Availability and Completeness of IGS Tracking Data

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Motivation

Timely availability and completeness of consistent Global Navigation Satellite System (GNSS) tracking data is a basic condition for the generation of best possible analysis products. The steadily increasing number of observation types is monitored for each individual station (and each relevant GNSS). Particular problems and anomalies concerning International GNSS Service (IGS) observation files are highlighted.

Database

For the data processing (and monitoring) at the Center for Orbit Determination in Europe (CODE), near real-time (hourly) and daily observation files are downloaded from IGS, EUREF and other data sources. This includes RINEX-2 and RINEX-3 files from more than 440 stations. Some basic meta information are automatically extracted and stored in XML files for a quick access. Based on these files CODE creates statistics of the downloaded RINEX files and makes them available at:

ftp://ftp.aiub.unibe.ch/igsdata/rnxdata.sum
ftp://ftp.aiub.unibe.ch/igsdata/rnxdata_more.sum
ftp://ftp.aiub.unibe.ch/igsdata/rx3data_more.sum

Availability of daily files

Looking at the 120-day period from March to June 2017, most of the stations have a complete set of daily RINEX-2 files, i.e., about 350 out of 415 stations submitting RINEX-2 data have a completeness of 95 % and more during the whole period. The RINEX-3 datapool is steadily building up with more than half of the sites already delivering RINEX-3 data files. Within the mentioned 120-day period, we have on average 230 RINEX-3 files per day in our datapool. About 175 of them have a completeness of 95 % and more over the 120-day period.

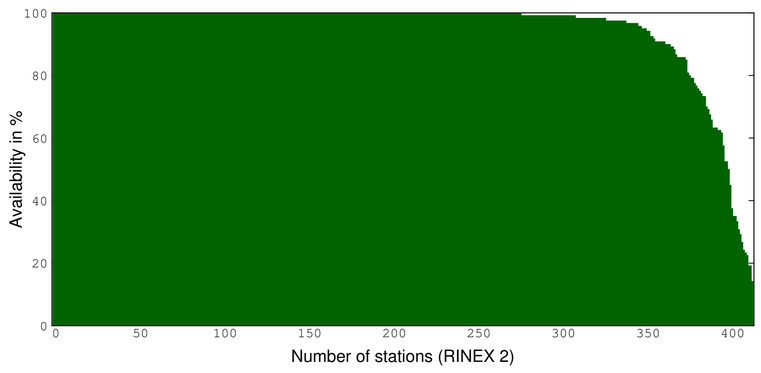

Figure 1: Looking at a 120-day period, most of the stations have uninterrupted time series of daily RINEX-2 observation files.

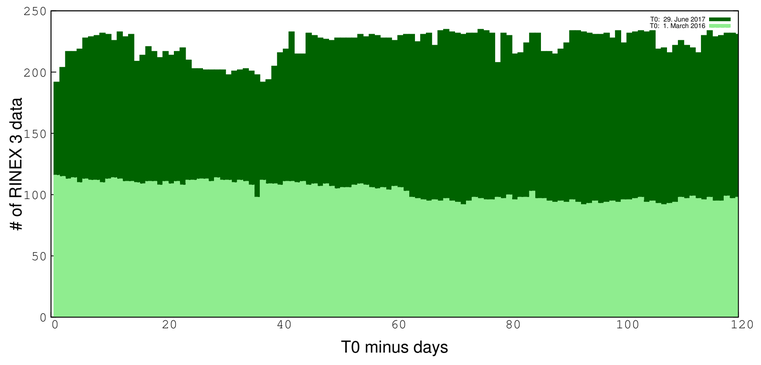

Figure 2: The majority of the RINEX-3 observation files is available with a relatively short latency. However, when assuming a RAPID processing scheme about 30-40 daily RINEX-3 files might not be available in time. The overall number of daily RINEX-3 files has more than doubled since early 2016.

RINEX versions used at CODE

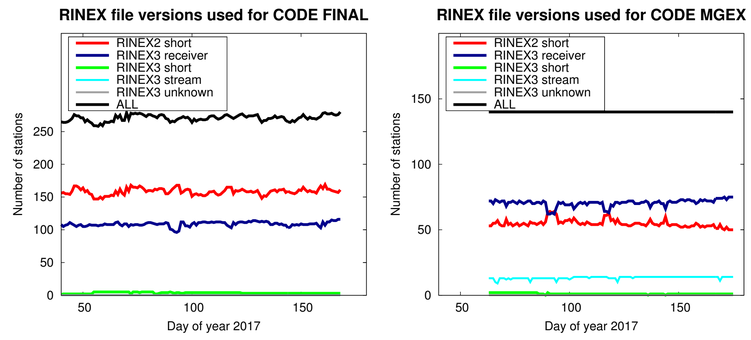

Figure 5: Total number and versions of RINEX observation files as used in the CODE FINAL and MGEX solutions.

Summary and conclusions

Systematic quality control for GNSS tracking data is indispensable to ensure best possible analysis products. Supported by the XML-based meta-data monitoring of our datapool we may conclude that:

- The RINEX-3 data base is progressing w.r.t. the number and completeness of daily files.
- Some RINEX-3 files are delivered with a significant latency.
- Few RINEX-3 files contain data of "zombie" satellites (with undefined PRNs).
- RINEX-3 files contribute to the CODE FINAL since 2017.
- There are still anomalies w.r.t. GLONASS frequency channels.

Frequent receiver firmware updates may contribute to ensuring quality and completeness of RINEX data.

Number of tracked satellites for each IGS station providing RINEX 3

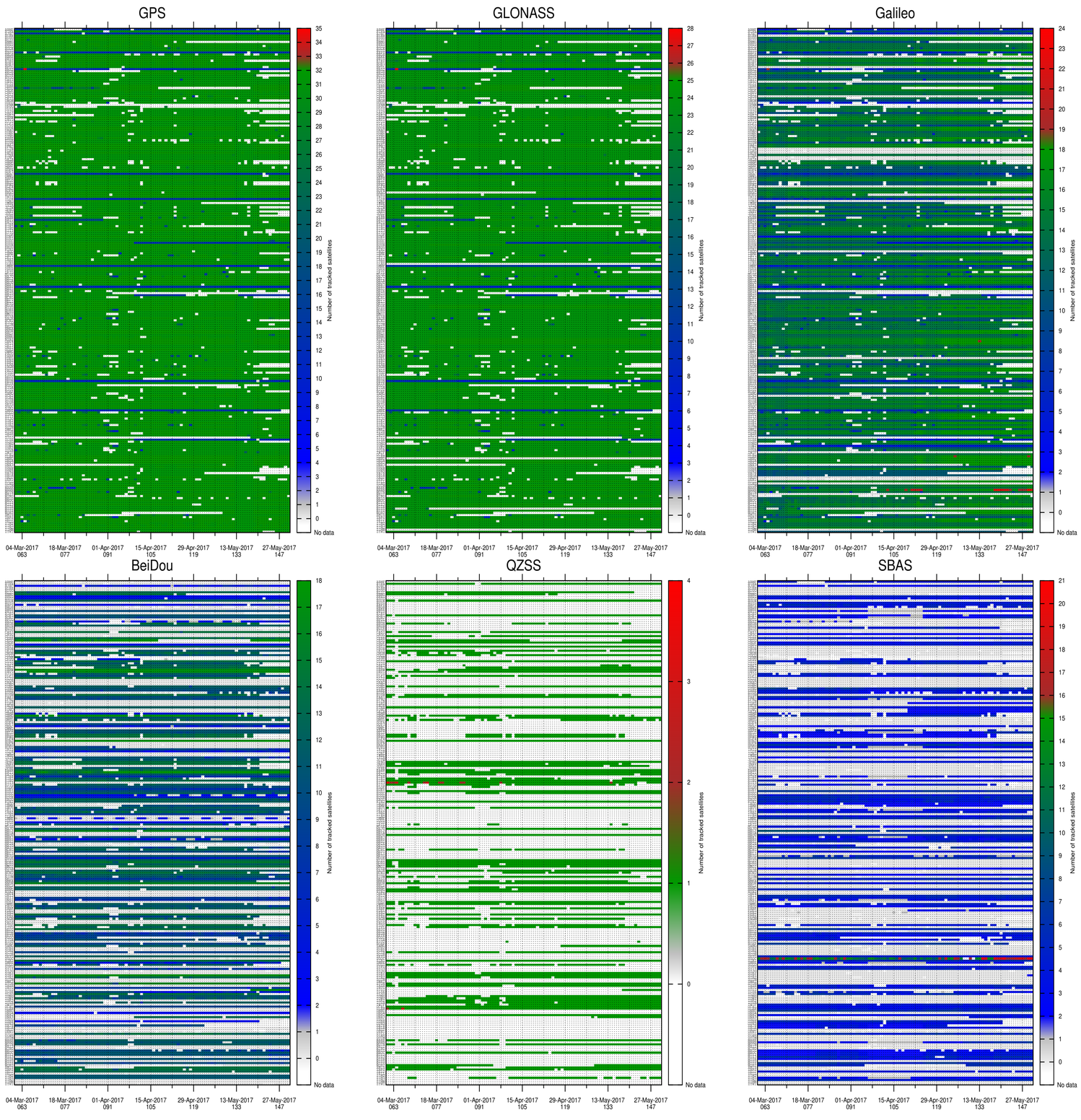

Figure 3: Number of tracked satellites for IGS stations, extracted from the internally established XML meta-database for RINEX-3 data files. Note that few stations report tracking data w.r.t. non-existent satellites. Therefore the maximum number of satellites in the legends may exceed the actual number of active satellites (indicated in red).

Verification of GLONASS frequency channel numbers

GLONASS frequency channel numbers are verified regularly for all tracking data collected at CODE. A data screening procedure is performed in a dedicated mode going through the complete range of possible GLONASS frequency numbers. It is assumed that the frequency number with the biggest number of valid observations (after the screening procedure) has been used by the receiver. Each thus obtained number is then compared to the default/reference frequency number (as defined in our satellite information file and given by the broadcasted frequency number). By this verification procedure, common switches in the GLONASS frequency channel numbers and also anomalies with respect to particular tracking stations (and receiver types) may be detected with short latency.

Figure 4 reveals three striking events: the GLONASS constellation change for R18 (from #801 to #743) on 22-Feb-2013. A specific receiver group (mostly JAVAD) continued collecting data from the previous SV #801 (see IGS Mail #6734). The second "line" corresponds to a constellation change (for R18) on 11-Apr-2014, where 3 receivers continued to record data with the old frequency channel number, namely SVTL (JAVAD TRE_G3TH DELTA) as well as HERS and BJNM (both SEPT POLARX3ETR). The problem was finally solved by a receiver reset (requested from our side). The third "line" corresponds to a constellation switch concerning R09 (from #736 to #802) and R17 (from #802 to #714) on 15-Feb-2016. We detected another anomaly regarding the satellites R17 and R27 on 27-Jan-2016 (IGSMAIL #7240).

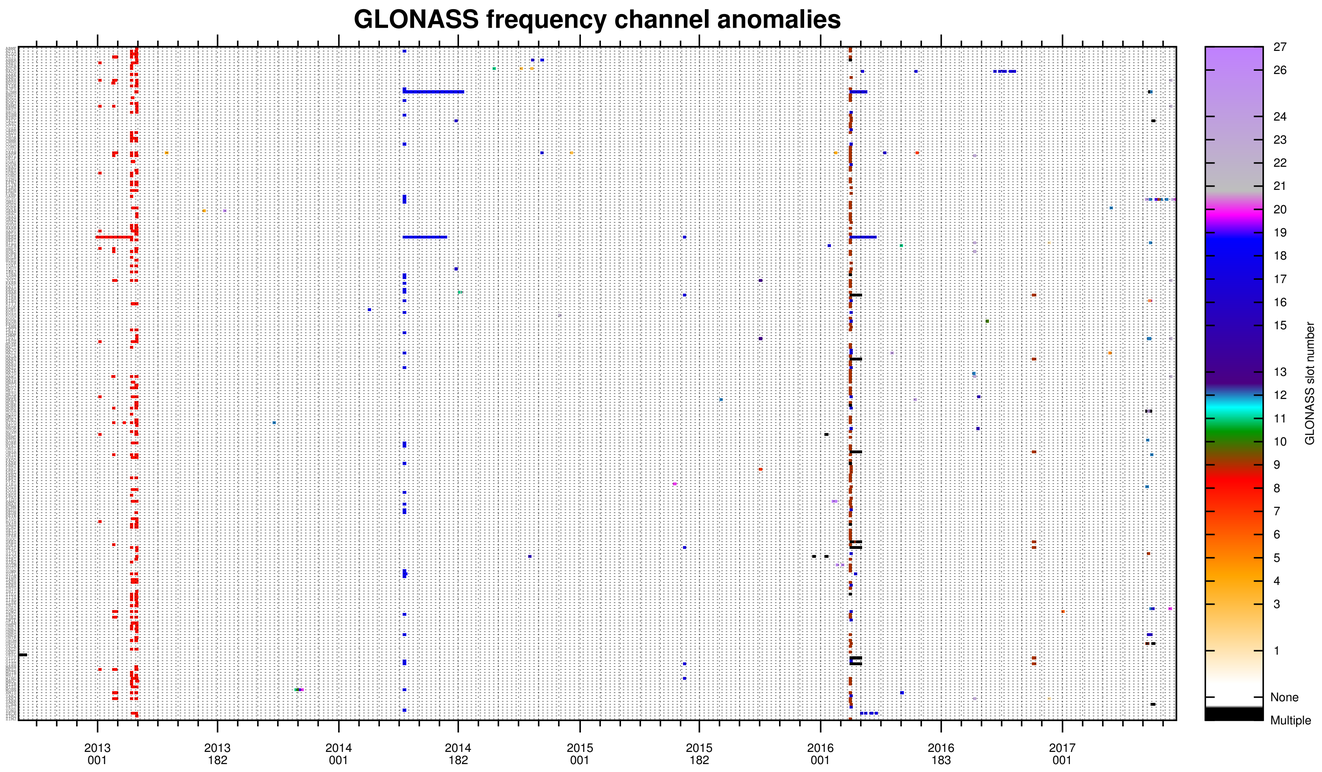

Figure 4: IGS stations with GLONASS frequency channel anomalies (out of 243 stations tracking the GLONASS constellation).

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