Availability and Completeness of IGS Tracking Data

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Motivation

- **GNSS observations are the basis for our activities/products.**
- **Timely availability of consistent GNSS tracking data is essential for the generation of best possible analysis products.**
- **The handling of the increasing number of observation types for each GNSS to be considered becomes a big challenge.**
- **Anomalies in the observation data should be recognized as soon as possible.**

Based on IGS(+) RINEX file monitoring summaries, regularly generated and posted to the anonymous ftp server of AIUB, achievements and the current status regarding availability, inconsistencies, and anomalies are presented.

New monitoring protocol files

CODE has developed a new RINEX file monitoring procedure.

Our refined protocol files include:

- **GPS, GLONASS, Galileo, SBAS, Compass, QZSS**
- **Generally all numbers from 01 until 99 for all GNSS (R24+ GLONASS, G37?, "zombies")**
- **Observation and navigation files (types o, n, g, l, q)**
- **Statistics for RINEX-2 (up to 2.12) and RINEX-3 files**
- **Single-phase satellite tracking is indicated**
- **Information regarding satellite status can be extracted**

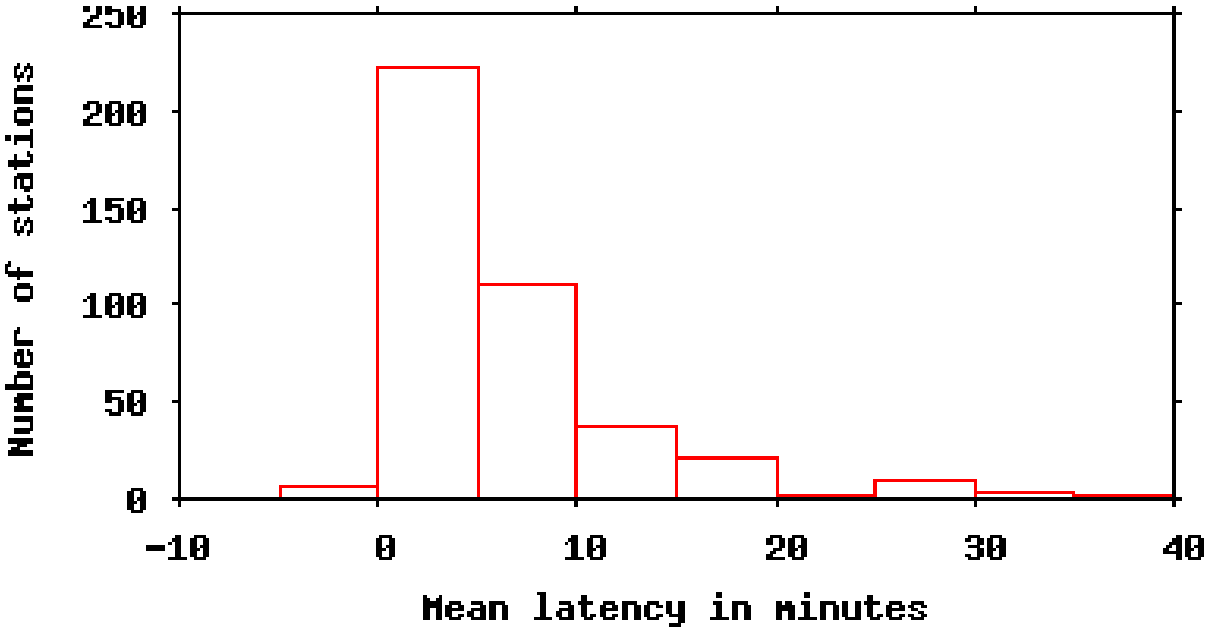
New protocol files are available at:
ftp://ftp.unibe.ch/aiub/igsdata/y<year>/<type>data2_d<day>.txt
ftp://ftp.unibe.ch/aiub/igsdata/<type>data2_[<satsys>_]{day,receiver}.txt

Database

- **Near-real-time (hourly) and daily observation files for the IGS and EUREF analysis at CODE**
- **RINEX-2 files from more than 380 stations**
- **IGS global, regional and operational data centers as well as other data sources**

Availability

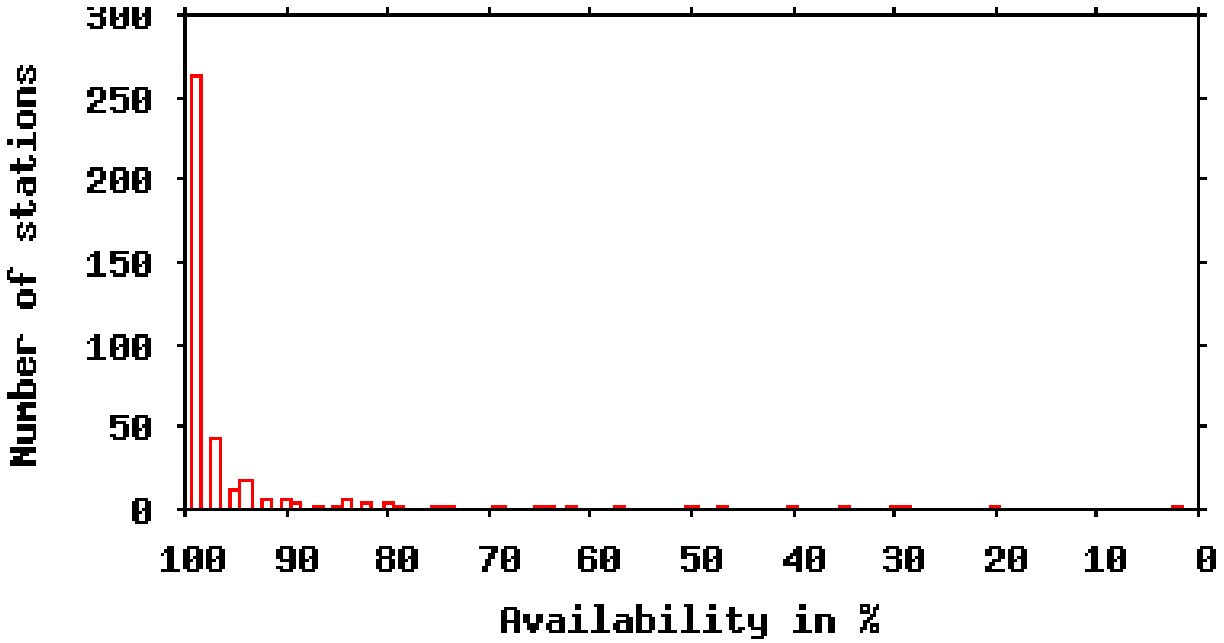
Timely availability of hourly observation files at the data centers looking at all 24 hours in 7 days:



For the hourly file latency in the last seven days, see:
ftp://ftp.unibe.ch/aiub/igsdata/all/<station>_nrtdata.txt

Availability

Looking at a recent 60-day period, many stations have uninterrupted time series of daily RINEX observation files:



For the daily file availability in the last 60 days, see:
ftp://ftp.unibe.ch/aiub/igsdata/rnxdata.sum

Monitoring of all available observation types

IGS(+) stations started to collect observation data for new GNSS signals

Variety of observation types in RINEX-2 files from recent 30 days:

4911	46.07%	G:L1	G:L2	G:C1	G:P1	G:P2	.	.	.
3987	37.41%	G:L1	G:L2	G:C1	.	G:P2	.	.	.
389	3.65%	G:L1	G:L2	G:C1	.	G:P2	.	G:L5	G:C5
386	3.62%	G:L1	G:L2	G:C1	G:P1	G:P2	G:C2	.	.
371	3.48%	G:L1	G:L2	G:C1	.	G:P2	G:C2	.	.
246	2.31%	G:L1	G:L2	G:C1	.	G:P2	G:C2	G:L5	G:C5
181	1.70%	G:L1	G:L2	G:C1	G:P1	G:P2	.	G:L5	G:C5
147	1.38%	G:L1	G:L2	G:C1	G:P1	G:P2	G:C2	G:L5	G:C5
32	0.30%	G:L1	G:L2	.	G:P1	G:P2	.	.	.
9	0.08%	G:L1	.	G:C1	.	.	.	.	.

Based on the new monitoring protocol files available at:
ftp://ftp.unibe.ch/aiub/igsdata/y<year>/odata2_d<day>.txt

Monitoring of all available observation types

IGS(+) stations started to collect observation data for new GNSS signals

Variety of observation types in RINEX-2 files from recent 30 days:

```
3368   54.53%   R:L1 R:L2 R:C1 R:P1 R:P2 .
2374   38.44%   R:L1 R:L2 R:C1 .    R:P2 .
 252    4.08%   R:L1 R:L2 R:C1 R:P1 R:P2 R:C2
  87    1.41%   R:L1 R:L2 R:C1 .    R:P2 R:C2
  57    0.92%   R:L1 .    R:C1 R:P1 .    .
  29    0.47%   R:L1 R:L2 R:C1 .    .    R:C2
   8    0.13%   .    R:L2 R:C1 .    R:P2 .
   1    0.02%   R:L1 R:L2 R:C1 R:P1 .    R:C2
```

Based on the new monitoring protocol files available at:
ftp://ftp.unibe.ch/aiub/igsdata/y<year>/odata2_d<day>.txt

Anomalies concerning phase tracking

Daily RINEX files with missing phase observations:

```
ASPA: TRIMBLE NETR5          4.19                    G01,G25:      L1 .  C1
CEDU: TRIMBLE NETR8          4.41                    G01,G25:      L1 .  C1
CNMR: TRIMBLE NETR5          4.48                    G01,G25:      L1 .  C1
GUUG: TRIMBLE NETR5          4.19                    G01,G25:      L1 .  C1
KARR: TRIMBLE NETR8          4.03                    G01,G25:      L1 .  C1
THTI: TRIMBLE NETR8          4.22                    G01,G25:      L1 .  C1 L5 C5
GRAB: IFEN SX_NSR_RT_800     2.4.0                   G18:          L1 .  C1
UNBN: NOV OEMV3              3.901                   G02,G08,G14:  L1 .  C1

COCO: TRIMBLE NETR8          4.42                    R01-R24:      L1 .  C1 P1
KARR: TRIMBLE NETR8          4.03                    R01-R24:      L1 .  C1 P1

IRKJ: JPS LEGACY             2.6.0 OCT,24,2007 OB    R19:          L1 .  C1
SOFI: LEICA GRX1200GGPRO     7.80/3.019              R01:          L1 .  C1
TERS: TPS ODYSSEY_E          3.4 DEC,12,2009 P2      R20:          L1 .  C1
THU2: JPS LEGACY             2.6.0 OCT,24,2007 OB    R19:          L1 .  C1
```

Daily RINEX files without phase observations at all:

```
POUS: TPS GB-1000            3.5 DEC,24,2010         R02,R06:      .  .
```

Completeness

Daily RINEX files with missing operational GPS satellites:

```
ANTC : TRIMBLE NETRS        1.1-5                       G32
COPO : TRIMBLE NETRS        1.2-0                       G32
IQQE : TRIMBLE NETRS        1.2-0                       G32
KGNI : TRIMBLE NETRS        NP 1.15 / SP 0.00           G32
KSMV : TRIMBLE NETRS        NP 1.15 / SP 0.00           G32
PARC : TRIMBLE NETR8        4.43                        G32
SOLA : TRIMBLE NETRS        1.1-3                       G32
YIBL : TRIMBLE NETRS        1.1-5                       G32
MTKA : ASHTECH Z18          0065      ZT16              G32
BISK : ASHTECH Z18          ZT16 0065                 G03 G32
VACO : ASHTECH Z18          ZT16 0065                 G03 G32
STHL : TPS NET-G3A          3.4P1                 G01
```

Daily RINEX files with missing operational GLONASS satellites:

```
BISK : ASHTECH Z18          ZT16 0065           R02 06 09 10 11 12 13 14 15 16 18 20 22
MTKA : ASHTECH Z18          0065      ZT16      R02 06 09 10 11 12 13 14 15 16 18 22
VACO : ASHTECH Z18          ZT16 0065           R02 06 09 10 11 12 13 14 15 16 18 22
BADG : JAVAD TRE_G3TH DELTA 3.2.7 MAY,16,2011   R04
JOG2 : TPS NETG3            3.4P2               R03 R18 R20
KERG : TRIMBLE NETR9        4.42                R20
POUS : TPS GB-1000          3.5 DEC,24,2010     R18 R22
WUHN : TRIMBLE NETR8        4.17                R12 R16
```

Summary and Conclusions

- **A significant improvement of the availability of hourly and daily RINEX observation files at the data centers has been achieved compared to previous years.**
- **We are confronted with an increasing number of signals, frequencies and satellite systems.**
  This implies new questions for receiver manufacturers, station operators, data centers, and specifically for the analysis centers and the user community.
- **A firmware or hardware upgrade should be considered for any receiver/antenna being unable to provide observation data for (at least) all operational GNSS satellites.**

Further issues

There are several further aspects in the context of IGS tracking data that could not be addressed in this presentation:

- The GPS quarter-cycle problem is still a serious issue...

- Different sets of (code) observable types for GPS and GLONASS have to be expected!

- RINEX-3 (file monitoring summaries including MGEX stations at: ftp://ftp.unibe.ch/aiub/mgex/y<year>/odata2_d<day>.txt)

- Correctness and consistency of RINEX meta data

- Site logs update latency (RINEX from real-time stream)

- ...