

Realtime PPP using EUREF and IGS Networks

Georg Weber¹⁾

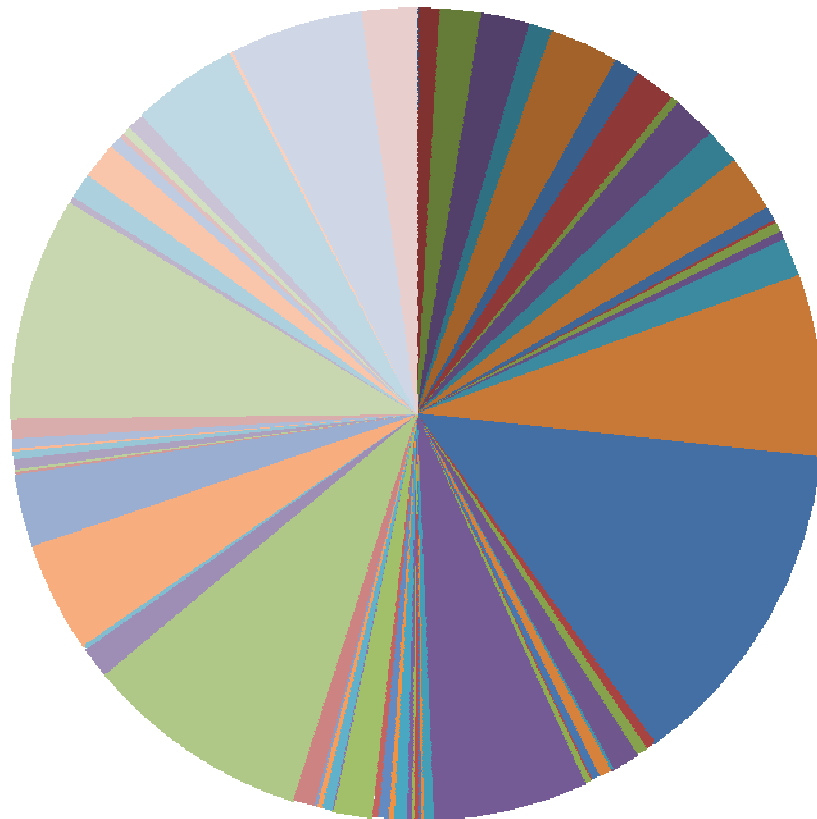
Leos Mervart²⁾ , Peter Neumaier¹⁾, Andrea Stürze¹⁾

¹⁾ Federal Agency for Cartography and Geodesy, Frankfurt am Main, Germany

²⁾ Technical University Prague, Department of Geodesy, Czech Republic

Usage of Realtime GNSS Resources from EUREF & IGS Disseminated via NTRIP

68 Countries from latest 1000 User registrations Status March 25, 2010

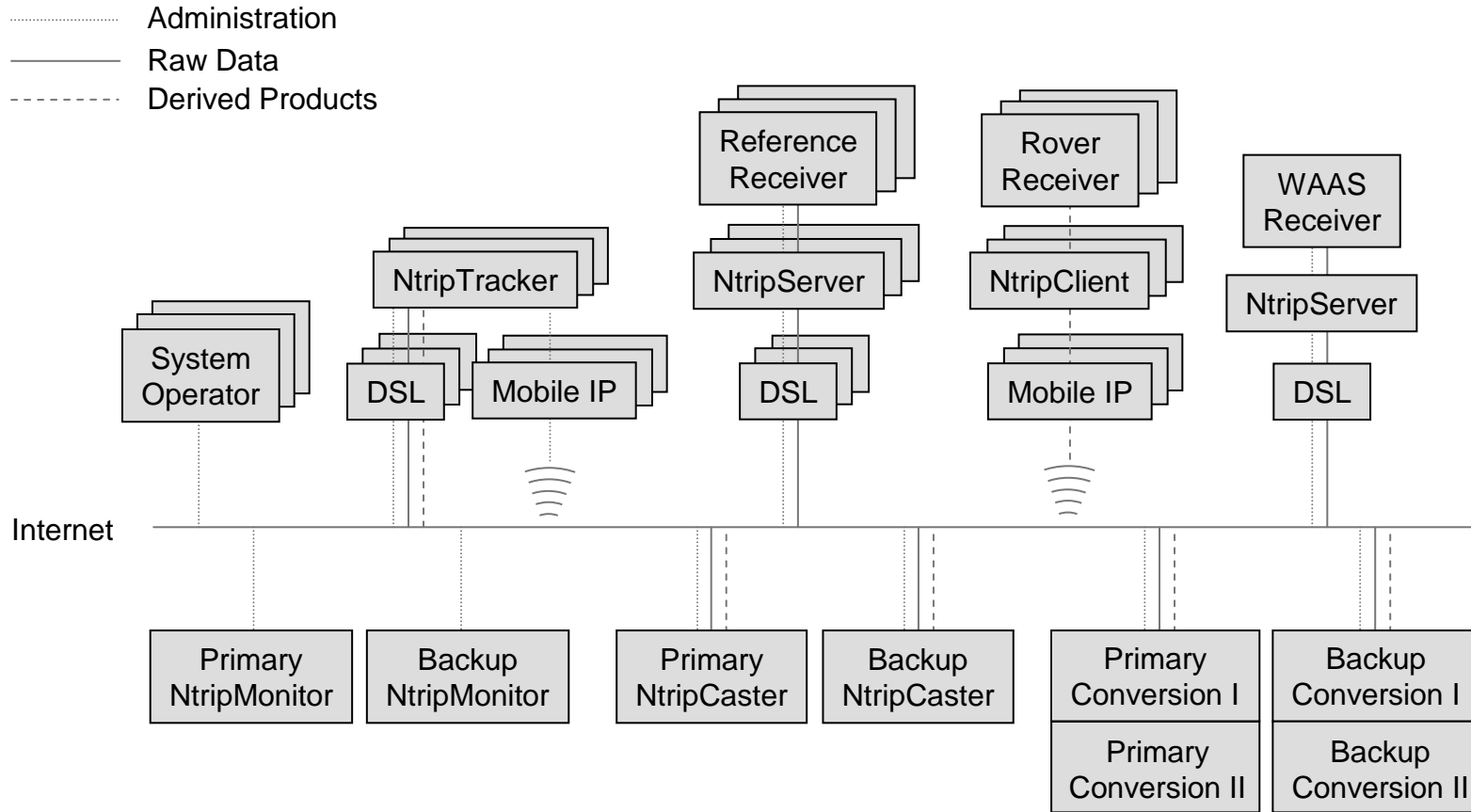


■ Albania	■ Argentina	■ Australia	■ Austria	■ Belgium	■ Brazil	■ Bulgaria	■ Canada
■ Chile	■ China	■ Croatia	■ Czech Republic	■ Denmark	■ Ecuador	■ Egypt	■ Estonia
■ Finland	■ France	■ Germany	■ Greece	■ Hong Kong	■ Hungary	■ Iceland	■ India
■ Indonesia	■ Iraq	■ Ireland	■ Italy	■ Japan	■ Kazakhstan	■ Kenya	■ Latvia
■ Lothian	■ Macedonia	■ Malaysia	■ Mexico	■ Moldova	■ Morocco	■ Netherlands	■ New Caledonia
■ New Zealand	■ Nigeria	■ Northern Ireland	■ Norway	■ Poland	■ Portugal	■ Puerto Rico	■ Romania
■ Russia	■ Saudia Arabia	■ Serbia	■ Singapore	■ Slovakia	■ Slovenia	■ South Africa	■ South Korea
■ Spain	■ Sri Lanka	■ Sweden	■ Switzerland	■ Taiwan	■ Thailand	■ Turkey	■ Ukraine
■ United Kingdom	■ Uruguay	■ USA	■ Venezuela				

EUREF & IGS: Enabling Access to Reference Frame in Real-time

- Past:
 - Providing coordinates and RINEX files from EPN sites for
 - Coordinate estimation in post processing
- Today:
 - Disseminating EPN & IGS observations streams and streams carrying orbit/clock correctors for
 - Real-time Precise Point Positioning
 - Network RTK

Real-time EUREF & IGS Service Provision Structure



Subversion Server @ software.rtcn-ntrip.org

- Open Source software development for Ntrip
- Concerns BNC, BNS, POSIX ntripclient/server/caster
- Includes bugtracker



**Wiki Server
Hypertext System
for Ntrip Software**

BKG Ntrip Client (BNC) v2.1

File Help

Observations RINEX Ephemeris Broadcast Corrections Feed Engine Serial Output Outages Miscellaneous PPP Client

Mountpoint: FFMJ1

Options: Static Use phase obs Estimate tropo Use GLONASS

Ref. coordinates: X: 4053455.817 Y: 617729.7434 Z: 4869395.7728

NMEA File (full path): c:\temp\rinex\nmea.txt Port:

Coordinates from Precise Point Positioning (PPP).

Streams:	resource loader / mountpoint	decoder	lat	long	nmea	ntrip	bytes
1	www.igs-ip.net:2101/CLK11	RTCM_3.0	50.00	10.00	no	2	35.6 kB
2	www.igs-ip.net:2101/FFMJ1	RTCM_3.0	50.09	8.66	no	2	32.779 kB
3	www.igs-ip.net:2101/RTCM3EPH	RTCM_3	50.09	8.66	no	2	30.429 kB

Log Throughput Latency Static PPP

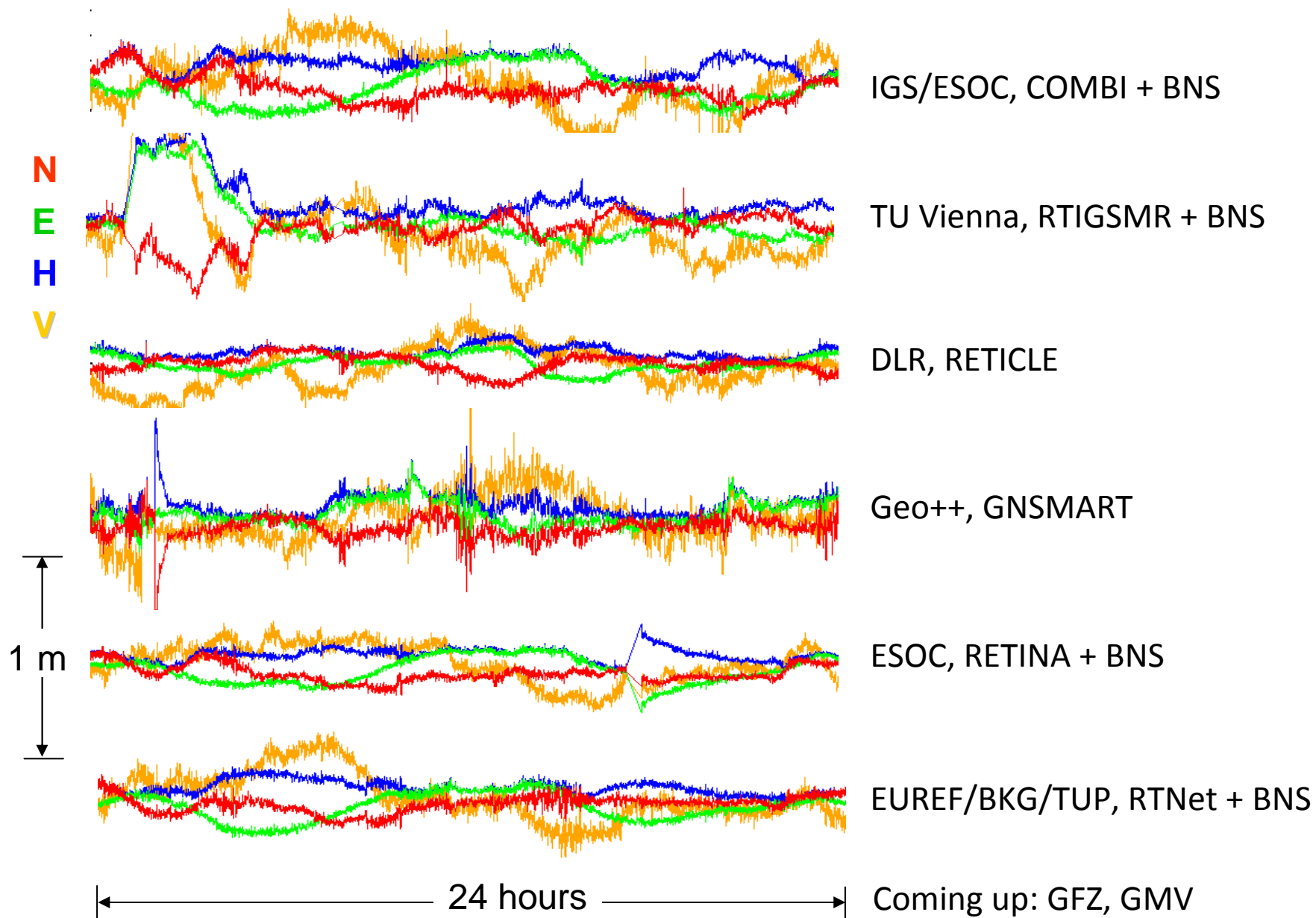
5.10 m
0.00 m
-5.10 m

Start 16:01:44

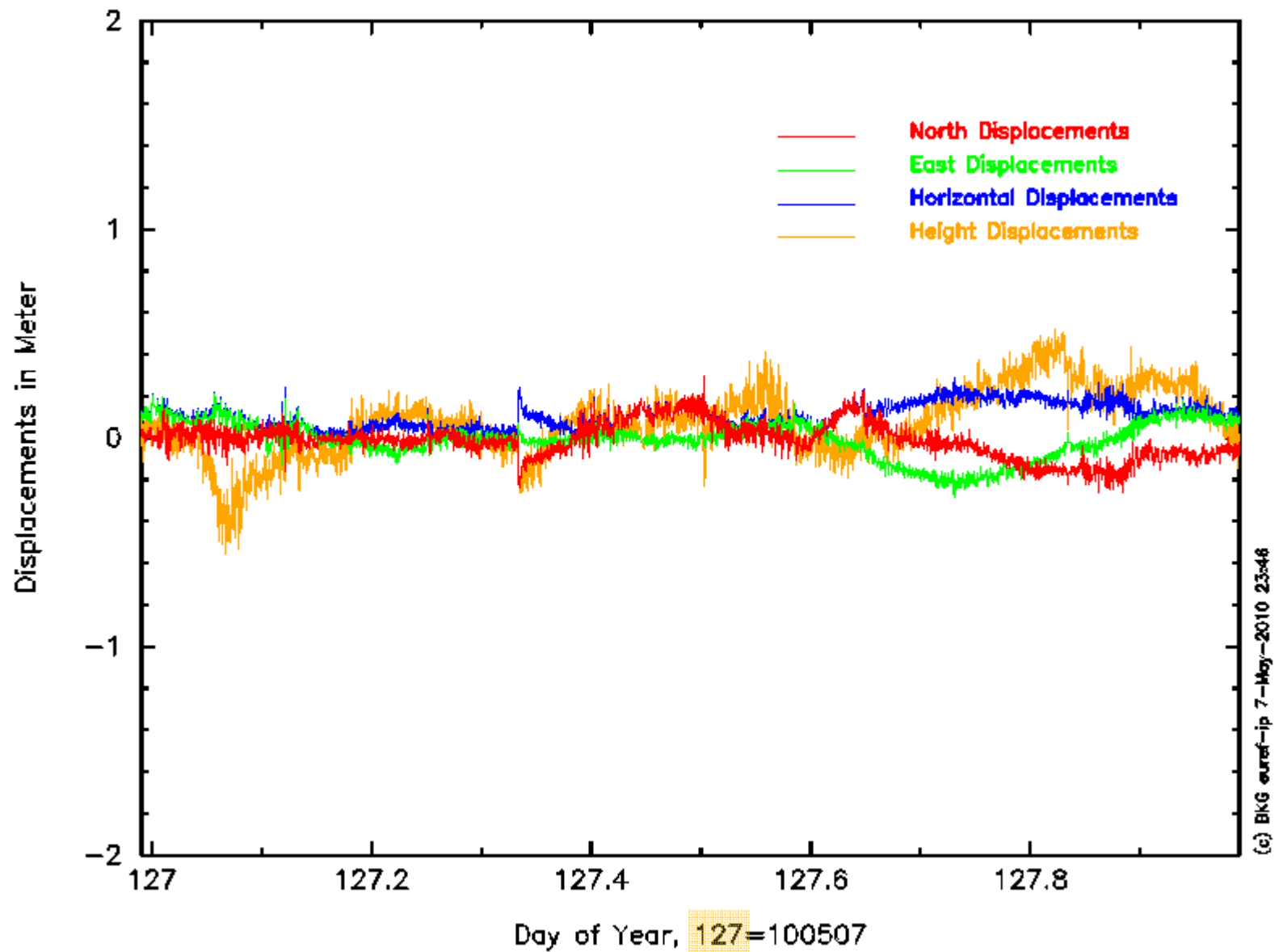
16:02 16:05

Add Stream Delete Stream Start Stop Help=Shift+F1

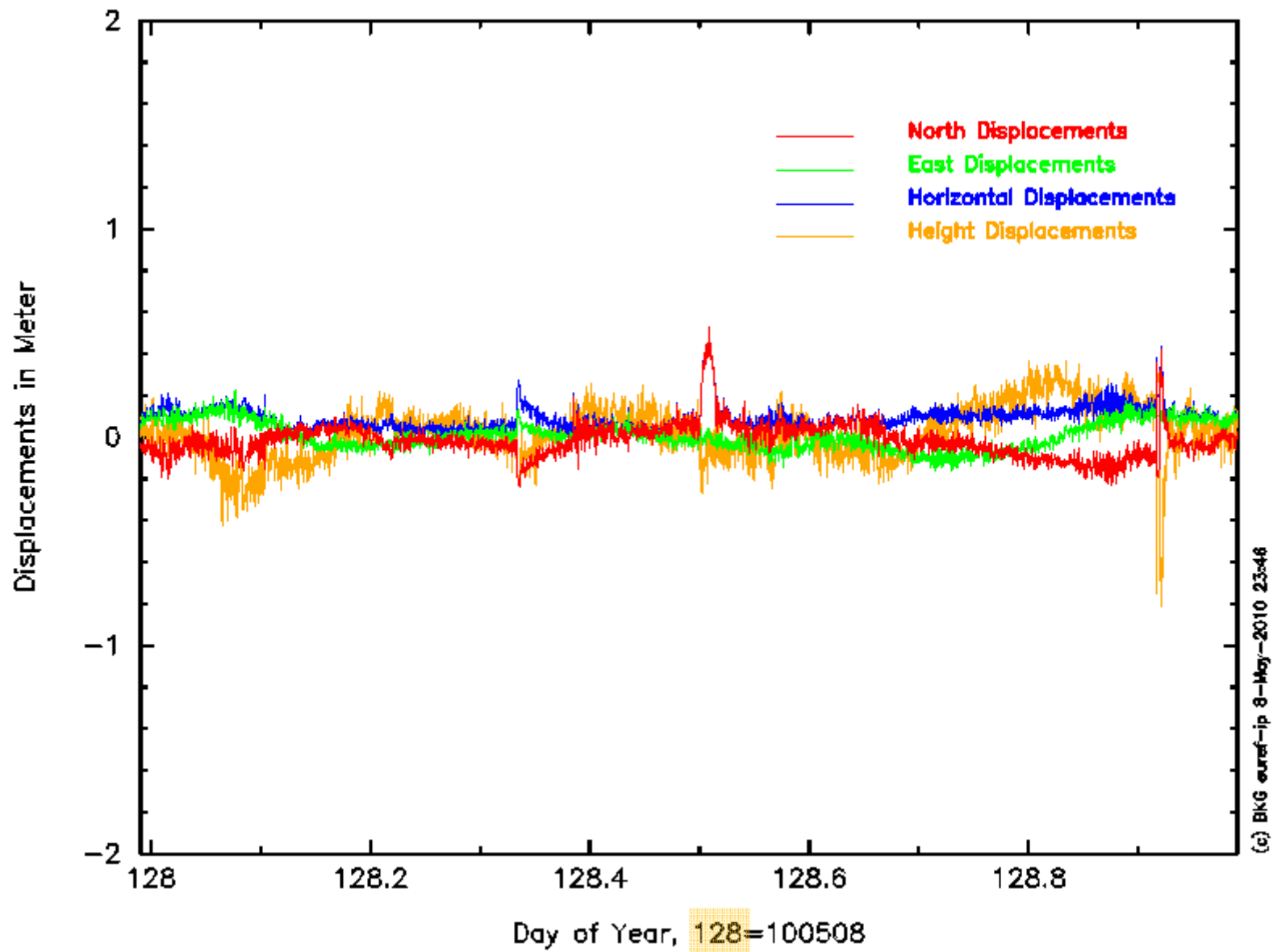
Real-time PPP Monitoring of IGS Analysis Centers using BNC



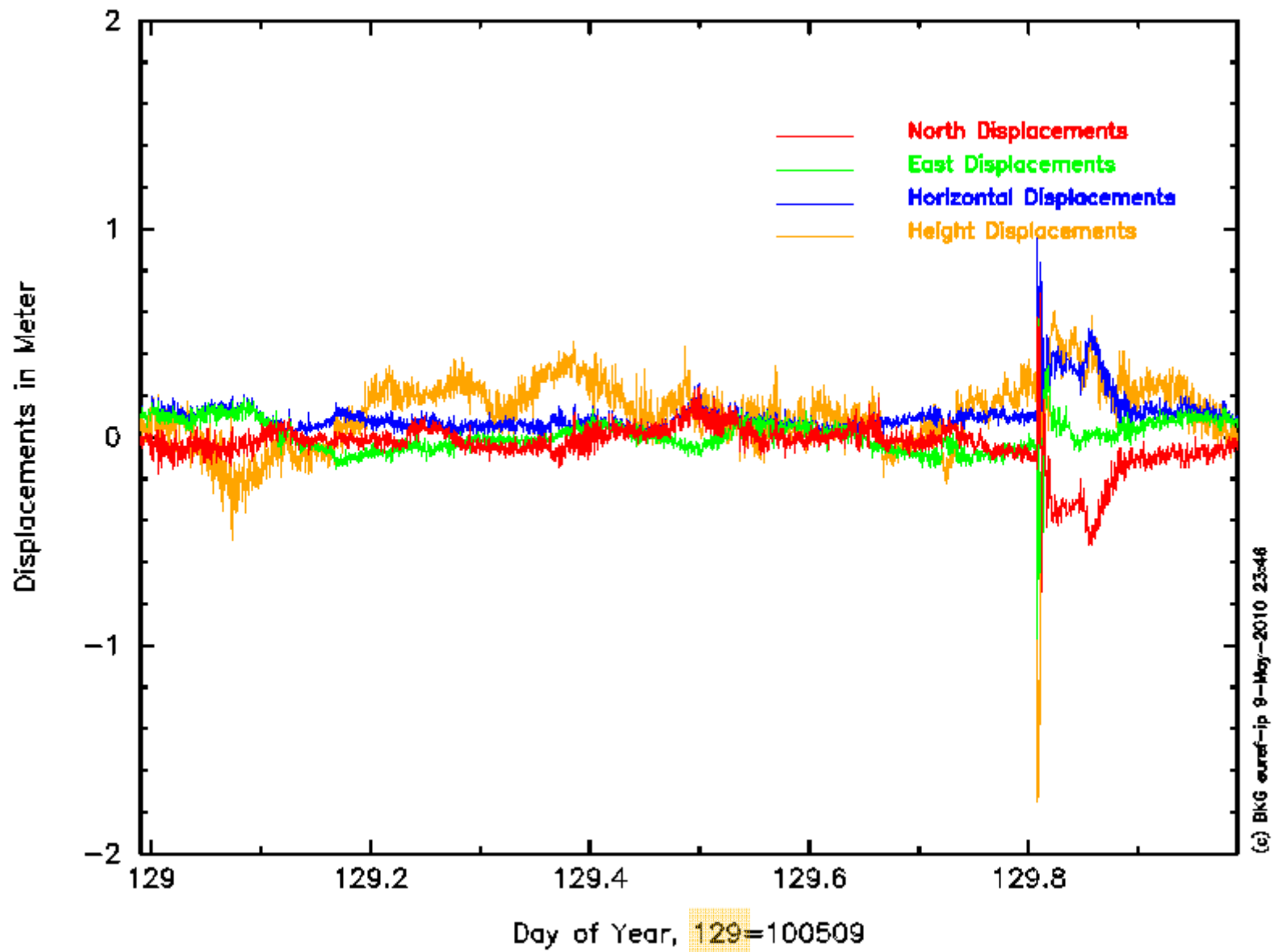
Displacements for FFMJ, Realtime PPP, 24h Sliding Window, IGS Combination



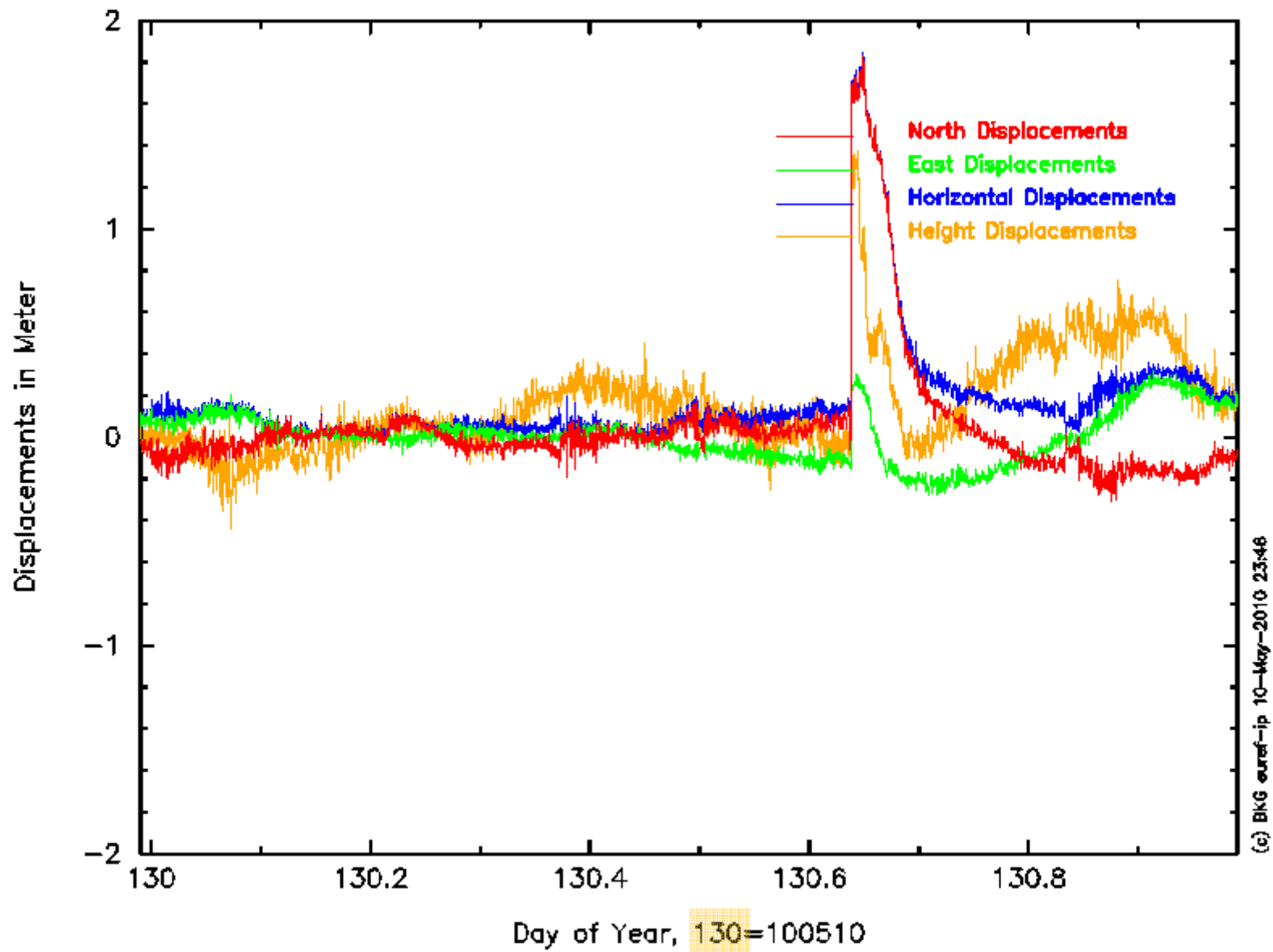
Displacements for FFMJ, Realtime PPP, 24h Sliding Window, IGS Combination



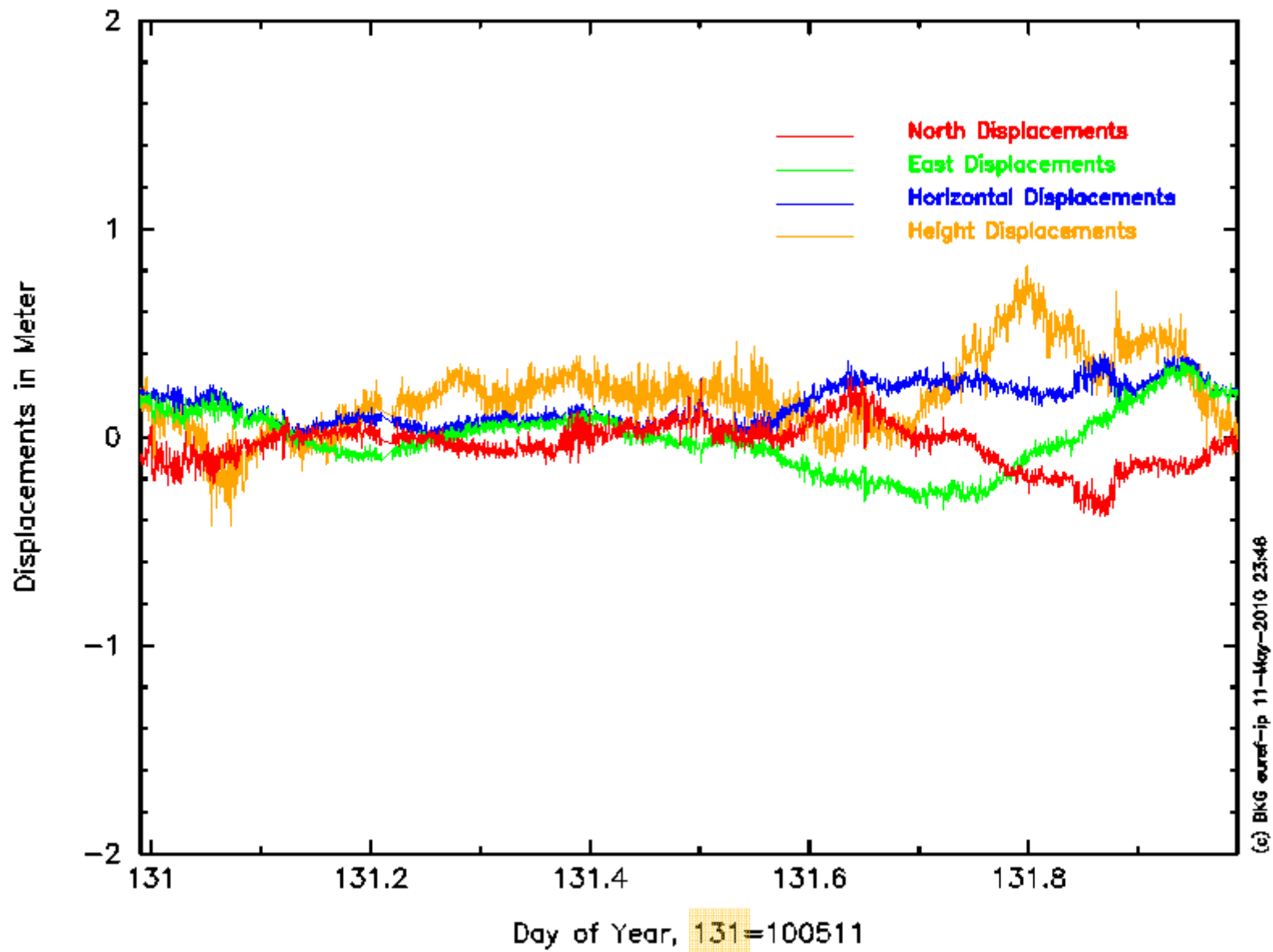
Displacements for FFMJ, Realtime PPP, 24h Sliding Window, IGS Combination



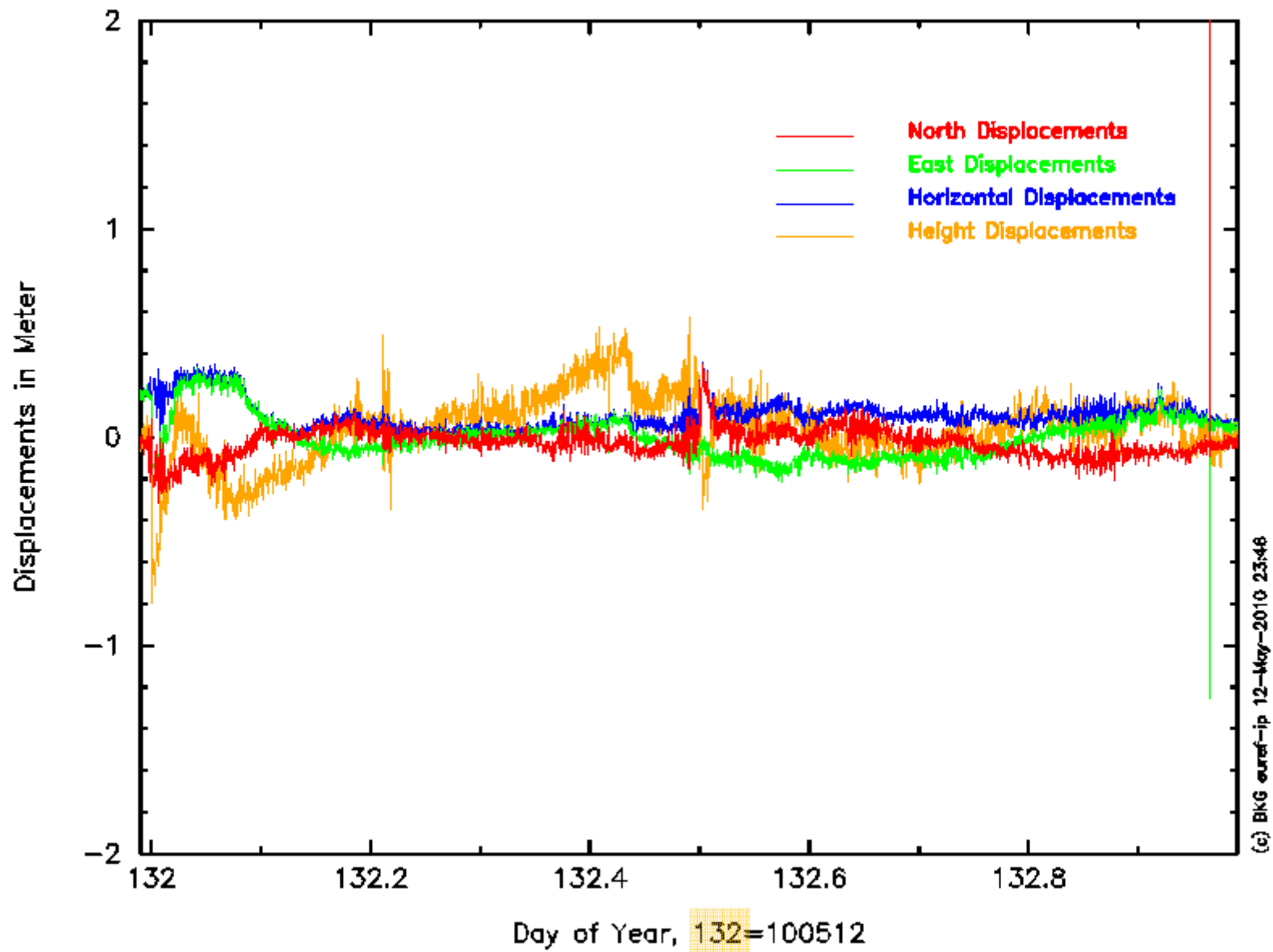
Displacements for FFMJ, Realtime PPP, 24h Sliding Window, IGS Combination



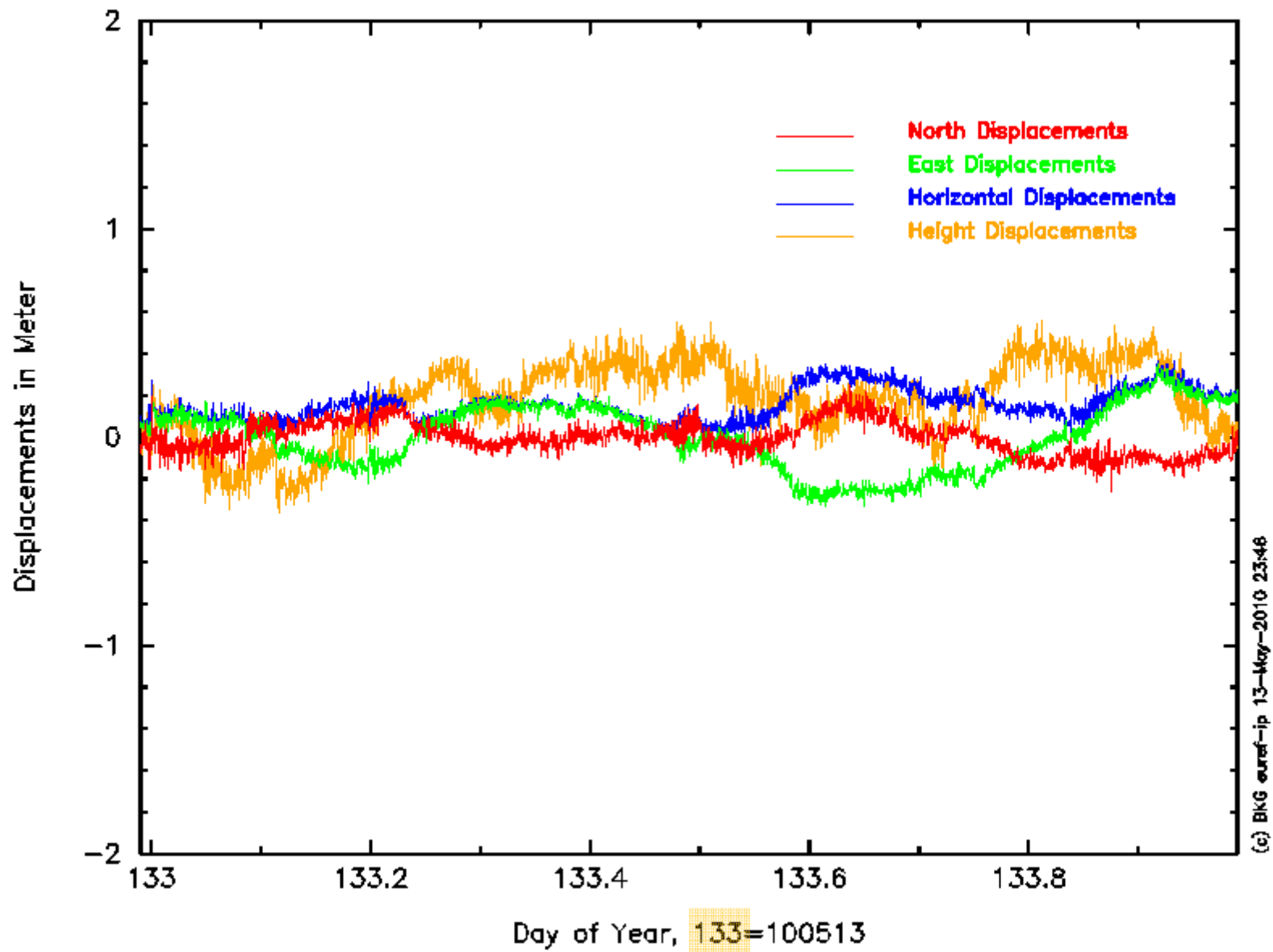
Displacements for FFMJ, Realtime PPP, 24h Sliding Window, IGS Combination



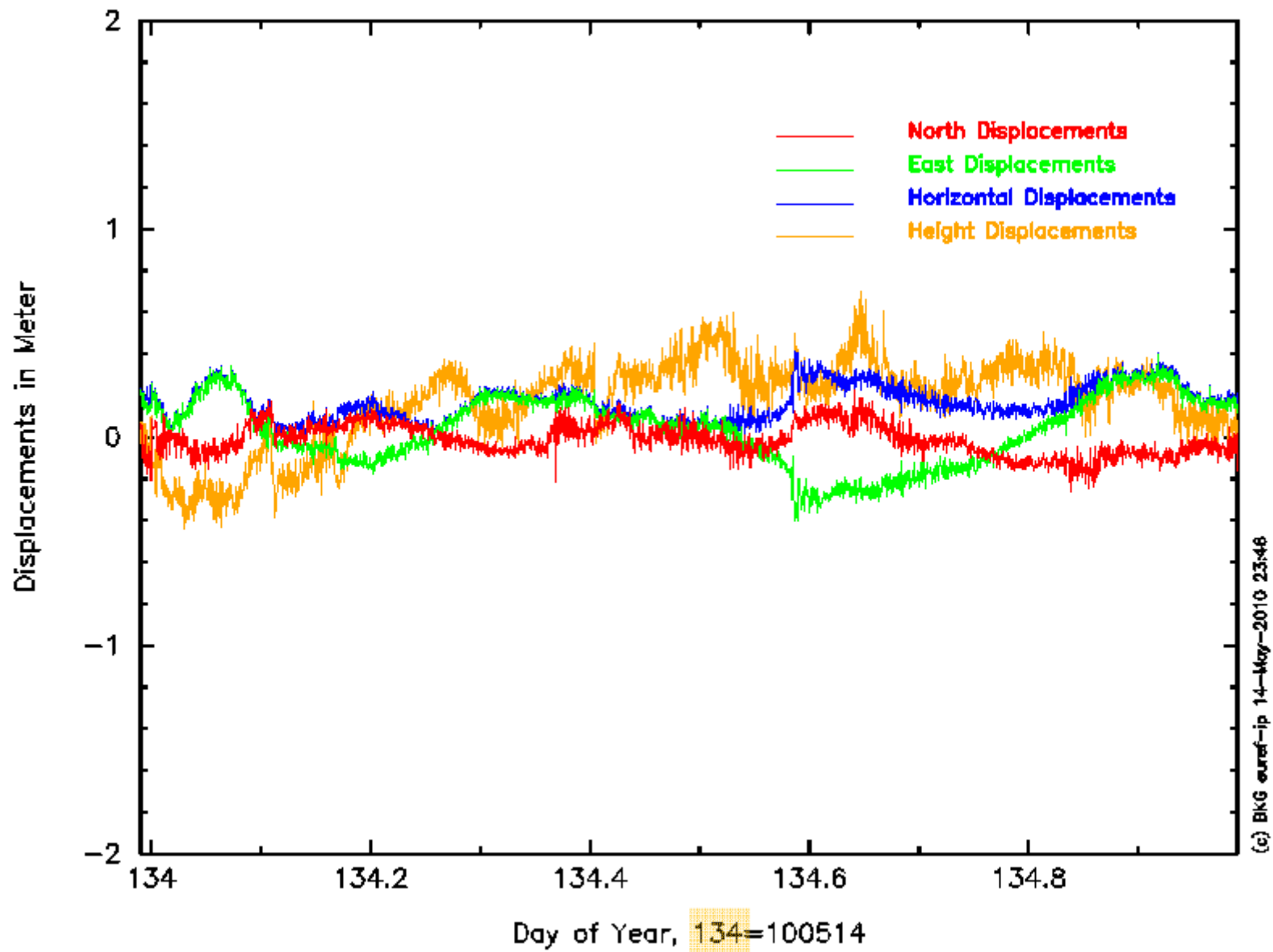
Displacements for FFMJ, Realtime PPP, 24h Sliding Window, IGS Combination



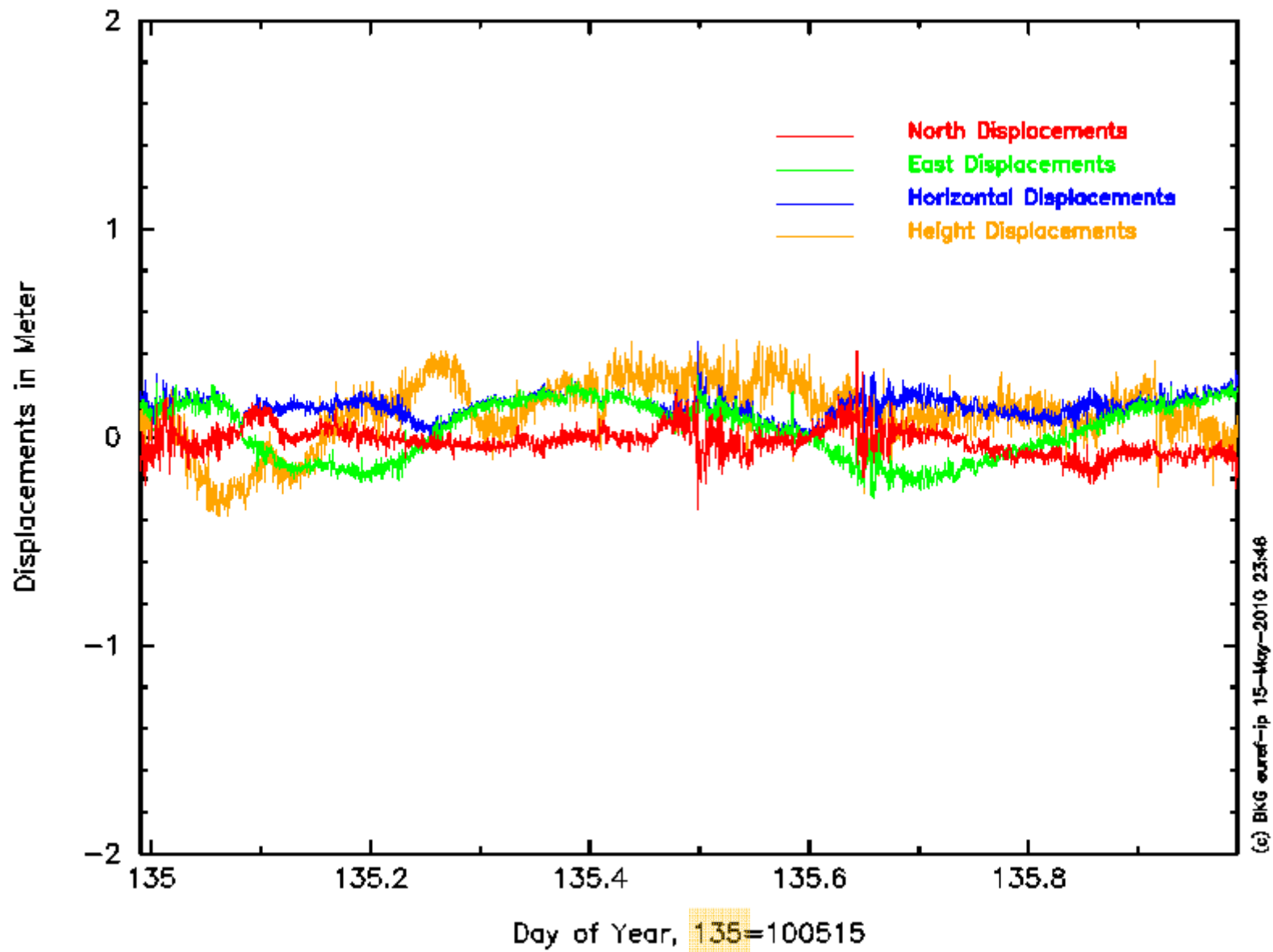
Displacements for FFMJ, Realtime PPP, 24h Sliding Window, IGS Combination



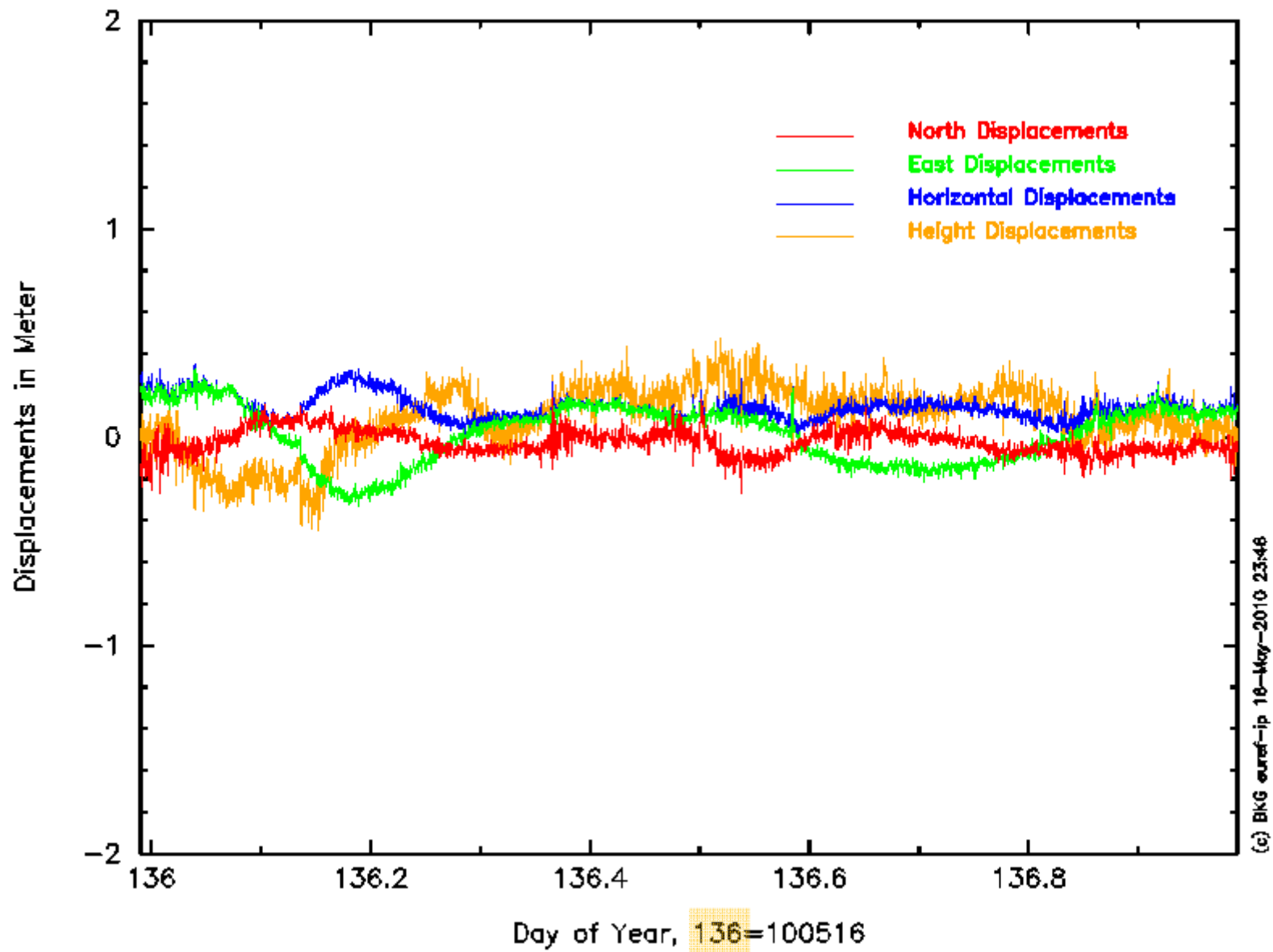
Displacements for FFMJ, Realtime PPP, 24h Sliding Window, IGS Combination



Displacements for FFMJ, Realtime PPP, 24h Sliding Window, IGS Combination

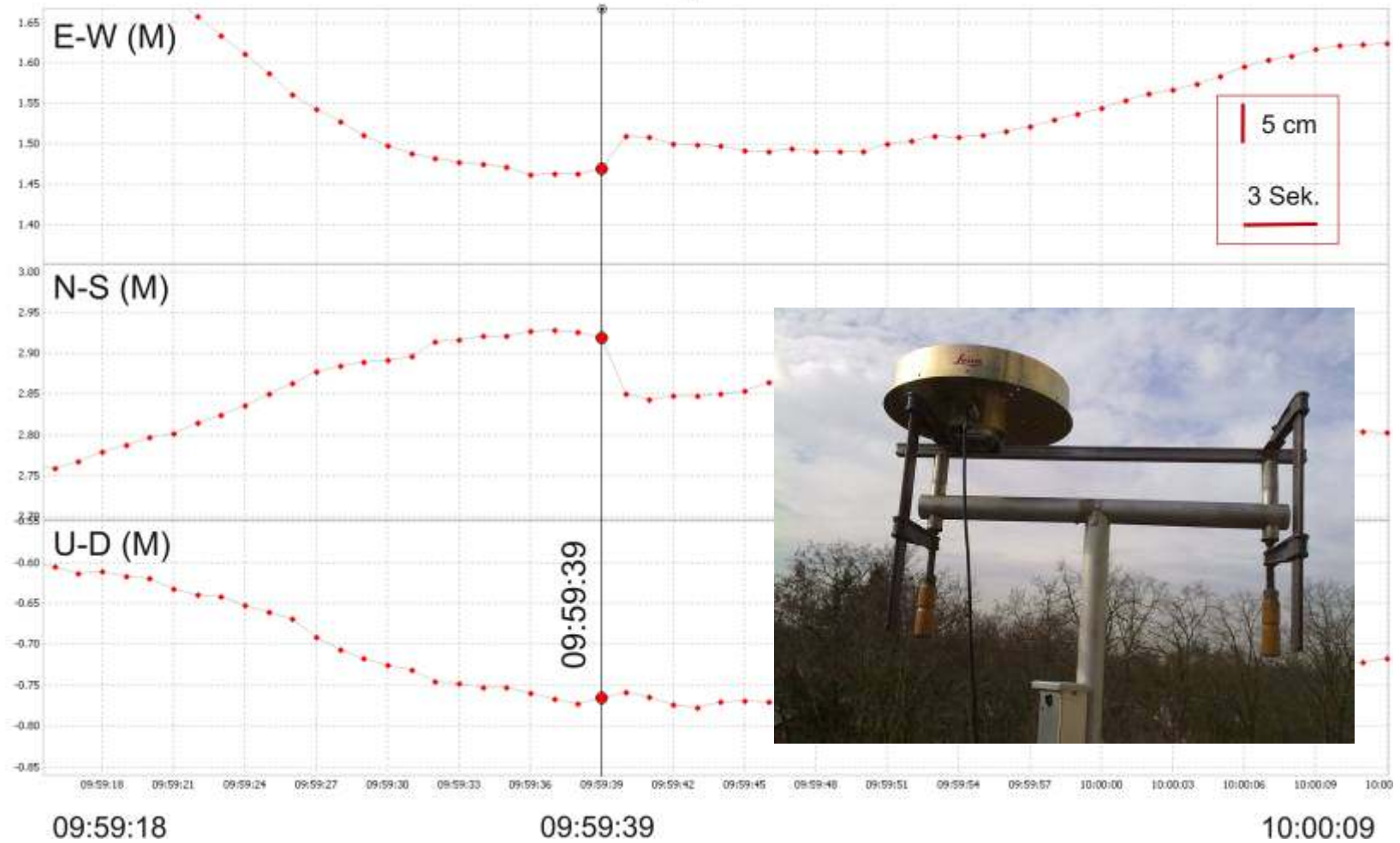


Displacements for FFMJ, Realtime PPP, 24h Sliding Window, IGS Combination



PPP for Monitoring of Natural Hazard

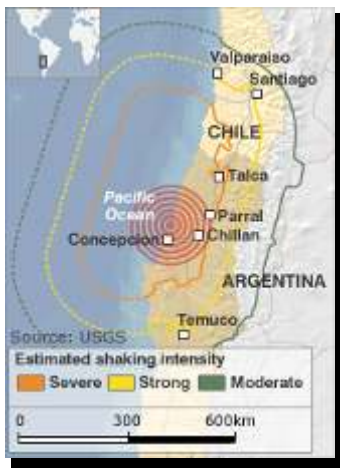
Horizontal Displacement: 10 cm



GNSS Receiver CONZ

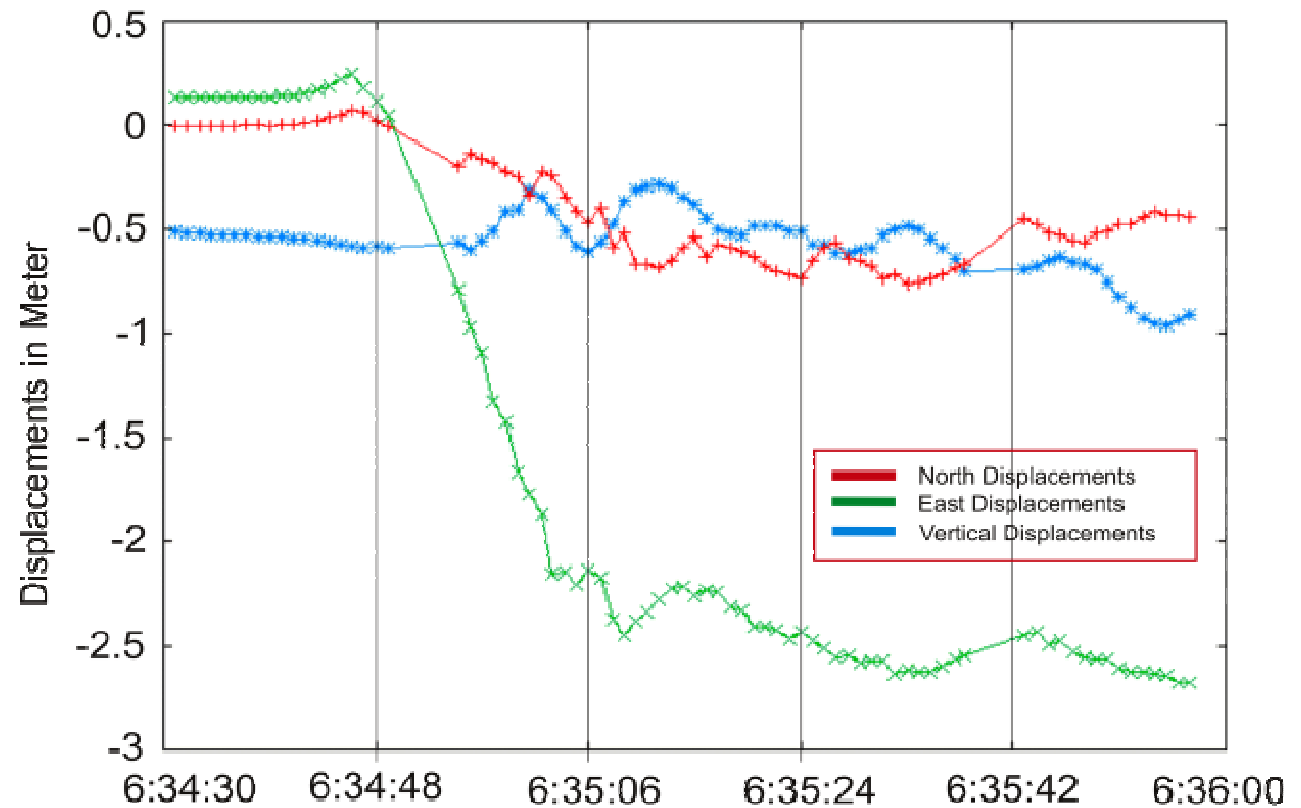


Earthquake Epicenter



Real-time PPP during earthquake using RTNet by GPSS

February 27, 2010



No post processing option in BNC at that time.

BNC, feeding an engine or a RINEX archive

BKG Ntrip Client (BNC) Version 1.7

File Help

Proxy General RINEX Observations RINEX Ephemeris Broadcast Corrections Feed Engine Serial Output Outages Miscellaneous

Directory: c:\temp\rinex

Interval: 1 day Sampling: 0 sec

Skeleton extension: SKL

Script (full path):

Version 3:

Saving RINEX observation files:

Streams:	resource loader / mountpoint	decoder	lat	long	ntrea	ntrip	bytes
1	euref-ip:2101/ACORD	RTCM_3.1	43.36	351.60	no	1	6.011 kB
2	euref-ip:2101/ALBHD	RTIBS	48.39	236.57	no	1	10.406 kB
3	euref-ip:2101/AUCKD	RTCM_3.0	-36.60	174.03	no	1	7.561 kB
4	euref-ip:2101/BL11D	RTCM_3.0	40.62	93.00	no	1	7.686 kB

Log Throughput

Add Stream Delete Stream Start Stop Help=Shift+F1

Serial Output Outages Miscellaneous

ntrip bytes

10.939 kB

10.854 kB

9.594 kB

12.015 kB

7.751 kB

13.809 kB

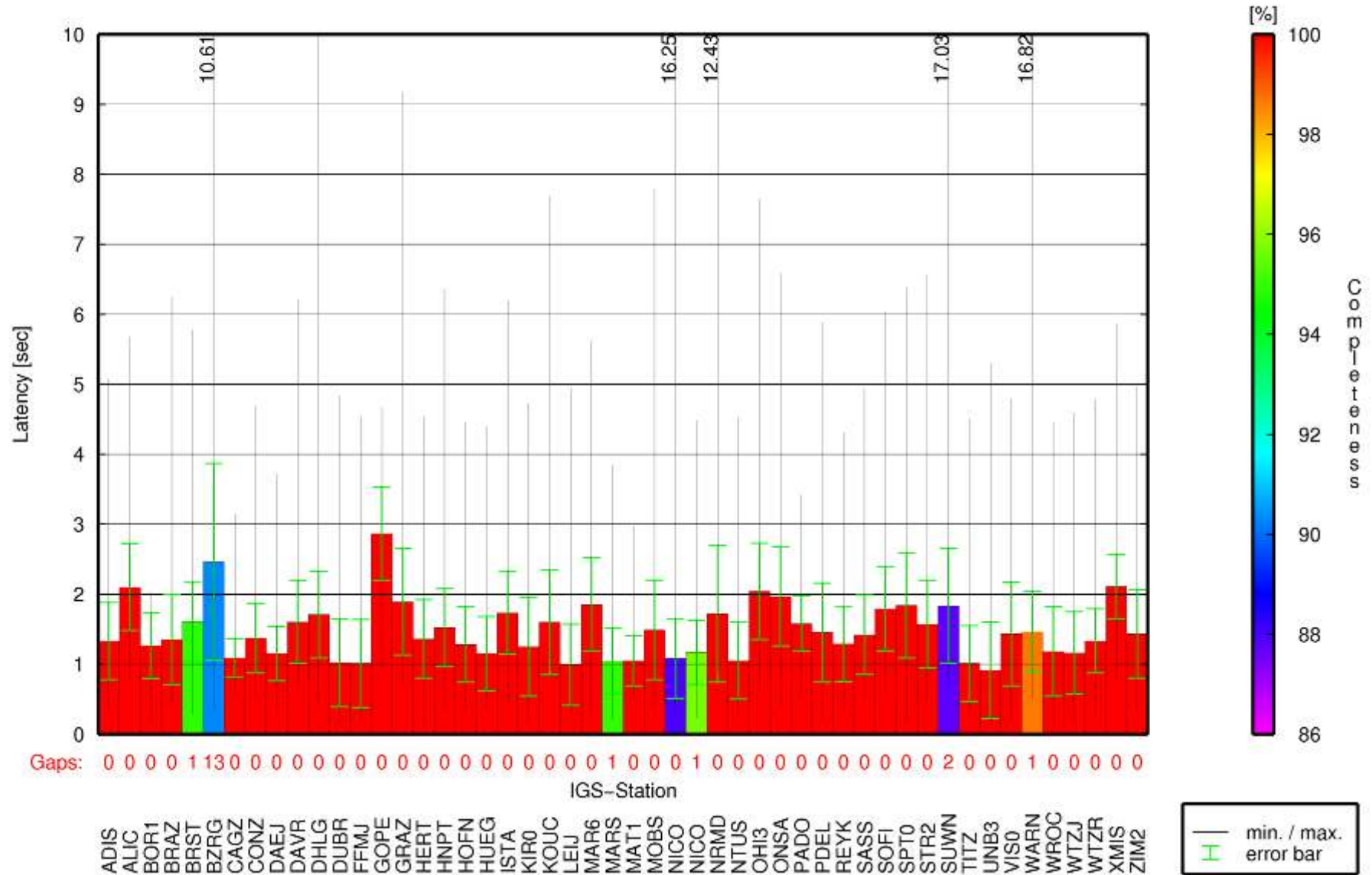
7.801 kB

7 www.gps-ip.net:2101/BL11D RTCM_3.0 -31.82 115.79 no 1 7.801 kB

Log Throughput Latency

Add Stream Delete Stream Start Stop Help=Shift+F1

Latency and completeness of RTCMv3 over an example period of 1 hour





PPP with EUREF & IGS

Configuration

BNC/PPP software on laptop.

Communication with receiver via Blue Tooth.

Wireless Internet connection via GPRS.

Standardization

RTCM SC104.

Make PPP option with orbit/clock correctors part of the receiver firmware.

Then: PPP with BNC to become redundant.

Reference Systems Support

IGS05/ITRF2005

ETRS89/ETRF2000

SIRGAS95/2000

NAD83

GAD94

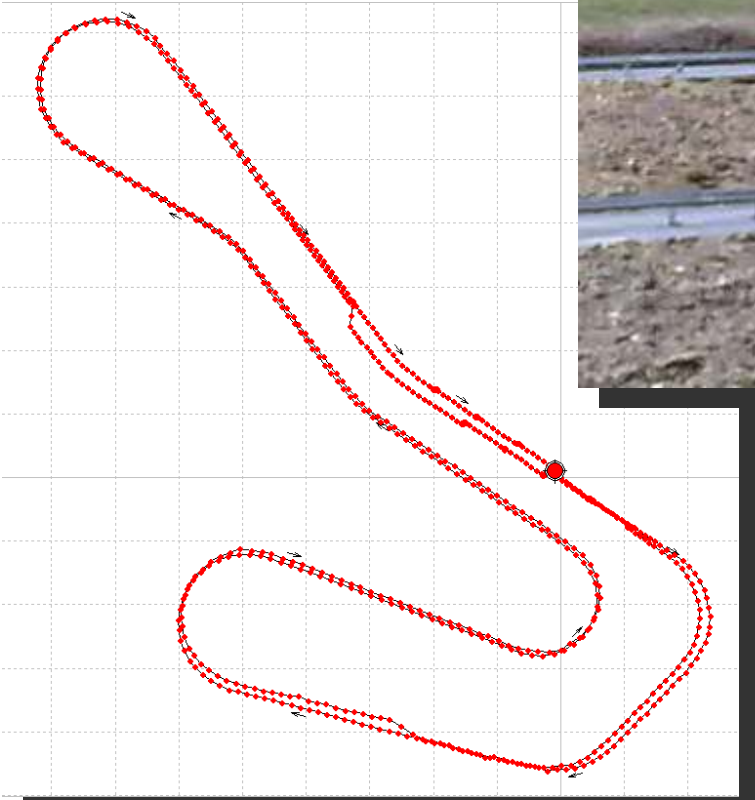


← GNSS Antenna

Kinematic PPP Test
Tractor on rails

PPP Test Bed

Precision Agriculture



Competing with RTK Networks? No!

Summary

Since an RTCM standard for streaming GNSS data first became available in 2004, a steadily growing number of well distributed reference stations provide free real-time access to satellite observations. These global resources enable the real-time estimation and dissemination of correctors for broadcast orbits and clocks. Corrections can be encoded in new RTCM messages under development to match specifics of the so-called State Space Representation (SSR) approach. As a result, Open Data Policy networks like IGS and emerging client software complying with RTCM standards permit real-time Precise Point Positioning (PPP) world-wide in the public domain - until recently the sole activity of a very few service providers.

This presentation describes efforts in the real-time PPP sector based on a premature RTCM standard and carried out in a cooperation of TUP and BKG. The major characteristics of its PPP server 'RTNet', an NTRIP-based stream dissemination system, and the PPP client program 'BNC' are presented. Introduced tools utilize the latest NTRIP version 2 standard for GNSS stream transport.