TCS GNSS DATA AND PRODUCTS

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Chair Executive Board
Royal Observatory of Belgium

EPOS-BE Webinar Nov. 24, 2023

Based on the work done by the whole EPOS-GNSS team

GNSS data in a nutshell

- **G**lobal **N**avigation **S**atellite **S**ystems, e.g. GPS, Galileo, GLONASS, BeiDou

- GNSS satellites emit radio signals captured by **GNSS stations** installed at fixed locations on the Earth

- GNSS stations are equipped with **high-precision GNSS instruments**

- GNSS data used for **multi-disciplinary applications**: maintenance of coordinate reference systems, monitoring of ground deformations, ionosphere, troposphere, …

GNSS TCS Mission
- Make openly available data from as many as possible GNSS stations
- Generate and distribute GNSS data products tuned to the needs of EPOS users

through EPOS data portal
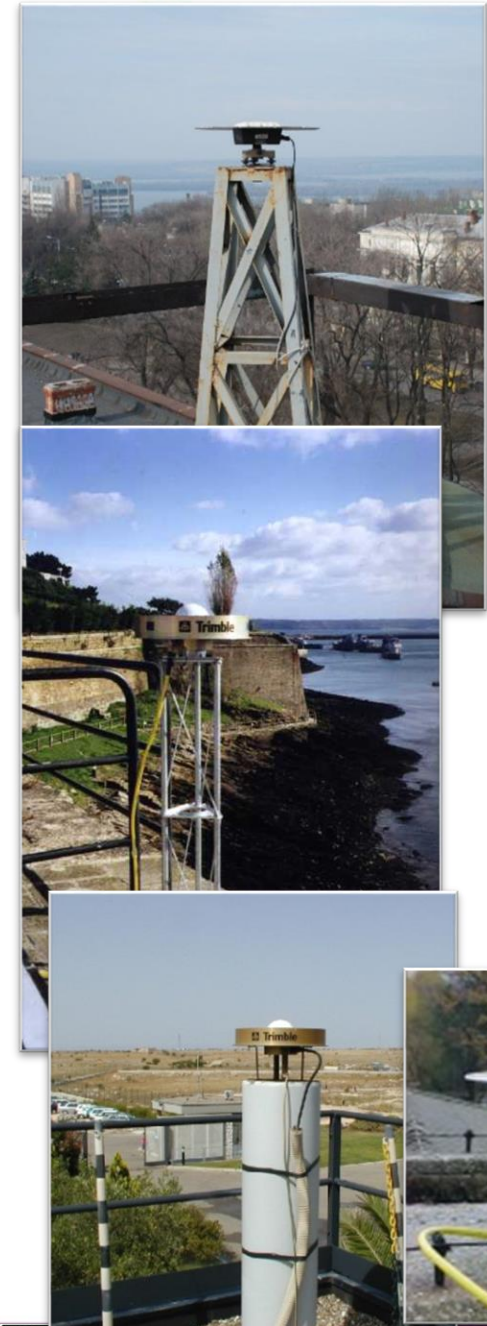
The challenge when we got started
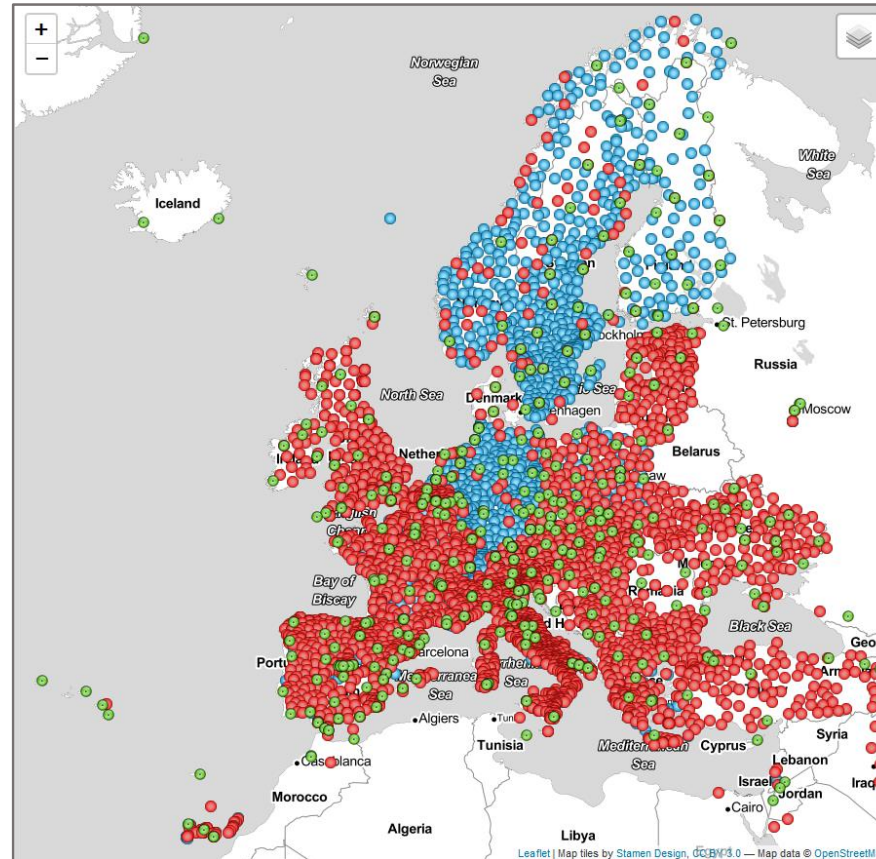
GNSS DATA AND PRODUCTS

~5000 existing GNSS stations with data operationally analyzed for high-precision applications
→ Huge potential for integration in EPOS RI

GNSS data used for multi-disciplinary applications

- Reference frames (EUREF)
- Surveying
- Ground movements and strain rates
- Space weather
- Numerical weather prediction
- Sea-level monitoring
- Soil moisture
- Ice and snow thickness
- ...

- Diverse communities, not necessarily talking to each other

- Different modus operandi and objectives

- Only small part of GNSS data discoverable in an organized way (EUREF stations < 400 – in green in map)

EUROPEAN PLATE OBSERVING SYSTEM

ROYAL OBSERVATORY OF BELGIUM

From 2015 on …

2002 2008 CONCEPTION PHASE | 2010 2014 PREPARATORY PHASE | 2014 2019 IMPLEMENTATION PHASE | 2020 PILOT OPERATIONAL PHASE

Bring diverse GNSS communities together using an inclusive approach and construct new GNSS infrastructure inspired by the existing EUREF network

✓ Set up governance framework with representatives from data providers and users

✓ Design and implement the necessary procedures and building blocks to provide operational services ensuring

- Discoverability of quality-checked GNSS data and station metadata

- Generation and discoverability of GNSS products

✓ Using international community-agreed standards

RELIABLE PRODUCTION CHAIN FOR PROVISION OF THE GNSS SERVICES

ROYAL OBSERVATORY
OF BELGIUM

EPOS
EUROPEANPLATEOBSERVINGSYSTEM

https://www.epos-eu.org/

TCS community portals

EPOS data portal
https://www.ics-c.epos-eu.org/
Access to **multi-disciplinary data & products**

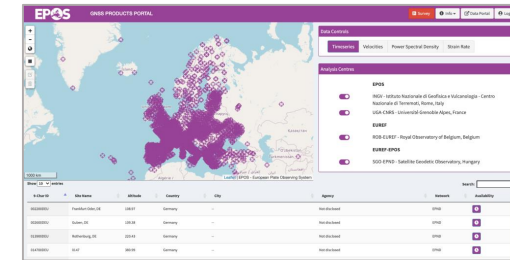*Live demonstration of data portal after coffee break*
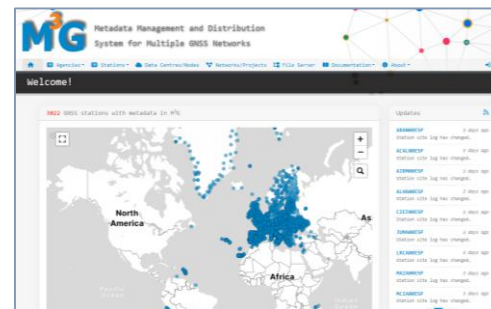
4 GNSS TCS Community Portals

GNSS data portal

GNSS products portal

France

Portugal

Portals specifically created/operated for EPOS

GNSS station metadata portal

GNSS data quality monitoring portal

Belgium

Belgium

GNSS data and products

EPOS data portal
https://www.ics-c.epos-eu.org/

Web services

Web services

EPOS-GNSS data gateway
http://gnssdata-epos.oca.eu/

EPOS-GNSS product portal
https://gnssproducts.epos.ubi.pt/

EPOS-GNSS data dissemination concept

EPOS GNSS Data Gateway: http://gnssdata-epos.oca.eu

10 EPOS-GNSS data nodes

Data repositories connected to each node

Distributed Data Access:

Station operators upload their GNSS observation data (daily RINEX 30s) to a data repository (or data center).

Data node

1. Performs quality control

2. Makes GNSS data visible to EPOS-GNSS data gateway

When users connect to Data Gateway and search for data, they will be redirected to nodes → data repositories
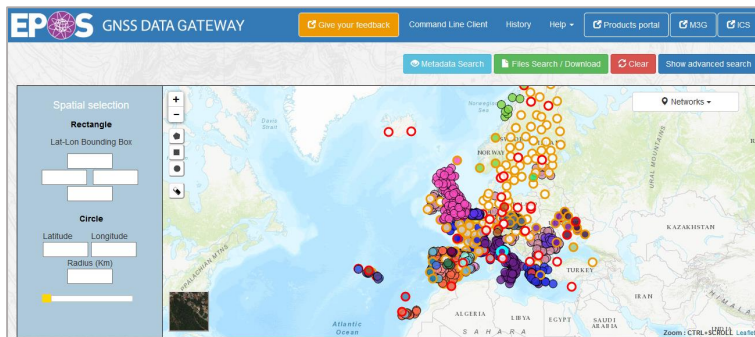
Data Gateway offers centralized access to GNSS (meta)data in all repositories via
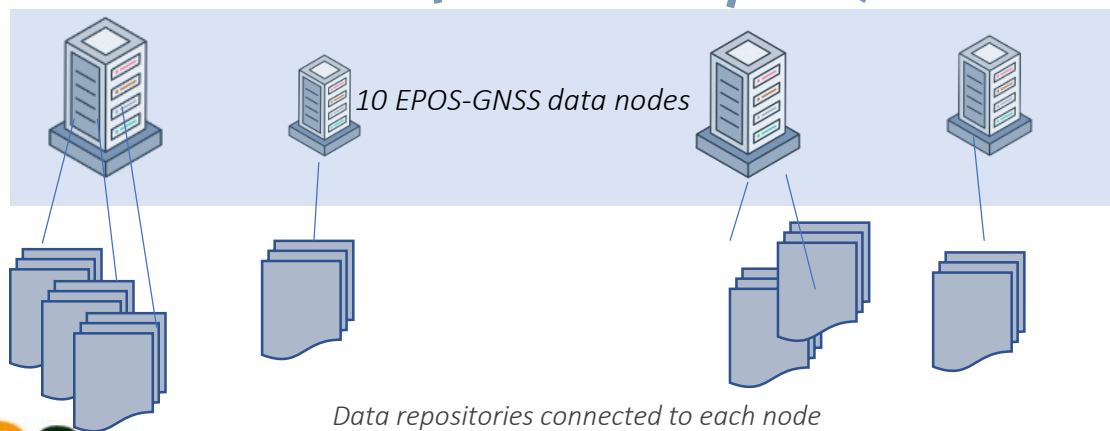- Web interface
- APIs

ROYAL OBSERVATORY
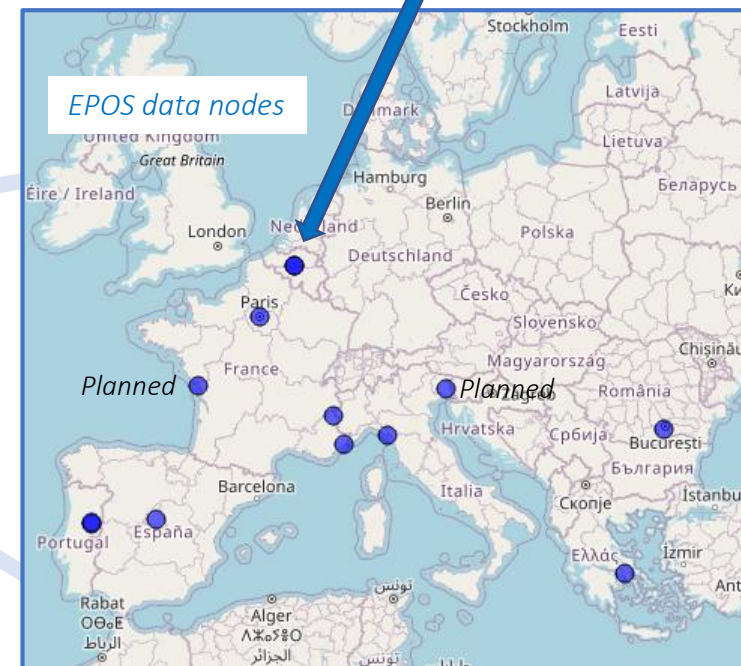OF BELGIUM

EPOS-GNSS data dissemination concept

EPOS GNSS Data Gateway: http://gnssdata-epos.oca.eu

10 EPOS-GNSS data nodes

Data repositories connected to each node

2 EPOS-GNSS data nodes at Royal Observatory of Belgium

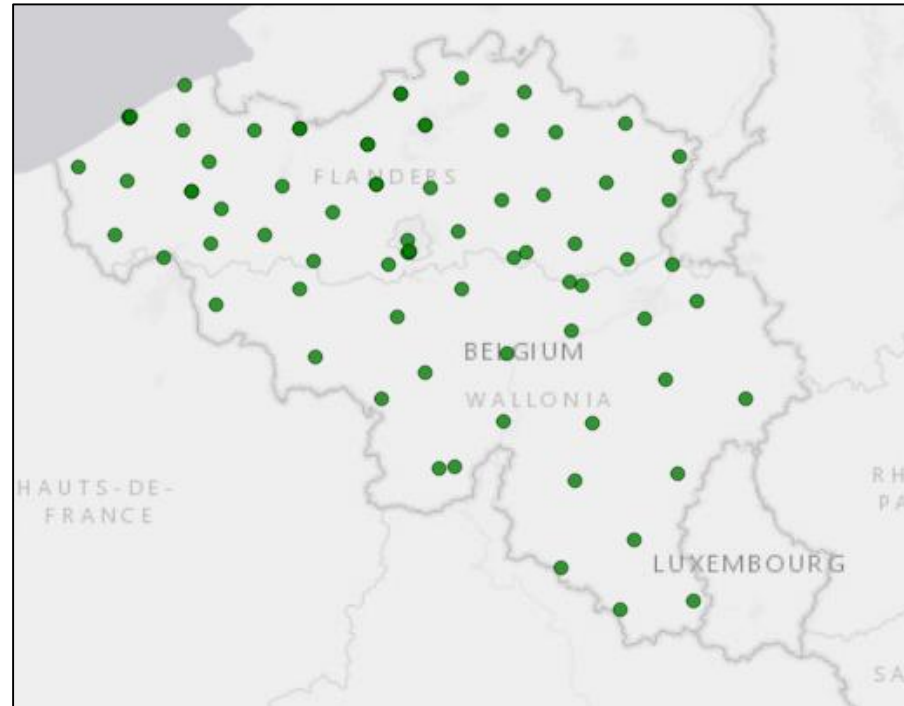*EPOS data nodes*

Planned

Planned

GNSS DATA AND PRODUCTS

Two GNSS data nodes in Belgium

Belgian national data node

Data from
- Royal Observatory of Belgium
- Digitaal Vlaanderen
- Service Public de Wallonie
- Centre Spatial de Liège
- Nationaal Geografisch Instituut

more permanently tracking GNSS stations are welcome!
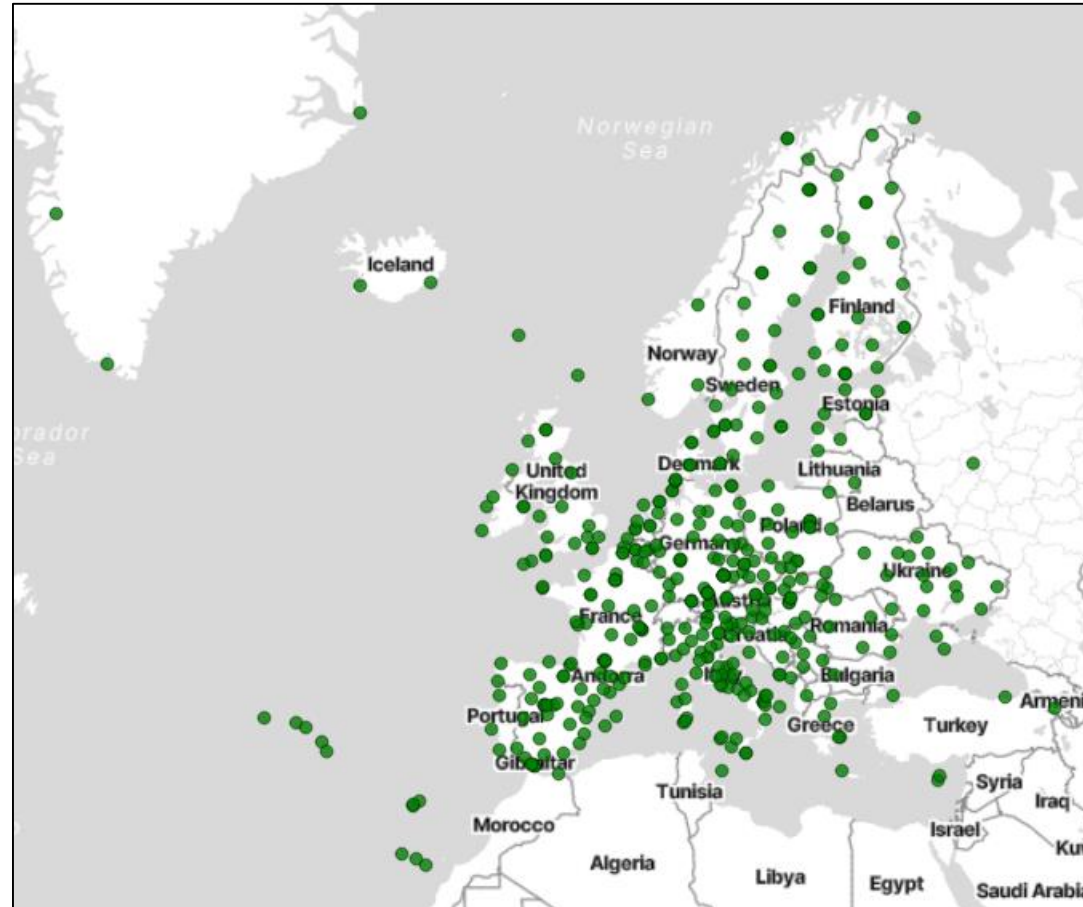
- # files: 450k
- # stations: 78
- 1996 - today

Daily RINEX data available through EPOS-GNSS data gateway or EPOS data portal

Two GNSS data nodes in Belgium

EUREF data node

GNSS data from
- 100+ different agencies

- # files: 2,3M
- # stations: 429
- 1996 - today
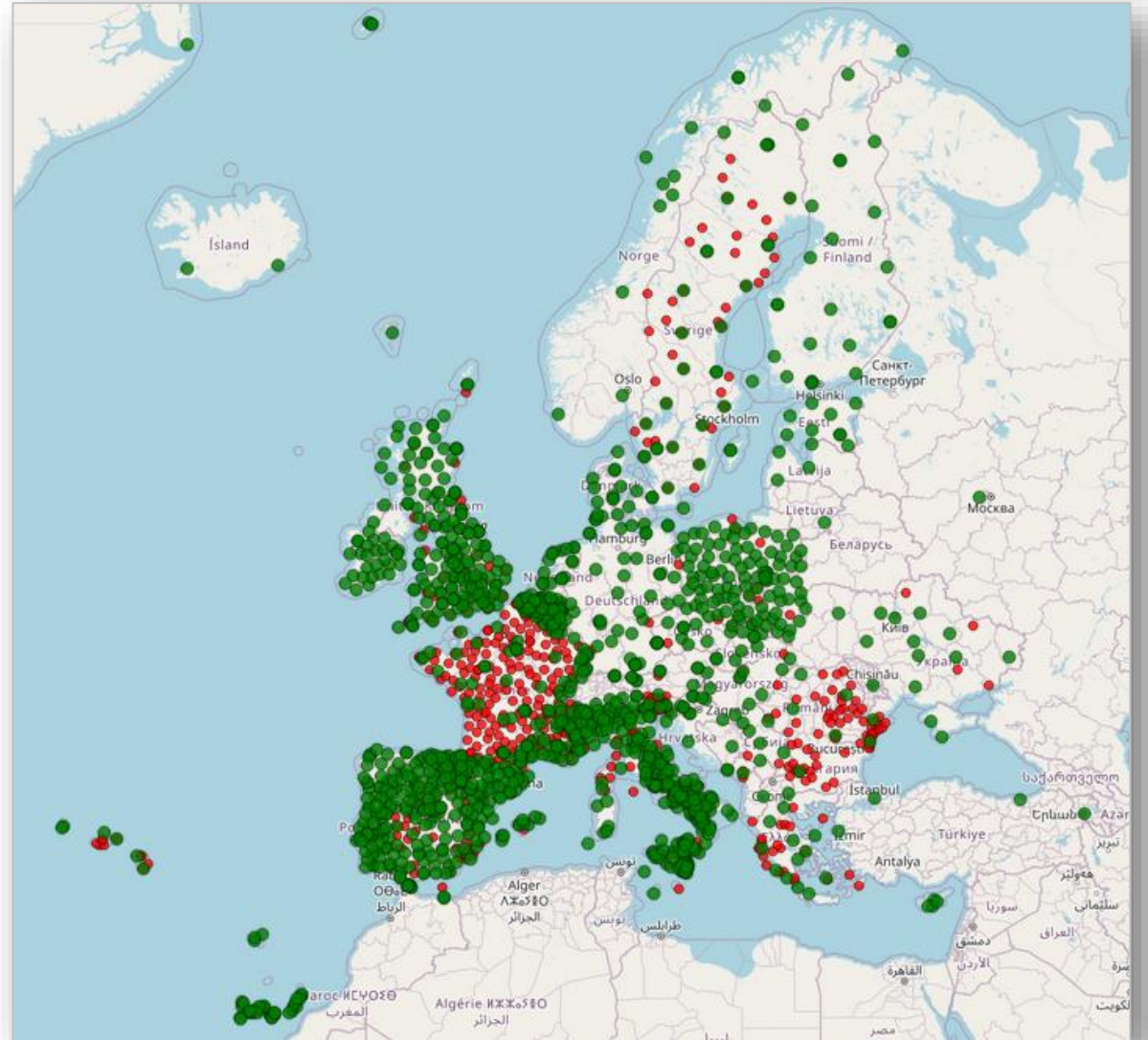
Daily RINEX data available through EPOS-GNSS data gateway or EPOS data portal

Present EPOS-GNSS network

GNSS DATA AND PRODUCTS
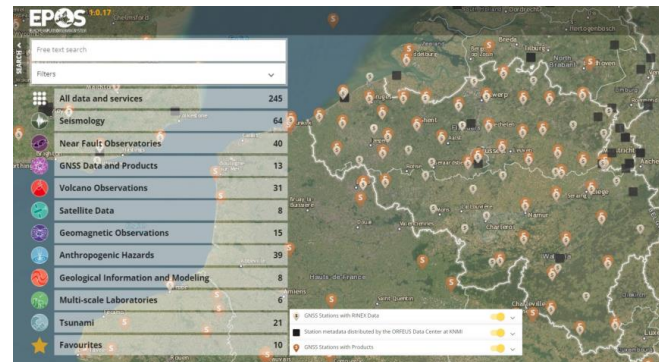

🔴 583 GNSS stations with data sets to be integrated

🟢 1363 GNSS stations with integrated data sets

EPOS
EUROPEAN PLATE OBSERVING SYSTEM

GNSS data and products

Portal of Integrated Core Services
https://www.ics-c.epos-eu.org/

Web services

Web services

EPOS-GNSS data gateway
http://gnssdata-epos.oca.eu/

EPOS-GNSS product portal
https://gnssproducts.epos.ubi.pt/

GNSS Products

GNSS DATA AND PRODUCTS

Daily/Weekly Station Positions

Daily / Weekly Position Time Series

Velocities

Strain Rate Maps

ROYAL OBSERVATORY OF BELGIUM

A. Socquet, EPOS-GNSS Webinar, Jan. 2021

GNSS DATA AND PRODUCTS

Origin of GNSS products

- 2 dedicated GNSS analysis centers (Italy, France) processing the data of all EPOS-GNSS stations

- EUREF analysis/combination centers (Belgium, Poland, Hungary)

    - Building on contributions from agencies all over Europe

    - Includes contributions from ROB, NGI in Belgium

- Strain rates (Sweden)

EPOS EUROPEAN PLATE OBSERVING SYSTEM

4 GNSS TCS Community Portals

Community Portals
Home

Within EPOS' framework, each Thematic Core Service (TCS) provid
where users can find a wide variety of data and other resources

- **Seismology**
- **Near-Fault Observations**
- **GNSS Data and Products**
- **Volcano Observations**
- **Satellite Data**
- **Geomagnetic Observations**
- **Anthropogenic Hazards**
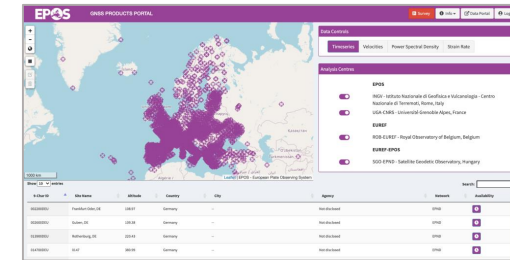- **Geological Information and Modeling**
- **Multiscale Laboratories**
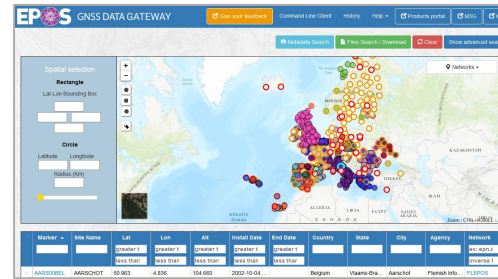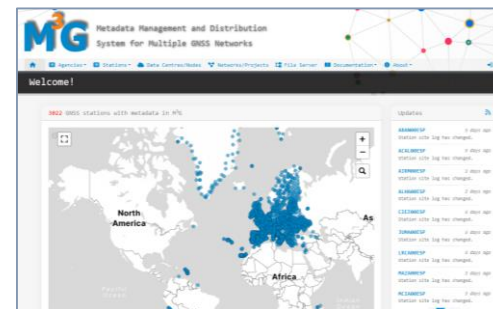
GNSS data portal

France

GNSS products portal

Portugal

Portals specifically created/operated for EPOS

GNSS station metadata portal

Belgium

GNSS data quality monitoring portal

Belgium

Added-value of EPOS-GNSS

https://gnss-metadata.eu

Provision of

- **Station metadata**
  - Site logs: e.g. equipment changes that can influence the estimated station position
  - DOI, data license

- GNSS data quality information
  - e.g. that allows to evidence when GNSS data quality can provide unreliable station position estimates

Belgian services provided by the Royal Observatory of Belgium

Added-value of EPOS-GNSS

Provision of

- Station metadata
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https://gnssquality-epos.oma.be/

Belgian services provided by the Royal Observatory of Belgium

Estimated positon time series

Subsidence of the station of about 3 cm

- Data quality monitoring system (DQMS)
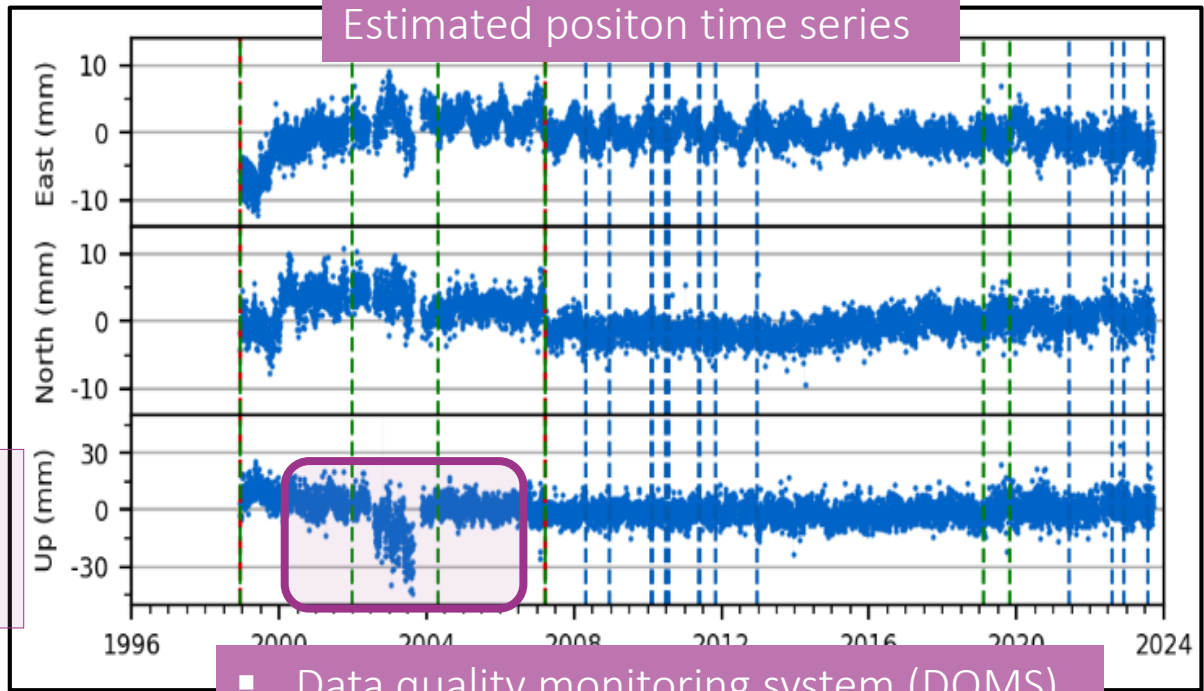- GNSS station metadata (M³G)

M³G & DQMS
provide valuable information to help identifying if a computed change in the position of a GNSS station is caused by a real ground movement or not
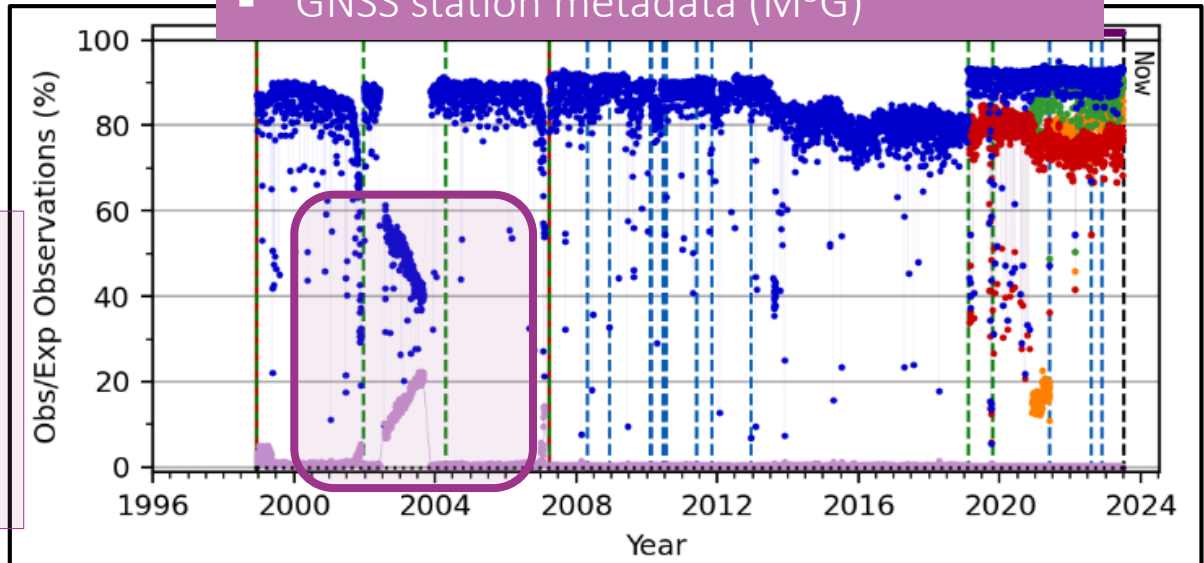
Computed subsidence is not "real" but caused by degraded data quality

Conclusions

GNSS DATA AND PRODUCTS

- New GNSS e-infrastructure providing data and data products of 1000's of GNSS stations to EPOS

- 4 TCS GNSS community portals: Data gateway, Product gateway, M^{3}G, DQMS

- E-infrastructure is operational, but not yet 'finished'

  - Optimize the chain of operational services

  - Add new GNSS datasets and new data nodes

  - Improve GNSS node software

  - Improve and extend GNSS products

Challenges:

- *Fill geographical gaps, GNSS stations at tide gauges*

- *High-rate data*

- *Real-time data*

EPOS
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M³G
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GNSS DATA AND PRODUCTS