GNSS precise analyses
at Geodetic Observatory Pecny

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Selected contributions to scientific services

EUREF – Reference Frame Sub-Commission for Europe of IAG

observations (1996..), data centre (2002..), analysis centre (1997..),
special projects (2002..), re-processing (2010), Technical Working Group (1999..) …

IGS – International GNSS Service (IAG service)

observations (1996..), analysis centre for ultra-rapid orbits (2004..), I-GEX experiment for
GLONASS, RTPP – Real-Time Pilot Project, M-GEX – multi-GNSS campaign,
TropoWG: tropospheric parameter comparisons, …

CEGRN – Central European GPS Geodynamic Reference Network
observations (1994..), analysis centre

E-GVAP – The EUMETNET EIG GNSS Water Vapour Programme (EUMETNET EIG)

observations (1999..), analysis centre (2000..), GOPE super-site, ZTD evaluations, Water
Vapor Radiometer (WVR), Expert team on GNSS membership

EPOS – European Plate Observing System (Preparatory/Implementation)

observations, data dissemination devel, GNSS QC software (2014-2019)
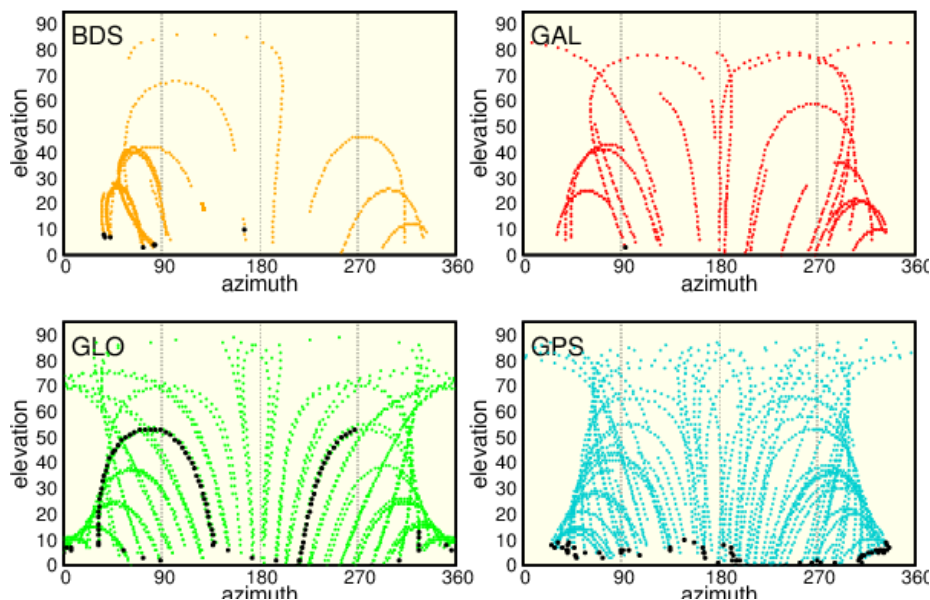
Software development: G-Nut/Anubis

G-Nut/Anubis for multi-GNSS data quality control (open-source)

- http://www.pecny.cz → **G-Nut** library , C++, object oriented, linux/window
- **qualitative & quantitative control:** positioning, multipath, sky plots, …

Selected users (developing the monitoring of permanent stations)

- Royal Observatory of Belgium
    → EUREF Permanent network
- **EPOS-IP (GLASS infrastructure)**
    → **GNSS data dissemination**
- Geoscience Australia (ref. network)
- Swisstopo (AGNES ref. network)
- ASI/e-GEOS (Italian ref. network)
- TELESPACIO France (REGINA network)
- other small users

GOP7 - Satellite sky tracks (azimuth-elevation plot)

Václavovic P, Douša J, **G-Nut/Anubis - open-source tool for multi-GNSS data monitoring**, IAG Symposia Series, Springer, Vol.143, 2016

Václavovic P, Douša J, Gyori G, **G-Nut software library - state of development and first results**, Acta Geodyn Geomater, 2013

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2nd EUREF reprocessing (1996-2014)

3 ACs process full (>250) EUREF Permanent Network (EPN)
- ASI /E-GEOS (Gipsy/Oasis)
- **GOP – Geodetic Observatory Pecný (Bernese V52)**
- MUT – Military University of Technology (GAMIT)

2 ACs contributes with EPN subnetworks
- LPT – Swisstopo (Bernese V52)
- IGN – Instituto Geografico National (Bernese V52)

EUREF combined solutions
- MUT/WUT – EUREF coordinate combined solution
- ASI/e-GEOS – EUREF tropospheric combined product
- FOMI – EUREF coordinate and velocity long-term solution

➔ **state-of-the-art models in homogeneous solution**

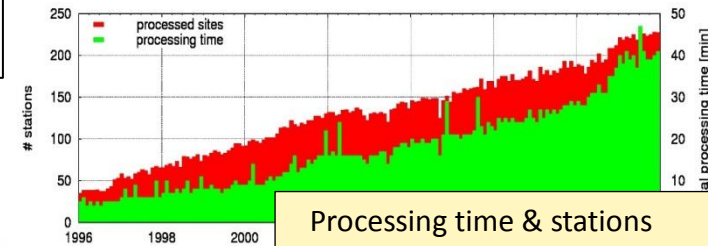**Coordinate time-series, derived velocities, discontinuities**
➔ geodynamic studies and reference frame maintenance
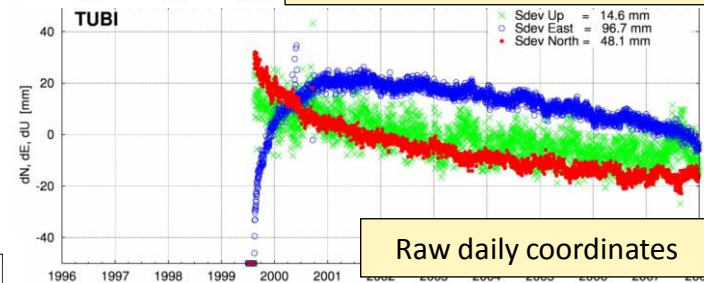
Troposphere parameters homogeneous time-series
➔ meteorological and climate research

EPN: http://epncb.oma.be
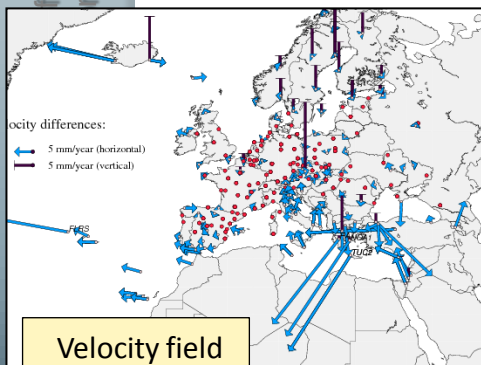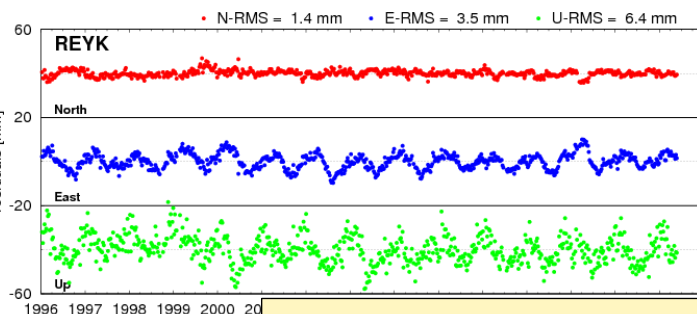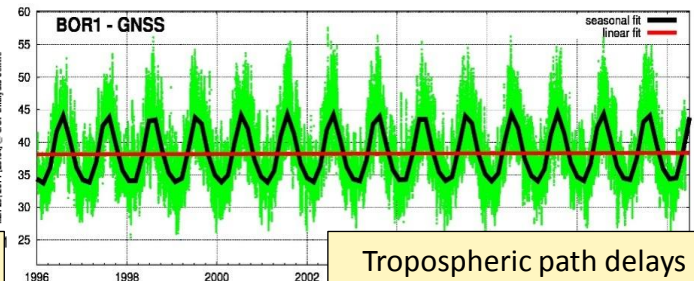
Processing time & stations

Raw daily coordinates

Velocity field

Weekly combined coordinates

Tropospheric path delays
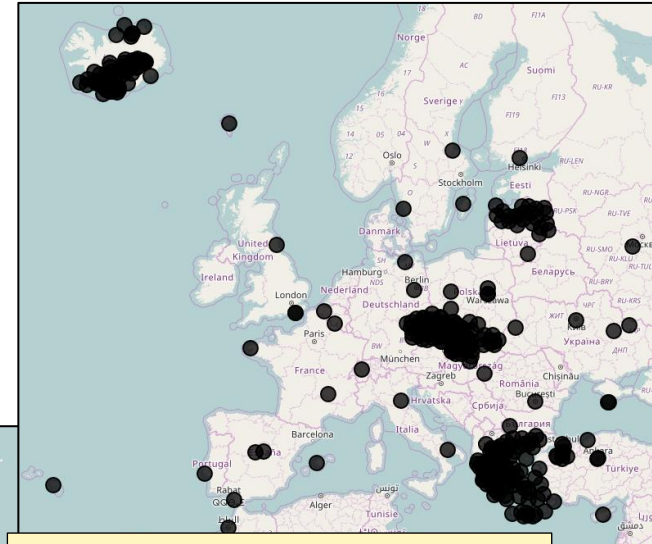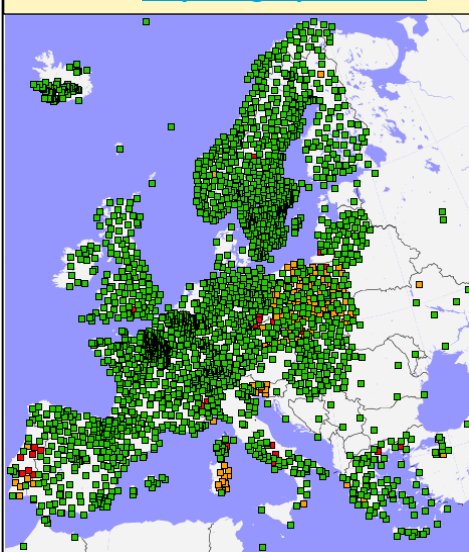
TropNET system developed at GOP

Software development & establishment of E-GVAP Analysis Centers

- KTU – Karadeniz Technical University in Trabzon, Turkey
- AUT – Aristotle University in Thessaloniki, Greece
- BEU – Bulent Ecevit University in Zonguldak, Turkey
- IMO – Icelandic Meteorological Institute, Iceland
- KNMI – Royal Meteorological Institute of the Netherlands
- *MUT – Military university of Technology, Warsaw, Poland*
- *CSU – Central South University in Changsha, China*
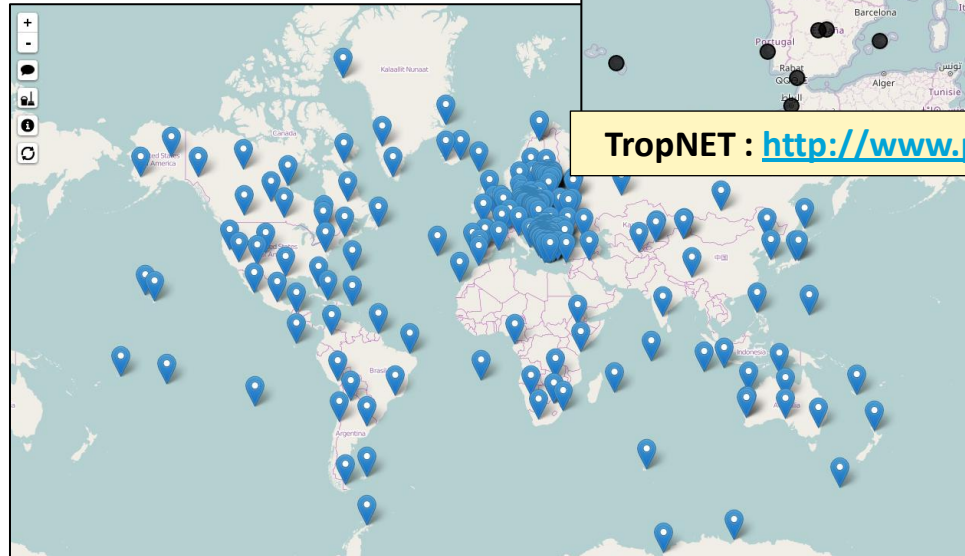- *SUT – Slovak University of Technology*

Processing other data:

- *Slovakia – SKPOS*
- *Latvia – LATPOS*

EGVAP: **http://egvap.dmi.dk/**

TropNET : **http://www.pecny.cz**

Douša J, Václavovic P, **Evaluation of ground-based GNSS tropospheric products at Geodetic Observatory Pecny,** *IAG Symposia, Springer, 2016*
Douša J, Bennitt GV, **Estimation and evaluation of hourly updated global GPS zenith tropospheric delays over ten months,** *GPS Solut, 2013*
Douša J, **Towards an Operational Near-real Time Precipitable Water Vapor Estimation,** *Phys Chem Earth, Part A, 2001*

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Specific analyses of permanent stations

Processing of dense GNSS permanent networks in the Czech Republic and Greece

- CZ total (103 sites): CZEPOS (24), VESOG (6), GeoNAS (18), TopNET (20) and others
- GR total (16 sites): PPGNet (6) and others (MERICA & NOA networks)

→ Daily and weekly solutions in SINEX format performed by Bernese GNSS software

→ Precise coordinates for monitoring and update of the national reference frame

→ Yearly combinations to check the stability of the stations including seasonal effects

…. Prepared for the monitoring tectonics (Greece)

…. Czech contribution to EUREF Densification:

http://epncb.oma.be/_densification

PPG NET

processed from other networks