

Introduction

The Metadata Management and Distribution System for Multiple GNSS Networks (M³G) [<https://gnss-metadata.eu>], maintained by the Royal Observatory of Belgium (ROB),

- provides a public open access service to standardize and distribute metadata of permanently tracking GNSS stations (currently 3150+)
- allows any agency (currently 140+) to maintain their GNSS station metadata in M³G
- responds to the need to apply FAIR data principles and lays the basis for using Linked Data Principles
- is used within the European Plate Observing System (EPOS) [<https://www.epos-eu.org>] and EUREF Permanent GNSS Network (EPN) [<https://epncb.oma.be>]

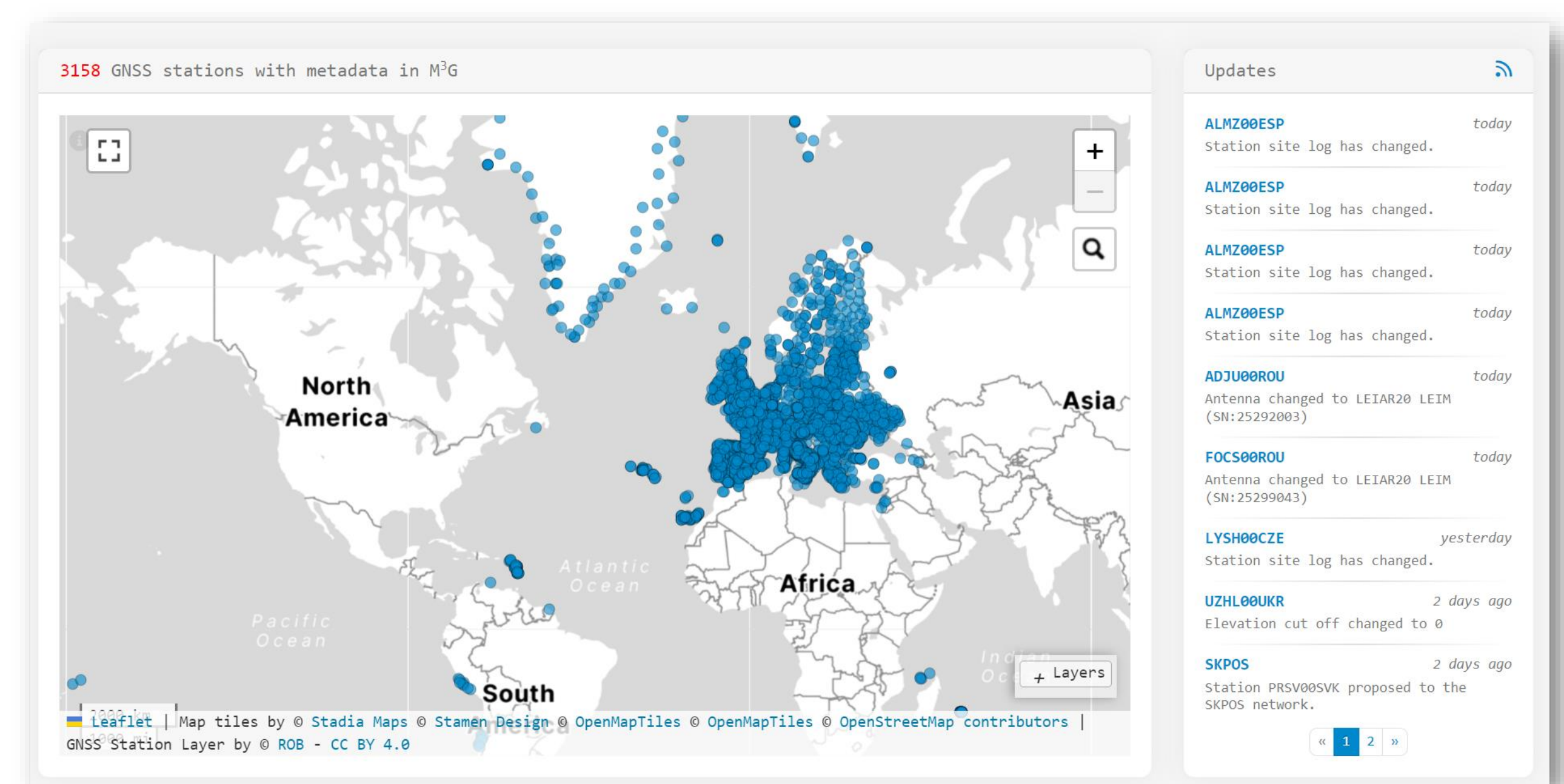


Figure 1: M³G home page [<https://gnss-metadata.eu>]

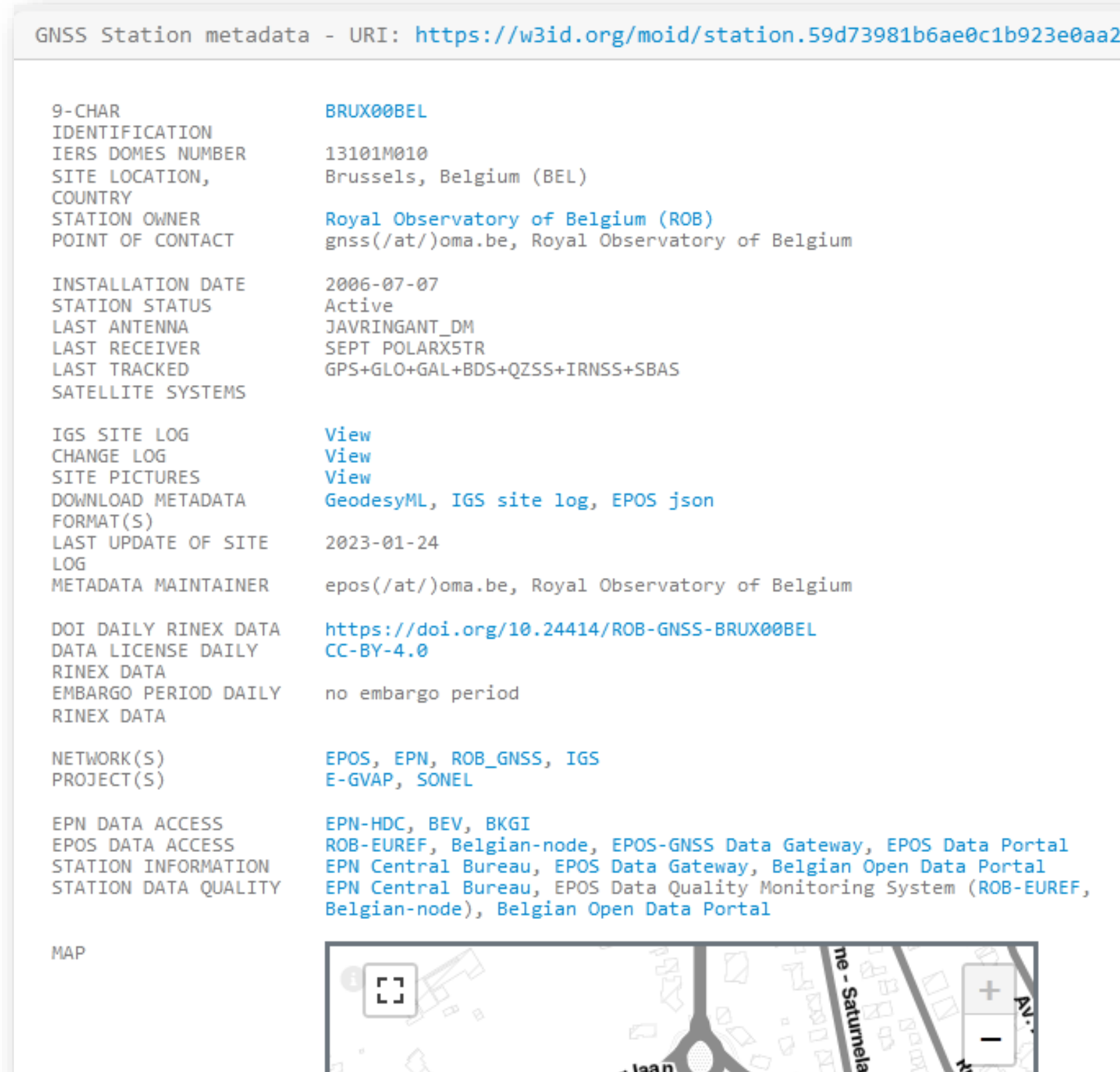


Figure 2: M³G's PID page for BRUX00BEL station [<https://w3id.org/moid/station.59d73981b6ae0c1b923e0aa2>]

M³G GNSS station information services

M³G's GNSS station metadata include the i) station description, location, and pictures, ii) Digital Object Identifier (DOI) and data license of the station's dataset, iii) GNSS networks to which the stations contribute as well as the network DOI, iv) the associated GNSS data centers.

All this information is openly available and M³G provides a wide range of services to access it:

- GNSS station metadata catalogue [<https://gnss-metadata.eu/site/metadata>]
- M³G GNSS metadata file server [<https://gnss-metadata.eu/data/>]
- Representational State Transfer API (REST API) to download and upload GNSS metadata [<https://gnss-metadata.eu/site/api-docs>]
- RSS feed to track the GNSS station metadata changes [<https://gnss-metadata.eu/site/rss/>]
- Permanent Identifier (PID) service to transform M³G GNSS metadata into Digital Objects [see Figure 2.]

Transforming M³G's Digital Objects into Linked Open Data

M³G aims at transforming its Digital Objects into Linked Open Data (LOD), which supports Findable, Accessible, Interoperable, Reusable (FAIR) data principles by construction [see Figure 3.]

LOD enables publishing structured interlinked data on the internet ensuring the usability, accessibility and long-term sustainability of digital resources as well as the machine-actionability of the Digital Objects.

To turn M³G Digital Objects into LOD, ROB has recently implemented:

- a Permanent Identifier (PID) service providing Unique Resource Identifiers (URIs) for a wide range of GNSS objects such as GNSS networks, GNSS data centers, data suppliers, and GNSS stations.
- PID pages embedding linked data as JSON-LD, making it easier to publish and consume data in a machine-readable format. This format offers rich, contextual information regarding the station's provenance and licensing, as well as the link between data centers and networks. Additionally, it includes the links to the accessible metadata formats (GeodesyML, IGS site log).

For more info:

"Session 1: GNSS Standards and Infrastructure" (01/July/2024, 9:00am - 10:00am)
ID: 235: "Enabling FAIR GNSS data repositories: the case of the EPN Historical Data Center"
A. Miglio, C. Bruyninx, A. Fabian, J. Legrand

REST API service in M³G

ROB published a REST API to POST, PUT and GET GNSS metadata and documented it on [<https://m3g-rob.github.io/doc4m3g/>].

The new service enables the users to:

- find and filter GNSS metadata. The filters are flexible, customizable and allow operators (=, <, !=, >).
List the stations whose metadata have been updated within the last month:

```
>curl -X GET "https://gnss-metadata.eu/v1/sitelog?page=1&filter[dateUpdate][gt]=2024-06-01T00:00Z" -H "accept: application/json"
```

- pass information to M³G using command-line instructions. For that purpose, station managers have a specific token permitting them to make changes to their metadata in M³G.

Firmware update for a specific station:

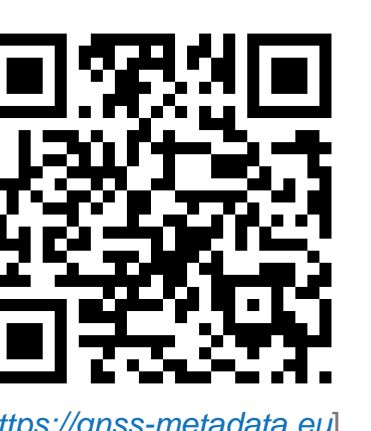
```
> curl -X PUT "https://gnss-metadata.eu/v1/sitelog/firmware-change?id=BRUX00BEL" -H "accept: application/json" -H "Authorization: Bearer <token>" -H "Content-Type: text/plain; charset=utf-8" -d '{"updateMadeBy": "gnss@oma.be", "endOfTheLastSection": "2022-08-15T13:55Z", "changedTo": "5.5.0"}'
```

Upload a site log from local disk for a specific station:

```
> curl -X PUT "https://gnss-metadata.eu/v1/sitelog/upload-sitelog?id=AILT00FRA" -H "accept: application/json" -H "Authorization: Bearer <token>" -H "Content-Type: text/plain; charset=utf-8" --data-binary "@ailt_20210415.log"
```

References

- Bruyninx C., Fabian A., Miglio A., Legrand J., How to integrate a GNSS station in EPOS, EPOS-GNSS Webinar, 18-19 January 2021, DOI:[10.24414/ROB-EPOS-GNSS.PR.01.2021](https://doi.org/10.24414/ROB-EPOS-GNSS.PR.01.2021)
- Bruyninx C., Legrand J., Fabian A., Pottiaux E., GNSS metadata and data validation in the EUREF Permanent Network, GPS Sol. 23 (2019), DOI:[10.1007/s10291-019-0880-9](https://doi.org/10.1007/s10291-019-0880-9)
- Wilkinson MD., The FAIR Guiding Principles for scientific data management and stewardship. Scientific Data, 3: 160018 (2016), DOI:[10.1038/sdata.2016.18](https://doi.org/10.1038/sdata.2016.18)



<https://gnss-metadata.eu>