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GRAS Test Results, including Maui Mission Results

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GRAS Test Results including Maui Mission Results

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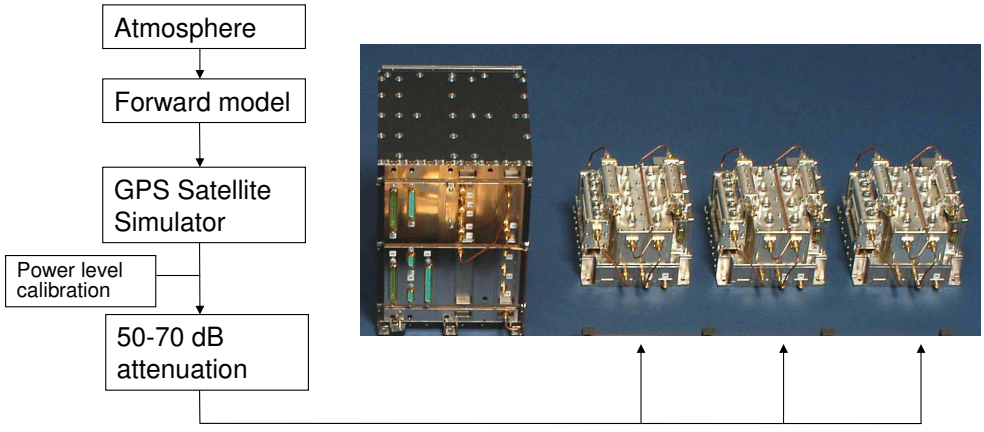
- **Results of tests from mountain top on Maui**

Anders Carlström

Tests using GNSS simulator

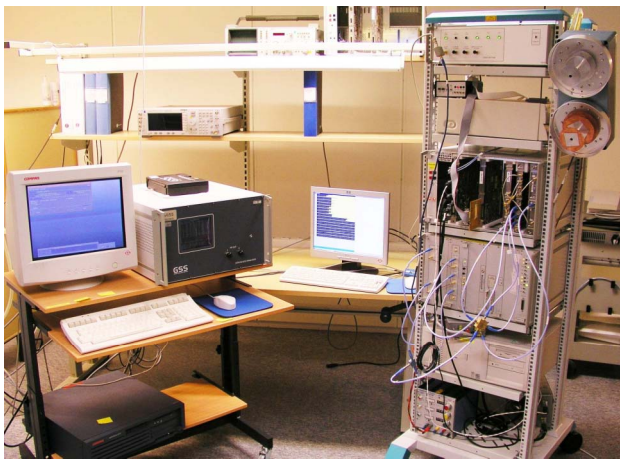


GNSS simulator capabilities

- Type: Spirent STR4760
- Simultaneous simulation of up to 12 GPS SVs
- L1, L2, CA, P1, P2, Pseudo-Y code
- Phase modulation due to orbit geometries
- User specified amplitude and phase modulation at 1 Hz
- Navigation data modulation

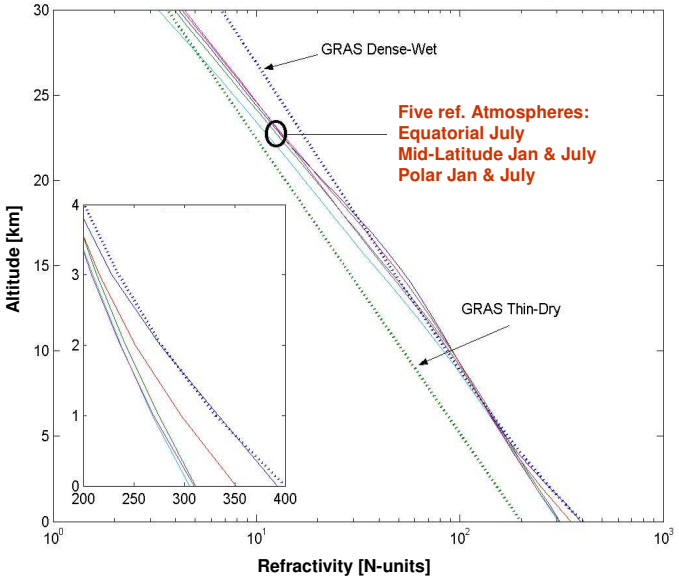
Occultation Laboratory at SE

- Receiver breadboard
  - -DF Front-End
  - -16 DF channels
  - -USO
  - -1553 I/F
- GNSS simulator
- Roof antenna
- Control PC
- Software upload PC

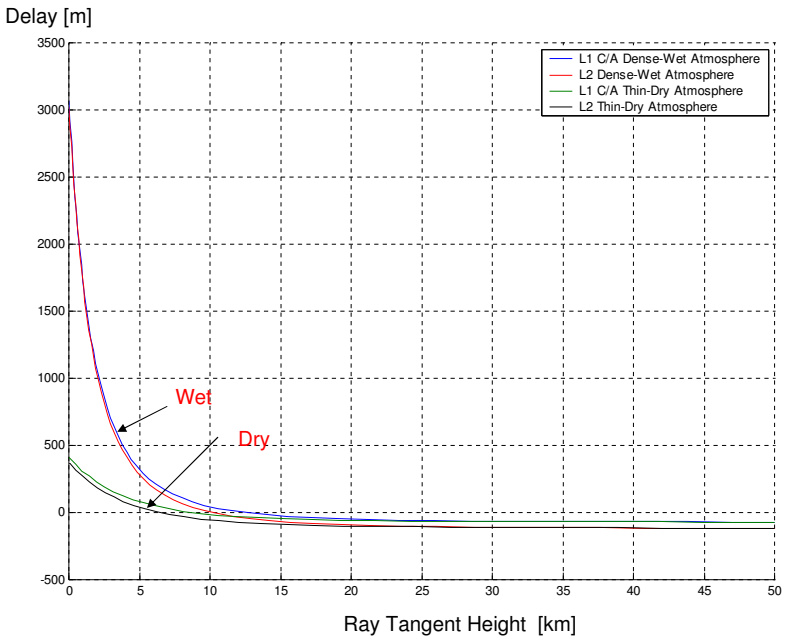


Atmosphere Models

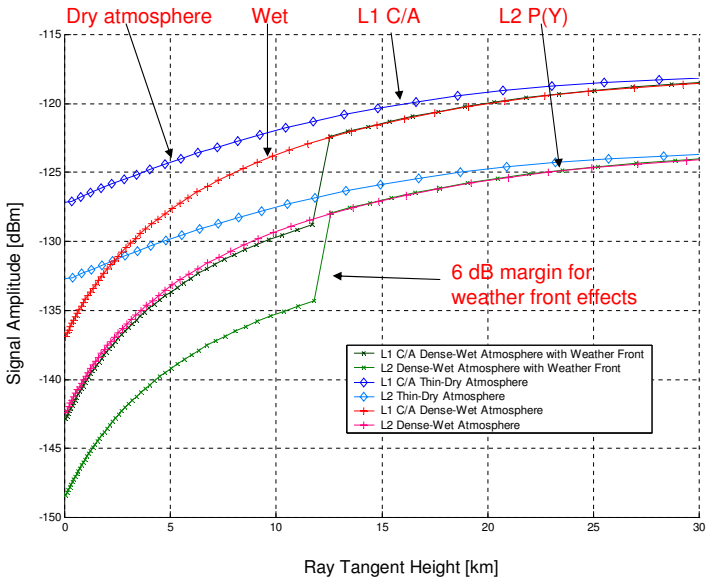
Comparison between five reference atmospheres (CIRA86+Q) and bi-exponential refractivity profiles used in GRAS tests



Input Test Signal - Phase

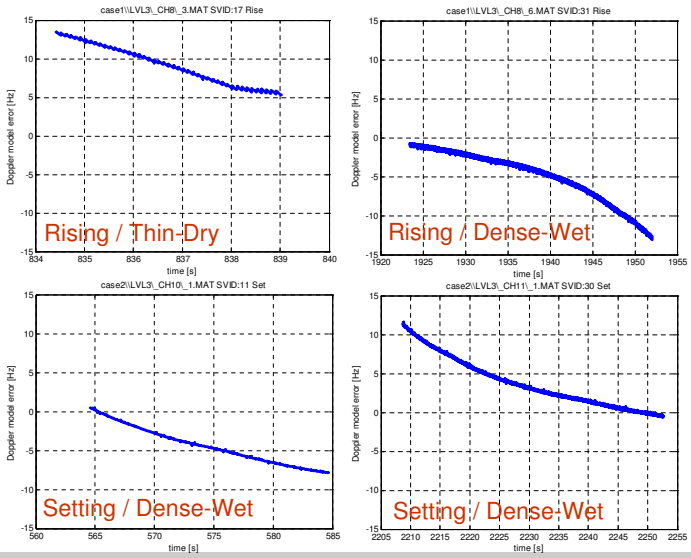


Input Test Signal - Amplitude



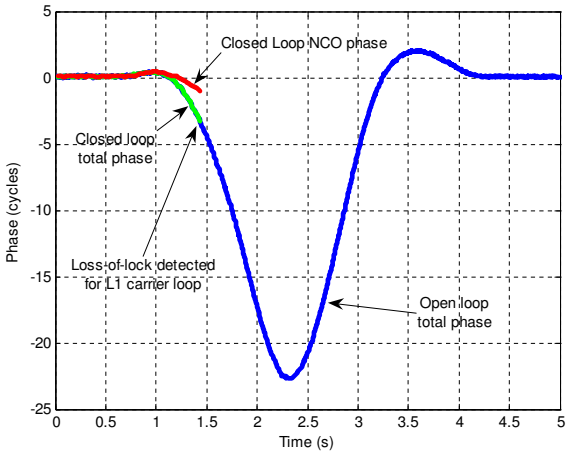
Test Results - Doppler Model Accuracy

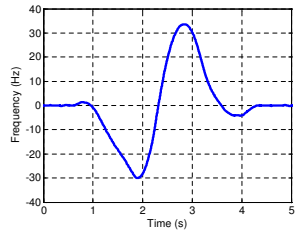
Within +/- 15 Hz for both atmosphere models

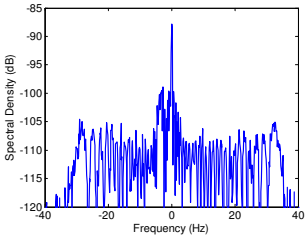


Test Results - Open Loop Raw Sampling

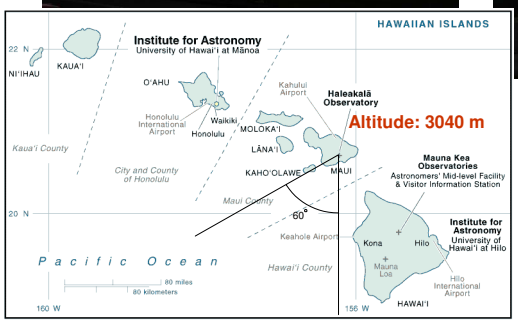
- **Pulse shaped phase modulation generated by the simulator**







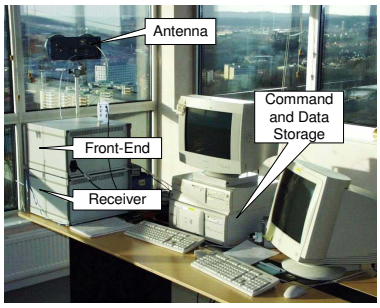
Mountain Top Measurements on Maui



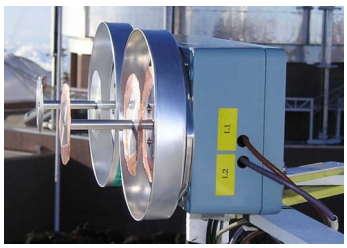
A project carried out by Saab Ericsson Space and University of Aalborg with objective to:

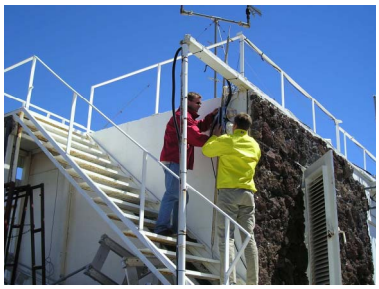
Establish experimental knowledge on the influence of signal multipaths and scintillations in the atmosphere as measured by the GRAS instrument

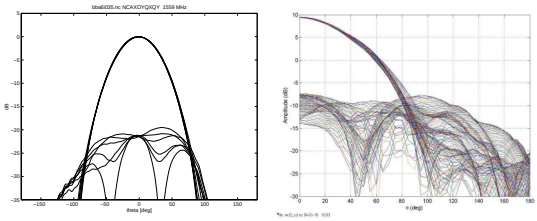
Instrument



Antenna





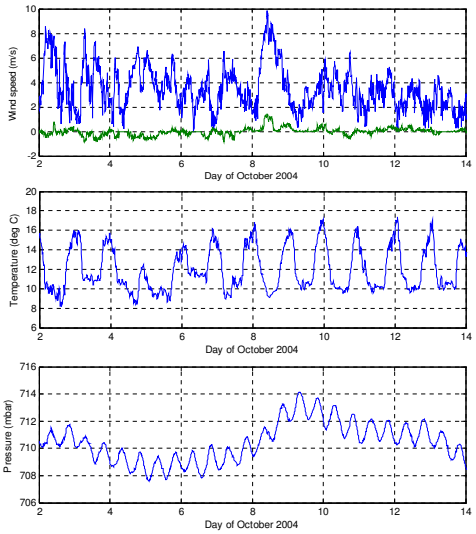


Peak gain: 10 dB (L1) / 8 dB (L2)
Field of view: +/- 60 deg

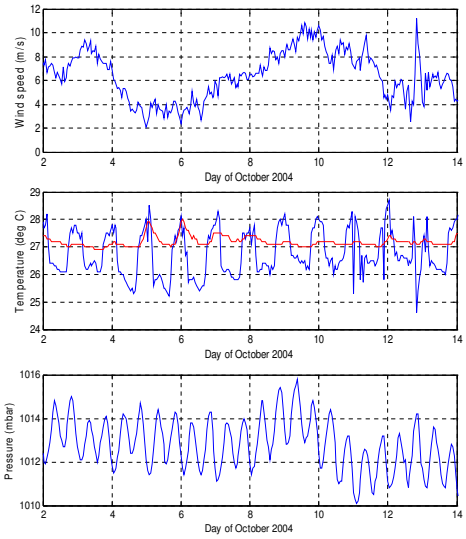
Installation

Weather Data

- **Summit**

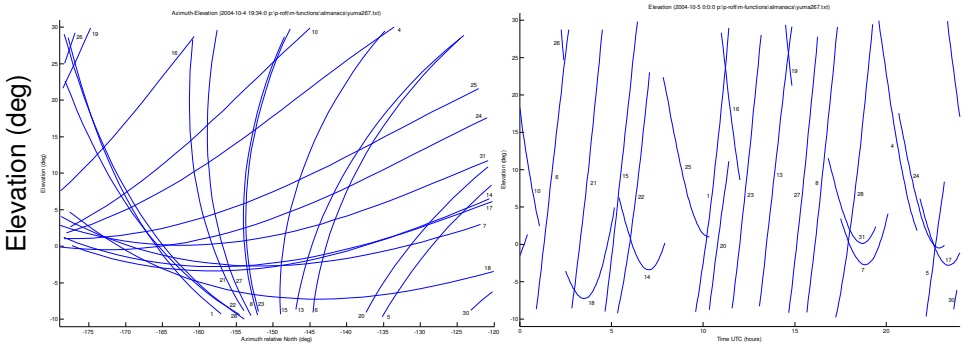


- **Sea level**



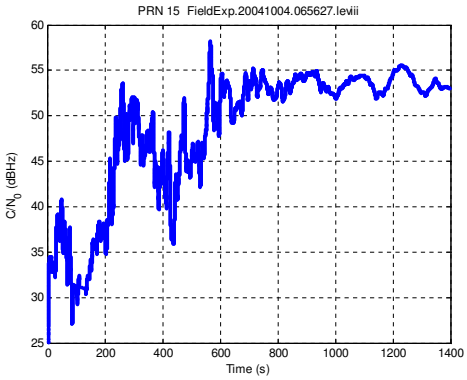
Occultation Geometry

- Rising occultation tracks concentrated around SW direction
- Occultations distributed over the day and repeated every day



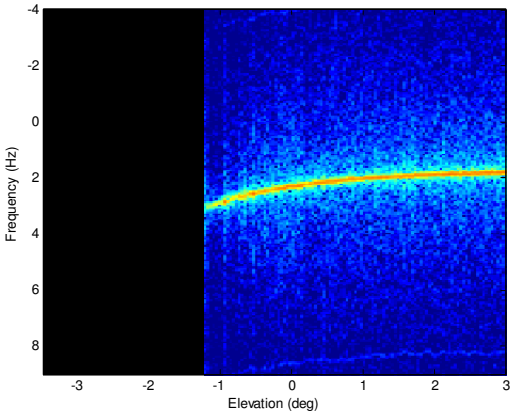
Signal Amplitude

- A typical rising occultation in Mauii data
  - Acquisition threshold is 28 dBHz
  - Tracking threshold is 26 dBHz
  - Carrier tracking is maintained as long as signal amplitude is sufficient

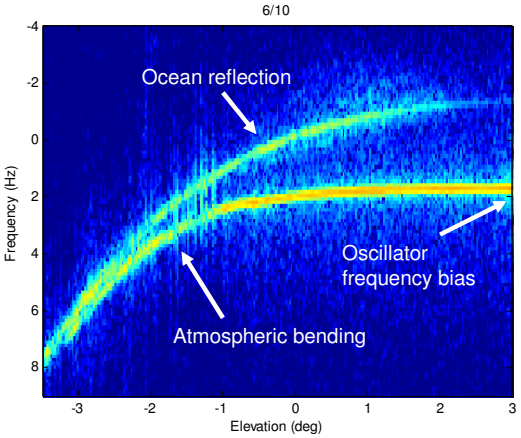


Spectral Signatures

Göteborg

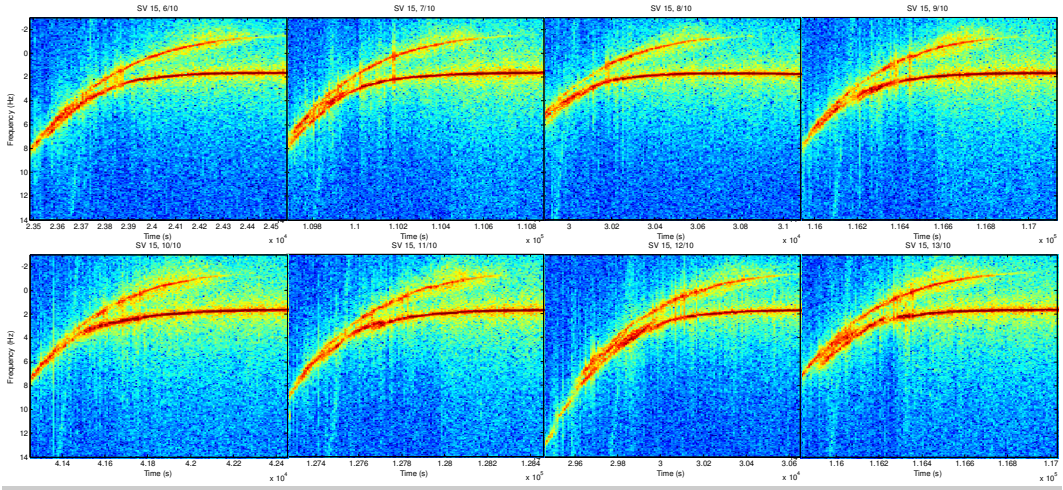


Maui

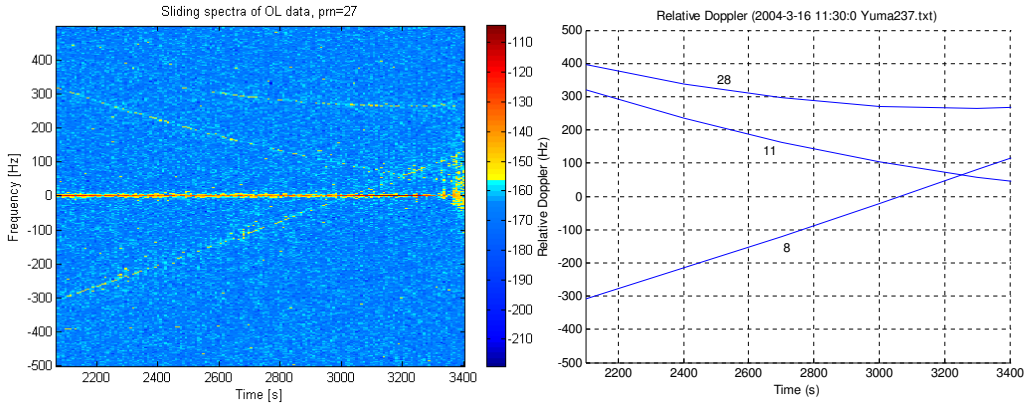


Time series of a daily occultation event

- **Shows atmospheric effects but no problems with tracking**

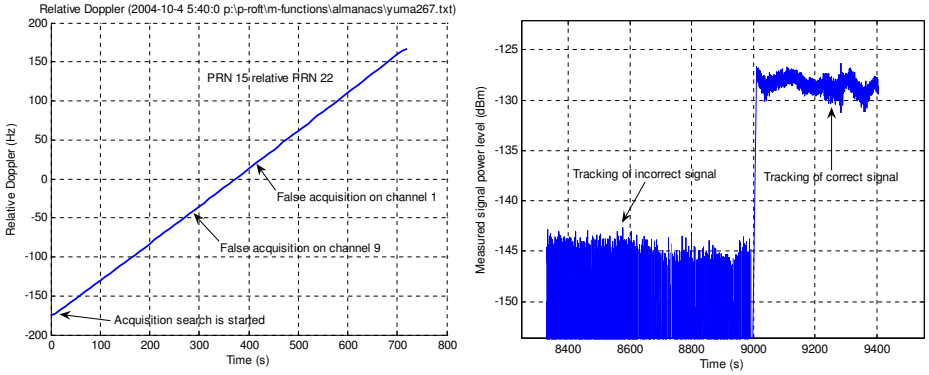


Interference between different PRNs visible in 1000 Hz raw sampling data



False acquisitions of interfering PRNs

- Occurred in 21 of 116 occultations
- High antenna gain on interferer ⇒ cross-correlation above threshold
- Small Doppler shifts compared to LEO ⇒ more likely to get critical Doppler



Conclusion

- GRAS Open Loop tracking has been successfully tested using GNSS simulator
- Both closed loop and open loop tracking performed well in mountain top tests with tropical conditions
- LEO conditions will be more dynamic