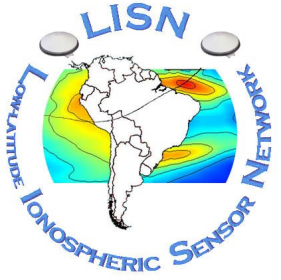




# LISN – Low-latitude Ionospheric Sensor Network

# A Distributed Observatory


# MRI proposals

**MRI proposals are for purchasing and/or developing instrumentation, that have budgets exceeding 100K, but less than 2 M. This is a total budget for the length of the proposal (1-5 years).**

**There is a limit of 3 MRI applications per institution.**

**No operational/management costs can be included.**

**Deadline is commonly the last week in January.**

**No funds for processing/modeling/assimilation can be included.**

**No cost sharing during last 3 years.**

# LISN Project Description

- To install and manage the first Distributed Observatory in South America. LISN will install 40 GPS, 5 magnetometers, and 5 ionosondes.
- LISN is a distributed observatory that will **nowcast** the state of the Low-latitude ionosphere in terms of TEC, scintillations, TEC depletions, bottomside F-region density, and E-region density and its dynamics.
- LISN needs a near real-time assimilation that will make it possible to determine the drivers of the low latitude ionosphere: meridional winds and vertical drifts, and help develop **forecast** capabilities.
- The Jicamarca IS radar and FPIs (Arequipa, Carmen Alto) can be used to validate assimilation results and to conduct more complete assimilations.

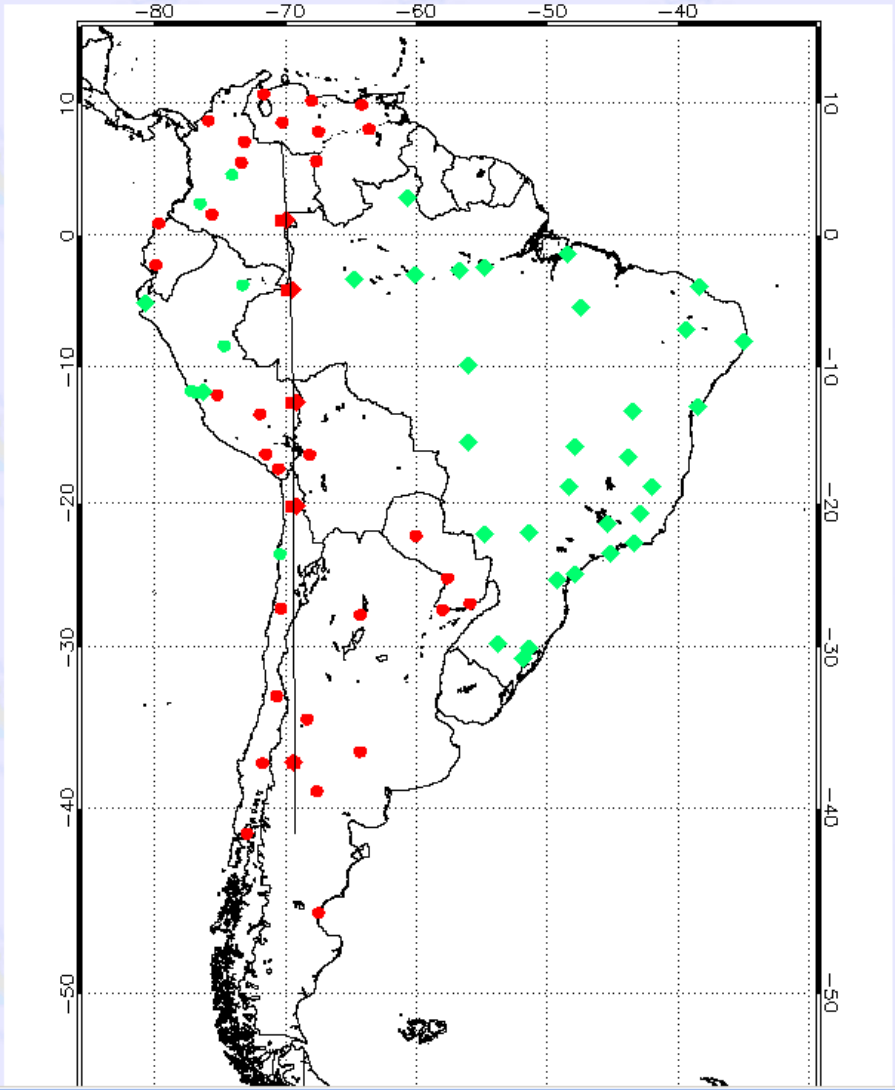
# LISN

**LISN had its origin in the Jicamarca cluster of instruments and the need to resolve the role of E-region densities on the onset of equatorial spread F.**

**The proposed sensor network and data assimilation system --- essentially a distributed observatory equipped with forecasting tools --- is a response to community needs to understand the day-to-day variability of the equatorial electrodynamics and stability of the low-latitude ionosphere and to make forecasts on a regional basis.**

**On July 2005 NSF awarded Boston College a MRI-ATM award for the installation of the LISN distributed observatory.**

# LISN Web Page (*http://jro.igp.gob.pe/lisn*)




**All stations in South America**

| | Station | G | I | M |
|---|---|---|---|---|
| 1. | Alta Floresta | G | | |
| 2. | Belem | G | | |
| 3. | Boavista | G | | |
| 4. | Bom Jesus da Lapa | G | | |
| 5. | Brasilia | G | | |
| 6. | Cananeia | G | | |
| 7. | Crato | G | | |
| 8. | Cuiabá | G | | |
| 9. | Curitiba | G | | |
| 10. | Dourados | G | | |
| 11. | Fortaleza | G | | |
| 12. | Gov. Valadares | G | | |
| 13. | Imperatriz | G | | |
| 14. | Manaus | G | | |
| 15. | Montes Claros | G | | |
| 16. | Parintins | G | | |
| 17. | Porto Alegre | G | | |
| 18. | Porto Velho | G | | |
| 19. | Pres. Prudente | G | | |
| 20. | Recife | G | | |
| 21. | Rio de Janeiro | G | | |
| 22. | Salvador | G | | |
| 23. | Santa Maria | G | | |
| 24. | Santarem | G | | |
| 25. | Tefe | G | | |
| 26. | Ubatuba | G | | |
| 27. | Uberlândia | G | | |
| 28. | Varginha | G | | |
| 29. | Viçosa | G | | |
| 30. | Antofagasta | G | | |
| 31. | Bogota | G | | |
| 32. | Popayan | G | | |

# Instrument selection

**Complementary instruments that will provide the necessary measurements to address the LISN science issues (GPS receivers, Magnetometers, Ionosondes). Their measurements should be able to fully constrain assimilation efforts.**

**Latest technology and Robust instrumentation.**

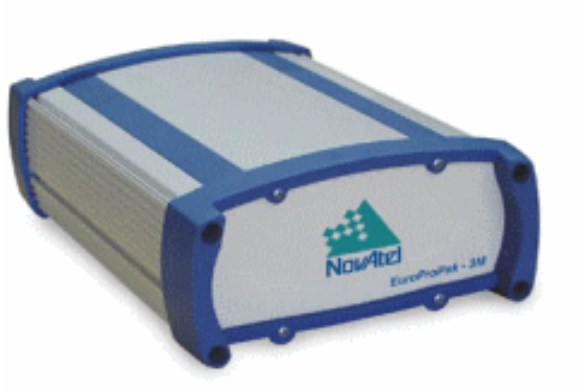
**GPS receivers are presently used by different communities (geodesy, GPS meteorology). Crustal motion projects like:**

**Earthquake deformation cycle, intraplate deformation and mountain building.**

**Very low frequency seismic waves.**

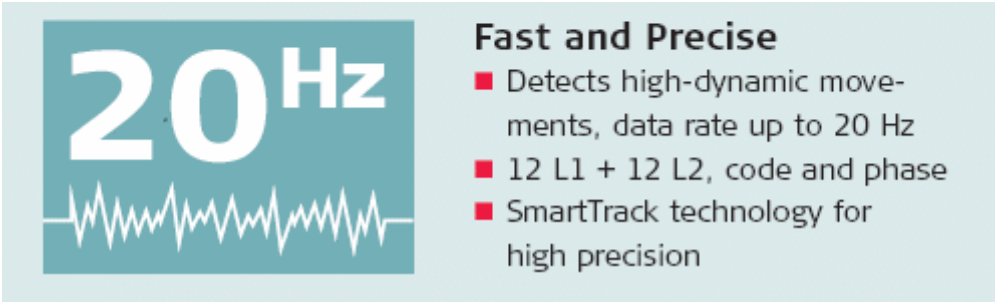
# Novatel GSV4004B

- Specially designed firmware able to calculate 50 Hz amplitude and phase scintillations.
- Receive phase and code from SBAS sat.
- Track up to 10 GPS satellites and 3 SBAS.

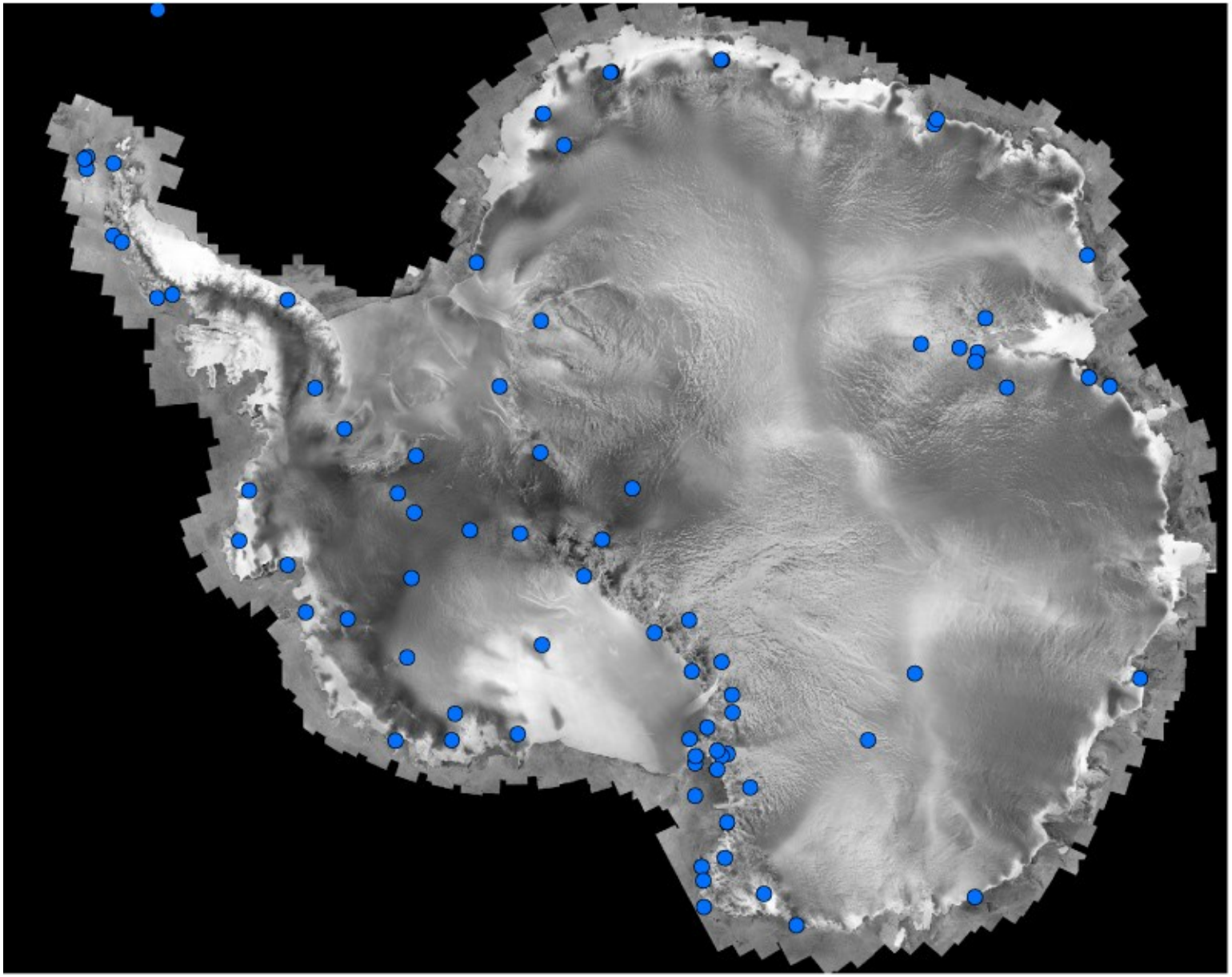


# Leica GMX902


- Provides 20 Hz TEC values.
- Measures amplitude and phase scintillations for L1 and L2.
- Ready for Galileo.



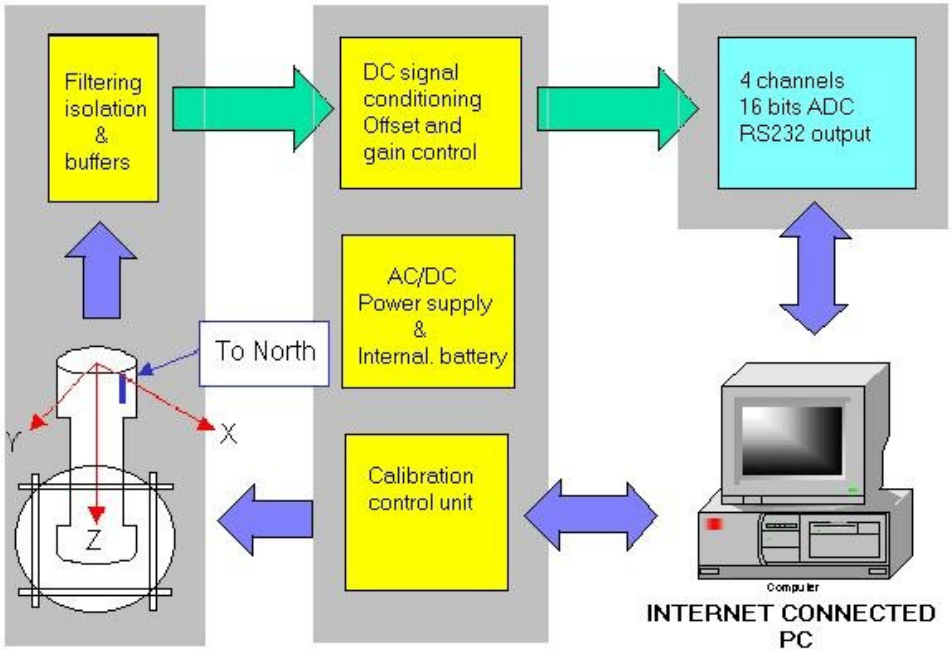
# POLENET: Planned GPS field deployments



# Prototype Magnetometer developed at Jicamarca

- Overall Range: +/- 60,000nT.
- Dynamic Range: +/- 2000nT
- Resolution : 0.1nT
- Output: +/-2.5 VDC (analog signal)
- Digital outputs: USB, 5 output channels, X, Y, Z and 2 temperature sensors
- Internet data rate: 5min.

- Sensor : Triaxial ring core fluxgate.
- Sensor Module: PVC cylinder 0.1 x 0.8 m, contains internal temperature sensor and 3 Helmholtz coils.
- Electronic unit: AGC, fields cancellation and filters, including a data logger of high resolution : 20 bits, 8 channels, USB.

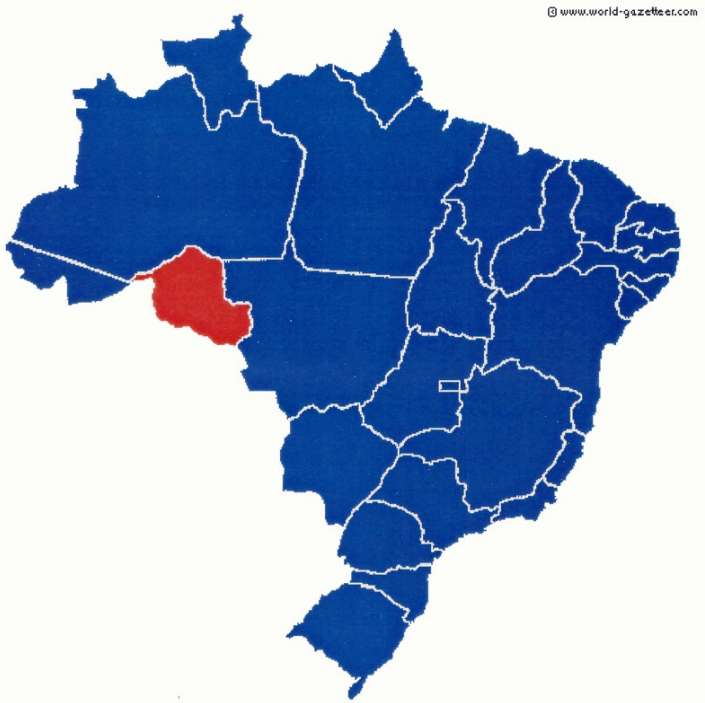


# Sites selection

The World Gazetteer

* current population figures for cities, towns and places of all countries
* largest cities of the world
* current national flags

**Rondônia** Brazil 2004




Cities and Places

http://www.world-gazetteer.com/d/d_br_ro.htm 11/30/2004

(population in [1000])

| rank | Place | Pop. 1996 | Pop. 2000 | Pop. 2004 | Latitude | Longitude |
|---|---|---|---|---|---|---|
| 1498 | Alta Floresta d'Oeste | 11 800 | 12 300 | 13 000 | 11.74°S | 61.38°W |
| | Alto Alegre do Parecis | | 2 400 | 2 600 | | |
| | Alto Paraíso | 2 400 | | 2 800 | 9.85°S | 63.31°W |
| | Alvorada d'Oeste | 8 600 | 8 500 | 8 700 | | |
| 386 | Ariquemes | 51 800 | 54 900 | 58 400 | 9.94°S | 63.08°W |
| 1144 | Buritis | 5 500 | 15 200 | 17 500 | | |
| 401 | Cacoal | 46 800 | 51 400 | 55 900 | 11.50°S | 61.42°W |
| 1714 | Candeias do Jamari | 6 800 | 9 400 | 11 200 | 8.79°S | 63.79°W |
| 1326 | Cerejeiras | 15 200 | 14 800 | 15 000 | | |
| 1387 | Colorado do Oeste | 16 400 | 14 700 | 14 200 | | |
| | Corumbiara | 1 700 | | 2 000 | | |
| 1321 | Espigão d'Oeste | 13 600 | 14 200 | 15 000 | 11.58°S | 60.99°W |
| | Governador Jorge Teixeira | 1 100 | | 1 300 | | |
| 609 | Guajará-Mirim | 31 300 | 33 000 | 35 000 | 10.80°S | 65.37°W |
| 707 | Jaru | 30 000 | 29 200 | 29 500 | 10.43°S | 62.45°W |
| 221 | Ji-Paraná | 80 800 | 91 000 | 100 800 | 10.90°S | 61.95°W |
| 1471 | Machadinho d'Oeste | 7 300 | 11 000 | 13 300 | 9.57°S | 62.16°W |
| | Ministro Andreazza | 1 700 | | 2 000 | | |
| | Mirante da Serra | 6 000 | | 7 000 | | |
| | Nova Brasilândia d'Oeste | 5 900 | | 6 800 | | |
| | Nova Mamoré | 6 700 | | 7 700 | | |
| | Novo Horizonte do Oeste | 1 100 | | 1 300 | | |
| 753 | Ouro Preto do Oeste | 26 100 | 26 500 | 27 400 | 10.66°S | 62.31°W |
| 767 | Pimenta Bueno | 26 700 | 26 400 | 26 900 | 11.64°S | 61.21°W |
| 70 | Porto Velho | 238 300 | 273 500 | 306 400 | 8.76°S | 63.91°W |
| 1551 | Presidente Médici | 12 100 | 12 200 | 12 500 | 11.27°S | 61.92°W |

# Operational costs per station

**To pay or not to pay to the local observer.**

**Electricity, Internet provider, phone/DSL/Internet.**

**Total cost about 1.2 K per year per GPS station.**

**Possible places to install small instruments: Universities, research institutes, Christians missionaries.**

# Human network

**Countries with extended investigation (and infrastructure) on space sciences: Argentina, Brazil, and Peru**

**Emerging countries: Chile, Colombia, Ecuador, and Venezuela.**

# LISN Workshop at Jicamarca

**The workshop will instruct scientists, engineers, and students from South America on:**

**(1) how to employ GPS receivers and ground-based magnetometers to diagnose the state and variability of the low-latitude ionosphere.**

**(2) how to install and operate a state-of-the-art sounder and simultaneously to make known the latest techniques of E and F region sounding.**

- **To be conducted between August 1 – 9 at Jicamarca.**
- **21 participants from 7 countries in South America.**
- **Classes on: fundamentals of GPS technology, GPS data analysis, biases calculations, development of algorithms to compute TEC, TEC perturbation and S4 scintillation index. and the application of these observables to ionospheric investigations.**

# LISN Server



JK
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