INFLUENCE OF REAL-TIME PRODUCTS LATENCY ON KINEMATIC PPP RESULTS

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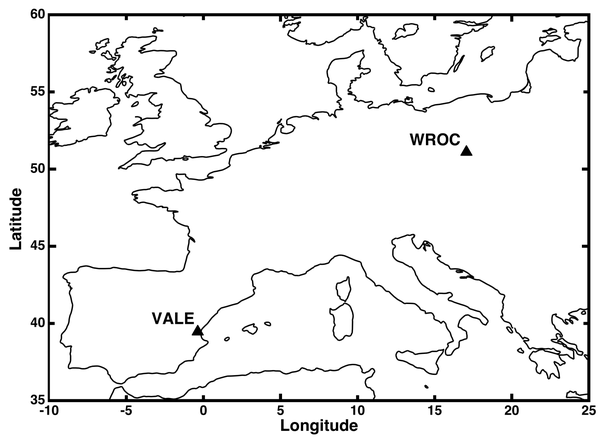
1. Introduction

Real-time Kinematic PPP is based on the International GNSS Service (IGS) real-time precise products such as orbits, clocks and code biases. An NTRIP client application is required to establish a communication link with the data center that hosts the products of interest. It is expected that the accuracy of the results are highly dependent on the latency of these products.

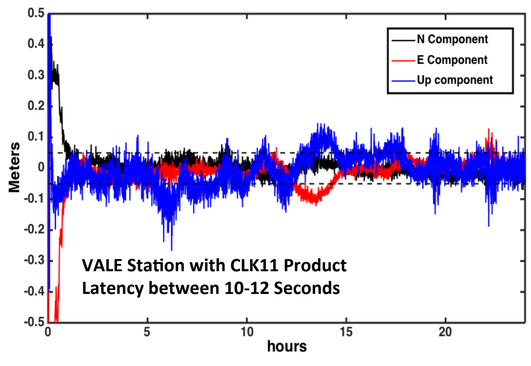
In this poster a case study is presented using WROC (Poland) and VALE (Spain) GNSS permanent stations. BNC software was used to obtain 24 hours of real-time kinematic PPP results (with true latency) and to store real-time corrections in files. Then, a kinematic PPP post-processing was done using the stored real-time IGS product. In this case, the corrections were synchronized with observation data, so the solution was free of latency effect. However any simulated time delay can be introduced into stored file (by changing the reference epoch and recalculating correction values using correction velocities) in order to obtain the kinematic PPP post-processing results with different simulated latency

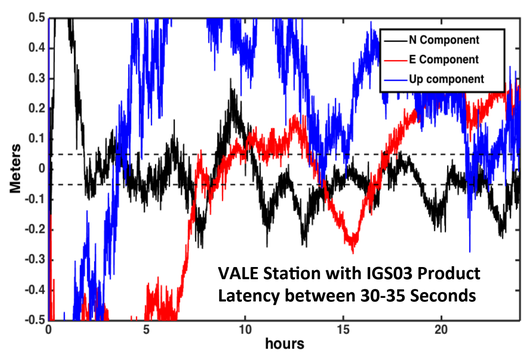
In this poster, statistical and graphic differences (the so-called BIAS) between kinematic PPP post-process results and kinematic PPP post-process with latency of 5, 10, 20, 30, and 40 seconds are presented. The results are also compared against true real-time solution.

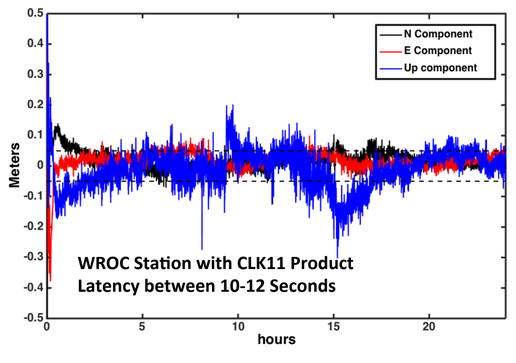
2. Permanent GNSS stations used

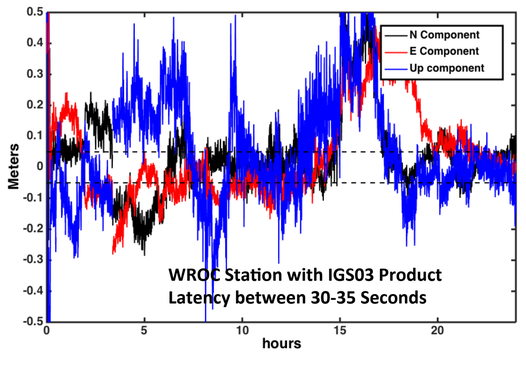


3. Observations (True Real-Time Kinematic PPP)

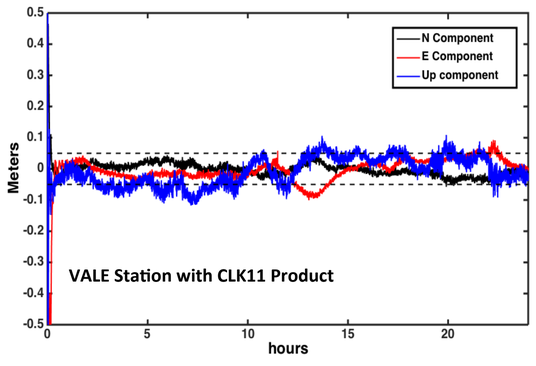


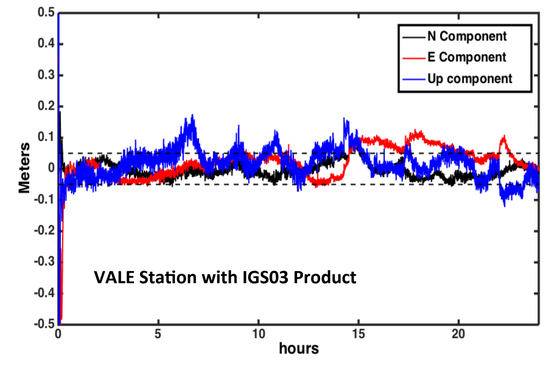


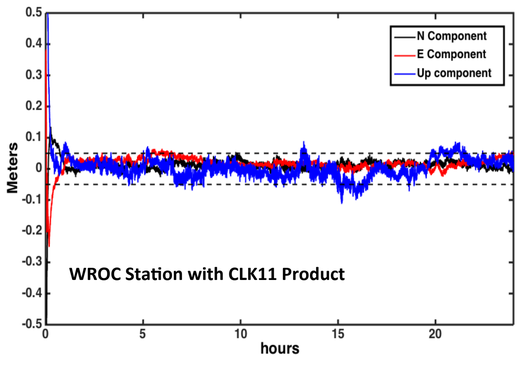


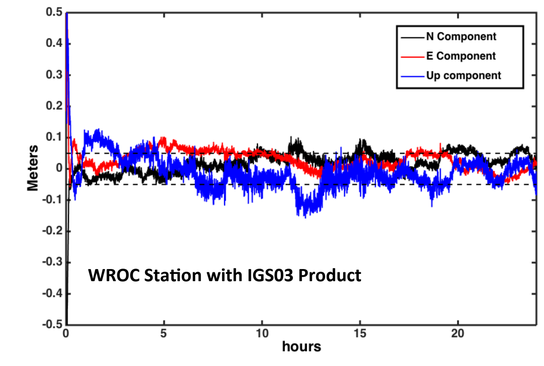


4. Post-Process (No Latency in the Products)

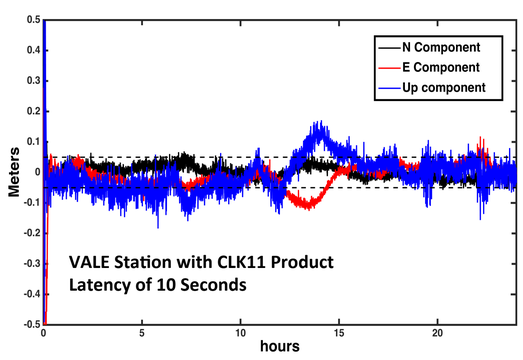


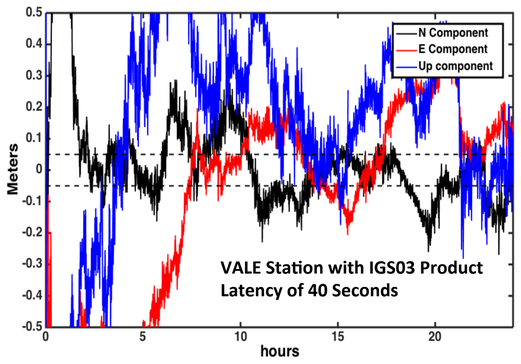


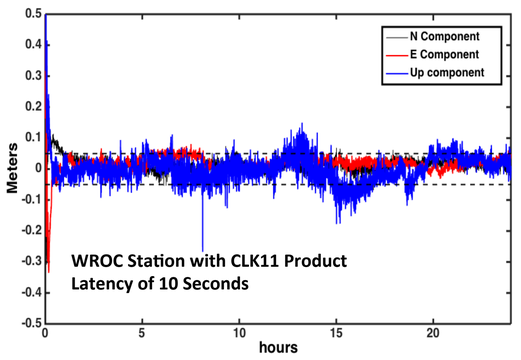


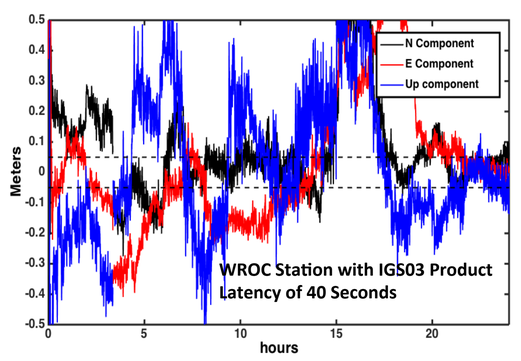


5. Post-Process With Latency Introduced in the Products



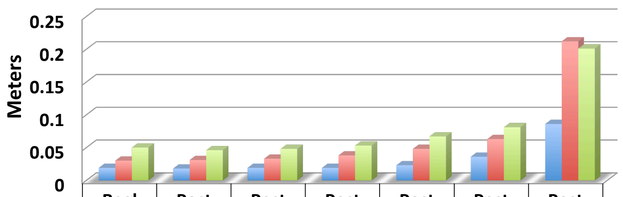






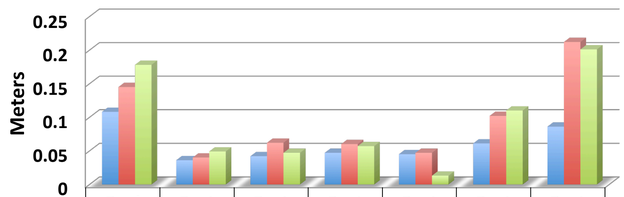
6. Numerical Results

RMS OF THE BIAS FOR VALE STATION USING CLK11



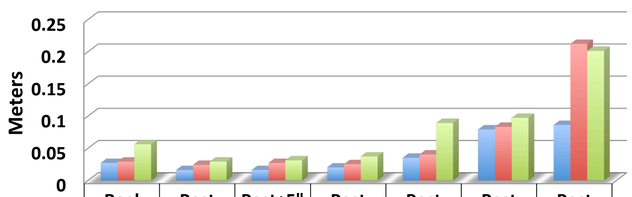
	Real time	Post process	Post +5"	Post +10"	Post +20"	Post +30"	Post +40"
N	0.019	0.018	0.019	0.019	0.023	0.036	0.086
E	0.03	0.031	0.033	0.038	0.048	0.063	0.212
Up	0.05	0.046	0.048	0.053	0.067	0.081	0.201

RMS OF THE BIAS FOR VALE STATION USING IGS03



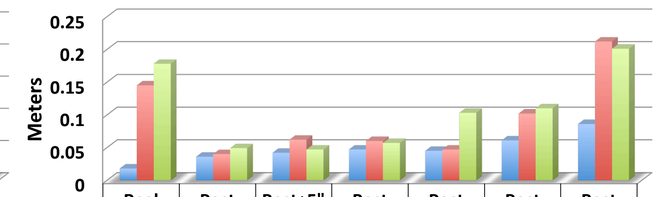
	Real time	Post process	Post +5"	Post +10"	Post +20"	Post +30"	Post +40"
N	0.108	0.036	0.042	0.047	0.045	0.061	0.086
E	0.145	0.04	0.062	0.06	0.047	0.102	0.212
Up	0.178	0.049	0.047	0.057	0.013	0.11	0.201

RMS OF THE BIAS FOR WROC STATION USING CLK11



	Real time	Post process	Post+5"	Post +10"	Post +20"	Post +30"	Post +40"
N	0.027	0.016	0.016	0.02	0.035	0.079	0.086
E	0.029	0.024	0.027	0.025	0.04	0.083	0.212
Up	0.056	0.029	0.031	0.037	0.089	0.097	0.201

RMS OF THE BIAS FOR WROC STATION USING IGS03



	Real time	Post process	Post+5"	Post +10"	Post +20"	Post +30"	Post +40"
N	0.018	0.036	0.042	0.047	0.045	0.061	0.086
E	0.145	0.04	0.062	0.06	0.047	0.102	0.212
Up	0.178	0.049	0.047	0.057	0.103	0.11	0.201

7. Conclusions

- **The methodology of delaying the products produces almost the same results as in the true Real-time observations.**
- **The accuracy of the results are highly dependent on the latency of the real-time orbit and clock products.**
- **A latency of about 10 seconds is required to ensure the accuracy of the real-time results in comparison with the post-process solution.**
- **CLK11 and IGS03 products provide similar results when no latency is present.**
- **It is recommended that IGS RT AC's should try to minimize their combined product latency.**

8. References

- **BKG.** ***Real-time GNSS satellite orbit and clock corrections from IGS and EUREF sources*****,** Website <http://igs.bkg.bund.de/ntrip/orbits> (accessed 01.12).
- **Hadas, T., Bosy, J. (2014).** ***IGS RTS precise orbits and clocks verification and quality degradation over time*****.** GPS solutions, 19(1), 93-105.
- **Martín, A., Anquela, A.B., Dimas-Pagés, A., Cos-Gayón, F. (2015).** ***Validation of performance of real-time kinematic PPP. A possible tool for deformation monitoring*****.** Measurement, 69, 95-108.
- **Mervart, L.** ***Introduction to BKG Ntrip Client (BNC) usage*****. Proc., PPP-RTK & Open Standards Symposium, 2012, Frankfurt, Germany,** Website <http://igs.bkg.bund.de/ntrip/symp> 2012, (accessed 05.12).

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