Federal Agency for
Cartography and Geodesy

Status of EPN Real-Time Activities

Wolfgang Söhne

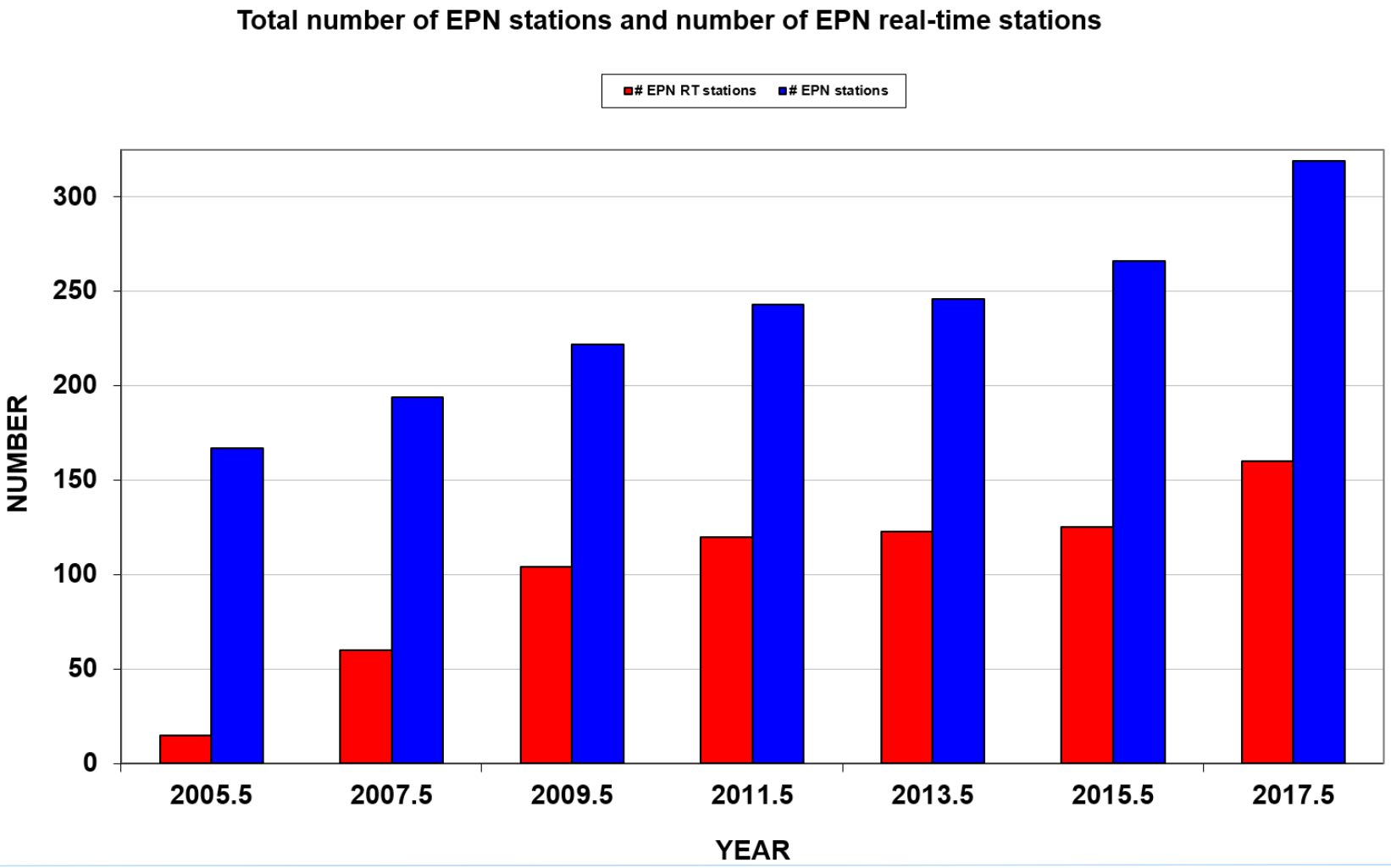
Contents

- Real-Time Data
- Real-Time Products
- From a Product to a Service
- Conclusions and Outlook

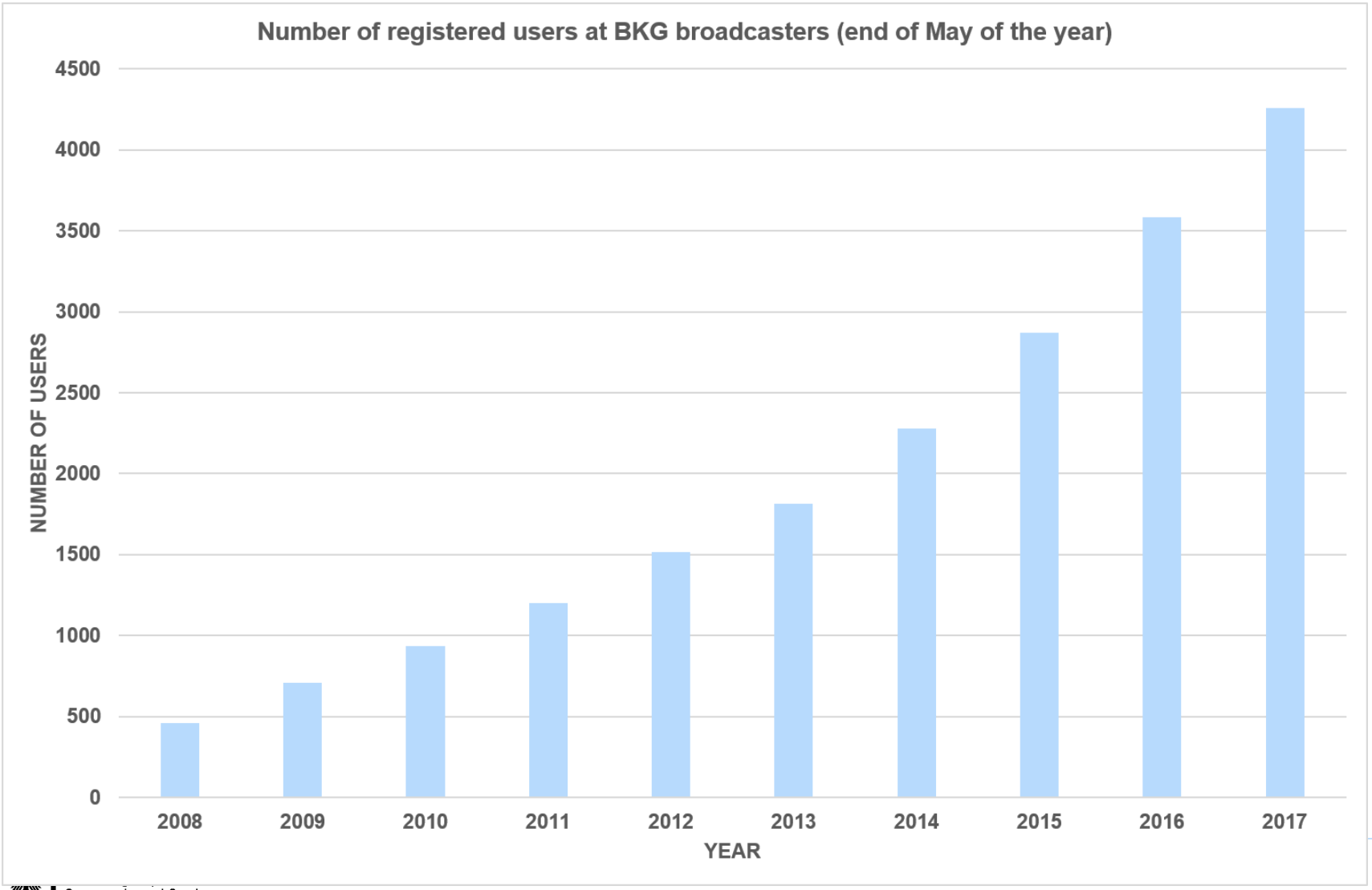
Real-Time Data

- Number of RT stations still on the level of approx. 50 %
- Step from RTCM 3.0/3.1 to RTCM 3.2/3.3 ongoing
  - 7 message types (6 and 7 high resolution)
  - E.g. 1071-1077 for GPS, 1081-1087 for GLO, 1091-1097 for GAL
  - Request for 1074/5, 1084/5, 1094/5
- Introduction of long mountpoint names
  - „white paper“ presented at IGS workshop
  - E.g. VAA20 → VAA200FIN0
  - „0“ at char. 9 for the „legal“ or most common RTCM stream

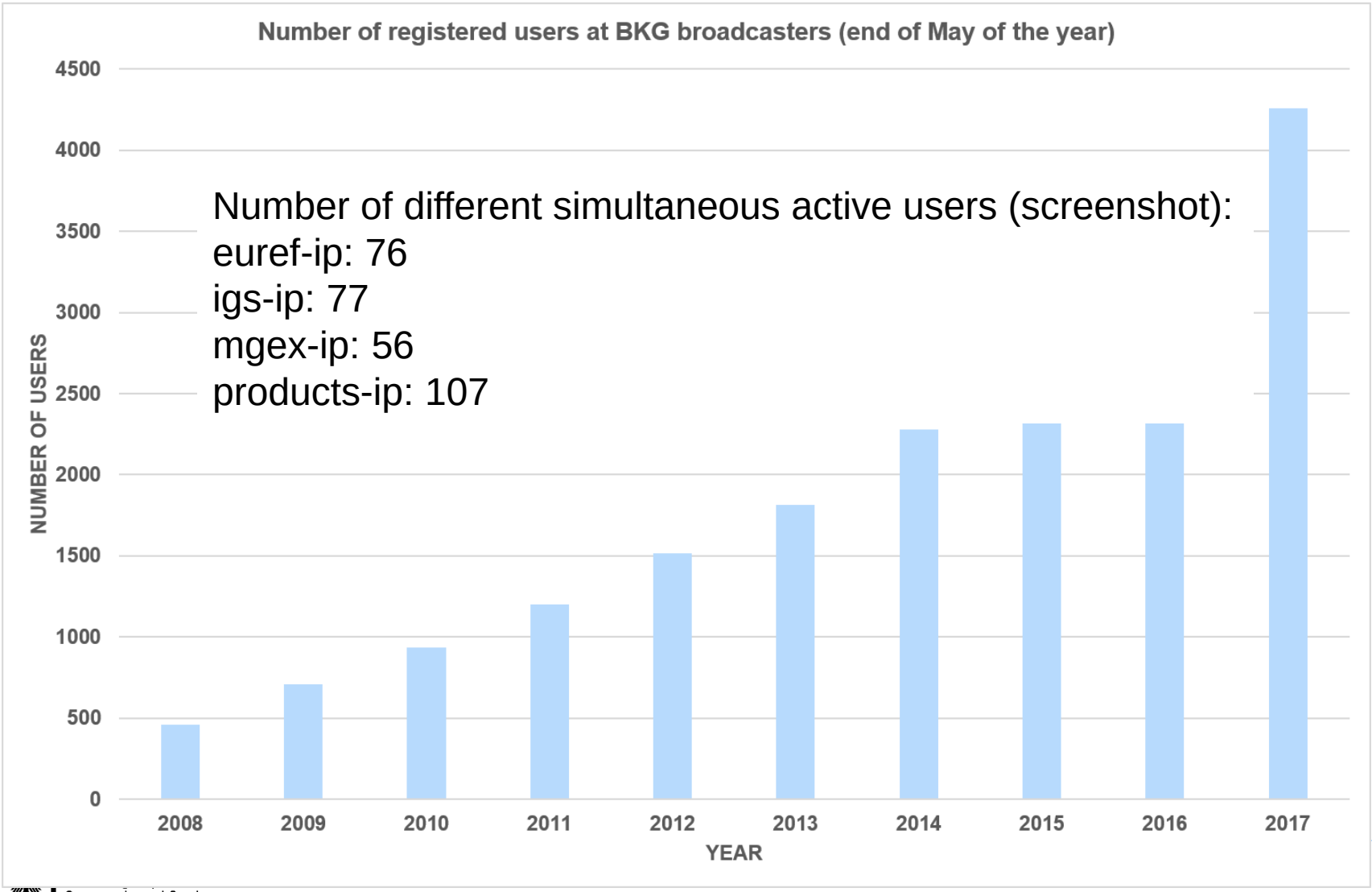
Real-Time Stations



Real-Time User Registrations



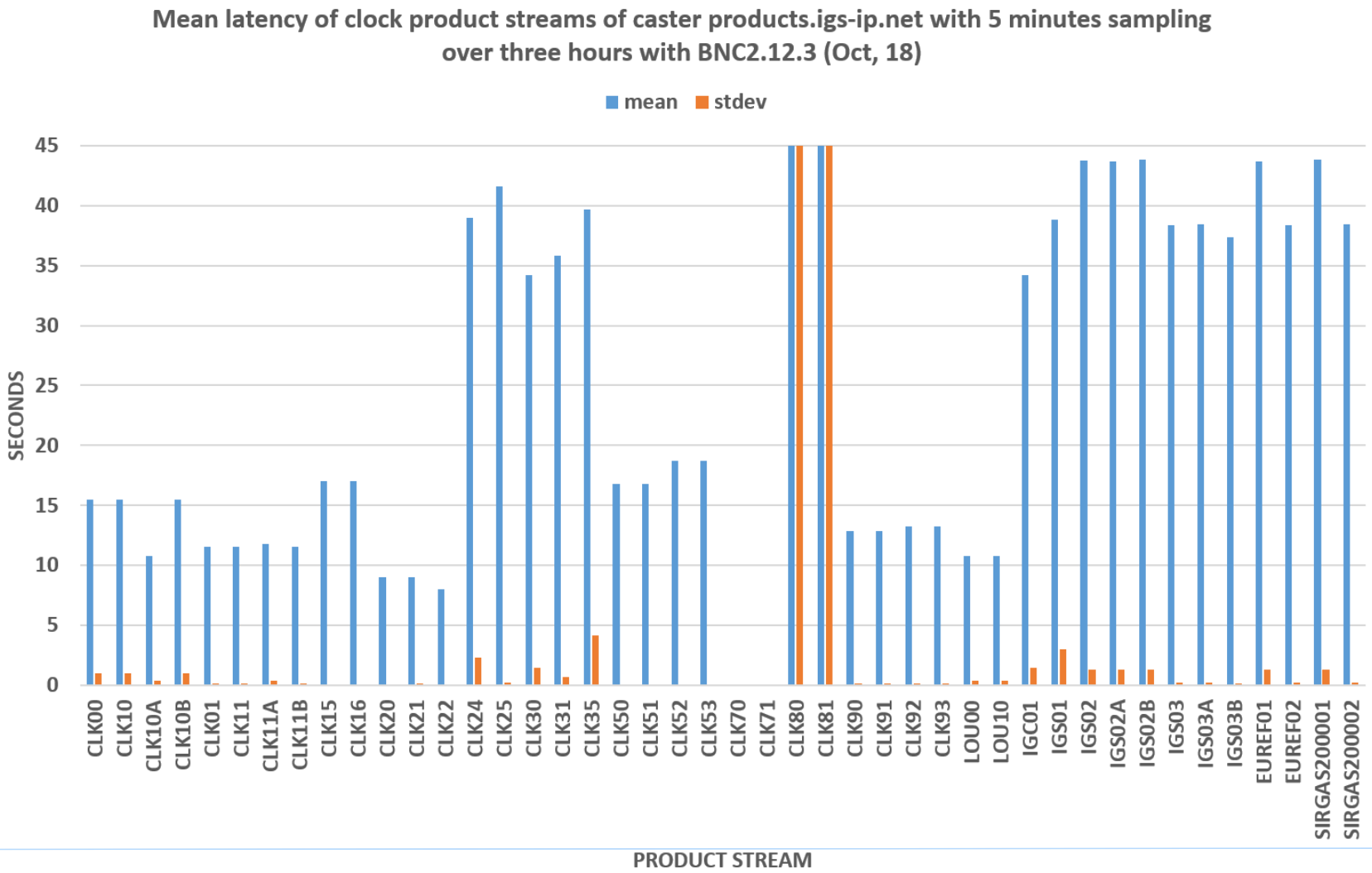
Real-Time User Registrations



Real-Time Products

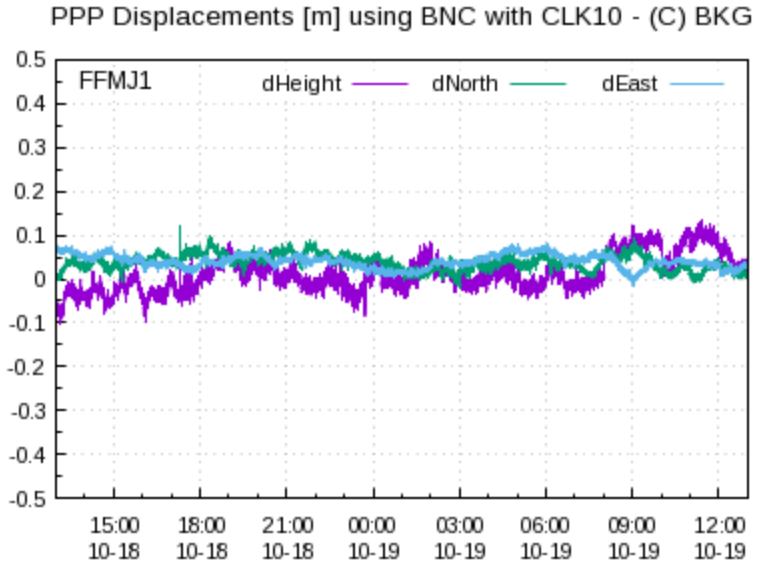
- Large variety (21) of individual orbit and clock correction streams CLKmn: 8 ACs (BKG, CNES, DLR, ESOC, GFZ, GMV, NRCan, Wuhan) with CoM and APC solution and variants
- Different Broadcast ephemeris streams RTCM3EPH_…
- Combined solutions IGCmn, IGSmn with CoM and APC
  - IGC01: combined GPS, CoM (ESOC)
  - IGS01: combined GPS, APC (ESOC)
  - IGS02: combined GPS, 8ACs, APC (BKG)
  - IGS03: combined GPS+GLO, 5 ACs, APC (BKG)

Real-Time Products – Latency



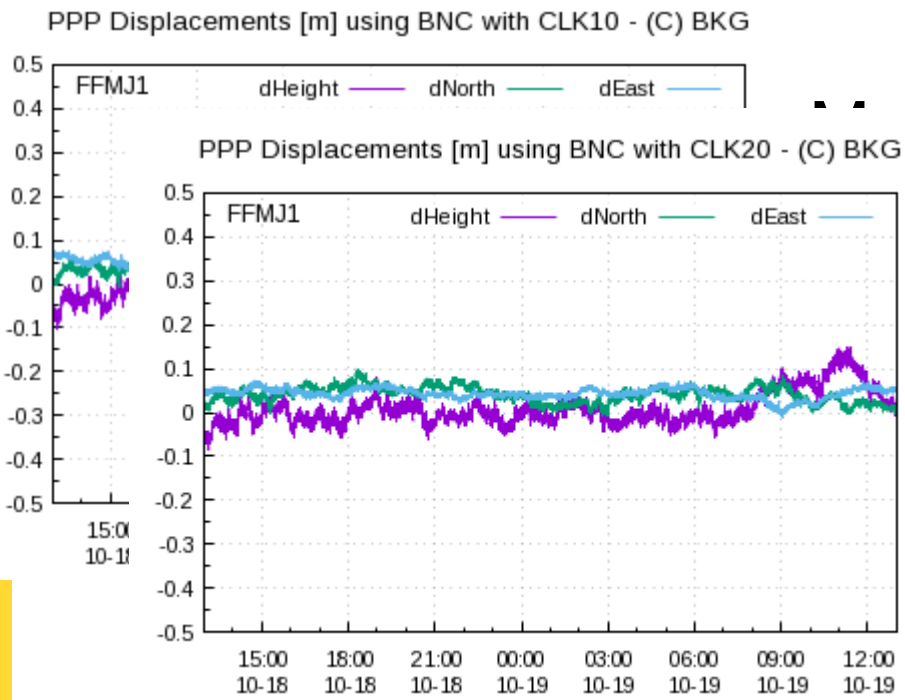
Federal Agency for Cartography and Geodesy

Real-Time Products - Monitoring

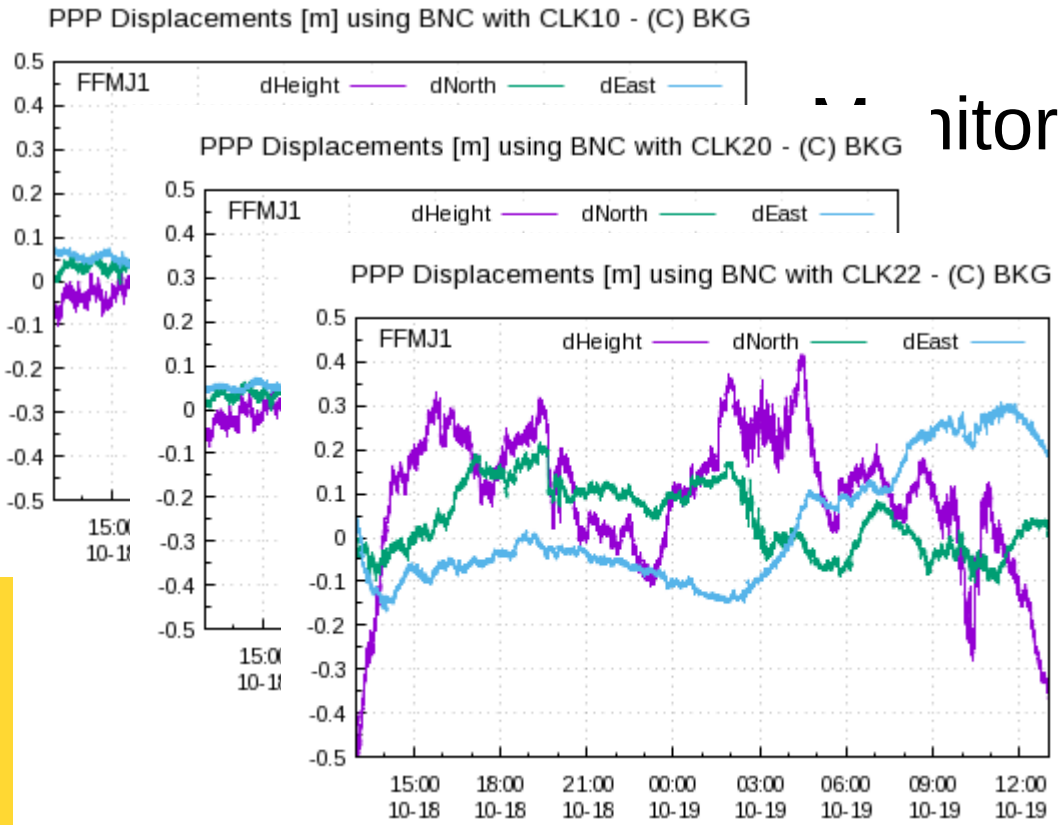

PPP Displacements [m] using BNC with CLK10 - (C) BKG
FFMJ1
dHeight
dNorth
dEast
0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
15:00 10-18
18:00 10-18
21:00 10-18
00:00 10-19
03:00 10-19
06:00 10-19
09:00 10-19
12:00 10-19

· Monitoring

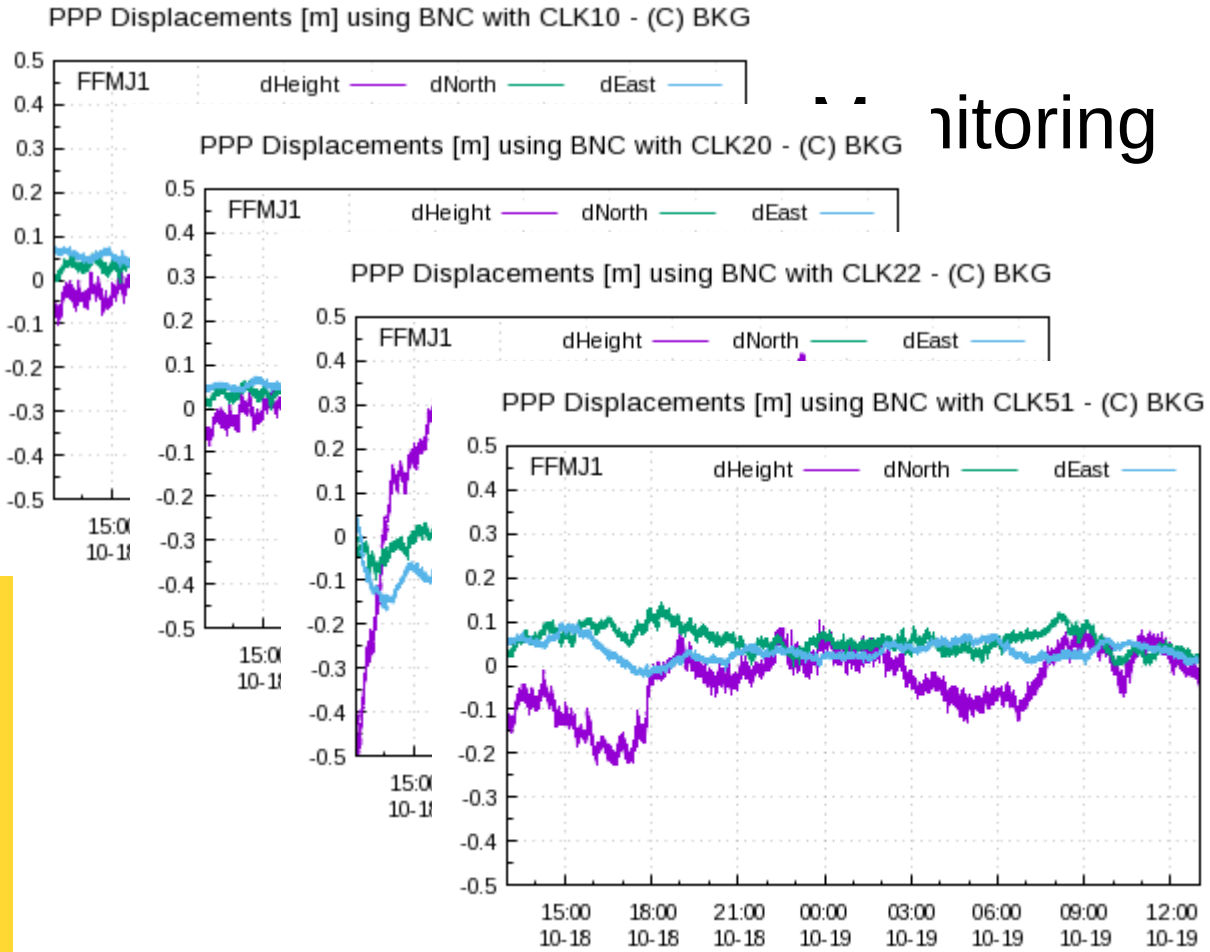
Monitoring


PPP Displacements [m] using BNC with CLK10 - (C) BKG
FFMJ1
dHeight
dNorth
dEast
PPP Displacements [m] using BNC with CLK20 - (C) BKG
FFMJ1
dHeight
dNorth
dEast
0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
15:00 10-18
18:00 10-18
21:00 10-18
00:00 10-19
03:00 10-19
06:00 10-19
09:00 10-19
12:00 10-19

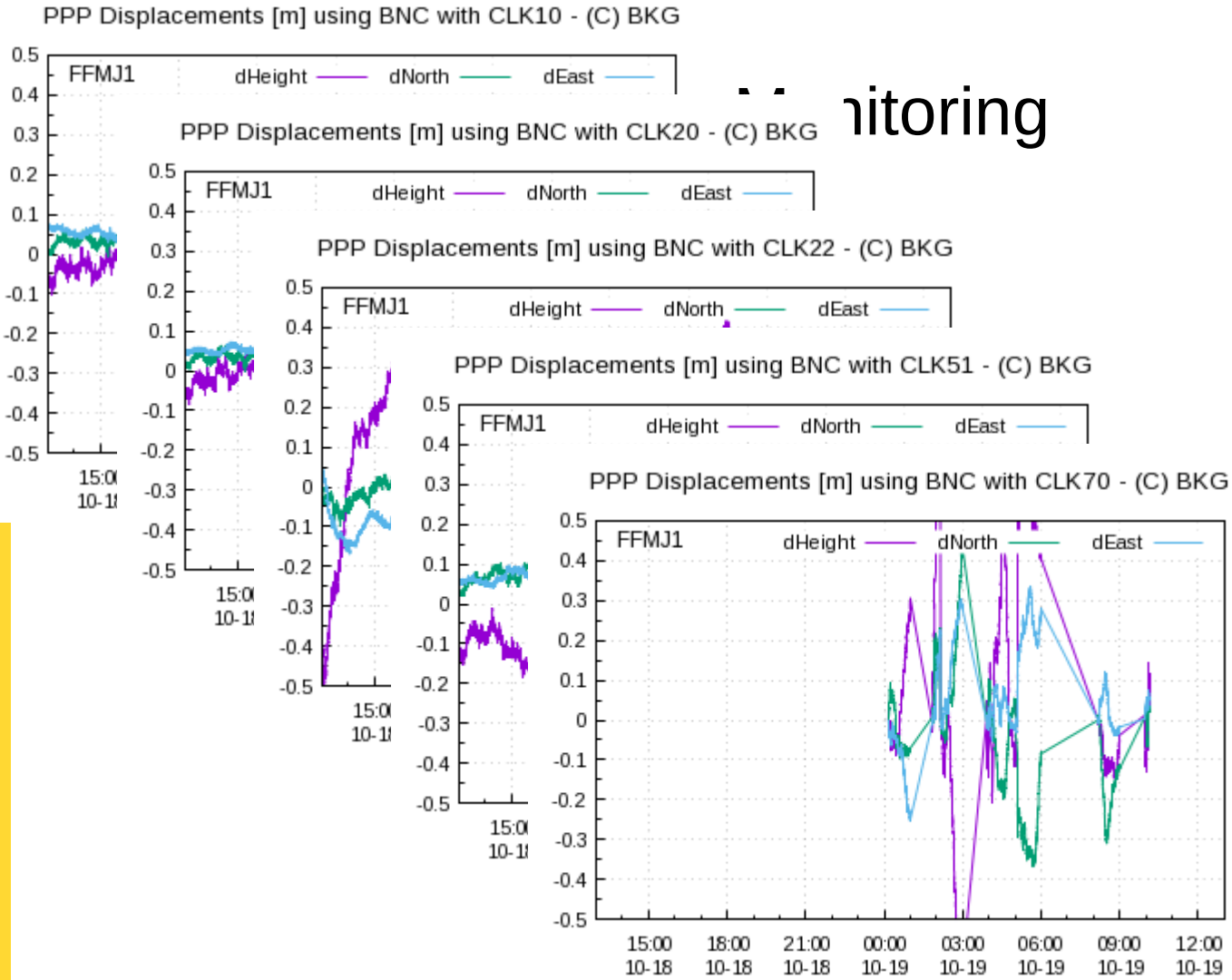
Monitoring


PPP Displacements [m] using BNC with CLK10 - (C) BKG
FFMJ1
dHeight
dNorth
dEast
PPP Displacements [m] using BNC with CLK20 - (C) BKG
FFMJ1
dHeight
dNorth
dEast
PPP Displacements [m] using BNC with CLK22 - (C) BKG
FFMJ1
dHeight
dNorth
dEast
0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
15:00 10-18
18:00 10-18
21:00 10-18
00:00 10-19
03:00 10-19
06:00 10-19
09:00 10-19
12:00 10-19

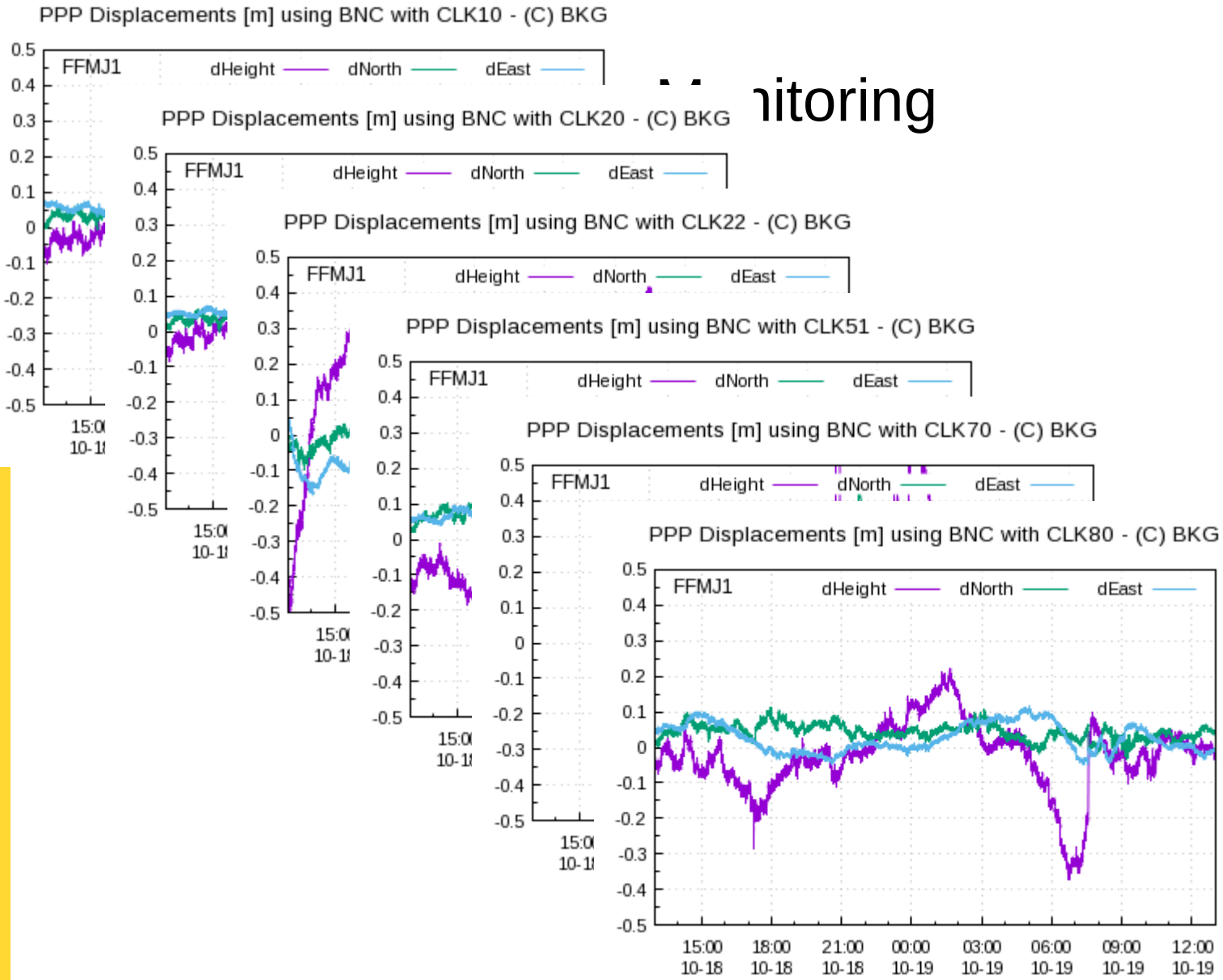
Monitoring


PPP Displacements [m] using BNC with CLK10 - (C) BKG
PPP Displacements [m] using BNC with CLK20 - (C) BKG
PPP Displacements [m] using BNC with CLK22 - (C) BKG
PPP Displacements [m] using BNC with CLK51 - (C) BKG
FFMJ1
dHeight
dNorth
dEast
15:00 10-18
18:00 10-18
21:00 10-18
00:00 10-19
03:00 10-19
06:00 10-19
09:00 10-19
12:00 10-19

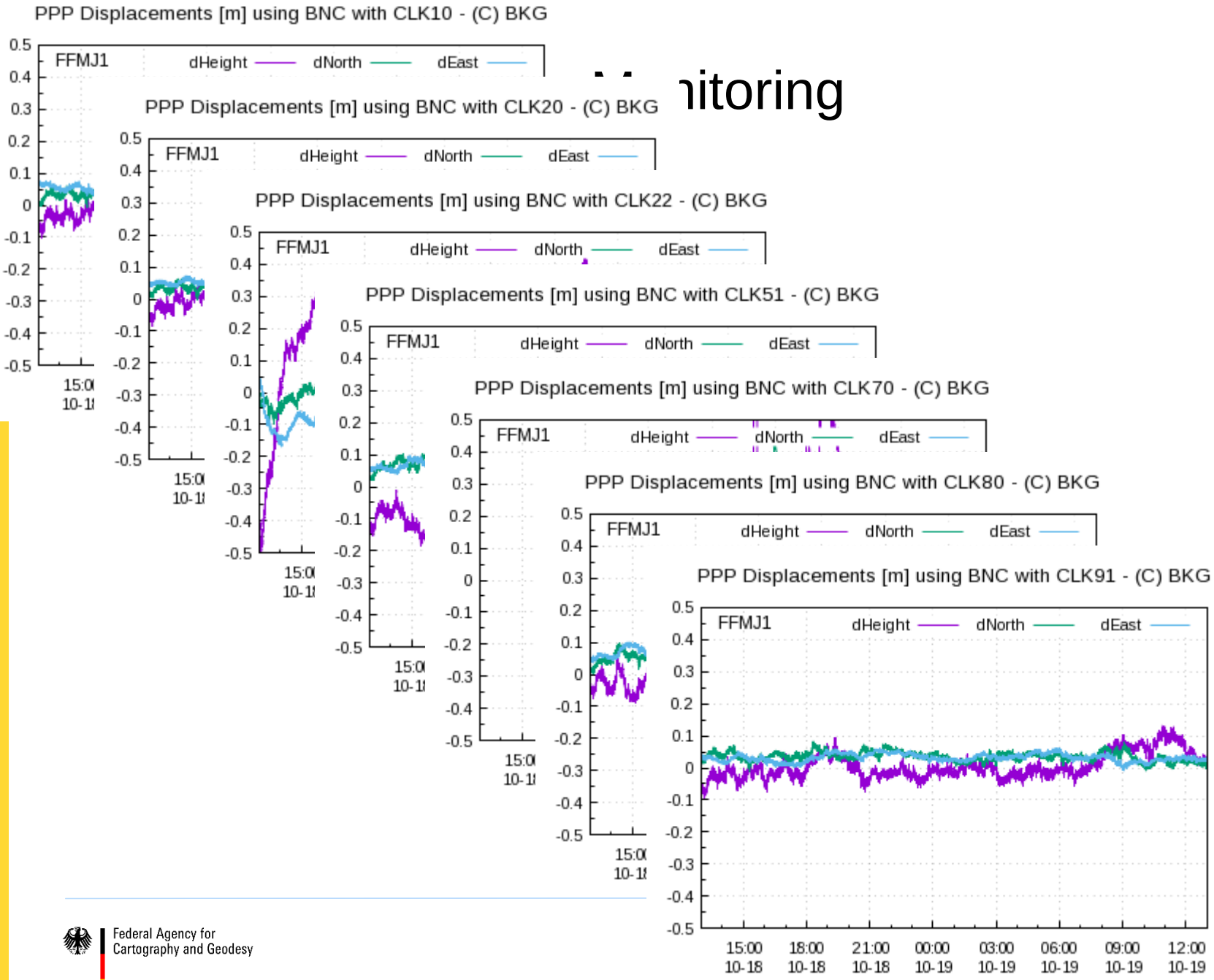
Monitoring

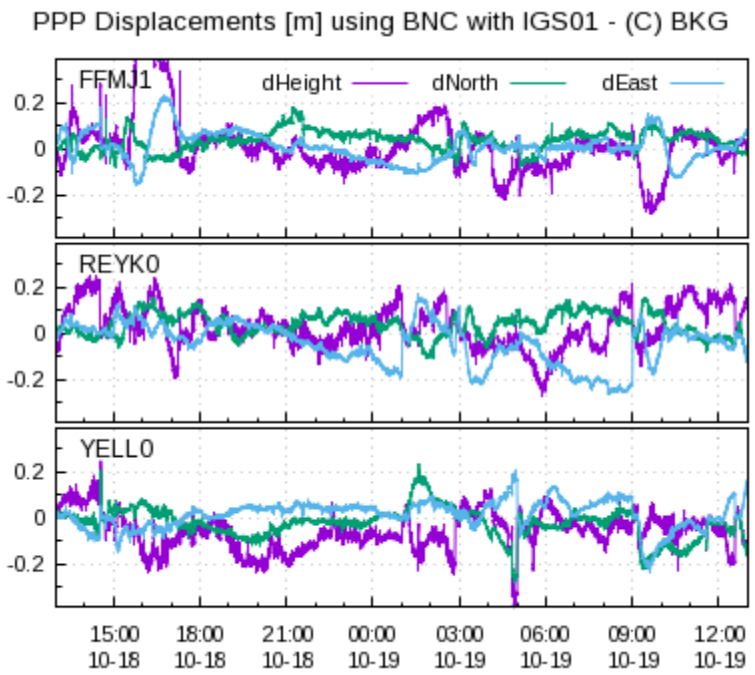

PPP Displacements [m] using BNC with CLK10 - (C) BKG
FFMJ1
dHeight
dNorth
dEast
PPP Displacements [m] using BNC with CLK20 - (C) BKG
PPP Displacements [m] using BNC with CLK22 - (C) BKG
PPP Displacements [m] using BNC with CLK51 - (C) BKG
PPP Displacements [m] using BNC with CLK70 - (C) BKG
15:00
10-18
18:00
10-18
21:00
10-18
00:00
10-19
03:00
10-19
06:00
10-19
09:00
10-19
12:00
10-19

Monitoring


PPP Displacements [m] using BNC with CLK10 - (C) BKG
PPP Displacements [m] using BNC with CLK20 - (C) BKG
PPP Displacements [m] using BNC with CLK22 - (C) BKG
PPP Displacements [m] using BNC with CLK51 - (C) BKG
PPP Displacements [m] using BNC with CLK70 - (C) BKG
PPP Displacements [m] using BNC with CLK80 - (C) BKG
FFMJ1
dHeight
dNorth
dEast
15:00 10-18
18:00 10-18
21:00 10-18
00:00 10-19
03:00 10-19
06:00 10-19
09:00 10-19
12:00 10-19

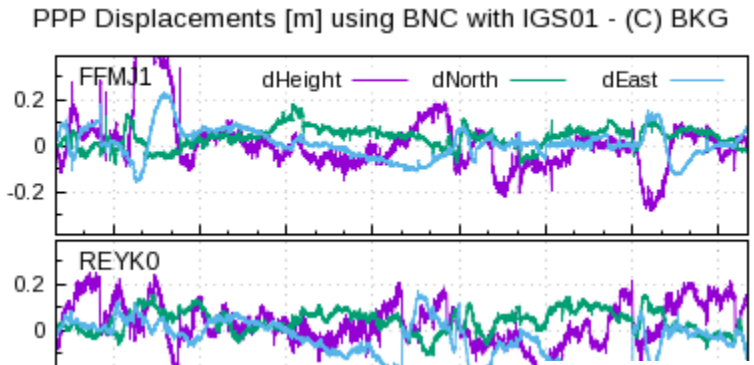
Monitoring

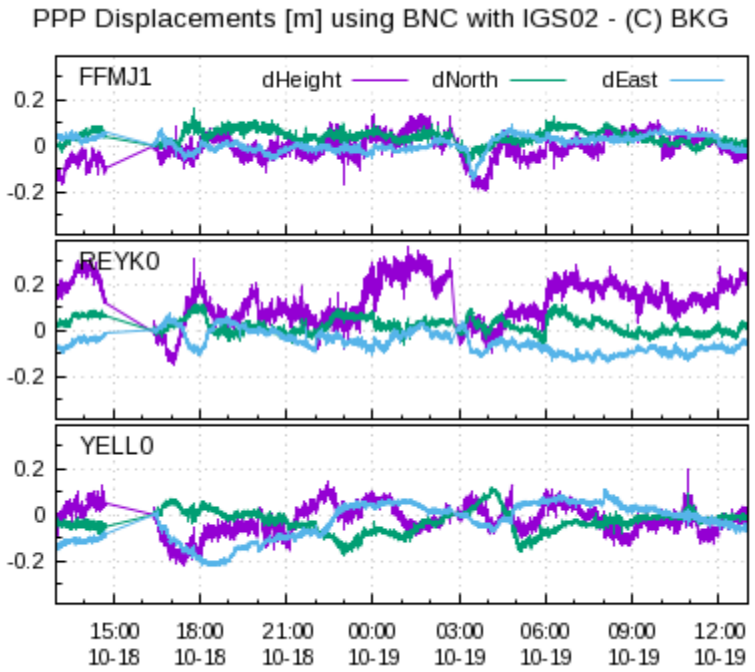

PPP Displacements [m] using BNC with CLK10 - (C) BKG
PPP Displacements [m] using BNC with CLK20 - (C) BKG
PPP Displacements [m] using BNC with CLK22 - (C) BKG
PPP Displacements [m] using BNC with CLK51 - (C) BKG
PPP Displacements [m] using BNC with CLK70 - (C) BKG
PPP Displacements [m] using BNC with CLK80 - (C) BKG
PPP Displacements [m] using BNC with CLK91 - (C) BKG
FFMJ1
dHeight
dNorth
dEast
15:00
18:00
21:00
00:00
03:00
06:00
09:00
12:00
10-18
10-19


PPP Displacements [m] using BNC with IGS01 - (C) BKG
FFMJ1
dHeight
dNorth
dEast
REYK0
YELL0
0.2
0
-0.2
15:00 10-18
18:00 10-18
21:00 10-18
00:00 10-19
03:00 10-19
06:00 10-19
09:00 10-19
12:00 10-19

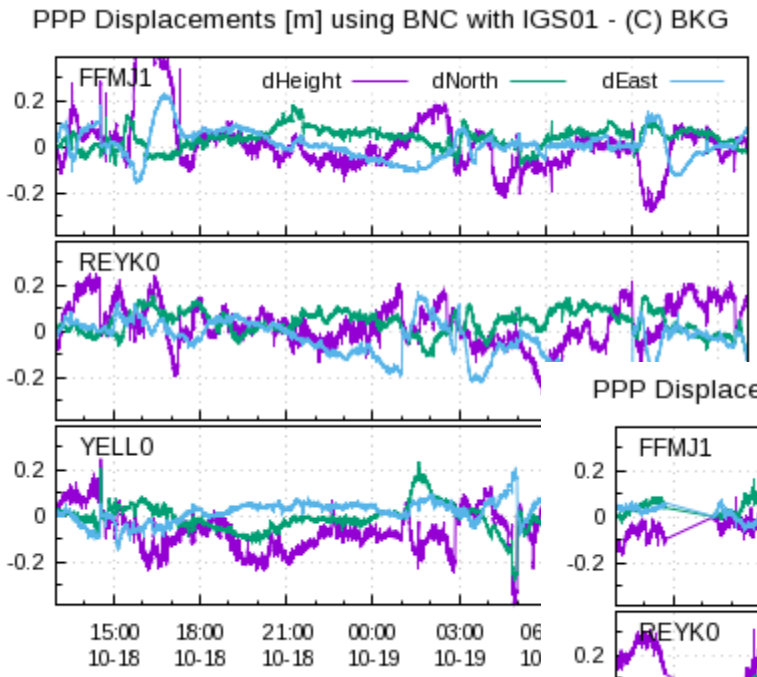
· Monitoring

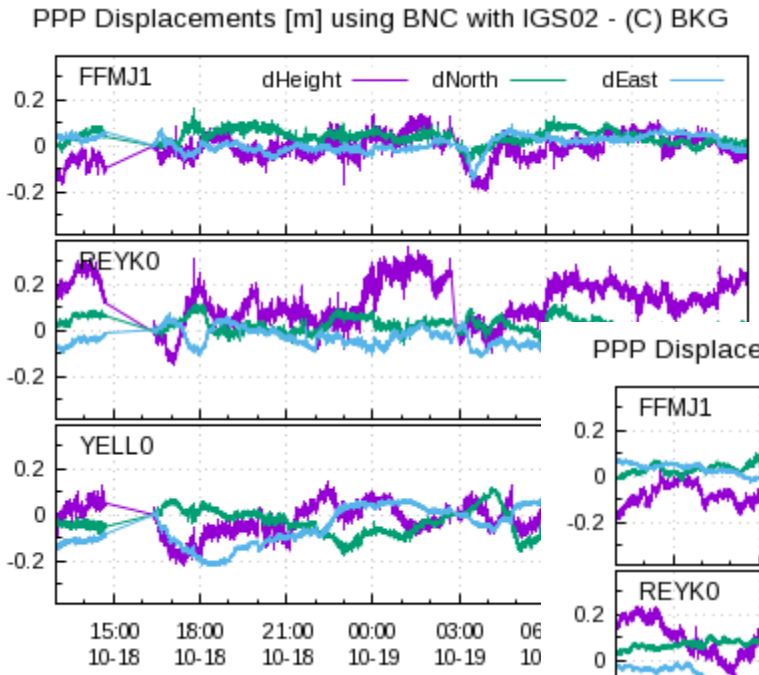
· Monitoring

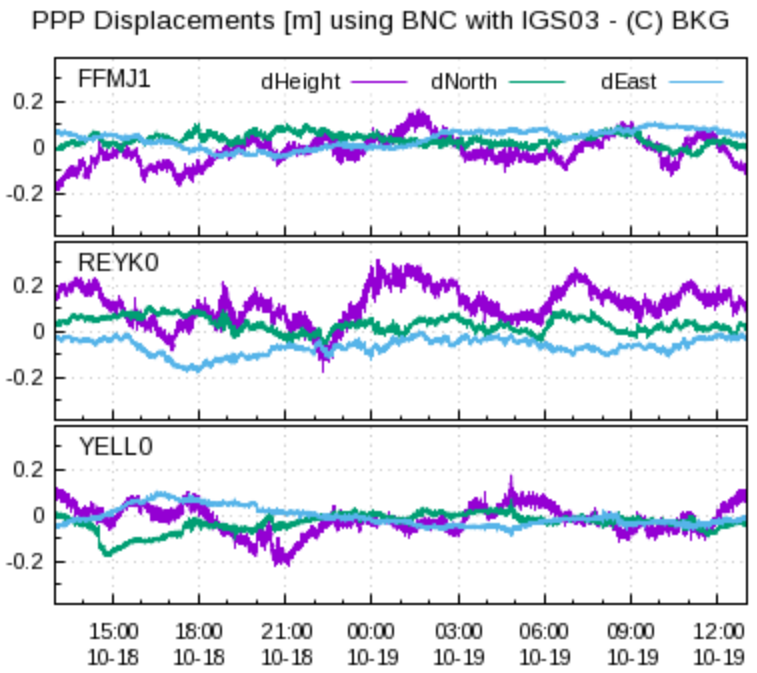

PPP Displacements [m] using BNC with IGS01 - (C) BKG
FFMJ1
dHeight
dNorth
dEast
REYK0
YELL0
0.2
0
-0.2
15:00 10-18
18:00 10-18
21:00 10-18
00:00 10-19
03:00 10-19


PPP Displacements [m] using BNC with IGS02 - (C) BKG
FFMJ1
dHeight
dNorth
dEast
REYK0
YELL0
0.2
0
-0.2
15:00 10-18
18:00 10-18
21:00 10-18
00:00 10-19
03:00 10-19
06:00 10-19
09:00 10-19
12:00 10-19

· Monitoring


PPP Displacements [m] using BNC with IGS01 - (C) BKG
FFMJ1
dHeight
dNorth
dEast
REYK0
YELL0
0.2
0
-0.2
15:00 10-18
18:00 10-18
21:00 10-18
00:00 10-19
03:00 10-19


PPP Displacements [m] using BNC with IGS02 - (C) BKG
FFMJ1
dHeight
dNorth
dEast
REYK0
YELL0
0.2
0
-0.2
15:00 10-18
18:00 10-18
21:00 10-18
00:00 10-19
03:00 10-19


PPP Displacements [m] using BNC with IGS03 - (C) BKG
FFMJ1
dHeight
dNorth
dEast
REYK0
YELL0
0.2
0
-0.2
15:00 10-18
18:00 10-18
21:00 10-18
00:00 10-19
03:00 10-19
06:00 10-19
09:00 10-19
12:00 10-19

Positioning Service

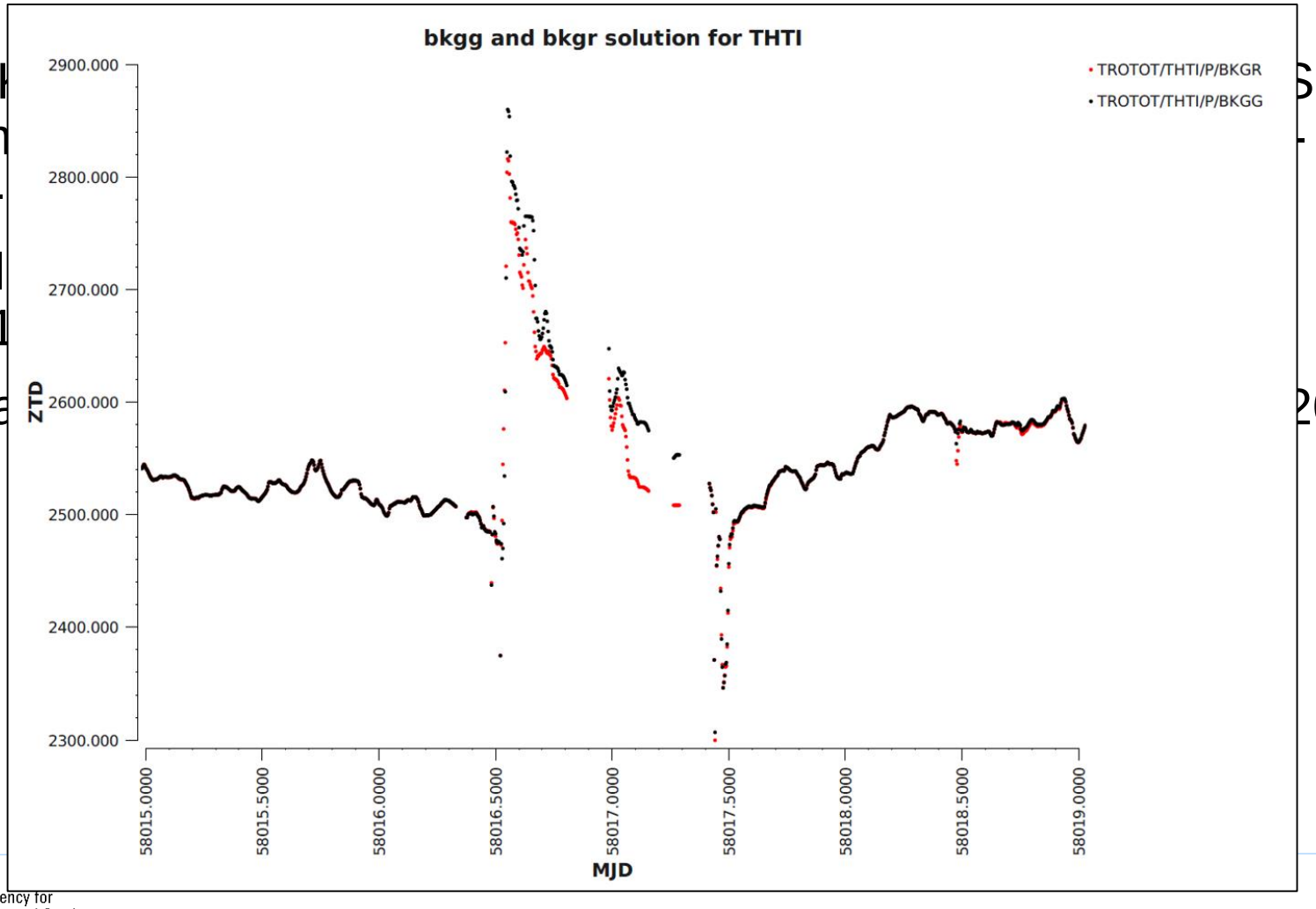
- Since 2017 BKG has been running a R&D project on the development of a positioning service for the federal administration
- First step (work package): critical review of existent structure, processing chain, products, tools, …
- Is International GNSS Service Real-Time Service (IGS RTS) offering a service?
  - IGS RTS is offering RT data and RT products on a „best effort“ basis
  - Description of data and products can be found with some effort (different aspects found in different places)
  - Summary of combination results contains some information about precision, mainly for the provider himself, with some delay
  - Monitoring, if any, takes place at different places
  - (Real-time) Information to the user about e.g. downtime, degradation, changes doesn‘t exist or just rudimentary

Positioning Service – example

- CLK20 individual solution included again in GPS+GLONASS combined orbit and clock correction stream IGS03 on 2017-09-20
- Solution was erroneous from 2017-09-20, ~ 12 UTC until 2017-09-21, ~ 12 UTC (58016.5-58017.5), degrading the combined solution
- Example shows the effect on BKG‘s contributions to COSTES1206 RT campaign

Positioning Service – example

- CL
  con
  09-
- Sol
  201
- Exa
  RT



Positioning Service

- A Positioning Service must contain
  - Risk analysis (at least internal)
  - Real-Time Monitoring system with real-time information about each element of the processing chain
  - Product description with key features and key numbers
  - User interaction with short reaction time
  - …

Conclusions & Outlook

- Real-Time Data
  - RT stations to keep the pace with overall EPN station evolvement
  - Homogeneous distribution of users to broadcasters still an issue
    → possibly open EPN RBCs to MSM, to global, to products?
- Real-Time Products
  - No „real“ EUREF / EPN RT product(s)
  - Standardisation of SSR in RTCM SC104 delayed
- RT PPP Software
  - BNC new version 2.13 close to final
  - G-nut/Tefnut – open source, download available
  - RTKLIB ~~new~~ version 2.4.3 (beta) available – development stopped?

Thank you for your kind attention!

Contact:

Federal Agency for Cartography and Geodesy
Section G2
Richard-Strauss-Allee 11
60598 Frankfurt, Germany

contact person
Wolfgang Söhne
wolfgang.soehne@bkg.bund.de
www.bkg.bund.de
Tel. +49 (0) 69 6333-263