

## GFZRNX-QC

### Advanced GNSS Data Processing and Quality Control for Multi-System Observations

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#### Introduction

GFZRNX-QC software is designed to streamline the processing of Receiver Independent Exchange Format (RINEX) observations and the generation of overall information by providing a robust and efficient solution for data cleaning and quality control. With a focus on multiple Global Navigation Satellite System (multi-GNSS) observations, GFZRNX-QC offers a comprehensive approach to ensuring data accuracy and reliability. GFZRNX-QC can allow users to efficiently manage and analyze data from various GNSS receivers, especially for low-cost GNSS receivers. The software incorporates advanced algorithms for data cleaning, helping users to eliminate inconsistencies and enhance the overall quality of GNSS observations. GFZRNX-QC conducts comprehensive quality control assessments on GNSS observations. This ensures that the processed data meets the highest standards of accuracy. The software generates detailed statistical results, offering insights into the performance and reliability of observations across the five major GNSS systems. This information aids researchers and analysts in making informed decisions.

#### Processing Mode

For easement of configuration, we simplified the command line for converting broadcast ephemeris files to the IGS standard SP3 products and then carrying out the quality control for multi-GNSS observations. Herein, the generated SP3 products should be used as input for the subsequent quality control.

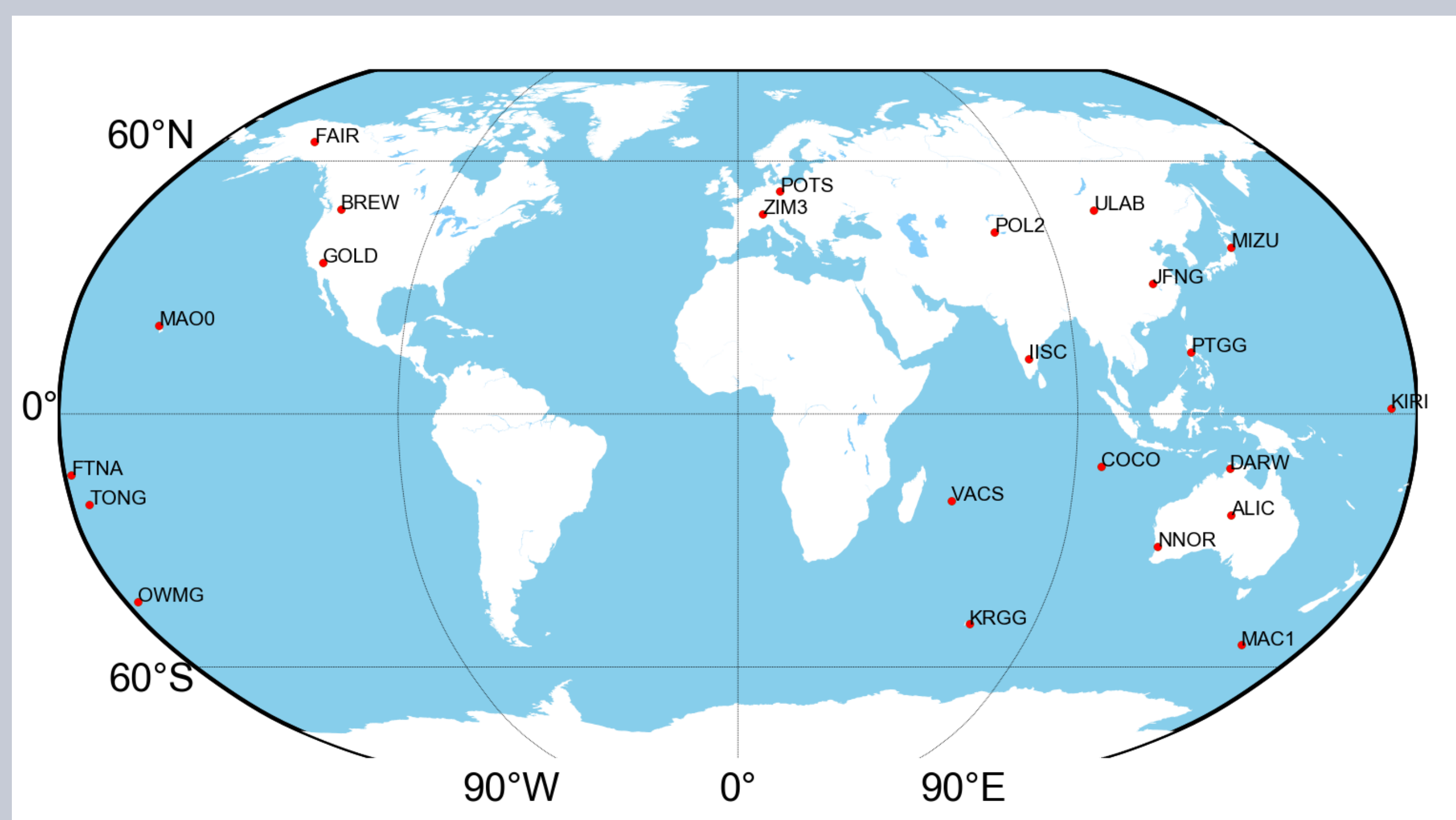
#### Mode – Orbit SP3

```
GFZRNX-QC -do_nav
-fnav ./BRDC_NAV.rnx
-fnav_chk ./BRDC_NAV.rnx_check
-fsp3 ./BRDC_ORB.sp3
-fclk ./BRDC.clk
-sp3_step 300
-tim_ctrl 59580 0 59580 79200
-satsys GRECJ
```

#### Mode – Quality Control

```
GFZRNX-QC -do_qc
-fsp3 ./BRDC_ORB.sp3
-fobs ./FILE_OBS.rnx
-fobs_sel ./obs_types_select.conf
-num_epo_spp 2640
-coor_spp
-tim_ctrl 59580 0 59580 79200
-l_check_pc -stacoord 0.0 0.0 0.0
-finter output_file_name
```

**Fig.1** Usage examples of GFZRNX-QC software to create summary files for broadcast navigation information and quality control of multi-GNSS observations.

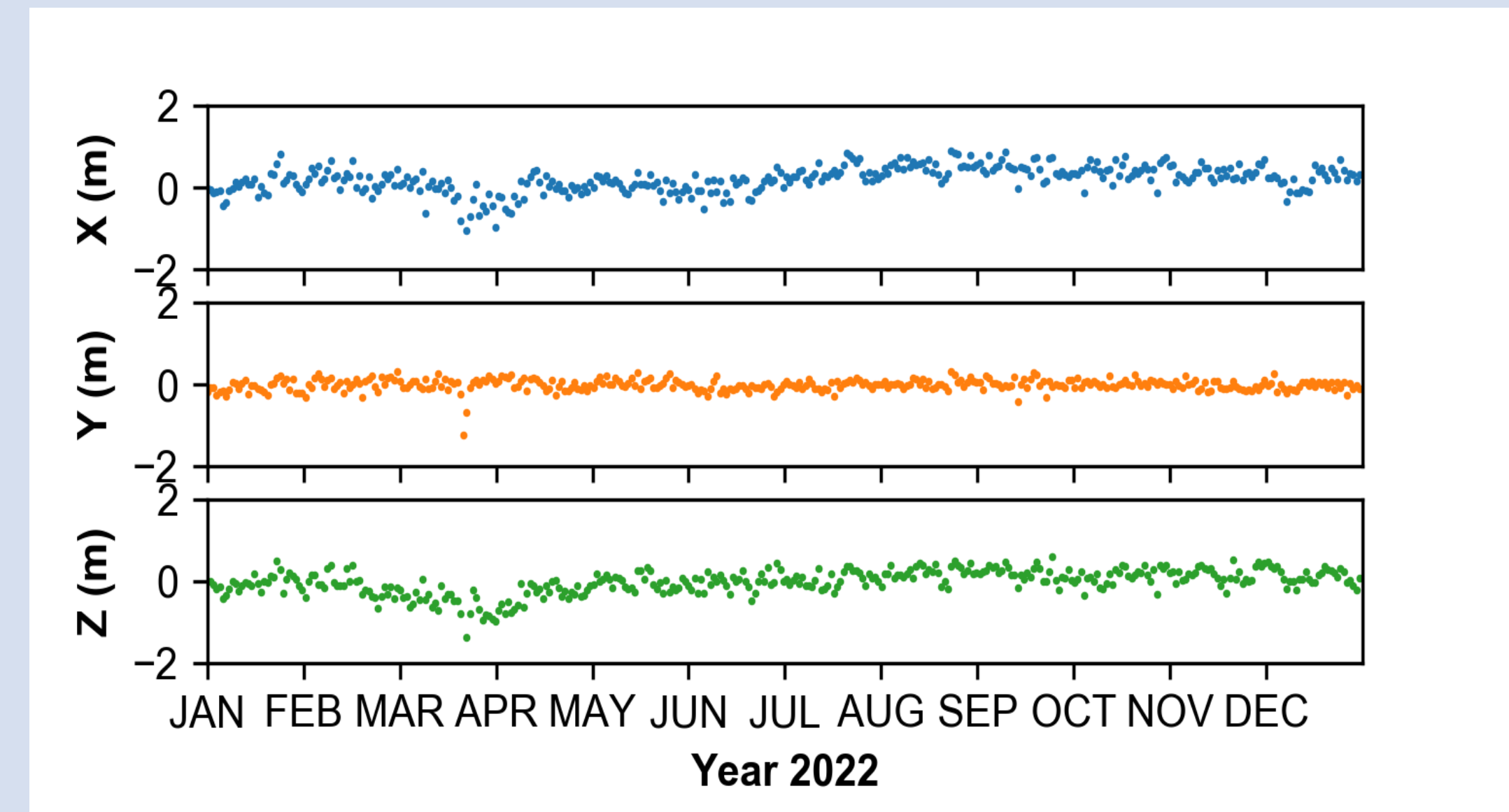


**Fig. 2** Global distribution of tracking stations selected for a long-term test of GFZRNX-QC software.

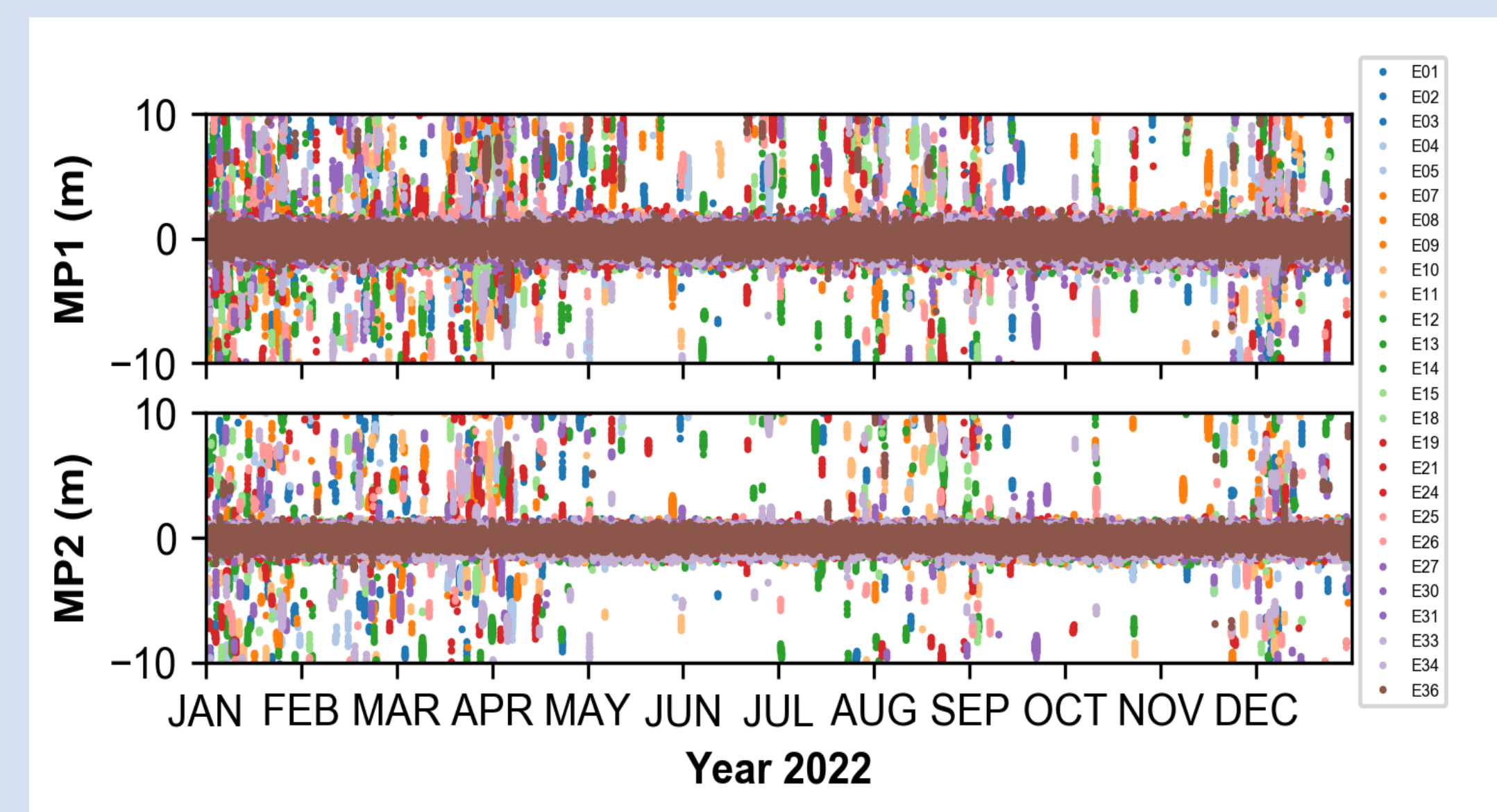
#### Long-term Test of Quality Control

By combining efficient data processing, advanced cleaning algorithms, and extensive quality control measures, GFZRNX-QC serves as a valuable tool for researchers, geodesists, and GNSS professionals seeking reliable and accurate observations and overall information from multiple satellite systems. Multi-year analysis results of globally distributed GFZ stations contributing to the International GNSS Service (IGS) network will be presented. As shown in Fig.2, 24 globally distributed IGS/MGEX ground stations are selected for a long-term test of quality control for multi-GNSS observations.

Taking IGS station POTS as a typical example, Fig. 3 and Fig.4 show the single point positioning (SPP) results and multi-path effects on Galileo observations over one year 2022, respectively. Additionally, the cycle slip detection is carried out by GFZRNX-QC. Fig.5 shows the total number of cycle slip for the five multi-GNSS constellations (GPS/GLONASS/Galileo/BDS/QZSS) over the year 2022. Currently, the long-term robustness of quality control by GFZRNX-QC can be almost guaranteed, as shown in the time series of preliminary results.

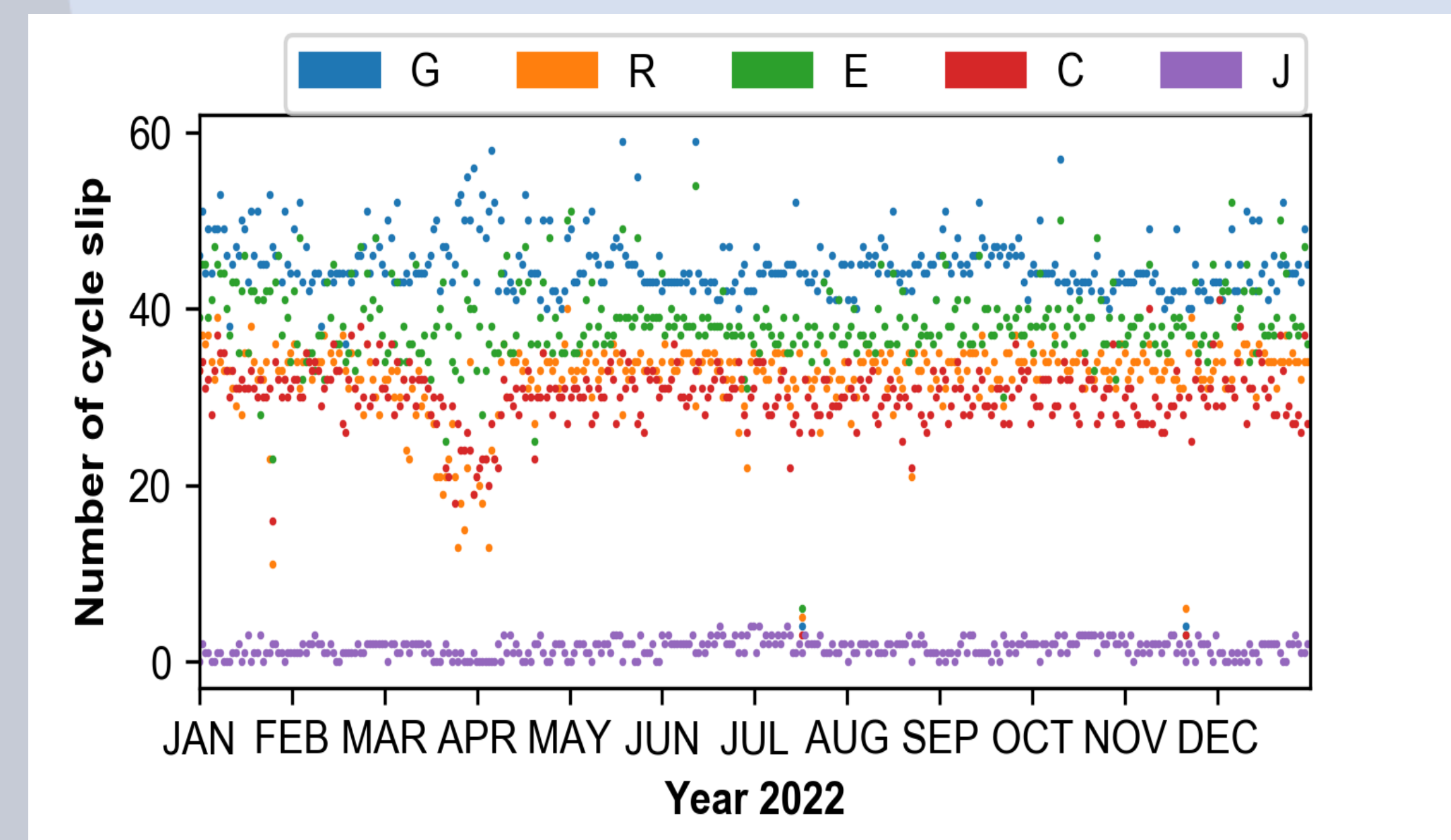


**Fig. 3** Time series of coordinates derived from SPP at POTS Station.

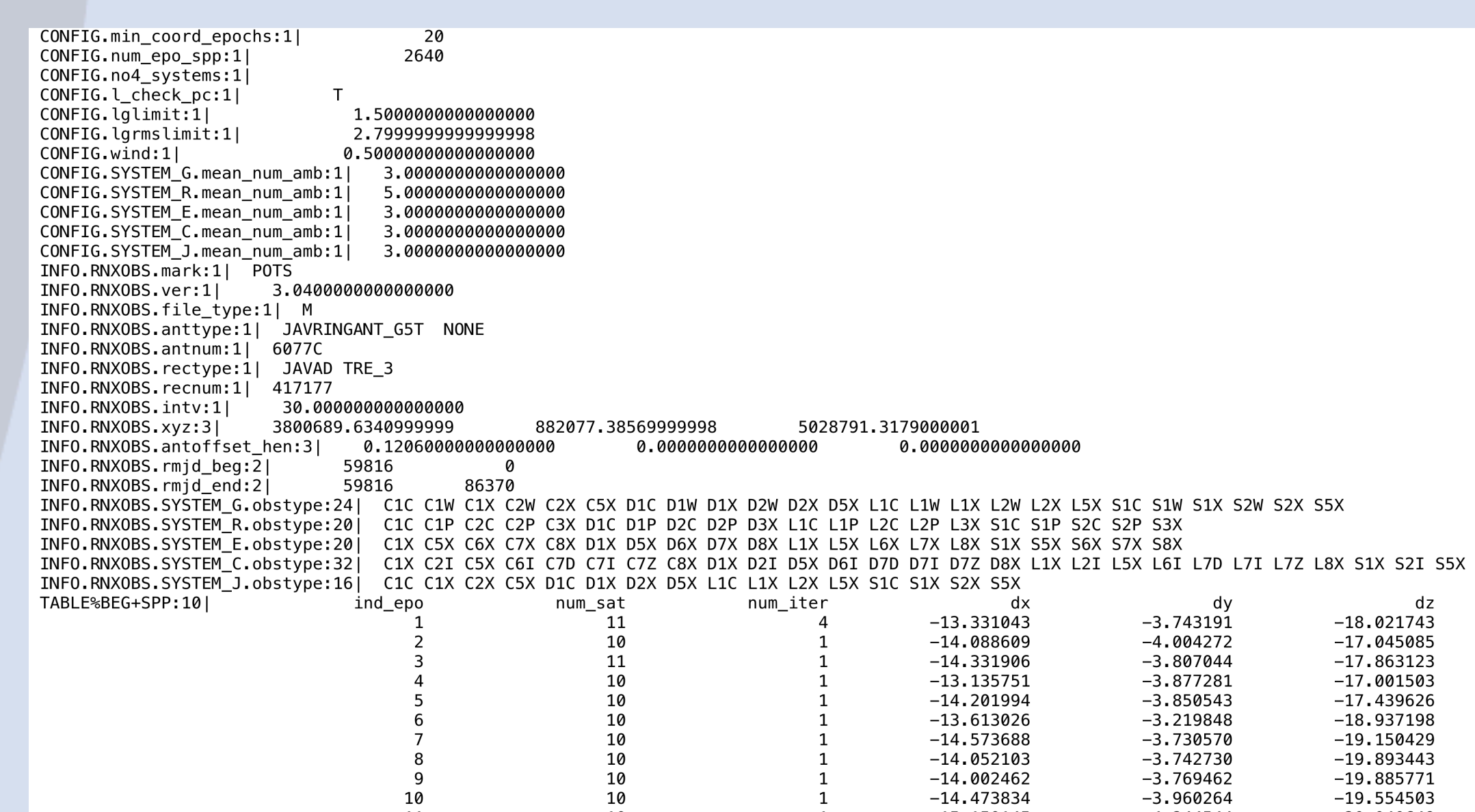


**Fig. 4** Multi-path effects on Galileo observations at POTS Station.

Summary results for quality control will be written as GFZRNX-QC internal format so that users can flexibly convert it to any format they are interested in. The GFZRNX-QC internal format of the summary output is shown in Fig.6.



**Fig. 5** Number of cycle slips for multi-GNSS constellations.



**Fig. 6** GFZRNX-QC internal format of the summary output file.

*Note: You can find the upcoming documentations by scanning QR code.*

