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EUREF Related Activities in the Czech Republic 2014 - 2015

National Report

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Symposium of the IAG Subcommission for Europe – EUREF 2015
Leipzig, Germany, 03 – 05 June 2015

Geodetic reference frames in the CR

- Czech Republic – area 78,864 km^2
- 74,761 triangulation points
- 35,560 associated points
- 1313 levelling lines – total 24,705 km
- 119, 372 levelling benchmarks (82,447 of Czech State Levelling Network)
- 462 gravity control stations

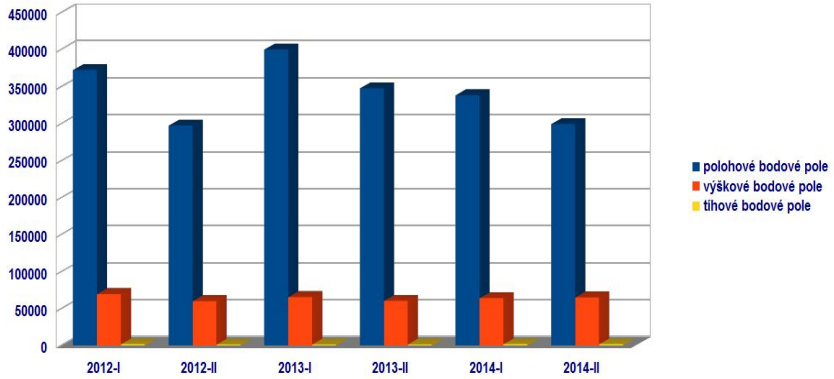
Management of coordinate reference systems

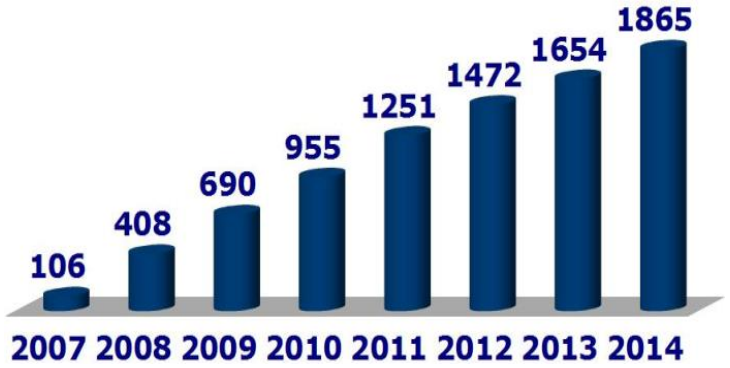
•COSMC+RIGTC+LSO WG on a new improved transformation table between ETRS89 x S-JTSK
• Implementation of the INSPIRE theme „Geographical Coordinate Grids“: new data set including geographical rectangular ETRS89/GRS80 grid (from 100 km down to 1m); along with ETRS89-LAEA projection published at the COSM Geoportal
• Conversion of heights by the QGZÚ-2013 quasigeoid model (90 x 60 m)

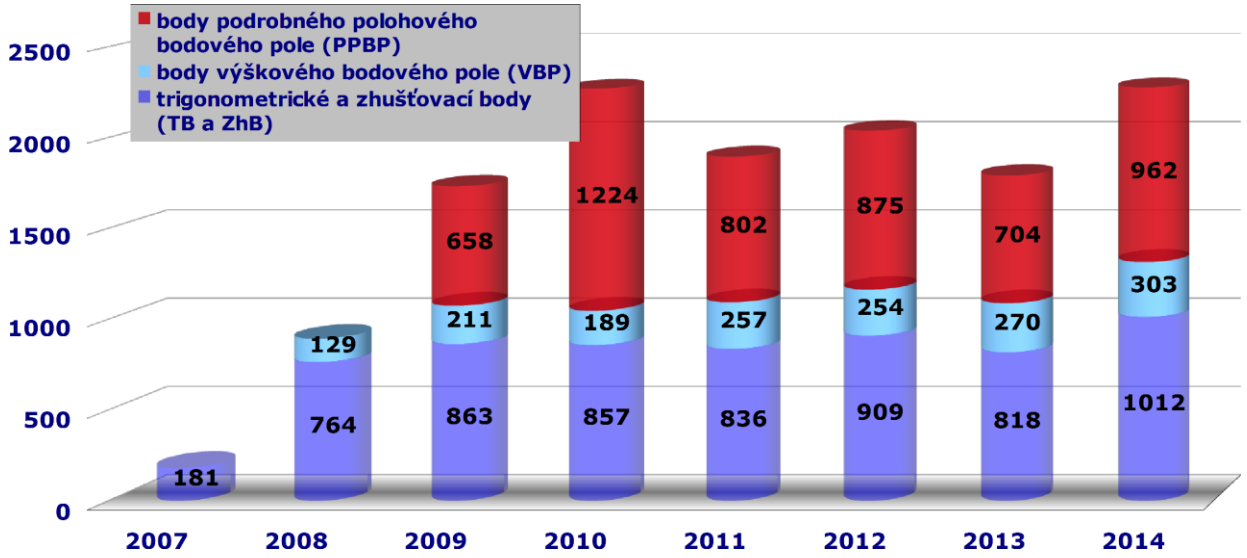
Database of control point fields

- Open and free access to the DB of fundamental and densification TP and height points
- Applications „Reporting on Damages“ (feedback to users) and „Statistics“
- Updating with respect to periodic and dynamic maintenance (1,865 cooperating users, 2,277 messages about defects of geodetic control points)
- Data flow between Information System of RE Cadastre and the DB and between DB and Information System of State Map work and Fundamental Geographical Database

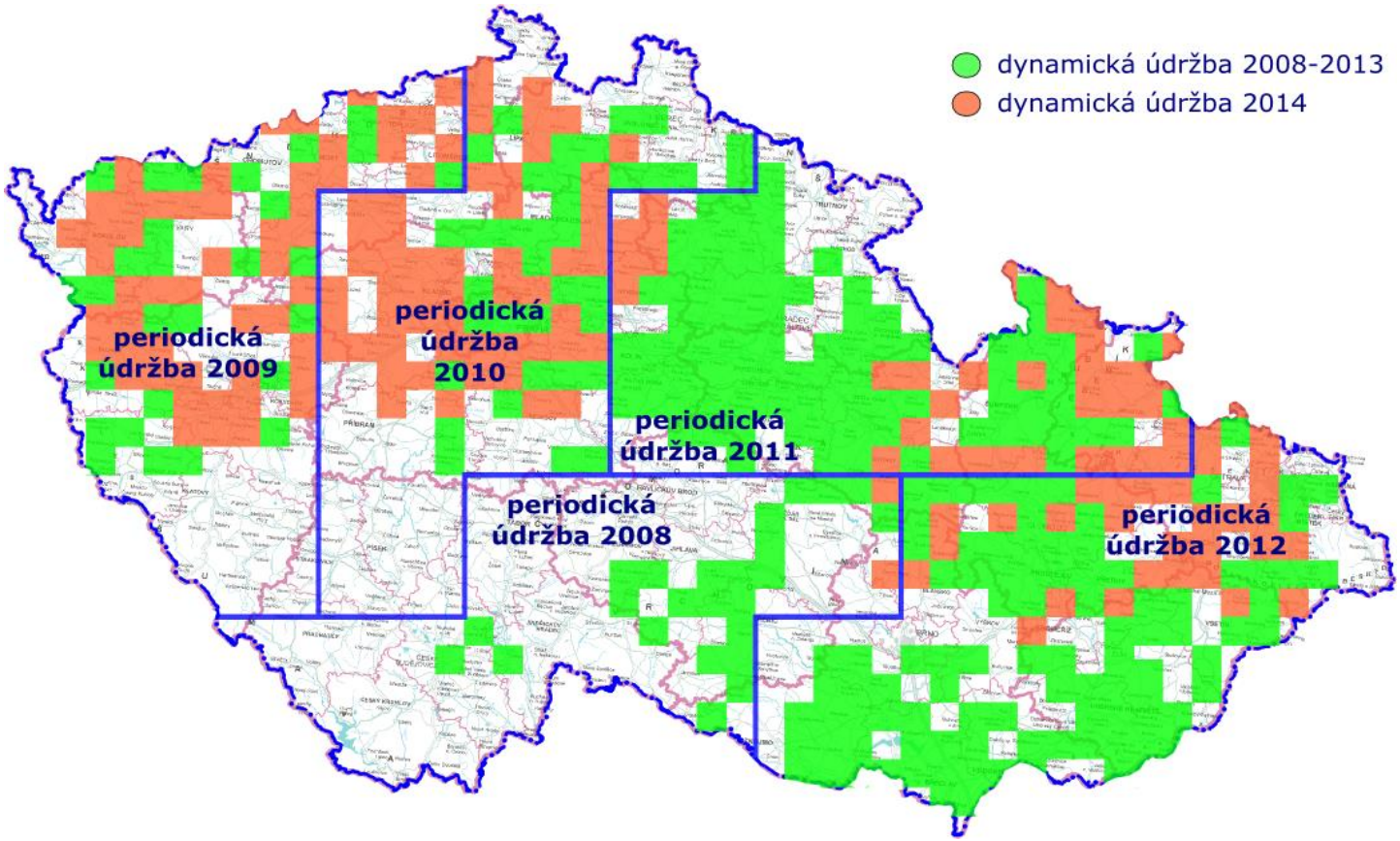
Statistics about the use of control points database – period 2012 - 2014







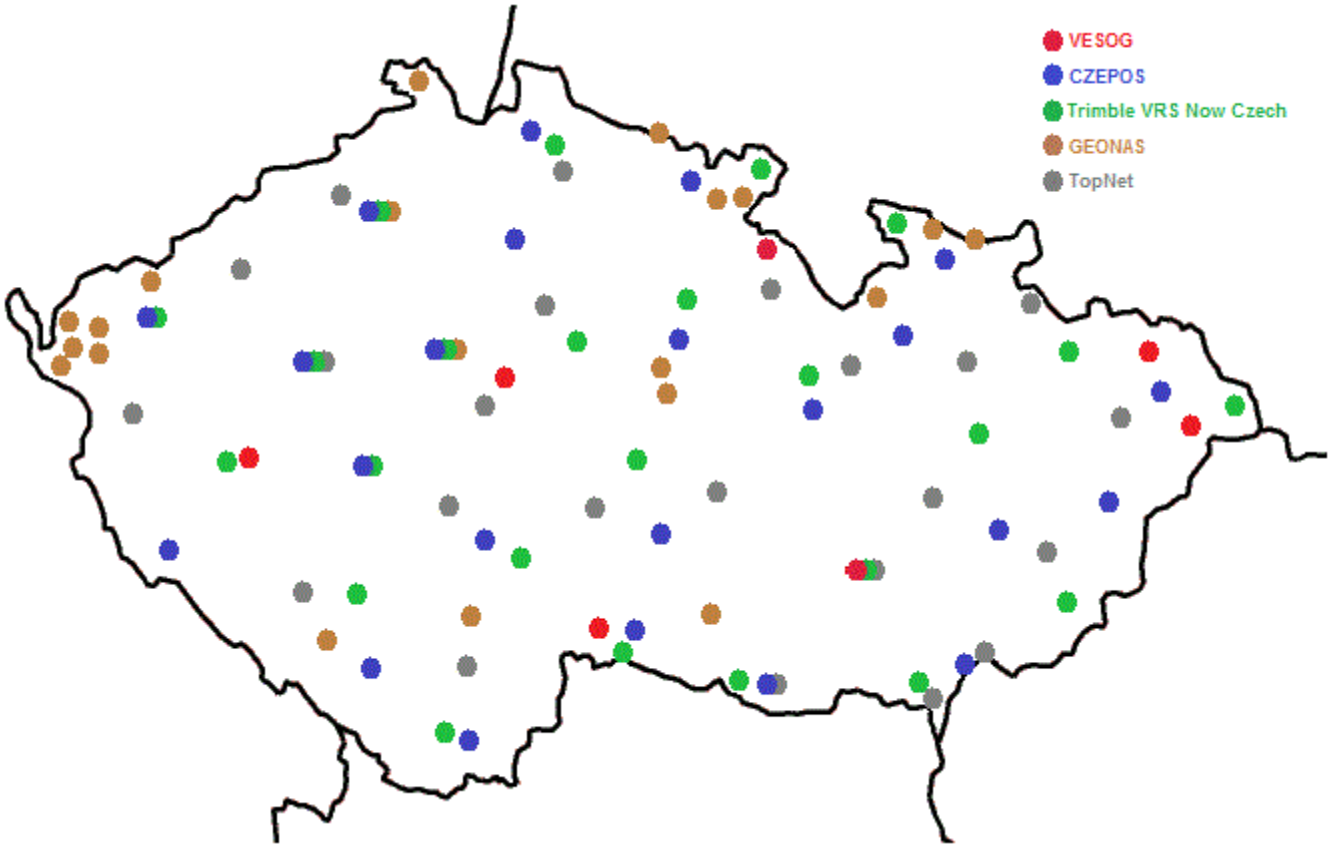
Maintenance of horizontal geodetic control point field (2008 – 2014)



Permanent GNSS Stations and Networks in the Czech Republic

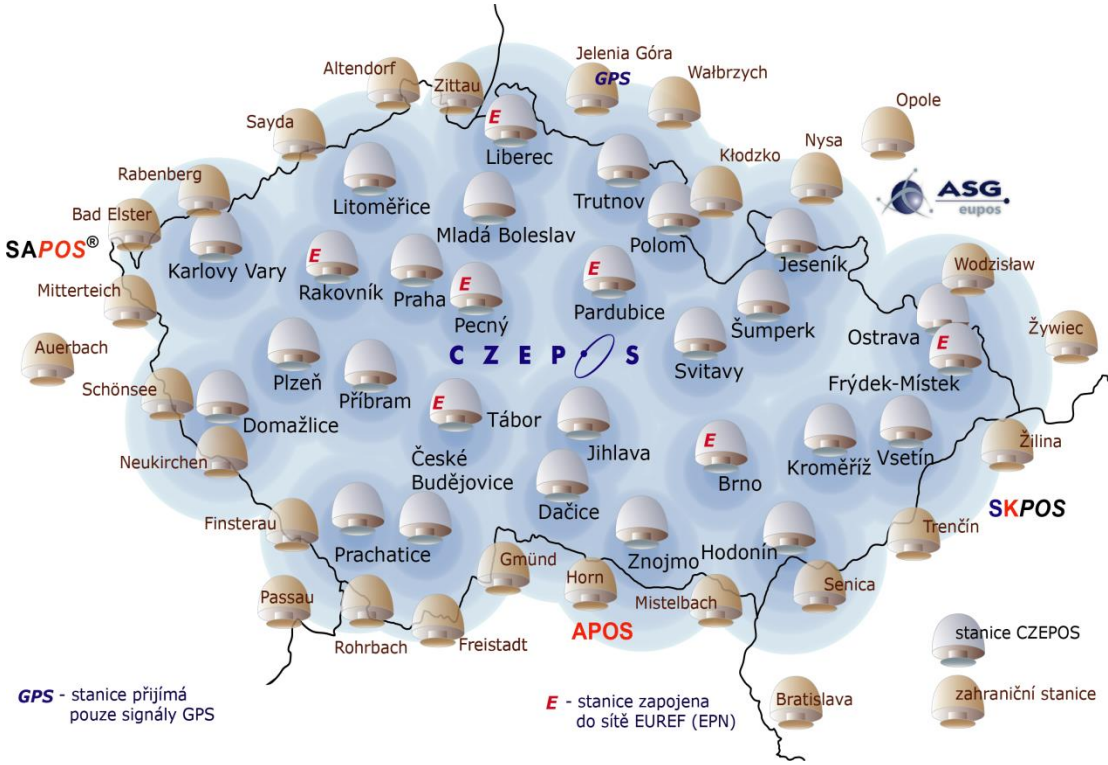
- Fundamental Geodetic Observatory Pecný – GOPE, http://www.pecny.cz (IGS, EPN, CZEPOS, VESOG, E-GVAP II)
- CZEPOS: http://czepos.cuzk.cz, Czech Positioning System, **28 PS**, operated by the Land Survey Office + **27 PS** of neighbour countries
- GEONAS: http://geonas.irsm.asc.cz, **19 PS**, experimental monitoring network operated by the Institute of Rock Structure and Mechanics, Acad. Sci. CR
- VESOG: http://pecny.asu.cas.cz/vesog/, research and experimental GNSS network operated by the RIGTC GOP and academic institutions, **8 PS**
- TopNet: http://www.geodis.cz, **23 PS**, includes also 11 GEONAS and 3 VESOG PS, operated by the private company GEODIS Brno
- Trimble VRS NOW Czech: http://www.geotronics.vrsnow, **24 sites** + 8 sites of Trimble VRS NOW Deutschland, operated by Geotronics Praha, s.r.o. private company
- several smaller networks, operated by private companies, e.g. *byS@T* and others
- **Total: 98 permanent stations, 12 of them EPN**

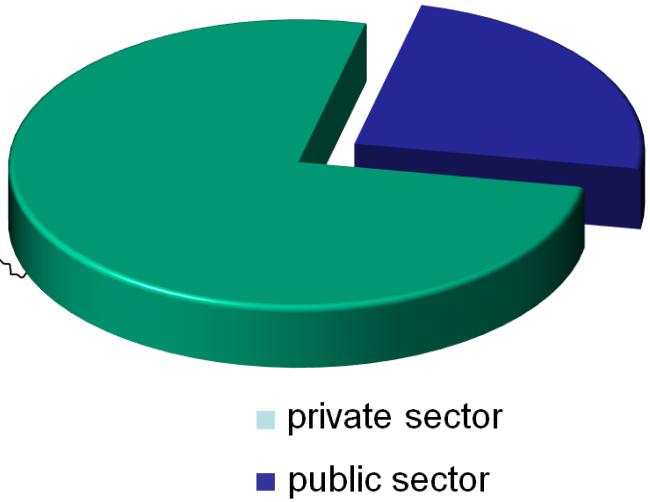
Permanent GNSS stations and networks in the Czech Republic



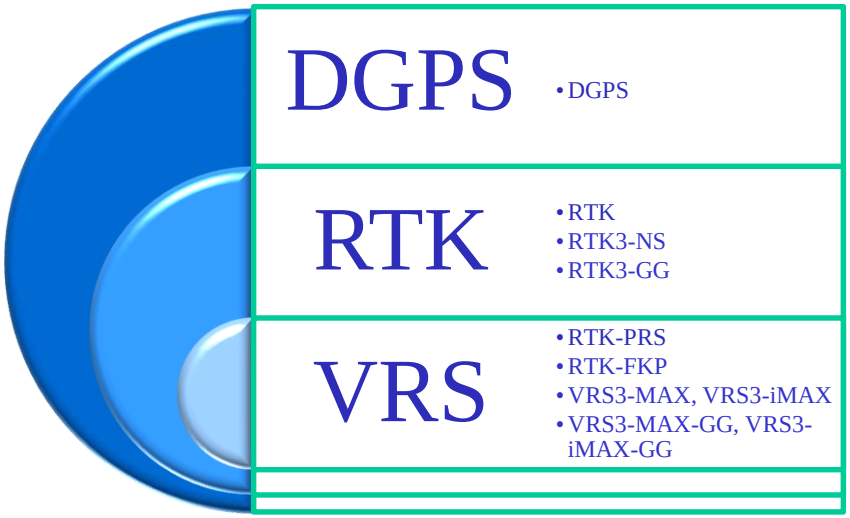
CZEPOS – operated by Land Survey Office since 2004/2005

Status 2014/2015: 28 + 27 stations, 1270 users



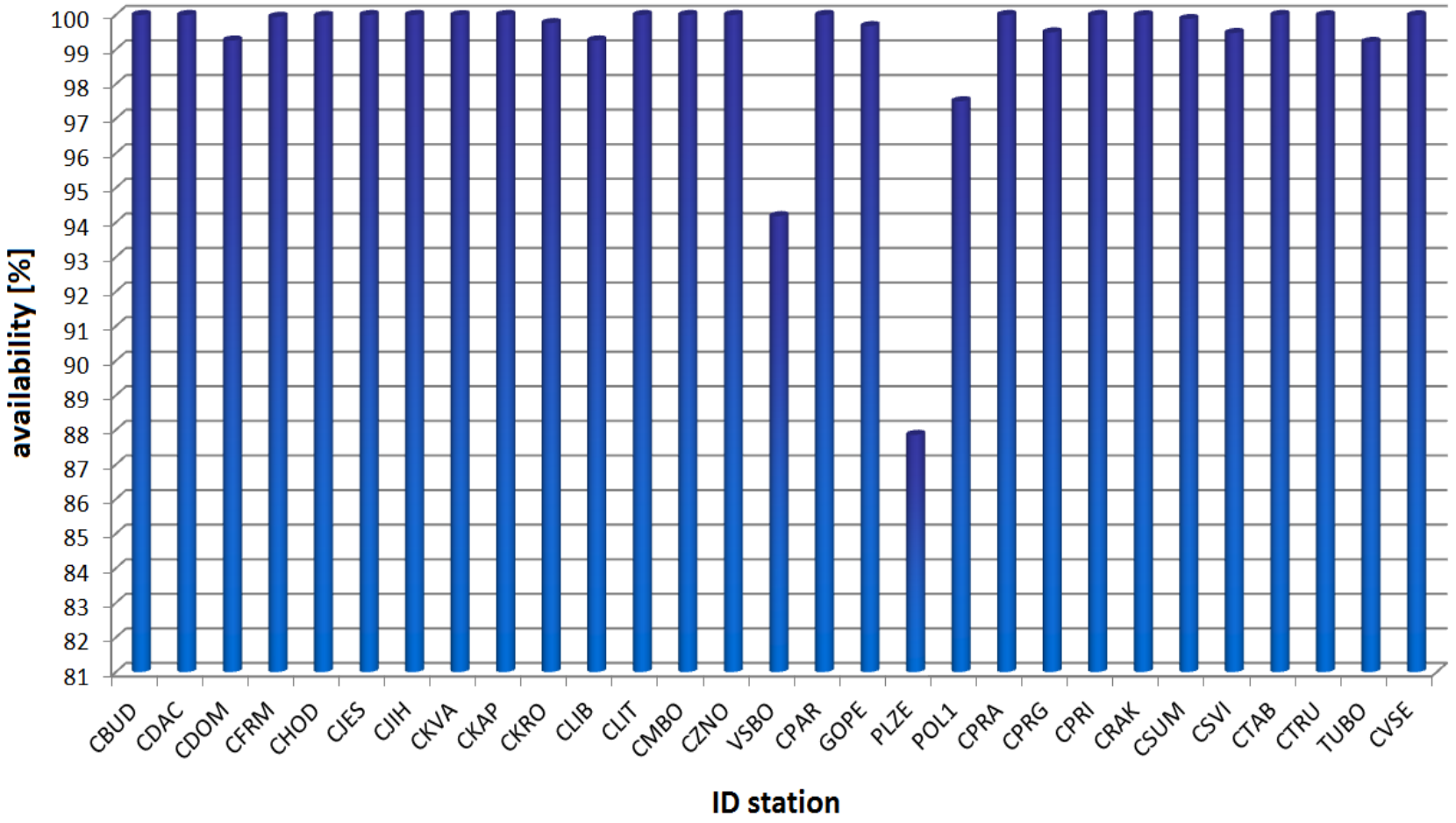


CZEPOS Services



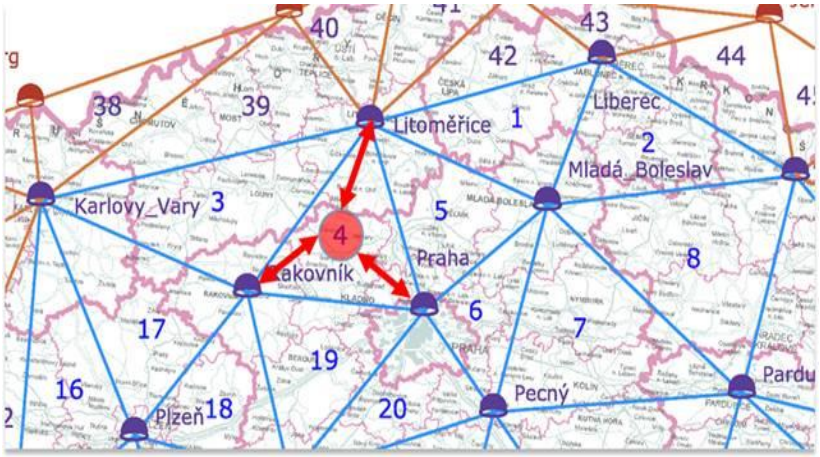
- **Real-time services:** RTK, RTK-FKP, RTK-PRS, RTK3, VRS3 = 80 Kč (3,26 €) / 1 hour, DGPS = 20 Kč (0,82 €) / 1 hour
- New VRS service with CMR/CMR+ formats
- **Post-processing:** data interval 1 – 4 sec = 80 Kč (3.26 €), 5 – 9 sec = 16 Kč (0.65 €), 10 – 19 sec = 8 Kč (0.33 €), ≥ 20 sec = 4 Kč (0.16 €)

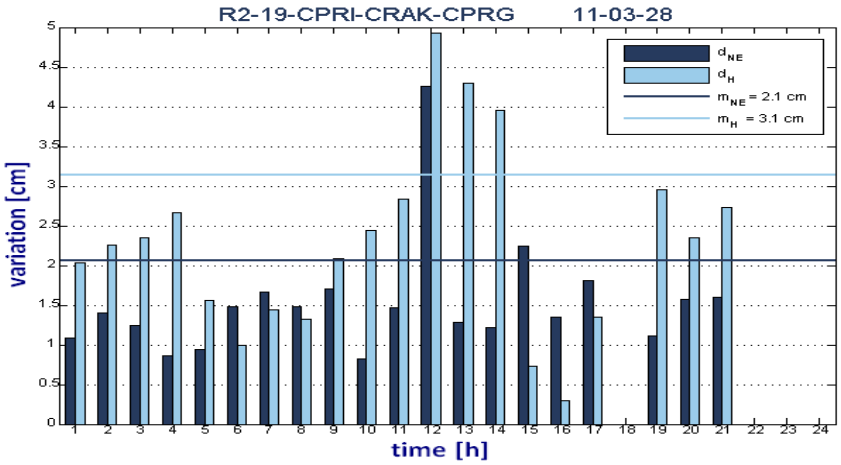
CZEPOS – availability of services



CZEPOS monitoring

- 75 triangulation test areas
- 3 test baselines in each area
- each baseline tested using site x VRS service
- Web application (cooperation with CTU)
- Operational since April 2010





GOPE – Fundamental GNSS Station

- Established in 1993, since 1995 has been contributing to IGS (International GNSS Service)
- Topcon Net-G3 receiver, Topcon CR-G3 antenna with a spherical radom TPSH, individual PC calibration
- Tracking the following GNSS: GPS NAVSTAR (L1C, L1P, L2P, L2C), GLONASS (L1C, L2P)
- Post-processing data + real-time data
- Post-processing data downloaded in RINEX 2.10 format in daily files with 30 sec sampling rate, hourly files/ 1 and 30 sec, 15-min files/ 1 sec
- Data are forwarded to the following data centers:

- GOP - RIGTC, Czech Republic (hourly and daily 30 sec data)
- BKG, Frankfurt am Main, Germany (hourly and daily 30 sec data)
- OLG, Graz, Austria (hourly and daily 30 sec data)
- CZEPOS, Land Survey Office, Czech Republic (hourly 1 sec data)
- CDDIS, NASA, U.S.A. (15-minute 1 sec data)

- Real-time RTCM 2.3 and RTCM 3 data streams forwarded in NTRIP protocol to VESOG caster and further to BKG and CZEPOS casters

Permanent GNSS station GOPE

Topcon CR-G3 antenna with TPSH radom

Topcon Net-G3 receiver

GOPE Participation in the M-GEX IGS project

- station GOP6 – excentric site of the main GOPE station in the Multi-GNSS Experiment
- Leica GRX1200+GNSS receiver + Leica AR25.R4 antenna with a spherical radom LEIT and individual PC calibrations
- Satellite tracking: GPS NAVSTAR (L1C, L1P, L2P, L2C, L5), GLONASS (L1C, L2P), Galileo (E1, E5a, E5b, AltBoc), SBAS (L1)
- Post-processing data in RINEX 2.10 (directly generated by the receiver) and RINEX 3.01 (conversion from 2.11 using own software in the operation centre):
  - hourly and daily files/ 30 sec data
  - 15 min files of 1 sec data
- Post-processing data forwarded to:
  - CDDIS, NASA, USA (only RINEX 3.01)
  - BKG, Frankfurt am Main, Germany (only RINEX 3.01)
  - IGN, Paris, France(RINEX 2.10 and 3.01)
  - GOP, RIGTC, Czech Republic (only RINEX 2.10)
- Real-time data streams
  - binary data Leica LB2
  - RTCM 2.3 a RTCM 3
  - NTRIP protocol forwarded to NTRIPcaster VESOG/GOP, RIGTC, Czech Republic, binary data LB2 forwarded to the M-GEX caster of the BKG, Frankfurt/Main, Germany

GOP6 M-GEX Site - antenna

GOPE Participation in the JAXA MGM Project

- MGM (Multi-GNSS Monitoring network) Project organized by the Japan Aerospace Agency JAXA – GOPE participates as a hosting station operating a receiver provided on loan by JAXA
- Javad DELTA-G3T receiver is connected through a signal splitter to the Leica AR25.R4 antenna with a spherical radom LEIT installed at the GOP6 site
- Satellite tracking:
- GPS NAVSTAR (L1C, L1P, L2P, L2C, L5)
- GLONASS (L1C, L1P, L2P, L2C)
- Galileo (E1, E5)
- SBAS (L1, L5) including the first QZSS satellite
- Real-time data forwarded to the NTRIP caster of the MGM project in Japan as Javad binary data
- Providing post-processing data generated by the Javad receiver for the M-GEX project under negotiations

GOPE - receivers

Leica GRX1200+GNSS receiver at GOP6

Javad DELTA-G3T receiver at GOP7/GOP6M

Analysis and Research

- EPN GOP Data Center
- EPN GOP Dedicated Analysis Center
- G-Nut Software Development
- Monitoring of permanent GNSS sites
- GNSS-based international projects
- Geodynamics – EPN velocities, CEGRN
- IDS Analysis Center GOP

EUREF GOP Data Centre

- Since 2002 daily and hourly GNSS data, navigation messages and precise products
- Since 2007 RT data flows of selected national, regional and global stations via a local NTRIP caster
- Since 2010 historical EPN archive of daily files has been mirrored in support of the full EPN re-processing, data quality monitoring
- Since 2013 EUREF and IGS RINEX 3.X data pool maintained for multi-GNSS data quality monitoring and for developments of new multi-GNSS product generation (ultra rapid orbits, coordinates, troposphere etc.)

EPN GOP Dedicated Analysis Centre

- New dedicated task – providing a complete EPN re-processing using Bernese SW
- Modifying the GOP processing system for the Bernese GNSS SW v5.2
- Implementing up-to-date models to comply with the Repro2 campaign specifications
- Optimizing strategy for all EPN stations processing in a single run

G-Nut software development

- GNSS SW library G-Nut developed since 2011 – four end user applications derived from the library up to now
- G-Nut/Geb for estimating precise coordinates in offline/real-time mode
- G-Nut/Tefnut for monitoring tropospheric parameters in offline/real-time mode
- G-Nut/Anubis for the data quality check supporting all GNSS constellations, modern frequency bands and signals
- G-Nut/Shu for calculating tropospheric corrections using 3D numerical weather data fields

GNSS Meteorology at GOP

- GOP routine NRT troposphere estimates contributing to E-GVAP-III project
- Hourly troposphere product provided with a maximum latency of 45 minutes from 4 variants (regional GPS, regional GPS+GLONASS, global GPS, RT GPS)
- Products operationally assimilated in several NWP models in Europe and worldwide
- Routine evaluation using newly developed tropospheric database GOP-TropDB
- Since May 2013 active participation in GNSS4SWEC (COST action 1216)

IDS Analysis Centre GOP

- Contribution to the DORIS combination for the realization of ITRF 2013 under development
- All data from the period 1992.0 – 2014 reprocessed following the IDS strategy
- Preliminary solution IDS-0 for ITRF 2013 finished
- Updated version IDS-1 under development
- DORIS data phase processing, satellite orbit modelling, onboard oscillator stability compensation, analysis of long time series of parameters derived from DORIS weekly solutions

GOP participation in international projects

- E-GVAP-III, GNSS4SWEC – COST ES1206
- EPOS - WG4 through the CzechGeo project
- EUPOS® – contribution to ECC
- CEGRN Consortium – MoU between CEGRN and EUREF
- ESA
- SPMS (GSA)

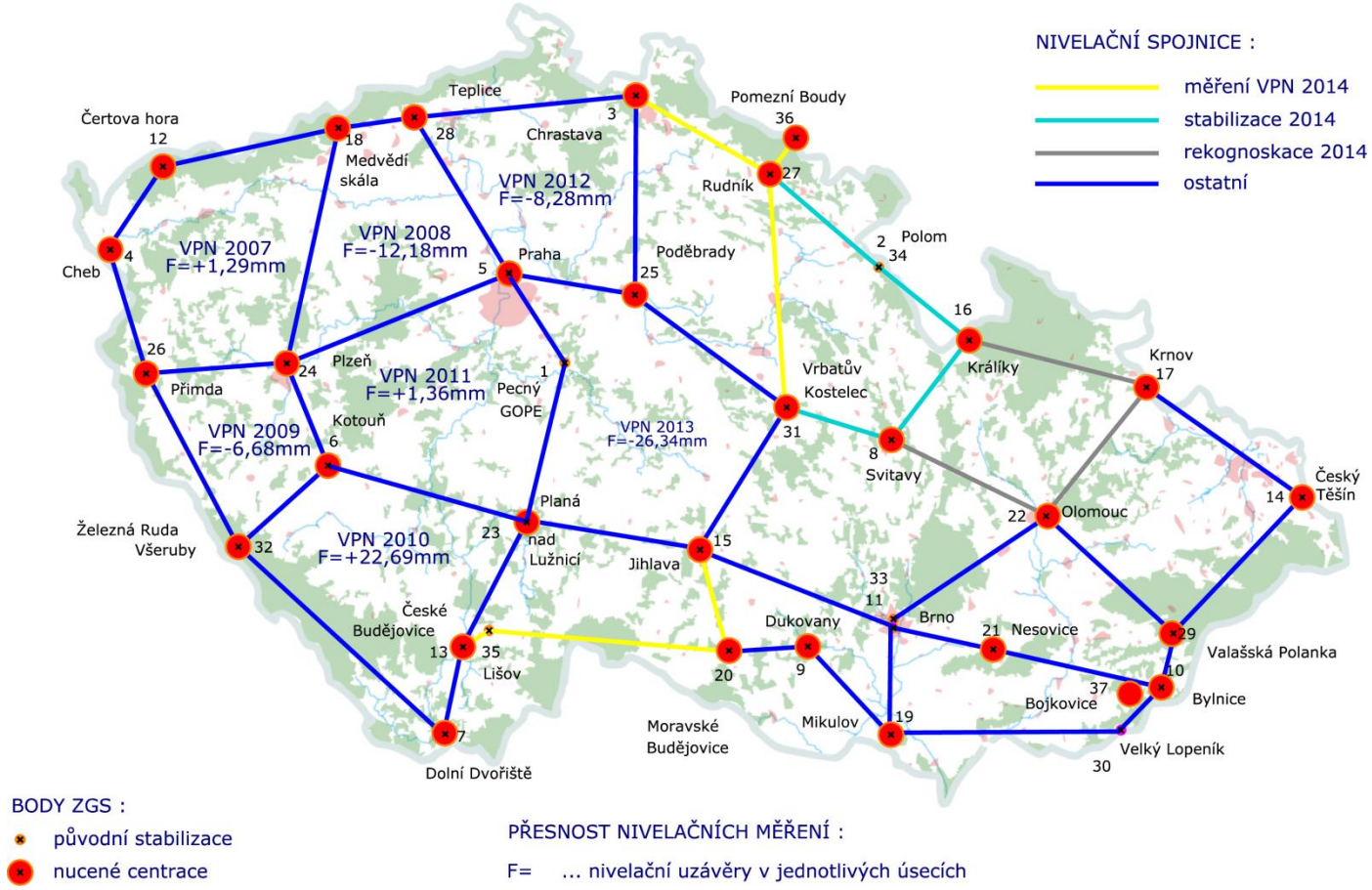
Monitoring of the Czech permanent GNSS sites – Analysis Center GOP

- Check of stability and quality
- Rapid solution used as a basis
- EPN processing standards and guidelines
- 8:00 UTC the daily solution compared with coordinates + statistical test
- Limits: 7mm, 7 mm and 15 mm for N,E,U components

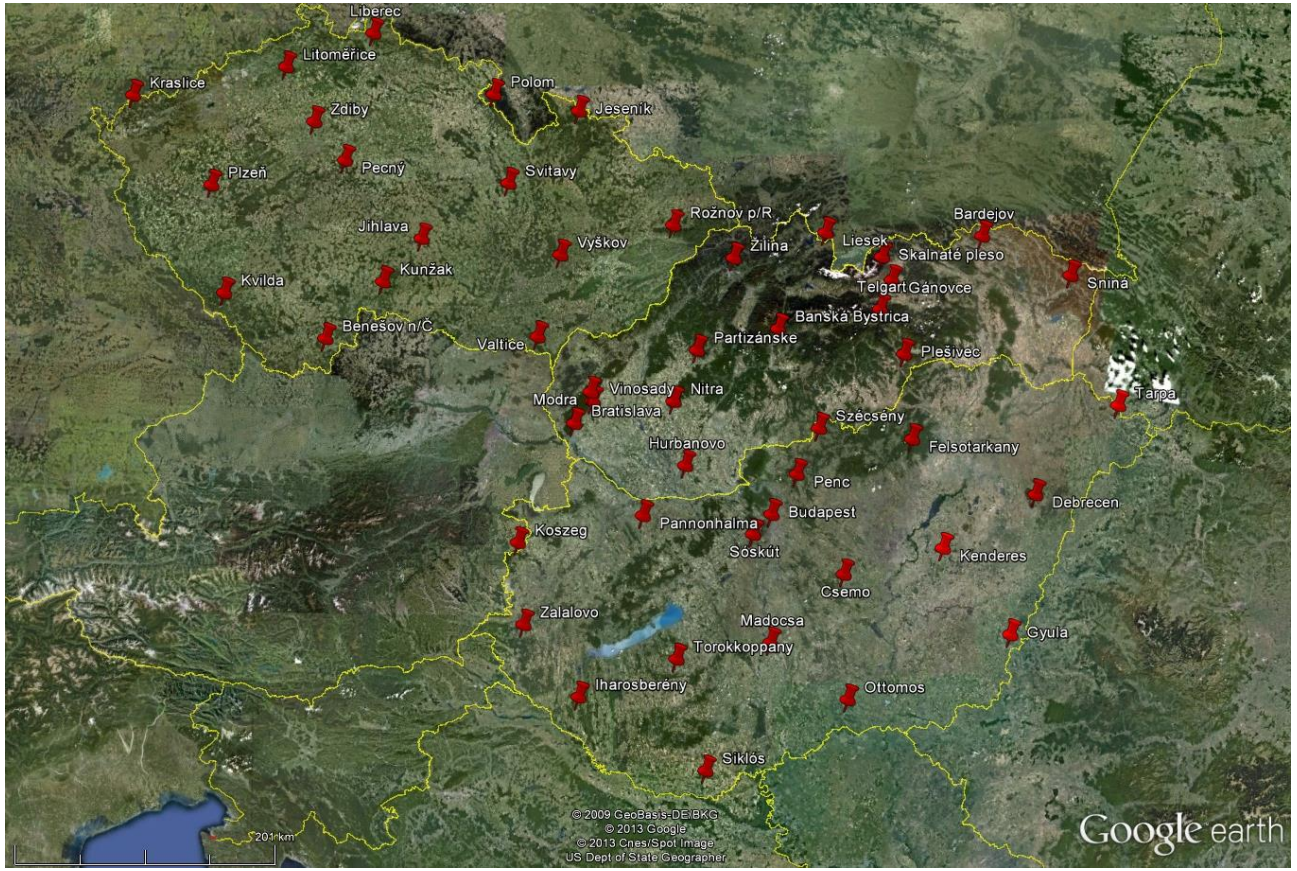
ECGN, gravity, geodynamics

- Very precise levelling lines in the geodynamic network (long-term rms/1 km error 0.62 mm)
- New gravity reference system S-Gr95/2010
- Detailed gravimetric quasigeoid OGZÚ-2013 (resolution 90 x 60 m)
- superconducting (OSG-050) and absolute gravimetry (FG5 No. 215) at GOP, environmental effects on gravity, contribution to GGP
- Absolute gravity measurements: Hungary (5 sites – Torokkoppany, Zalalovo, Sopron-Bánfalva, Sopron-Muck, Fertorákos)
- Operation of 6 permanent stations in Greece
- Repeated absolute gravity measurements at GNSS permanent stations (3 EPN): GOPE (11), POL1 (2), KUNZ (2) and ZDIB (3), PLZE (1), BRNO (1)

Land Survey Office: 2014 Progress in Fundamental Geodynamical Network

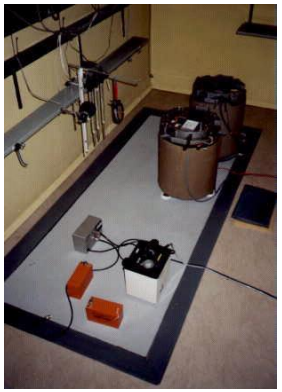


Absolute gravity measurements with FG5 No 215 in Czechia, Slovakia and Hungary



Tidal Gravimetry at GO Pecný and Environmental Effects

- gravity time series by GWR OSG-050, Askania Gs15 No. 228 and by LCR 137
- calibration by FG5 No. 215 absolute gravimeter
- very broadband 3-D seismometer
- climatological station
- meteorological parameters
- soil moisture
- ground water level



Thank you for your attention !

for more detailed information please visit

http://czepos.cuzk.cz

http://www.cuzk.cz

http://pecny.cz