Long-term GNSS data quality monitoring in the distributed EPOS e-infrastructure

ROYAL OBSERVATORY OF BELGIUM

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

IGS INTERNATIONAL GNSS SERVICE

Introduction

The European Plate Observing System (EPOS) is a European research e-infrastructure that aims to enhance the integration, accessibility, and utilization of multi-disciplinary datasets (such as GNSS) and services for Solid Earth research.

The Royal Observatory of Belgium (ROB) developed a new EPOS community web portal (https://gnssquality-epos.oma.be) accompanied by alarms that monitor the availability and quality of GNSS data distributed through EPOS. This web portal presents the tracking performance of 1700+ EPOS-GNSS stations.

This unique set of GNSS data quality indicators provides helpful information that can be used to detect a potential degradation of the quality of the GNSS observations.

EPOS-GNSS data quality monitoring portal

allows users to check the distribution and the availability of the EPOS-GNSS station data by GNSS network, data node, or metadata maintainer.

provides plots of several GNSS data quality indicators, such as:

- the % of observed vs. expected observations. (Figure 7a, 8a).
- the number of missing epochs.
- the number of observed satellites.
- the maximum number of observations.
- the number of cycle slips. (Figure 9a).
- the Standard Point Positioning results.
- the multipath values on code observations. (Figure 9b).

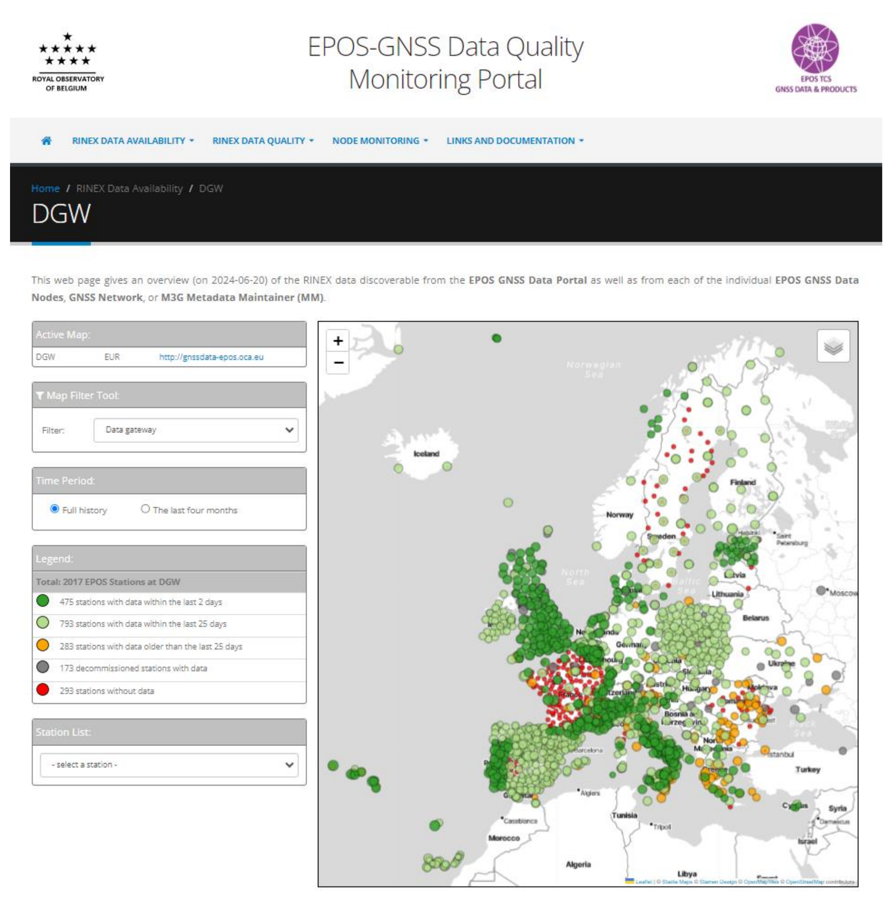


Figure 2. GNSS Data Quality Monitoring web portal: RINEX Data Availability.

Available data

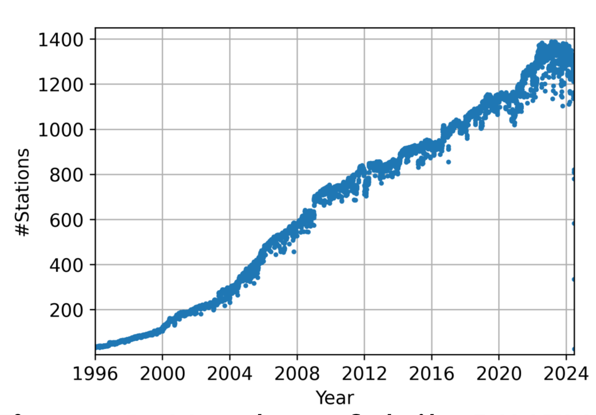


Figure 3. Number of daily RINEX files discoverable from the EPOS-GNSS Data Gateway as function of the time.

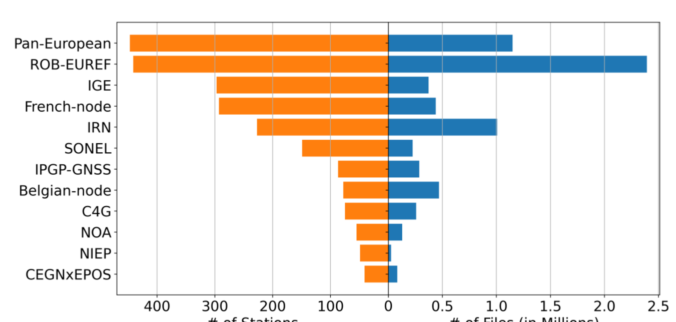


Figure 4. Number of daily RINEX files discoverable from the 12 active GNSS data nodes.

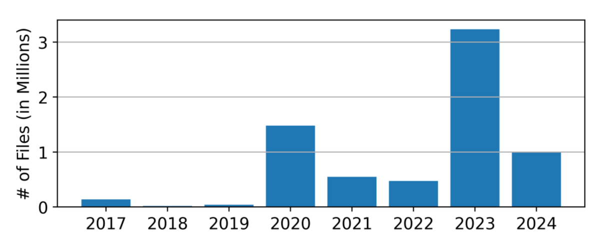


Figure 5. Number of new daily RINEX files published by EPOS-GNSS per year.

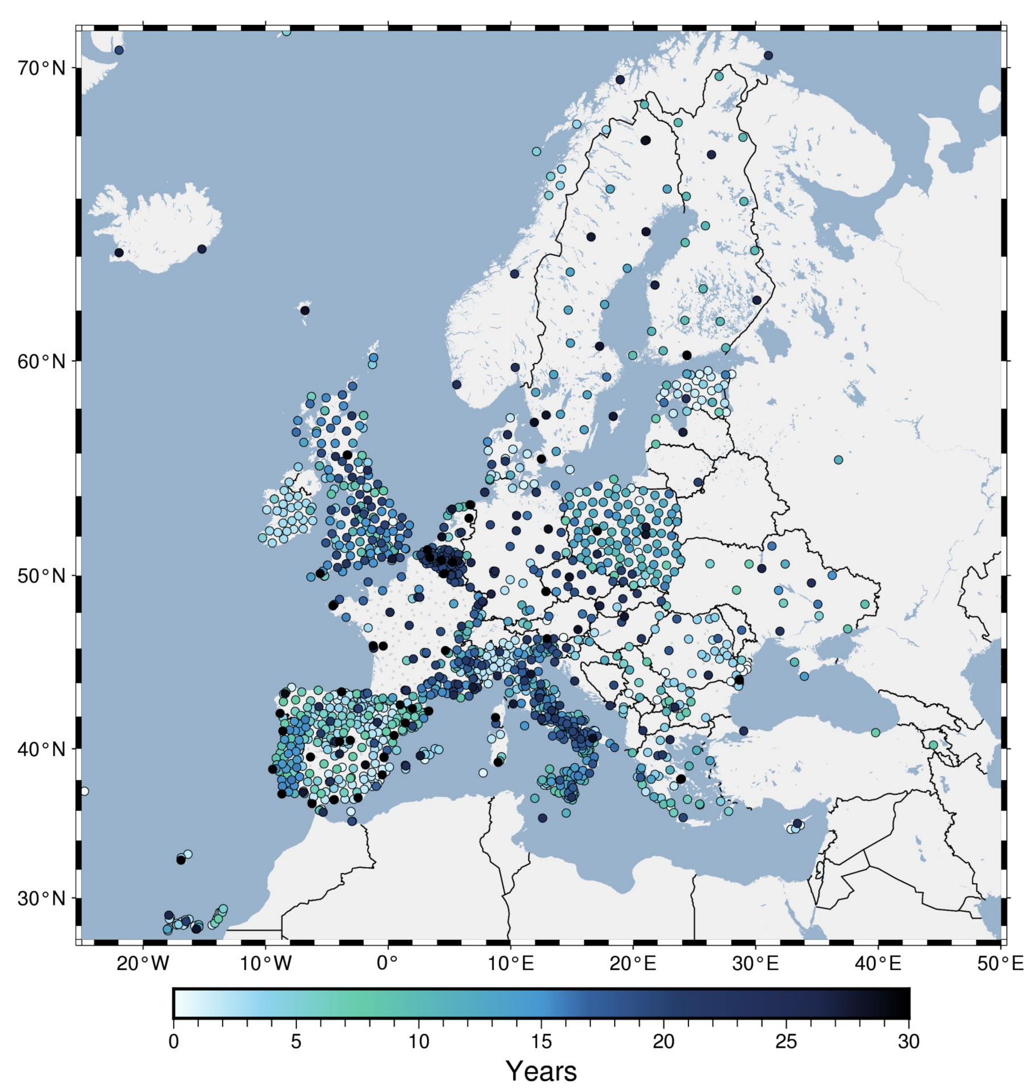


Figure 6. Map of the 1724 EPOS stations with data at DGW ; the colour code shows the number of days with quality metrics (converted in years). 293 EPOS-GNSS stations without data are shown in grey. Some nodes are still populating.

References and links

EPOS-GNSS data quality monitoring web portal: https://gnssquality-epos.oma.be/
EPOS Data Portal: https://www.ics-c.epos-eu.org/
EPOS-GNSS Data Gateway: https://gnssdata-epos.oca.eu/
EPOS-GNSS Product Portal: https://gnssproducts.epos.ubi.pt/
M³G: https://gnss-metadata.eu/
G-Nut/Anubis Software: https://gnutsoftware.com/software/anubis

[1] Blewitt, G., W. C. Hammond, and C. Kreemer (2018), Harnessing the GPS data explosion for interdisciplinary science, Eos, 99, https://doi.org/10.1029/2018EO104623

[2] Vaclavovic, P., Dousa, J. (2015). G-Nut/Anubis: Open-Source Tool for Multi-GNSS Data Monitoring with a Multipath Detection for New Signals, Frequencies and Constellations. In: Rizos, C., Willis, P. (eds) IAG 150 Years. International Association of Geodesy Symposia, vol 143. Springer, Cham. https://doi.org/10.1007/1345_2015_97

EPOS-GNSS data workflow

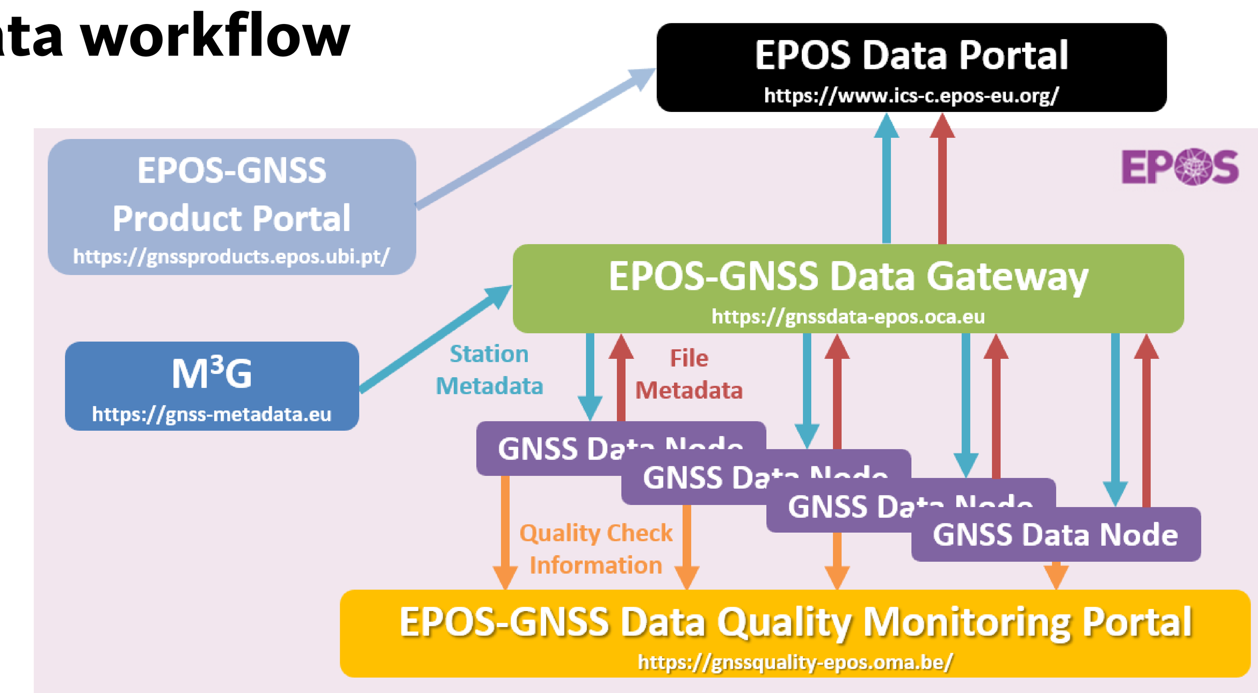
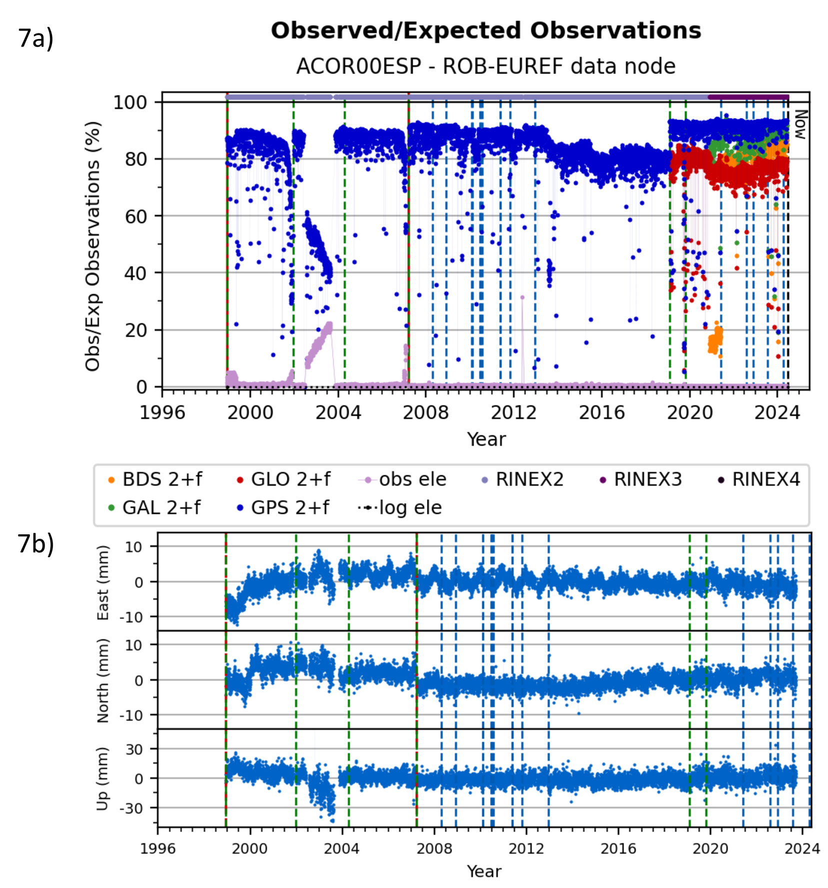


Figure 1. Schema of the EPOS-GNSS data workflow.

- **EPOS data portal**: provide access to (meta)data and products from the EPOS-GNSS and other thematic core services.
- **EPOS-GNSS Data Gateway** (DGW): provide access to GNSS RINEX data from a distributed infrastructure of twelve GNSS data nodes.
- Station metadata are inserted in **M³G** (Metadata Management and Distribution System for Multiple GNSS Networks) and are synchronized to the DGW and then from the DGW to the nodes.
- **GNSS data nodes**: RINEX files are checked using the G-Nut/Anubis software[2] and inserted at the node level. The metadata of the validated RINEX files are synchronized to the DGW to make them discoverable through the DGW and the EPOS data portal.
- **EPOS-GNSS data quality monitoring portal**: provide access to the plots of GNSS data quality indicators retrieved from the nodes.
- **EPOS-GNSS Product Portal**: provide access to the EPOS-GNSS products.

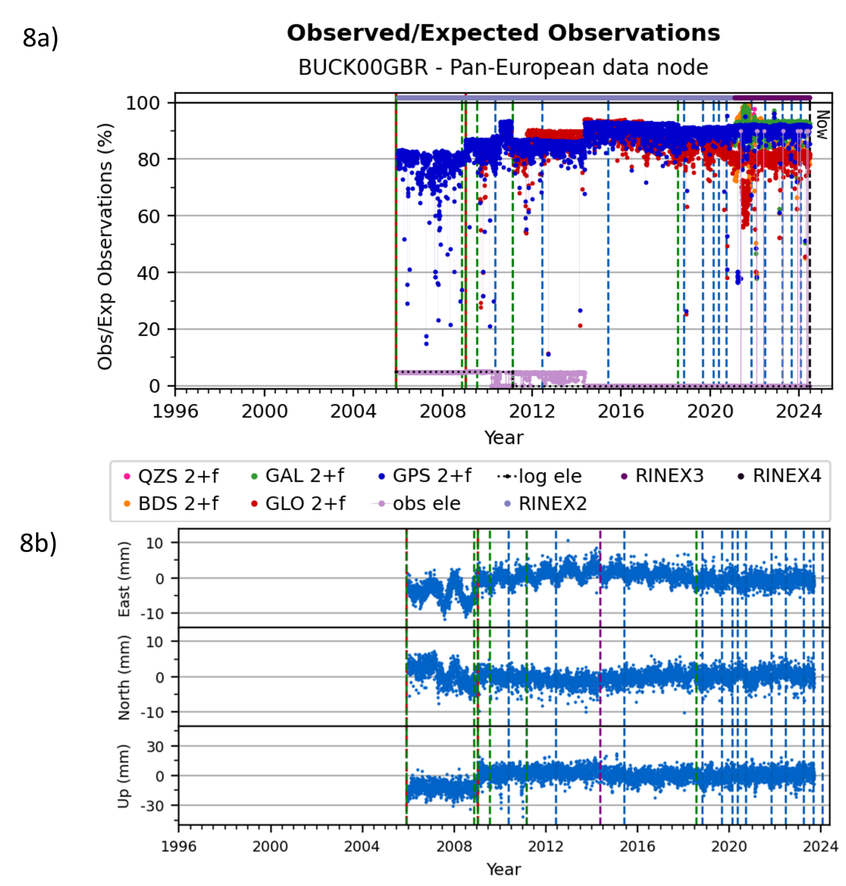
What is the added value of GNSS data quality indicators?

The degraded quality of daily GNSS data can impact the accuracy of GNSS products. Examples below illustrate how GNSS quality plots can help to correctly interpret and model detrended GNSS position time series.



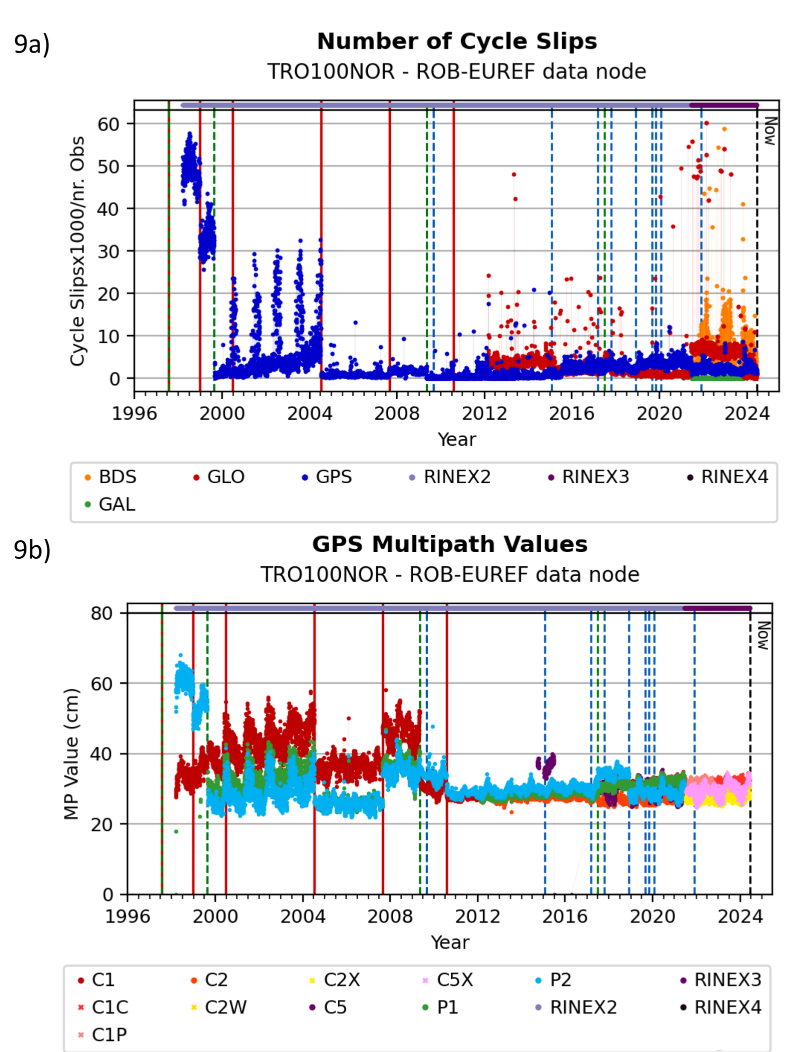
Figures 7. Degraded tracking at low elevation in 2003 caused spurious subsidence at the station ACOR00ESP.

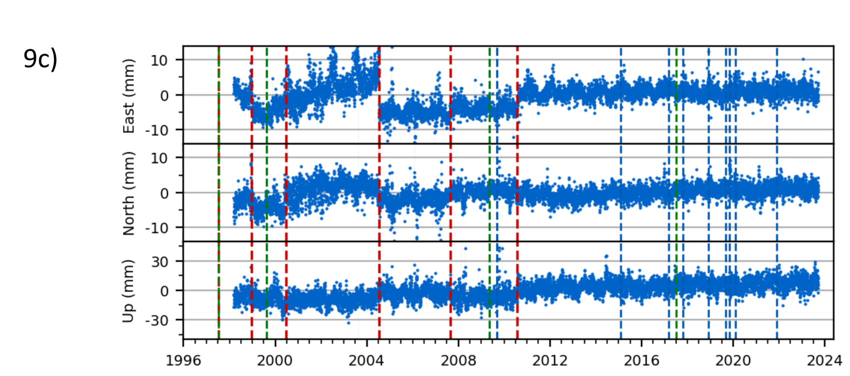
a) % of observed/expected observations, minimum elevation is shown in purple.
b) Detrended position time series from Nevada Geodetic Laboratory (NGL[1]).



Figures 8. Example of an undocumented change affecting the cut off angle in 2014 for the station BUCK00GBR.

a) % of observed/expected observations, minimum elevation is shown in purple.
b) Detrended position time series from NGL[1], a purple vertical line in 2014-05-16 shows an un-documented change of the cut off angle observed.





Figures 9. Degraded tracking performance between 2000 and 2004 affecting the number of cycle slips, the multipath values and the position time series for the station TRO100NOR.

a) Number of cycle slips per number of observations.
b) Daily mean of code multipath per frequency band and satellite constellation.
c) Detrended position time series from NGL[1].

More details: Bamahry, F., Legrand, J., Bruyninx, C., Fabian, A. (2024). EPOS-GNSS Data Quality Monitoring Web Portal. International Association of Geodesy Symposia, Chapter 264. Springer, Cham. https://doi.org/10.1007/1345_2024_264 (in press).

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