Schweizerische Eidgenossenschaft
Confédération suisse
Confederazione Svizzera
Confederaziun svizra

armasuisse
Swiss Federal Office of Topography swisstopo

Multi-GNSS Working group

E. Brockmann, Carine Bruyninx, Alessandro Caporali, Rolf Dach, Jan Douša, Heinz Habrich, Wolfgang Sőhne, Christof Vőlksen

Content

- RINEX3 QC monitoring at swisstopo using updated versions of anubis and bnc (E. Brockmann)
- Anubis features (J. Dousa)
- BNC features (W. Söhne)

Tools in use at swisstopo

- G-Nut/Anubis with several improvements
  - Single frequency data are possible to plot
  - GDOP values per satellite system
  - Complete new config mechanism
  - …
- Bnc
  - Multipath computation for all signals (instead of only MP1 and MP2)
  - Extended information in a txt file
  - …
- Not used: recently published GFZ RINEX3 tool
- Thanks a lot for the support and iterations necessary to further improve the quality monitoring in the last months !

RINEX Monitoring

RINEX 2 (208 CH-EU stations)

http://www.swisstopo.admin.ch/swisstopo/geodesy/pnac/html/en/anubis_monitor_r2.html

sortable tables

ANTENNA
AOAD/M_B
AOAD/M_T
AOAD/M_T
AOAD/M_T
AOAD/M_T
AOAD/M_T
ASH700936A_M
ASH700936A_M
ASH700936A_M
ASH700936A_M
ASH700936C_M
ASH700936C_M
ASH700936D_M

pdf with all plots

RINEX 3 QC (31 stations)

MARKER	RECEIVER		ANTENNA		Vers	In	Epo	G	R	E	C	PDF
AJAC 10077M005	LEICA GR25	3.11	TRM57971.00	NONE	3.02	30	2880	30	24	6	8	ajac_r3.pdf
AUTN 10080M001	LEICA GR25	3.11	TRM57971.00	NONE	3.02	30	2880	30	24	6	8	autn_r3.pdf

http://www.swisstopo.admin.ch/swisstopo/geodesy/pnac/html/en/anubis_monitor_r3.html

Example: ZIM3

- Firmware version 4.85 -> 4.93
- zim3_r3_20150319.pdf

- Positive: Errors/bugs detected with QC and forwarded to Trimble removed

- Negative: Trimbles firmware change also resulted in new features in the binary T02 files -> special teqc version (Lou Estey; not yet downloadable) in use to ensure the RINEX2 data flow.

1) Beidou problem version 4.85 Bugreport June 17, 2014

```
Example for ZIM31650.14D:

     3.02           OBSERVATION DATA    M (MIXED)           RINEX VERSION / TYPE
NetR9 4.85          Receiver Operator   14-JUN-14 00:00:00  PGM / RUN BY / DATE
ZIM3                                                        MARKER NAME
14001M008                                                   MARKER NUMBER
GEODETIC                                                    MARKER TYPE
TRIMBLE NETR9       SWISSTOPO                               OBSERVER / AGENCY
5229K50741          TRIMBLE NETR9       4.85                REC # / TYPE / VERS
60369               TRM59800.00     NONE                    ANT # / TYPE
  4331300.1495   567537.0851  4633133.5110                 APPROX POSITION XYZ
        0.0000        0.0000        0.0000                 ANTENNA: DELTA H/E/N
G   12 C1C L1C S1C C2W L2W S2W C2X L2X S2X C5X L5X S5X     SYS / # / OBS TYPES
S    3 C1C L1C S1C                                         SYS / # / OBS TYPES
R   12 C1C L1C S1C C1P L1P S1P C2C L2C S2C C2P L2P S2P     SYS / # / OBS TYPES
E   12 C1X L1X S1X C5X L5X S5X C7X L7X S7X C8X L8X S8X     SYS / # / OBS TYPES
J   12 C1C L1C S1C C2X L2X S2X C5X L5X S5X C6X L6X S6X     SYS / # / OBS TYPES
C    9 C2I L2I S2I C7I L7I S7I C6I L6I S6I                 SYS / # / OBS TYPES
```

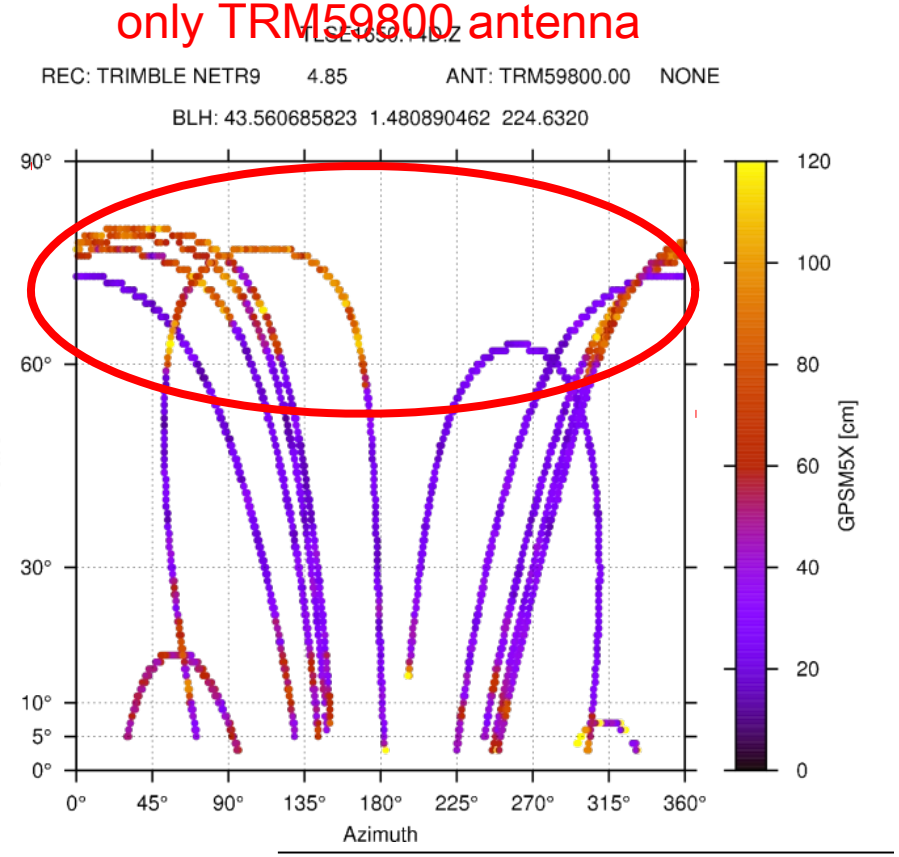
- C2I, L2I, and S2I (3.01) should be renamed to C1I, L1I, and S1I according to 3.02 format
- Repaired in Version 4.93
- Anubis+swisstopo tool no longer need to treat the wrong format

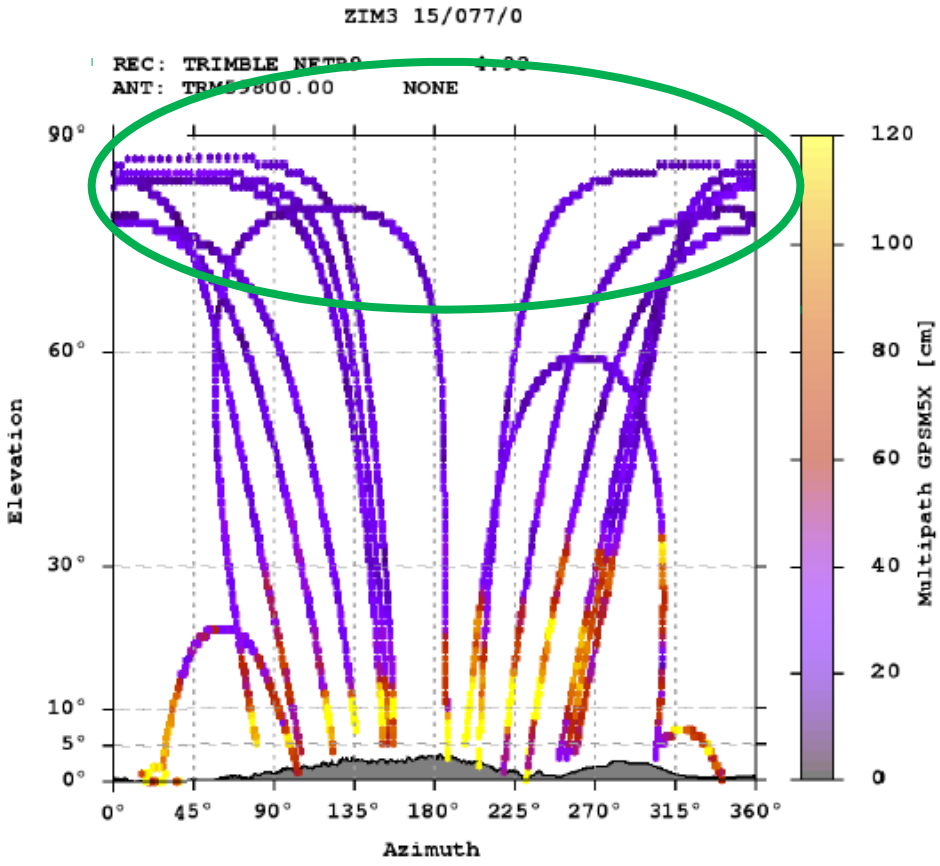
2) MP5 GPS NetR9 and TRM59800.00 antenna + Q-I (X) Tracking: Bugreport June 17, 2014

Repaired in Version 4.93

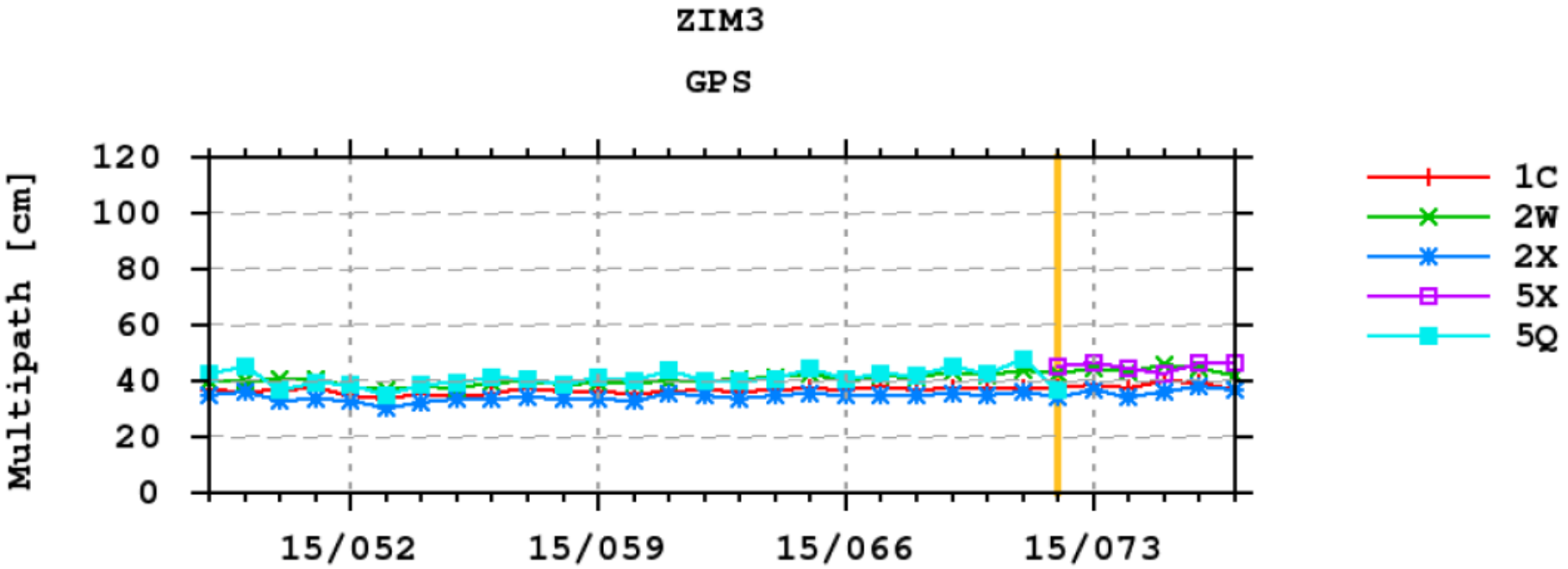
Ok for cephyr antenna

hight noise on high elevations only TRM59800 antenna



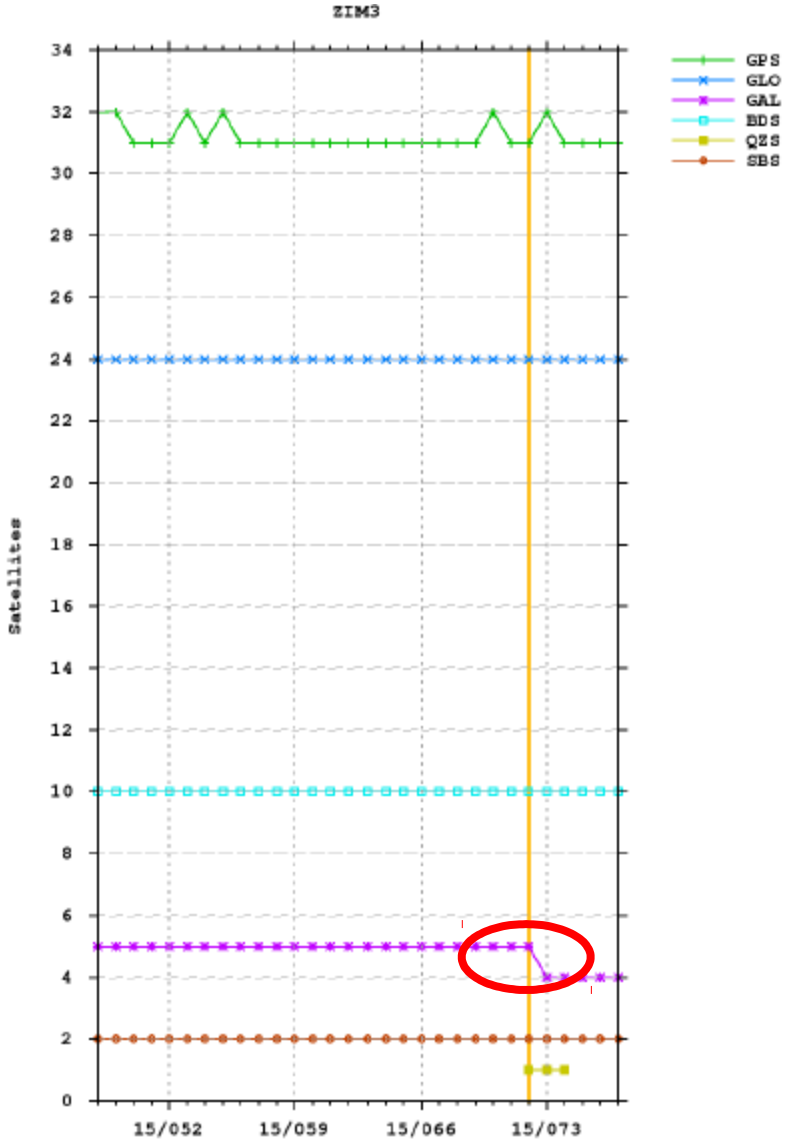


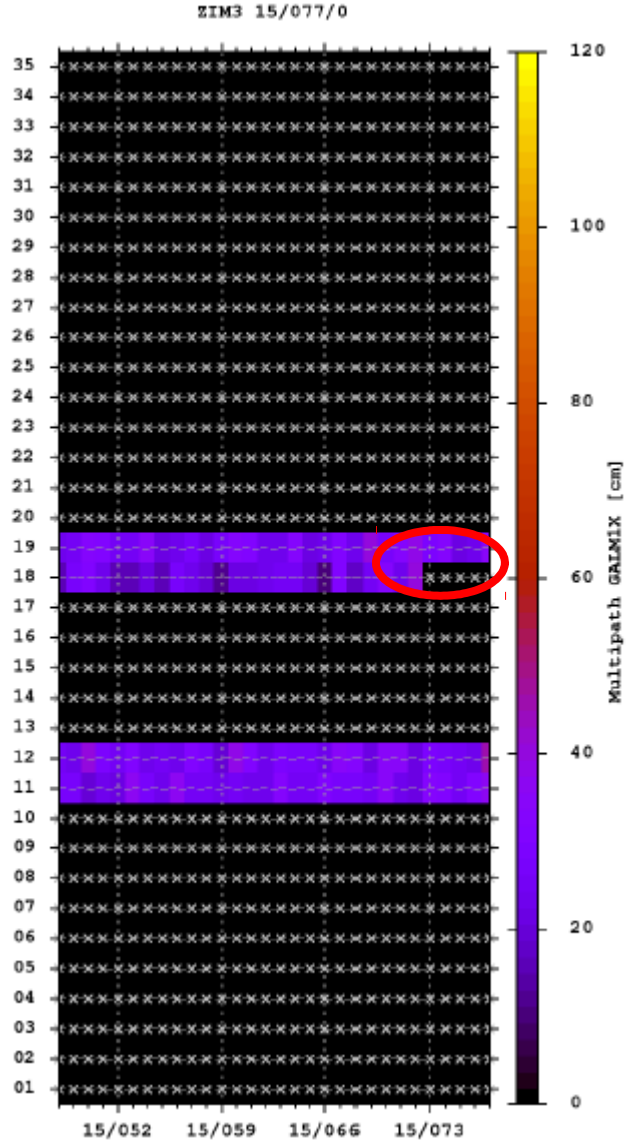
NetR9 V4.93: without increased MP L5 Q -> Q+I (X) tracking



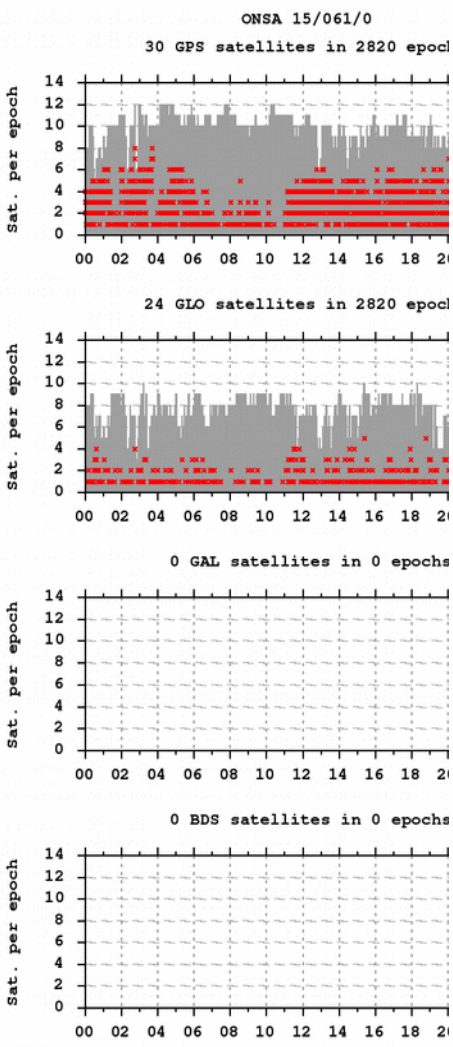
Friday, March 13 2015: Version 4.93

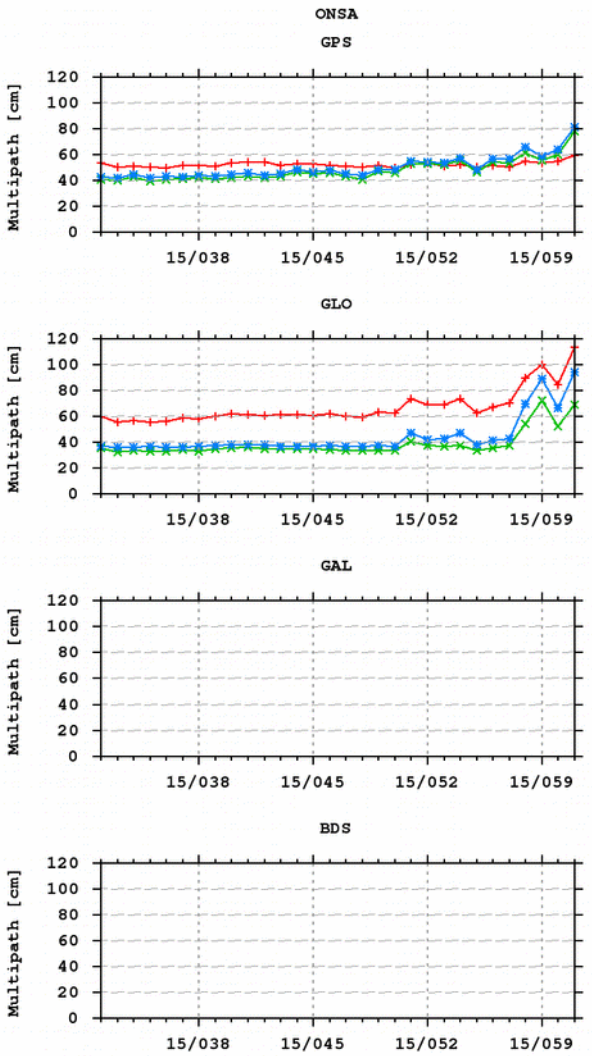
Version 4.93 – no E18 tracking

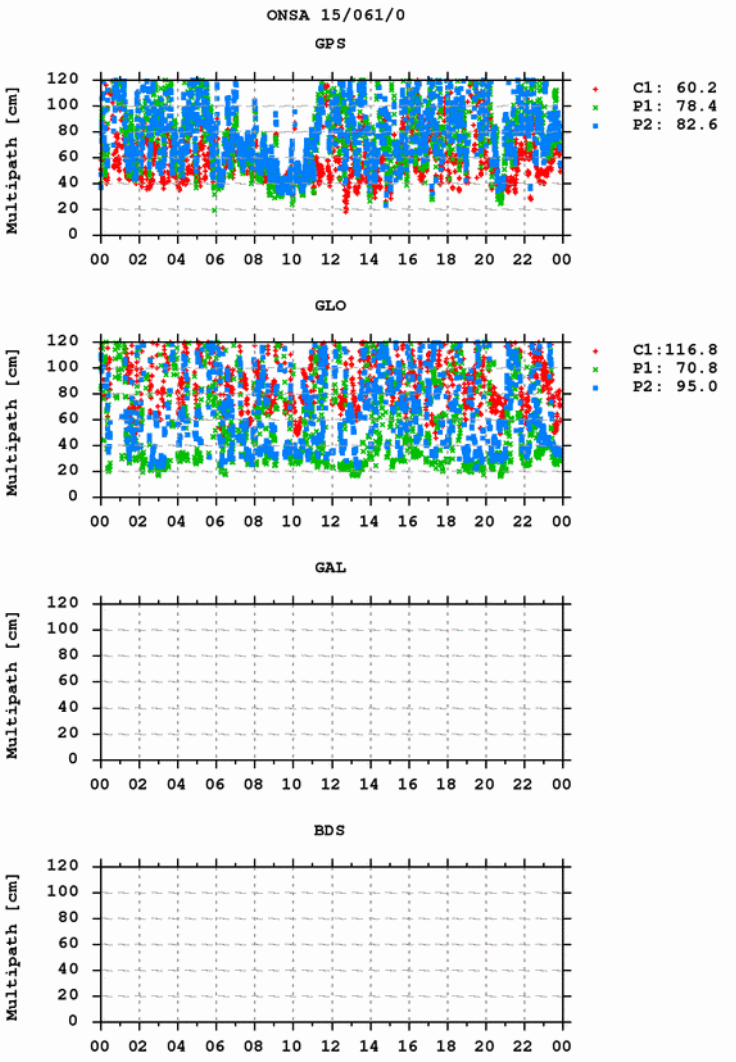




Example performance problems ONSA







Short news for Anubis QC Tool

Release 1.3

Research Institute of Geodesy, Topography and Cartography
Geodetic Observatory Pecný (GOP)

Jan Douša, Pavel Václavovic

Geodetic Observatory Pecný, RIGTC, Czech Republic

EUREF TWG Meeting
March 23-24, 2015, Warsaw, Poland

History and recent releases

- **2015-03-18 - Released Anubis 1.3.2** - actual official release after minor bug fixing described in: RELEASE_NOTES

- **2015-01-28 - Released Anubis 1.3** - complete multi-GNSS capability: all-constellations/-bands/-signal pre-processing & selection, advanced statistics, support of merged navigation messages etc.

- **2014-08-13 - Released Anubis 1.2** - navigation messages for all GNSS constellations, GPS, GLONASS, Galileo, BeiDou standard positioning

- **2014-04-29 - Released Anubis 1.1** - qualitative QC for GPS&GLO, Bancroft positioning, boost-independent version, RINEX3.02 support

- **2013-08-16 - Released Anubis 1.0** - multi-path detection for all constellations, signals and frequencies

- **2013-03-10 - Released Anubis 0.9** - beta version

→ *roughly half a year between major releases with new functionalities*

→ *continuous debugging and providing minor releases in the meantime*

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Important news

- New multi-frequency cascade cycle-slip detection and recovery
  - all GNSS constellations and all signals
  - for all bands if 2/3/4/5 frequencies available
- New observation handling and signal bands & attributes selection
  - priorities for each GNSS and for each frequency band
- New web mini docu + New extraction and plotting tool
  - Initial end-user QC visualization and support
- New information
  - histograms of sampling rates + auto estimate of sampling rate
  - improved counting expected vs. available observations (with/wout NAV)
  - estimated satellites crossing horizon for theoretical check of low-elevation data
  - histograms of observations at predefined elevation bins
- Merging and saving(!) navigation messages in RINEX 3.02 file
  - GPS, GLONASS, Galileo, BeiDou, SBAS, QZSS
- Provided precompiled binaries along with the source code (GPL v3)
  - Linux static 32bit & 64bit
  - In near future considering Windows, BDS, OS2 (not officially supported yet)

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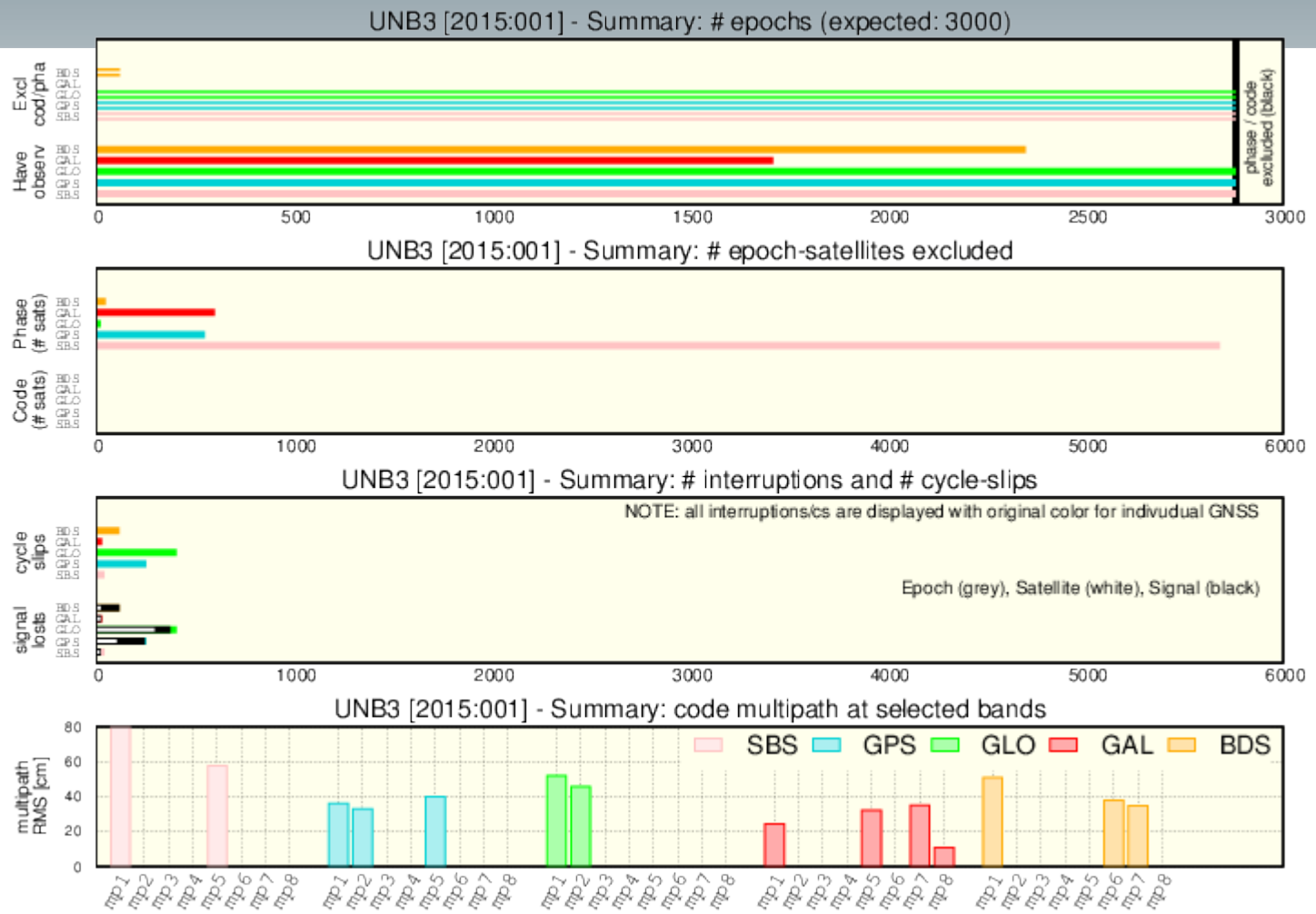
Refined implementations & testing

- Various internal improvements
  - refined observation container structure
  - initial use of smart pointers (testing support of c++11 standards)
  - data decoding filtering (site/satellite specific, period, signals, ..)
  - Improved handling large clock drifts, GDOP for individual GNSSs
  - data decoding/checking/changing (Beidou B1/B2 in RINEX 3.01 vs. 3.02)
  - etc.

- G-Nut/Anubis 1.3 extensive testing:
  - RINEX 3.xx tested on all EURv3 sites (2012-2014)
  - RINEX 3.xx tested on all IGS/M-GEX sites (2013-2014)
  - RINEX 2.xx tested on all EUREF Permanent Network sites (1996-2014)
  - RINEX 2.xx & 3.xx AGNES & EUREF testing at Swisstopo

  → **thanks for a very constructive feedback provided by S.Lutz & E.Brockmann**

QC visualization - Summary 1



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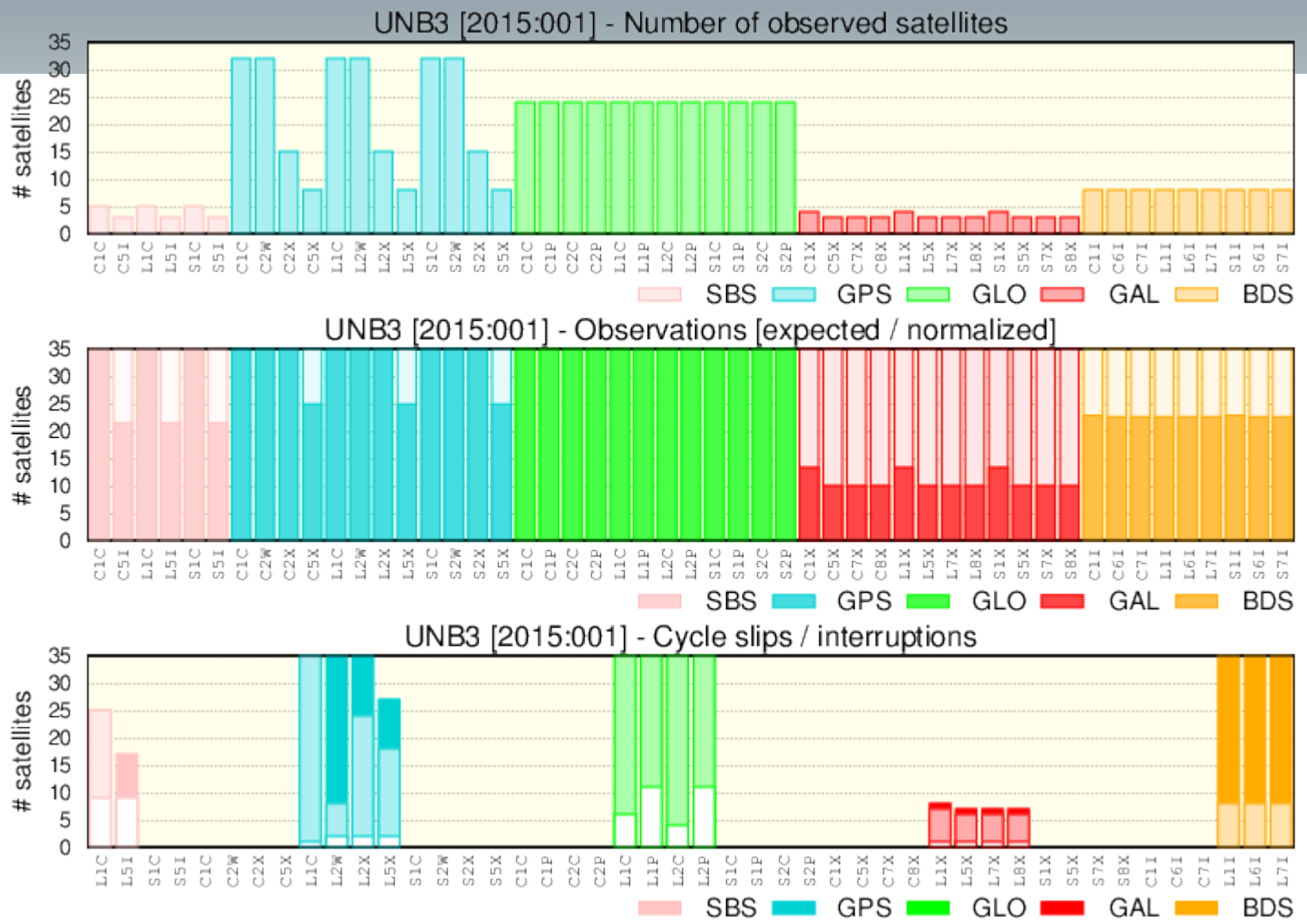
QC visualization - Summary 2



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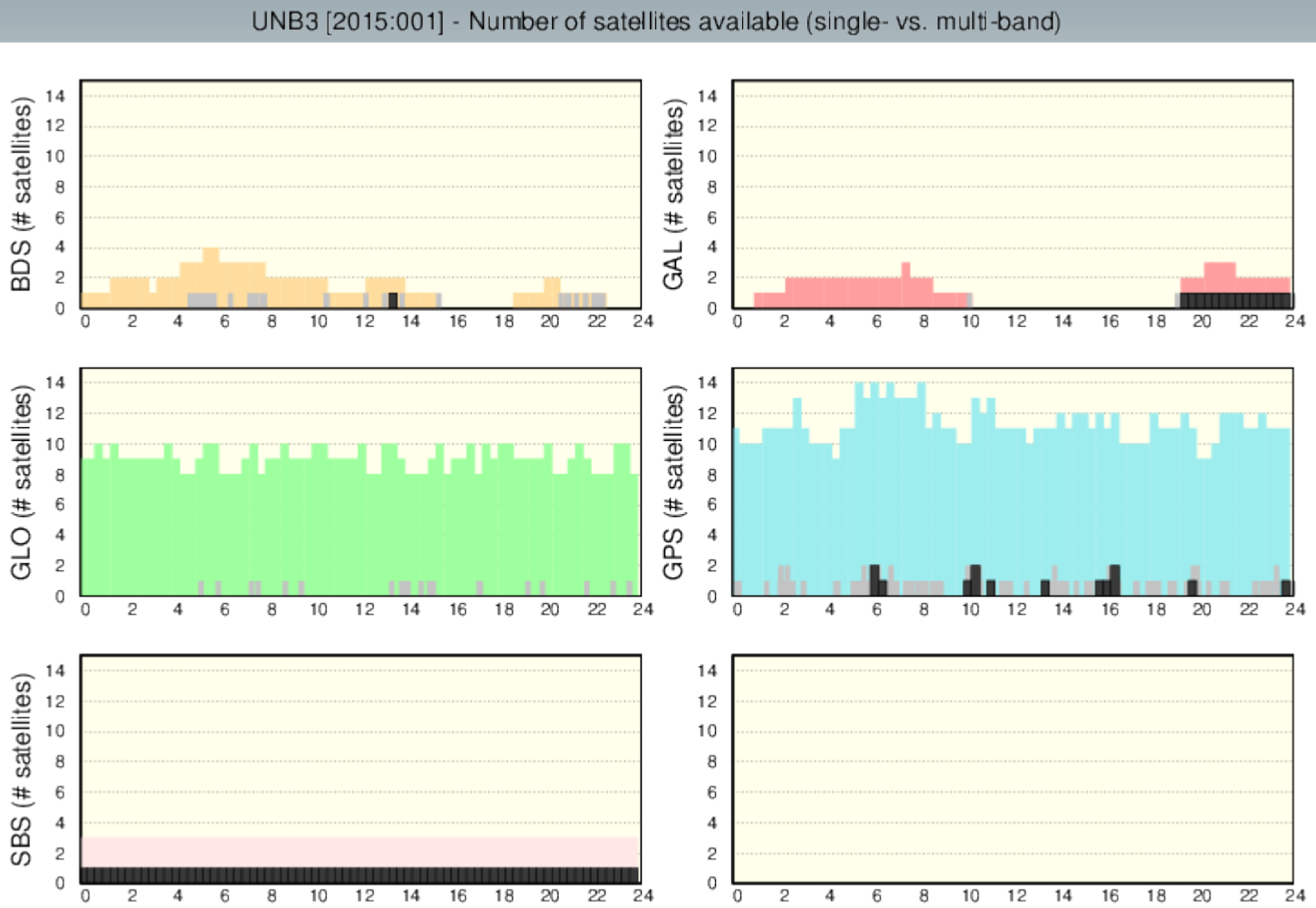
QC visualization – Frequency bands 1



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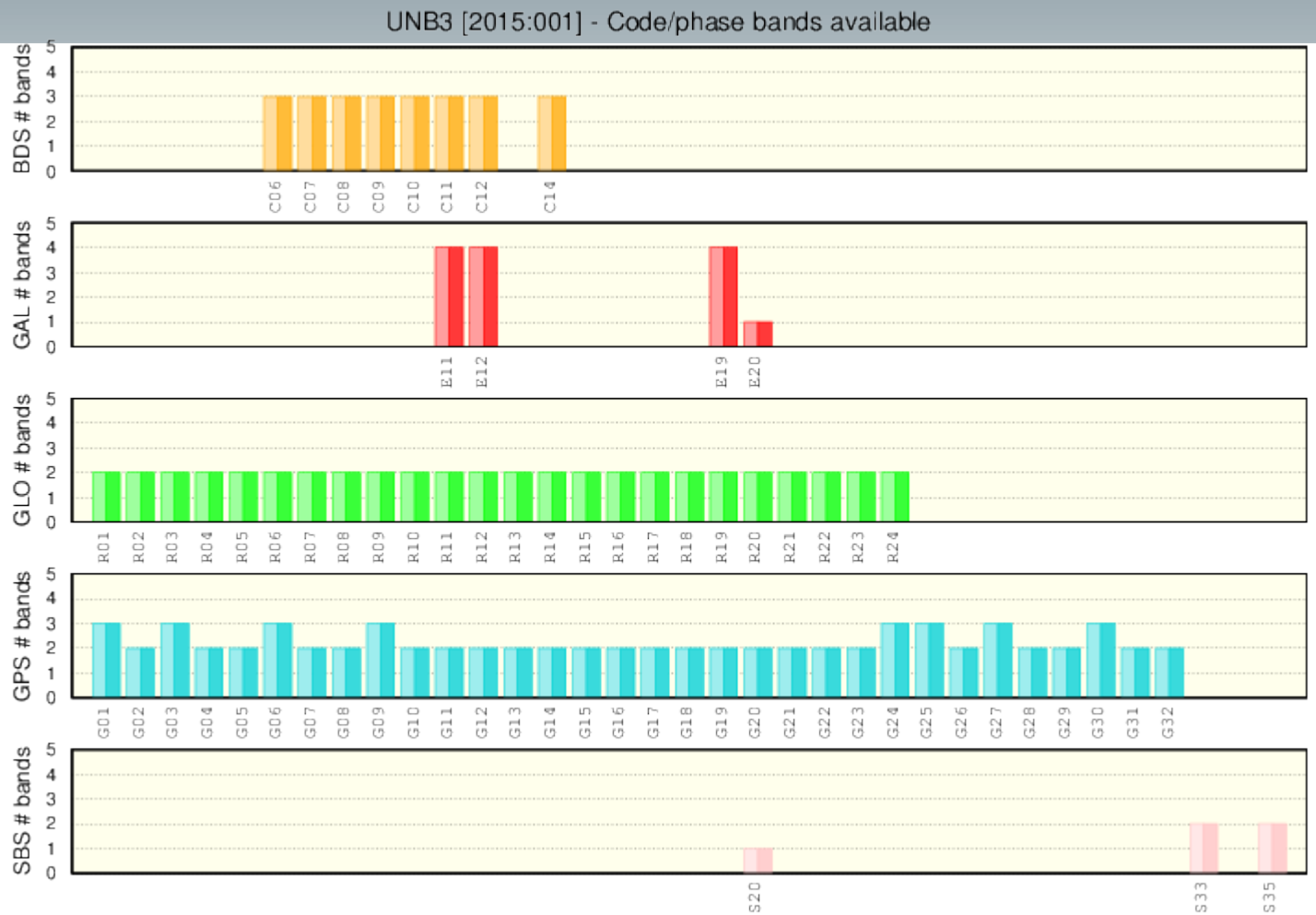
QC visualization – Frequency bands 2



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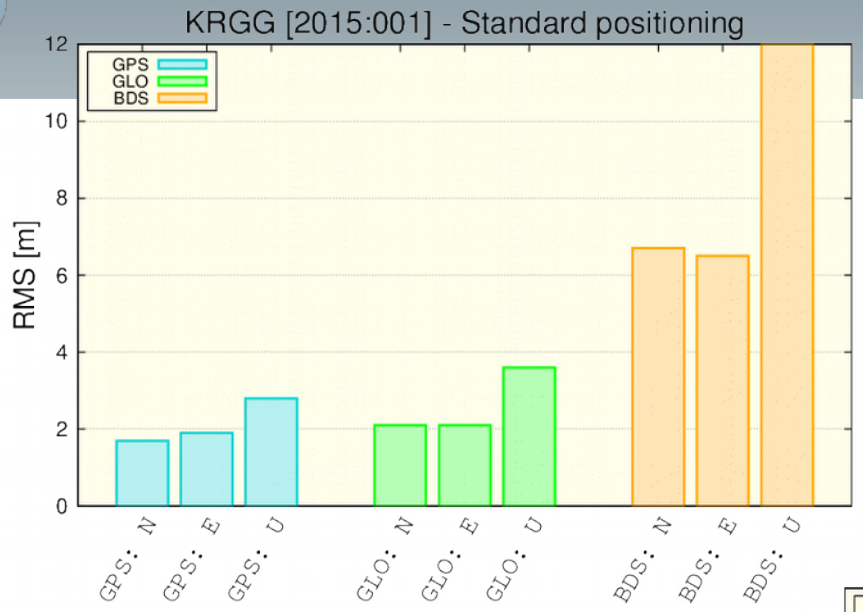
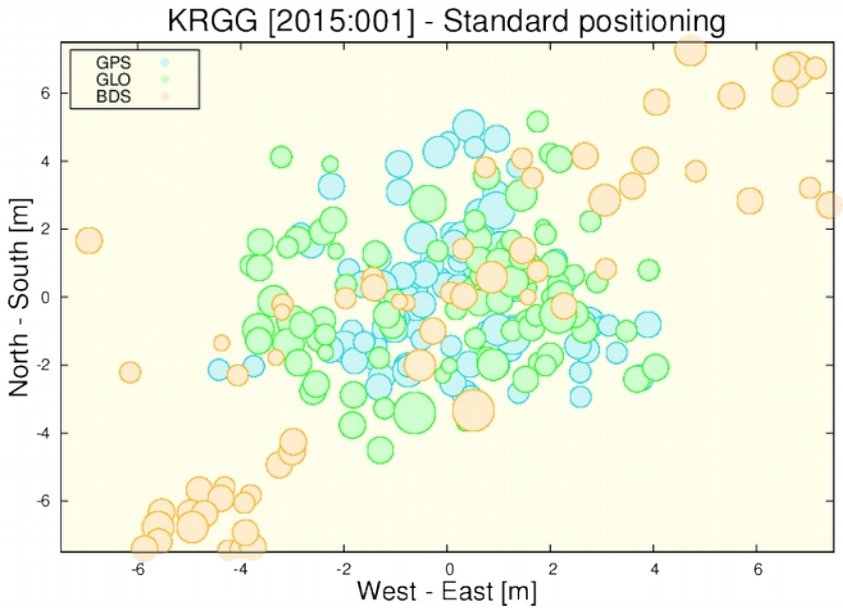
QC visualization – Std. Positioning





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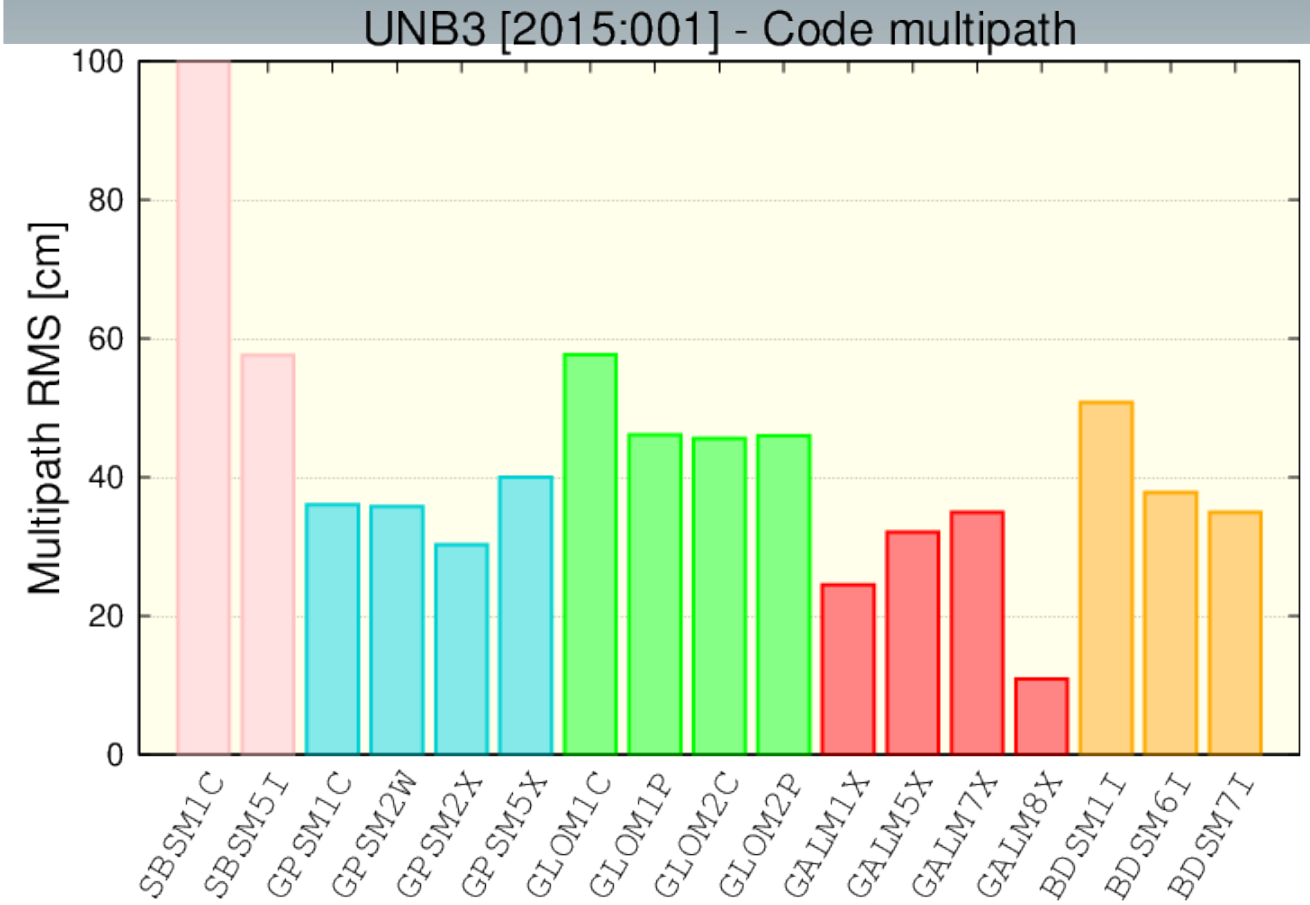
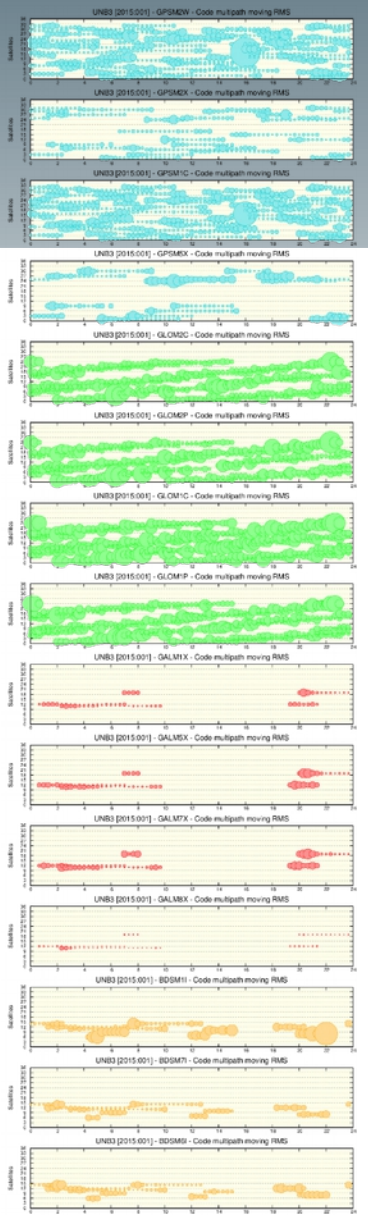
QC visualization – Multipath





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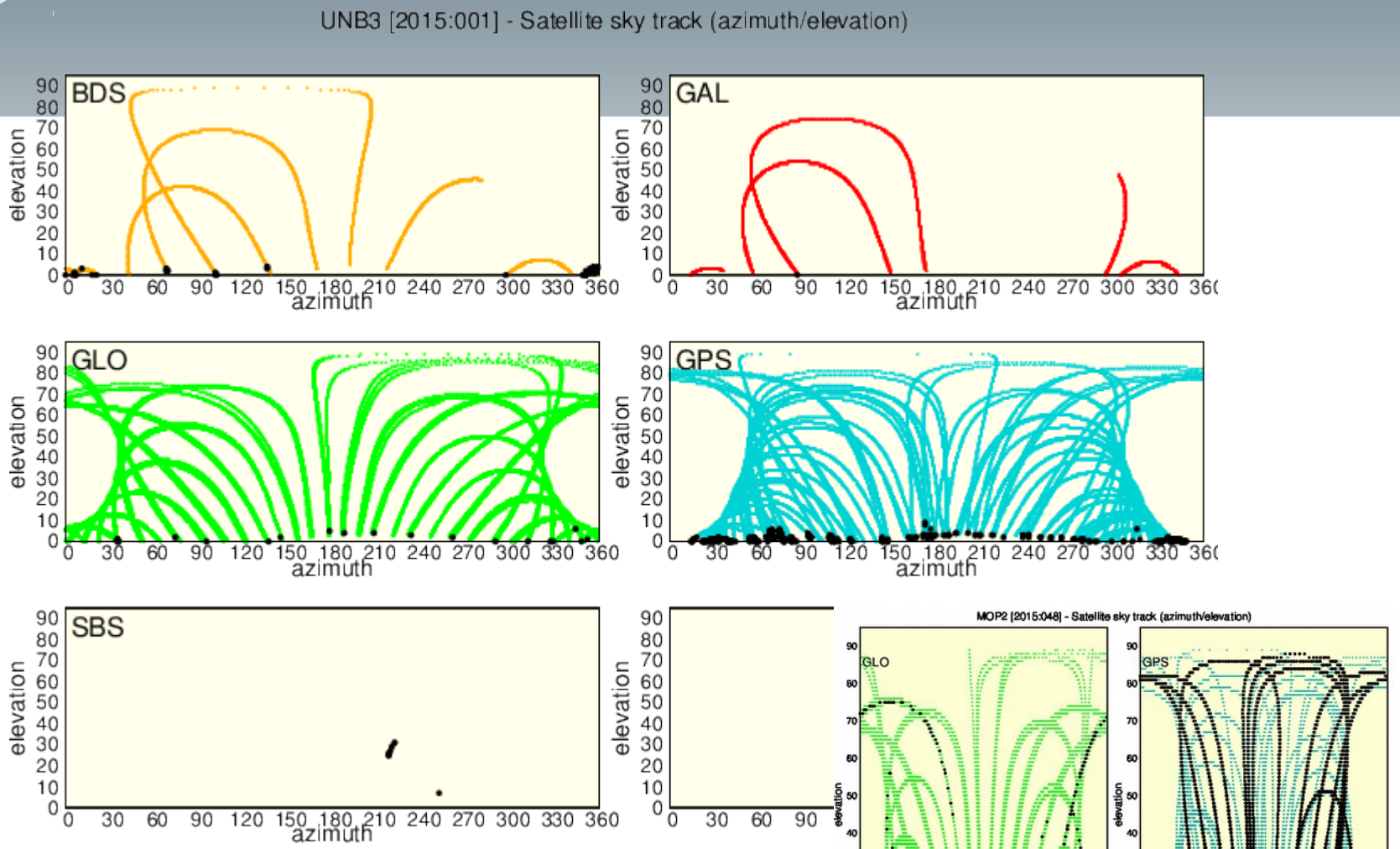
QC visualization – Skyplot + Unusable



Research Institute of Geodesy, Topography and Cartography
Geodetic Observatory Pecný (GOP)

Federal Agency for
Cartography and Geodesy

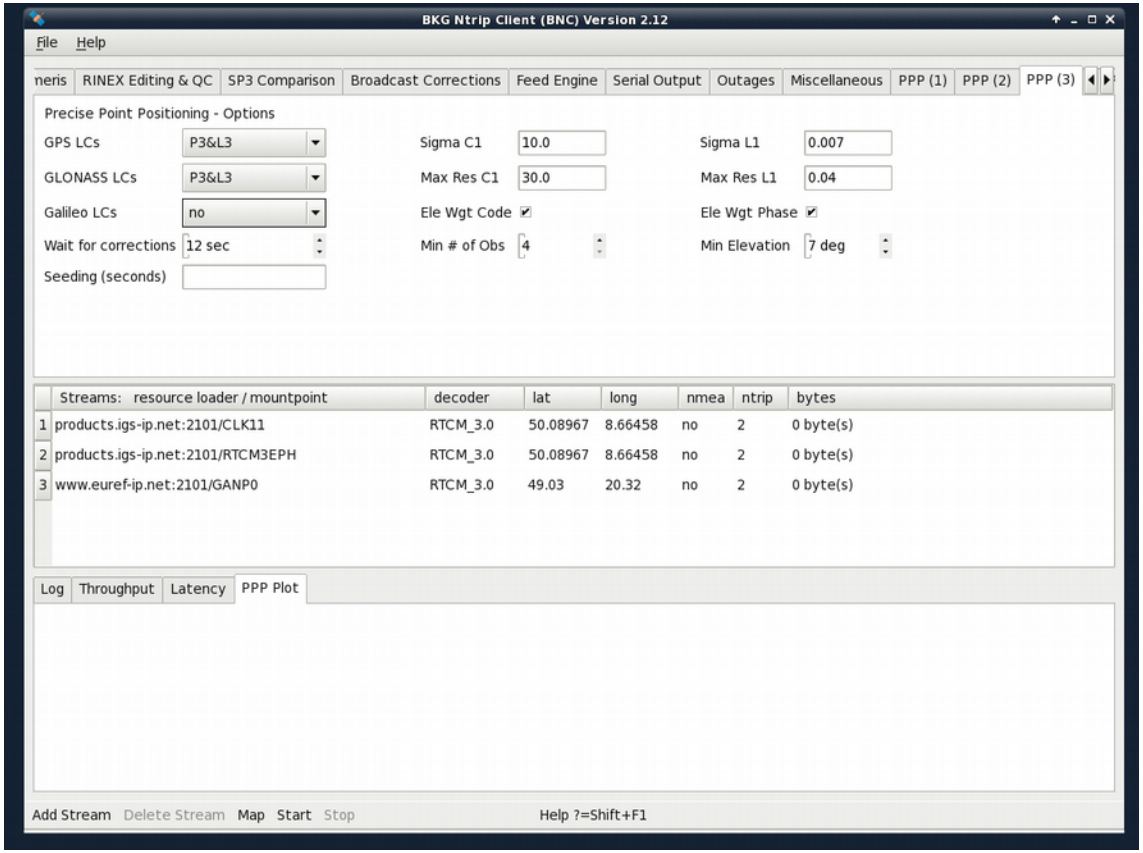
BNC Quality Checking

Federal Agency for Cartography and Geodesy

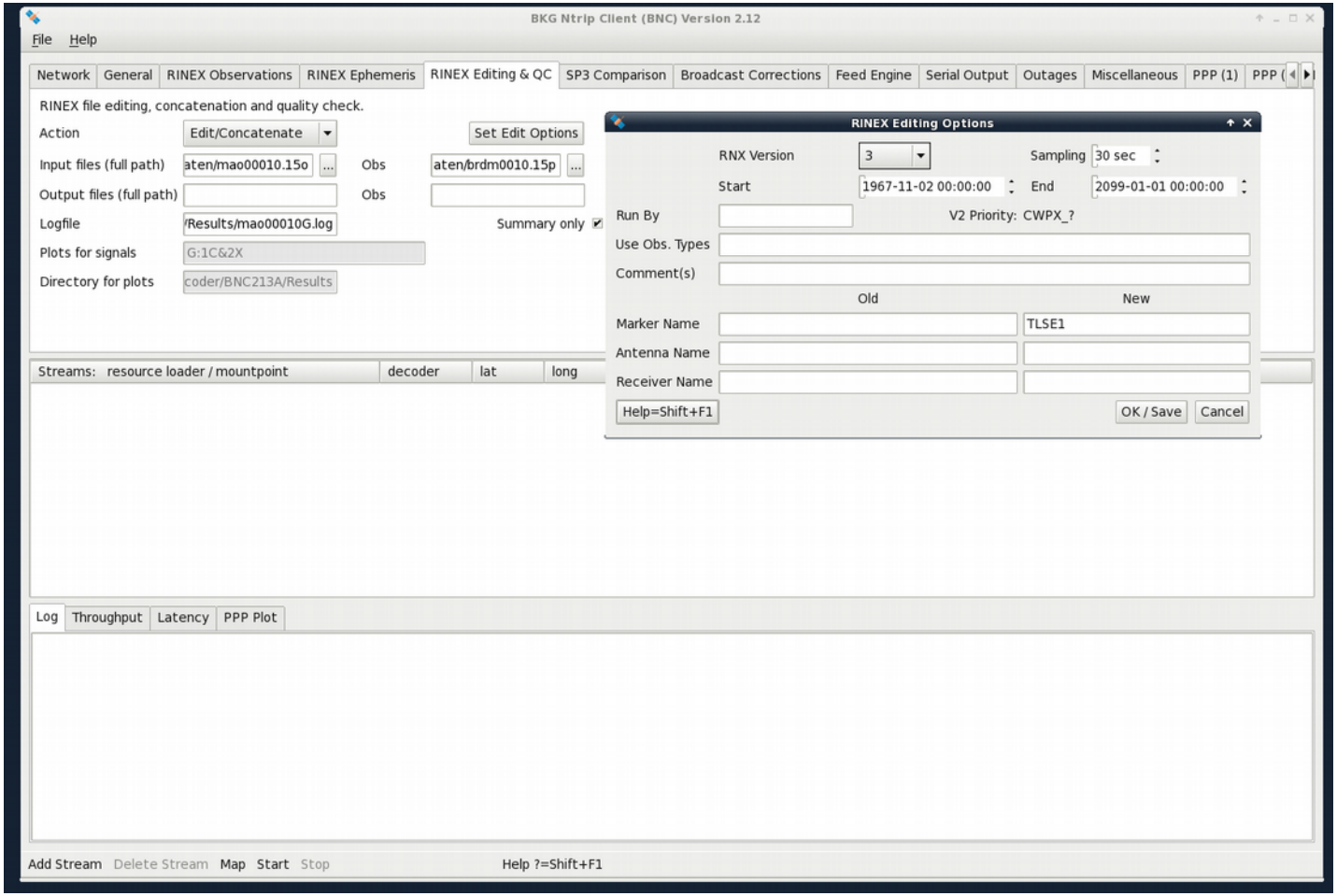
BKG Ntrip Client (BNC)

- **BNC 2.12**
  - **Completely new PPP module implemented**
  - **Galileo processing**
  - **BeiDou ephemeris decoding**
  - **Full Rx2 <-> Rx3 conversion**
  - **SINEX TRO output**
  - **Quality control feature for Rx3**

BKG Ntrip Client (BNC)



BKG Ntrip Client (BNC)



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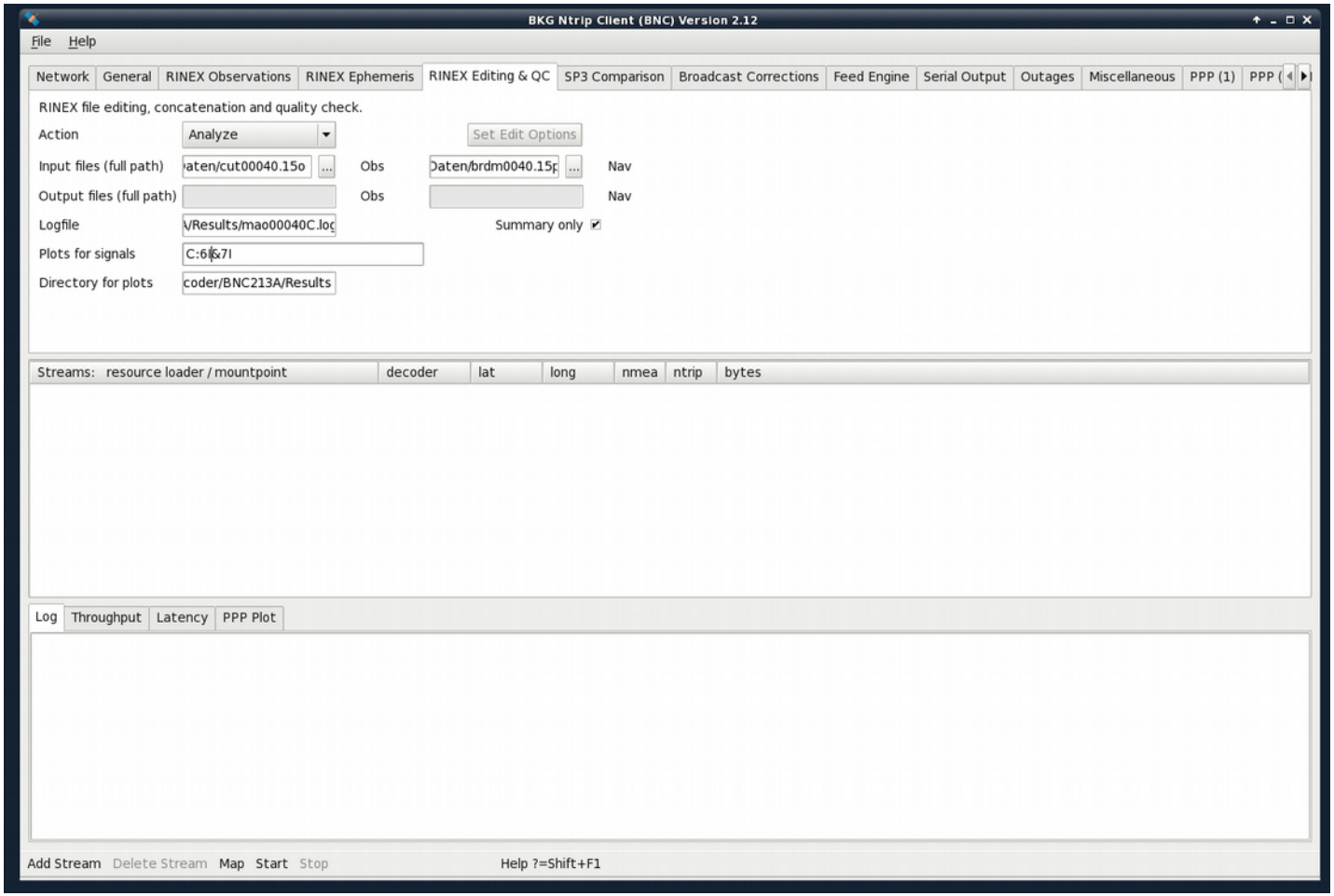

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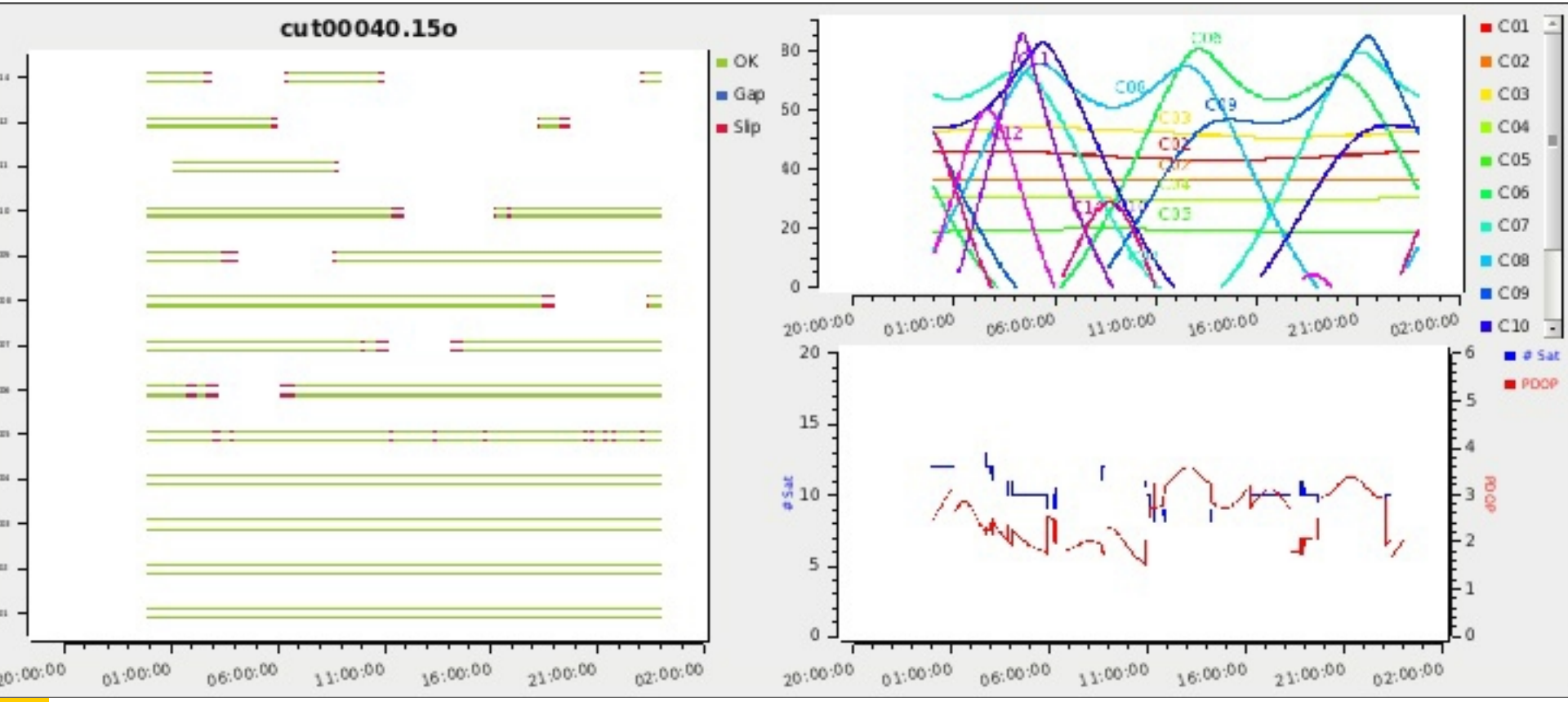
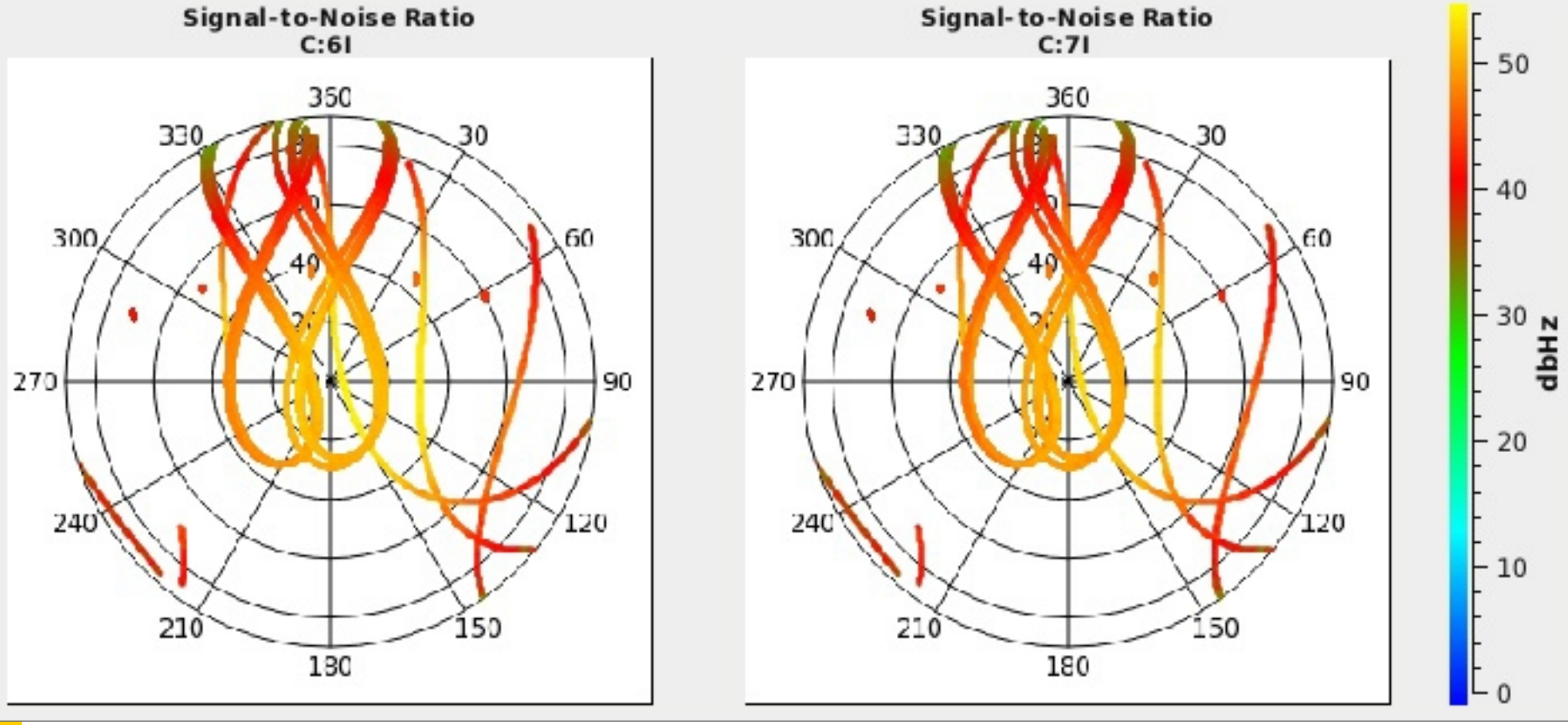
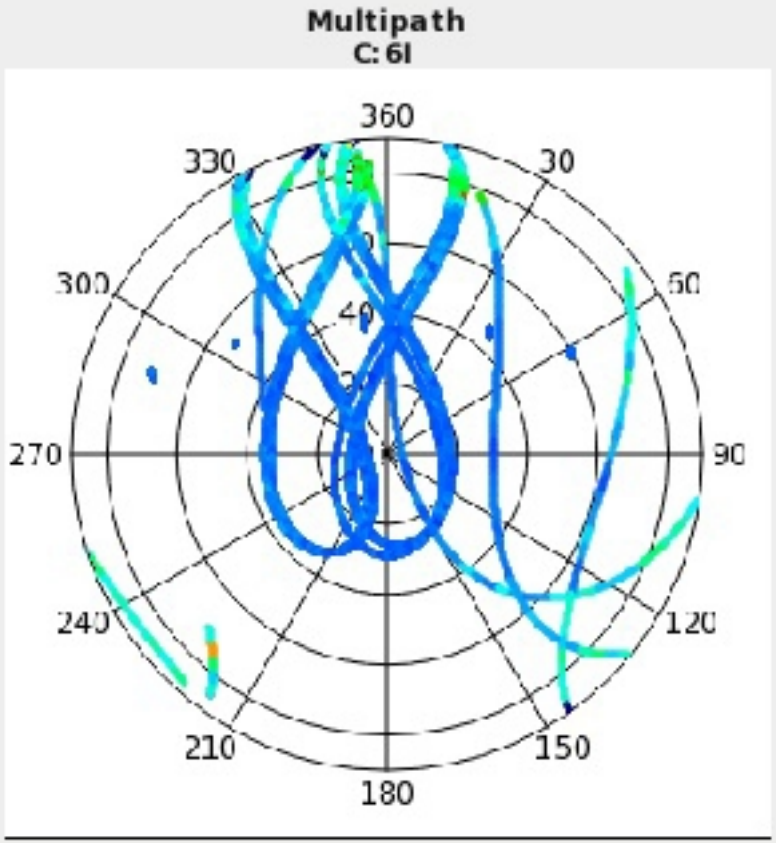
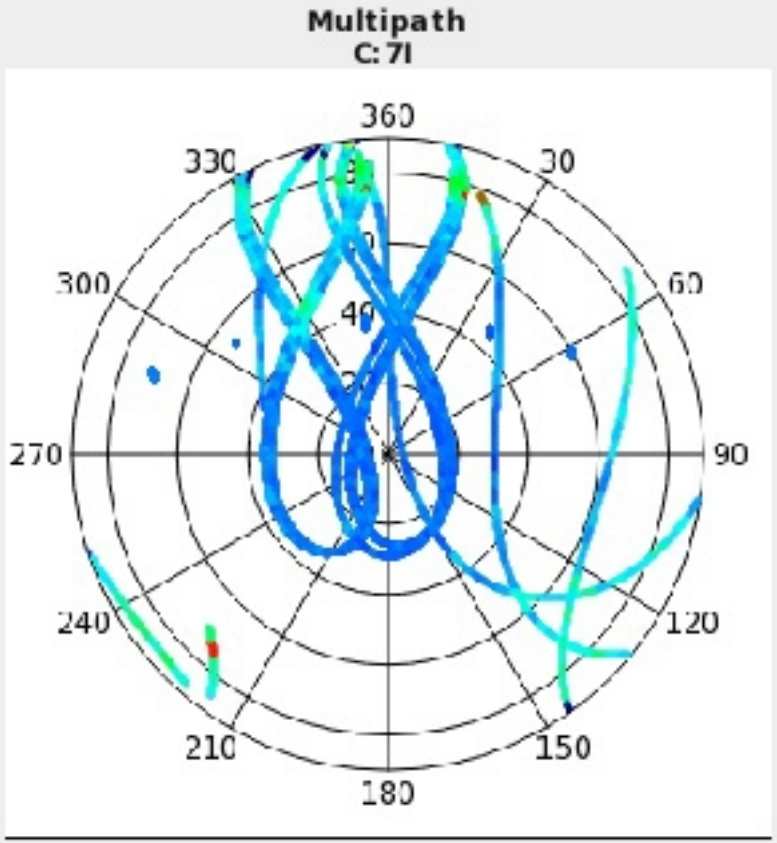


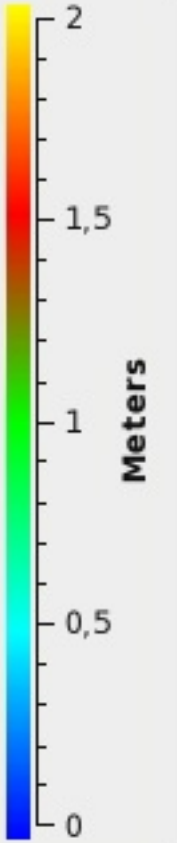
BKG Ntrip Client (BNC)



BKG Ntrip Client (BNC)







BKG Ntrip Client (BNC)

soehne@

Datei Bearbeiten Ansicht Suchen Terminal Hilfe

```
QC Format Version : 1.0

Navigation File(s): brdm0120.15p
Ephemeris         : 6118 OK   2 BAD
  Bad Ephemeris   : brdm0120.15p S29 2015 01 12 22 25 04
  Bad Ephemeris   : brdm0120.15p R02 2015 01 12 23 30 00

Observation File  : cut00120.15o
RINEX Version     : 3.02
Marker Name       : CUT0
Marker Number     : 59945M001
Receiver          : TRIMBLE NETR9
Antenna           : TRM59800.00     SCIS
Position XYZ      :  -2364337.2971   4870285.5843  -3360809.8188
Antenna dH/dE/dN  :   0.0000   0.0000   0.0000
Start Time        : 2015-01-12 00.00.00.0
End Time          : 2015-01-12 23.59.30.0
Interval          : 30
Navigation Systems: 1    C

  C: Satellites: 13
  C: Signals   : 3    1I 6I 7I

      C:   1I: Observations      :  29488
      C:   1I: Slips (file+found):    131 +     2
      C:   1I: Gaps              :     12
      C:   1I: Mean SNR          :   42.2
      C:   1I: Mean Multipath    :   0.39

      C:   6I: Observations      :  29456
      C:   6I: Slips (file+found):    142 +     2
      C:   6I: Gaps              :     32
      C:   6I: Mean SNR          :   44.8
      C:   6I: Mean Multipath    :   0.25

      C:   7I: Observations      :  29456
      C:   7I: Slips (file+found):    142 +     2
      C:   7I: Gaps              :     32
      C:   7I: Mean SNR          :   44.3
      C:   7I: Mean Multipath    :   0.28
```