GNSS Services in EPOS' Pilot Operational Phase

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For EPOS-GNSS Executive Board

Royal Observatory of Belgium

EUREF Symposium, 26-28/05/2021, Ljubljana, Slovenia

Outline

- Introduction
- Pre-operational GNSS data services
- Pre-operational GNSS product services
- Conclusions

European Plate Observing System (EPOS)

What?

EPOS is the European Research Infrastructure serving Solid Earth science

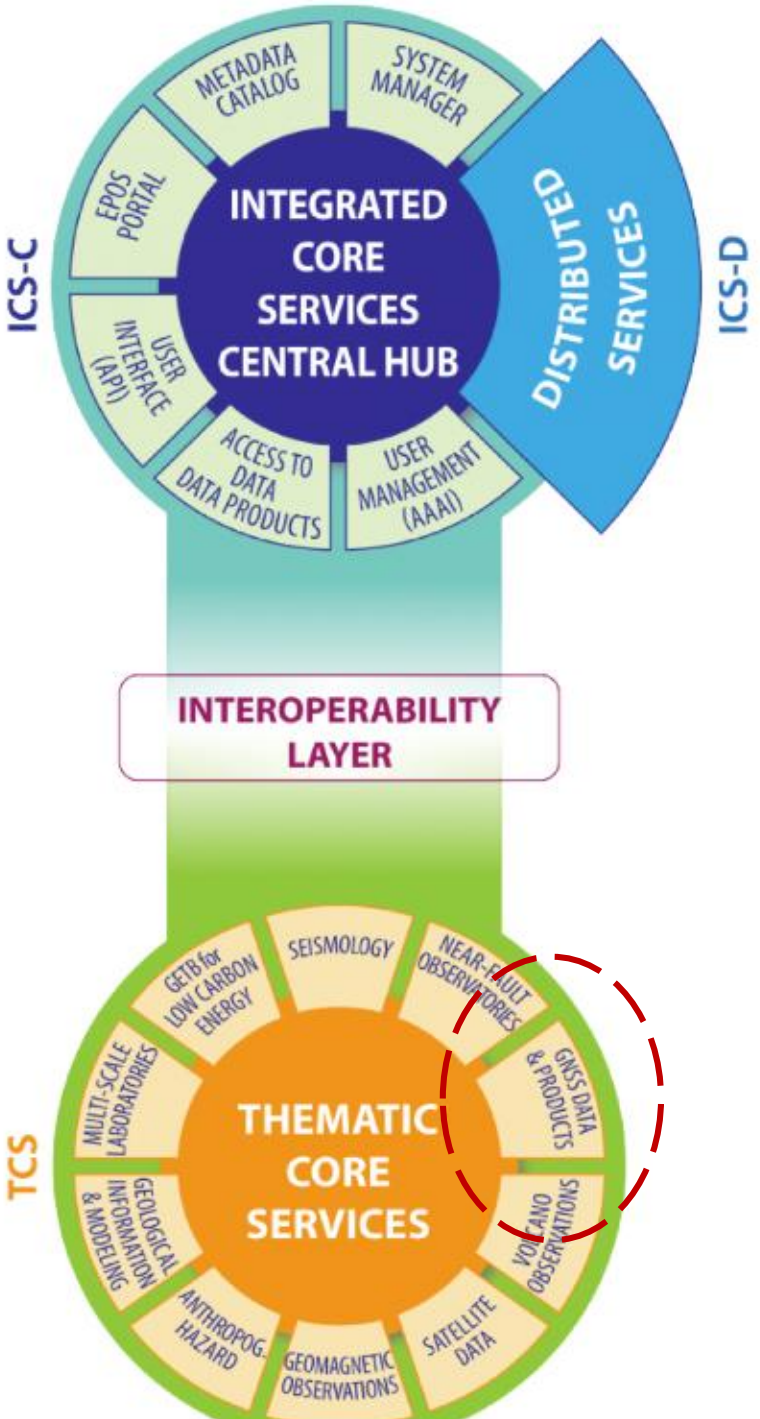
In Practice

Measure how ground moves

Understand why ground moves

Multidisciplinary research platform to provide access to quality controlled data from diverse Earth science disciplines, together with tools for their use in analysis and modelling

POP aims at enabling Data and Service provision and strengthen their sustainability



Central Hub of EPOS Integrated Core Services

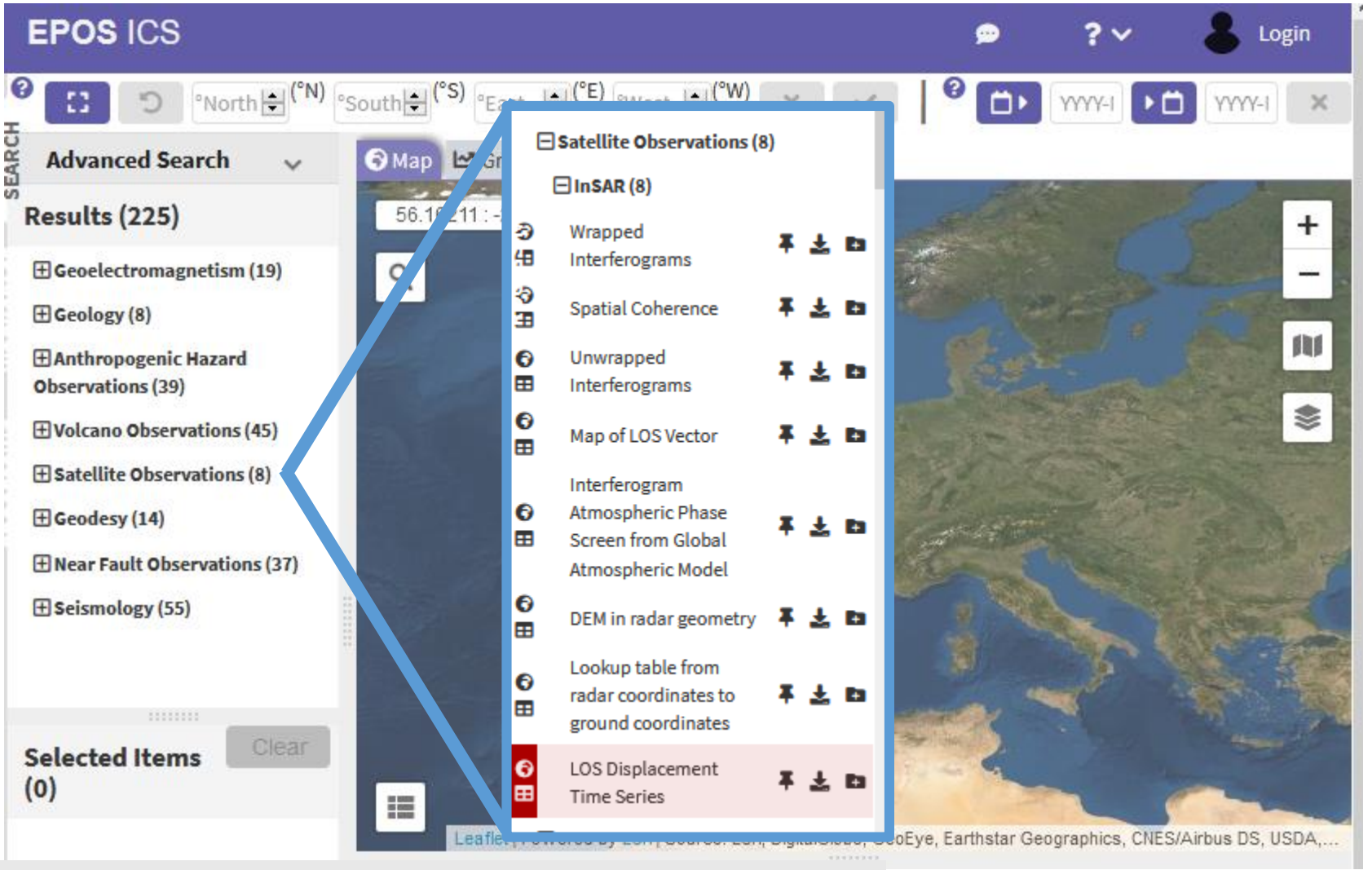
https://www.ics-c.epos-eu.org/

ICS services are not yet fully operational and are presently evaluated and improved

Central Hub of EPOS Integrated Core Services

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

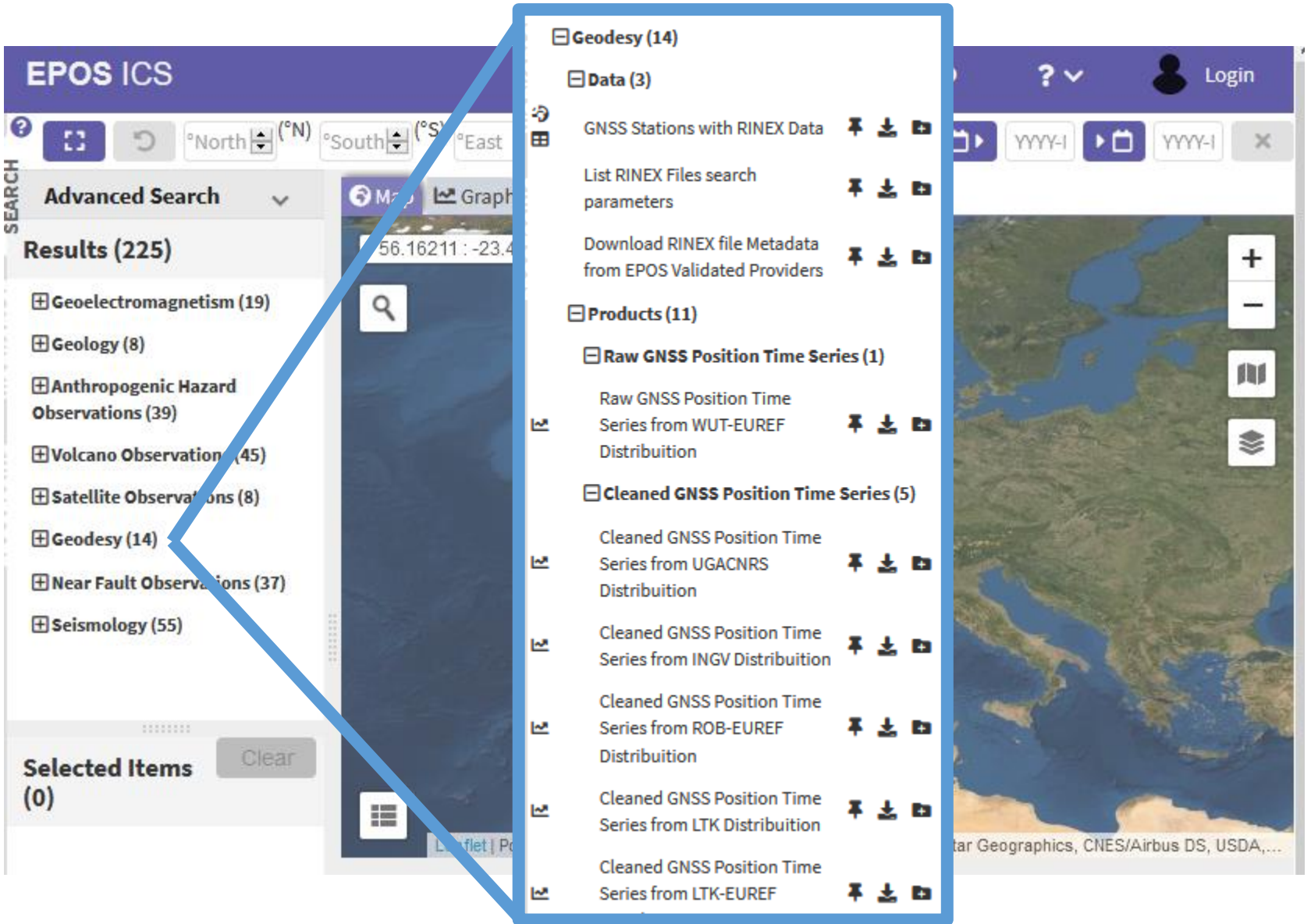
Access to (meta)data from different communities



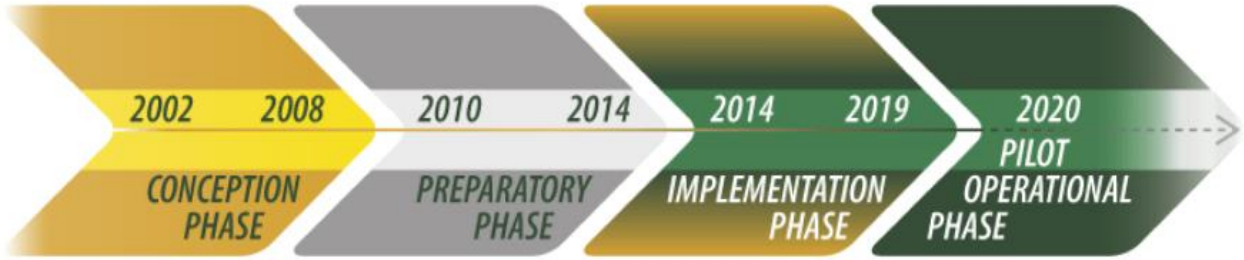
ICS training video https://www.youtube.com/channel/UCW-W9nukPpUP4iH94D4D1rw

EPOS Integrated Core Services

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



EPOS Timeline - GNSS



2011: EPOS reached out to EUREF TWG

EUREF TWG appointed representative to EPOS.

2012: Impossible for EUREF (no legal entity) to formally not contribute to EPOS.
Individual EUREF agencies could **assure EUREF standards are transposed to EPOS.**

2015: EPOS Implementation Phase

Several EUREF agencies helped to shape the future EPOS infrastructure.

2019: EUREF resolution encouraging its members to contribute to EPOS

More and more agencies involved in EUREF started to contribute also to EPOS.

2020: Start of EPOS Pilot Operational Phase

Some of the EPOS-GNSS services are mature enough to be tested by EPOS.

2021: EUREF-EPOS ERIC Memorandum of Understanding under preparation

EPOS goals related to GNSS:

- ✓ Provide access to GNSS data, metadata, and products
- ✓ Promote best practices for GNSS station operation, data quality control and data management
- ✓ Maintain and develop GNSS products for Solid Earth sciences

From as much as possible GNSS stations all over Europe

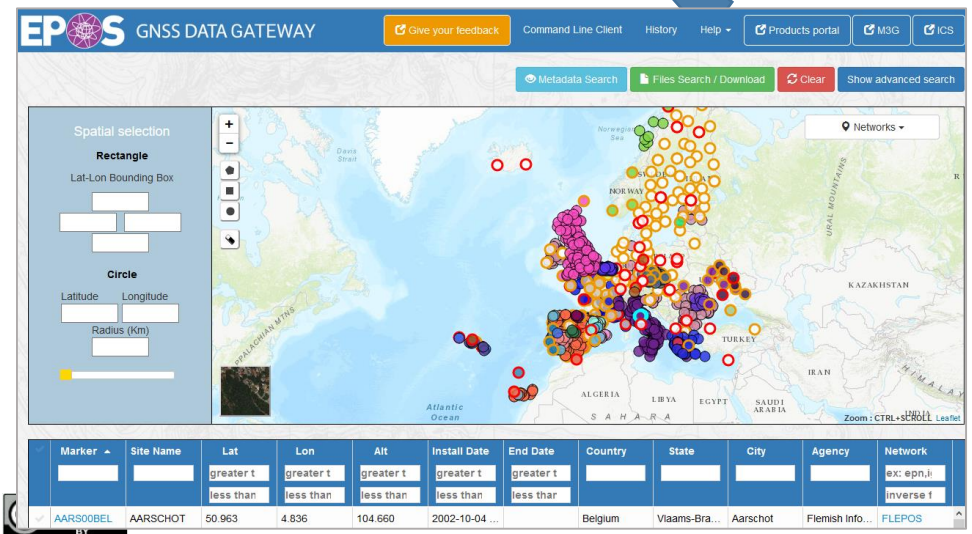
Organization of GNSS Services in EPOS

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

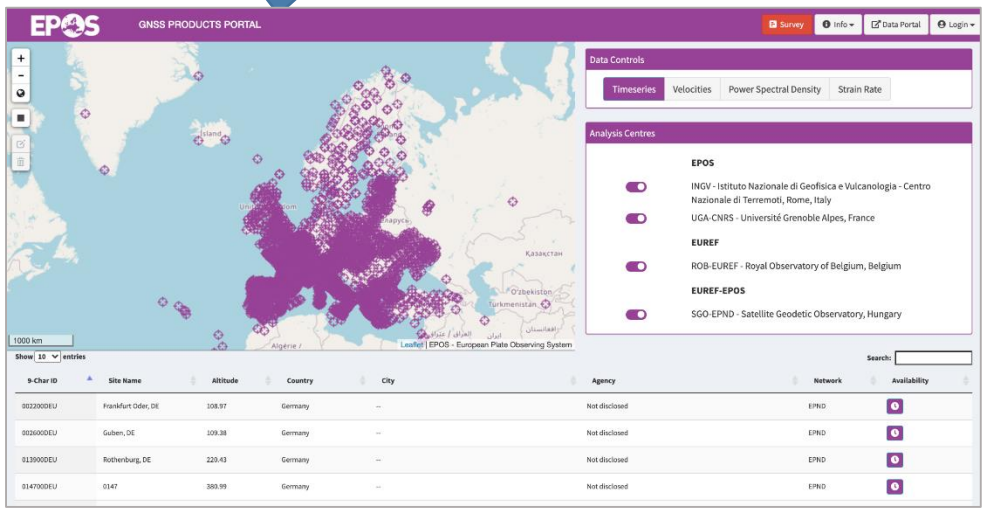
Web services

Web services

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



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



ROYAL OBSERVATORY OF BELGIUM

EUREF Symposium, 26-28/05/2021, Ljubljana, Slovenia

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EPOS-GNSS station network

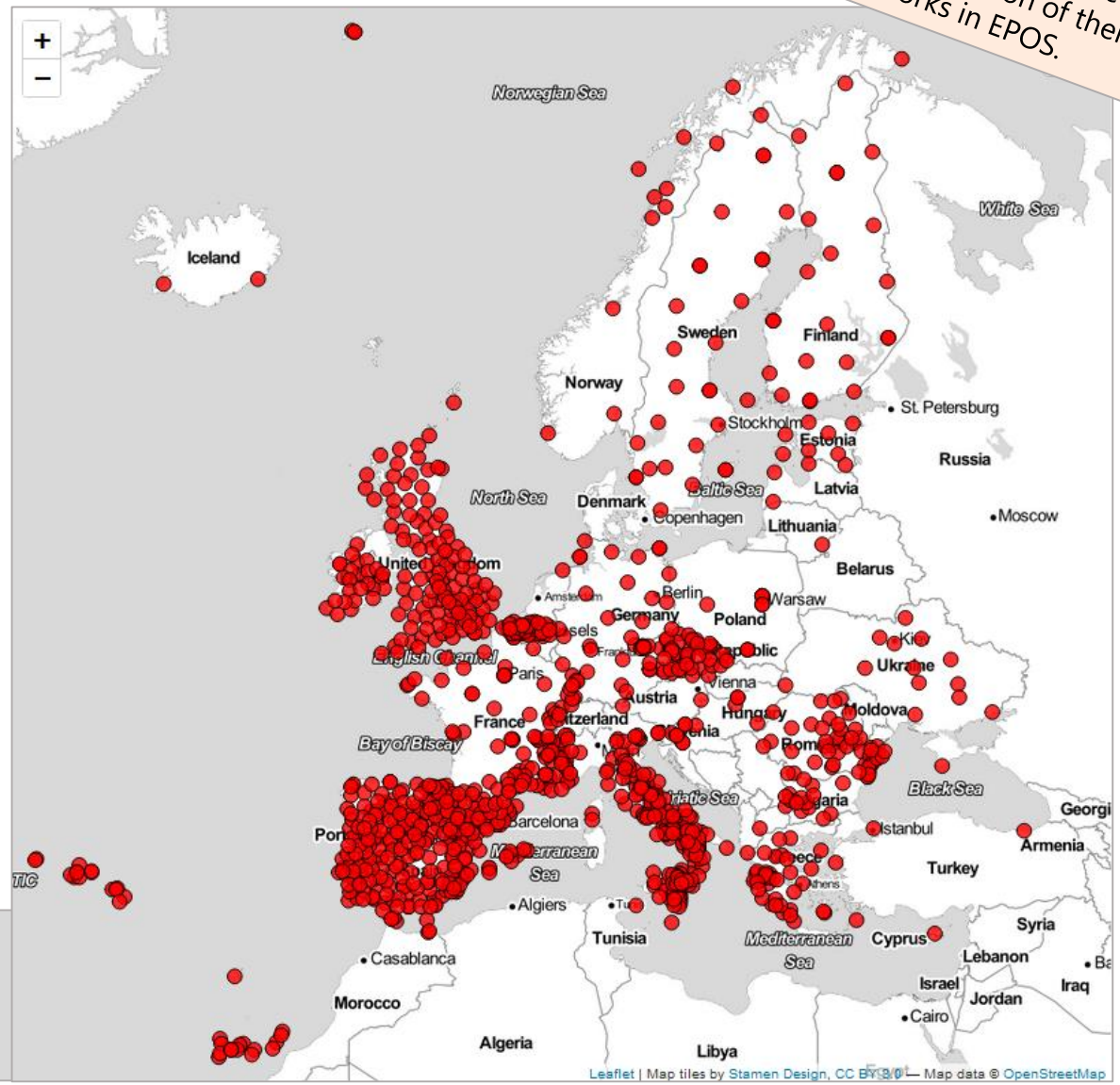
1. Permanently tracking GNSS stations
   a) Presently active
   or
   b) Decommissioned stations that worked for minimally 3 years

2. Maintain station metadata (site log + other metadata)

3. Provide free access to daily RINEX data (v2 or v3)

Agencies providing GNSS data to EPOS need to formalize this through the signature of the EPOS-GNSS data supplier letter

Several countries are preparing the integration of their dense networks in EPOS.



1205 stations
✓240 EPN stations (66%)
✓828 EPN densification stations
✓137 other GNSS stations

16 stations from the Netherlands (received on 27/05/2021 are not yet included)

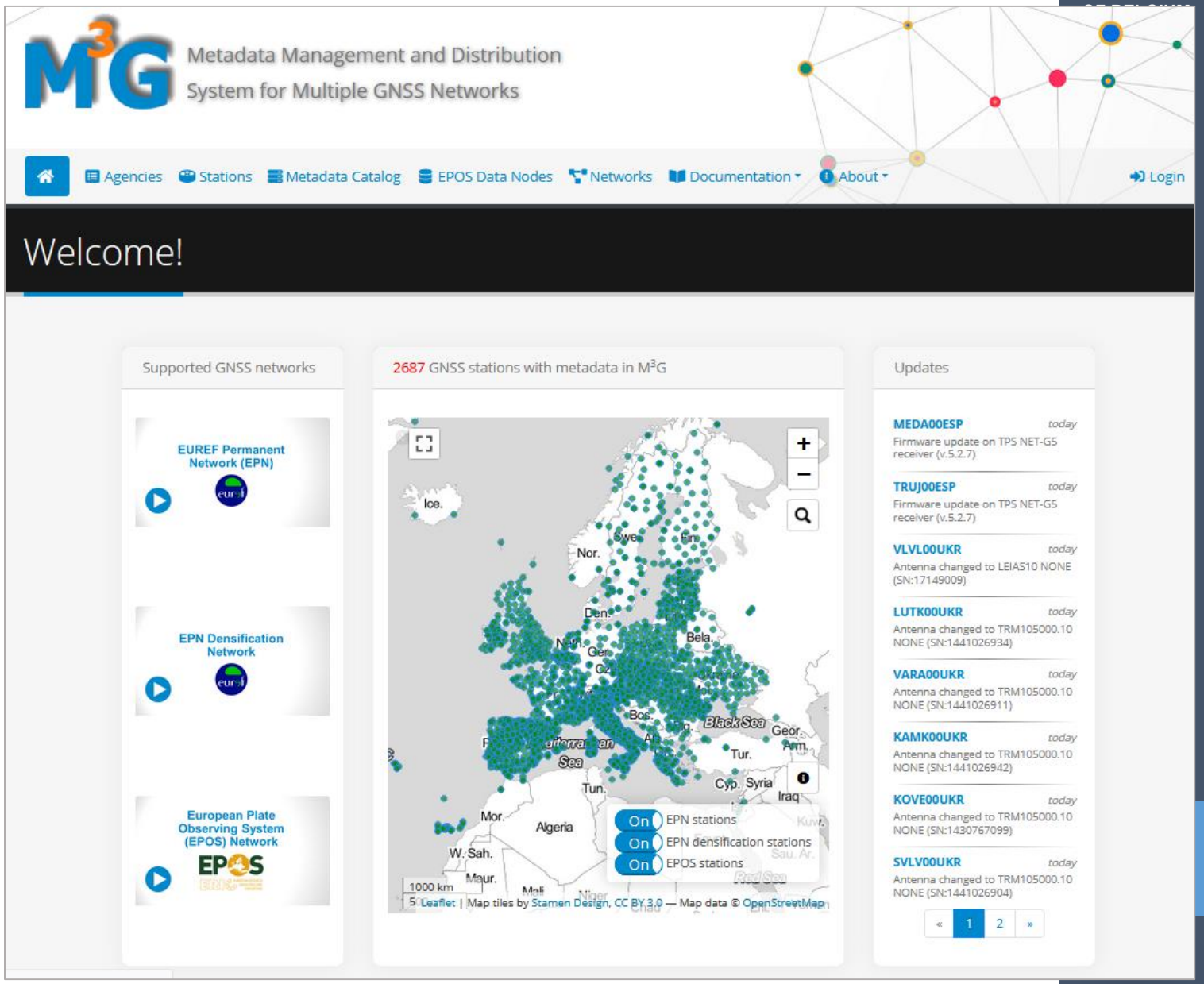
EPOS-GNSS station site logs

https://gnss-metadata.eu

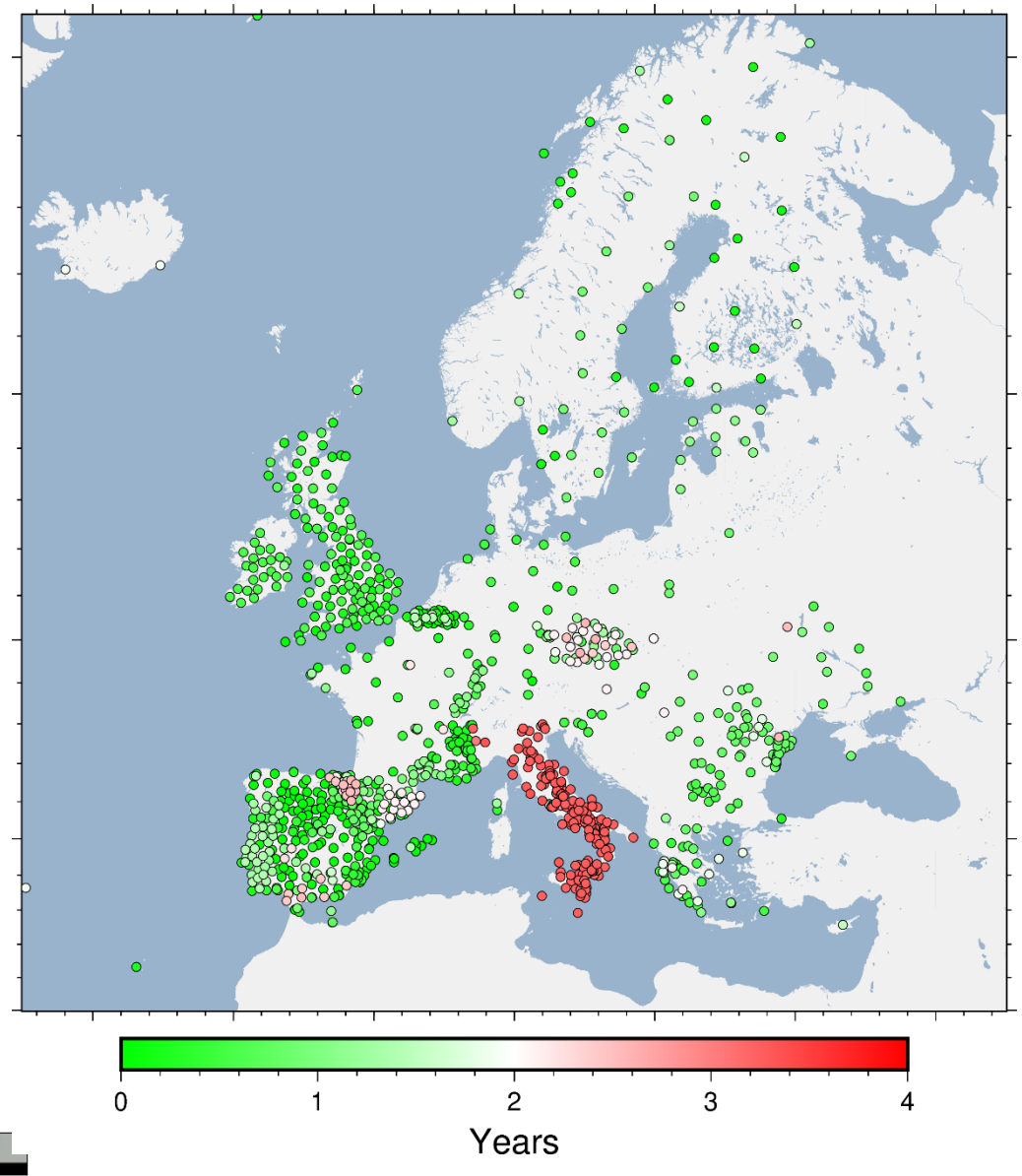
Development of M³G

Full harmonization between EUREF and EPOS

- M³G used to submit/validate site logs of EPN, EPN densification and EPOS stations
- IDENTICAL site logs in EUREF and EPOS for common stations
  - Site log has to be submitted just once



EPOS-GNSS station metadata



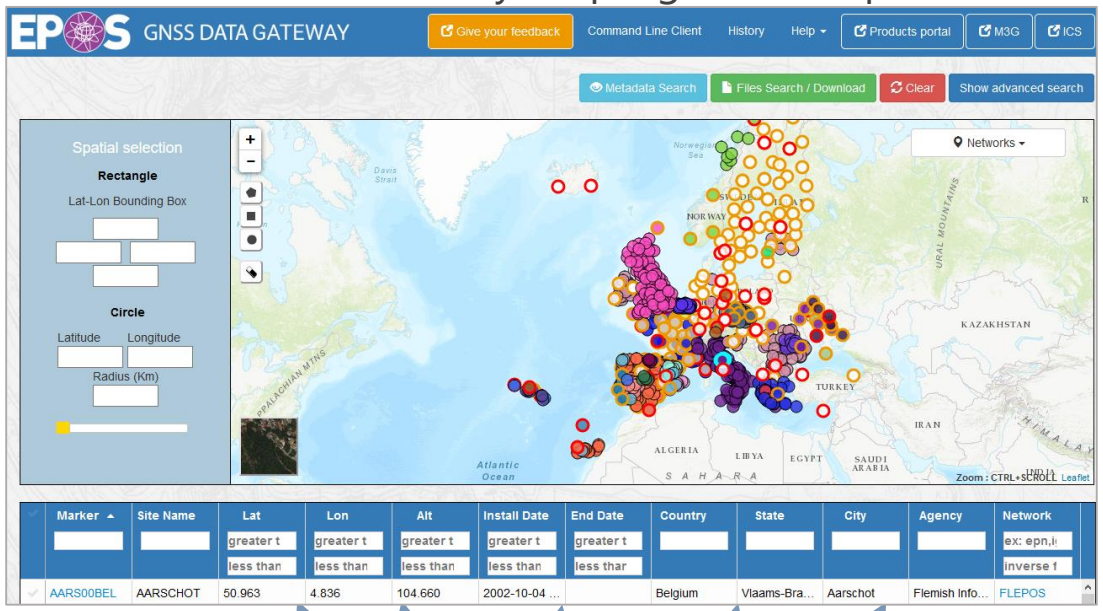
Time since last site log update

- Site log updates are time consuming for agencies operating large amount of stations
- Goal: to automatically trigger site log update in M³G when agency updates site logs in their local data base

One of the issues to be solved during EPOS Pilot Operational Testing

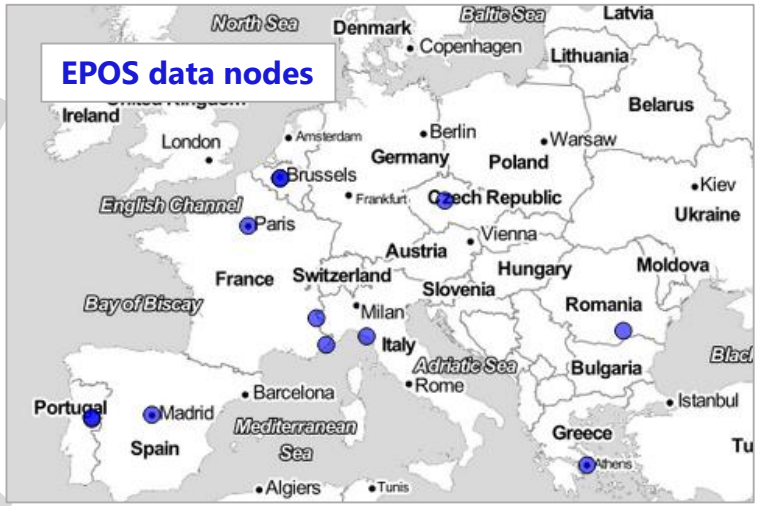
GNSS data availability

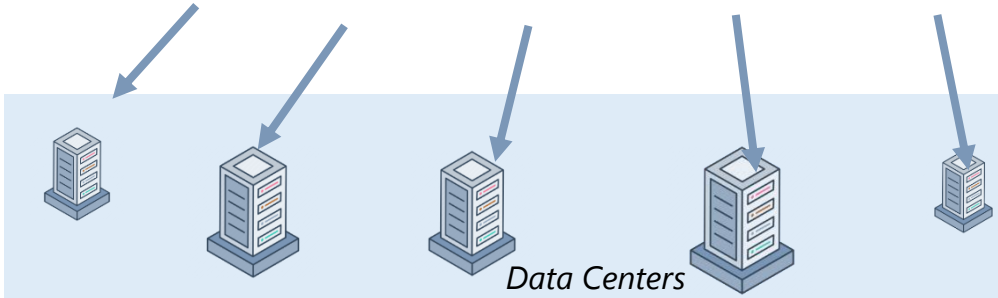
EPOS GNSS **Data** Gateway: http://gnssdata-epos.oca.eu



Centralized access to RINEX data via
- Web interface
- APIs

EPOS data nodes provide access to RINEX data available from underlying data centers IF they pass quality control





RINEX data remain at Data Centers

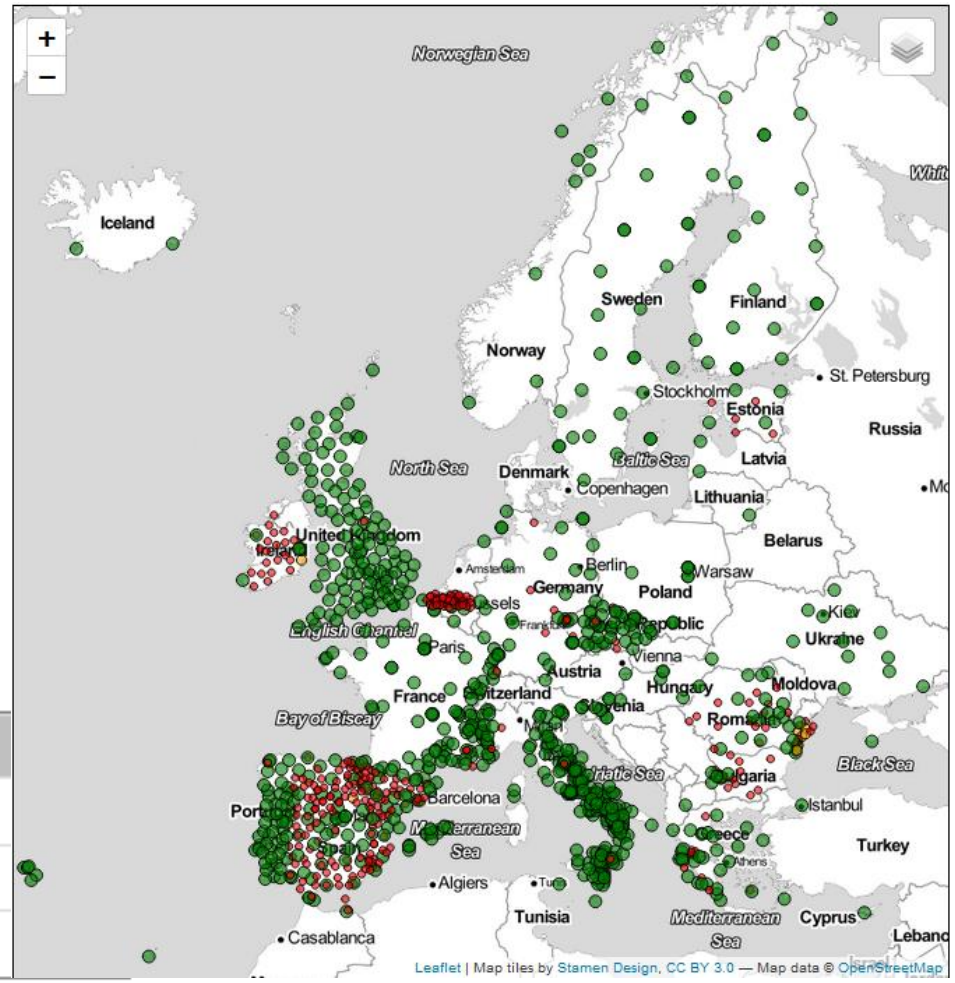
GNSS Data Discoverable from EPOS Data Gateway

Pilot Operational Phase

Not all station data are accessible yet from EPOS-GNSS data gateway

- Some nodes still being set up (e.g. Belgian node)
- Some nodes are still being populated
  - Clean up all RINEX data & site logs

Only RINEX data consistent with site log info will be accessible from EPOS-GNSS data gateway



1205 EPOS Stations at DGW	
833 stations with more than 30 days of RINEX data	
11 stations with less than 30 days of RINEX data	
361 stations without RINEX data	

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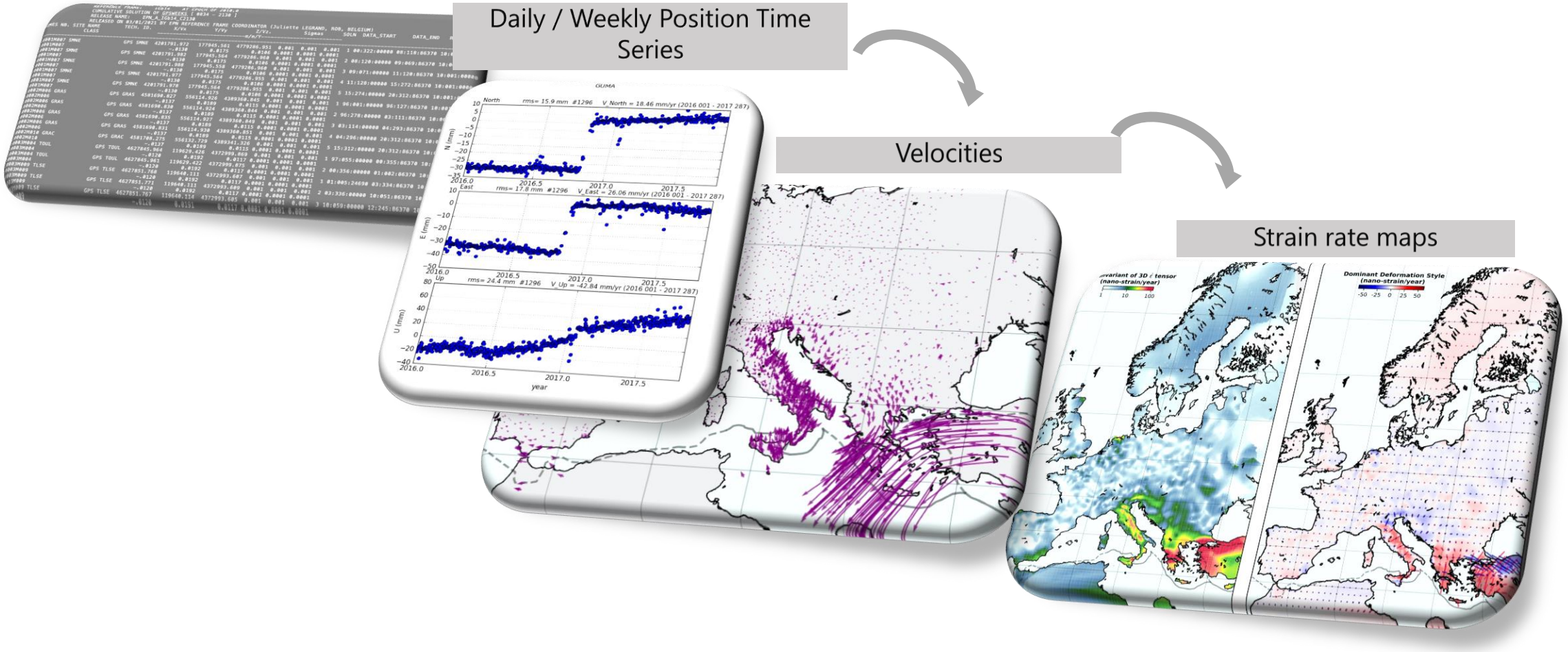
GNSS Products

Daily / Weekly Positions

Daily / Weekly Position Time Series

Velocities

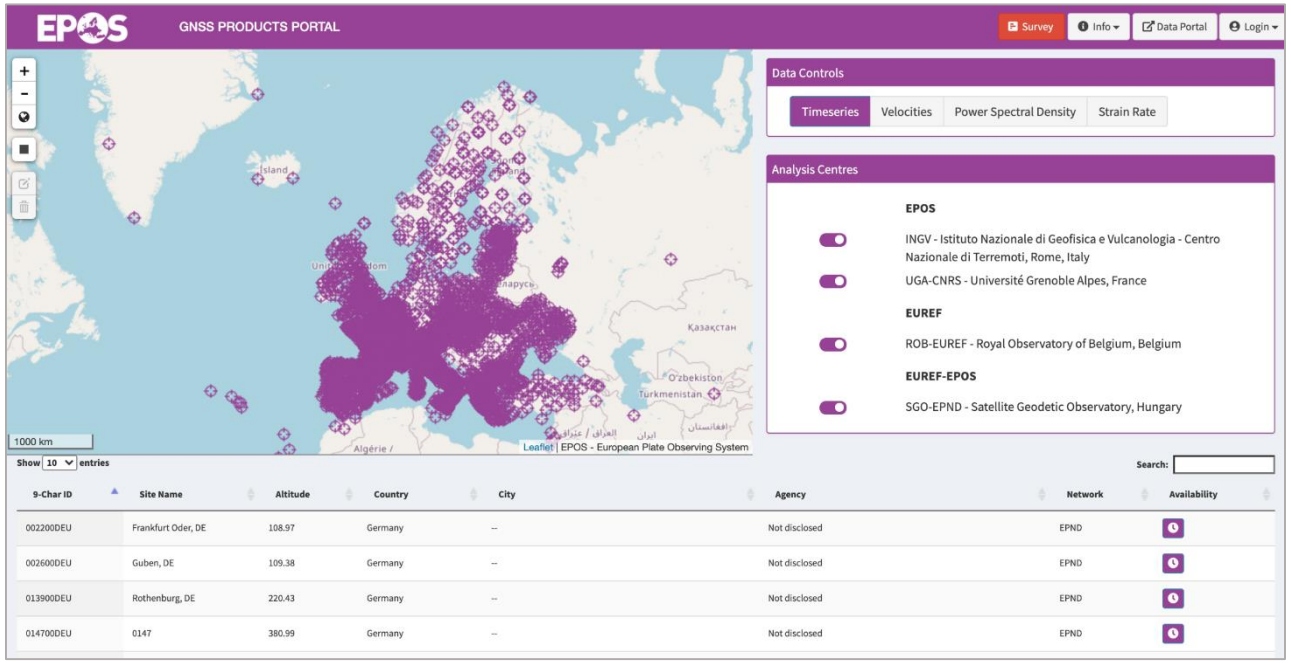
Strain rate maps



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

GNSS Products

EPOS-GNSS Product Portal: https://gnssproducts.epos.ubi.pt/



Analysis Centers UPLOAD products to product portal

Products can be based on data from EPOS and non-EPOS stations (taking data licenses into account)

EPOS Pilot Operational Testing: EPOS-GNSS Product Portal currently under revision!

<u>Uploaded GNSS Products</u>

A. EPOS-specific solutions
   1. Double difference
   2. PPP

B. EUREF solutions
   1. EPN daily combined solution
   2. EPN reference frame solution
   3. EPN densification solution

C. EUREF-EPOS solutions
   1. Combination of A.1, A.2, B.3
   2. Strain rates

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EPOS' Pre-Operational GNSS Services in a Nutshell

Ambition: Provide information on ground motions based on permanent GNSS stations in Europe

Collaboration between agencies involved in EUREF and geophysicists from all over Europe

Data Services

- Collection of and access to station metadata through M^{3}G
- Centralized access to daily RINEX data through EPOS-GNSS Data Gateway

Contributions from
- EPN station managers
- EPN data centers
- EPN Central Bureau

Product Services

- EPOS-specific GNSS data analysis
- Centralized access to GNSS products through EPOS-GNSS Product Portal
  - EUREF products
  - EPOS-specific products
  - Common EUREF-EPOS products

Contributions from
- EPN analysis coordinator,
- EPN reference frame coordinator
- EPN densification WG
- EPN deformation modeling WG

Linked through **web services (APIs) to the EPOS ICS** where GNSS data and products can be combined with other data.