw Univ. of Envir. & Life Sciences

TOMO2 GNSS tomography model - NRT IWP



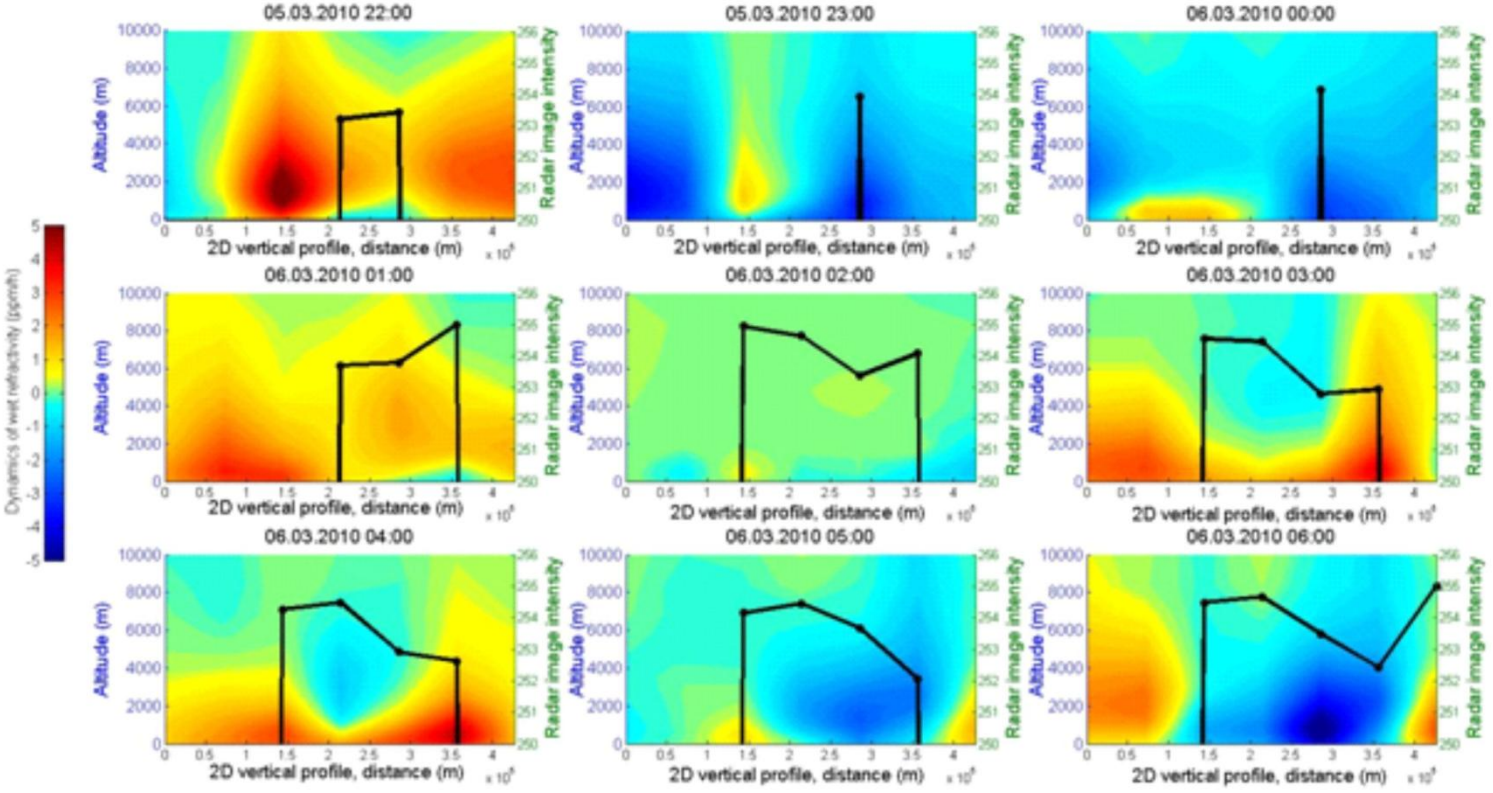
quality of all-weather data available from real-time GNSS ground based observations



GNSS for meteorology (4)

Wroclaw Univ. of Envir. & Life Sciences

application of GNSS observations to weather forecasting



GNSS for meteorology (5)

University of Warmia and Mazury, Olsztyn

- **validation of near real-time troposphere models in precise positioning**

Advanced methods for satellite positioning

University of Warmia and Mazury, Olsztyn

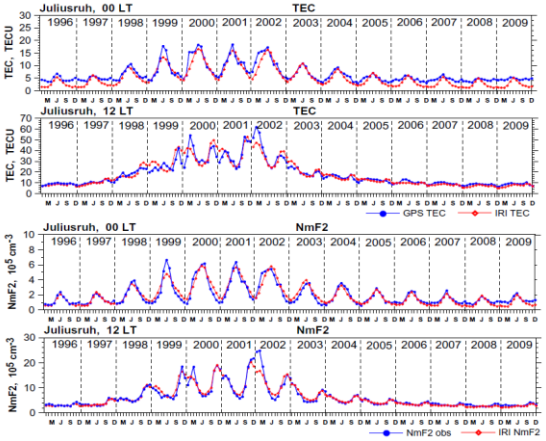
- **development of the Modified Ambiguity Function Approach for precise GNSS positioning**
- **development of the algorithm for GPS + Galileo and multi-frequency Galileo precise positioning**

Monitoring ionosphere (1)

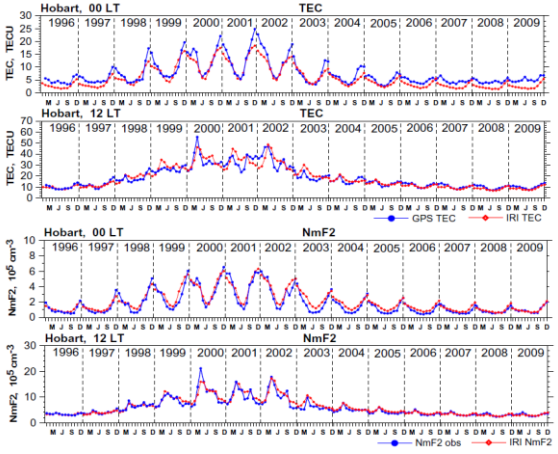
University of Warmia and Mazury, Olsztyn

cross-hemisphere comparison of mid-latitude ionospheric variability during 1996–2009

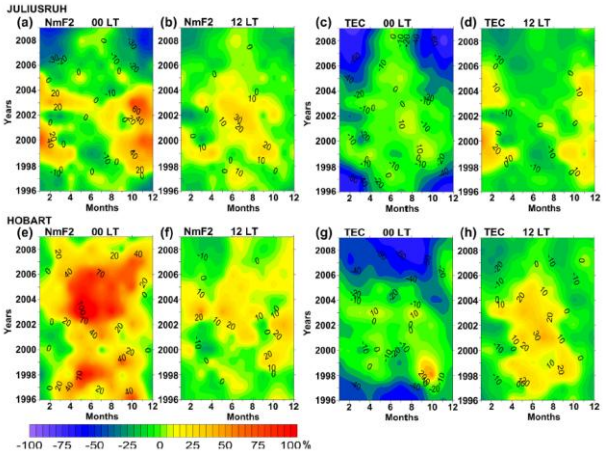
Juliusruh (54.6N; 13.4E)



Hobart (42.9S; 147.3E)



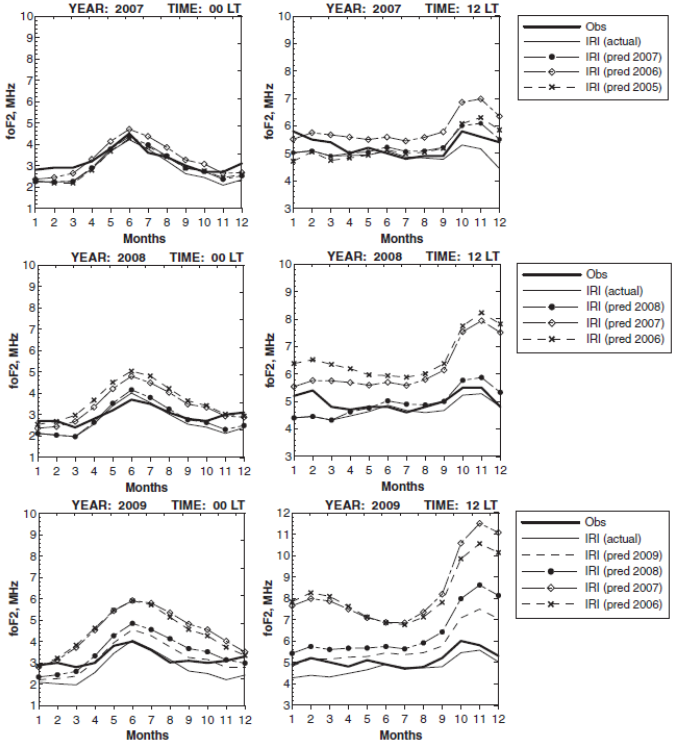
percentage model-data differences for Juliusruh and Hobart



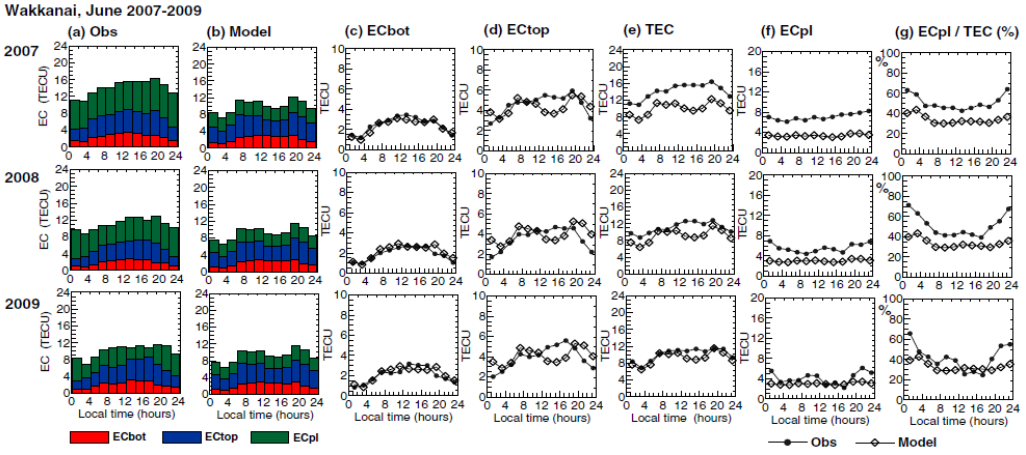
Monitoring ionosphere (2)

University of Warmia and Mazury, Olsztyn

comparative study of foF2 measurements with IRI-2007 model predictions during extended solar minimum



analysis of GPS TEC data and FORMOSAT-3/COSMIC radio occultation measurements



ASG-EUPOS network in Poland

Head Office of Geodesy and Cartography

reference stations of ASG-EUPOS network

- **101 of the Polish part**
- **23 foreign**

- **Trimble® Pivot Platform GNSS infrastructure software implemented**

- **1 station added**
- **2 stations excluded**
- **4 stations upgraded**
- **1 station moved**
- **1 station replaced**

- **ETRF2000 coordinates since 1 May 2012**

- **growing number of regular users (>12 500)**
- **RTK service most popular (up to 700 simult. conn.)**

- **free of charge services**

Use of data from satellite gravity mission

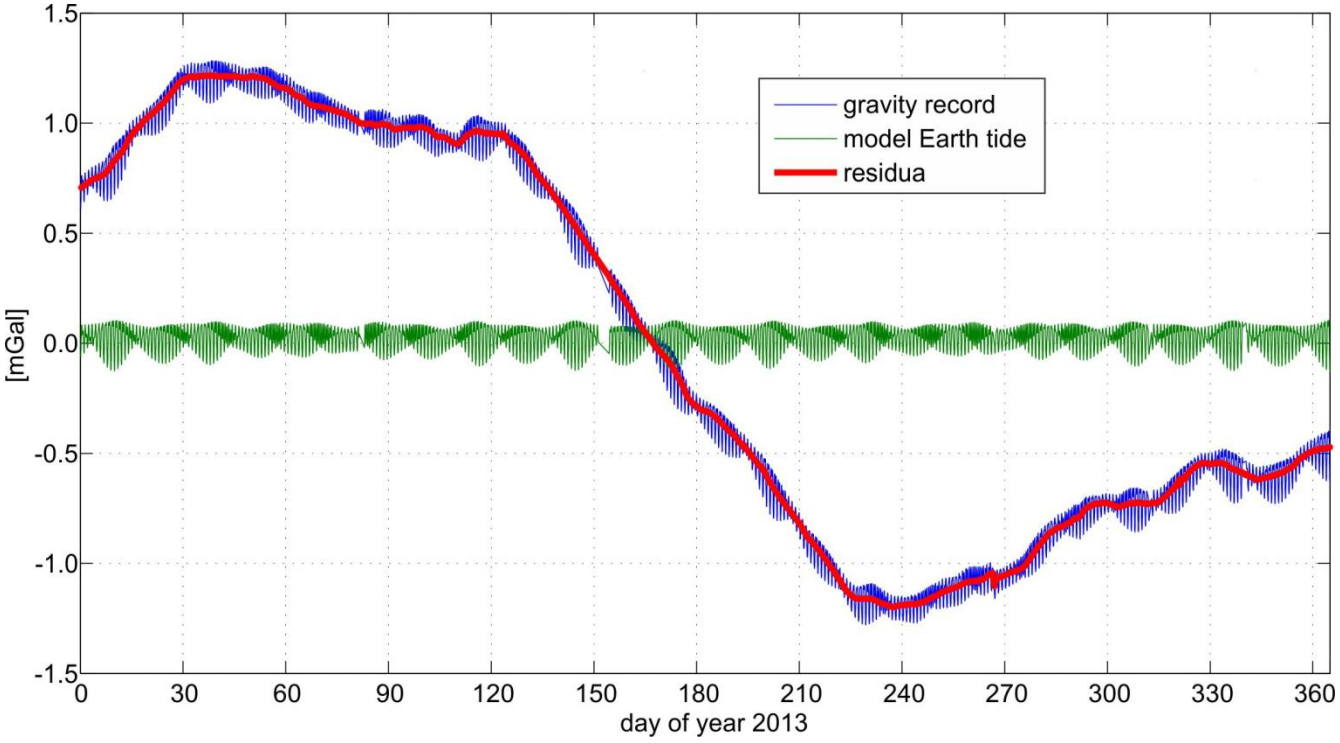
Institute of Geodesy and Cartography, Warsaw

- **evaluation of recent GOCE global geopotential models (GGMs) over the area of Poland**
- **assessment of the use of GOCE-based GGMs for modelling the gravimetric quasigeoid for Poland**
- **evaluation of quality of terrestrial gravity and GNSS/levelling data in Sudan with GOCE-based GGMs**

Earth tides monitoring

Borowa Gora Geodetic-Geophysical Observatory of IGiK

- **gravity record using LCR G gravimeter since January 2010**
  - **analysis of tidal record**



Satellite Laser Ranging

SRC PAS Borowiec station operates within ILRS and EURULAS

- **no SLR observations in 2013 – laser damage**
- **analysis of SLR data 1983-2012 from 74 fixed SLR stations and 63 sites of mobile stations**
  - **quality estimate of reference frames**
  - **quality of SLR stations**
  - **analysis of SLR data with GNSS data**
  - **verification of local geodetic ties**

Geodynamics

Research network GGOS-PL

- established in 2011
- integrates research activity of 8 Polish observatories
- joint research projects and joint activities to raise standards and services
- cooperation with national and international research institutions involved in monitoring the Earth and its environment

WUT

- investigation of the atmospheric effects in gravity measurements records