

ION GNSS 2014

# MAGICGNSS' REAL-TIME POD AND PPP MULTI-GNSS SERVICE

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SESSION B6: PRECISE POINT POSITIONING AND L-BAND SERVICES

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# OUTLINE

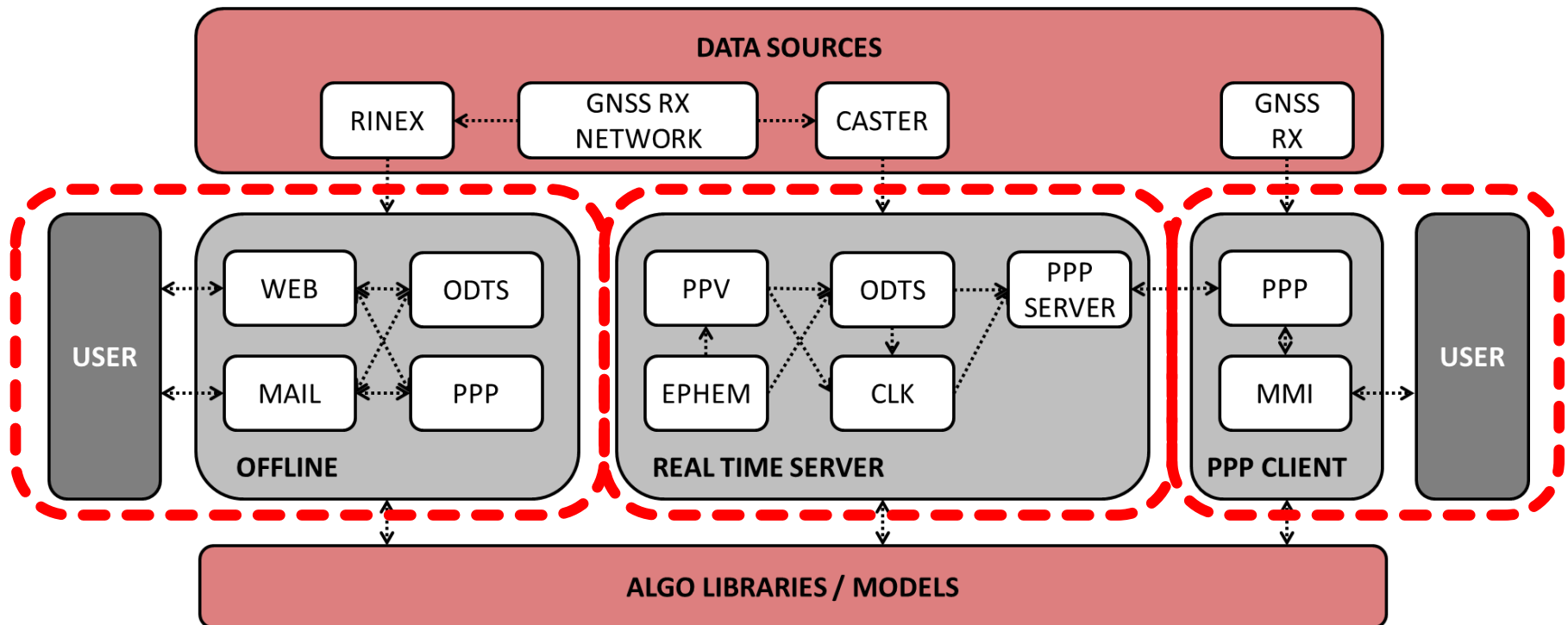
- Motivation for *magicGNSS* development
- *magicGNSS* overview
- Web Service Infrastructure
- Real Time Server Infrastructure
- Real Time PPP Client
- *magicGNSS'* performances
- Conclusions and future work

# MOTIVATION

- *magicGNSS* web service
  - R+D project started back in 2007
  - Provide the GNSS community with a set of useful GNSS tools
  - Effort to develop GMV's POD and PPP SW to keep our algorithmic knowledge at state-of-the-art level
  
- *magicGNSS* real-time service
  - Answer to IGS' call on 2008 for IGS Real-Time Pilot Project
  - Precise orbit and clock products generation in real-time
  - Evaluate real-time PPP performances in the field
  - Learn and overcome the challenges associated to the end-to-end PPP process
    - Communications
    - Robustness
    - Reliability
  - Challenges of implementing the PPP algorithm in portable devices
    - CPU and memory load
    - Power consumption

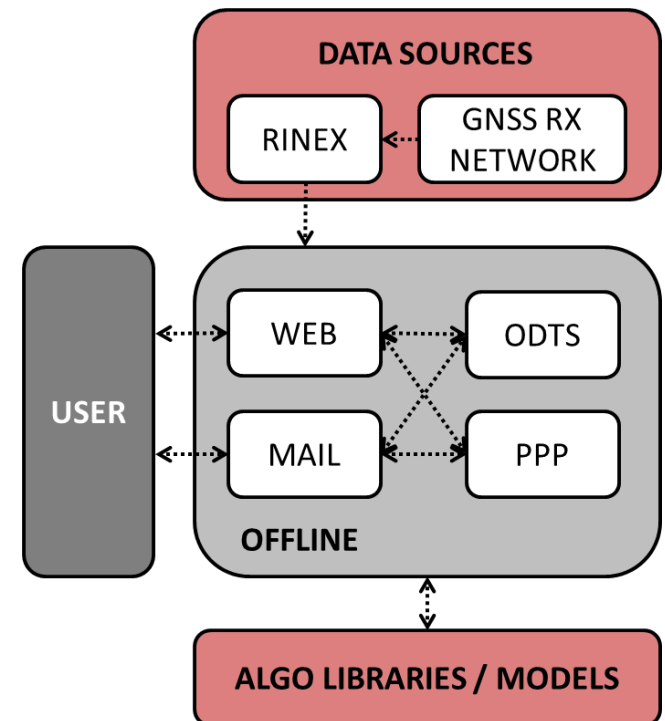
# MAGICGNSS OVERVIEW

- *magicGNSS* is built up from 3 high level elements:
  - Offline web service
  - Real-Time product server
  - Real-Time PPP client
- All three elements share the same low level algorithmic libraries which guarantees results consistency and SW maintainability



# MAGICGNSS' WEB SERVICE

- Online platform ([magicgnss.gmv.com](http://magicgnss.gmv.com)) which enables a registered user to run a set of different multi-GNSS tools
- PPP computed using as reference IGS products or GMV's products generated by means of an IGS network
- PPP can be run by mail sending mail to [magicpp@gmv.com](mailto:magicpp@gmv.com)
- Processes RINEX 3.02 files
- ODTS processing based on IGS stations or previously uploaded user stations
- 6.0 beta version allows GPS+GLONASS+Galileo processing

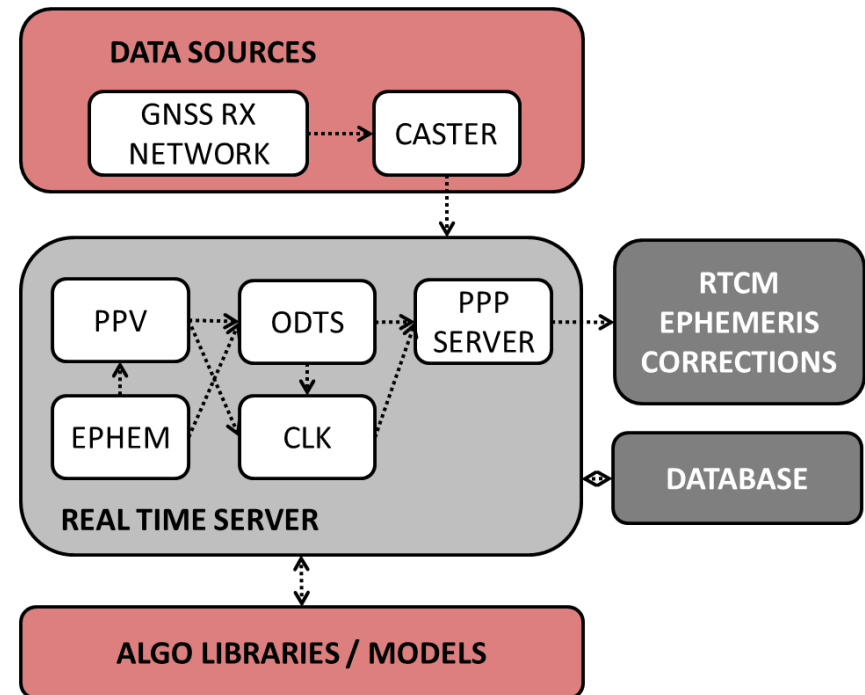


# MAGICGNSS' WEB SERVICE (2)

- Submitted RINEX validation used to be performed by means of TEQC (<http://facility.unavco.org/software/teqc/teqc.html>). Powerful and well-tested but some limitations:
  - It performs a very strict format validation that leads to reject many usable RINEX by PPP/ODTS
  - It does not support new RINEX versions (3.xx)
- GRIAL (Gmv RInex AnaLyzer). Designed and developed to achieve three important goals:
  - Adapt the RINEX v2.xx analysis to the *magicGNSS* requirements
  - Support RINEX v3.xx formats
  - Take advantage of the knowledge acquired with the maintenance and support tasks of *magicGNSS* to try to fix the most common problems found in the different RINEX versions
- PPP by mail rejection greatly improved by the usage of GRIAL

# MAGICGNSS' REAL-TIME SERVER

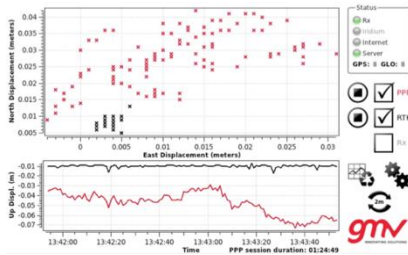
- Infrastructure for generation of:
  - Precise multi-GNSS orbits and clocks for real-time and post-processing applications
  - RTCM ephemeris corrections for HA positioning in real-time
- Modular architecture for distributed processing
- Data retrieval, from a worldwide RTCM station network via NTRIP
- Configurable in real-time by means of a database
- Accepts connections from multiple PPP clients



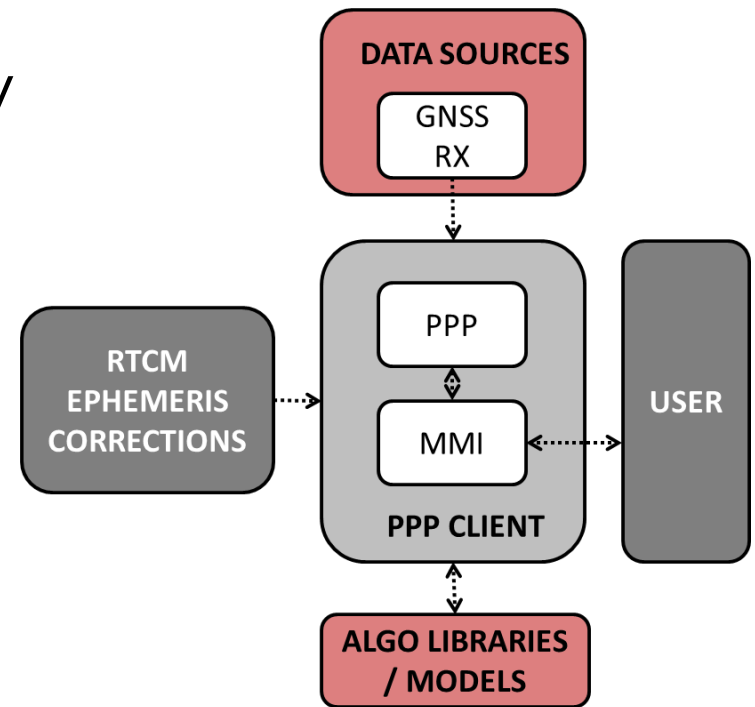
# MAGICGNSS' REAL-TIME PPP CLIENT

- PPP module able to compute HA user position in real-time based on:
  - RTCM observations and ephemeris coming from a GNSS receiver via serial port
  - RTCM ephemeris corrections coming from an external service provider

- User logs and runs the PPP client by means of an MMI



- Position generated in NMEA format
- Allows running RTK by means of rtklib





# RTCM STATUS

- The latest RTCM 3.2 standard developed by the SC.104 intends to support highly accurate differential and kinematic positioning as well as a wide range of navigation applications as PPP
- For POD and PPP applications 3 family messages are crucial:
  - Observations
  - Ephemeris
  - Ephemeris correction messages
- Multi-GNSS coverage has been improved, but certain gaps persist:

	GPS	GLONASS	Galileo	BeiDou	QZSS
Observations (MSM)	YES	YES	YES	YES	YES
Ephemeris	YES	YES	YES	NO	YES
Ephemeris corrections	YES	YES	NO	NO	NO

# MAGICGNSS' REAL TIME DATA SOURCES

- NTRIP casters (<http://ntrip.org/>)



rt.igs.org:2101



www.igs-ip.net:2101

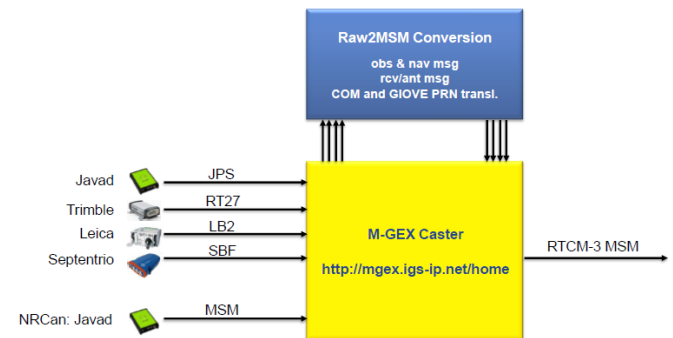
- IGS network GPS + GLONASS only
- MGEX network for multi-GNSS

# IGS' MULTI-GNSS EXPERIMENT PROJECT

- Established to explore and promote the usage of new navigation signals and constellations within the IGS (<http://www.igs.org/mgex>)
- Multi-GNSS sensor station network
  - Around 110 stations located in 90 sites
  - RTCM3-MSM real-time data streams (5 streams per registered user)
  - RINEX 3.02 data archive
- Multi-GNSS products from 5 AC`s
  - European Space Operations Centre (ESOC)
  - Center for Orbit Determination in Europe (CODE)
  - GeoForschungsZentrum Potsdam (GFZ)
  - Technische Universität München (TUM)
  - Wuhan University



Real-time M-GEX RTCM-3 MSM Stream Generation

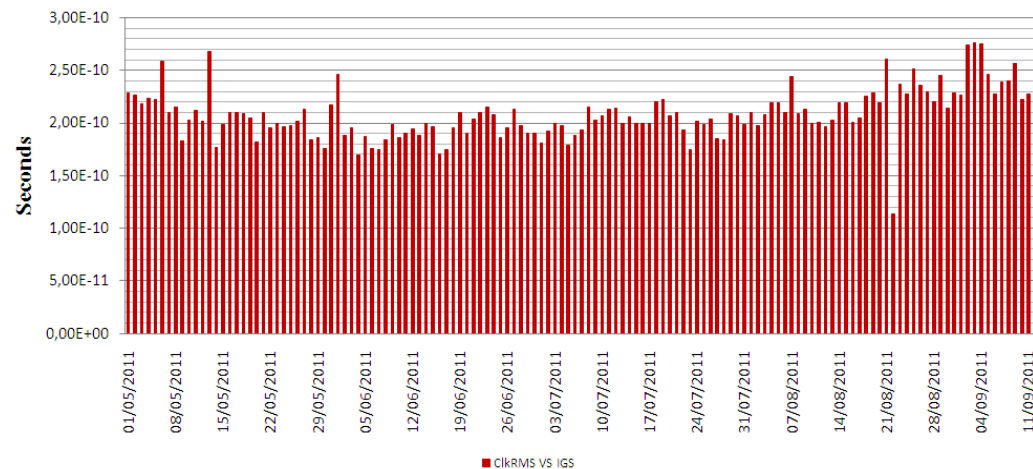
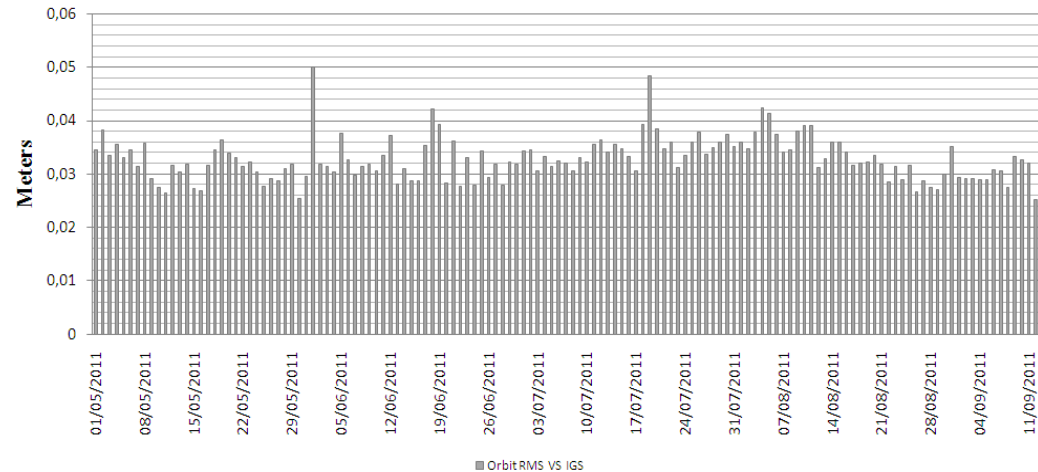


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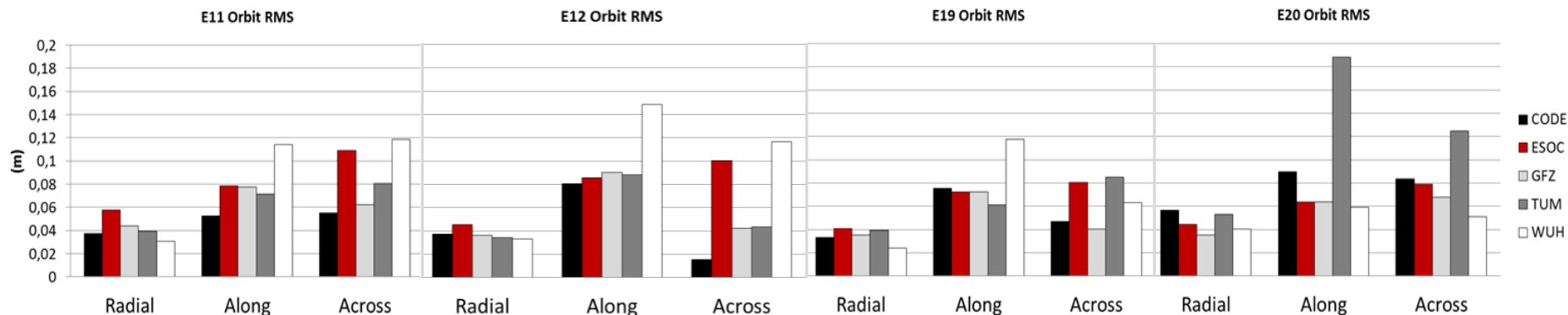
# MAGICGNSS' WEB SERVICE PERFORMANCES

- Offline ODTs process running in off-line post-processing mode with a latency of 2 days and specific setup, which allows the generation of GMV's reference products
- Typical GPS typical performances are around:
  - 3,5 cm RMS for the orbit
  - 0.2 ns RMS for the clock accuracy



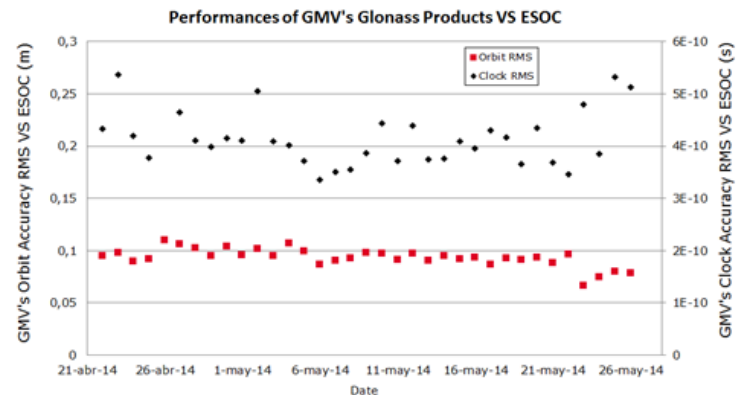
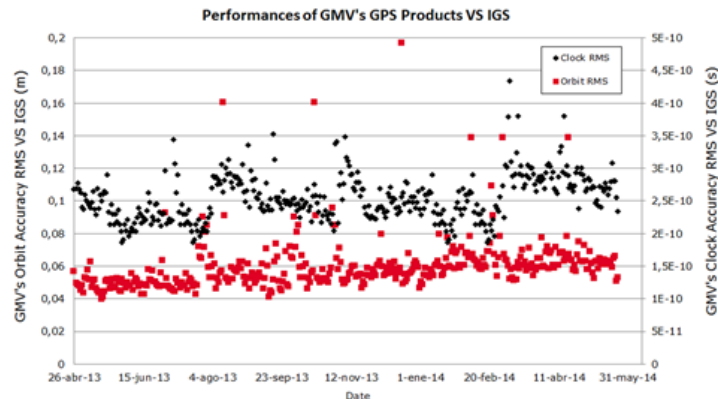
# MAGICGNSS' WEB SERVICE PERFORMANCES (2)

- Experimental *magicGNSS*' web server with MGEX stations for reference product generation
- MGEX' products used as reference for GALILEO product quality assessment
- Centimetric consistency between all the solutions



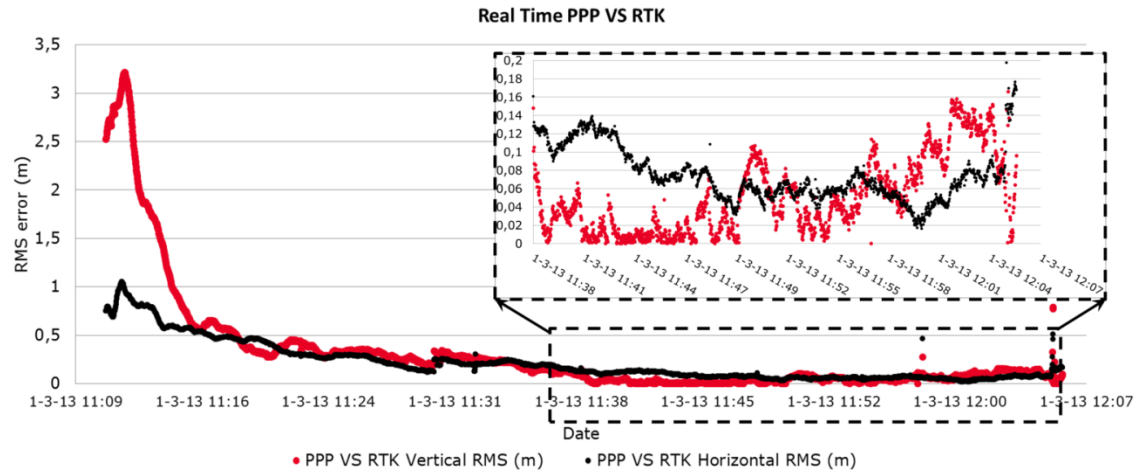
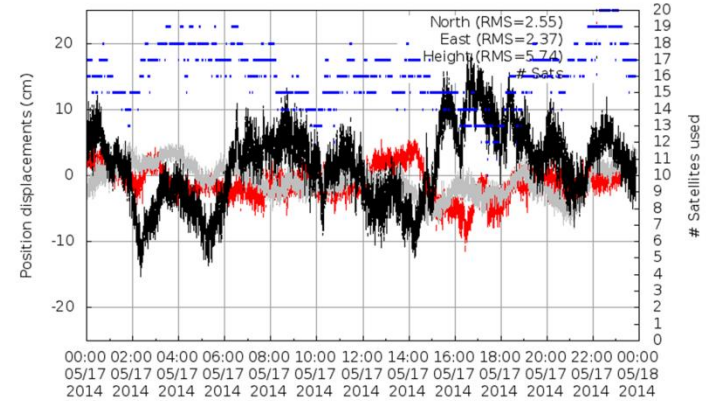
# MAGICGNSS' REAL TIME SERVER PERFORMANCES

- Quality of the Real-Time GPS and GLONASS orbits and clocks has been assessed during the past years versus IGS in the frame of IGS' Real Time Service ([rt.igs.org](http://rt.igs.org))
- Typical GPS orbit accuracy is about 6 cm, RMS, and clock accuracy is about 0.25 ns, RMS versus IGS rapid products
- Typical GLONASS orbit accuracy is about 10 cm, RMS, and clock accuracy is about 0.4 ns, RMS versus ESOC (European Space Operations Centre) products.



# MAGICGNSS' REAL-TIME PPP CLIENT PERFORMANCES

- Base station coordinates continuously monitored
- Real-Time PPP performances assessed versus RTK in open field kinematic environments
- Centimetric consistency between RTK and PPP under nominal circumstances



# CONCLUSIONS AND FUTURE WORK

- A increasing number of users is using *magicGNSS*. A chance for improving, but workload increase
- Upgrade *magicGNSS* online version for multi-GNSS processing
- Challenges both at server and client level
  - Products quaity
  - Communications
  - Convergence
  - Robustness
- MSM data availability and multi-GNSS SSR message definition issues need to be tackled for real-time multi-GNSS service testing





Thank you

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