Tests with RTK and PPP onboard ships

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Contents

- Tests of RTK and PPP by Lantmäteriet and the Swedish Maritime Administration.
- How we estimate the errors.
- Computations with free or open softwares
- Test session Jacob Hägg 2012-06-26
- Test session Baltica 2013-12-10,11
- Concluding remarks

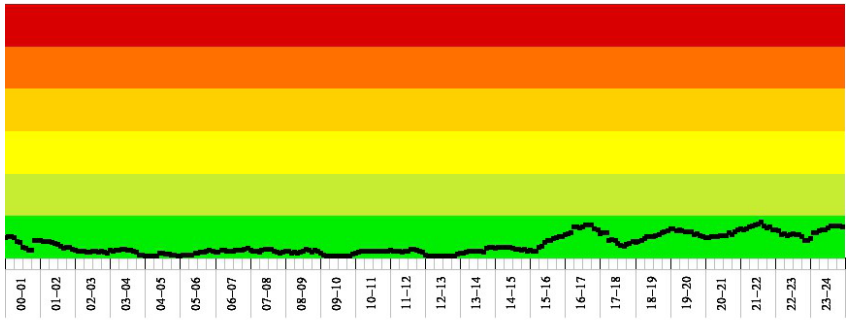
Test measurements together with the Maritime Administration

- 2012-06-26 Jacob Hägg trip around Gräsö
- Aiming for an evaluation of the RTCM Master-Auxiliary concept
- Presented by Johan Sunna
- 2013-12-10,11 Baltica outside Oxelösund
- To test PPP both in real time and in post-processing.
- Preliminary evaluation only, Galileo data remains to be processed.

Uncertainty of the measurements

- As ”true position” I have used a RTK solution with fixed ambiguities made with RTKLIB 2.4.1.
- Errors = PPP solution – RTK solution.
- Errors are given in a local North East Up system.
- Computations are made in ITRF2008

Jacob Hägg 2012-06-26 Ionosphere monitor



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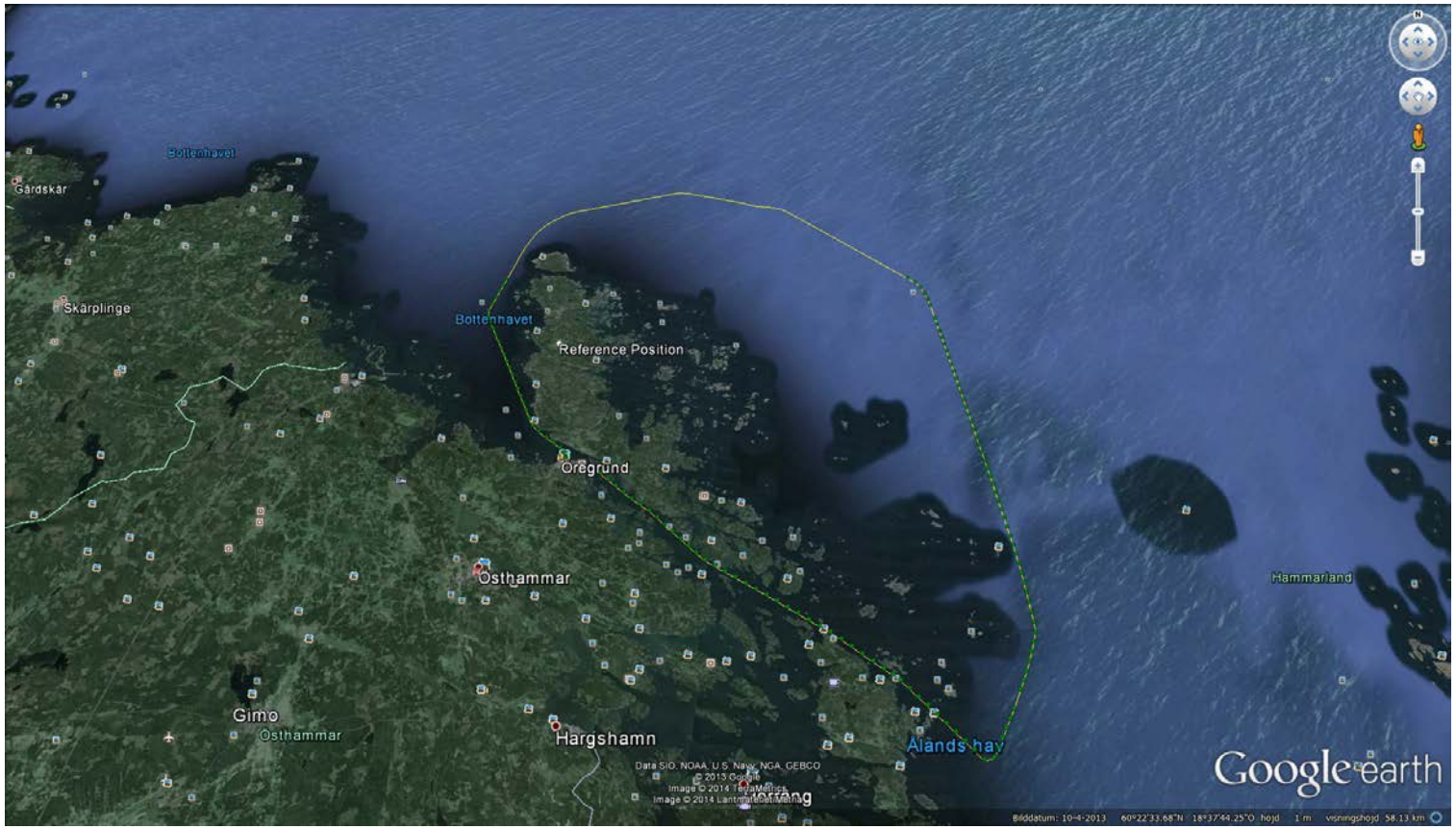
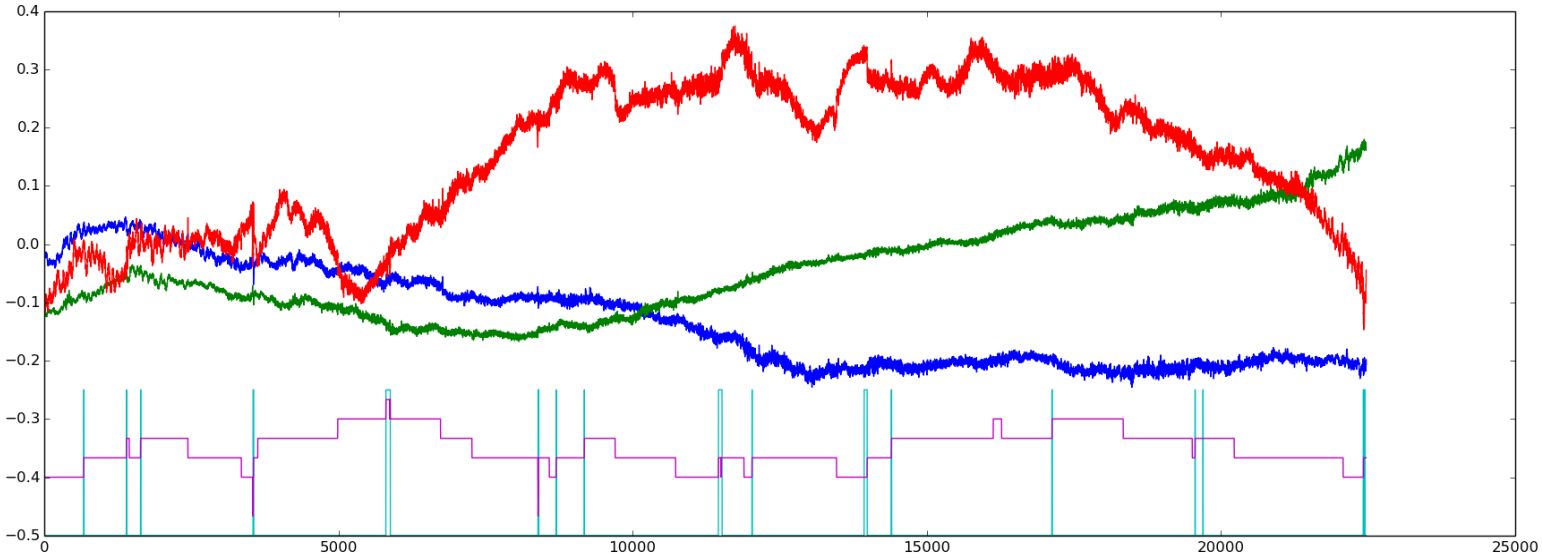

Bottenhavet
Gårdskär
Skärplinge
Bottenhavet
Reference Position
Oregrund
Osthammar
Hammarland
Gimo
Osthammar
Hargshamn
Ålands hav
Google earth

PPP post-processing with RTKLIB 2.4.1 forwards and backwards N blue E green U red



rms N 0.154 m E 0.093 m U 0.200 m

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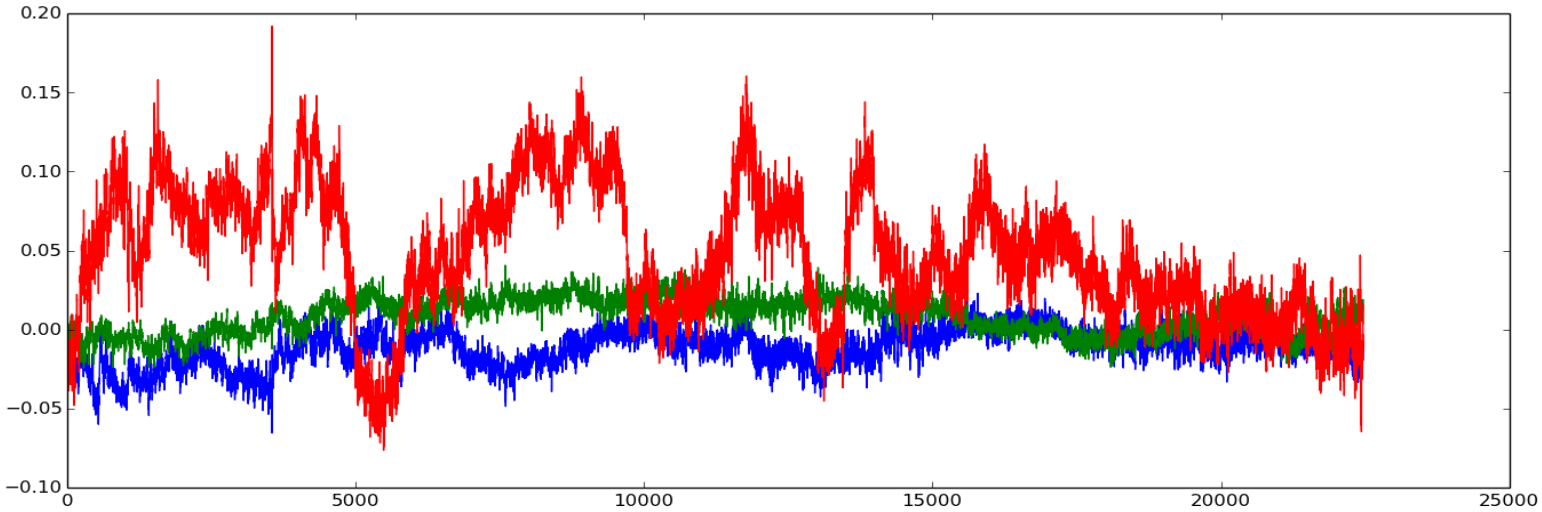
Online PPP services

- JPLs APPS based on Gipsy.
- NRCans CSRS-PPP.
- UNB GAPS
- GMV magicGNSS

CSRS-PPP kinematic post-processing using GPS, GLONASS and IGS products



rms N 0.017 m E 0.014 m U 0.063 m

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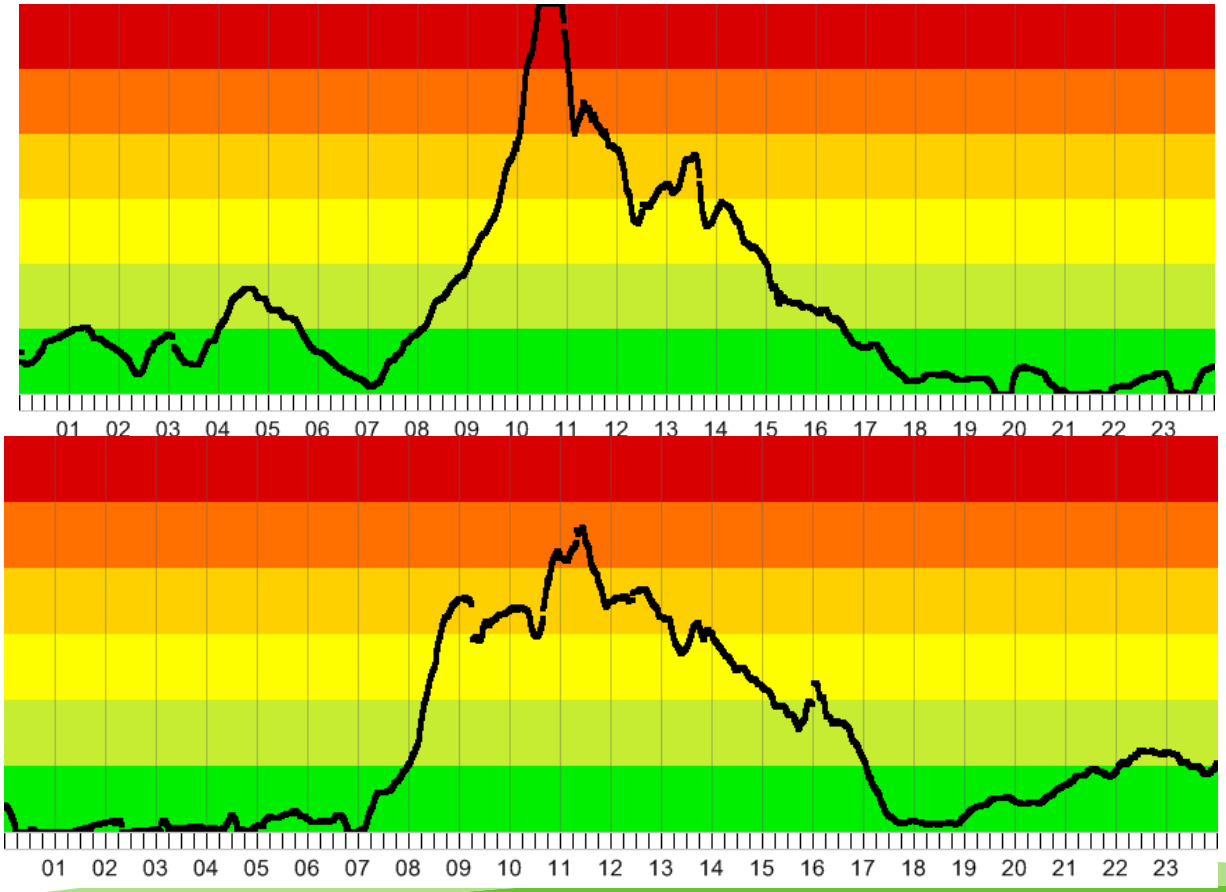
Measurement with Baltica outside Oxelösund 2013-12-10,11

- Trimble NetR9
- Javad TRE_G3TH Sigma
- Both to connected to Trimble Zephyr antenna on Baltica
- Post-processing with RTKLIB 2.4.1, CSRS-PPP
- Real time measurement with BNC 2.10 and GPS+GLONASS SSR corrections from IGS: correction stream CLK11
- During the second day the measurements coincides with a 4 hour passage of the 4 Galileo satellites

Baltica 2013-11-10,11 Ionosphere monitor



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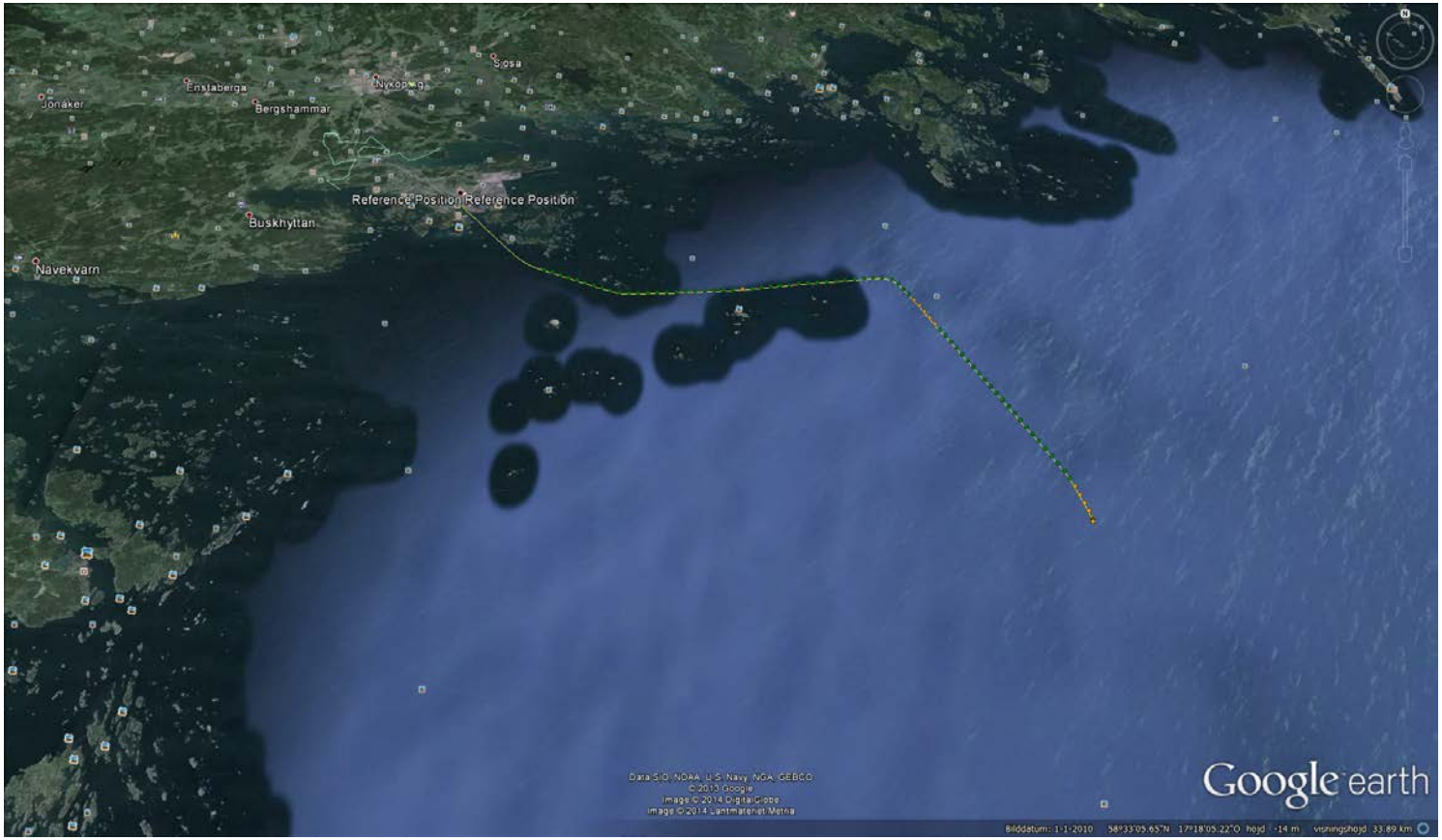
Baltica



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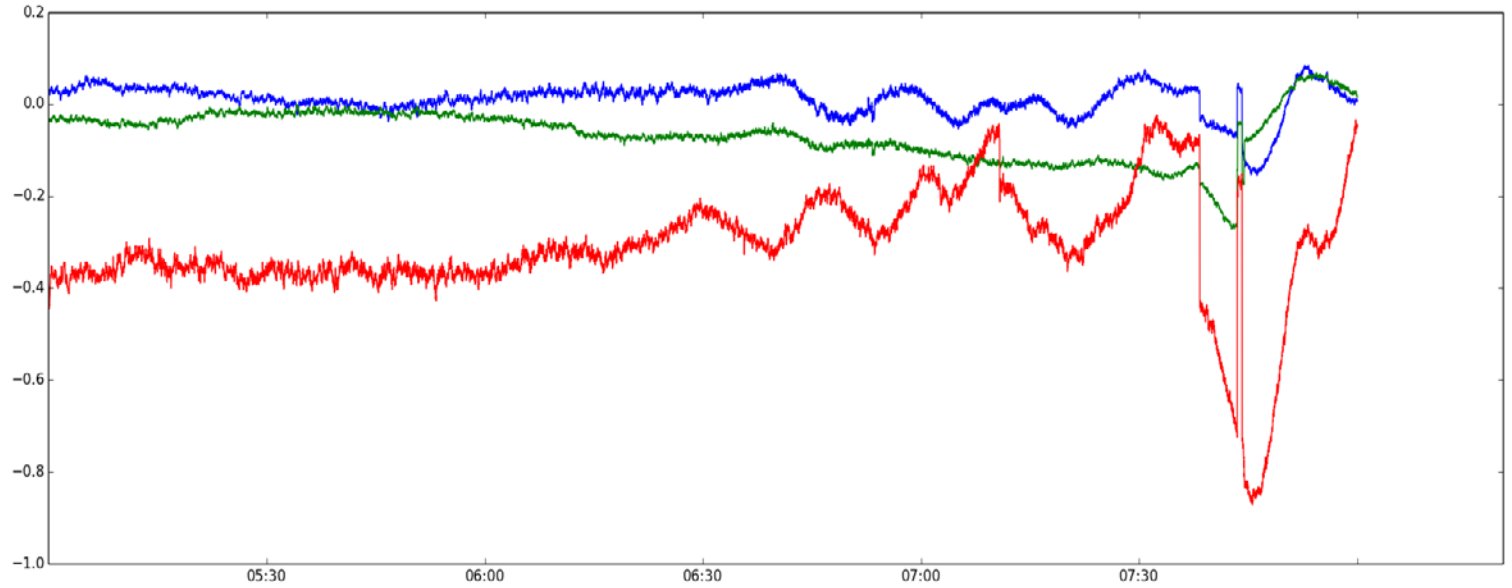
CSRS-PPP post-processing 05:00 – 08:00 RTK fix 05:00 – 07:11 and 07:15 – 07:38



rms N 0.025 m E 0.071 m U 0.277 m

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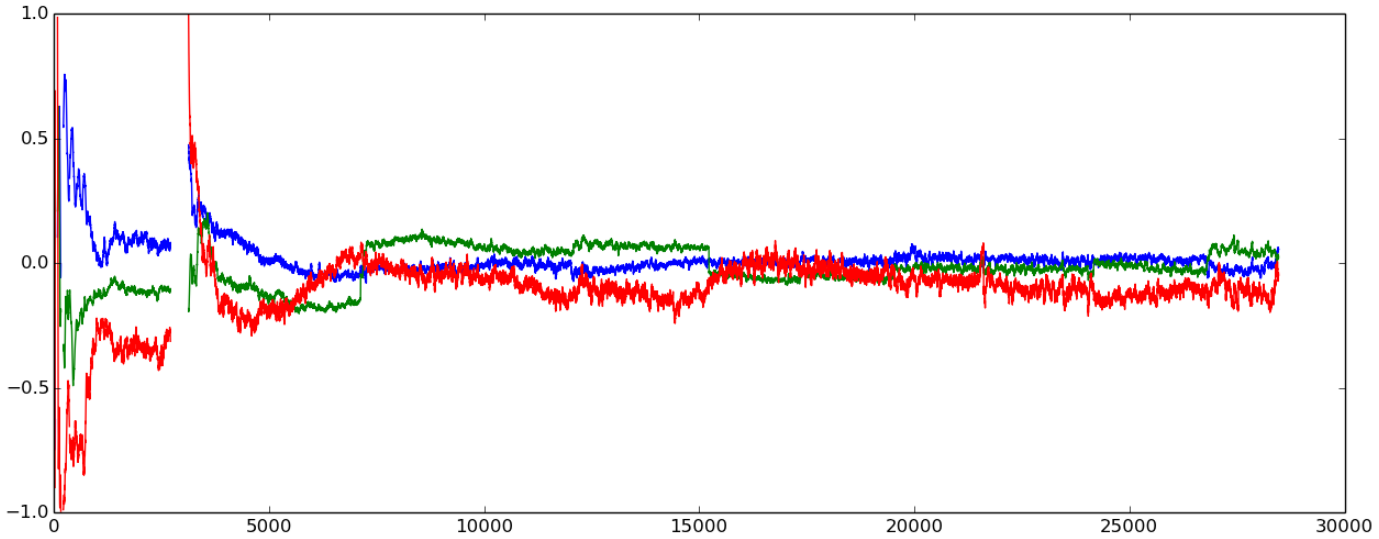
Real time BNC PPP using IGS clock-correction stream CLK11 (truth CSRS – PPP solution)



rms N 0.080 m E 0.087 m U 0.178 m

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Concluding remarks

- From these very limited tests it seems as:
- Kinematic PPP in real time gives an uncertainty of 1-2 dm.
- Kinematic PPP in post-processing gives an uncertainty of 2-8 cm in the horisontal components and 1-2 dm in the vertical.

- For kinematic PPP the vertical component is a weak point.
- Under periods with unquiet ionosphere it is hard to measure with RTK far from a base station (> 25km).
- More data is available (ie Trimble NetR9 data).
- There are Galileo measurements from day 2.

Concluding remarks 2

- Evaluating kinematic GNSS tests is hard, especially on cm-level
- It is too easy to test PPP in static mode on a known point.
- How do you come up with the ”moving truth”?
- Kinematic PPP, yet don’t have anything like ”fixed ambiguities”.
- I had to write a support program in Python Pandas to get the measurement epochs synchronised.