EUREF Activities

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Reference Frame Sub Commission 1.3a for Europe of the International Association of Geodesy (IAG)

EUREF

Reference Frame Sub Commission 1.3a for Europe of the International Association of Geodesy (IAG)

- The **IAG Sub-commission EUREF** is responsible for the maintenance of the European Terrestrial Reference System (**ETRS89**).
- EUREF is composed of representatives from **European IAG member countries**; annual symposium (plenary) and the Governing Board (GB)
- Links to about **130 European organizations**, agencies, universities from more than 30 countries – related to geo-referencing, positioning, and navigation
- Provides all of its products and services on the “best effort” basis and **free of charge** to the public
- Runs **EPN**, the EUREF Permanent GNSS Network, basis of the European reference frame ETRF. Multi-GNSS approach.

Highlights 2017–2018

- EUREF Symposium and resolutions
- Development within EPN
- EPN Multi-Year solution and station velocities
- Metadata management
- ETRF2014 and EPN solution
- EPOS and EUREF

EUREF symposium 2018

May 30 – June 1, Amsterdam

Resolution No. 1.

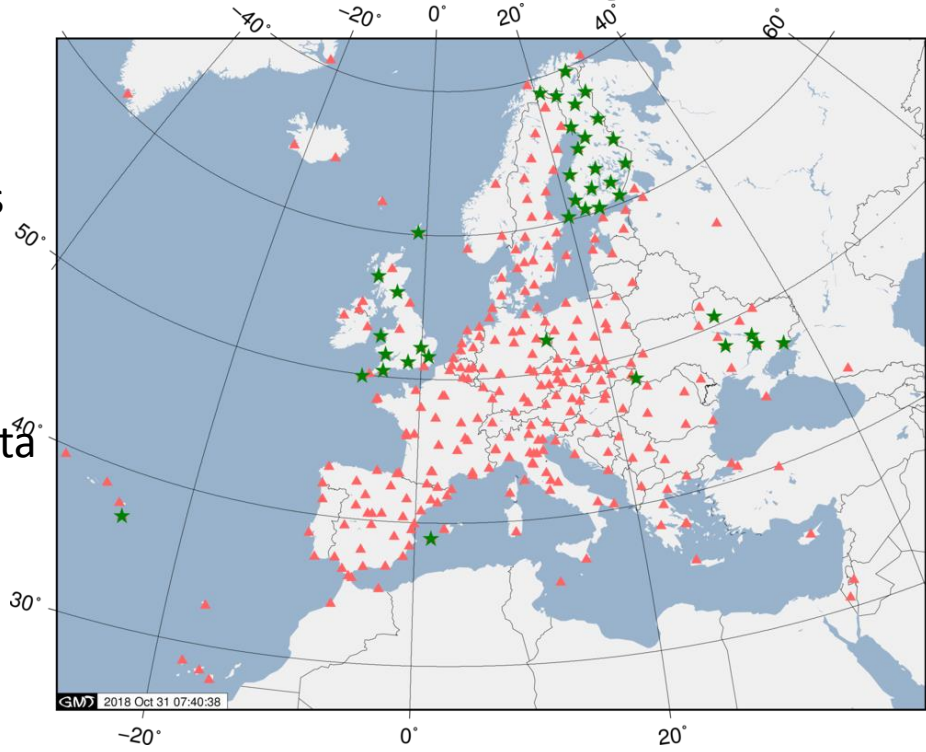
- The IAG Reference Frame Sub-commission for Europe (EUREF)
- *recognising* that Galileo is developing towards a fully deployed global navigation satellite system
- *and further recognising* the effort within the IGS MGEX working group to significantly improve the quality and availability of the Galileo orbits
- *and noting* the efforts and investment of station managers to install multi-GNSS stations and to establish the associated dataflows
- *encourages* the analysis centres to build their capabilities for processing Galileo observations
- *however noting* the analysis centre's requirement for Galileo specific receiver antenna calibrations
- ***asks* the EUREF community, GSA, ESA and the GNSS industry to support the IGS antenna working group in order to overcome the missing receiver antenna calibrations for Galileo signals**

Resolution No. 4.

- The IAG Reference Frame Sub-commission for Europe (EUREF)
- *recognising* that InSAR technology is now a well established data collection technique in Europe delivering precise data with a high temporal rate
- *and noting* the potentially high impact of linking InSAR measurements to conventional geodetic reference systems
- *and further recognising* the potential of collocating InSAR transponders or reflectors with continuous GNSS stations and geodetic benchmarks
- ***encourages* the EUREF community to start to consider the integration of InSAR technology into reference system activities**

EPN Data, Products, Activities (C. Bruyninx)

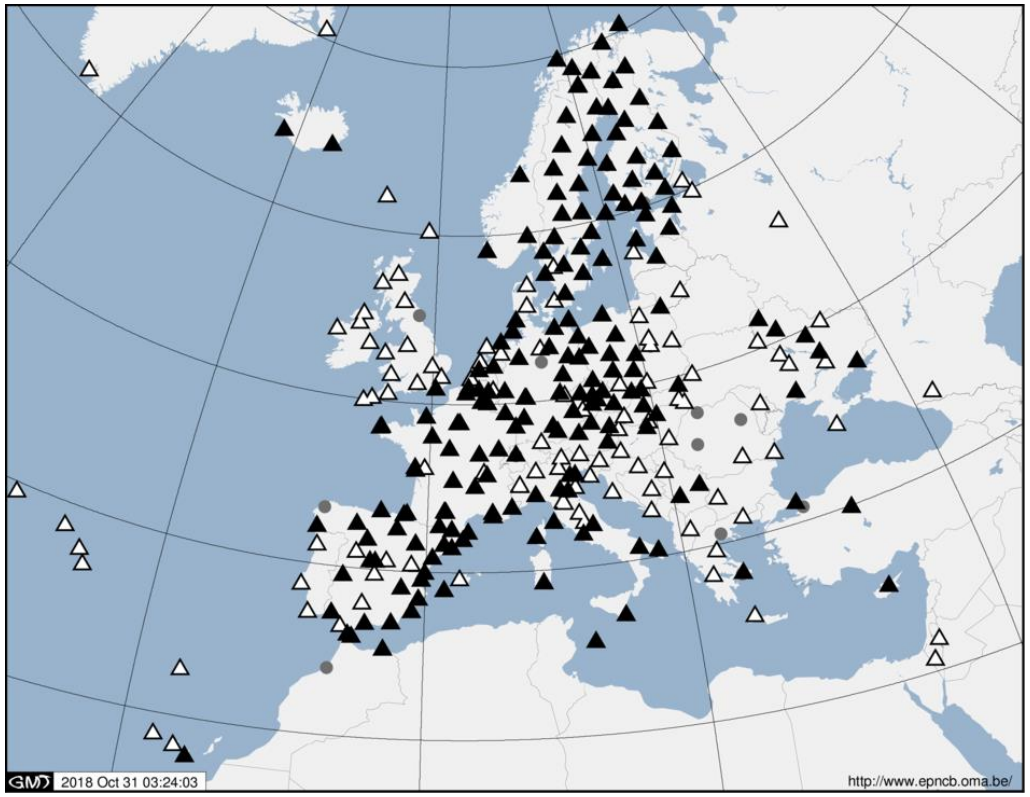
- Observation, navigation and meteorological data files. Real-time observation data
- ITRS/ETRS89 station positions and velocities
- Tropospheric zenith path delays
- Real-time satellite orbit/clock corrections
- **Data reprocessing:** Reprocessing historic data to improve station time series, antenna corrections, satellite orbit information,…
- **Multi-GNSS:** New GNSS are available. More stations are able to observe all GNSS satellites. EPS is adopting new systems.
- **RINEX3 format:** Adoption of RINEX3 format for GNSS data submission, archiving and analysis.



14 new EPN stations during last year

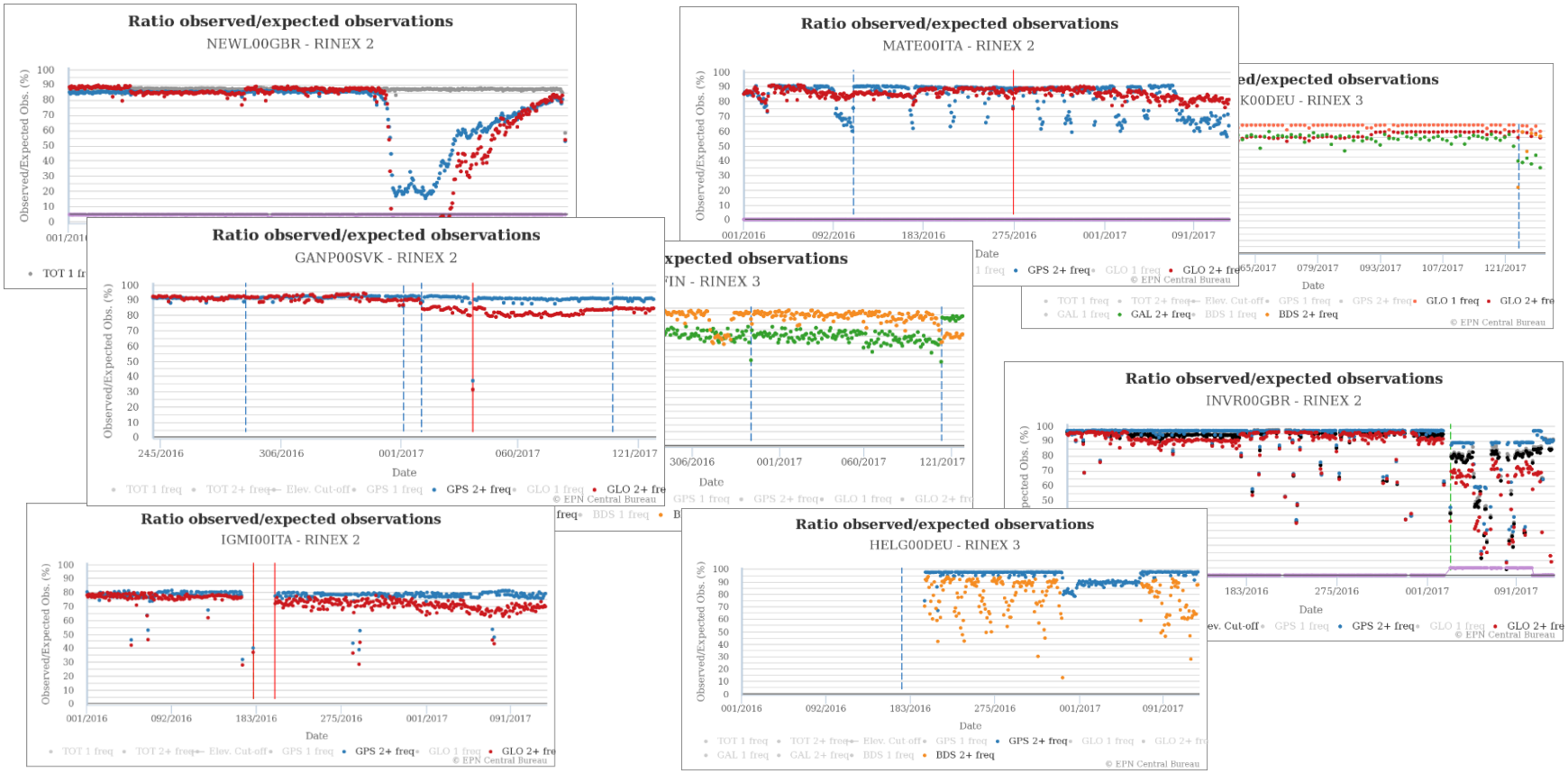
Multi-GNSS EPN Tracking Network

- GPS-only : 21 stations (6%)
- △ GPS+GLO: 120 stations (36%)
- ▲ GPS+GLO+GAL+… : 191 stations (58%!)



Monitoring of EPN Data Completeness

http://www.epncb.eu/

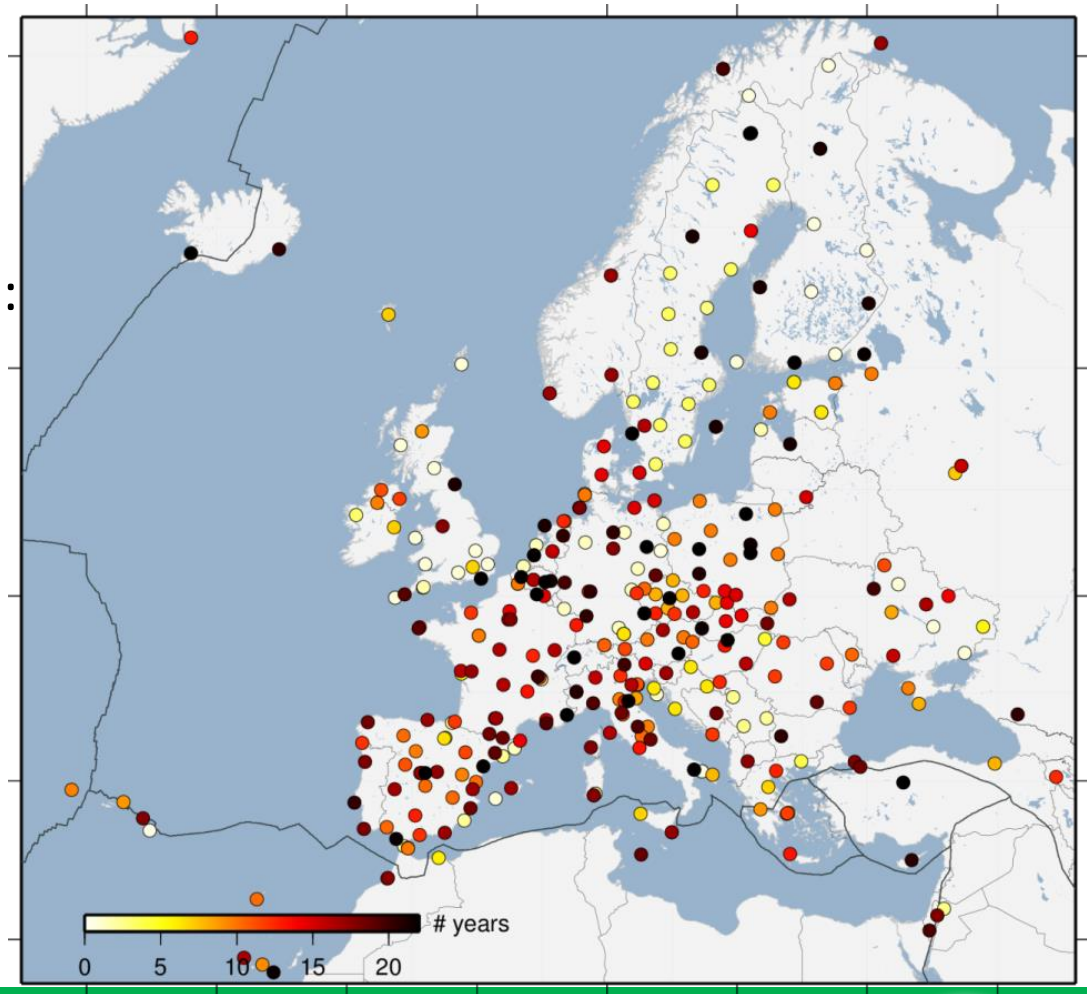


EPN multi-year solution (Legrand)

Multi-year combination of the EPN **daily** SINEX files (EPN-repro2 + final) aligned to **IGS14**

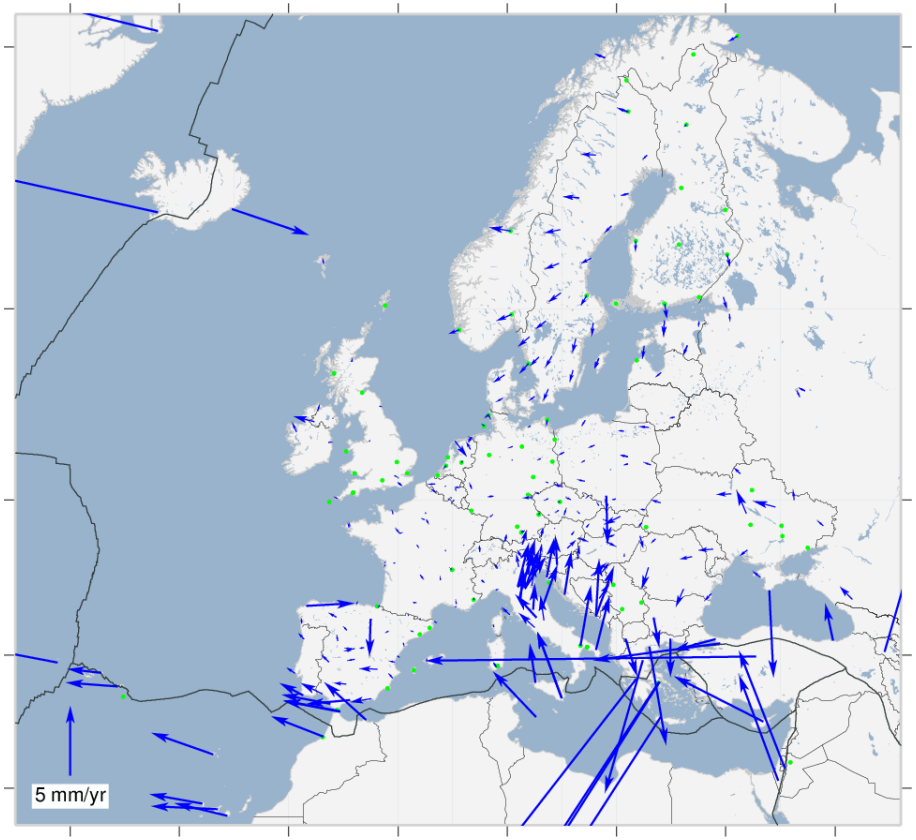
Product updated each 15 weeks:

- Multi-year Positions & Velocities
- Cleaned position time series
- List of Discontinuities
- List of Outliers

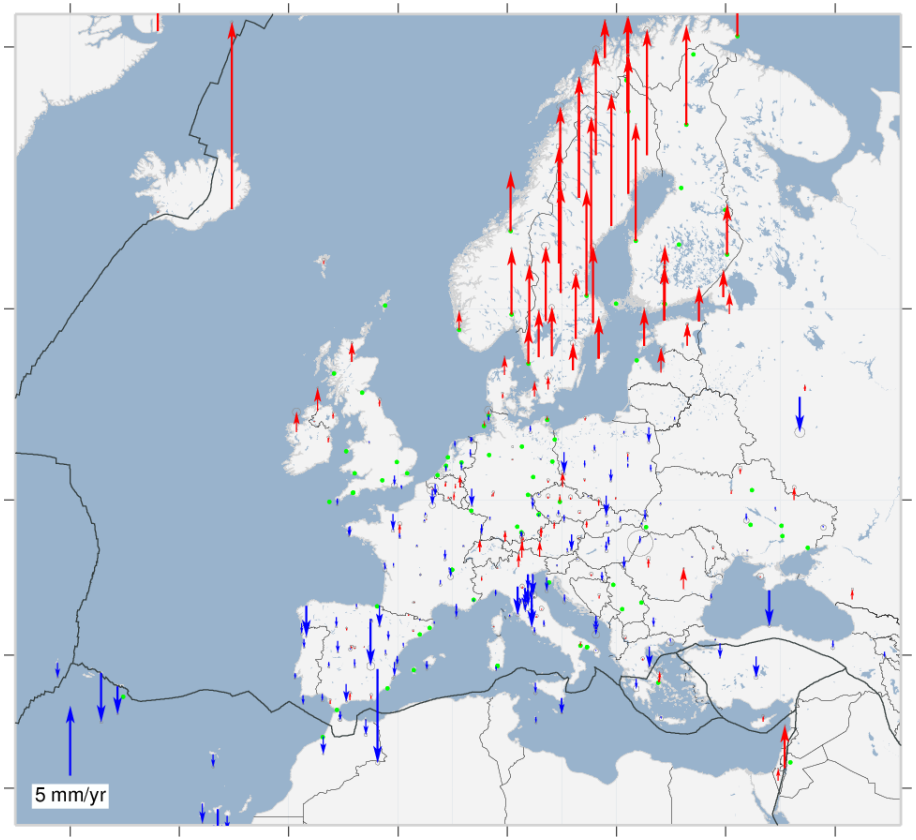


number of years of observations
(380 stations in the multi-year solution)

Velocities from multi-year solution



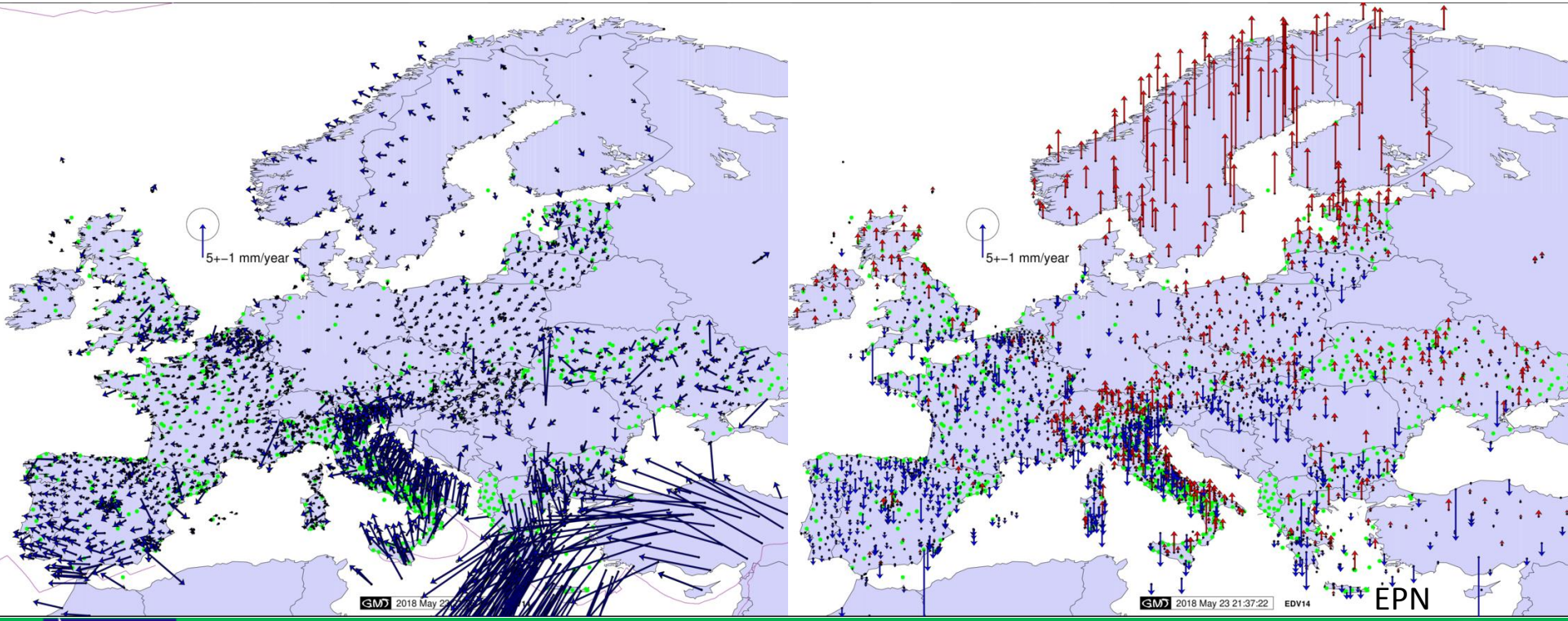
ETRF2014 horizontal velocity field derived from the latest EPN cumulative solution



ETRF2014 vertical velocity field derived from the latest EPN cumulative solution

EPN Densification station velocities

ETRF2000 horizontal velocity field derived from the latest EPN Densification cumulative solution. In ETRF2000, the horizontal velocities are expressed with respect to the Eurasian plate. The Eurasian plate rotation model from ITRF2014 (Altamimi et al., 2017) has been used.



New **M**etadata **M**anagement and distribution system for **M**ultiple **G**NSS Networks

https://gnss-metadata.eu/

- ✓ Centralized system for submitting and validating GNSS metadata
  - Unique site log submission system for all networks (EPN, EPN densification, EPOS)
  - Metadata validation process handles the different rules of each network
  - After validation, site logs are distributed to the portals of the networks
  - GeodesyML compliant
- ✓ Manage content of IGS-style site logs, but also additional station metadata: DOI, license, embargo time, nominal data submission, local/national network, …
- ✓ GDPR compliant: centralized management of personal data and personal privacy preferences

Bruyninx

Achieving the ETRS89 Realization

Fundamentally based on transformation from ITRS to ETRS89

Transformation formula ITRFyy -> ETRFyy

Positions

$$X^E(t_c) = X^I_{YY}(t_c) + T_{YY} + \begin{pmatrix} 0 & -\dot{R}3_{YY} & \dot{R}2_{YY} \\ \dot{R}3_{YY} & 0 & -\dot{R}1_{YY} \\ -\dot{R}2_{YY} & \dot{R}1_{YY} & 0 \end{pmatrix} \times X^I_{YY}(t_c).(t_c - 1989.0)$$

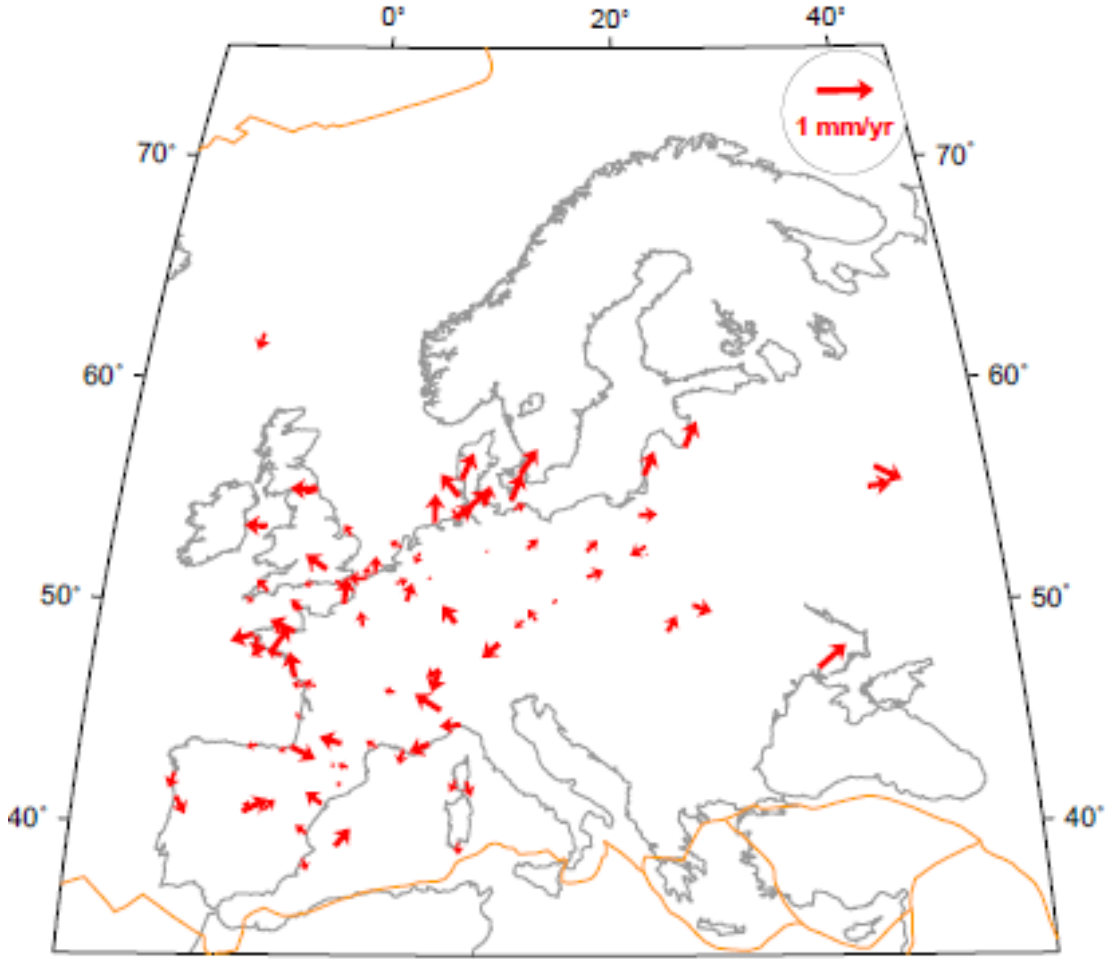
Velocities

$$\begin{pmatrix} \dot{X}^E_{YY} \\ \dot{Y}^E_{YY} \\ \dot{Z}^E_{YY} \end{pmatrix} = \begin{pmatrix} \dot{X}^I_{YY} \\ \dot{Y}^I_{YY} \\ \dot{Z}^I_{YY} \end{pmatrix} + \begin{pmatrix} 0 & -\dot{R}3_{YY} & \dot{R}2_{YY} \\ \dot{R}3_{YY} & 0 & -\dot{R}1_{YY} \\ -\dot{R}2_{YY} & \dot{R}1_{YY} & 0 \end{pmatrix} \times \begin{pmatrix} X^I_{YY} \\ Y^I_{YY} \\ Z^I_{YY} \end{pmatrix}$$

ETRS89 is co-moving with the stable part of the Eurasia Plate

Altamimi

ITRF2014 Plate Motion Model: Residuals after removing Eurasia Rotation Pole



Altamimi

Transformation parameters

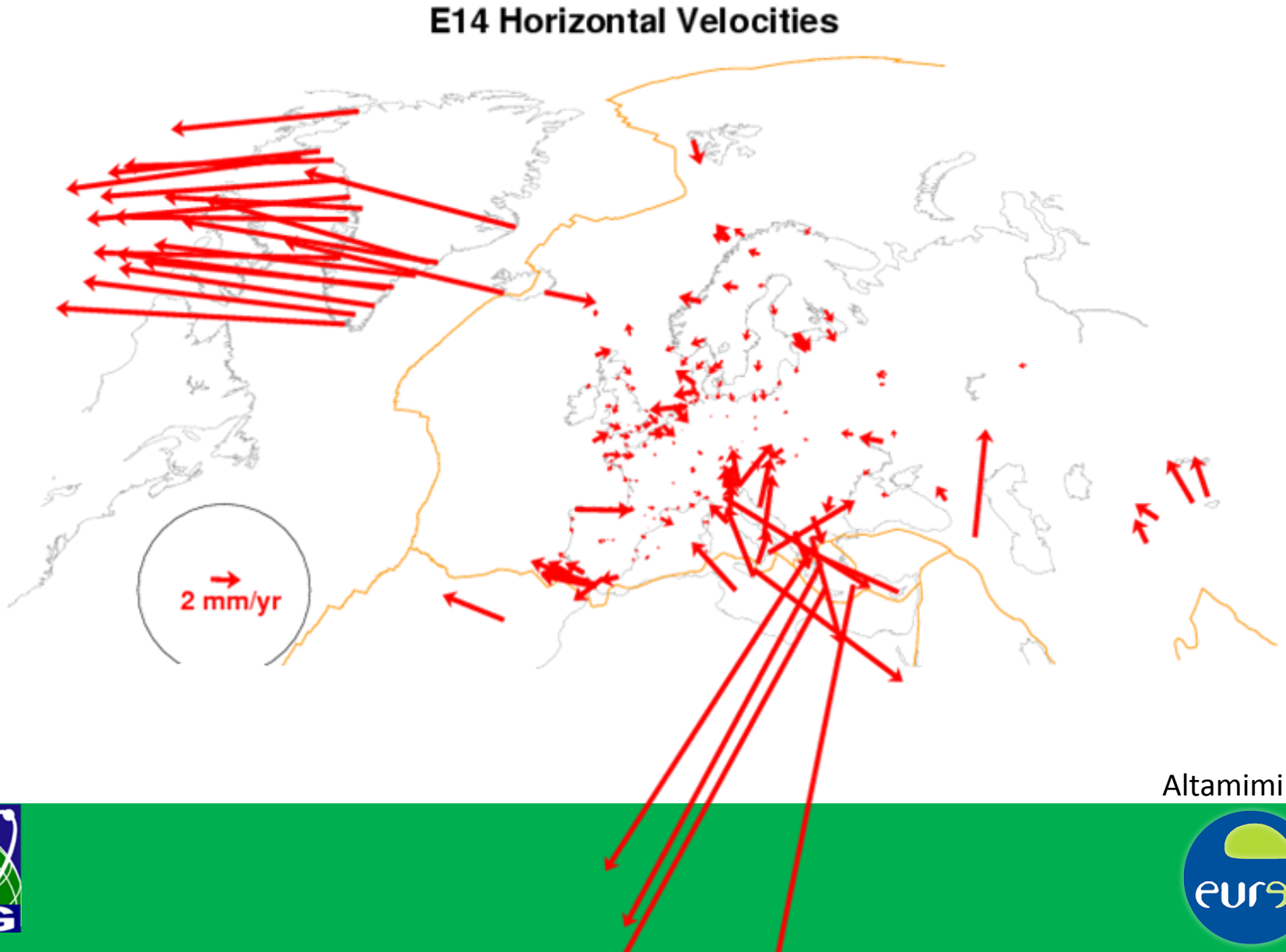
	T1 mm	T2 mm	T3 mm	D 10-9	R1 mas	R2 mas	R3 mas	Epoch y
From ITRF2000 to ETRF2000:								
	54.0	51.0	-48.0	0.0	1.701	10.290	-16.632	10:001
Rates	0.0	0.0	0.0	0.0	0.081	0.490	-0.792	
From ITRF2014 to ETRF2014:								
	0.0	0.0	0.0	0.0	1.785	11.151	-16.170	10:001
Rates	0.0	0.0	0.0	0.0	0.085	0.531	-0.770	

Angular velocity of Eurasia

ETRF2014 and ITRF2014 share the same origin, scale and Up velocities

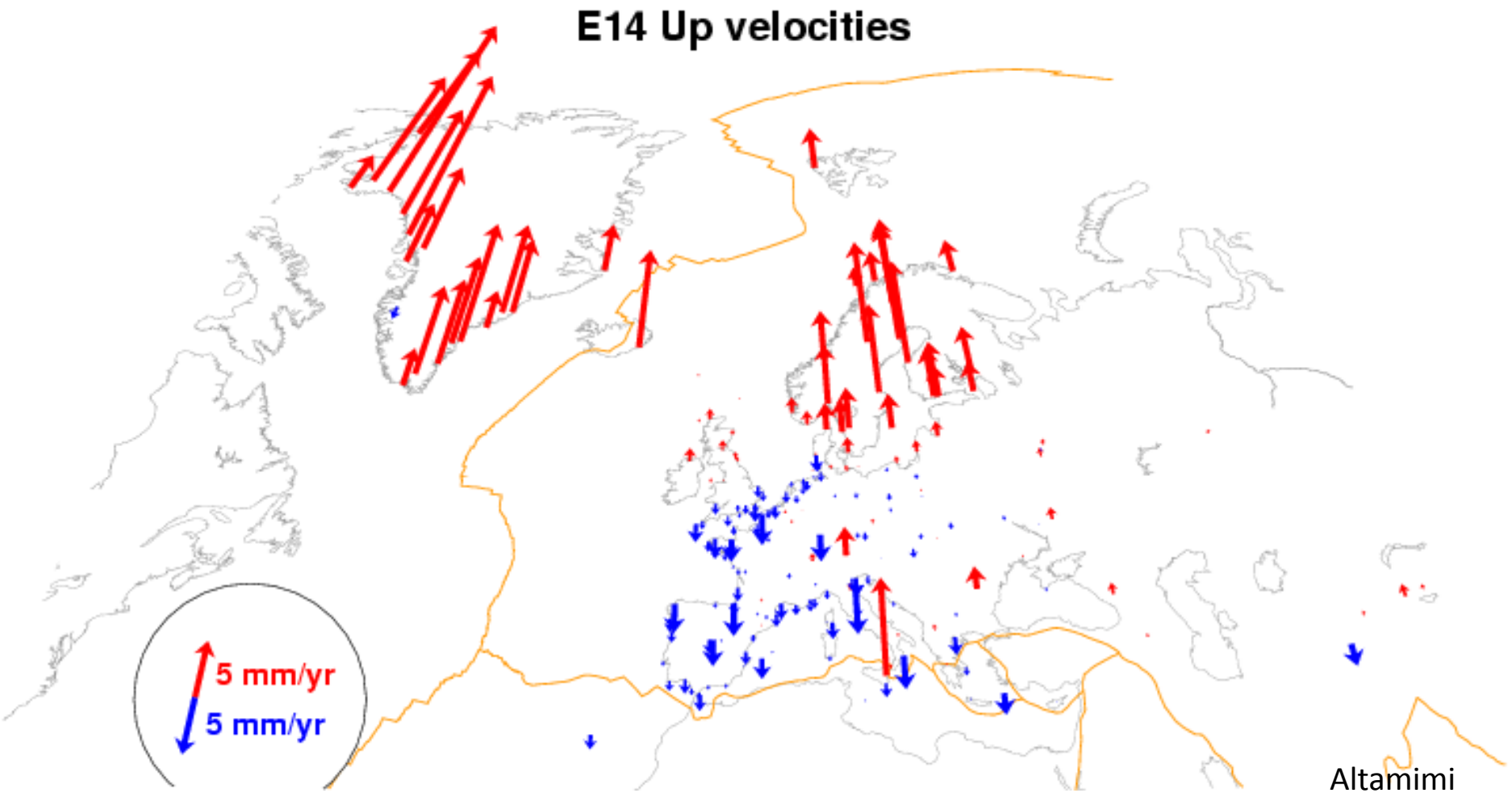
Altamimi

ITRF2014 → ETRF2014 : Horizontal Velocities



Altamimi

ITRF2014 → ETRF2014: UP velocities



Altamimi

EPOS (European Plate Observing System)

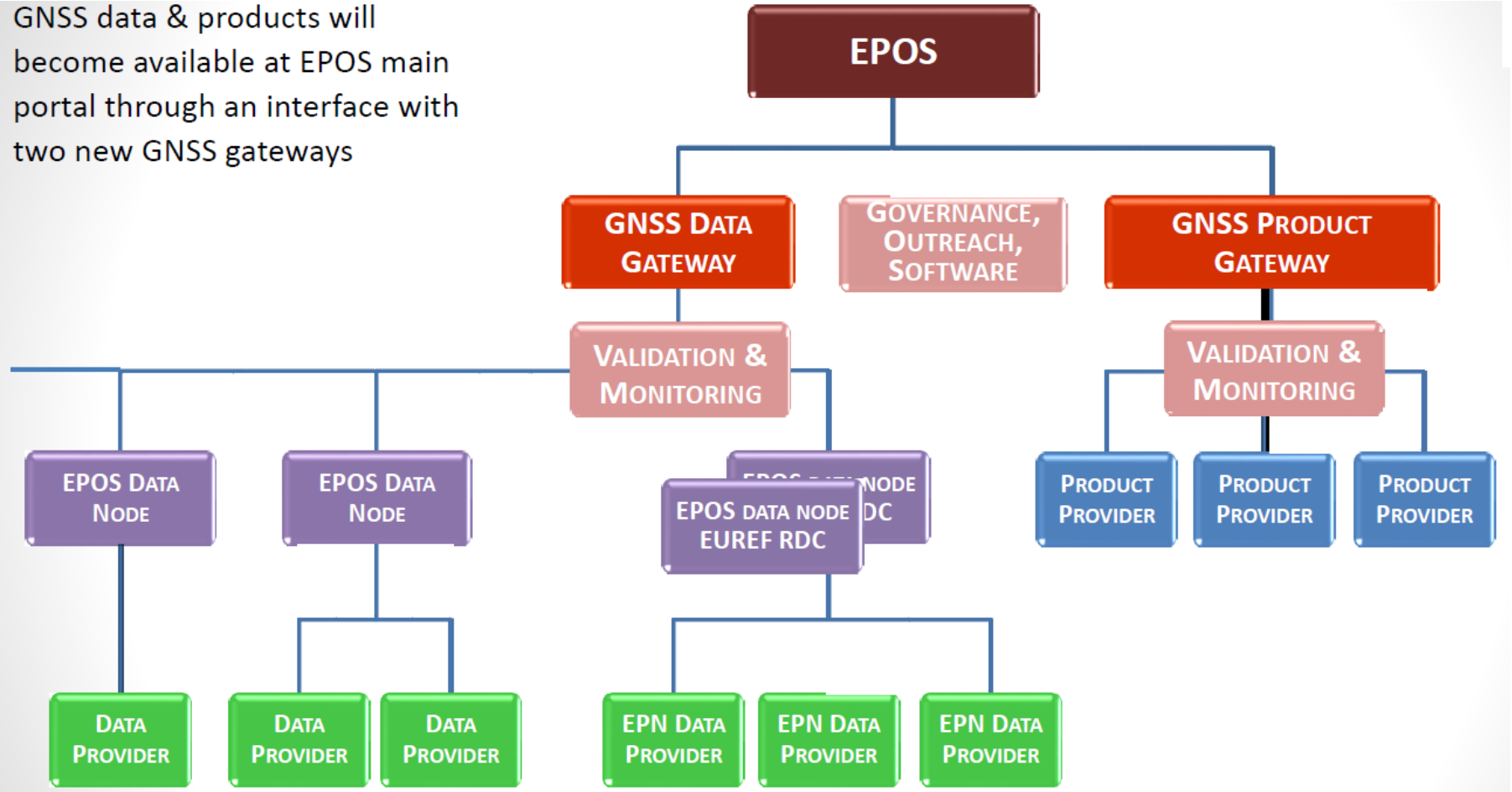
European Research Infrastructure (ESFRI) serving **Solid Earth science** (study the internal structure and dynamics of planet Earth, from the inner core to the surface)

Provide **(open) access** to data and products as well as tools for visualization, processing and analysis through the EPOS portal

EUREF has made an agreement with EPOS to submit data of the EPN stations to EPOS

EPOS (European Plate Observing System)

GNSS data & products will become available at EPOS main portal through an interface with two new GNSS gateways



EUREF links

- EUREF web page: http://www.euref.eu/
- EUREF permanent Network EPN: http://www.epncb.oma.be

Thank you for your attention