ION GNSS 2015

MAGICGNSS' RTCM-BASED SERVICE, A LEAP FORWARD TOWARDS MULTI-GNSS HIGH ACCURACY REAL-TIME PROCESSING

SEPTEMBER 16TH , 2015 - ION GNSS 2015, TAMPA, FLORIDA, USA

SESSION E2A: NEXT GENERATION GNSS POSITIONING

D. Calle
A. J. García
D. Luque
I. Rodríguez
G. Tobías

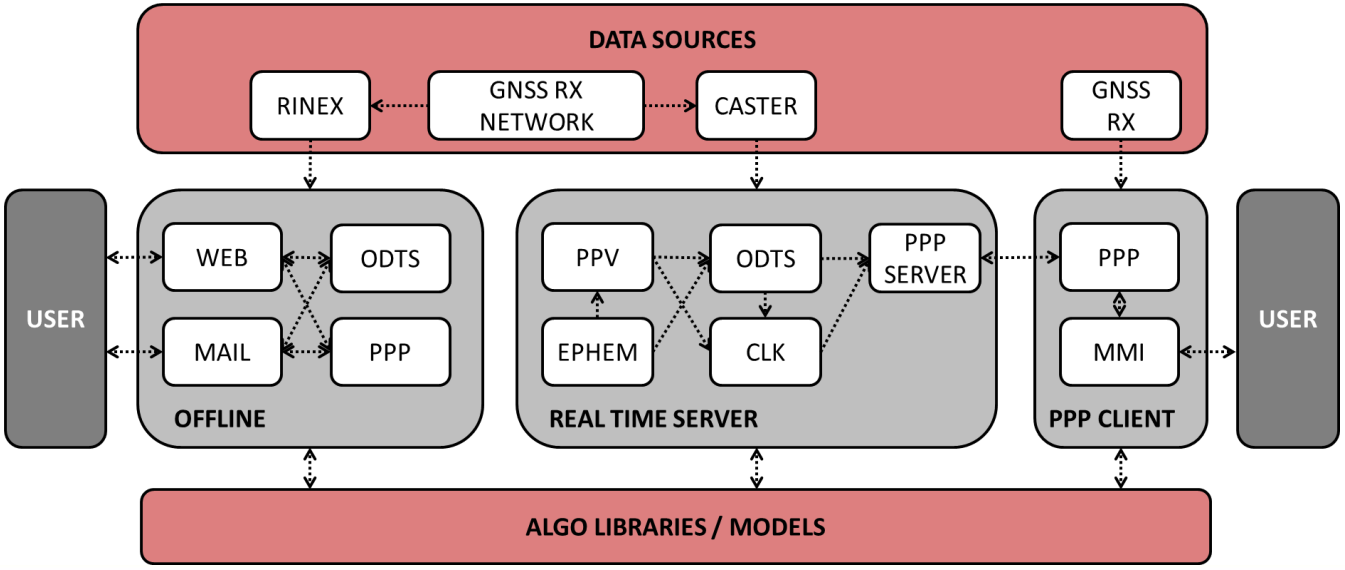
OUTLINE

- *magicGNSS* overview
- Motivation for *magicGNSS* development
- *magicGNSS* 7.0
- Real Time Server Infrastructure
- Real Time PPP Client
- RTCM status
- Conclusions and future work

MAGICGNSS OVERVIEW

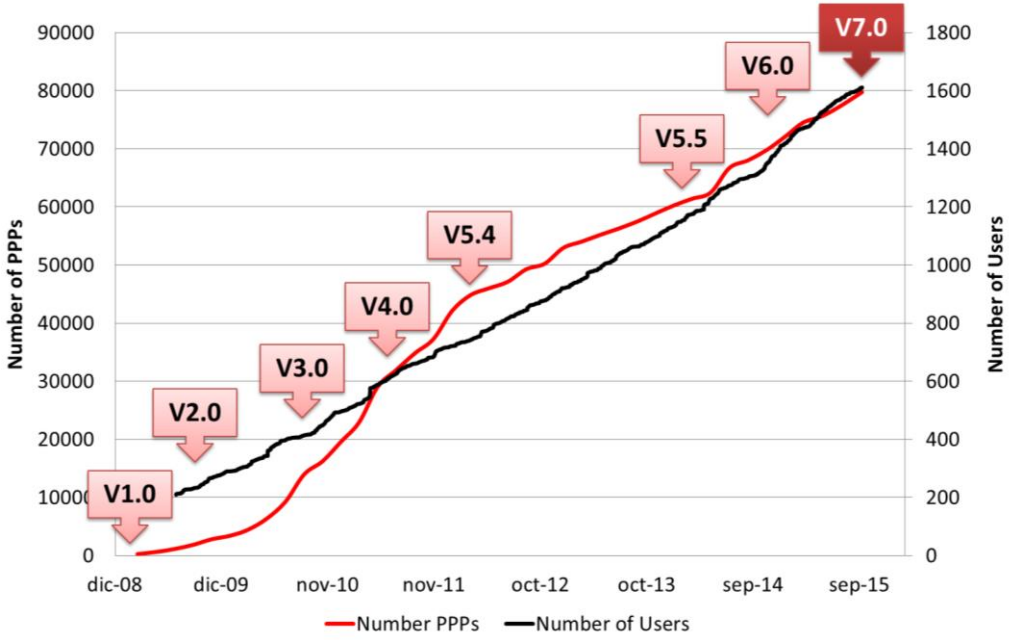
- *magicGNSS* is a suite comprises a set of GNSS tools and services which have been developed and tailored by GMV throughout the years to cope with the needs of the wide variety of GNSS users.

- *magicGNSS* is built up from 3 high level elements:
  - Post-processing service
  - Real-Time product server
  - Real-Time PPP client



MOTIVATION

- *magicGNSS* web service
  - **Provide the GNSS community with a set of useful GNSS tools**
  - Keep GMV's POD and PPP knowledge at state-of-the-art level



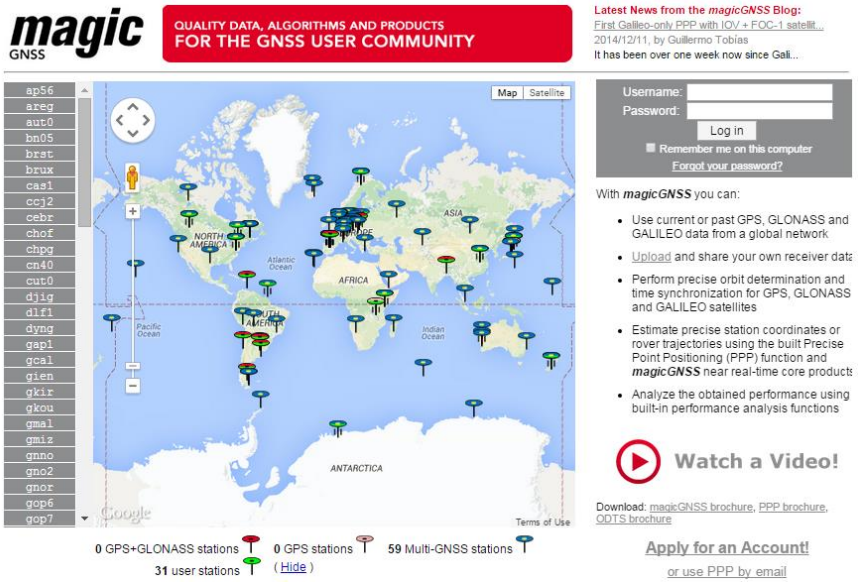
- *magicGNSS* real-time service
  - Answer to IGS' call on 2008 for **IGS Real-Time Pilot Project**
  - Precise orbit and clock products in real-time
  - Evaluate real-time PPP performances in the field
  - Learn and overcome the end-to-end PPP processing challenge
  - Challenges of implementing the PPP algorithm in portable devices
  - Analyse feasibility of a low cost PPP service

MAGICGNSS 7.0

- Addition of BeiDou and QZSS
- Single frequency PPP processing
- Long Term multi-GNSS Ephemeris service for A-GNSS
- Migration of PPP client to Android
- GAP Bridging for PPP
- PL computation at PPP
- PPP access through web API
- Real-Time Station monitoring

MAGICGNSS' WEB SERVICE

- Post processing service (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 multi-GNSS network (MGEX)
- **PPP** can be run by **mail** sending mail to magicpp@gmv.com
- Multi-GNSS **ODTS** processing based on IGS stations or previously uploaded user stations



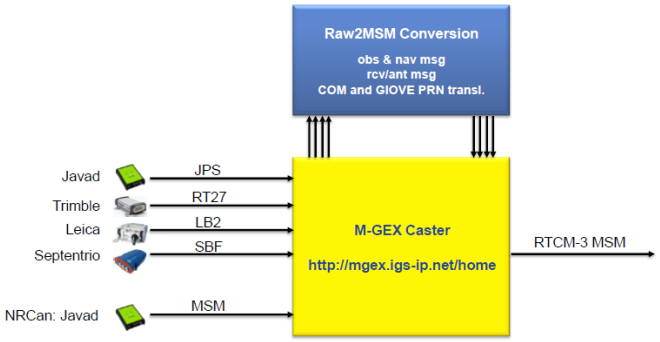
IGS' MULTI-GNSS EXPERIMENT PROJECT

- 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

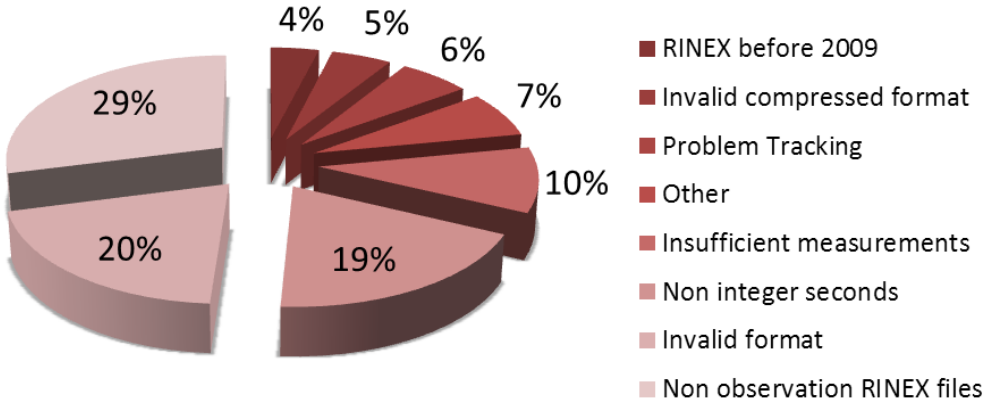


IGS Workshop, 22-27 July 2012, Olsztyn, Poland 5

PPP BY MAIL SERVICE

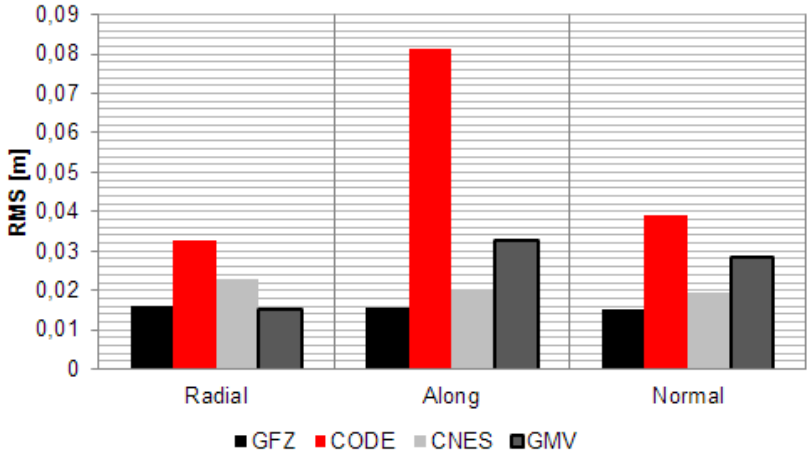
- PPP by mail largely used with wide variety of RINEX received, validation becomes an issue

- **GRIAL** (Gmv RInex AnaLyzer):
  - 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

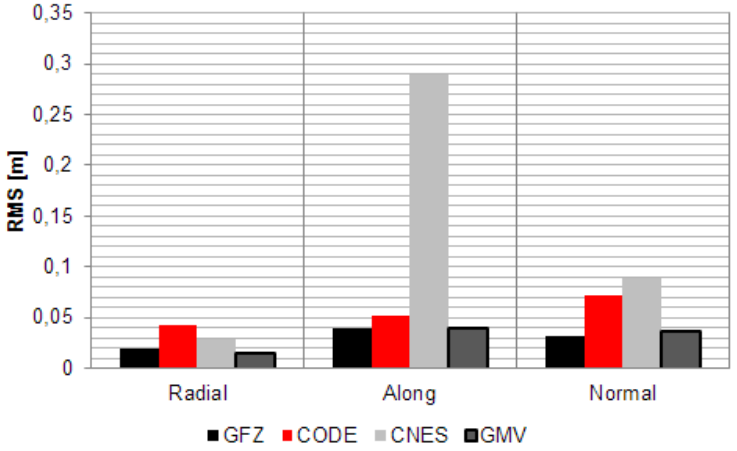


- PPP by mail errors reduced **from 35% to less than 10%**

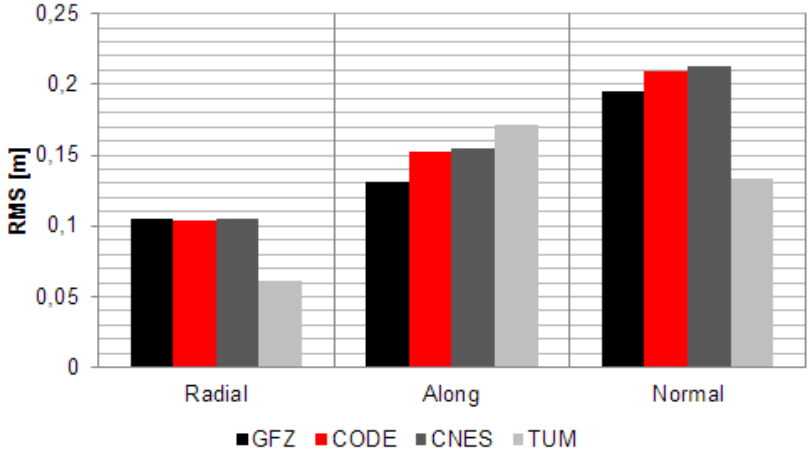
POST-PROCESSED PRODUCTS PERFORMANCES



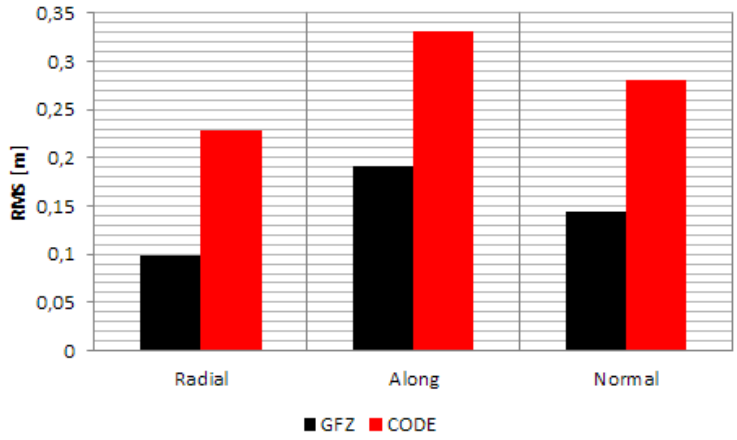
IGS GPS rapid



IGS GLONASS Rapid



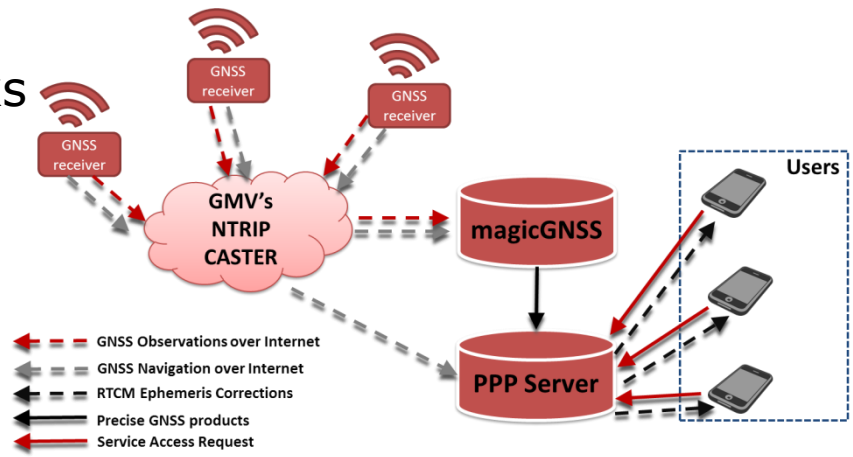
Galileo MGEX



BeiDou MGEX

MAGICGNSS' REAL-TIME SERVER

- Infrastructure for generation of:
  - Precise multi-GNSS orbits and clocks for real-time and post-processing
  - 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**

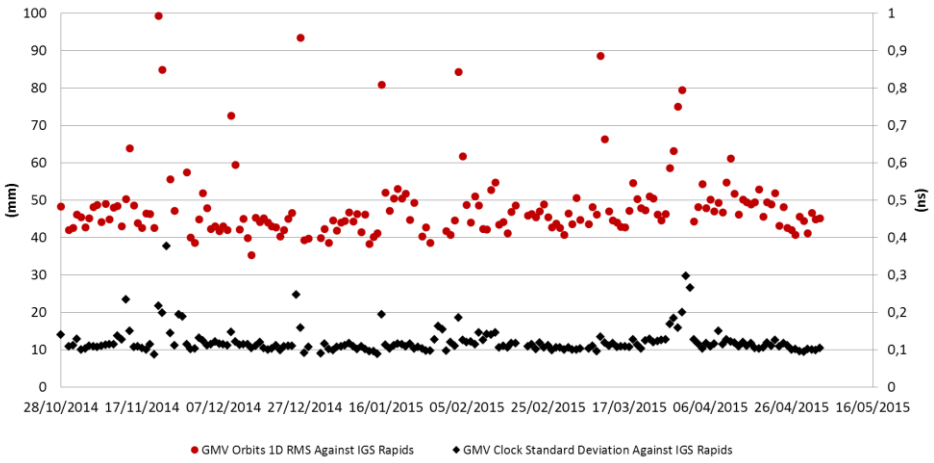
MGEX Network

MAGICGNSS' REAL-TIME SERVER PERFORMANCES

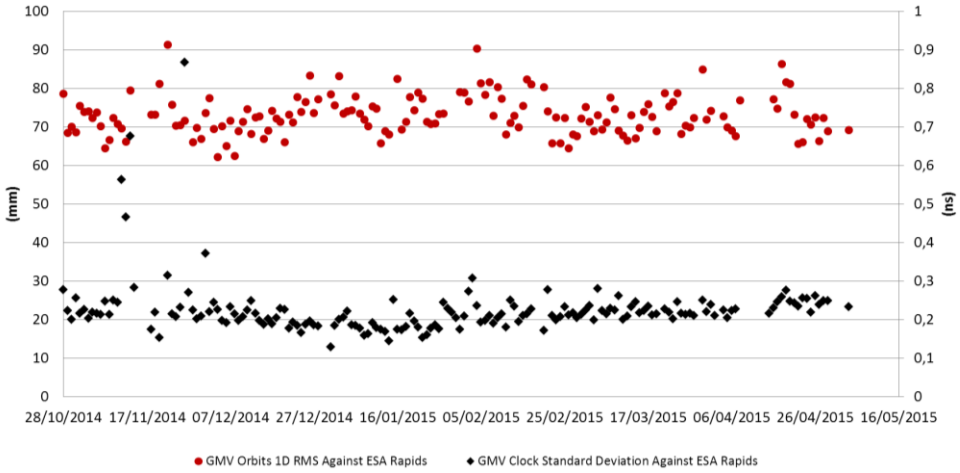
- Quality of the Real-Time GPS and GLONASS orbits and clocks assessed in the frame of **IGS' Real Time Service** (rt.igs.org)

- GPS orbit accuracy is 4,5 cm, RMS, clock accuracy is about 0.1 ns, STDEV versus IGS rapid products

- GLONASS orbit accuracy is about 7 cm, RMS, clock accuracy is about 0.2 ns, STDEV versus ESA products.



GPS

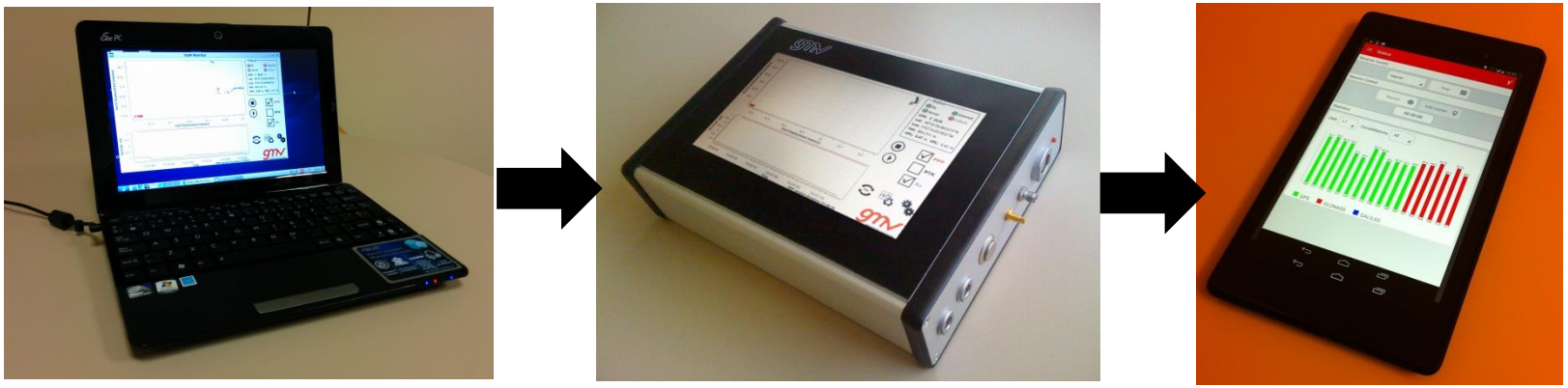


GLONASS

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
  - RTCM ephemeris corrections coming from an external service provider
  - **Maximize portability and cross-compatibility**

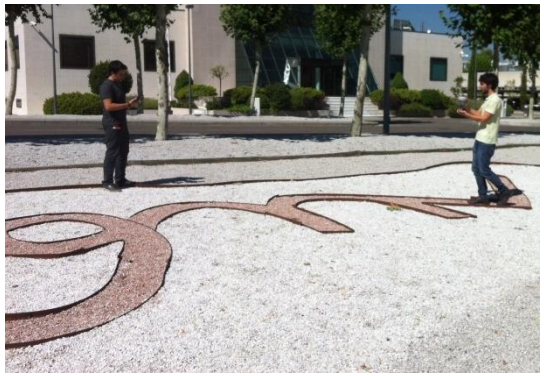
- Evolved from laptop to SBC with LCD to **Android**

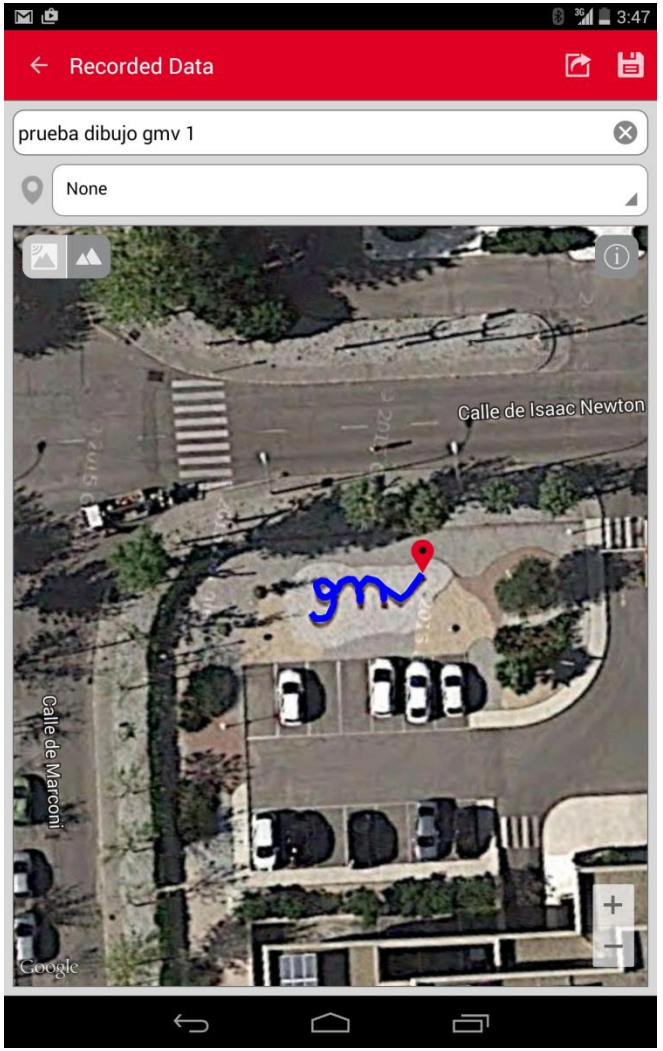


2011 **2012** **2015**

MAGICGNSS' REAL-TIME PPP CLIENT APP

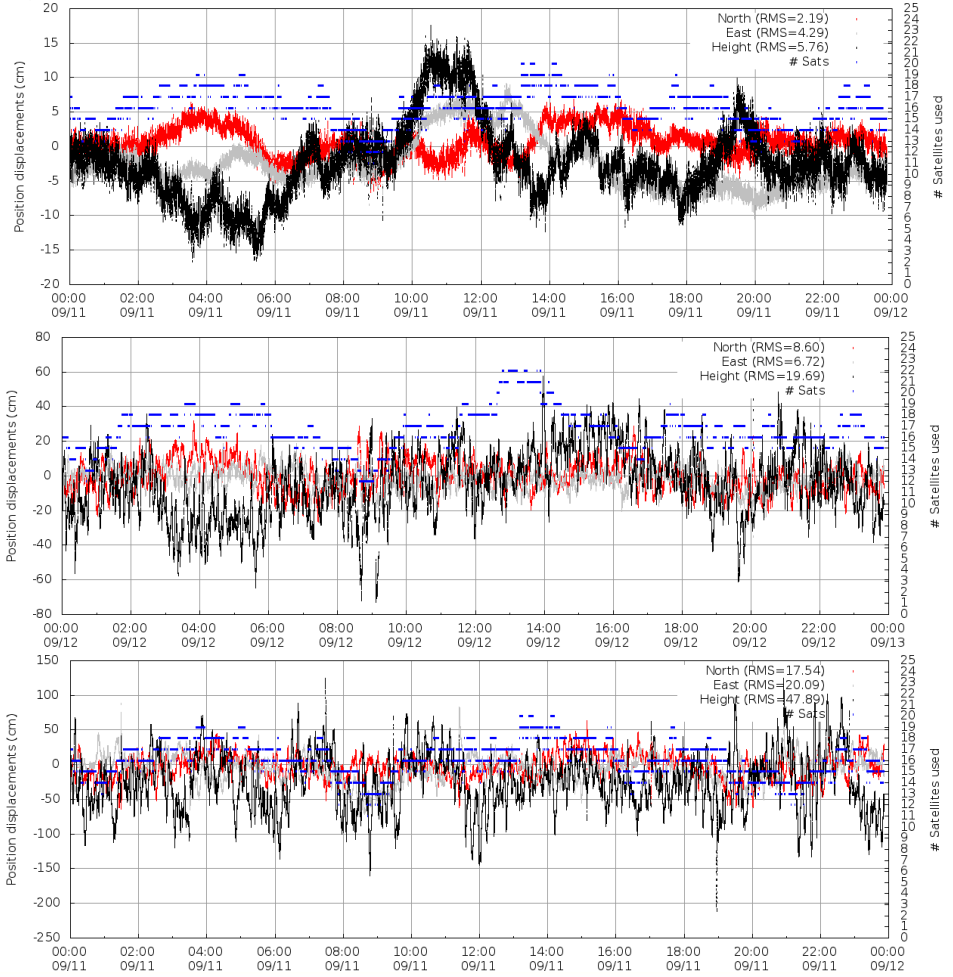
- Current *magicPPP* client supports:
  - Dual and single frequency PPP processing
  - GAP bridging to speed up re-convergence
  - Protection Level computation
  - Quickstart capability
  - Integrated PPP API





MAGICGNSS' REAL-TIME PPP CLIENT PERFORMANCES

- Real Time products routinely monitored by means of a PPP client with different configurations and Receivers
  - Double Frequency PPP
    - 3cm HRMS
    - 6cm VRMS
  - Single Frequency PPP
    - 15cm HRMS
    - 25cm VRMS
  - SF PPP Low Cost Rx
    - 25cm HRMS
    - 50cm VRMS



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	YES	NO	NO

CONCLUSIONS AND FUTURE WORK

- A increasing number of users is using *magicGNSS*. A chance for improving!
- Improve multi-GNSS product accuracy for upcoming constellations
- Challenges both at server and client level
  - Products quality
  - Communications
  - Convergence
  - Robustness
- MSM data availability and multi-GNSS SSR message definition issues need to be tackled for real-time multi-GNSS service provision

Thank you

Guillermo Tobías
GMV - GNSS BU
gtobias@gmv.com

Visit us in booth 118/120

gmv®
INNOVATING SOLUTIONS