Multi-GNSS Capability of the EUREF Permanent Tracking Network

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http://www.epncb.eu/

ROYAL OBSERVATORY OF BELGIUM

EUREF Symposium Amsterdam, 30/5- 1/6, 2018

Tracking Network

324 stations in the EPN

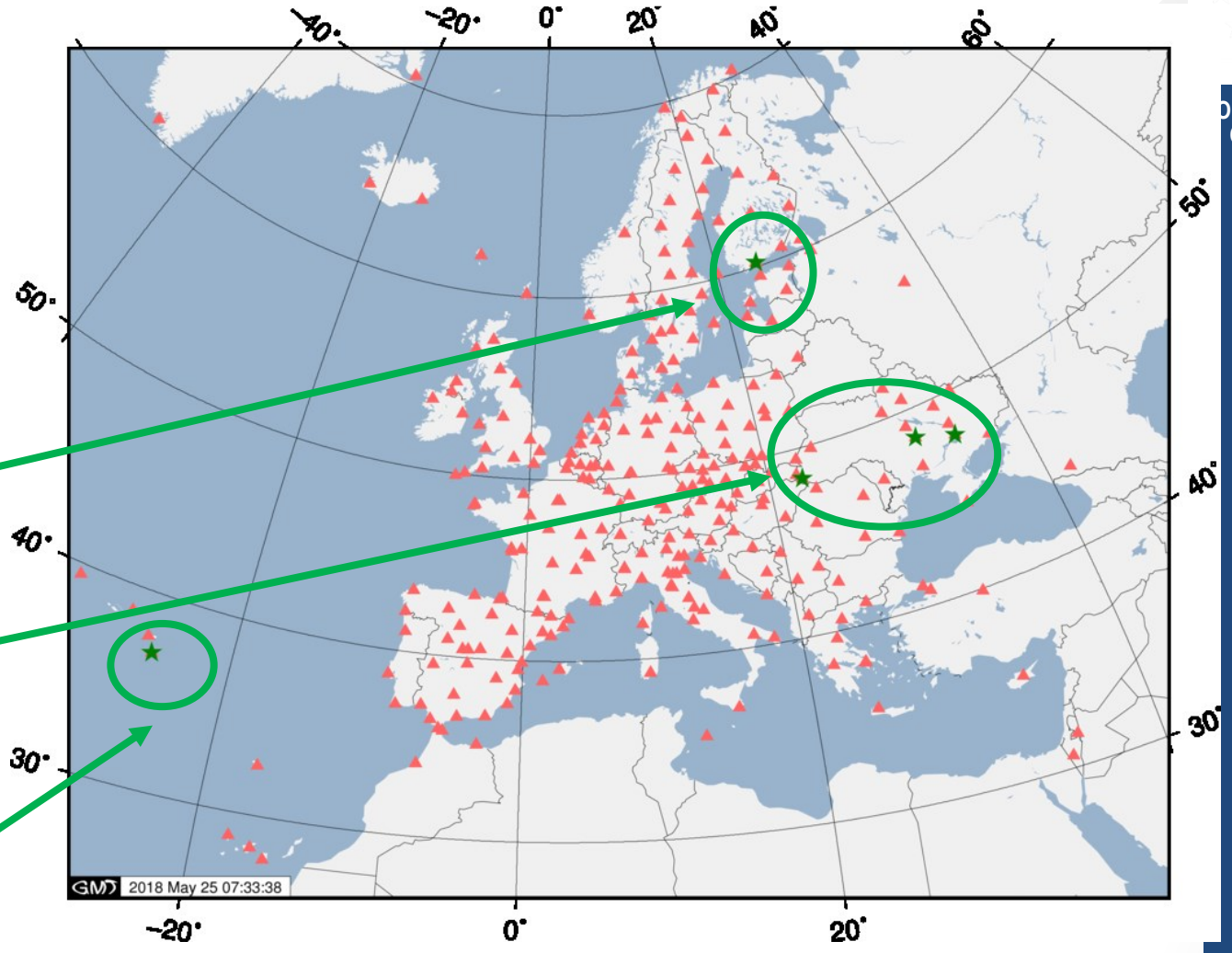
5 new stations since last symposium
(39 new stations last year….)

METG00FIN (Metsahovi, Finland)
GPS+GLO+GAL+BDS+SBAS, real-time, IGS

KRRS00UKR, MKRS00UKR, ZPRS00UKR
Ukraine
GPS+GLO

RAEG00PRT (San Pedro, Portugal):
GPS+GLO, real-time, IGS

1 station removed from EPN:
CREI00FRA
(IGN moved away from building)



Proposed Stations

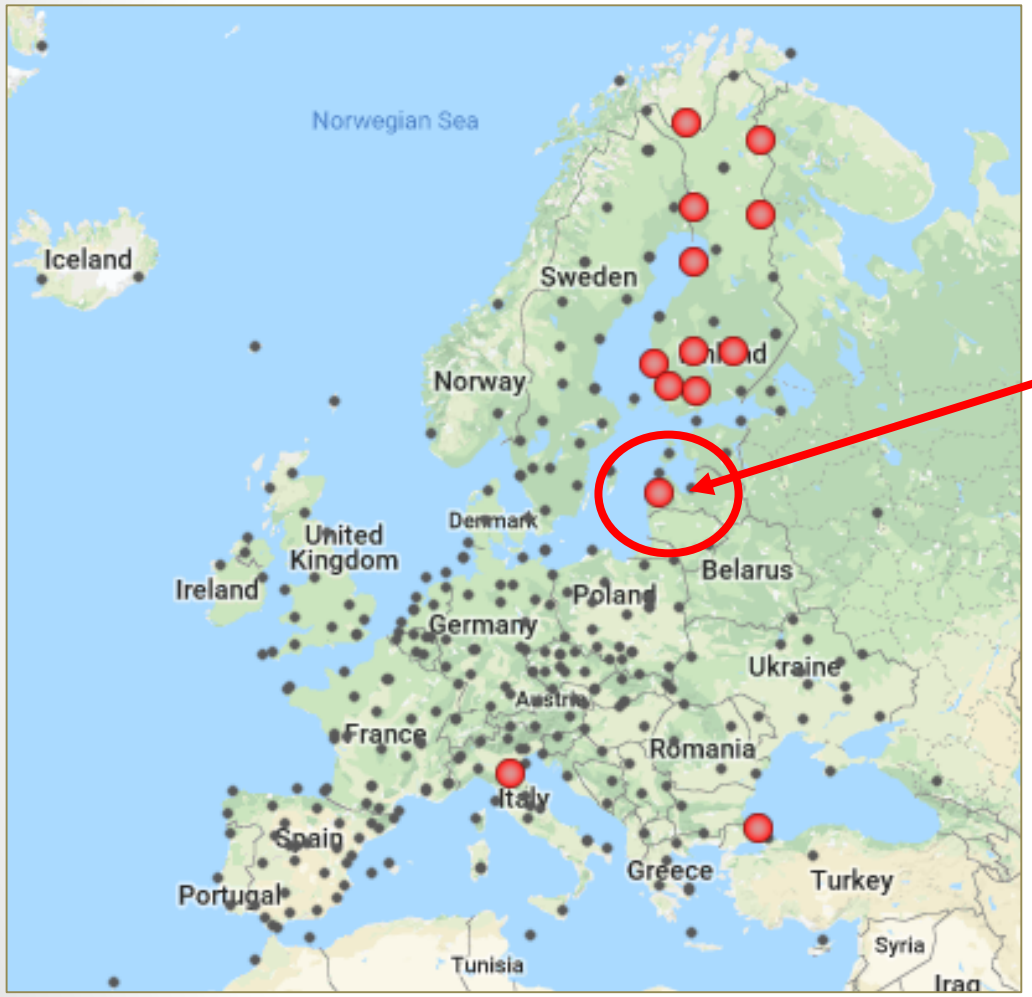
Italian station proposed in Dec. 2017:

IGM200ITA
Twin station IGMI00ITA

GPS+GLO+GAL+BDS+SBAS

Data upload not reliable yet
Metadata inconsistency

Proposed Stations



Latvian station proposed in June 2016:

VAIN00LVA

GPS+GLO+GAL+BDS+SBAS

Not succeeding to reliably upload daily and hourly data to BKG and BEV

Proposed Stations

Finish stations proposed already end 2017:

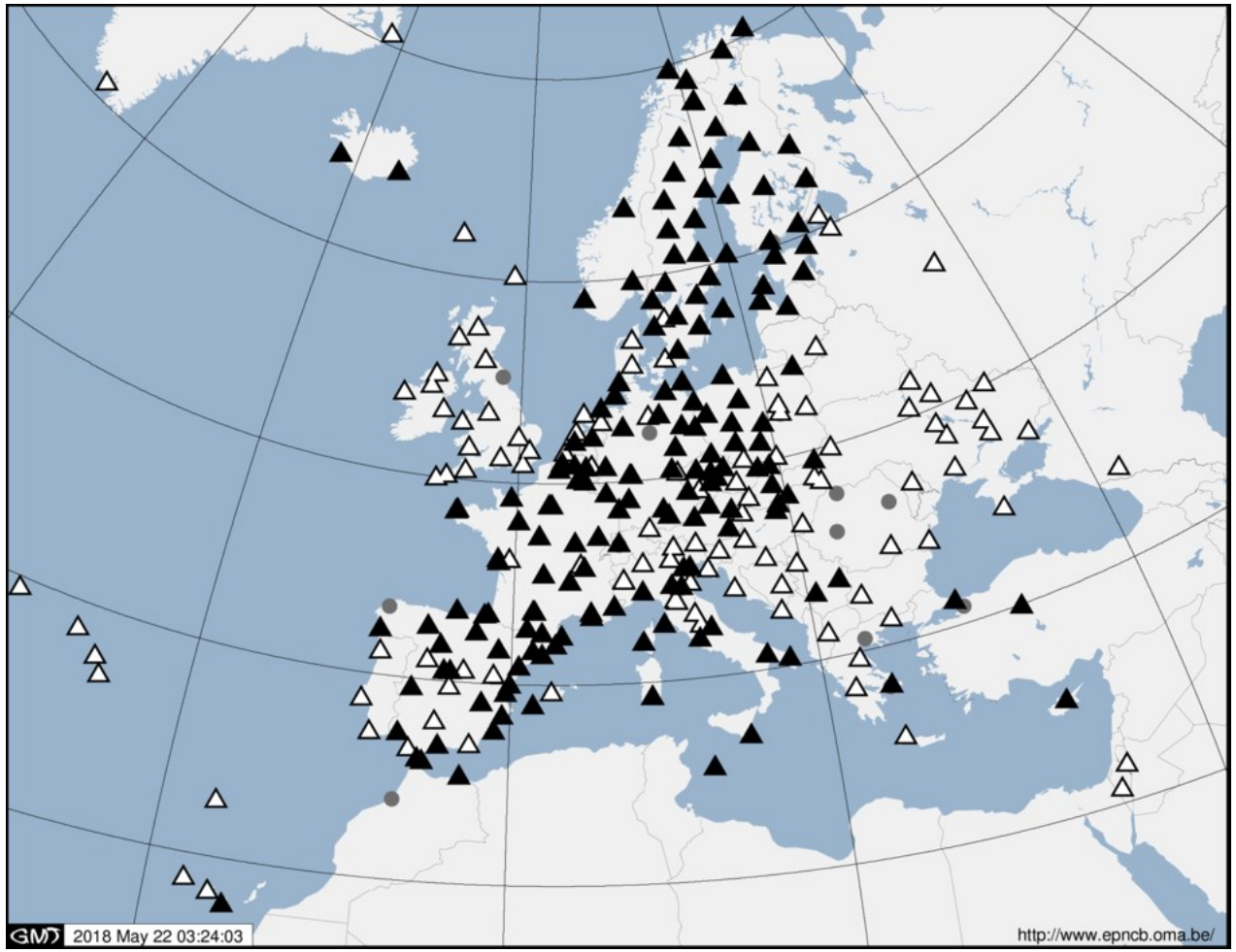
Not yet included in EPN because of lack of interested analysis centers!
(1-2 available, not 3)

GPS+GLO+GAL+BDS+SBAS
Real-time
Individual antenna calibrations

Multi-GNSS Tracking Network

Based on observations in RINEX data:

- ● GPS-only : 21 stations (7%)
- △ GPS+GLO: 130 stations (40%)
- ▲ GPS+GLO+GAL+… (RNX 3): 172 stations (53 %!)



Exceptionally well ?
In IGS, 38% of the stations indicate GAL tracking in site log

Galileo in Site Log, but no RINEX 3 Galileo Data

Checks each 1-2 months

24 stations:
ADAR00GBR, ARIS00GBR, CHIO00GBR, EDIN00GBR, INVR00GBR, NEWL00GBR, PMTH00GBR
PFA200AUT
POLV00UKR, PRYL00UKR, MARP00UKR, DNMU00UKR, MIKL00UKR
PULK00RUS
SCOR00GRL, KELY00GRL
SJDV00FRA, CHIZ00FRA, LROC00FRA
ALME00ESP, SALA00ESP, SFER00ESP, COBA00ESP
BOGI00POL

Site log should reflect constellations in submitted RINEX files, NOT receiver capability

Galileo Observables Extracted from RINEX 3

RECEIVER TYPE	CARRIER PHASE SIGNALS				
	E1	E5a	E6	E5b	E5a+b
TPS NET-G5	L1B	L5I	L6B	L7I	L8Q
JAVAD TRE_3 DELTA	L1X	L5X		L7X	L8X
JAVAD TRE_3 DELTA	L1X	L5X	L6X	L7X	L8X
JAVAD TRE_G3TH DELTA	L1X	L5X			
JAVAD TRE_G3TH DELTA	L1X	L5X		L7X	
LEICA GR10	L1C	L5Q		L7Q	L8Q
LEICA GR25	L1C	L5Q		L7Q	L8Q
LEICA GR25 (TOR2)	L1C				L8Q
LEICA GR30	L1C	L5Q		L7Q	L8Q
LEICA GR50	L1C	L5Q		L7Q	L8Q
LEICA GRX1200+GNSS	L1X	L5X		L7X	L8Q
LEICA GRX1200+GNSS	L1C	L5Q		L7Q	L8Q
SEPT POLARX4	L1C	L5Q		L7Q	L8Q
SEPT POLARX4TR	L1C	L5Q		L7Q	L8Q
TRIMBLE NETR9	L1X	L5X		L7X	L8X
TRIMBLE NETR9 (BBYS)	L1X				
TRIMBLE SPS855	L1X	L5X		L7X	L8X

Signal complexity is not reflected by RINEX 2 format

Dual frequency double difference network processing: 2 common frequencies between Galileo stations required
L1/L5

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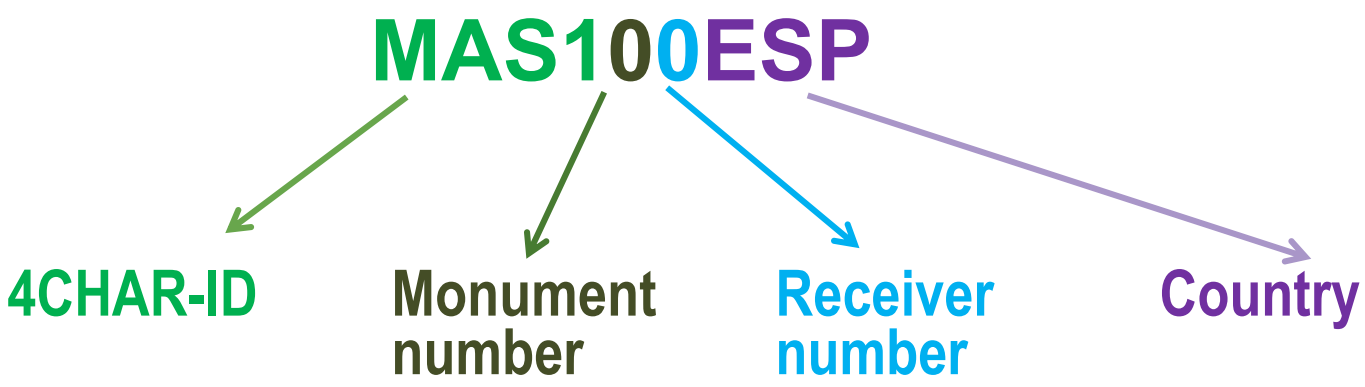
RINEX 3 Station Naming



Stations with duplicate 4-char ID in different countries allowed

Also IERS will start to attribute DOMES numbers to stations with same 4-char ID, but located in different countries

EPN site logs:

ftp://epncb.eu/pub/station/log/brux_20180201.log

ftp://epncb.eu/pub/station/log_9char/brux00bel_20180201.log

(agreed with IGS CB)

ROYAL OBSERVATORY OF BELGIUM

RINEX 3 File Naming

MAS100ESP_R_20142350000_01D_30S_MO.crx.gz

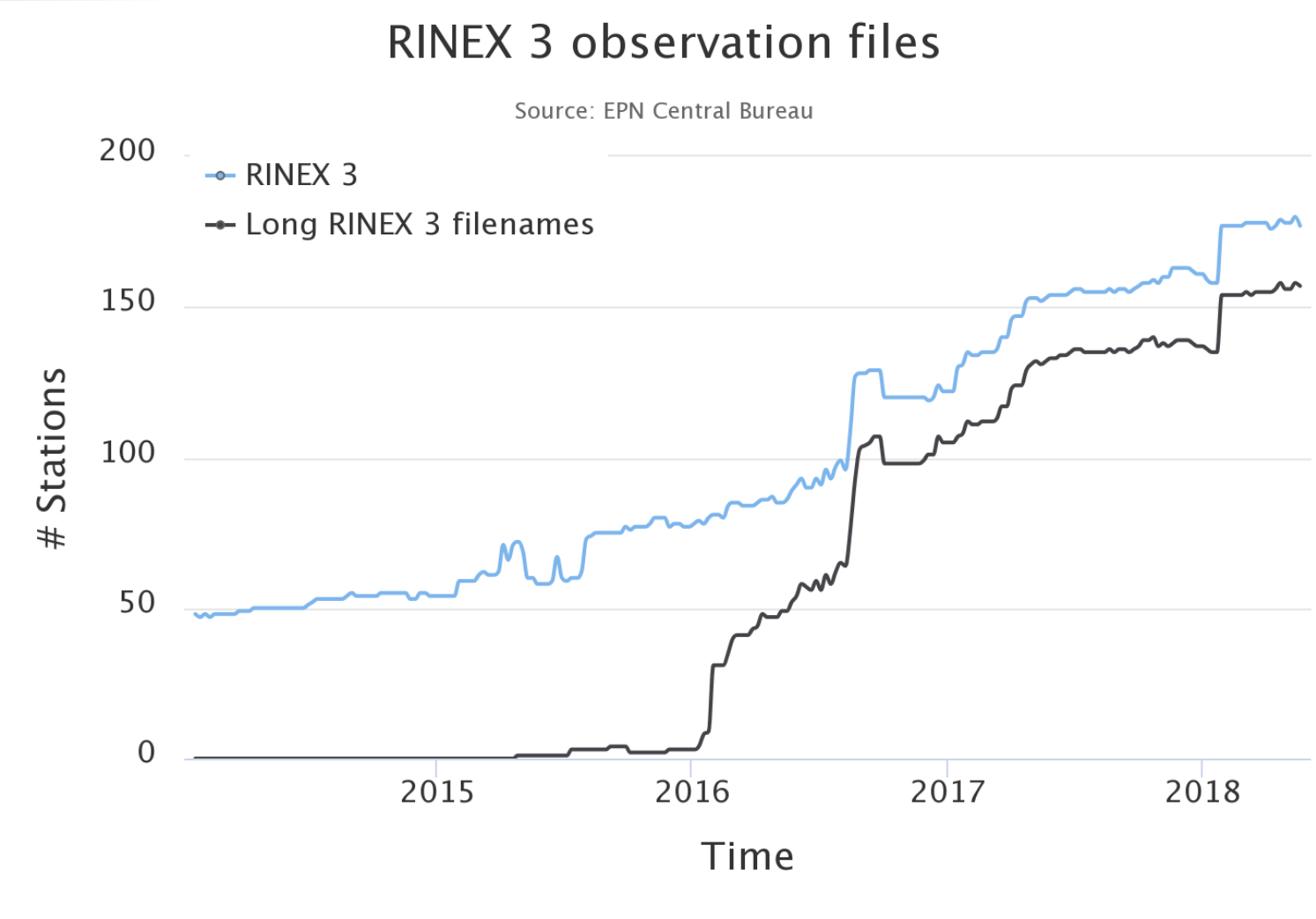
New long station name

Today: submit RINEX 2 and RINEX 3 (long filenames)

Ultimate goal: stop producing RINEX 2 and only produce RINEX 3 files with long file names (NOT NOW)

ROYAL OBSERVATORY OF BELGIUM

Usage of RINEX 3 Long Filenames



19 EPN stations provide RINEX 3 with only short filenames

No improvement with respect to last symposium!

RINEX 3.02: 107 stations
RINEX 3.03: 90 stations

Lessons Learned from Data Format

→ Work to be done at station manager level

Multi-GNSS Data Quality Monitoring

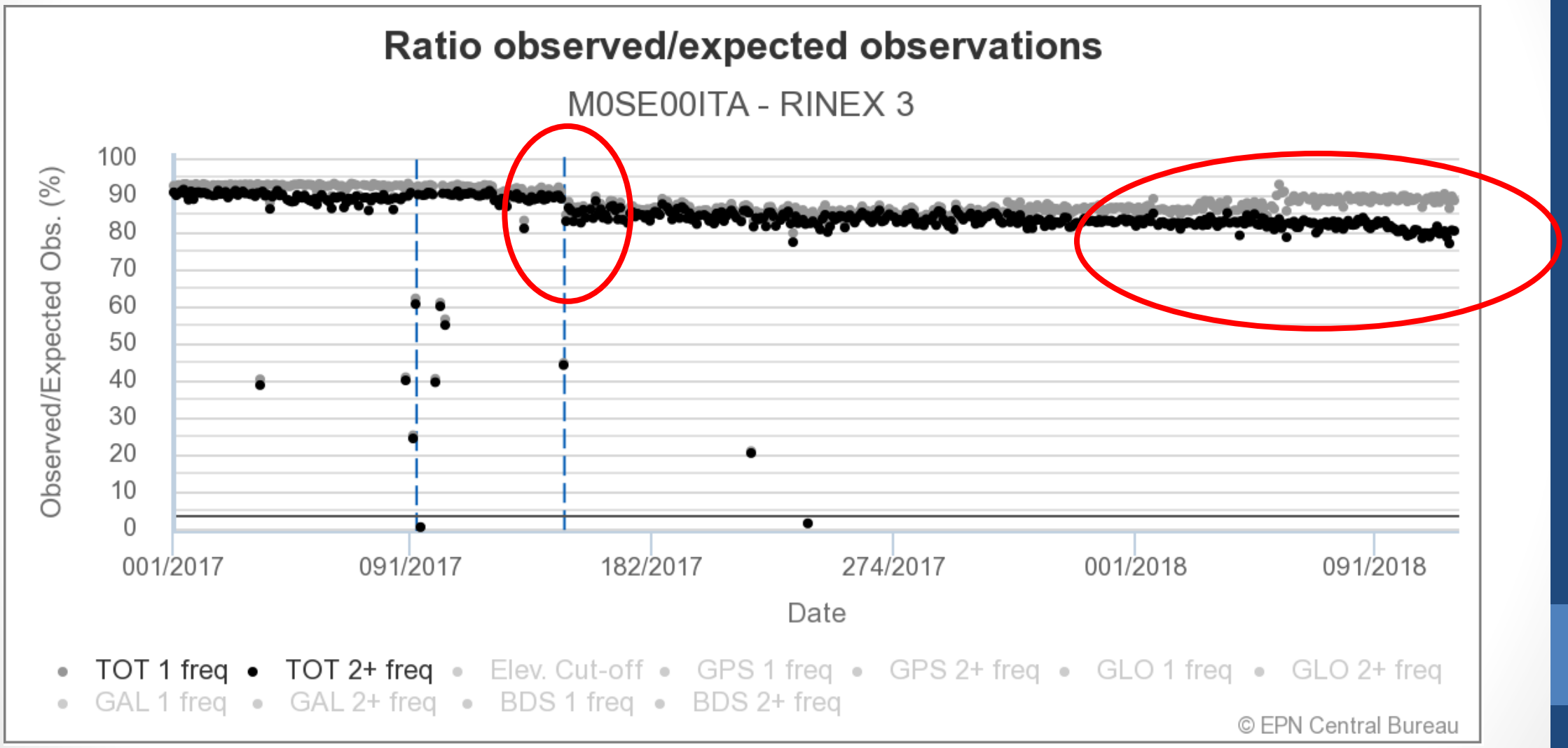
Daily quality checks using G-nut/Anubis- *Václavovic P, Dousa J (2016)*

+ Self-developed plotting scripts on top of Anubis

% observed/expected observations (single frequency and 2+ frequency)

- For each constellation + total (mean)

Multi-GNSS Data Quality Checks



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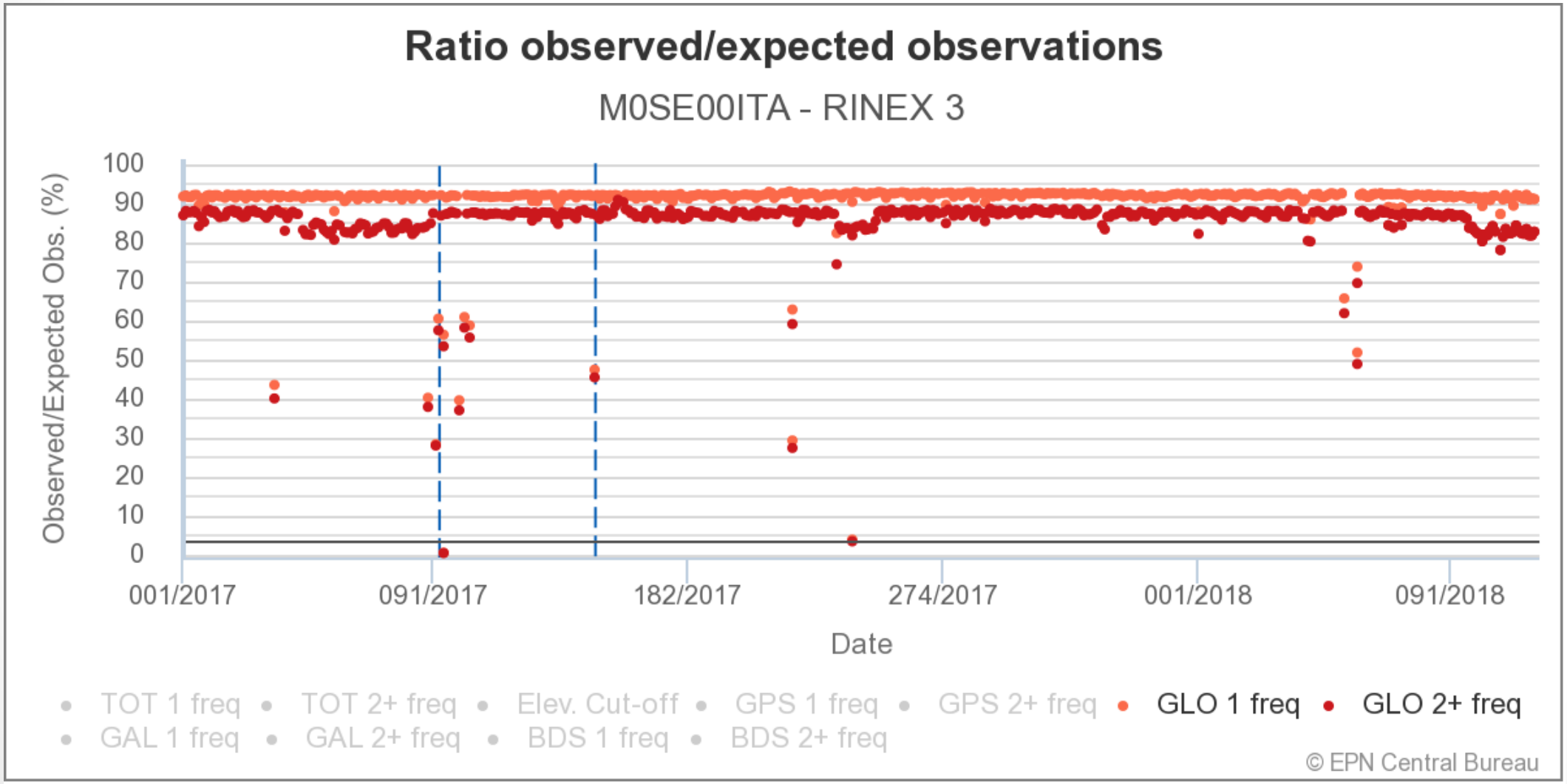
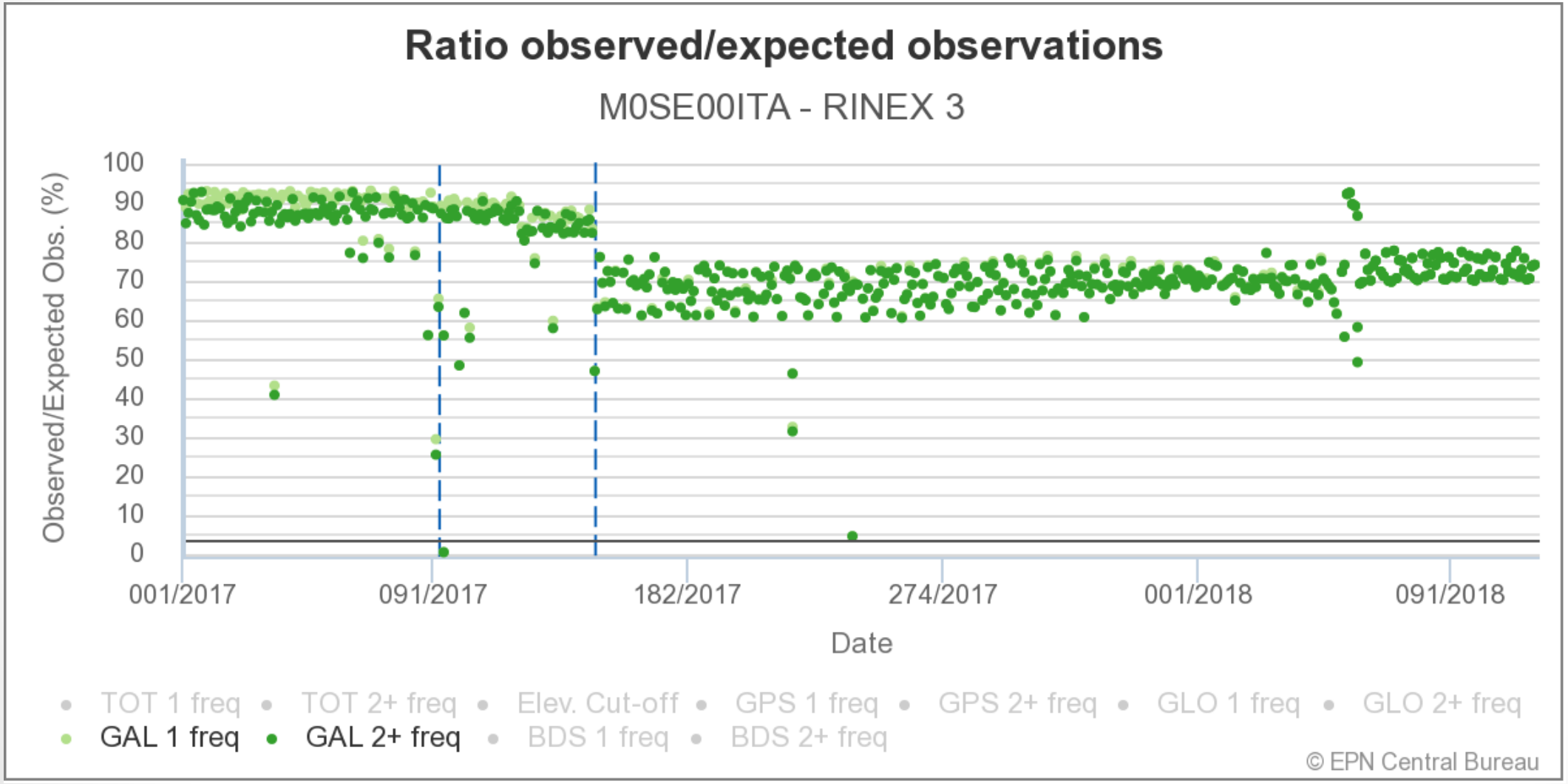
GLONASS Tracking



ROYAL OBSERVATORY OF BELGIUM

Galileo Tracking



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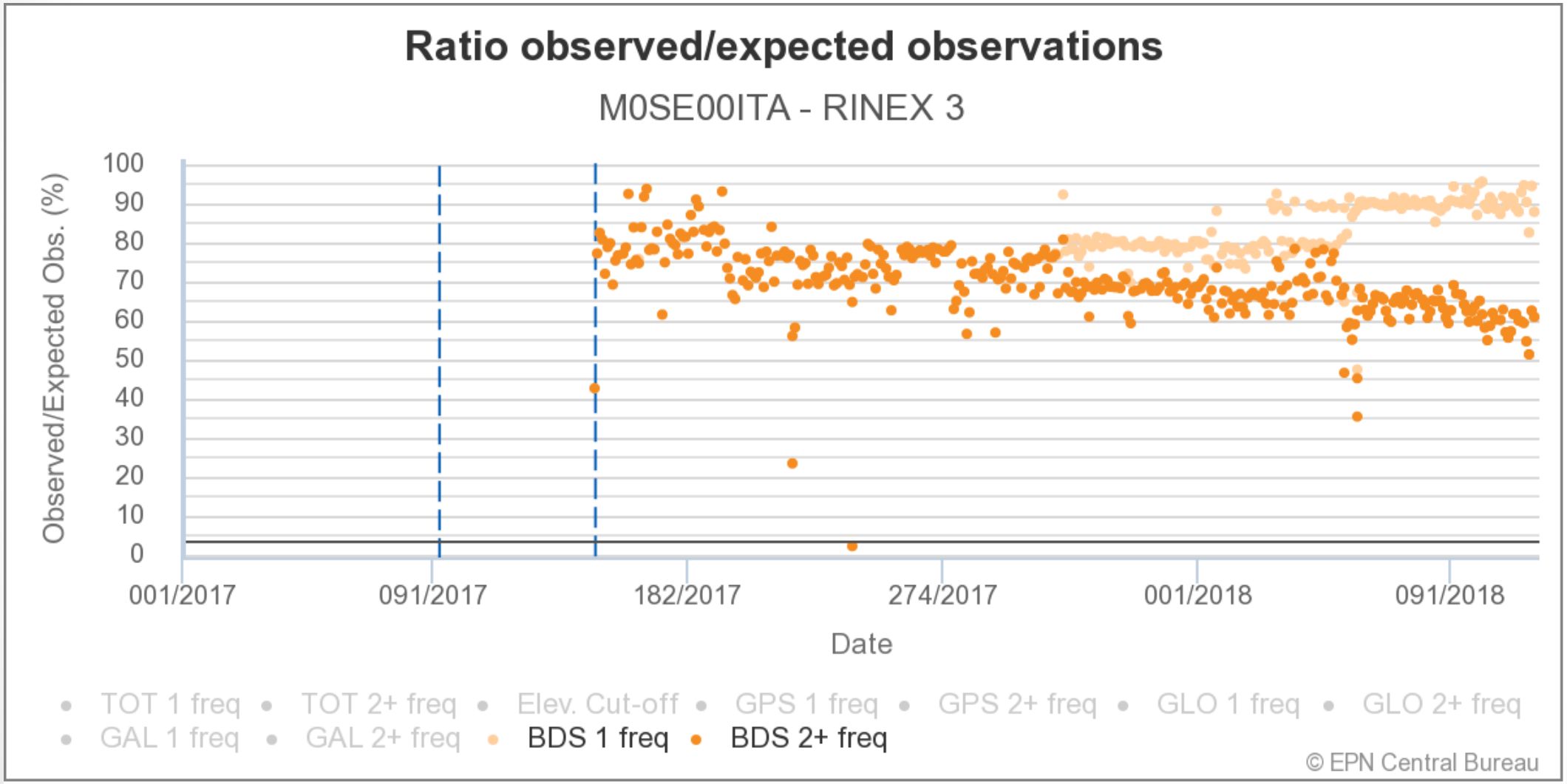
BeiDou Tracking



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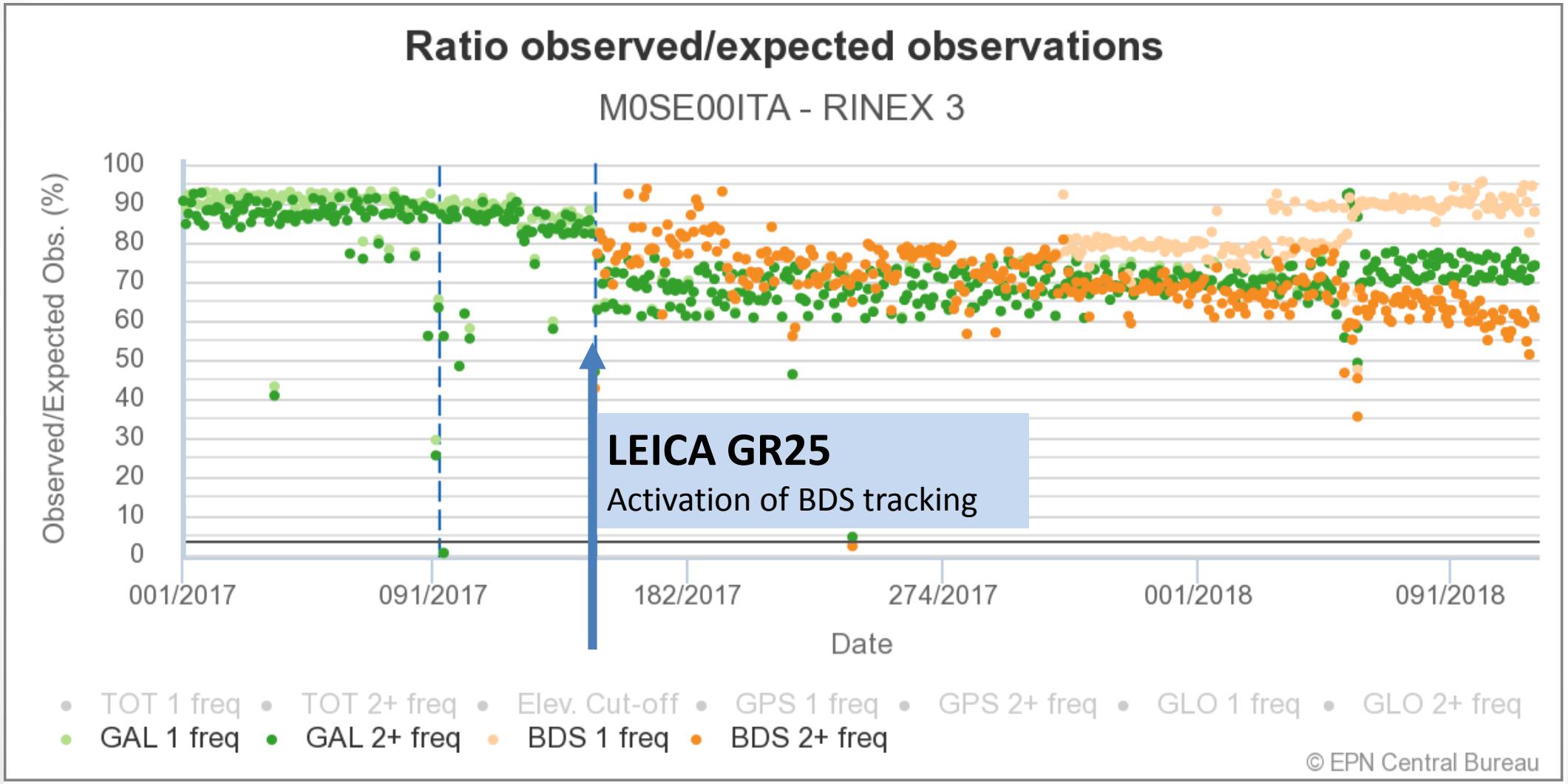
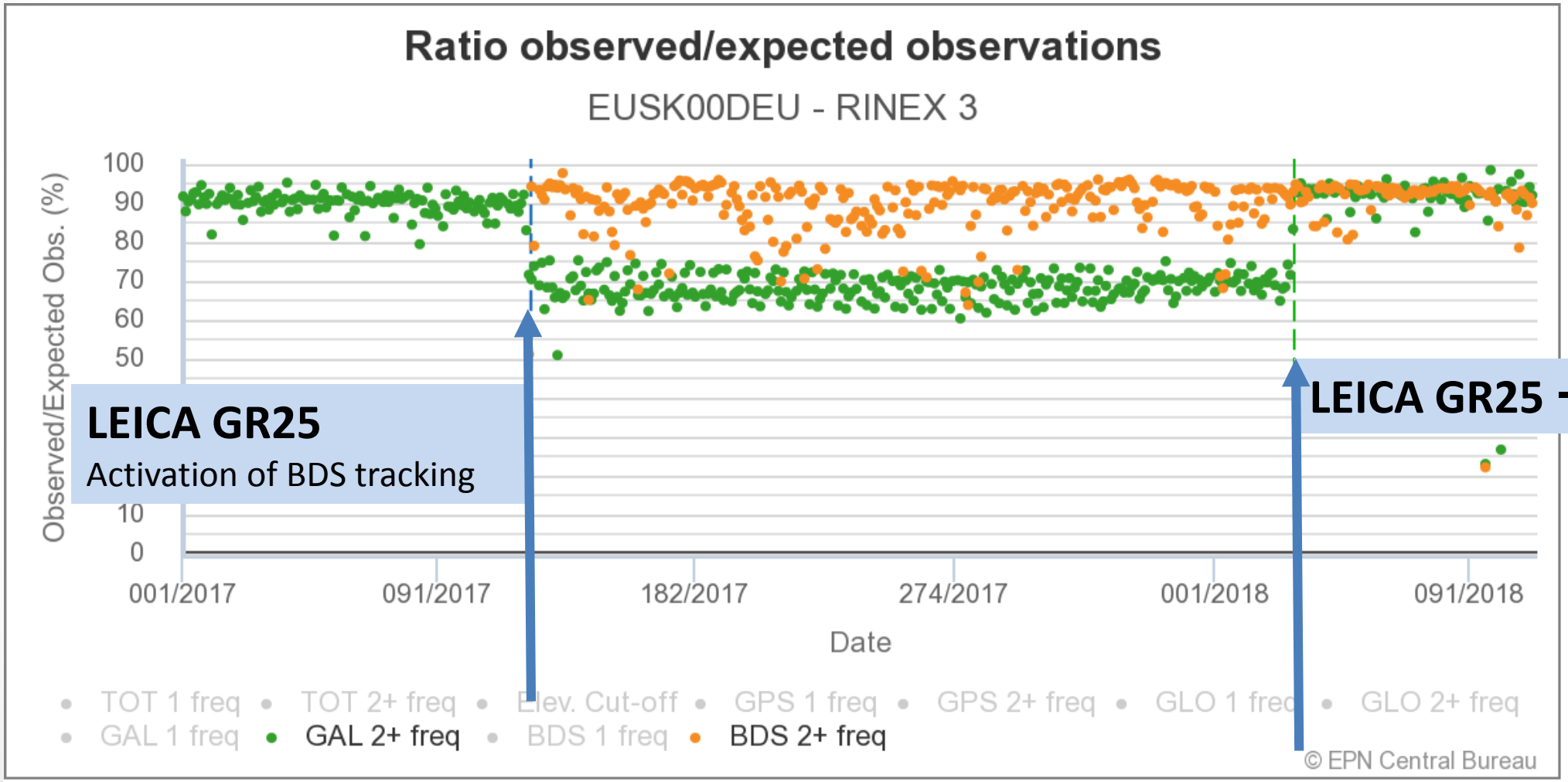
Simultaneous Galileo and BeiDou Tracking

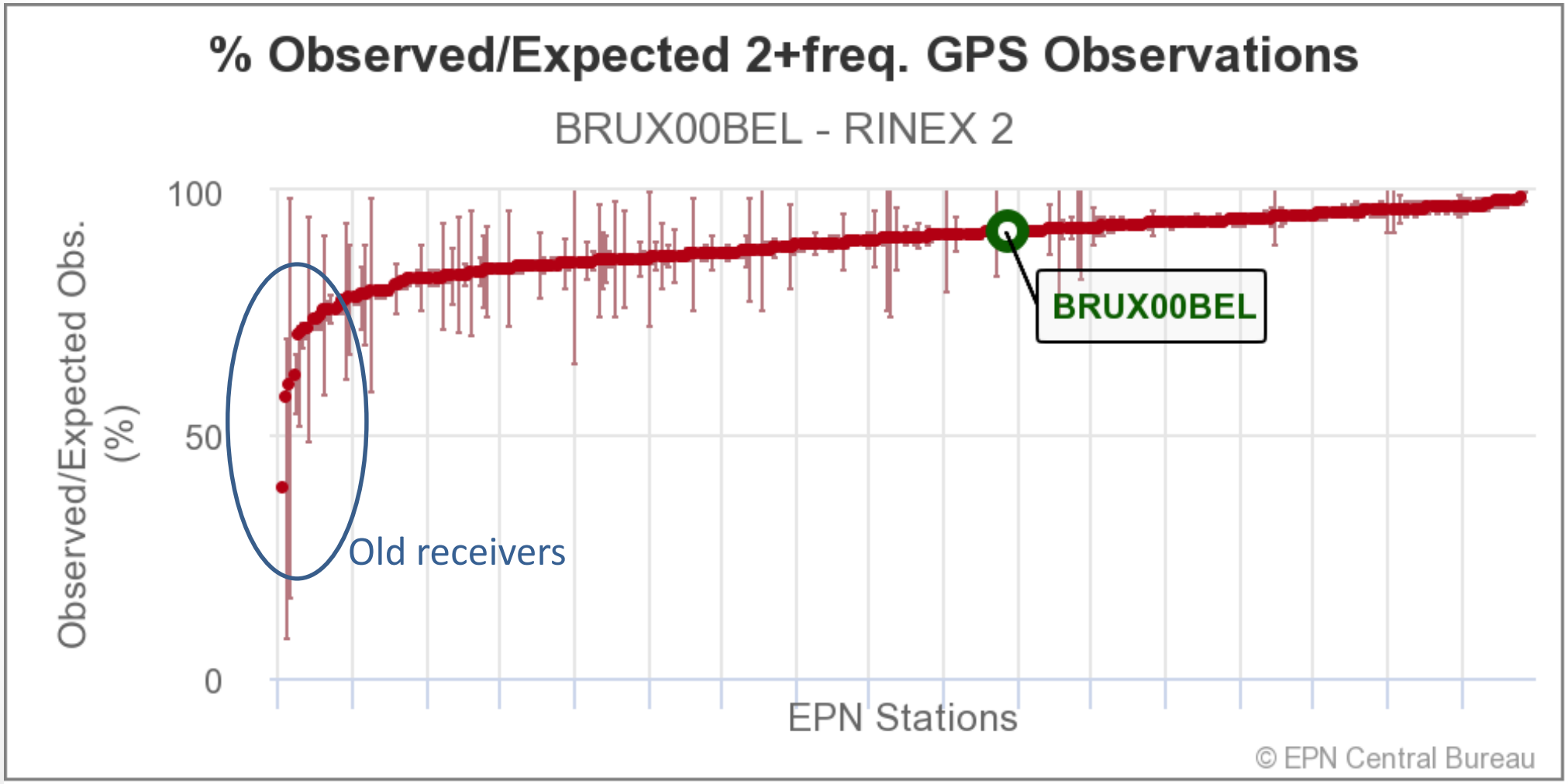


ROYAL OBSERVATORY OF BELGIUM

Simultaneous Galileo and BeiDou Tracking



GPS Tracking : RINEX 2



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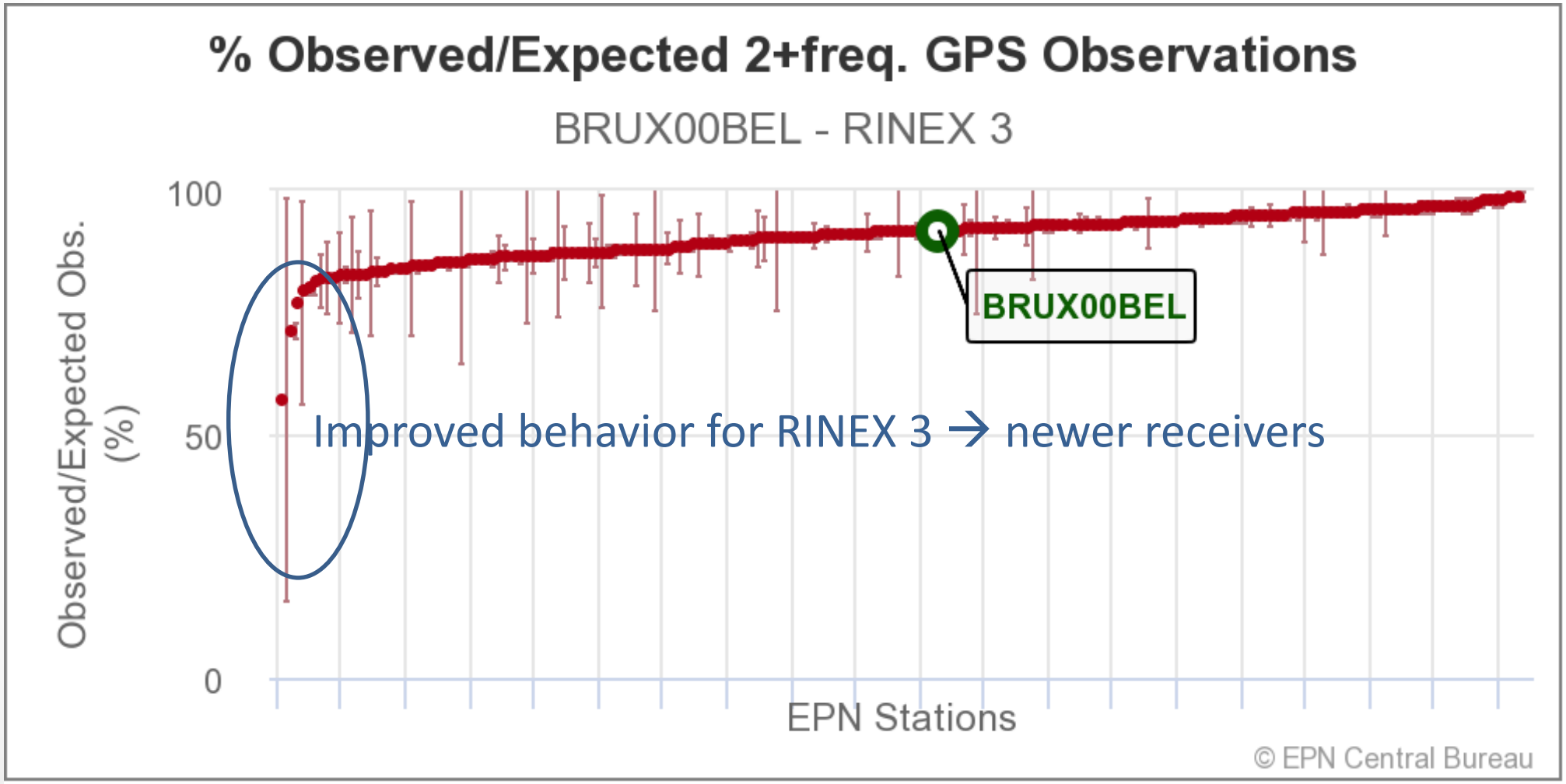
GPS Tracking : RINEX 3



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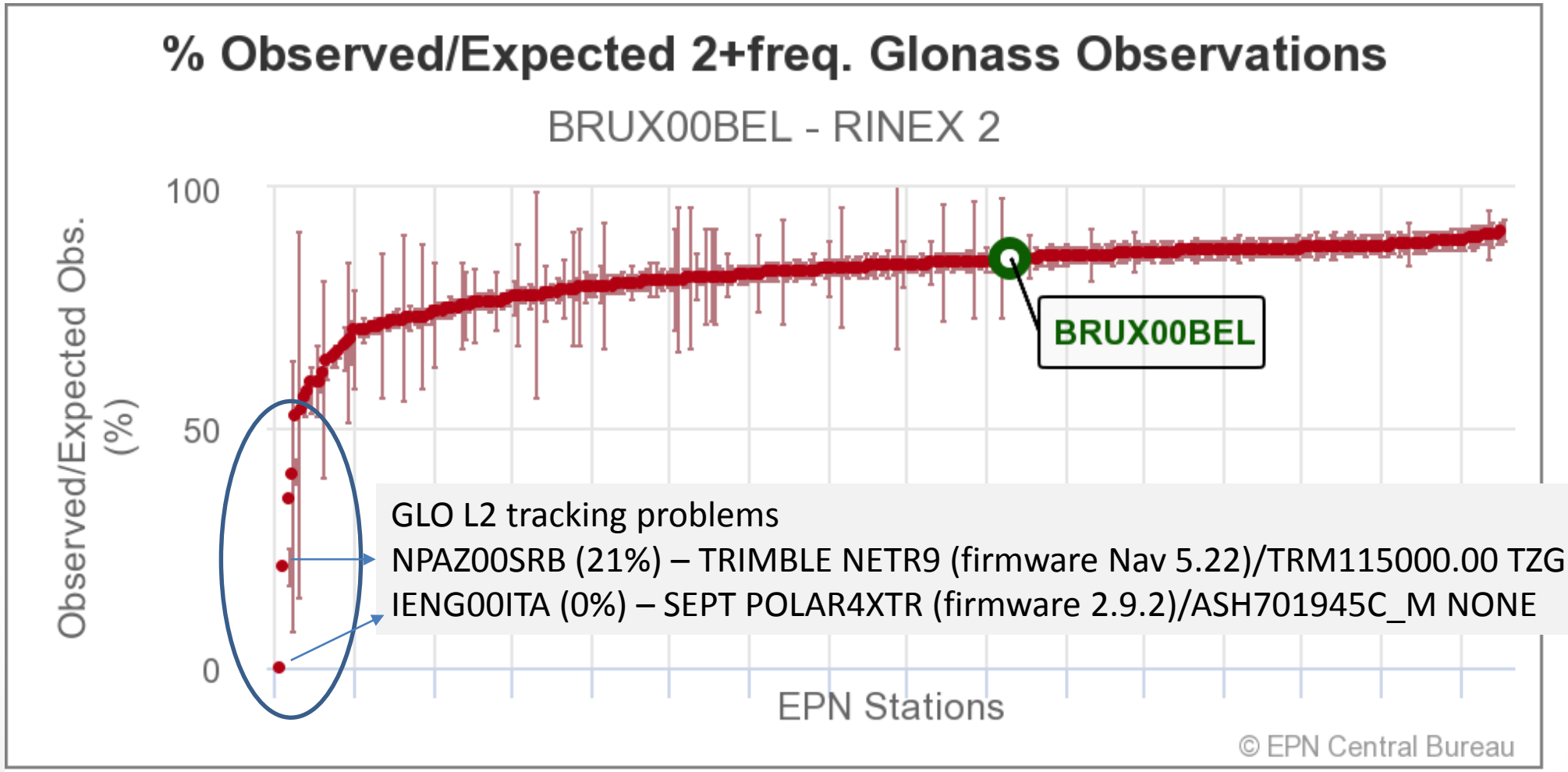
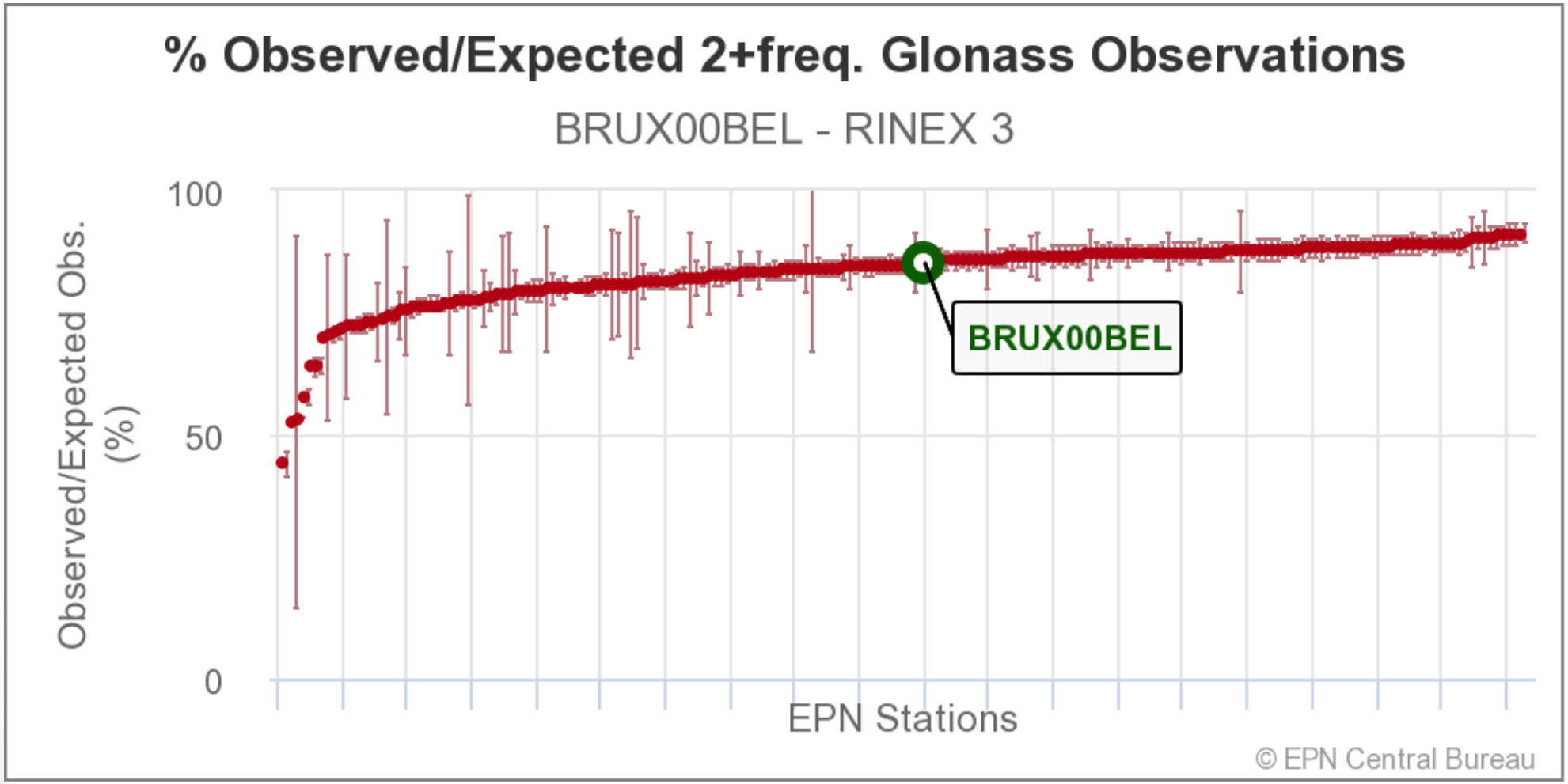
GLONASS Tracking : RINEX 2



GLO L2 tracking problems
NPAZ00SRB (21%) – TRIMBLE NETR9 (firmware Nav 5.22)/TRM115000.00 TZGD
IENG00ITA (0%) – SEPT POLAR4XTR (firmware 2.9.2)/ASH701945C_M NONE

ROYAL OBSERVATORY OF BELGIUM

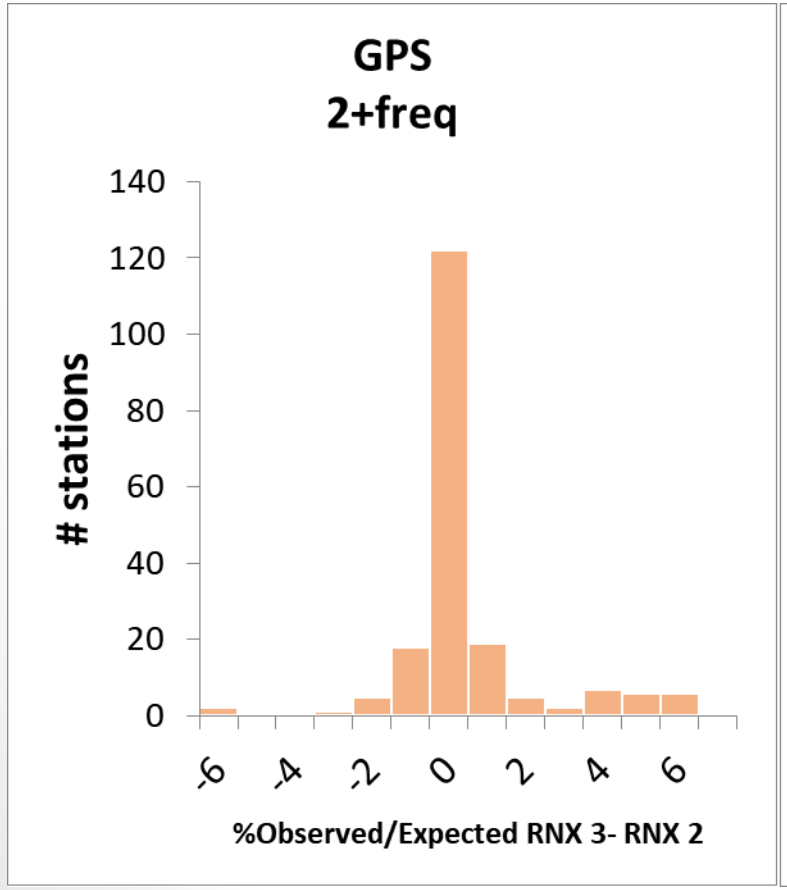
GLONASS Tracking: RINEX 3

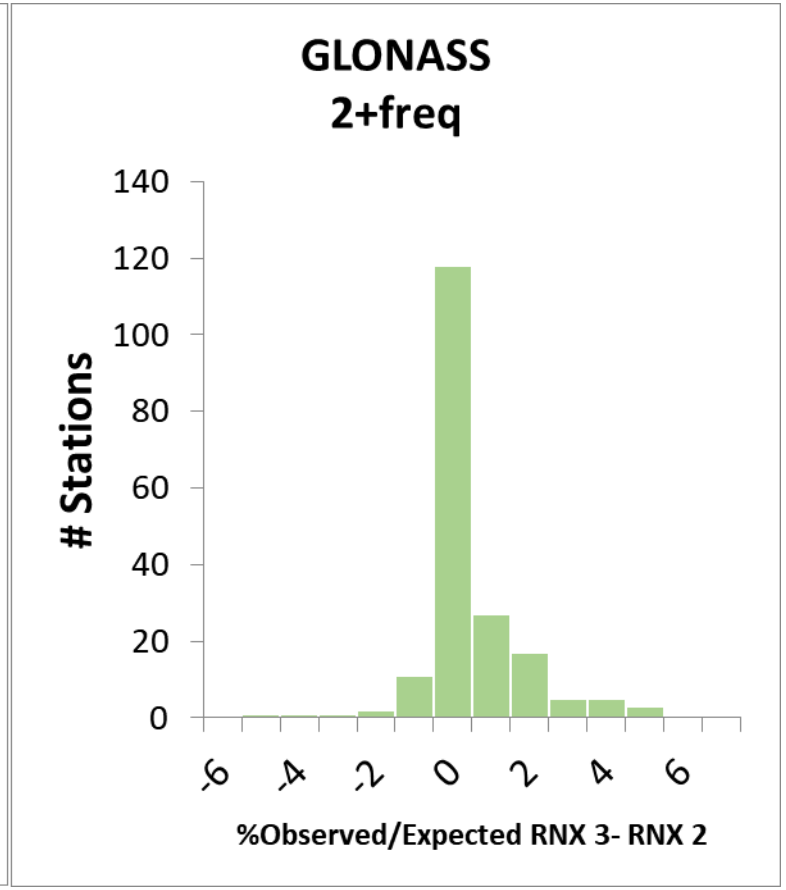


ROYAL OBSERVATORY OF BELGIUM

Larger Number of GPS/GLO obs. in RINEX 3?

Comparison of % obs./expected dual+ freq. from RINEX 2 with RINEX 3





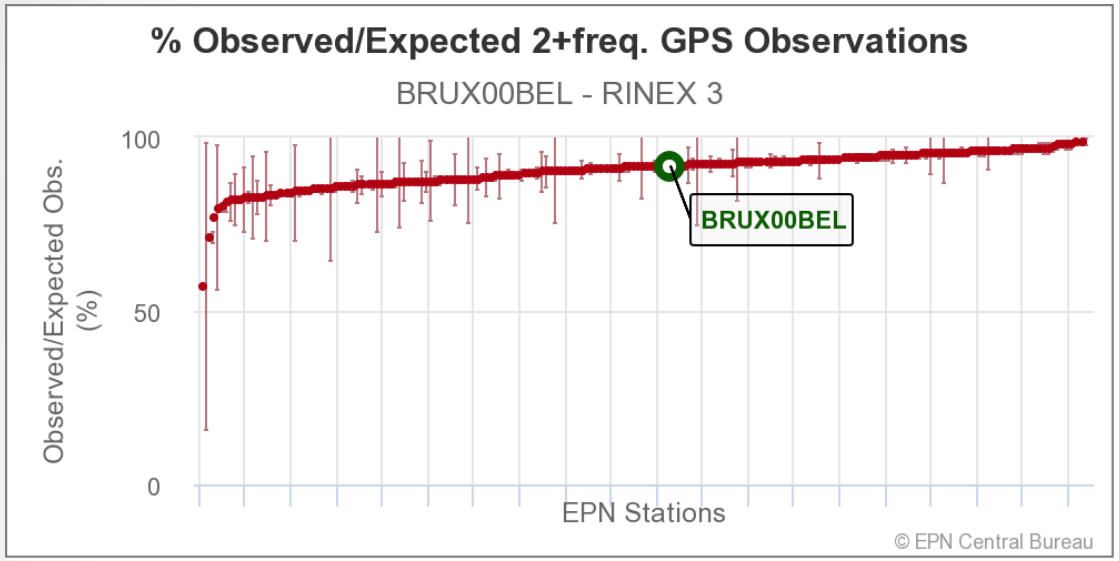
Mostly affected receivers for :

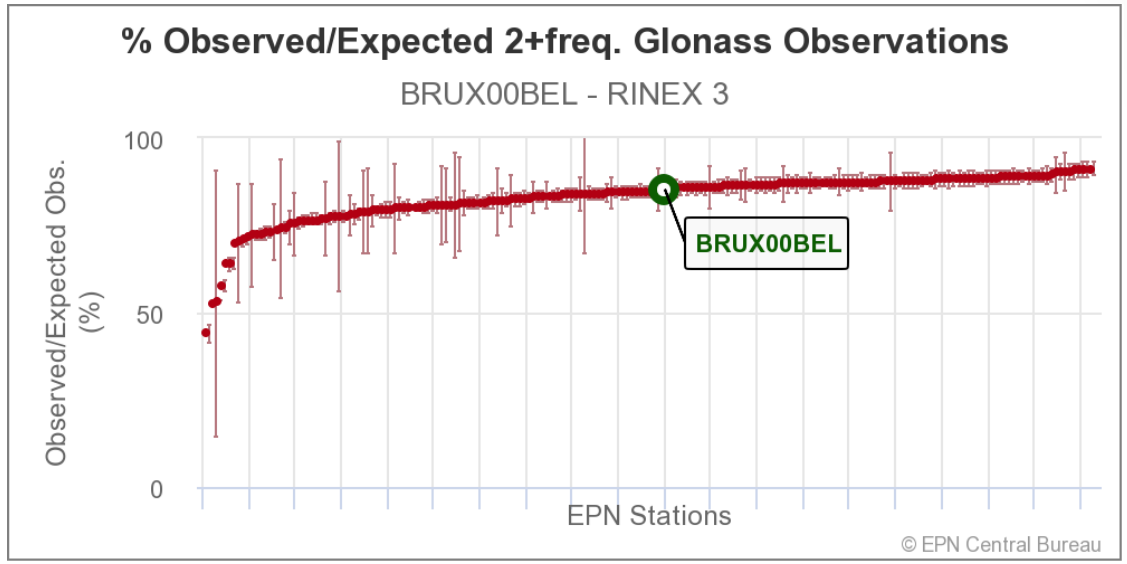
JAVAD TRE_G3TH DELTA (3.6.7)

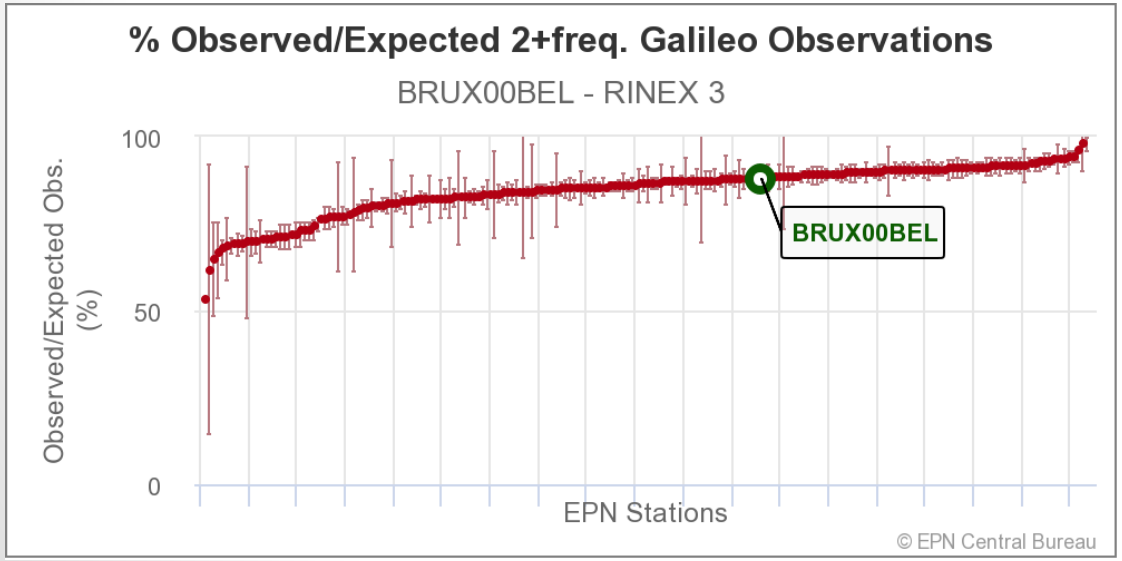
TRIMBLE NETR9 (5,22)

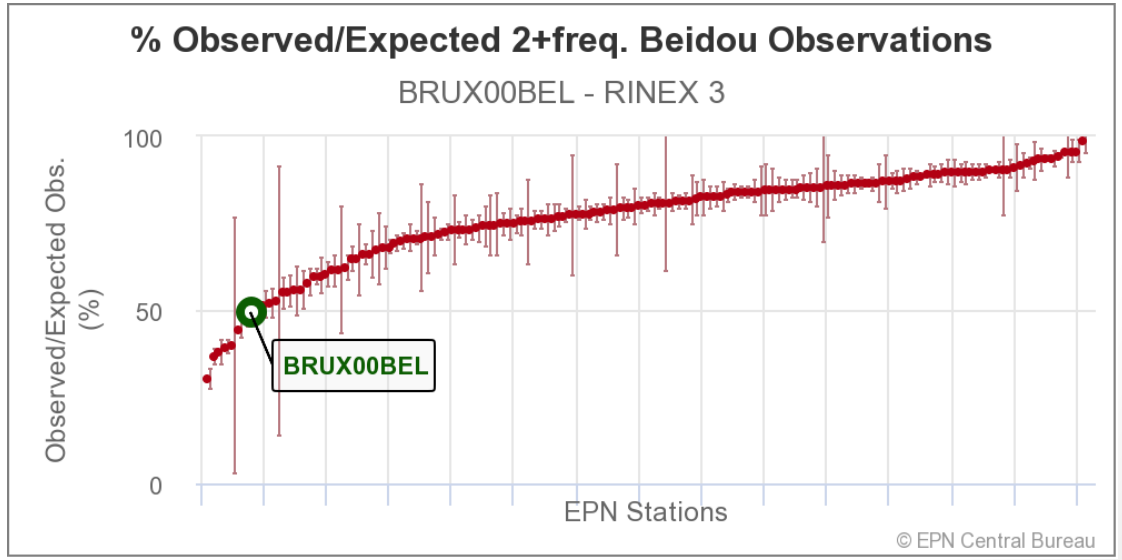
JAVAD TRE_3 DELTA (3.7.3 Feb,02,2018)

Beidou Tracking Problems









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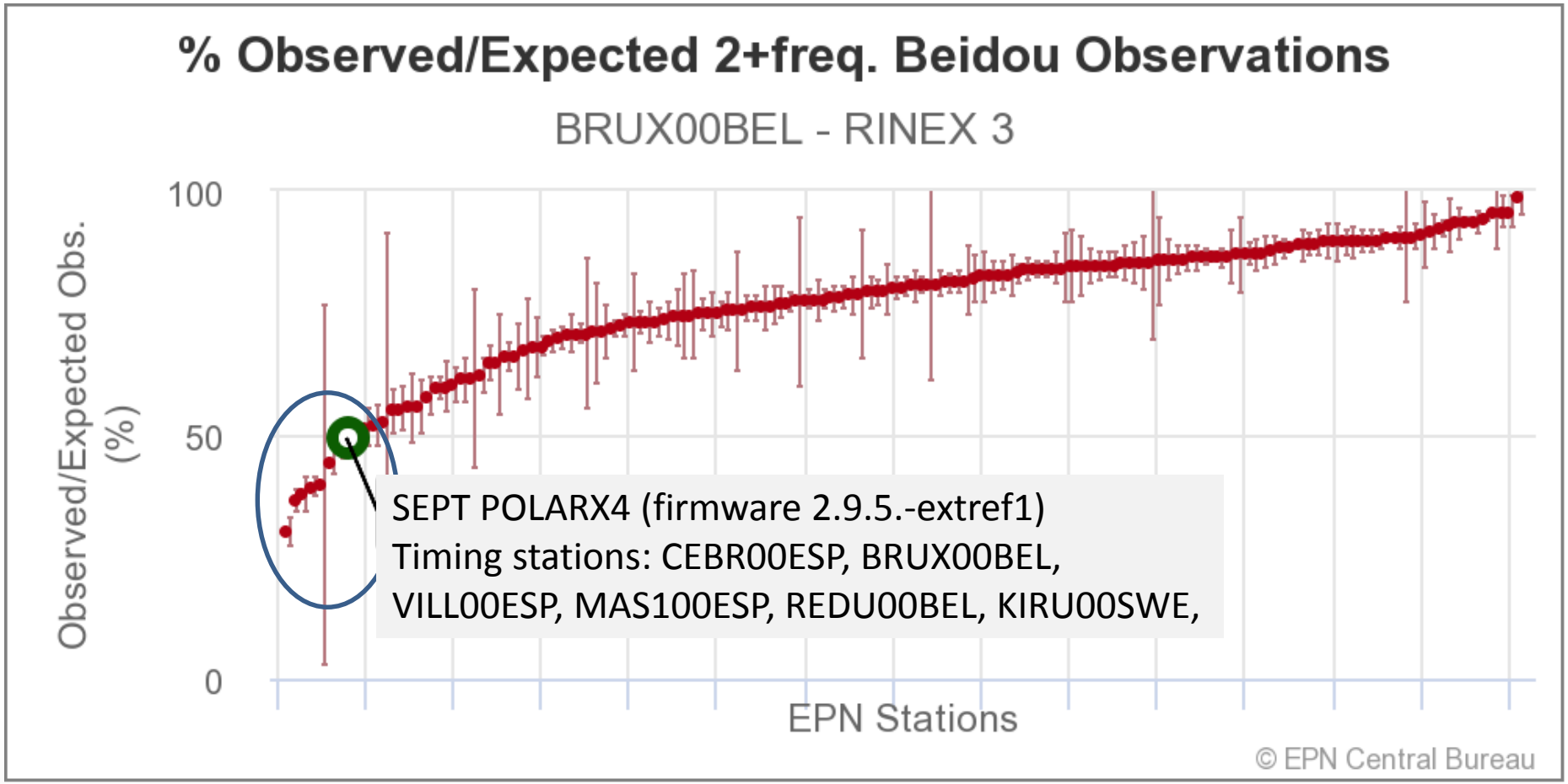
Beidou Tracking Problems



ROYAL OBSERVATORY OF BELGIUM

Lessons Learned from Data Quality Checks

- For analysists:
  - Use RINEX 3 when available, even if only processing GPS+GLO
- For station managers:
  - Keep receiver firmware up to date
  - Submit RINEX 2 and RINEX 3(.03)
  - Prioritize satellite systems tracked
    - In EPN: GPS+GLO+GAL
  - Check the EPN CB plots

New Site Log Submission System

ROYAL OBSERVATORY OF BELGIUM

EUREF Permanent GNSS Network

HOME | ORGANISATION | NETWORK & DATA | PRODUCTS & SERVICES | DOCUMENTATION | NEWS, EVENTS & LINKS

STATUS
- Network Status
- Station List
- Maps
- Tracked Frequencies
- Data Quality

DATA ACCESS
- Introduction
- Daily & Hourly
- Real Time
- Highrate

TOOLS
- Station Log Submission
- Station Picture Submission

FUTURE
- EPN CB
- M3G (only migrated OC) NEW

- a network of continuously operating GNSS (Global Navigation Satellite Systems, such as GPS, GLONASS, Galileo, Beidou, ...) reference stations,
- data centres providing access to the station data,
- analysis centres that routinely analyze the GNSS data,
- product centres or coordinators that generate the EPN products,
- and a Central Bureau that is responsible for the daily monitoring and management of the EPN.

The network is operated under the umbrella of the IAG

Next Meetings

2018-05-30 / 2018-06-01 :
EUREF 2018 Symposium (Amsterdam, Netherlands)

2018-06-03 / 2018-06-08 :

New Site Log Submission System

ROYAL OBSERVATORY OF BELGIUM

ROYAL OBSERVATORY OF BELGIUM

EUREF Permanent GN
Network

HOME | ORGANISATION | NETWORK & DATA | PRODUCTS & SERVICES | DOCUMENTAT

Home / Network & Data / Tools / Station Log Submission

Station Log Submission

This on-line station log submission allows to:

- Create a new station log conform the IGS/EPN station log format
- Upload, update, validate and save a station log on your local disk
- Upload, validate and save a station log in the EPN data base (only for EPN operational centres (OC) and for stations listed in their OC form)

Frequently ask
Javascript has

LOGIN

Operational centre : (select an OC)

Password:

Request (or forgot ?) password

Security code:

Submit

NOT REGI

General us

Use the gu
account ha
to the EPN

EPN statio

Request y
Operationa
button "Re
email to al

M3G gnss-metadata.eu

Metadata Management and distribution system for Multiple GNSS Networks

Login as Operational Center

- Home
- Registered agencies/stations
- Data Centers
- Guidelines
- Application version
- Login

LOGIN AS OPERATIONAL CENTER

Login ID

Password

Remember Me

Reset Password | Login | Reset

This project has received funding from the European Union's Horizon 2020 research and innovation programm under grant agreement N° 676564.

ROYAL OBSERVATORY OF BELGIUM

euref

EPOS EUROPEANPLATEOBSERVINGSYSTEM

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New Site Log Submission System

Ready for GeodesyML, EPN and EPOS

Switch: each Operational Centre will be contacted individually (EPN and EPN Densification)

Status: 30% of EPN and EPN densification OC have been migrated to new system

ROYAL OBSERVATORY OF BELGIUM

GDPR - General Data Protection Regulation

May 25, 2018

- Minimum standards for processing personal data from EU citizens
- Personal data : name of a person, email, telephone number, …, location, IP address, cookie data,...

- ROB (EPN CB) processes (stores, uses, distribute) personal data from responsible persons of GNSS stations, operational centers, data centers, analysis centers, …
- Done in the frame of service of public interest of even “contract” in the broad sense
- No need to ask individual consent to store and use personal data

- Update privacy statement to clearly explain what we do with these personal data, how long we keep them
- Provide mechanisms to edit/remove the personal data
- Presently: all personal data are publicly available. In case you do not agree, email epncb@oma.be, but personal email will be sent to data centers and analysis centers.
- Within M3G: explicit consent will be asked to publicly publish personal data.

Thank you

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