Federal Agency for
Cartography and Geodesy

EPN Special Project “Real-Time Analysis” – Status Report

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Highlights

- Real-time observational data
  - EUREF regional broadcaster
  - Broadcaster guidelines
  - Reviving EUREF-IP mailing list
- Real-time navigational data
  - Standardization progress
- Real-time processing
  - IGS RTS status
  - PPP activities

EUREF Broadcaster

- Purpose: User should be able to get access to RT data (mountpoints) through different casters (redundancy concept)
- Goal: User should be able to switch between Regional Broadcasters (RB) without degradation of performance (e.g. availability, latency, …)
- Requirement: Identical setup at each broadcaster, e.g. identical mountpoint naming
- Valid for observations as well as for products
- Monitoring of general status done by ROB: http://www.epncb.oma.be/ann/epnstream2.php

EUREF PERMANENT NETWORK

REAL-TIME PRODUCTS

Mountpoint	ASI (status: 2015-05-28 13:55 UTC)	BKG (status: 2015-05-28 13:55 UTC)	ROB (status: 2015-05-28 13:55 UTC)
EUREF01	RTCM 3.0 - BKG	RTCM 3.0 - EUREF filter combination	RTCM 3.0 - EUREF filter combination
EUREF02	RTCM 3.0 - BKG	RTCM 3.0 - EUREF filter combination	RTCM 3.0 - EUREF filter combination
RTCM3EPH	RTCM 3 - products.igs-ip.net:2101/RTCM3EPH (1)	RTCM 3.0 - products.igs-ip.net/RTCM3EPH(1)	RTCM 3.0 - products.igs-ip.net/RTCM3EPH(1)

REAL-TIME DATA STREAMS

Mountpoint	ASI (status: 2015-05-28 13:55 UTC)	BKG (status: 2015-05-28 13:55 UTC)	ROB (status: 2015-05-28 13:55 UTC)
ACOR0	RTCM 3.1 - ergnss-ip.ign.es:2101/ACOR0(1)	RTCM 3.1 - ergnss-ip.ign.es:2101/ACOR0(1)	RTCM 3.1 - IGNE, Servicio de Program Geodesicos
AJAC0	RTCM 3.1 - rgp-ip.ign.fr:2101/AJAC1(1)	RTCM 3.1 - www.igs-ip.net:2101/AJAC0(2)	RTCM 3.1 - none
ALAC0	RTCM 2.3 - ergnss-ip.ign.es:2101/ALAC0(1)	RTCM 3.0 - ergnss-ip.ign.es:2101/ALAC0(1)	RTCM 3.1 - IGNE, Servicio de Program Geodesicos
ALBA0	RTCM 2.1 - ergnss-ip.ign.es:2101/ALBA0(1)	RTCM 3.0 - ergnss-ip.ign.es:2101/ALBA0(1)	RTCM 3.1 - IGNE, Servicio de Program Geodesicos
ALME0	RTCM 2.3 - ergnss-ip.ign.es:2101/ALME0(1)	RTCM 2.3 - ergnss-ip.ign.es:2101/ALME0(1)	RTCM 2.3 - IGNE, Servicio de Program Geodesicos
AUT10	RTCM 3.0 - www.euref-ip.net:2101/AUT10(1)	RTCM 3.0 - none	RTCM 3.0 - none
BELF0	RTCM 3.1 - www.euref-ip.net:2101/BELF0(1)	RTCM 3.1 - Ordnance Survey of Northern Ireland	RTCM 3.1 - Ordnance Survey of Northe Ireland
BELL0	RTCM 3.0 - www.euref-ip.net:2101/BELL0(1)	RTCM 3.0 - ICC Catnet	RTCM 3.0 - ICC Catnet
BOGI0	Last received on 2015-03-12 12:15 UTC	RTCM 3.0 - IGiK	RTCM 3.0 - IGiK
BOR10	RTCM 2.3 - www.euref-ip.net:2101/BOR10(1)	RTCM 2.3 - SRC PAS	RTCM 2.3 - SRC PAS
BORJ1	RTCM 3.0 - www.euref-ip.net:2101/BORJ1(1)	RTCM 3.0 - BKG	RTCM 3.0 - BKG
BORR0	RTCM 3.0 - icverva.icv.gva.es:2101/RTBO1(1)	RTCM 3.0 - ICV	RTCM 3 - Ant Descriptor-Protecte Cartographic Institute of Valencia
BRST0	RTCM 3.0 - rgp-ip.ign.fr:2101/BRST1(1)	RTCM 3.0 - www.igs-ip.net:2101/BRST0(2)	RTCM 3.1 - none
BRUX0	Last received on 2015-03-12 09:45 UTC	Last received on 2015-05-28 11:35 UTC	Last received on 2015-05-28 11:35 UTC
BRUX1			RAW - ROB -- http://www.gnss.be
BRUX7			RTCM 3.2 - ROB

EUREF Broadcaster

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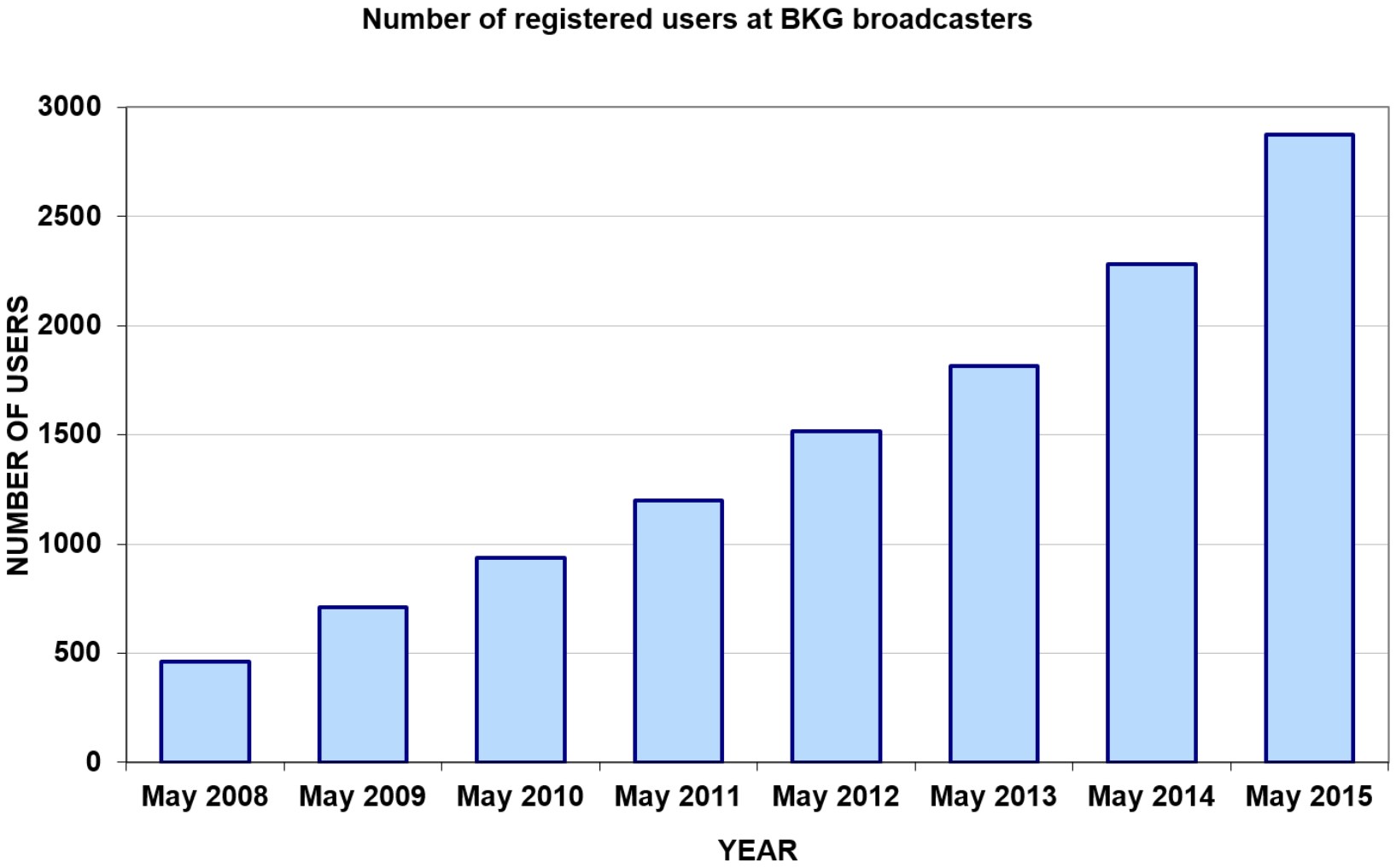
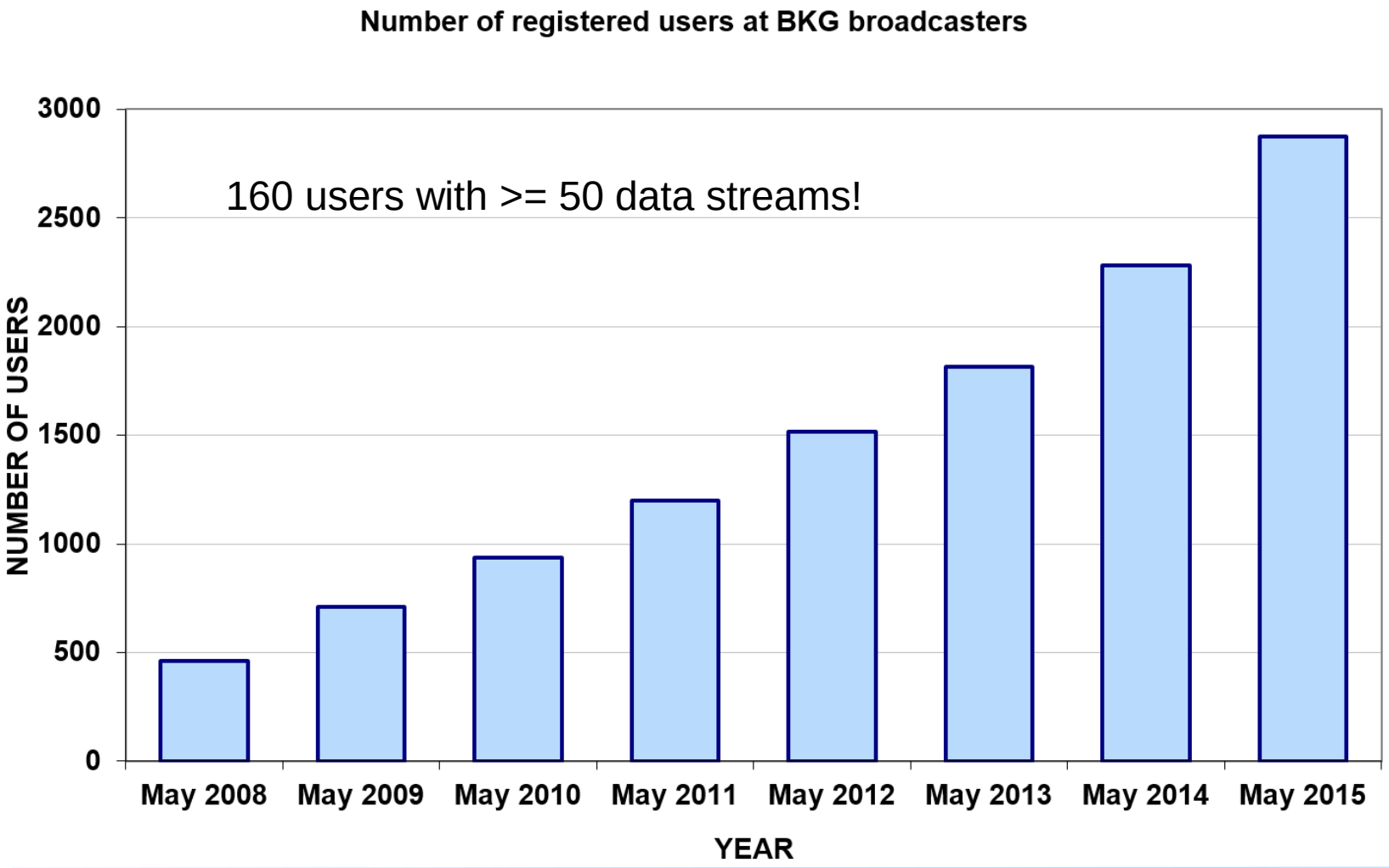
- Requirement: Identical setup at each broadcaster, e.g. identical mountpoint naming
- Valid for observations as well as for products
- Monitoring of general status done by ROB: http://www.epncb.oma.be/ann/epnstream2.php
- Monitoring of correct contents to be done by BKG (e.g. sourcetable content vs. real data stream content for all three RBs on a regular basis)

EUREF Broadcaster



EUREF Broadcaster



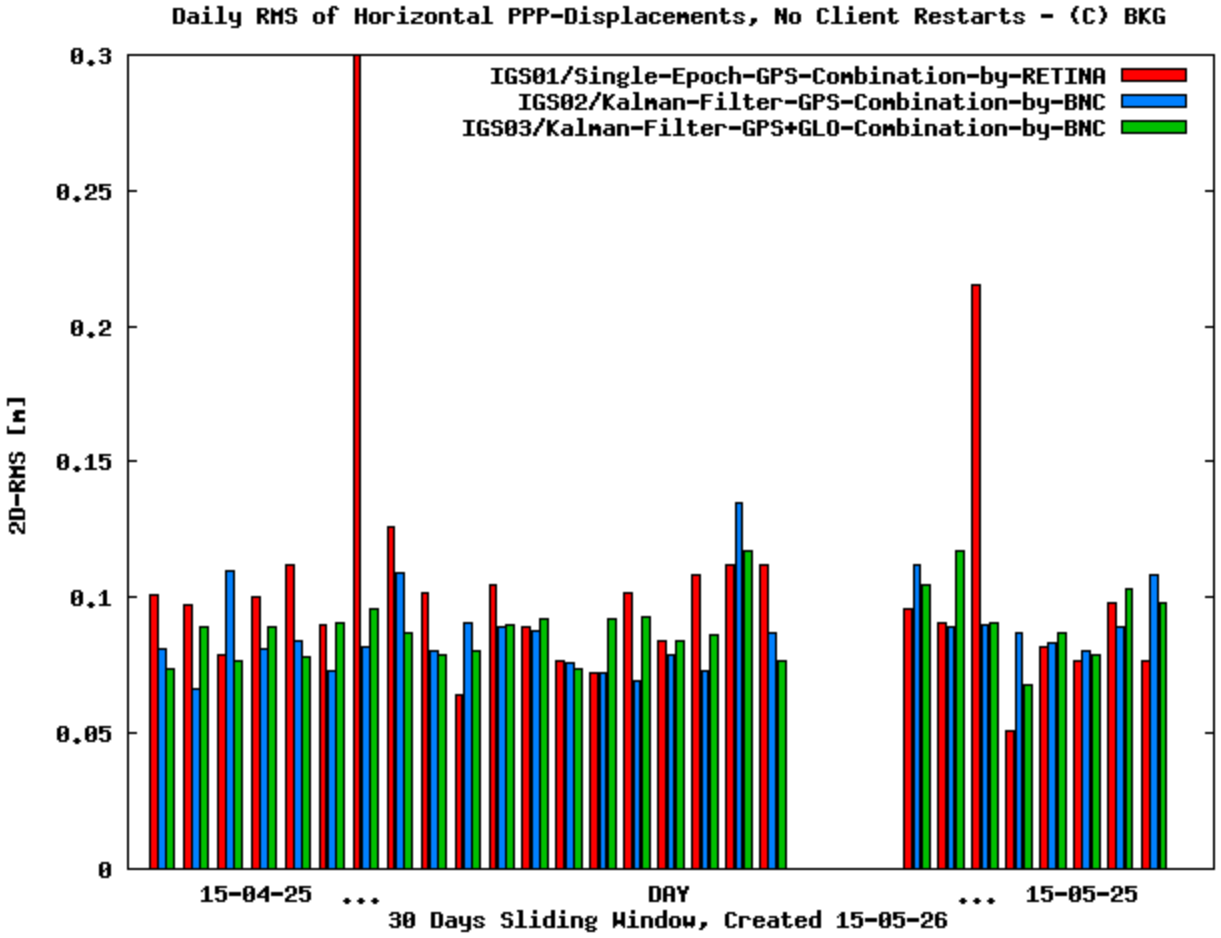
RT Navigational Data

- Purpose: get navigation messages of each satellite of each constellation immediately after initialization
- Currently not possible from space segment
- RTCM3EPH-MGEX
  - Contains GPS(1019)+GLO(1020)+GAL+BDS+QZS(1044)+SBAS(1043)
  - Sampling rate every 5/10 seconds
- GAL message type 1045/1046
  - Issue with F/NAV (E5A) vs. I/NAV (from E1B and E5B)
- BDS preliminary message type 63 (implemented by BKG, DLR and Geo++)

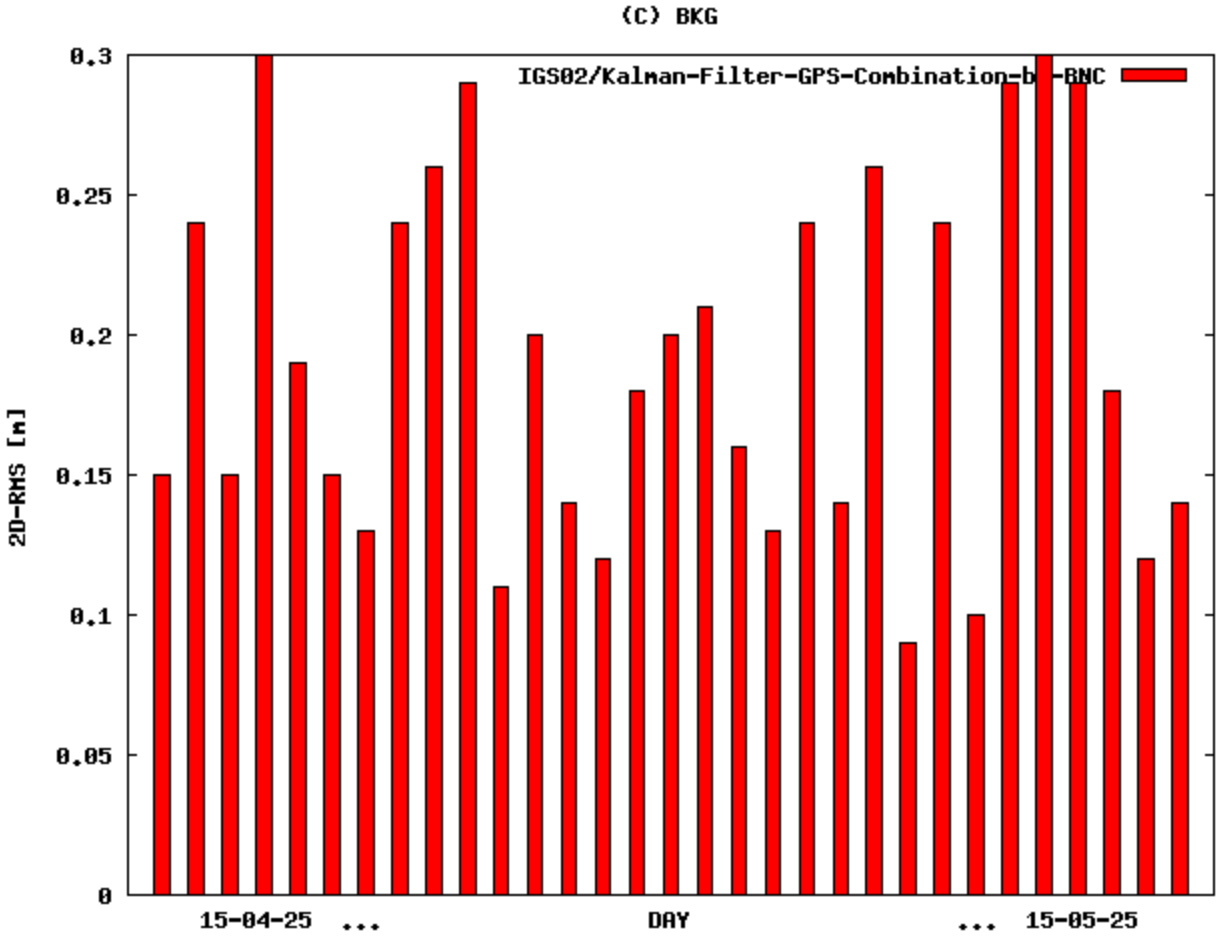
RT Analysis

- IGS Real-Time Service (RTS) started in 2013
  - 10 RT ACs – 8 contributing routinely
  - 8 individual contributions for GPS, 4 for GPS+GLO
  - IGS01: GPS-only combined solution by ESOC
  - IGS02: GPS-only combined solution by BKG
  - IGS03: GPS+GLO combined solution by BKG
  - Combined product IGS01 very stable with clock standard deviation (sigma) of 0.15 ns
- EPN RT Data used as input for IGS RTS
  - Only few European stations necessary equally distribution and for global coverage

RT Analysis


Daily RMS of Horizontal PPP-Displacements, No Client Restarts - (C) BKG
IGS01/Single-Epoch-GPS-Combination-by-RETINA
IGS02/Kalman-Filter-GPS-Combination-by-BNC
IGS03/Kalman-Filter-GPS+GLO-Combination-by-BNC
2D-RMS [m]
0.3
0.25
0.2
0.15
0.1
0.05
0
15-04-25 ... DAY ... 15-05-25
30 Days Sliding Window, Created 15-05-26

RT Analysis


(C) BKG
IGS02/Kalman-Filter-GPS-Combination-b -BNC
2D-RMS [m]
0.3
0.25
0.2
0.15
0.1
0.05
0
15-04-25
...
DAY
...
15-05-25

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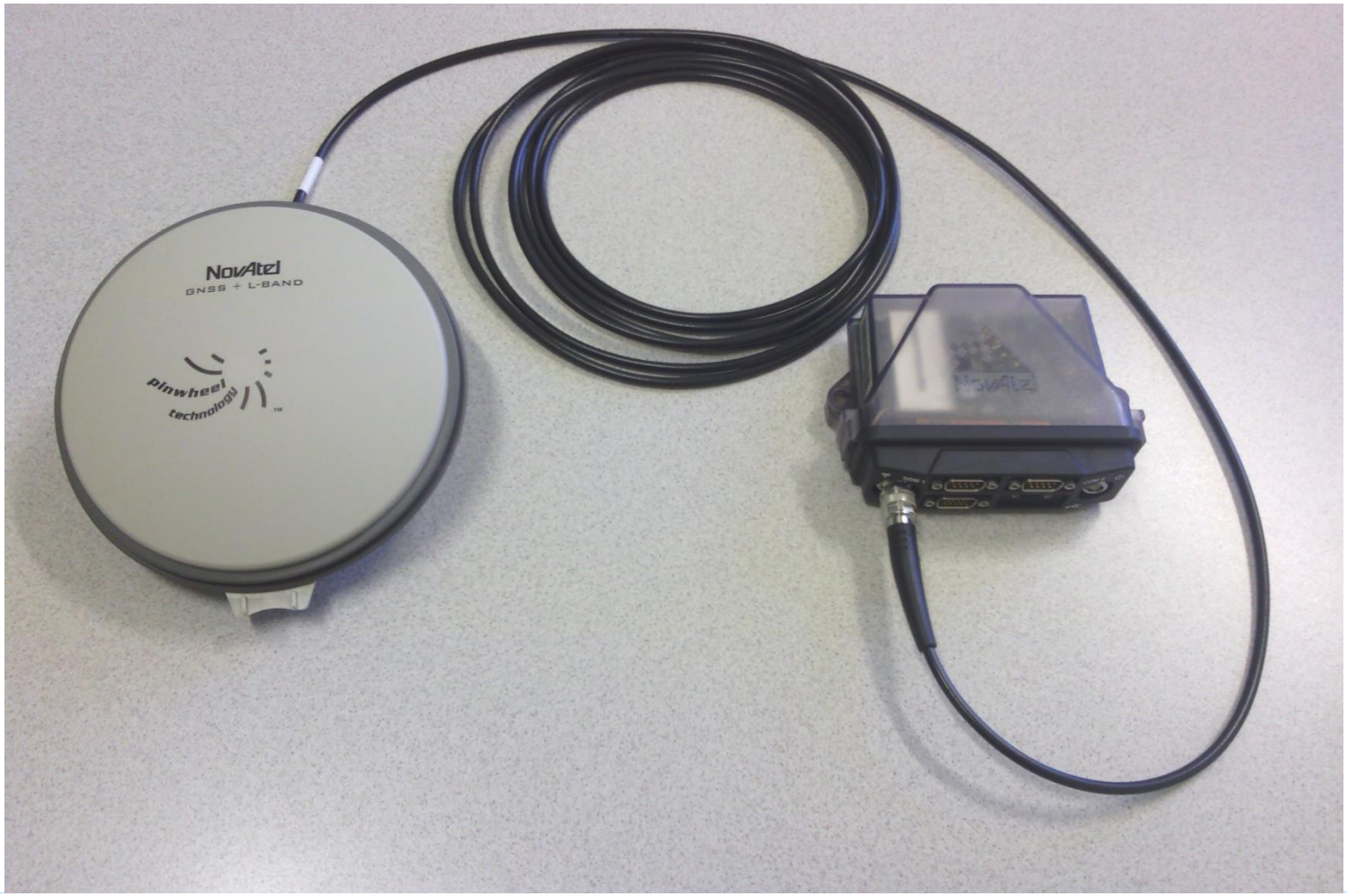
- EPN RT Data used as input for IGS RTS
  - Only few European stations necessary equally distribution and for global coverage
- MGEX RT
  - Approx. 80 RAW data streams converted by BKG to RTCM 3.2 (HP-MSM)
  - New: first(?) HP-MSM RT data stream directly from station: NAUR (SEPT POLARX4TR, Firmware 2.9.0) – GPS+GLO+GAL+BDS+SBAS

EPN RT Analysis

- Precise Point Positioning (PPP) still growing market
  - „precise“ thanks to the availability of real-time corrections (orbits, clocks, biases, …)
  - RTCM SC104 WG on „State Space Representation“ (SSR) in charge with the standardisation
- Commercial receiver supporting open standard SSR
  - NovAtel Flex6 (OEM628 receiver board)
  - Allowing usage of open standard satellite orbit and clock corrections using RTCM SSR level 1 messages

EPN RT Analysis



EPN RT Analysis

Setup in BKG

1 Mount and connect a GNSS antenna

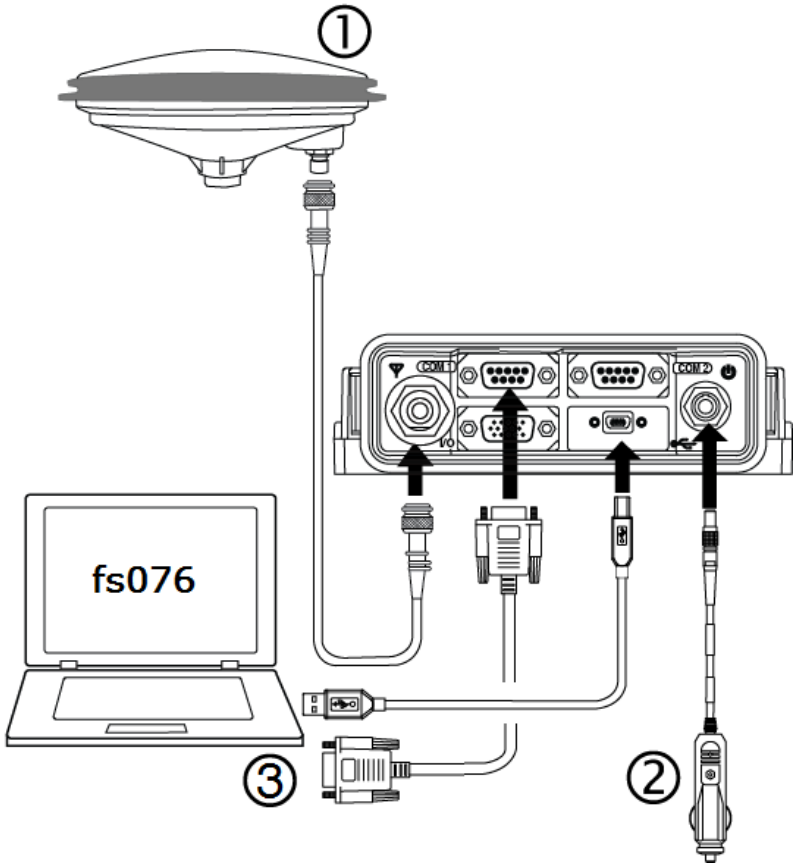
2 Connect a power supply

3 Connect USB and COM1 ports to a computer f

setup and monitoring

USB: setup and monitoring

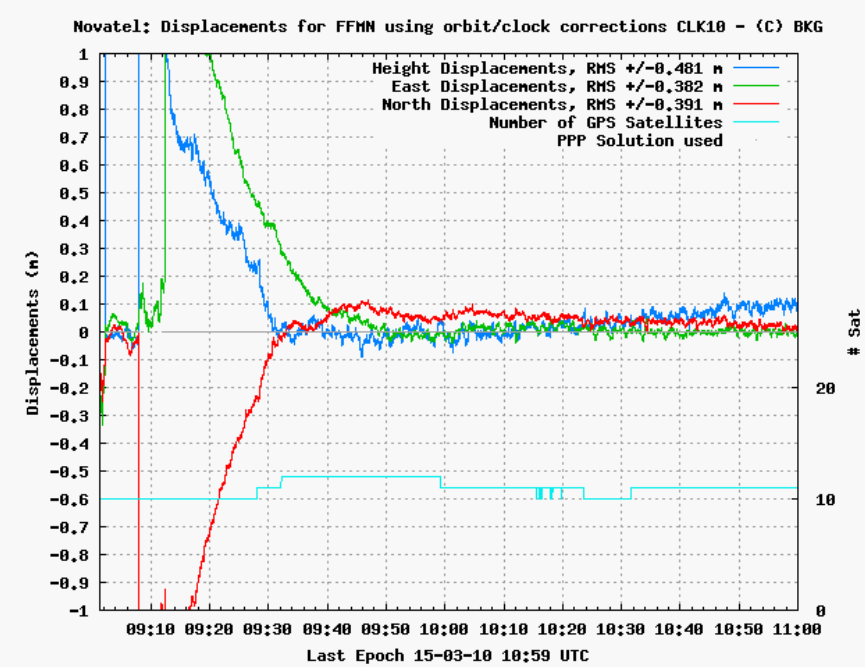
COM1: RTCM3 orbit/clock corrections

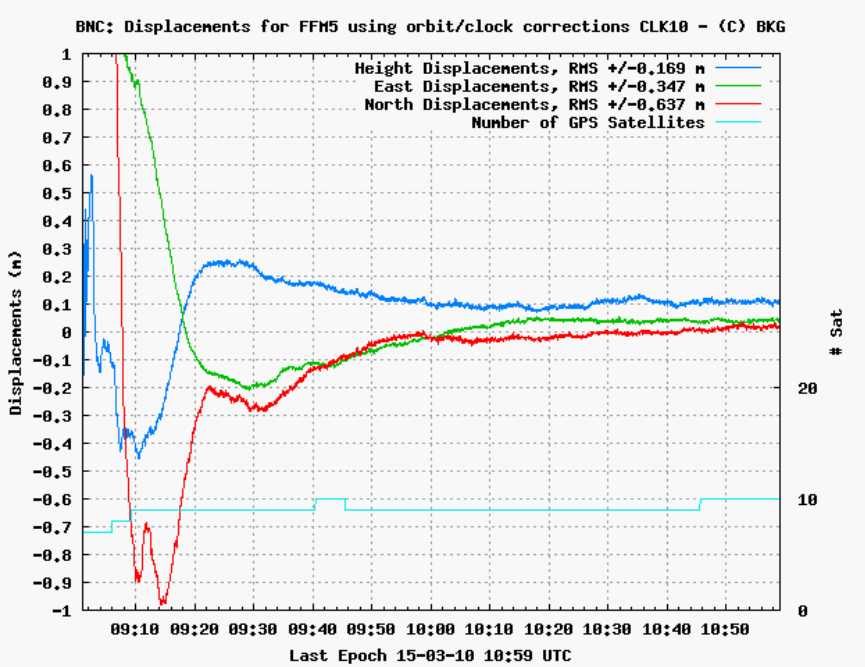


EPN RT Analysis

NovAtel vs. BNC: PPP displacements, 2 hours, CLK10 corrections used

BNC configuration: 10m XYZ-init, 100m XYZ-WhiteNoise





EPN RT Analysis

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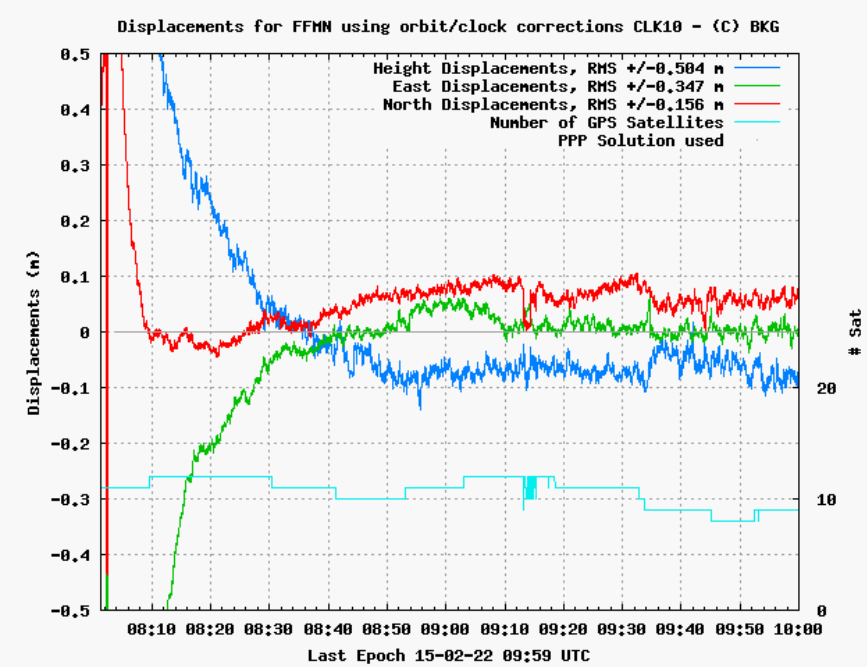
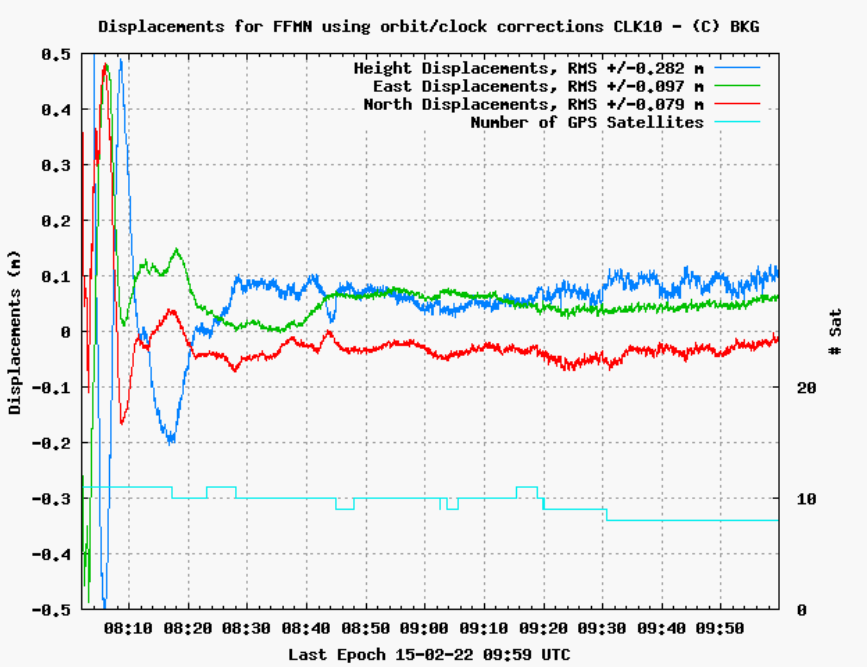
BNC configuration: 10m XYZ-init, 100m XYZ-WhiteNoise

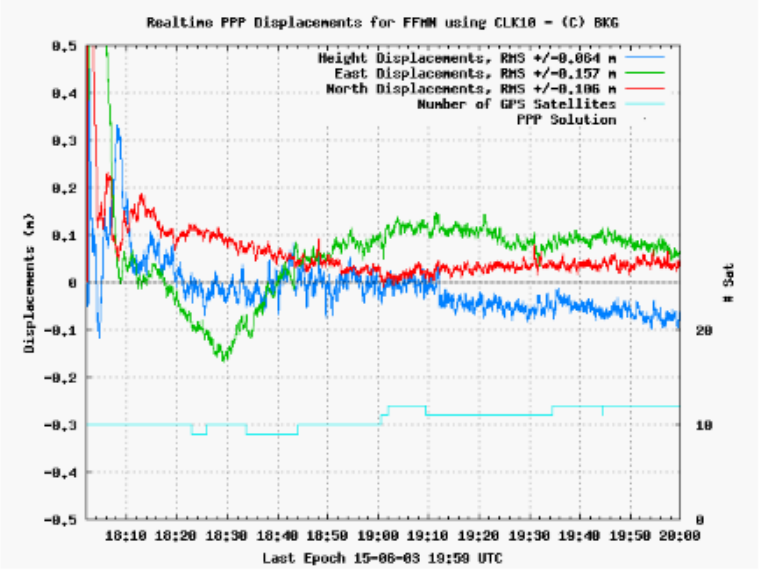




EPN RT Analysis

PPP Monitor Scenario 27

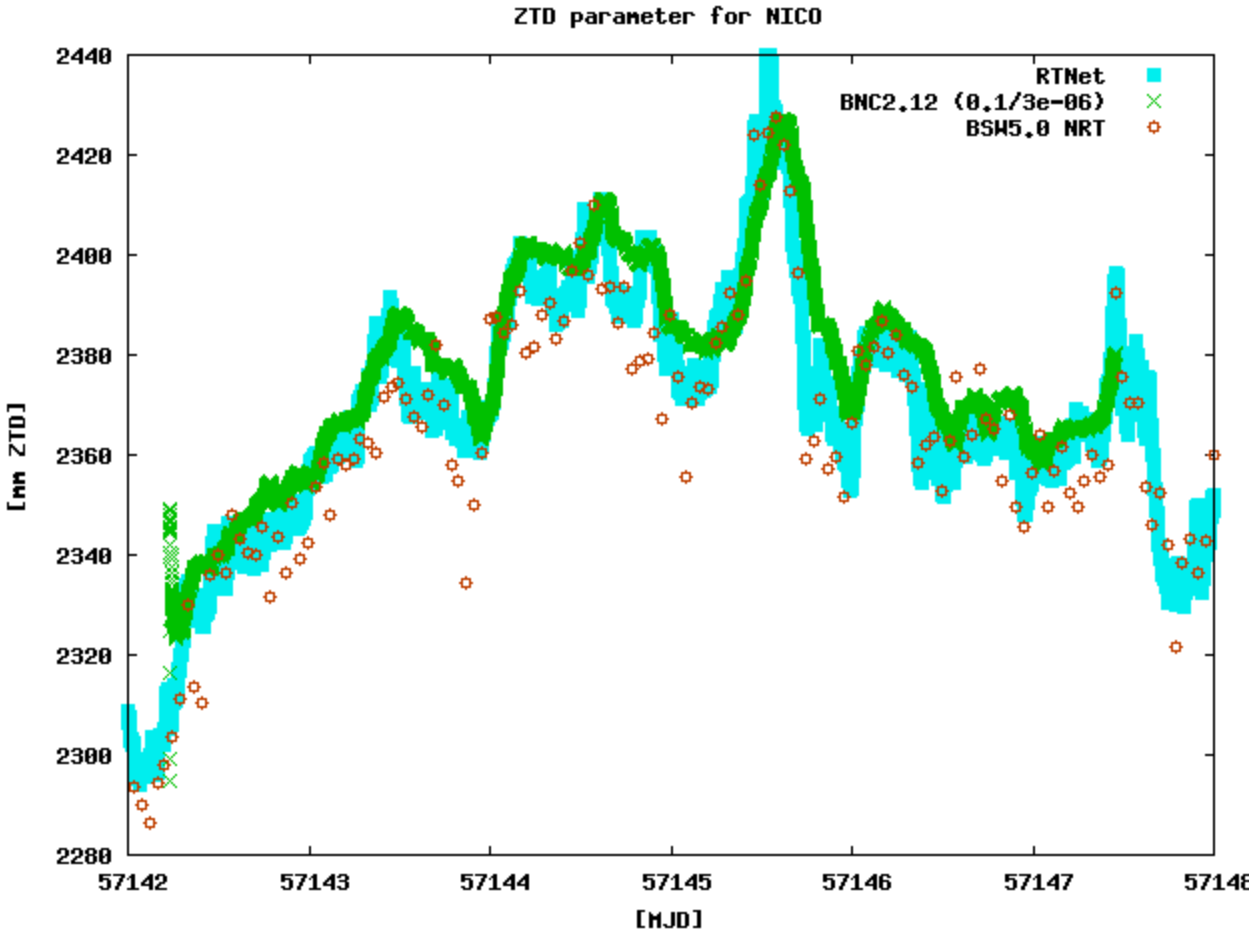
- PPP client software: Novatel OEM628 Receiver
- Location: Station FFMN, Frankfurt, Germany
- Antenna: TRM29659.00
- Observations: 1Hz, dual frequency, GPS only
- Reference: ITFR2005/IGS05, Lat=50.09050462129, Lon=8.66499584663, Height=178.93m
- Orbit/clock corrections software: RTNet by GPS Solutions
- Orbits: CODE Ultra Rapid product
- Orbit/clock corrections stream: CLK10 on products.igs-ip.net by BKG
- Orbit/clock corrections encoding: BKG Ntrip Client (BNC)
- Broadcast ephemeris stream: RTCM3EPH on products.igs-ip.net by BKG
- PPP mode: Fully kinematic
- PPP filter converged criteria: Horizontal standard deviation 0.15m
- Sigma for a priori coordinates: ±10.0m
- Receiver restart: Every 2 hours
- Plot update: Every 2 hours



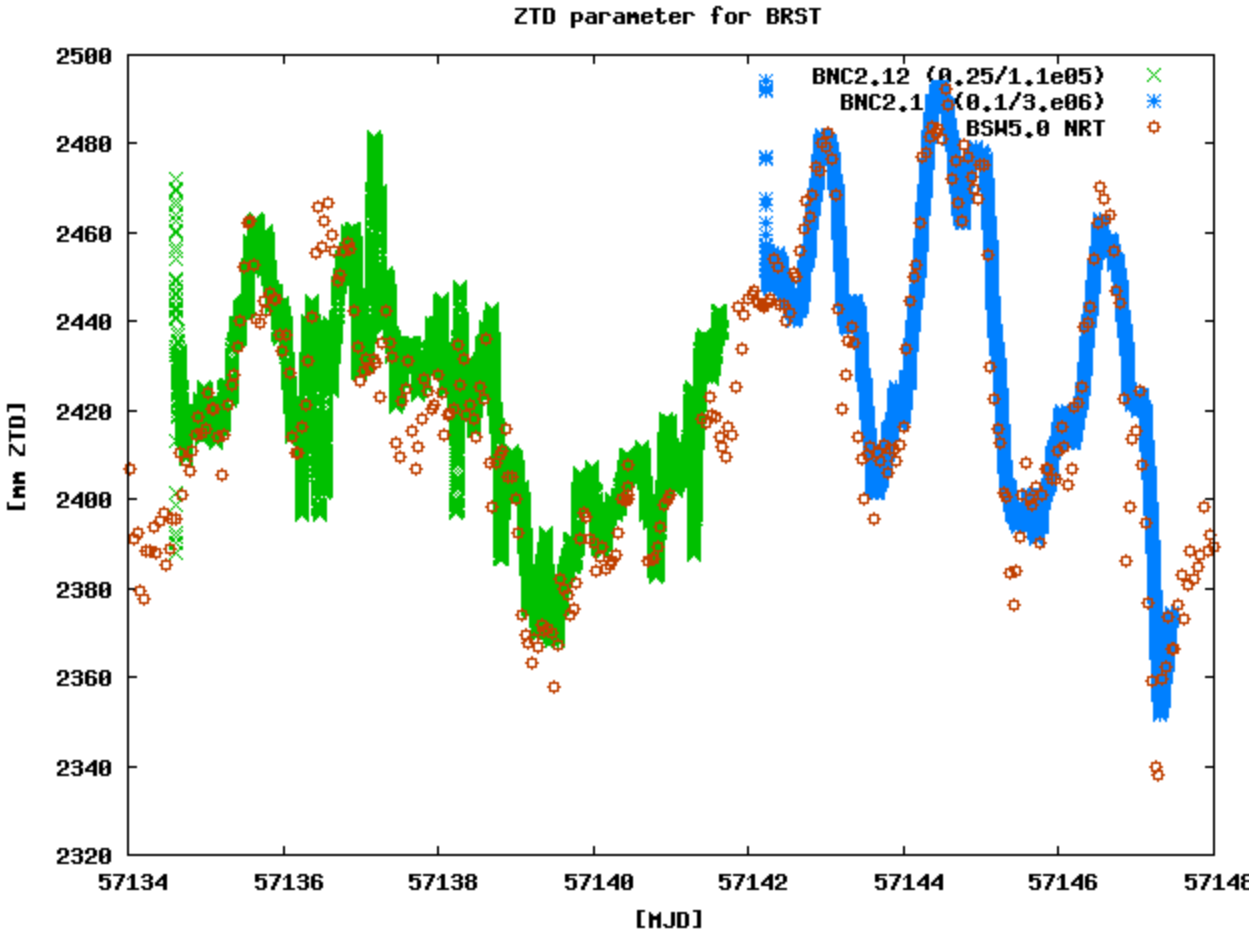
RT Analysis

- EPN RT Data used as input for (N)RT troposphere products
  - E.g. solution ‚bkgh' of E-GVAP using highrate 15 min RINEX v2 files stored from RT data streams with BSW5.0
  - → Talk by H. Vedel – E-GVAP (session #4, this afternoon)
  - Participation to PPP RT pilot project of ES1206 using RT data streams with various software packages (G-Nut, Gipsy) and BNC2.12:
    - multiple PPP solutions with one BNC command, individual configuration for each mountpoint
    - SINEX TRO output
  - → Talk by J. Jones et al. – COST Action ES1206 (session #4, this afternoon)

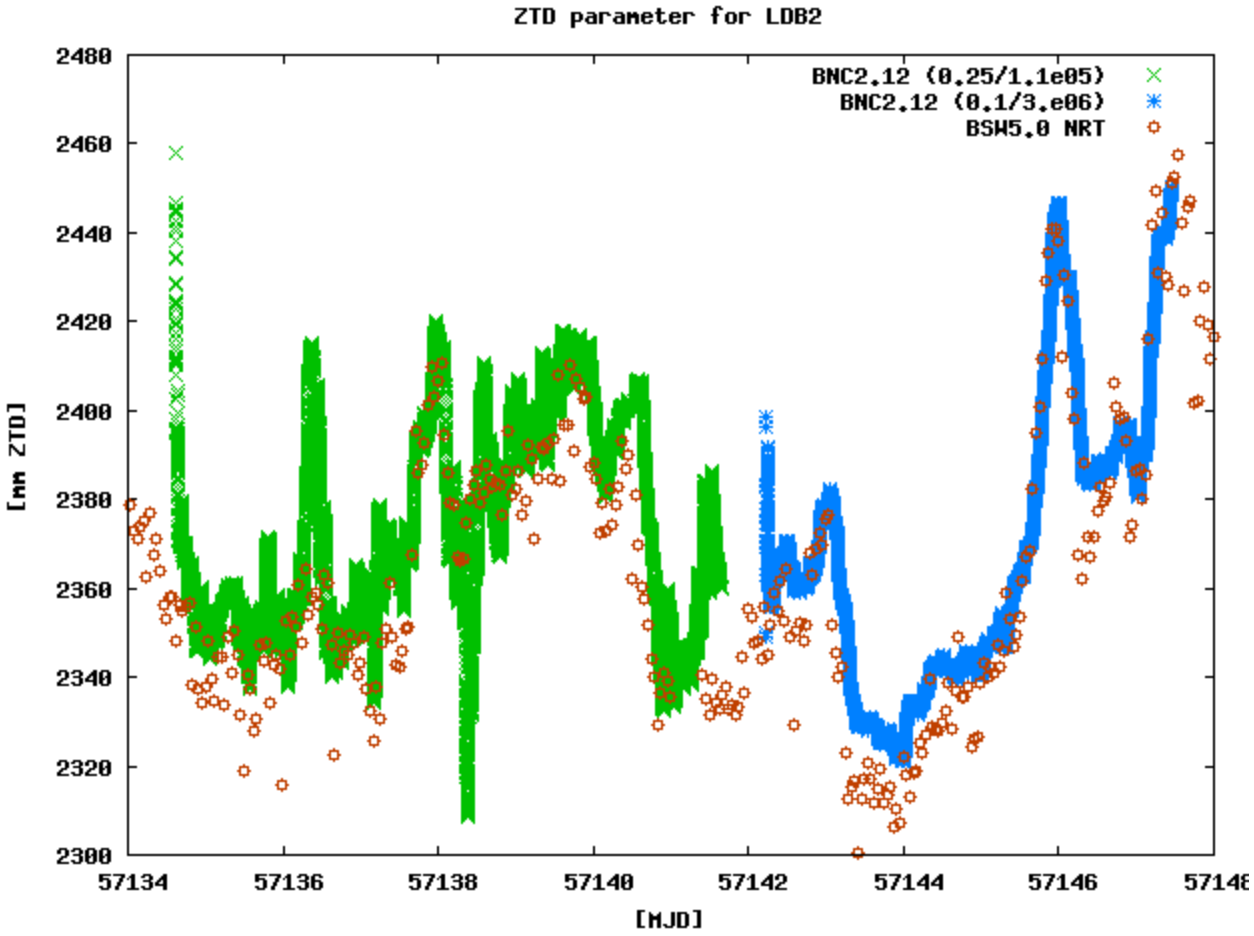
RT Analysis


ZTD parameter for NICO
RTNet
BNC2.12 (0.1/3e-06)
BSW5.0 NRT
[mm ZTD]
[MJD]
2440
2420
2400
2380
2360
2340
2320
2300
2280
57142
57143
57144
57145
57146
57147

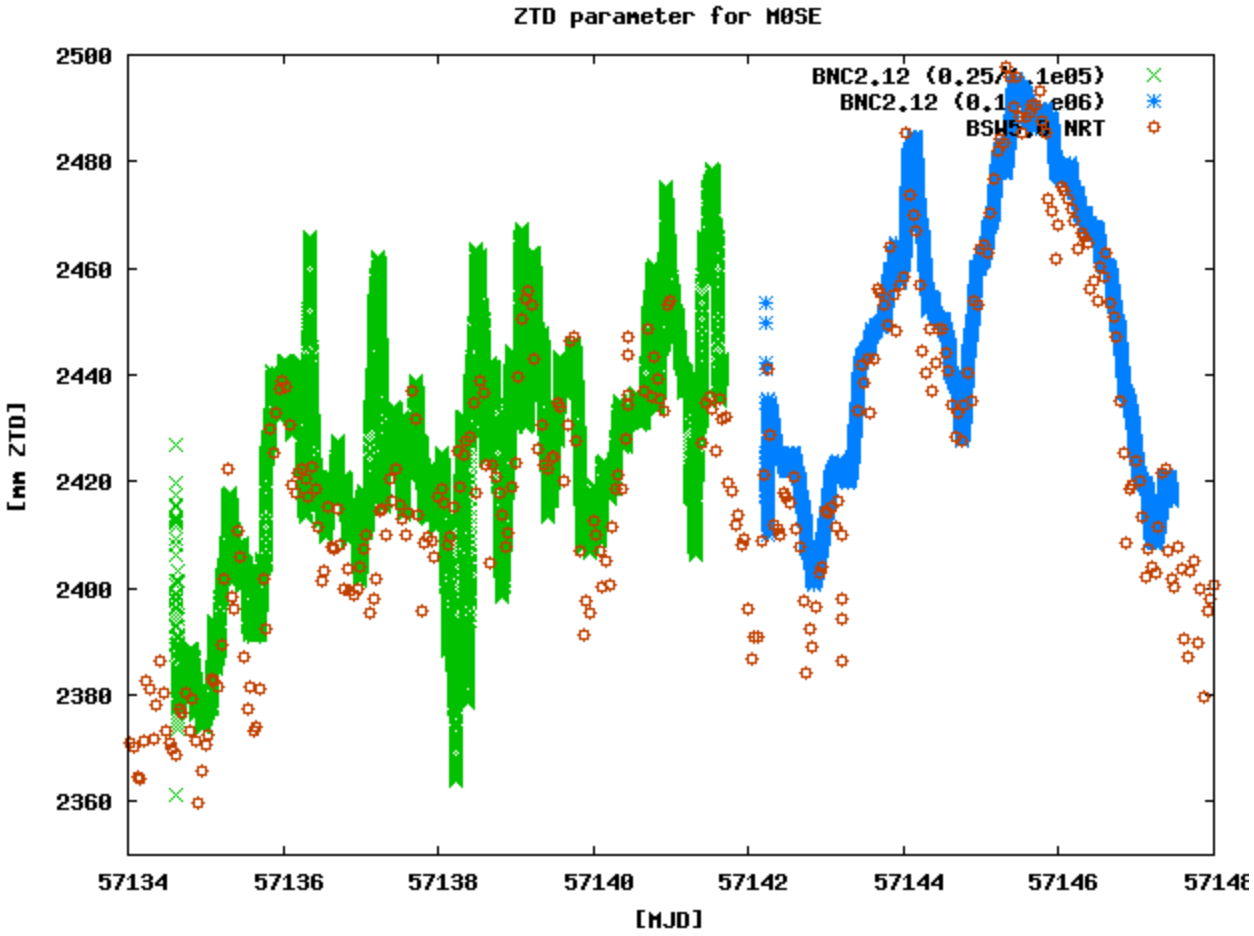
RT Analysis


ZTD parameter for BRST
BNC2.12 (0.25/1.1e05)
BNC2.1 (0.1/3.e06)
BSW5.0 NRT
[mm ZTD]
[MJD]
2500
2480
2460
2440
2420
2400
2380
2360
2340
2320
57134
57136
57138
57140
57142
57144
57146

RT Analysis


ZTD parameter for LDB2
BNC2.12 (0.25/1.1e05)
BNC2.12 (0.1/3.e06)
BSW5.0 NRT
[mm ZTD]
[MJD]
2480
2460
2440
2420
2400
2380
2360
2340
2320
2300
57134
57136
57138
57140
57142
57144
57146

RT Analysis


ZTD parameter for M0SE
BNC2.12 (0.25
.1e05)
BNC2.12 (0.1
e06)
BSH5.0 NRT
2500
2480
2460
2440
2420
2400
2380
2360
[mm ZTD]
57134
57136
57138
57140
57142
57144
57146
[MJD]

Thank you for listening !

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