The Low-latitude Ionosphere Sensor Network (LISN)  
*The First Distributed Observatory in South America*

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*Thanks to our sponsors and many international colleagues!*

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Outline

- Objectives for the LI SN Observatory
- Network Architecture
- LI SN
  - Instruments
  - Early Measurements
  - Science Topics
  - Status
  - Benefits
- Summary
The Low Latitude Ionospheric Sensor Network (LISN)

- 70 GPS Receivers
- TEC, TIDs
- Scintillation
- 5 Ionosondes
- Virtual height
- Bottomside density profiles
- Meridional winds
- Nighttime capability
- 5 Magnetometers
- Monitor ionospheric currents
- Measure Vertical plasma drifts

To address key questions about the physics of the equatorial ionosphere

Develop nowcast/forecasts capabilities on the onset of Spread F

Jicamarca

IPPs after all

Installed

Planned
TEC Values Observed near the Crest (BoaVista) and Magnetic Equator (Ji-Parana)

Mar 10-11, 2008
Boa Vista

Mar 6-7, 2008
Boa Vista

Mar 10-11, 2008
Ji-Parana

Mar 6-7, 2008
Ji-Parana
S4 Scintillation Index observed in SA on March 08, 2008
Vertical Incidence Pulsed Ionospheric Radar (VIPIR)
Designed for extreme performance and flexibility
8 Receiving Antennas – dipoles (4 N/S and 4 E/W)
4 Transmitting Antenna towers
Ionosonde Measurements from Jicamarca
(Designed by Terry Bullett and Bob Livingston)

Puerto Maldonado, Peru
El Leoncito, Argentina

ESF Precursor 01:27UT
Full Blown ESF 02:37UT
1 hour, 10 minutes after first detection
LISN funded the design of a prototype magnetometer by Oscar Veliz. Right Figure shows a comparison with UCLA magnetometer.

Characteristics of Jicamarca’s Triaxial ring core fluxgate magnetometer:
- High Sensitivity and field resolution (0.1nT)
- Long term mechanical and thermal stability
- Highly robust electronics and system reliability (multi-layer circuitry).
- Low power consumption
- Data readily available to Internet uploading (5 min cadence time).
Magnetometer Measurements from Ancon and Puerto Maldonado

![Map of South America with cities marked, including Ancon and Puerto Maldonado.]

- **H** and **Z** Magnetic Field Intensities (in μT)
- **Dec** (Declination Angle) in (min)
- **Time (UT)** ranges from 0 to 24
- **Dates** for measurements: Mar 9-2008
Complementary Aspect of LISN

LISN data will be complemented with an assimilative physics-based model designed to “nowcast” the ionosphere above the same geographic region.

Model based on LLIONS

• Solves ionospheric densities ($O^+$, $NO^+$, $O_2^+$, $H^+$) along magnetic field lines
• Multiple runs to cover longitude range
• Determine low latitude ionospheric drivers
• NeQuick applications in development
• Other modeling/tomographic collaborations welcome…

(Figure Courtesy of V. Eccles, Space Environment Corporation)
LISN - Data Flow Diagram

GPS TEC/Scintillation

Remote PC

Internet/Phone/DSL

Magnetometer Measurements

Boston College Server

Ionosonde Measurements

DELL Master Server

http://jro.igp.gob.pe/lisn
Near Real-time TEC Values

http://jro.igp.gob.pe/lisn/

Feb 13-14, 2008
TEC wave Perturbations associated with TIDs

1 TEC unit fluctuations seen moving from Huancayo to Ancon (westward direction).
GPS Receivers
- 30 GSV4004 receivers – purchased/prepared/deployed
- More receivers to be added (~15)
- Collaborations with other institutions (~25)
- 30 fully operational – http://jro.igp.gob.pe/lisn

Ionosondes
- 1 is working in Jicamarca
- 2 to be installed in June (Peru, Argentina)
- All deployed by mid 2009

Magnetometers
- All 5 constructed
- 1 Installed
- 4 by early 2009

System installation complete July 2009
Just in time for Solar Cycle 24!

Cycle 23-24 Sunspot Number Prediction (June 2008)

Operational Phase of LISN
SUMMARY

- LISN Motivation – Low Latitude Features
- LISN Architecture
- LISN Goals
  - Coordinated Measurements
  - Study electrodynamics of the low-latitude region
  - Develop tools to nowcast/forecast initiation of Spread F
- Examples of measurement techniques
- Current Status
Lessons Learned

- The successful operation of the LISN instruments depends upon two important factors: (1) local persons willing to provide proper logistic and maintenance support and (2) Internet connectivity.

- LISN has motivated the following new projects:
  - Brazil – Eurico dePaula – Scintillation measurements using different sensors. Maps of scintillation in SA.
  - Argentina – Claudio Brunini – New methods for calculations of TEC.
  - Peru – Oscar Veliz – Development of magnetometer prototype.
  - Colombia – Jaime Villalobos – Space Physics School at the Universidad Nacional.
1st LISN Team Meeting – Jicamarca, Peru - August 07
31 Participants – 7 Countries

Thanks for LISteNing!