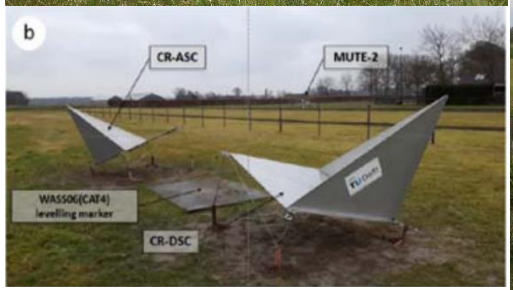
P1.1:Proposed guidelines for including colocated InSAR infrastructure in GNSS sitelogs

Lennard Huisman (NSGI - Kadaster)
Hans van der Marel (Delft University of Technology)



a) Coupled active transponder: ACTR/C,
b) Two colocated, not coupled, corner reflectors: CR/A and CR/D,
c) Active transponder integrated with GNSS: ACTR/I,
d) Integrated Geodetic Reference Station (IGRS) CBW100NLD: CR/I,
e) Integrated setup SPVL00SVK: CR/I

```
7.   Collocation Information

7.1  Instrumentation Type     : TIDE-GAUGE STATION
       Status                 : PERMANENT
       Effective Dates        : 1996-08-27/CCYY-MM-DD
       Notes                  : Tide gauge at Noordzee coast operated by RIKZ.

7.2  Instrumentation Type     : UNDERGROUND LEVELING BENCHMARK
       Status                 : PERMANENT
       Effective Dates        : 2004-12-30/CCYY-MM-DD
       Notes                  : Dutch height system NAP benchmark No. 024F0042

7.3  Instrumentation Type     : INSAR ACTR/D
       Status                 : PERMANENT
       Effective Dates        : 2012-05-14/2012-11-16
       Notes                  : InSAR transponder No. CAT1, occupancy code 01A0
                              : Systems: RS2

7.4  Instrumentation Type     : INSAR ACTR/D
       Status                 : PERMANENT
       Effective Dates        : 2012-11-16/2015-03-14
       Notes                  : InSAR transponder No. CAT1, occupancy code 01B0
                              : Systems: RS2
                              : CAT moved to other side of mast

7.5  Instrumentation Type     : INSAR ACTR/D
       Status                 : PERMANENT
       Effective Dates        : 2015-03-14/2015-12-27
       Notes                  : InSAR transponder No. CAT1, occupancy code 01B1
                              : Systems: RS2, S1
                              : Sentinel-1 (S1) observations added to program

7.6  Instrumentation Type     : INSAR ACTR/C
       Status                 : PERMANENT
       Effective Dates        : 2023-03-16/CCYY-MM-DD
       Notes                  : InSAR transponder No. E137, occupancy code 01C0
                              : Systems: S1

7.x  Instrumentation Type     : (GPS/GLONASS/DORIS/PRARE/SLR/VLBI/TIME/etc)
       Status                 : (PERMANENT/MOBILE)
       Effective Dates        : (CCYY-MM-DD/CCYY-MM-DD)
       Notes                  : (multiple lines)
```

P2.1

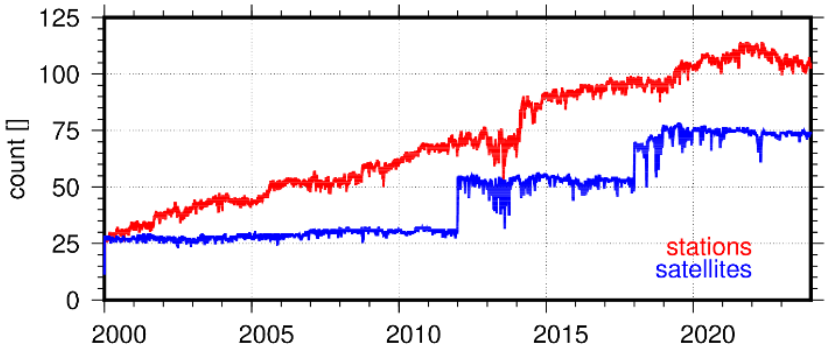
EVALUATING THE POTENTIAL OF ACTIVE AND PASSIVE SAR CORNER REFLECTORS AS COMPLEMENTARY GEODETIC INFRASTRUCTURE IN SWEDEN

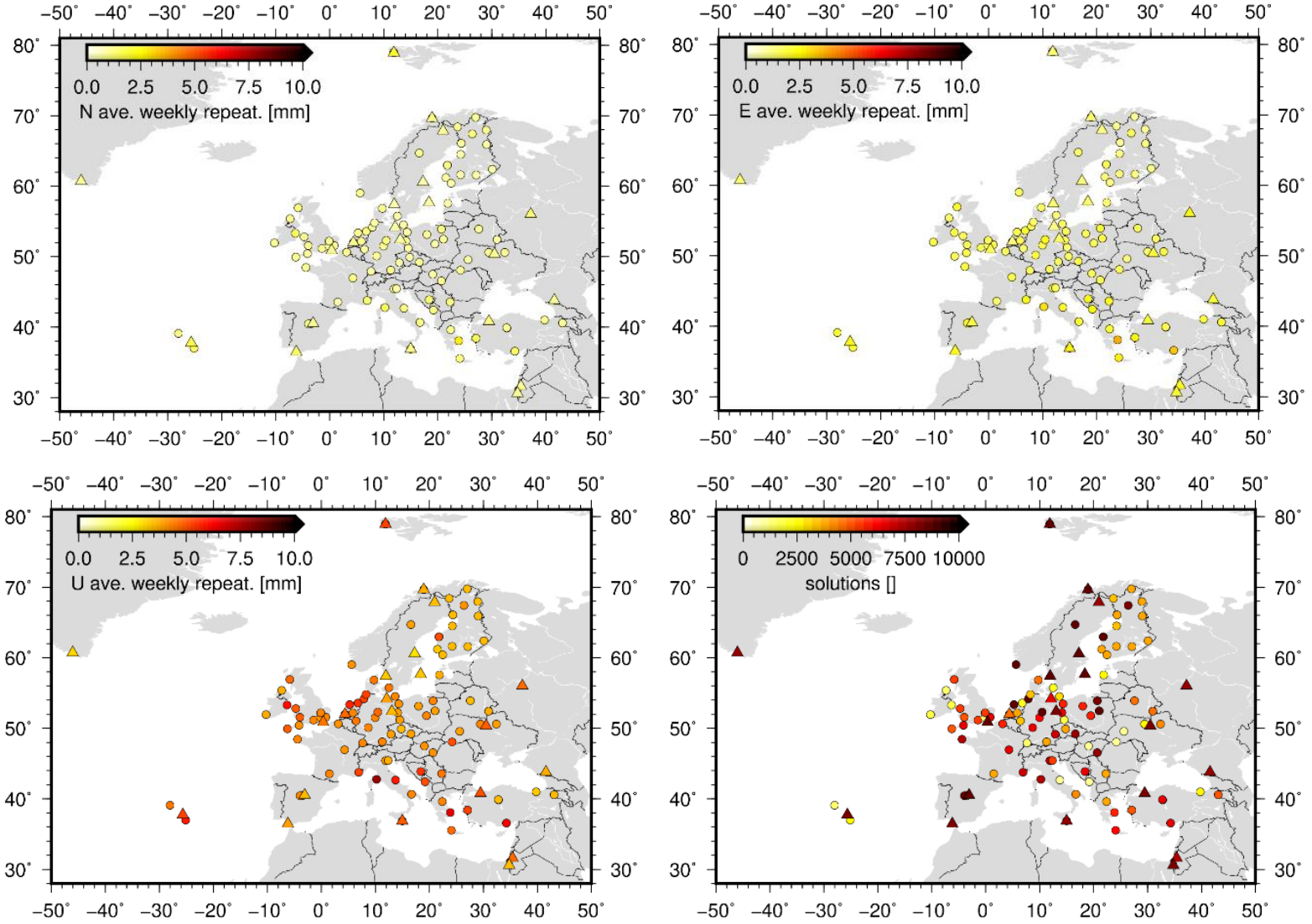
- Three compact active transponders (CAT) and 18 passive corner reflectors (CR) have been installed in Sweden.
- The CATs and CRs are installed near twin fundamental class A SWEPOS GNSS stations.
- Displacement time series from CRs align within 2-3 mm accuracy with GNSS measurements.

P2.2 **An update of GFZ's contribution to EPN-Repro3**

Topics:

- station selection,
- processing scheme,
- first results covering 2000 to 2024.





UNIWERSYTET WARMIŃSKO-MAZURSKI W OLSZTYNIE

ICGC Institut Cartogràfic i Geològic de Catalunya

P 2.3: LOW-COST GNSS ANTENNAS IN PRECISE POSITIONING: A FOCUS ON MULTIPATH AND ANTENNA PHASE CENTER MODELS

G. Krzan, K. Dawidowicz, J. Paziewski
Institute of Geodesy,
University of Warmia and Mazury in Olsztyn, Poland
grzegorz.krzan@uwm.edu.pl

EUREF Symposium 2024, 5th – 7th June, Barcelona, Catalonia, Spain

Fig. 1. GNSS antennas used in the experiment:

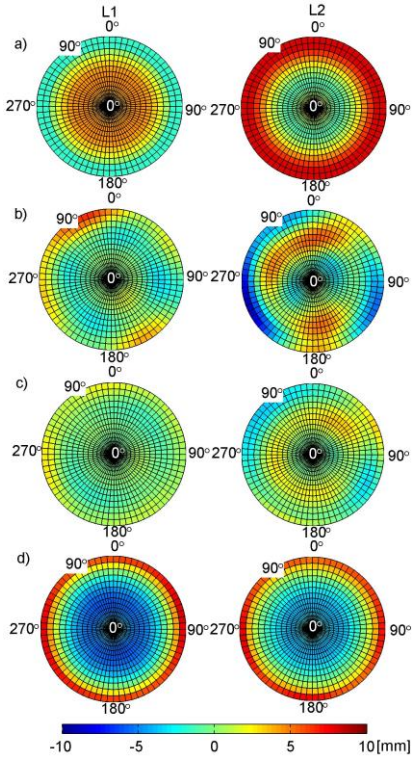


Fig. 2. Antenna PCV patterns: a) Tallysman TW7972, (b) JAVGRANT-G3T, c) TRM105000.10, d) TRM159900.00.

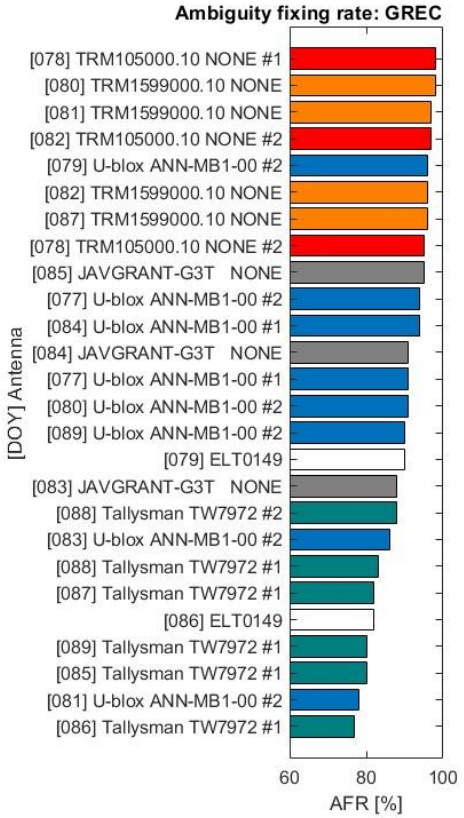


Fig. 3. Ambiguity fixing rates for GREC solution

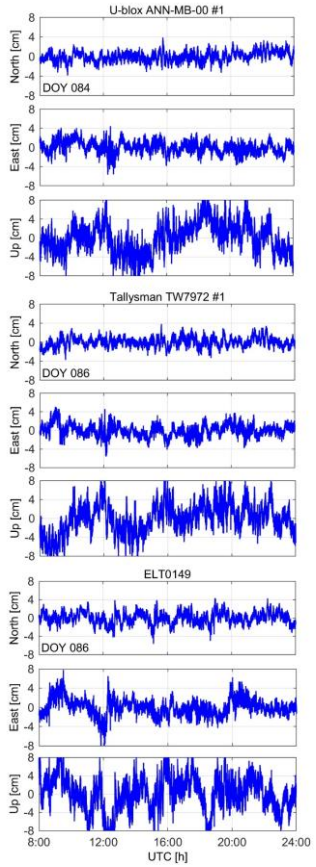


Fig. 4. Coordinate residuals time series of GPS-only PPP-AR kinematic solution for low-cost antennas.

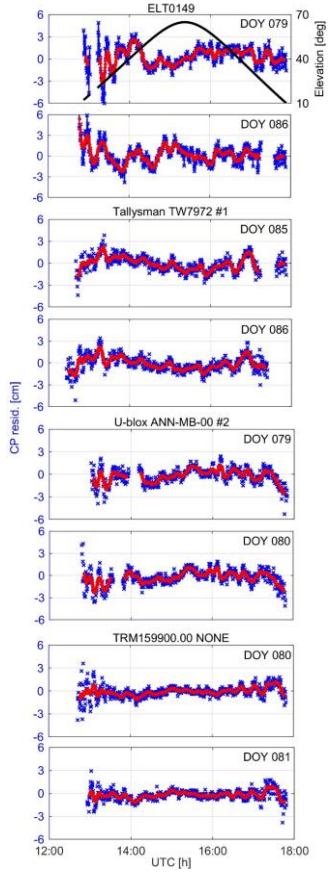


Fig. 5. Carrier phase IF residuals and elevation angle for GPS PRN 26 satellite

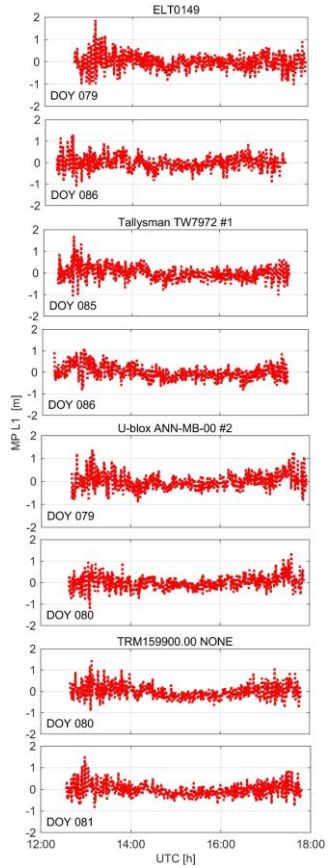


Fig. 6. Multipath of L1 and L2 from CMC linear combination for GPS PRN 26 satellite for the low-cost antennas and TRM159900.00.

Acknowledgements

This study was supported by the project “Innovative precise monitoring system based on integration of low-cost GNSS and IMU MEMS sensors” POIR 01.01.01-00-0753/21, co-financed by the European Regional Development Fund within the Sub-measure 1.1.1 of the Smart Growth Operational Program 2014–2020. We would like to express our great appreciation for GNSS products, and the PRIDE PPP-AR software provided by Wuhan University.

The study was published in Krzan, G., Dawidowicz, K. & Paziewski, J. Low-cost GNSS antennas in precise positioning: a focus on multipath and antenna phase center models. GPS Solut 28, 103 (2024). https://doi.org/10.1007/s10291-024-01645-3

P2.4

Belgian national report

EUREF Symposium 2024

Royal Observatory of Belgium

- Creation of a new national open data portal and associated API to search and download Belgian GNSS datasets
- Further development of our GNSS station metadata service M3G

NGI Nationaal Geografisch Instituut — IGN Institut Géographique National

- Progress on the new 3D geodetic network
- new functionalities of the coordinate transformation API
- installation of new Integrated Geodetic Reference Stations and its support for the possible installation of the Einstein Telescope.
- switch to a new metadata management procedure using M3G (gnss-metadata.eu) and its benefits with regards to the contributions to the EPN
- contributions to organisations such as EPOS and UN-GGIM are mentioned

ICGC Institut Cartogràfic i Geològic de Catalunya

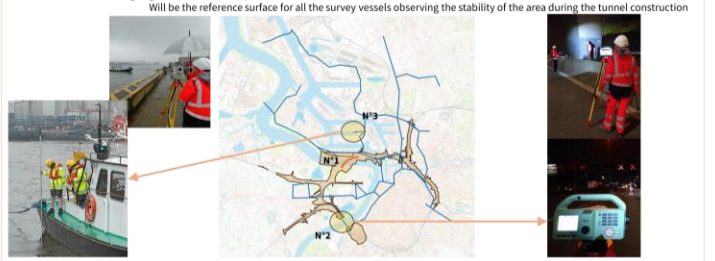
Oosterweel

- Underwater tunnel construction **(N°1)**
  - ± €7 billion project
  - Largest infrastructure project

November 2022 1.05 km levelling under river 'Scheldt' to connect East and West side of the levelling area **(N°2)**

Since 2023 1-month levelling campaign / year to control the height benchmarks along the blue lines

March 2024 Levelling of ground surface of ship dock **(N°3)**
Will be the reference surface for all the survey vessels observing the stability of the area during the tunnel construction



EPOS

- Belgium is founding member of EPOS European Research Infrastructure Consortium and plays an active role in e.g.
  - The EPOS governance
  - As GNSS network and software coordination center
  - Operating the Belgian (78 stations) and EUREF GNSS data nodes
  - Operating the GNSS data quality control

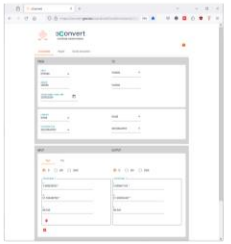
Belgian EPOS data node
https://belgium-epos.gnss.be/

EPOS data quality monitoring
https://gnssquality-epos.oma.be

EUREF poster: Bamahry et al., *Toward long-term data quality monitoring of EPOS-GNSS stations.*
EUREF presentation: Bruyninx et al., *Assessment of EPOS' GNSS data.*

oConvert

- Coordinate transformation web-app
- REST API
- New functionalities:
  - ETRS89(ETRF2000) ↔ WGS84(ITRF2014)
  - EGM (1996 - 2008) - & EVRF (2000 - 2007 – 2019)-heights



Open Data Portal

- Web portal
- REST API
- Build on FAIR data principles
- 78 stations

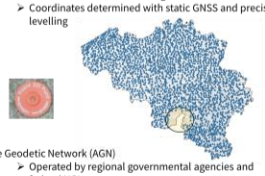
Open Data Portal for Belgian GNSS data
https://gnss.be/opendataportal/belgiandata.php

- Web portal
- REST API
- Build on FAIR data principles
- GNSS station metadata for 3000+ GNSS stations

Metadata Management and Distribution System for Multiple GNSS Networks
https://gnss-metadata.eu

Geodetic Network

- 3D Project
  - 2183 points (98 % completed)
  - 2018 → mid-2024 (planned)
  - Stainless steel nails in existing solid concrete surfaces
  - Coordinates determined with static GNSS and precise levelling



- Active Geodetic Network (AGN)
  - Operated by regional governmental agencies and federal NGI
  - NGI is responsible for initial coordinates and monitoring of stations
  - All information and results on website (https://agn.ngi.be)

Integrated Geodetic Reference Stations

- 2 IGRS in support of Belgian ground motion mapping in Doel and Houthalen – Helchteren
- Joint project Geological Survey of Belgium - NGI

'Local scale of ground deformation along faults in area and vicinity of one possible Einstein Telescope location'

- Joint ULiege/CSL – NGI project
- 2 IGRS in support of Einstein Telescope project
- Time series along Gueule fault and Gulp fault, which cross the Einstein Telescope area in the Pays de Herve (Belgium) and Heerlerheide fault in the Roer Valley Graben (Germany).

International cooperation

- UN-GGIM - Subcommittee on Geodesy – Global Geodetic Centre of Excellence
- EUREF (member governing board, network coordinator, reference frame coordinator, analysis center, historical data center, real-time broadcaster, reprocessing)
- IGS (member of Reference Frame, Real-Time, Troposphere, Antenna working groups and Infrastructure committee)
- EPOS (member of EPOS ERIC executive committee, chair of EPOS ERIC Service Coordination Committee, chair EPOS-GNSS Executive Board, member of EPOS-GNSS Consortium Board, network coordinator, software coordinator)
- IAG (member of several working groups and governing boards)
- E-GVAP (national delegate and member of the expert group on GNSS data processing, analysis centre)
- RDA - Research Data Alliance (member of the "Complex Citations" working group)
- GGOS (member of GGOS "Data and Information Systems" and "DOIs for Geodetic Data Sets" Committees)
- EUROGEOGRAPHICS

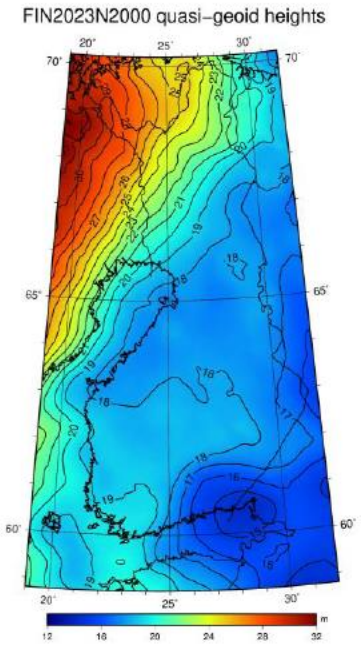
EPN

- Since the beginning of 2015, NGI is taking part in the EPN Densification
- Week 1656 (2 October 2011) up to week 2315 (19 May 2024)
- EPN analysis center (daily rapid and final solutions, Repro3 solution ready by summer 2024)
- 2 EPN densification analysis centers (ROB not started yet with Repro3)
- ECTT: all transformations ETRS89 ↔ ITRS Updated to include ETRF2020 : https://epncb.oma.be/_productservices/coord_trans/

P2.5

NLS
FINNISH GEOSPATIAL
RESEARCH INSTITUTE
FGI

National Report of Finland



Updates and information on:

- FinnRef permanent GNSS network: backbone of Finnish reference systems
- New Finnish height transformation surface (geoid model) FIN2023N2000
- National Standards Laboratory activities
- Metsähovi research station
- FINPOS positioning service
- New EGNOS RIMS station in Kuusamo
- 2023/2024 FINNARP Expedition to Aboa, Antarctica

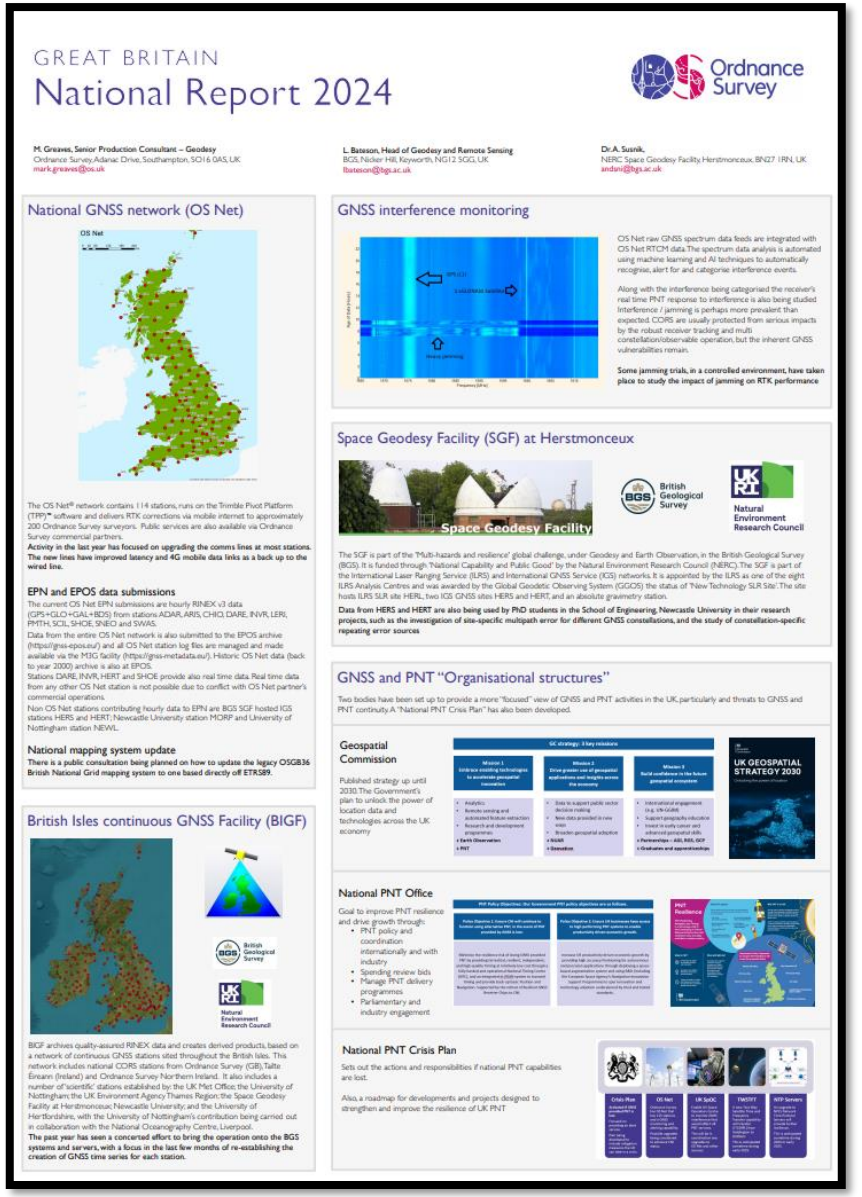
Pasi Häkli, pasi.hakli@nls.fi

EUREF symposium, Barcelona, Spain, June 5-7, 2024

P2.6 National Report of Great Britain

POSTER

M. Greaves
(Poster) Presentation to EUREF 2024



Ordnance Survey

Reminder, resolutions at:
https://tinyurl.com/EUREF2024Resolutions
and
https://shorturl.at/duEIN

Thank you

Mark Greaves

Senior Production Consultant – Geodesy, Ordnance Survey

www.os.uk

mark.greaves@os.uk

EUREF 2024 Symposium
June 5, 2024 - June 7, 2024

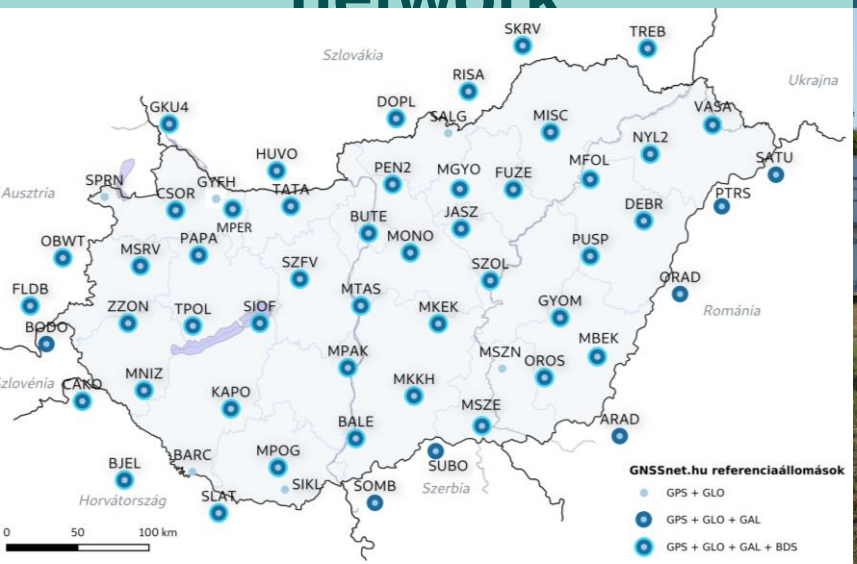
LECHNER Non-Profit Ltd.

P2.7

National Report for Hungary

Status of EUREF related geodetic networks and recent activities in Hungary

Status of the national CORS network

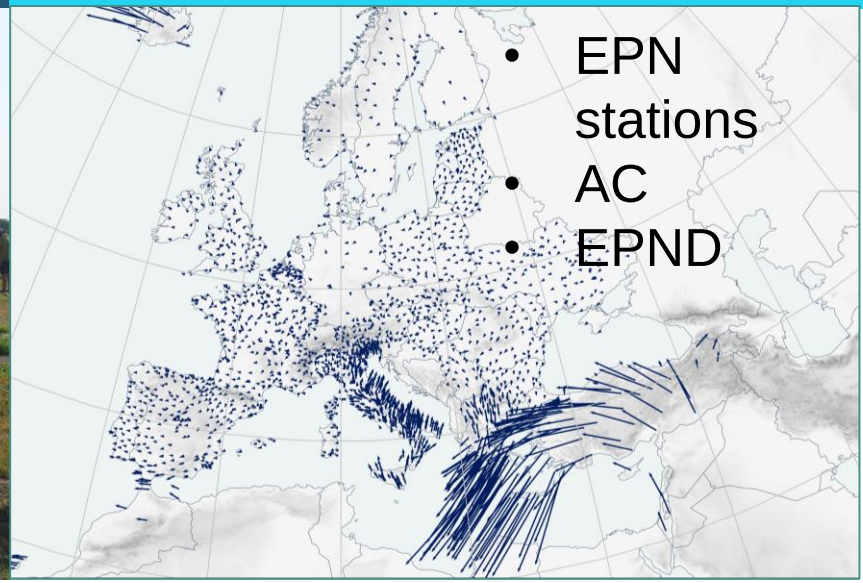


GNSSnet.hu reference stations

Towards a kinematic height reference (INGRIM)

MSZE IGRS site

Contribution to EUREF activities



- EPN stations
- AC
- EPND

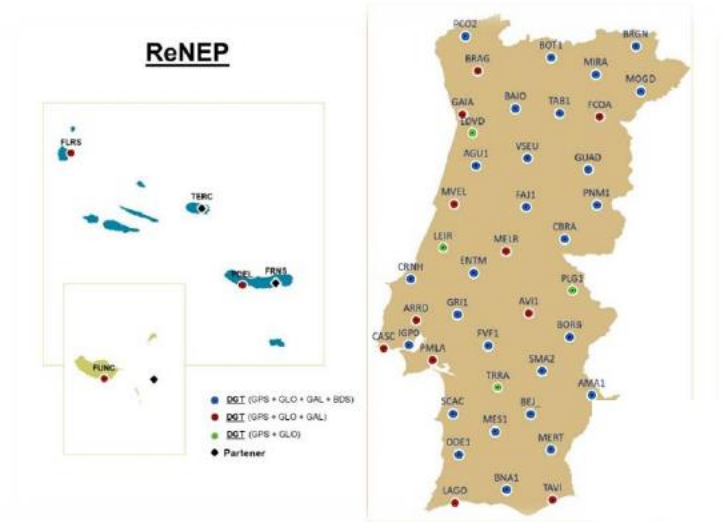
EPND D2237

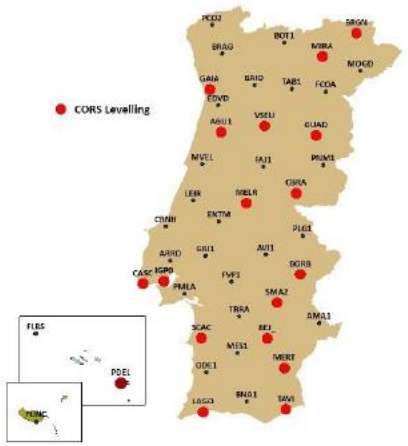
Sandor Toth, Ambrus Kenyeres, Balint Magyar
Lechner Non-Profit Ltd. – **Satellite Geodetic Observatory**, Penc, Hungary

P2.9 EUREF Symposium 2024 - Barcelona – June 2024

National Permanent GNSS Stations Network (ReNEP)

42 mainland; 4 in Azores; 1 in Madeira



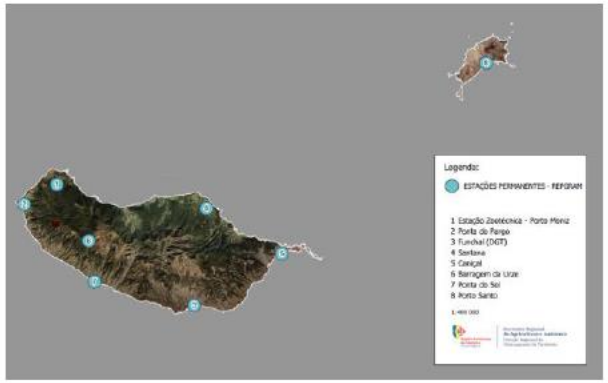


- 6 stations with GPS & GLONASS
- 14 stations with GPS , GLONASS & GALILEO
- 27 stations with GPS, GLONASS, GALILEO and BEIDOU

Regional Permanent GNSS Stations Networks

REPRAA - Azores

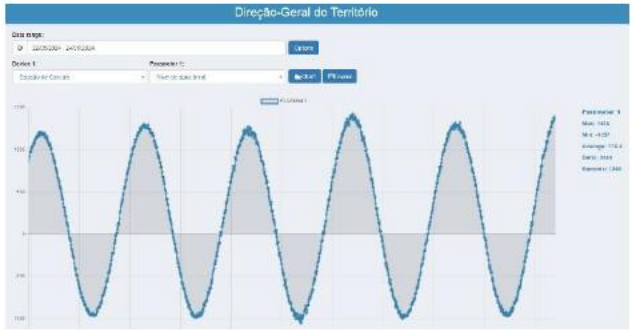
REPGRAM - Madeira



Tide Gauges

Datalogger

Radar sensor



EUREF Web Page

- New programing language

https://www.euref.eu/

P2.10

NATIONAL REPORT OF SWEDEN

A comprehensive national report will be published at EUREF's website

- Improvement of the GNSS Interference Monitoring System
- New version of SWEPOS™ Post-processing Service
- Update of SWEPOS Ionosphere Monitor
- Implementation of BSCD2000 – Baltic Sea Chart Datum 2000

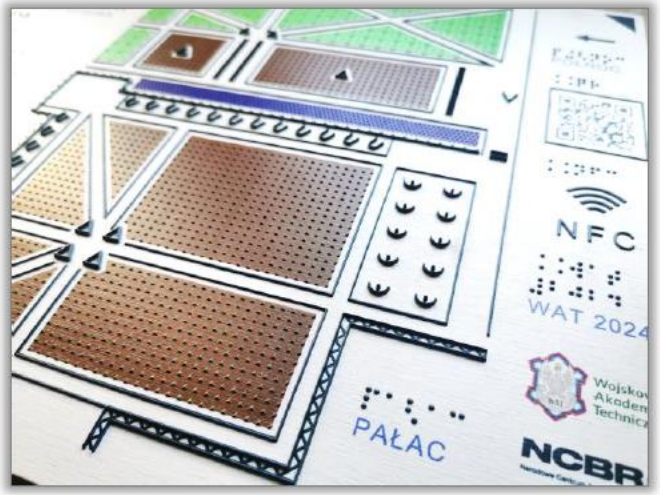
P3.1 TOUCH THE REFERENCE FRAME

Araszkiewicz A., Mościcka A., Wabiński J., Kiliszek D., Śmiechowska-Petrovskij E., Traut-Seliga A., Całka B., Zwirowicz Rutkowska A.

UNIQUE SET OF SYMBOLS

TACTILE MAP EDITING RULES

NOT ONLY TOUCH



- Part of the final tactile map entitled "Baroque garden in Wilanów - terraces".

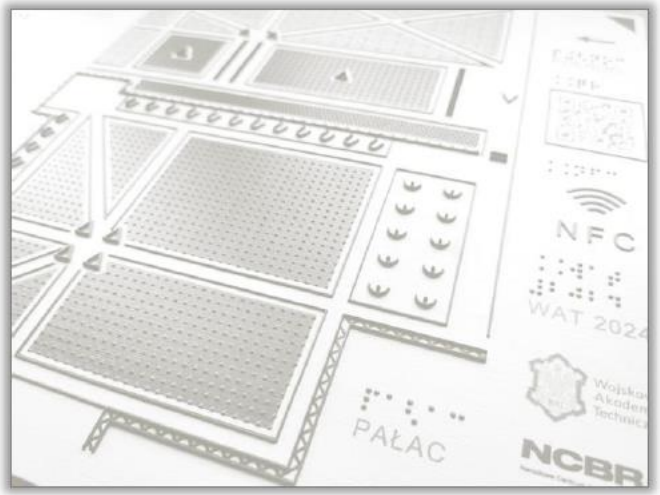
P3.1 TOUCH THE REFERENCE FRAME

Araszkiewicz A., Mościcka A., Wabiński J., Kiliszek D., Śmiechowska-Petrovskij E., Traut-Seliga A., Całka B., Zwirowicz Rutkowska A.

UNIQUE SET OF SYMBOLS

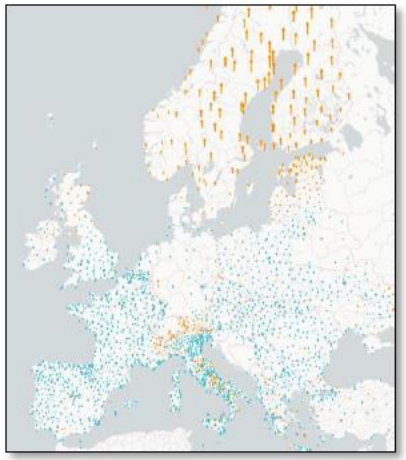
TACTILE MAP EDITING RULES

NOT ONLY TOUCH

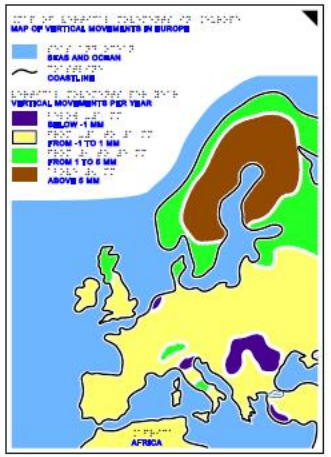


◂ Part of the final tactile map entitled "Baroque garden in Wilanów - terraces".

TECHNOLOGY APPLIED TO EUREF MAPS



▾ Example of tactile map for EUREF

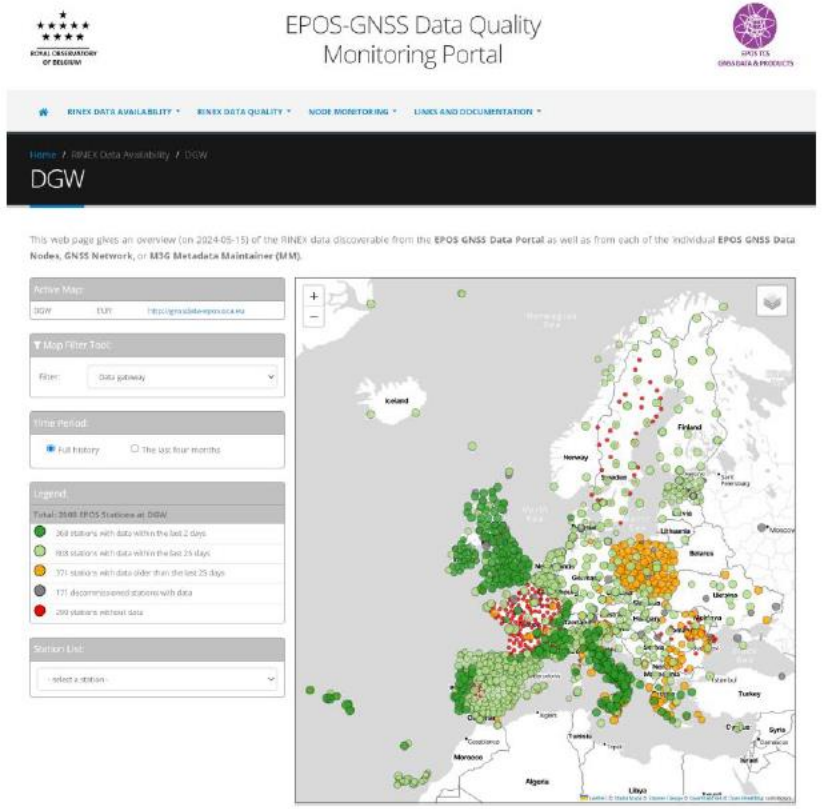


P3.2

Toward long-term data quality monitoring of EPOS-GNSS stations

Fikri Bamahry, Juliette Legrand, Carine Bruyninx
Royal Observatory of Belgium

- Overview of EPOS-GNSS workflow.
- Introduction of:
  - EPOS-GNSS data quality monitoring web portal.
  - GNSS data quality indicators.
- Number of GNSS data discoverable through EPOS.
- Example of GNSS data quality indicators usage.



GNSS data quality monitoring web portal: RINEX data availability.

This work was funded by the Belgian Federal Science Policy Office (BELSPO) through the ESFRI-FED program.

ROYAL OBSERVATORY OF BELGIUM

EUREF Symposium, June 5-7, 2024, Barcelona, Spain

EUREF2024