IONGNSS 2011
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# First broadcast of SBAS-SACCSA test signal in the Caribbean, Central America and South America

Session C4: GNSS Space Based Augmentation Systems (SBAS)

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- Introduction
- SBAS Demonstration architecture
- Obtained Results
- Safety Aspects
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# Introduction

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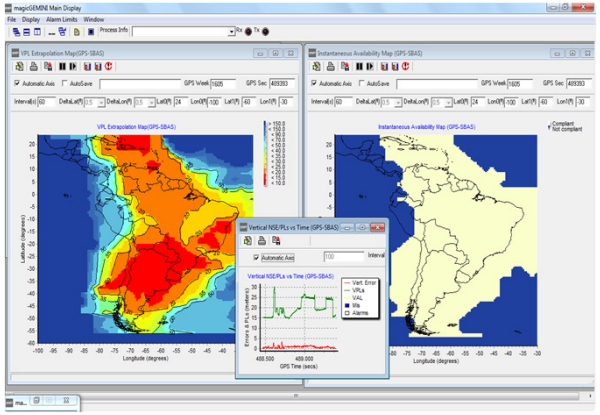
# Introduction

- First SBAS GEO test signal in Latin America
  - SACCSA coordination meeting (RCC/7) **Bariloche, Argentina (14-15.10.2010)**
- RCC/7 participants:
  - Argentina, Bolivia, Brazil, Colombia, Costa Rica, Guatemala, Panama, Spain, Venezuela, COCESNA, IFALPA and ICAO.
- With the support from:
  - ICAO, AENA and GESA laboratory (Universidad Nacional de La Plata, Argentina"), and the Argentinean State represented by ANAC.
- Integration of **GMV** and **Inmarsat** technologies
- Filmed video in the following web link
  http://www.gmv.com/magicsbas/gallery/gallery.html



# SBAS Demonstration architecture

- *magicSBAS*
- *SBAS signal generator*
- *Inmarsat GEO satellite*
- *magicGEMINI*
- *NTRIP reference stations*
- *User receiver*

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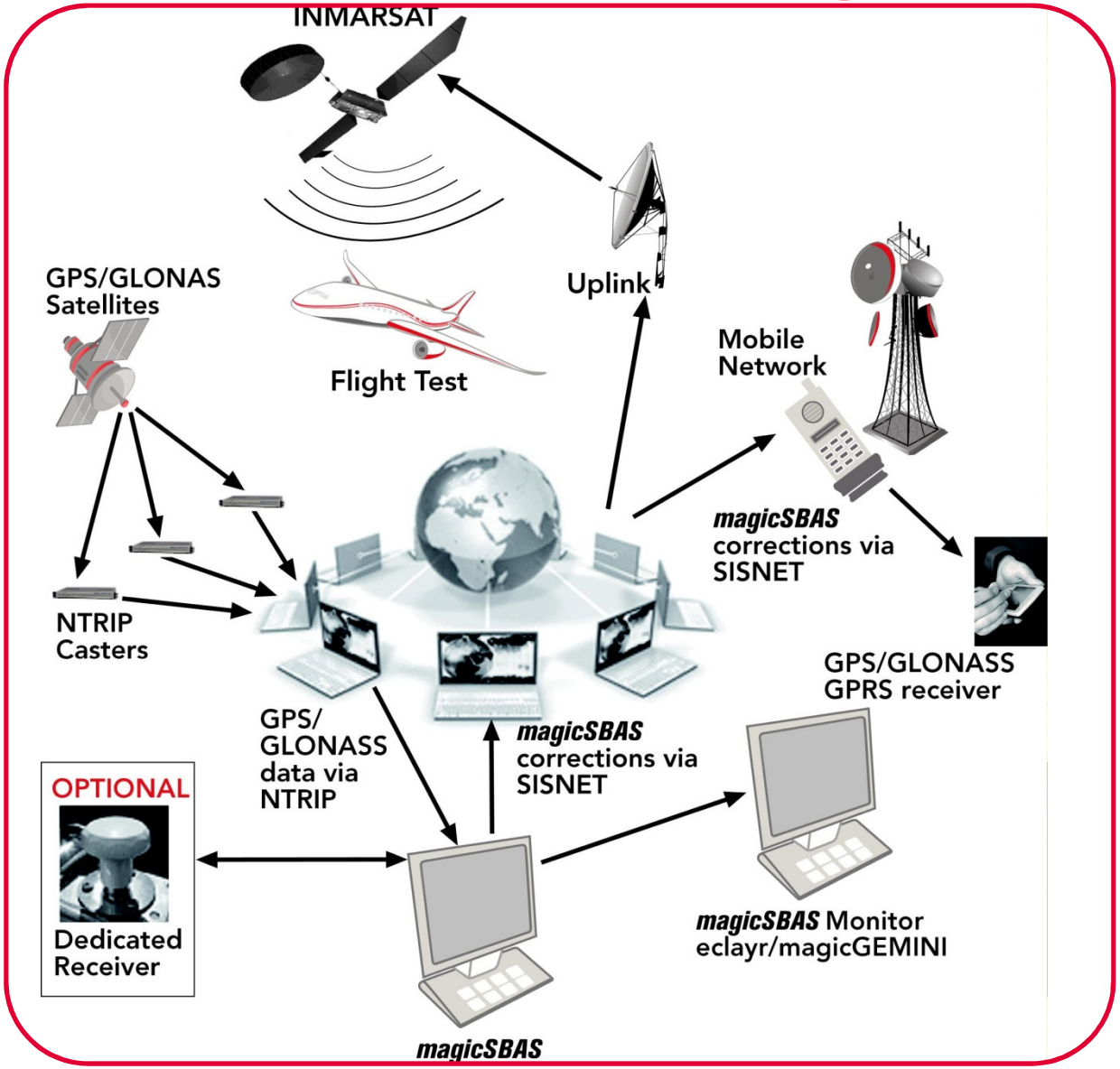
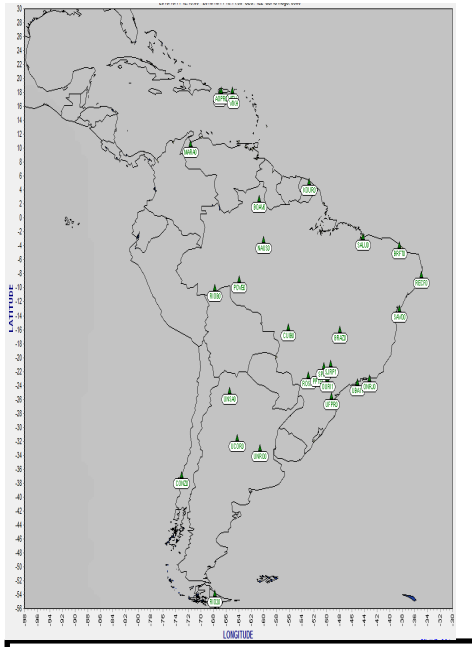
# Demo architecture: *magicSBAS*



User receivers used:

- Septentrio PolaRx2 in Spain
- GPS map 276C Garmin in Argentina

# Demo architecture: *SBAS signal generator*

- SBAS signal generator owned by **Inmarsat**, used for L1/L5 payload validation

L1/L5 SBAS Receiver
(by Novatel)

- It basically consists of:
  - L1/L5 GPS/SBAS Receiver
  - L1/L5 Signal Generator, and
  - L1/L2 GPS Receiver/Antenna and an SBAS Processor/Controller

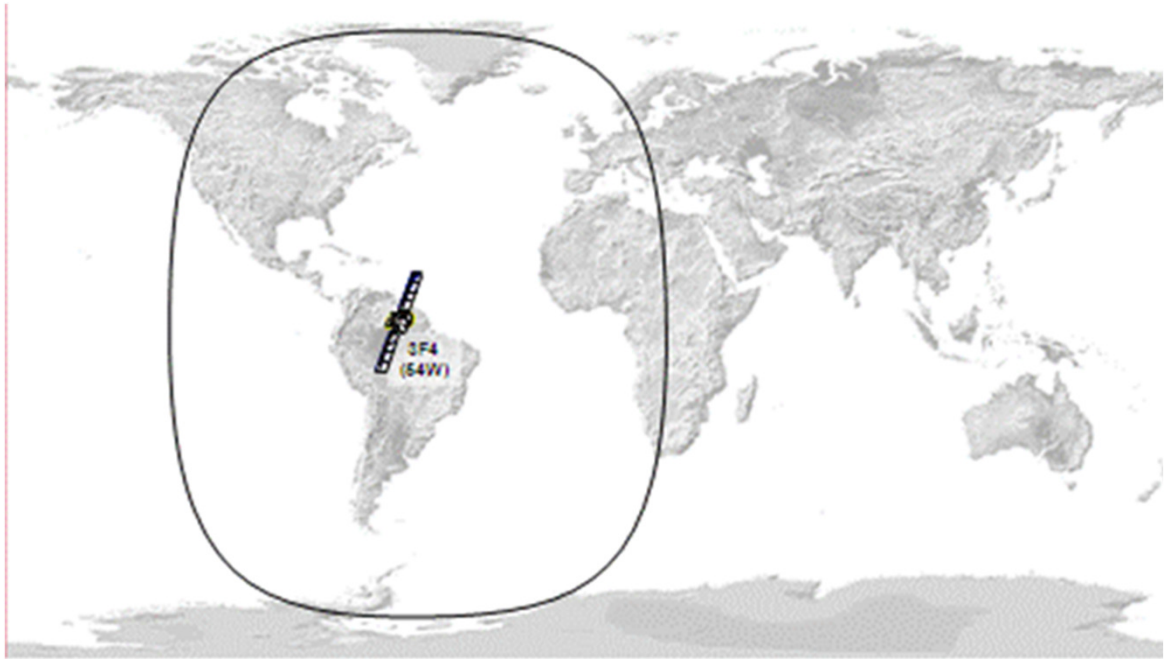
(For the purpose of the demonstration, only the L1 signal was generated.)

L1/L5 SBAS Signal Generator
(by GPS Silicon Valley)

# Demo architecture: *Inmarsat GEO*

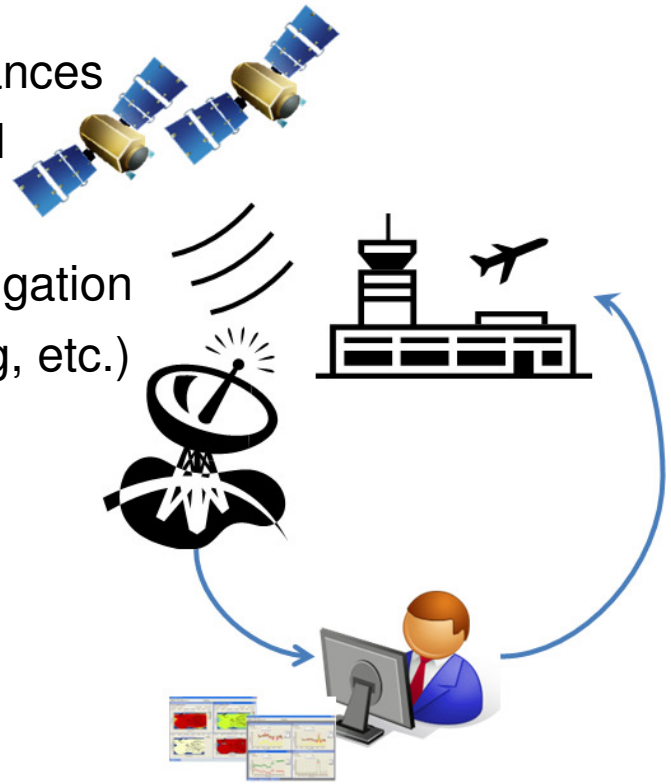
- Navigation transponder in GEO **Inmarsat-3F4**
  - Positioned over the Americas continent (Longitude 54ºW)

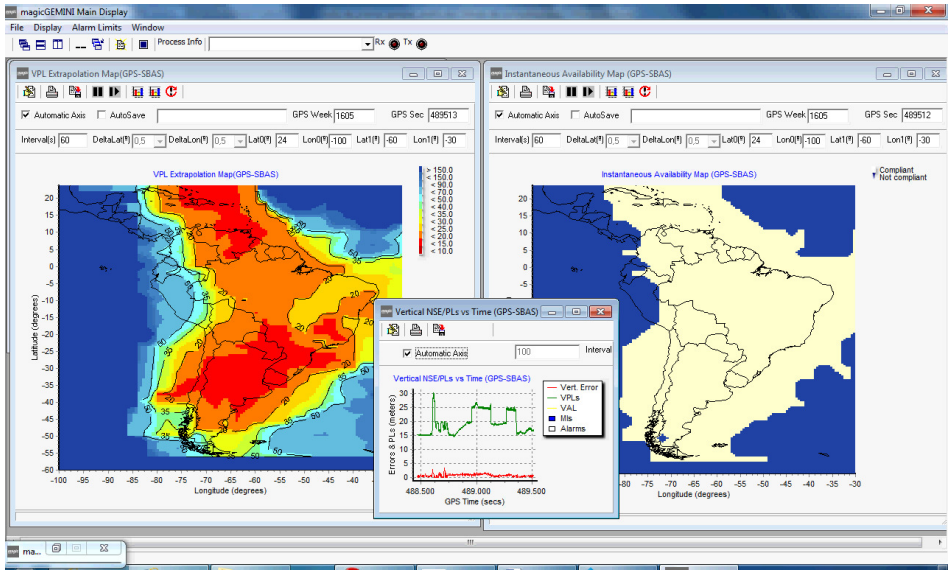
- Uplink from **Inmarsat** communication station located in Fuccino (Italy)




# Demo architecture: *magicGEMINI*

- ***magicGEMINI*** (**GMV**) used to check SBAS performances
  - GNSS performance analysis and monitoring tool
  - Targeting air navigation service providers
    - Implementation of Performance Based Navigation
    - Transition to GNSS (certification, monitoring, etc.)
  - MOPS and SARPS compliant.
  - Real time and post-processing






magic GEMINI
ULTIMATE GNSS OPERATIONAL PERFORMANCE MONITOR AND ANALYSIS SYSTEM
FOR THE AVIATION COMMUNITY

# SBAS demonstration Obtained Results

- *Introduction*
- *magicSBAS performances*
- *Additional demonstrations*

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# SBAS obtained Results: *Introduction*

- ***magicSBAS*** has been **adapted to South America**
  - Algorithms customized to equatorial regions.


- Ref. station network consistent on available NTRIP real time stations

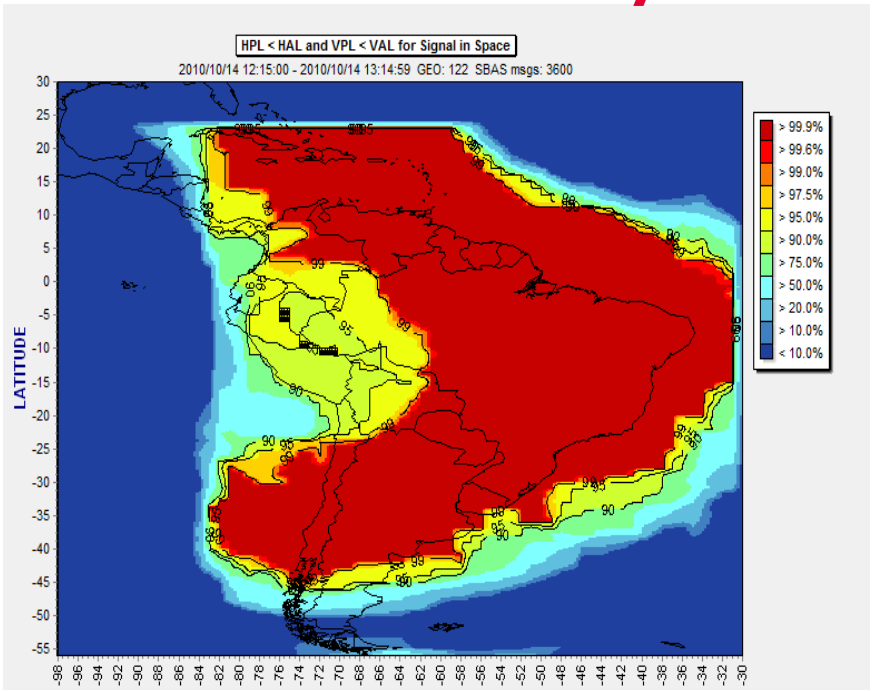
- Execution in September and October 2010.
  - Broadcast by the Inmarsat GEO on 14 and 15 Oct. 2010.
  - Low-medium ionosphere activity, not representative of the worst case

- Different analyses were done to study the obtained demo performances:
  - From a GPS receiver at GMV premises in Madrid (covered by footprint)
  - In-situ SBAS performances in San Carlos de Bariloche, Argentina

- Performances highly dependant on data availability
  - Data transmission on the internet
  - Focus of the paper is on the technology integration

# magicSBAS performance analysis
## Latin America

### APV-I Availability




Red area: 99.9%

**Data sources: IGS/IBGE/UNESP/UPRM**

(igs.bkg.bund.de / www.ibge.gov.br / gege.fct.unesp.br/ www.uprm.edu)

❖ Note: Performance figures highly depend on NTRIP station availability, so different availability figures where obtained

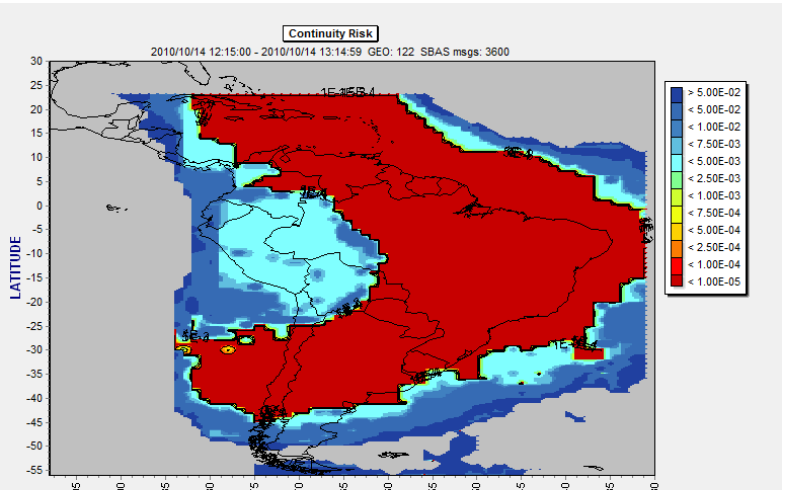
### Accuracy

* Horizontal (95%): 1-2 m
* Vertical (95%): 2-3 m

### Integrity

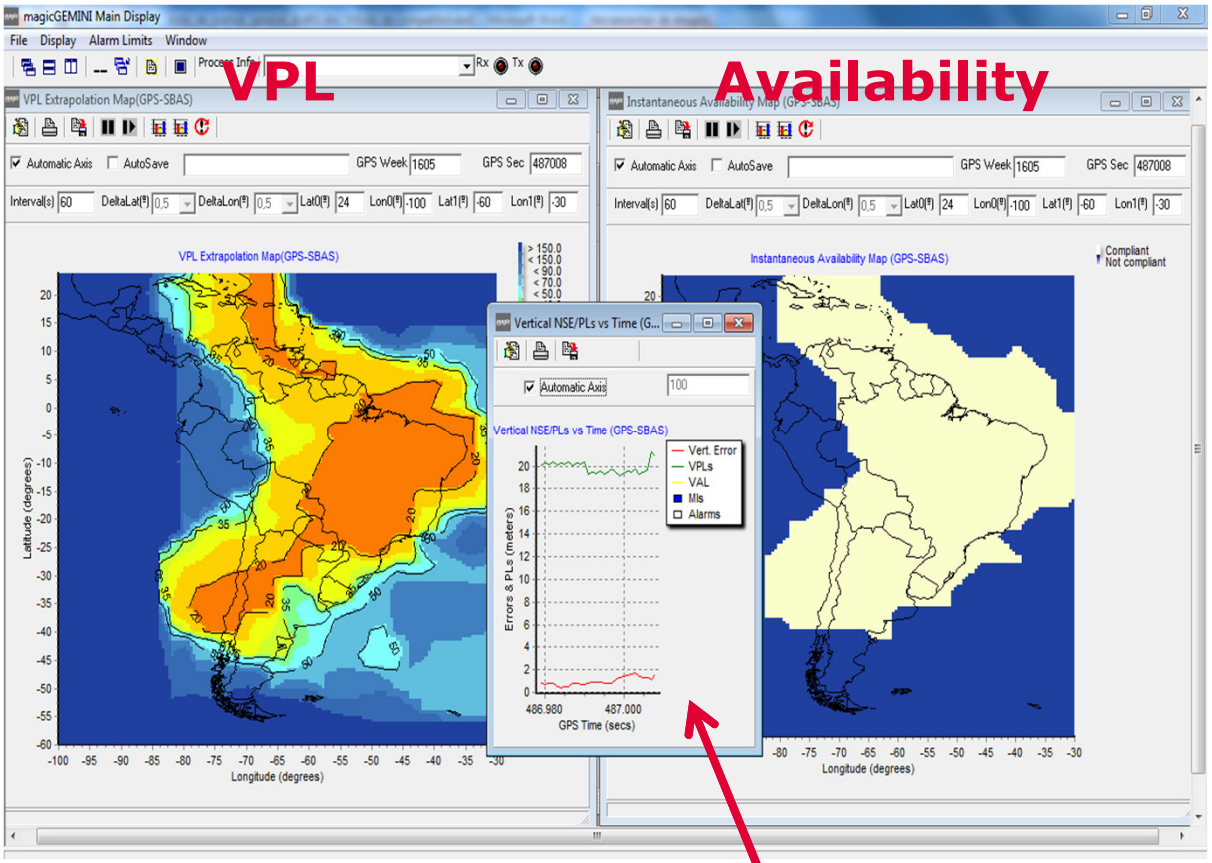
* Safety Index 95% < 0,27

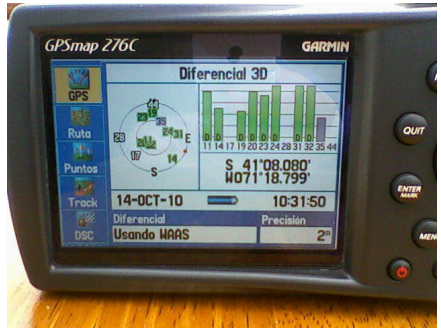
### Continuity




Red area: $10^{-5}$

# magicSBAS performance analysis:
## *In-situ performances*
## Latin America



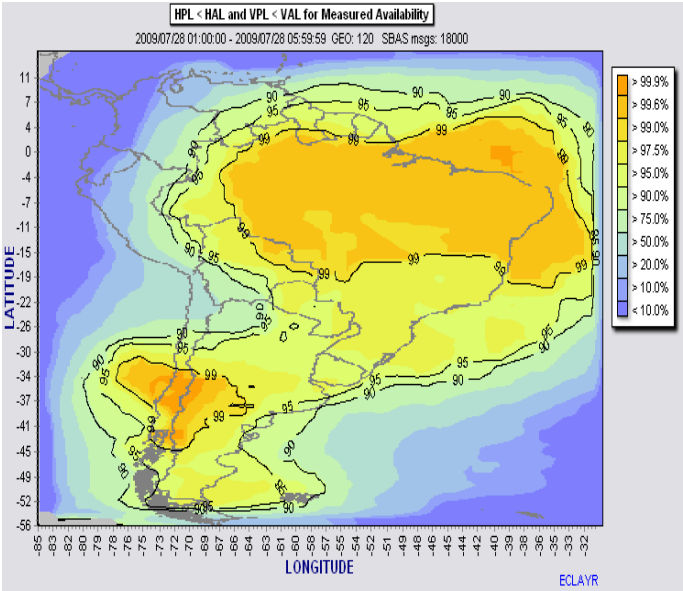

- Demo SBAS GEO (PRN 122) as seen by the Garmin receiver
- Rx configured to process test SBAS signal (MT0)

**Integrity: NSE vs PL**

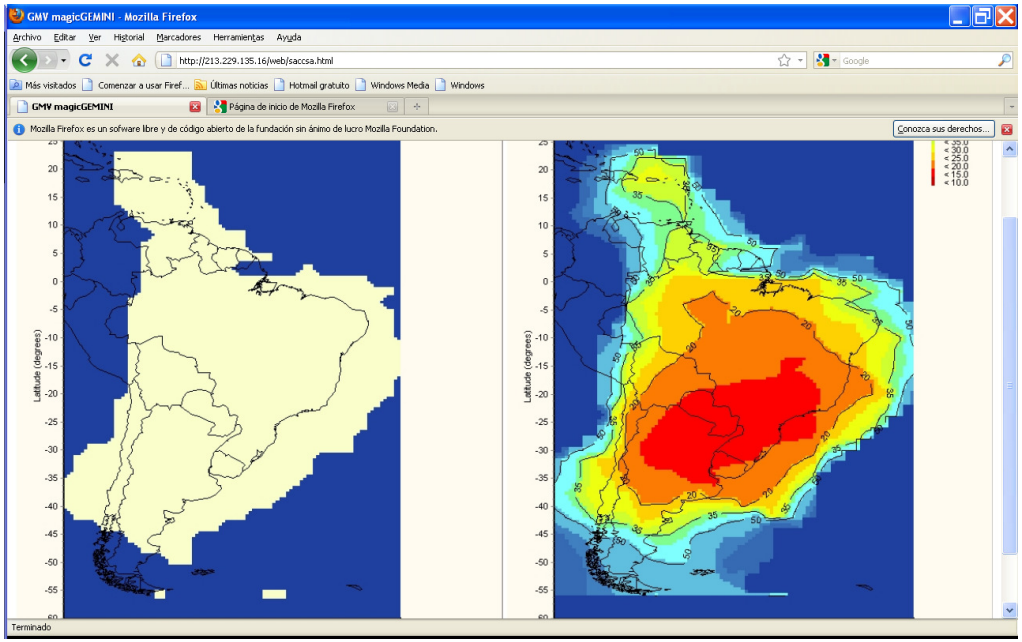
# magicSBAS aditional demonstrations

Additional demonstrations (without GEO broadcast)

July-August 2009:
Celeste project demonstrations




November 2010:
ICAO CNS/ATM Mexico




A web platform with internet data dissemination

- 213.229.135.14:5555 (subject to change)

  (e-mail to magicSBAS@gmv.com)

# SAFETY Aspects

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# Safety Aspects

- Safety a fundamental aspect to consider in the demo
  - Ensure no interference with other operational SBAS

- Barriers used:
  - MT0 enabled  and transmitted every 6 s (magicSBAS only mode)
  - The configured IGPs did not overlap EGNOS or WAAS
  - MT27 configured to define a Service Area over South America
  - Highest possible delta UDRE for the outside region.
  - PRN used was PRN 122

- ICAO was aware of the intention to broadcast the test signal
  - FAA and the European Commission were informed with the signal in the air
  - It could be convenient to have a coordination mechanism for further test

- Are new safety barriers needed to avoid interference from ill-willed signals?
  - Could it be convenient to add authentication in SBAS L5?

# Conclusions

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# Conclusions

- First SBAS test GEO signal time in the Caribbean, Central America and South America regions
- The purpose of the transmission was:
  - to complete the integration of **GMV**'s ***magicSBAS*** with **Inmarsat** GEO payloads (Inmarsat-3F4 in this case)
  - to show that SBAS test system is affordable with minimum infrastructure investments.
- Broadcast during the Seventh Meeting of the Coordination Committee (RCC/7) of ICAO Regional Project RLA/03/902 – SACCSA, held in San Carlos de Bariloche, Argentina, from 14 to 15 October 2010.
- A great success with excellent results and with a minimum cost.
- The presented technology constitutes a fundamental engineering and demonstration asset for those entities considering the deployment of an operational SBAS in any region

*http://www.gmv.com/magicsbas/magicsbas.htm*

*http://www.gmv.com/magicsbas/gallery/gallery.html*


Thank you
J. Caro, GMV
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