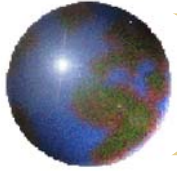




The Low-latitude Ionosphere Sensor Network (LISN): Initial Campaigns and Implications for an African Network

Cesar Valladares & Patricia Doherty
Boston College

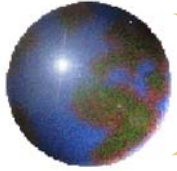




Outline

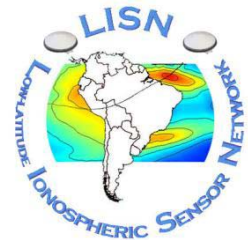
- ❖ Objectives for the LISN Observatory
- ❖ Network Architecture
- ❖ LISN
 - ❖ Instruments
 - ❖ Early Measurements
 - ❖ Science Topics
 - ❖ Status
- ❖ LISN for Africa?
- ❖ Summary

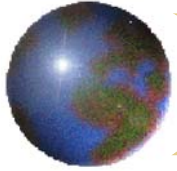




Objectives of the LISN Observatory

- **To install the first Distributed Observatory in South America**
- **To nowcast the state of the low-latitude ionosphere in terms of TEC, scintillations, TEC depletions, bottomside E- and F- region densities**
- **To address key questions about the low-latitude ionosphere**
 - **drivers of the low-latitude ionosphere**
 - **the effect of E and Es layers on inhibiting ESF**
 - **the role of Gravity Waves on seeding plasma bubbles**
 - **alternative theories for ESF**
 - **longitudinal variability of the low-latitude ionosphere**
- **To initiate collaboration with South American scientists working on Space Weather problems. Motivate researchers and students in South America by providing science projects in space physics and creating programs for instrument development.**





The Low Latitude Ionospheric Sensor Network (LISN)

- To address key questions about the physics of the equatorial ionosphere
- Develop nowcast/forecasts capabilities on the onset of Spread F



**IPPs after all
70 receivers
are integrated**

•70 GPS Receivers

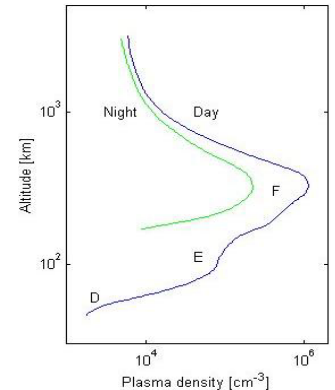
- TEC, TIDs
- Scintillation

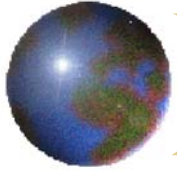
•5 Ionosondes

- Virtual height
- Bottomside density profiles
- Meridional winds
- Nighttime capability

•5 Magnetometers

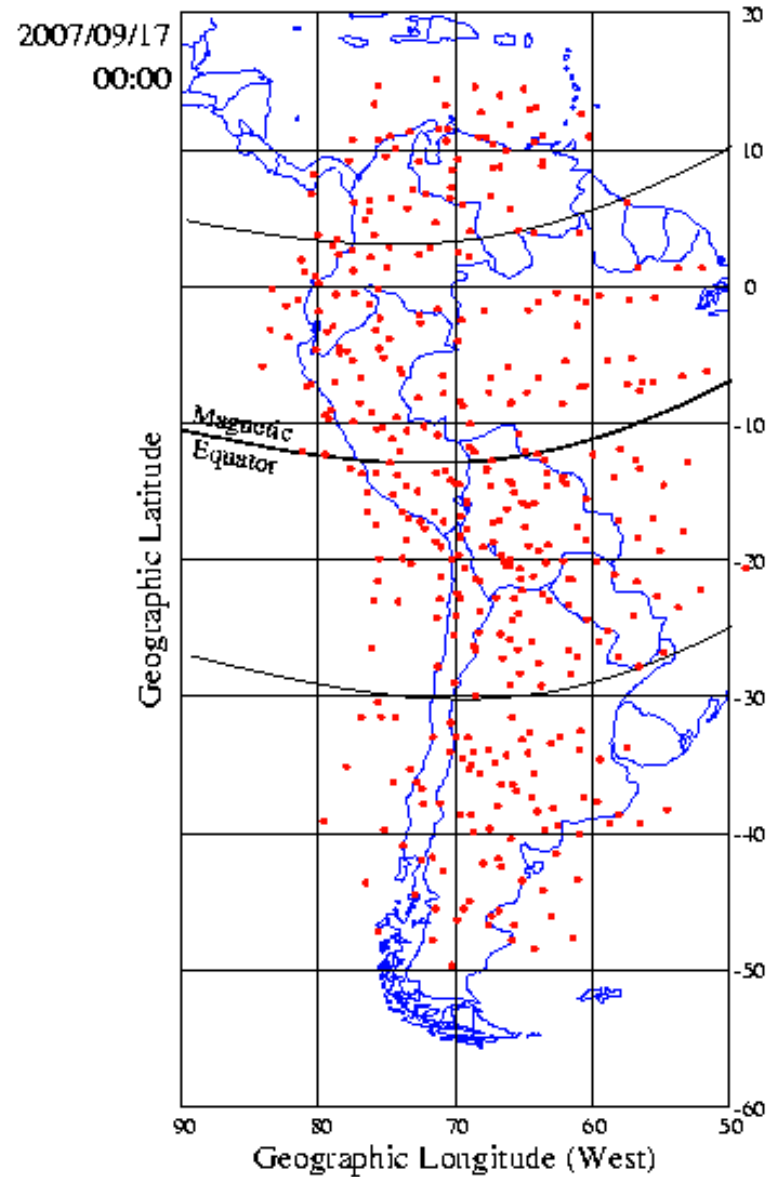
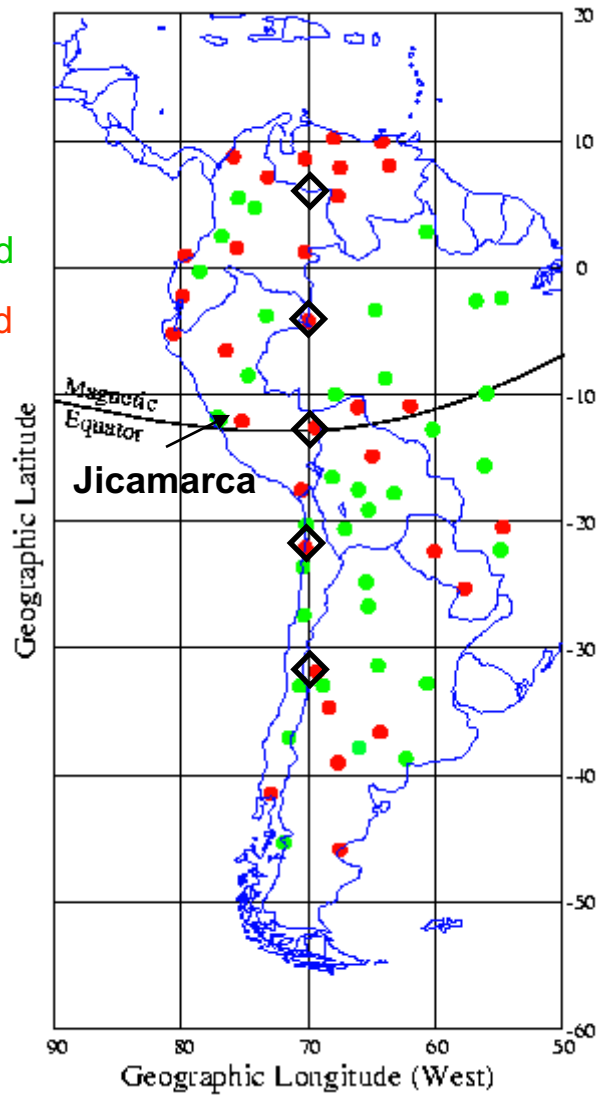
- Monitor ionospheric currents
- Measure Vertical plasma drifts

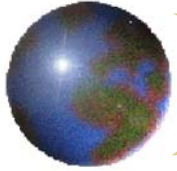




The Low Latitude Ionospheric Sensor Network (LISN)

- Installed
- Planned

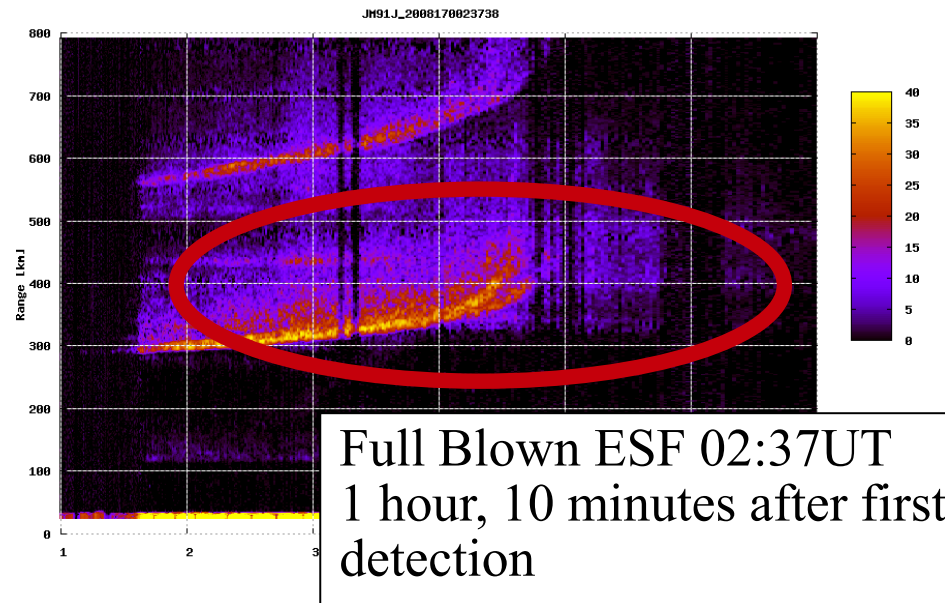
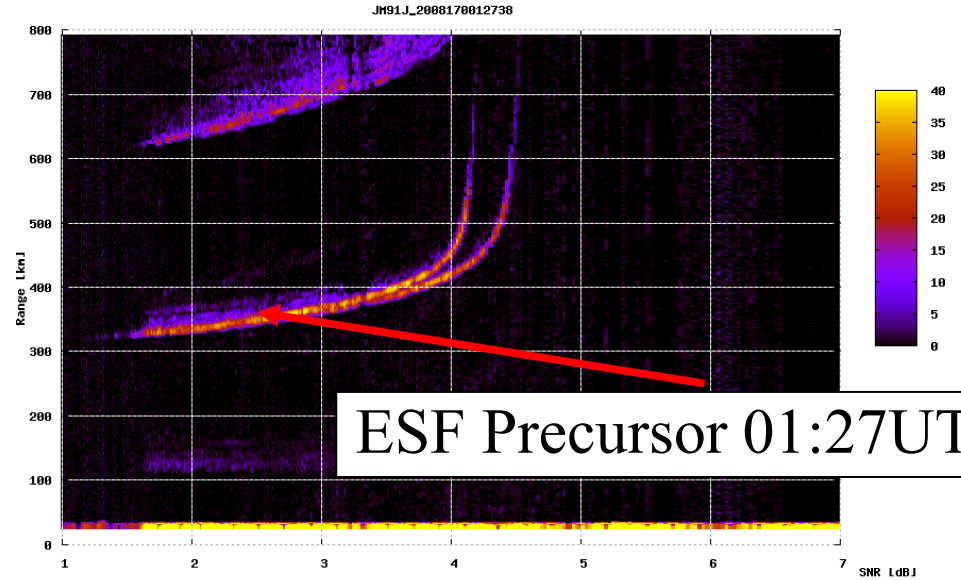


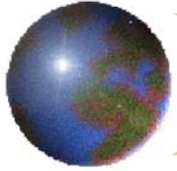


VIPER Ionosonde Measurements

(Designed by T. Bullett and R. Livingston)

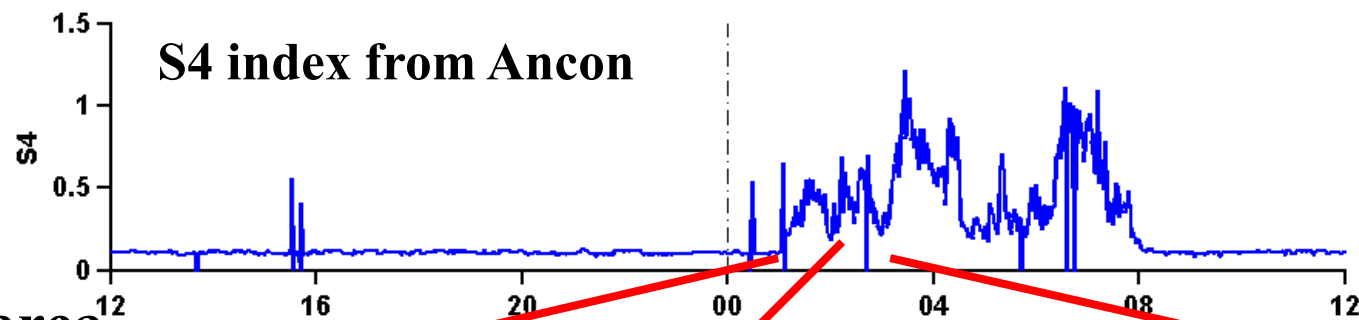
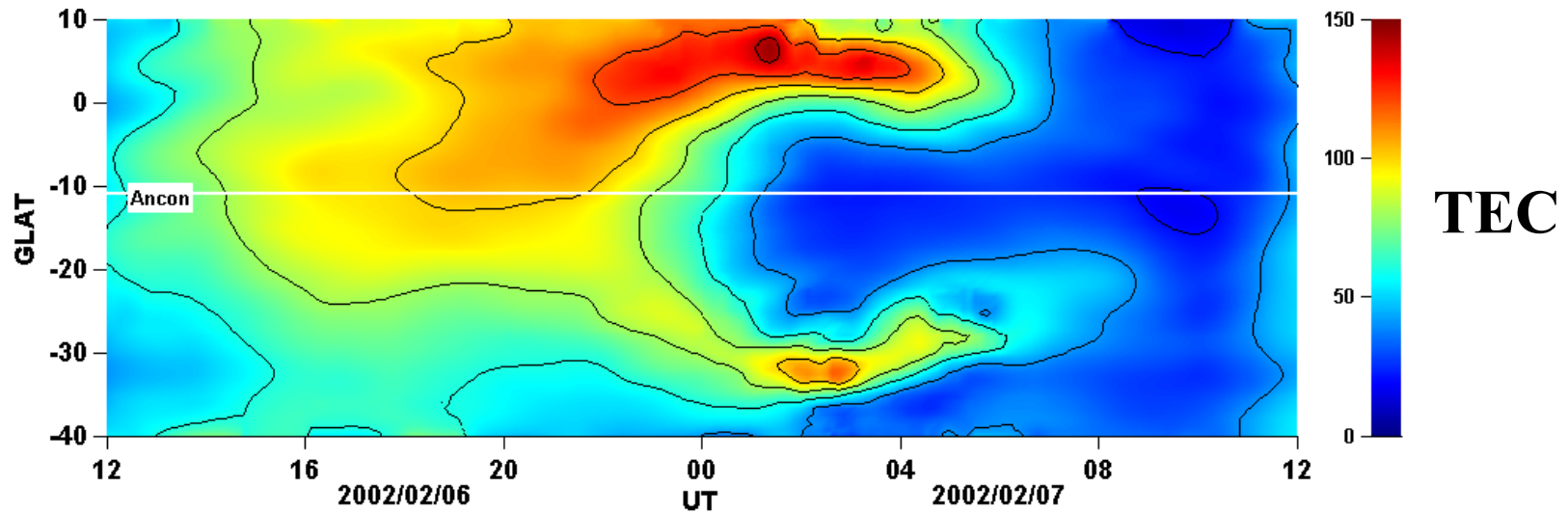
SNR [dB]



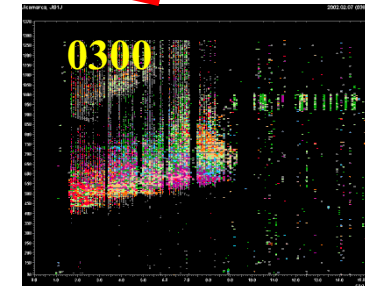
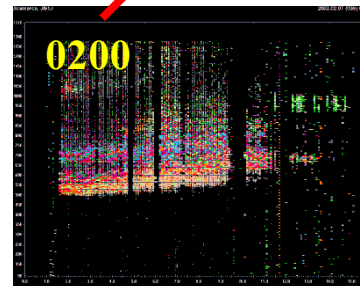
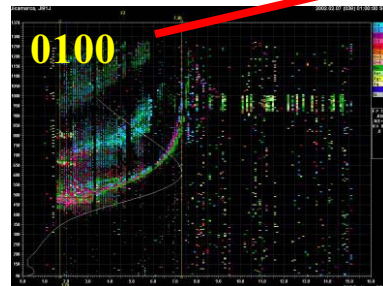


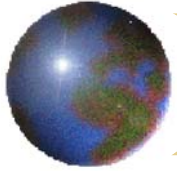
Benefits of Coordinated Measurements

TEC, UHF Scintillations, and Ionograms - Feb 07, 2002



**Jicamarca
sounder
observes
range-type
ionograms**





LISP - Data Flow Diagram

GPS TEC/Scintillation



<http://jro.igp.gob.pe/lisp>



Remote PC



Boston College Server

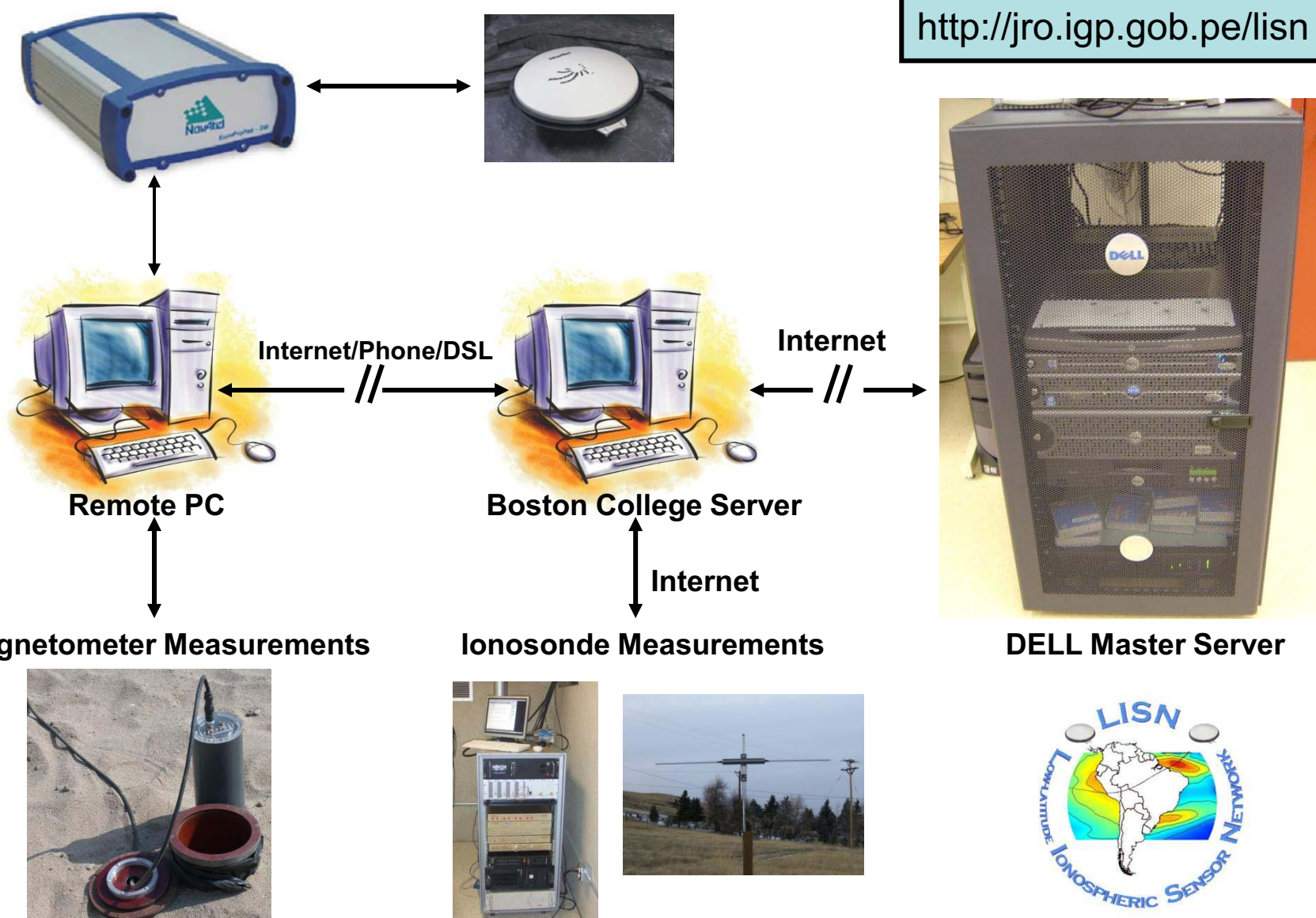
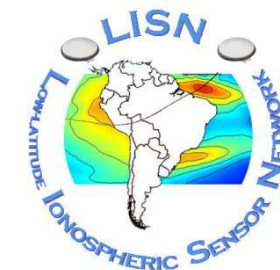


DELL Master Server

Magnetometer Measurements



Ionosonde Measurements

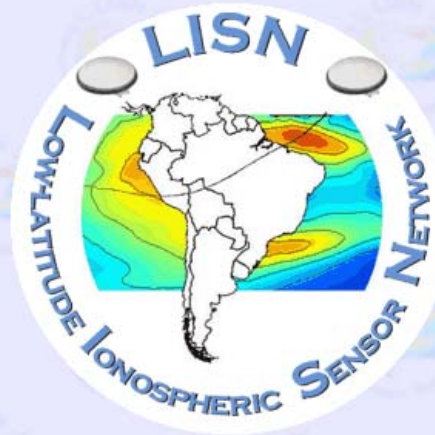




LISN Web Page (<http://jro.igp.gob.pe/lisn>)

LOW-LATITUDE IONOSPHERIC SENSOR NETWORK

- [Home](#)
- [About LISN](#)
- [Equipment](#)
- [Stations](#)
- [Other](#)



[LISN Workshop Aug. 2007 - Taller de Trabajo LISN Ago. 2007](#)

Telecommunications play an important role in science and technology world-wide. This field has its own phenomena that need to be explained, and that is the challenge for LISN.

LISN, as a permanent array of the newest geophysical instruments in South America, closely coordinate as a "distributed observatory". Our main focus is on complex and extreme state of disturbance that take place in the magnetical-equatorial ionosphere nearly every day after sunset, and on the ionosphere-thermosphere-electrodynamics (ITE) system that constantly controls the dynamics of the plasma density, creating the proper conditions to initiate plasma turbulence.

Known and studied for seven decades, the equatorial Spread F (ESF) phenomena are now held responsible for causing high-technology (GPS) navigation and communication failures that depend on inter-hemispheric link. Enough is known and understood about this region and its process to show conclusively that nothing less than a meteorological approach to detailed and comprehensive observations, integrated closely with assimilative modeling, can lead to physical understanding and the imperatives of practical forecasting and nowcasting.

Stations



[All Stations](#)



[Peru](#)



[Brazil](#)



[Ecuador](#)



[Argentina](#)



[Chile](#)



[Paraguay](#)



[Bolivia](#)



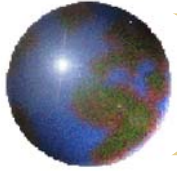
[Colombia](#)



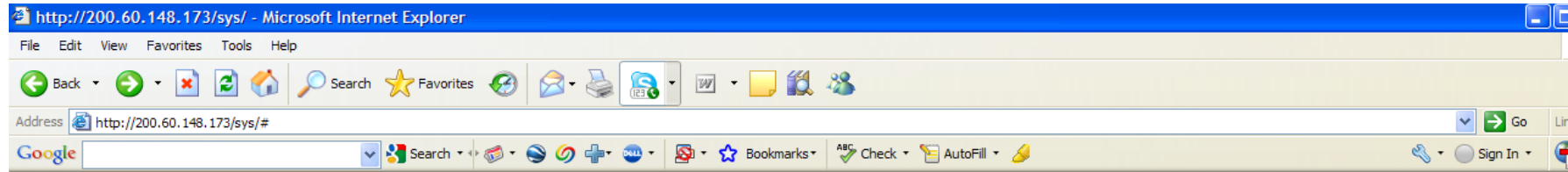
[Venezuela](#)

©2006 LISN



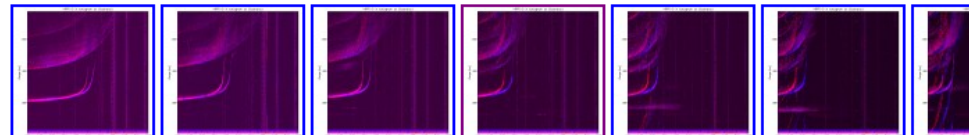


Near Real-time display of VIPIR ionograms at <https://200.60.148.173/sys/>



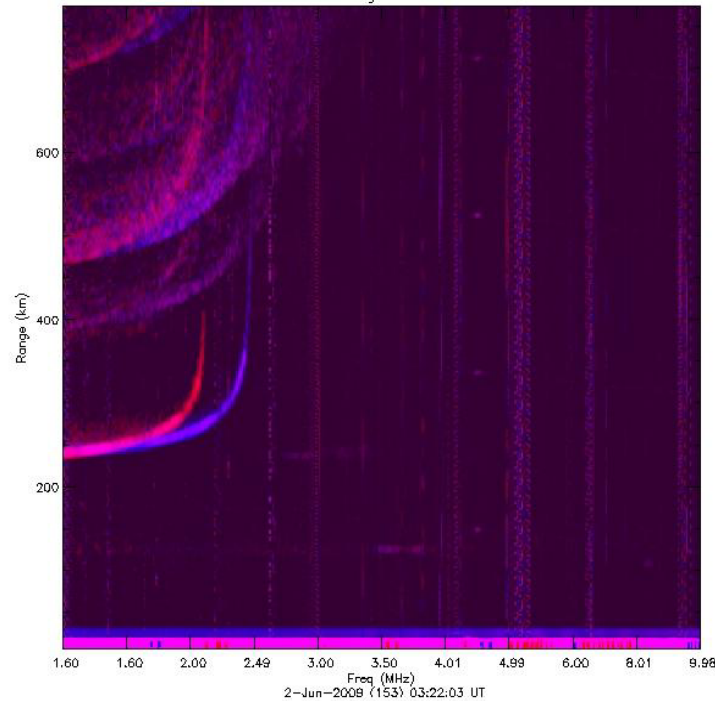
jro
2009
June

June						
S	M	T	W	T	F	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				



VIPIR D-X Ionogram at Jicamarca

04:00





GPS historical data at <https://200.60.148.173/gps/>

Microsoft Internet Explorer browser window showing the LISN website.

LISN Low-latitude Ionospheric Sensor Network

Look for Station

Peru
Cuzco
2009
May

May

S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
	31					

Monthly files

rinex

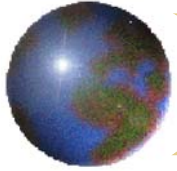
cuzc_0905.09d.tar

Daily files

- Rinex Data : cuzc_090531.09d.tar.gz (320.16 kB)
- Scintillation Data : cuzc_090531.scn.gz (76.51 kB)
- Position Data : cuzc_090531.pos.gz (388 Bytes)
- Binary Data : cuzc_090531.nvd.gz (1.89 MB)

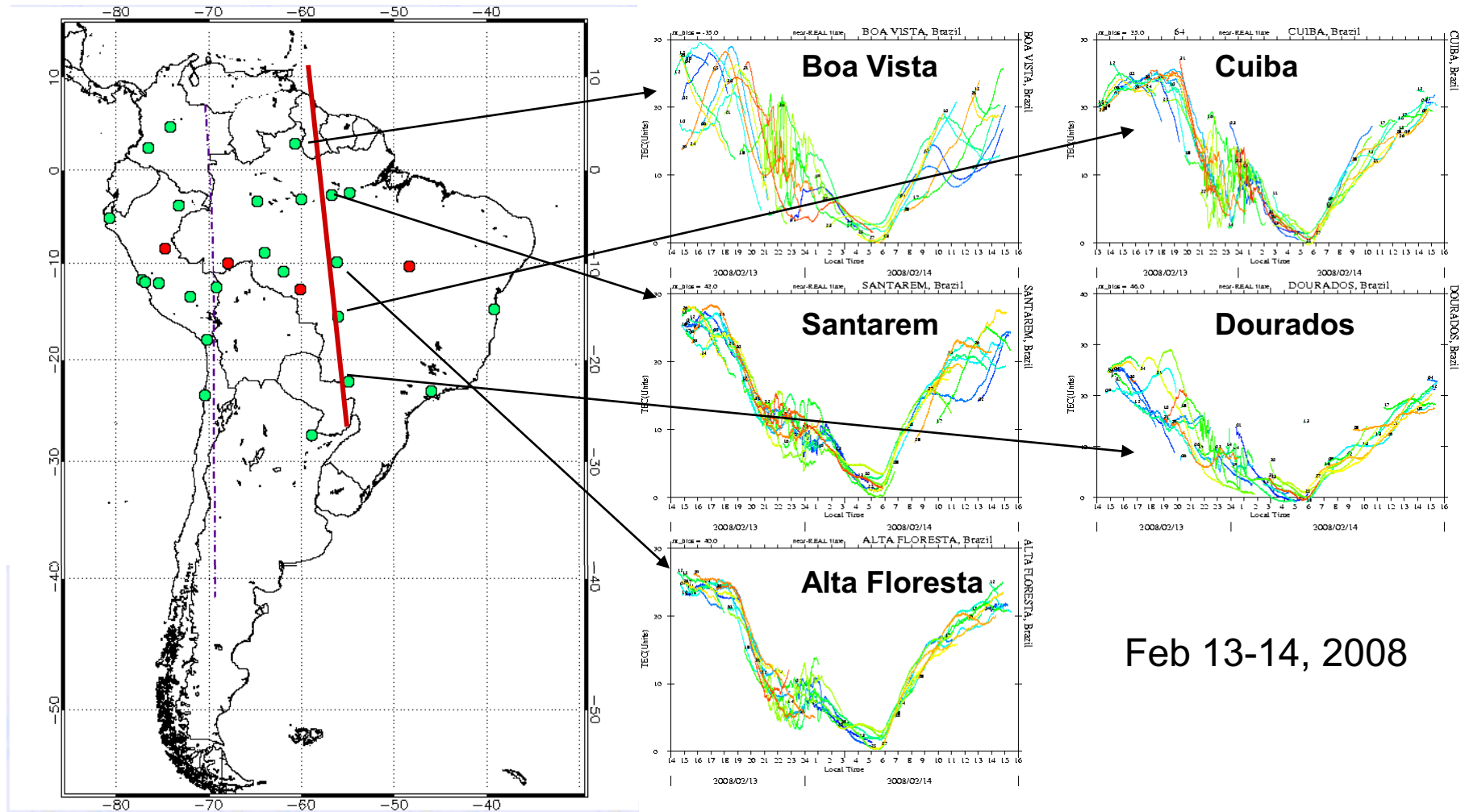
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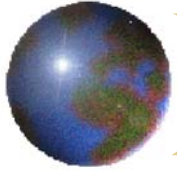
password:



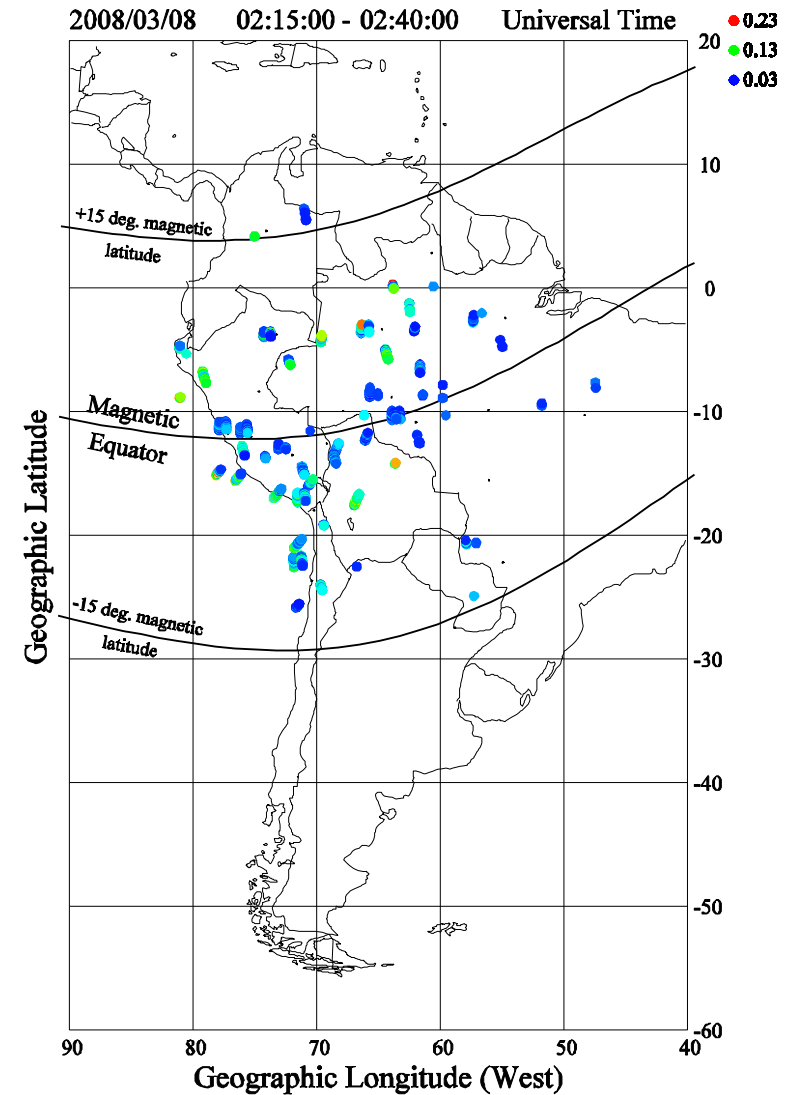
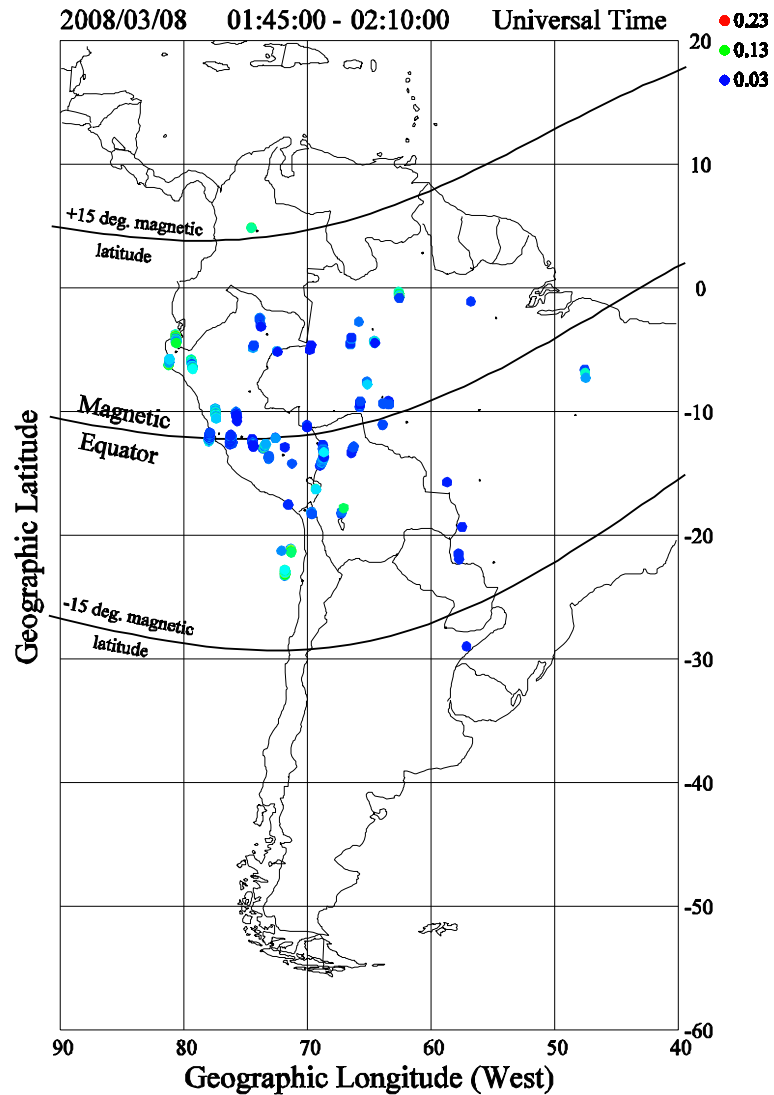
Near Real-time TEC Values

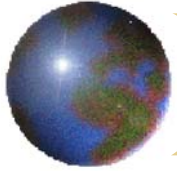
<http://jro.igp.gob.pe/lisn/>





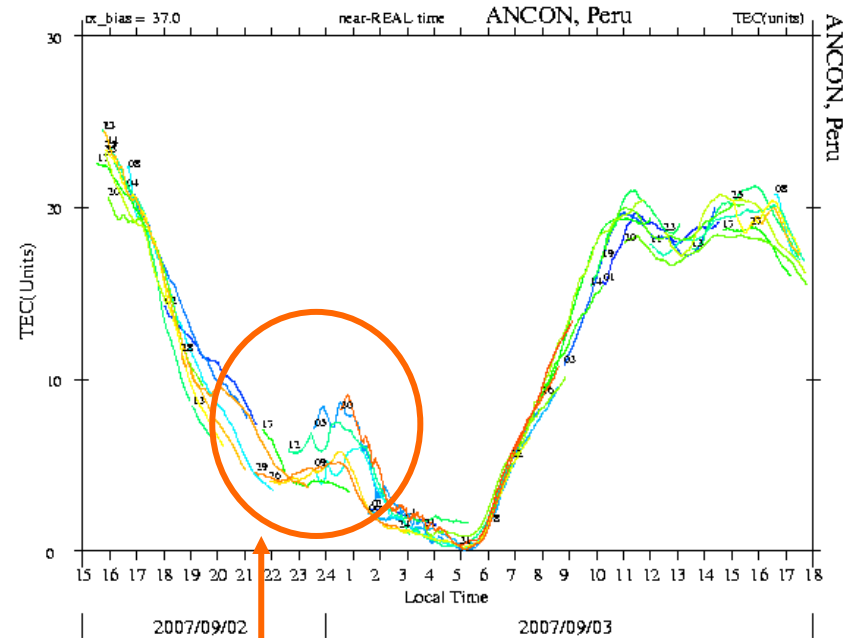
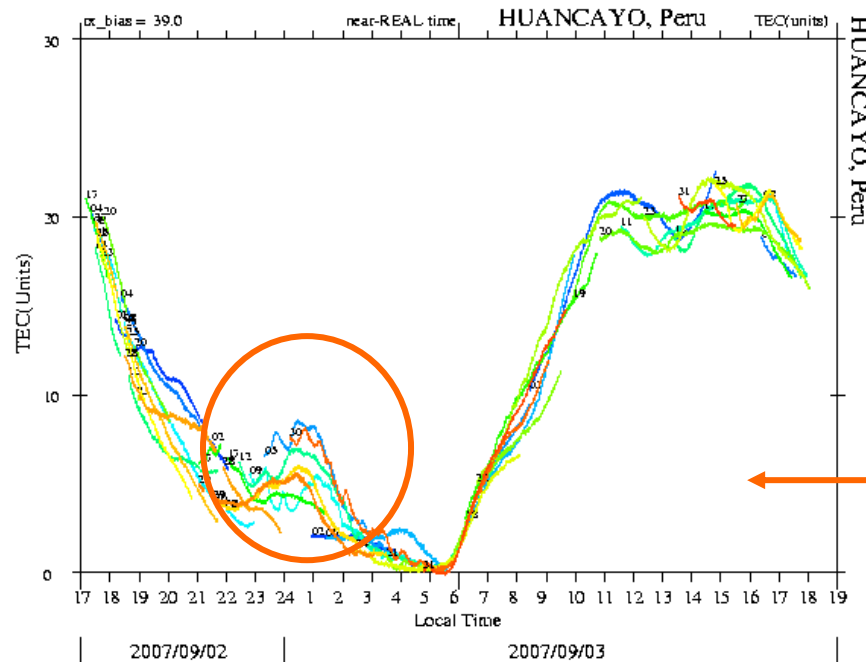
S4 Scintillation Index observed in SA on March 08, 2008





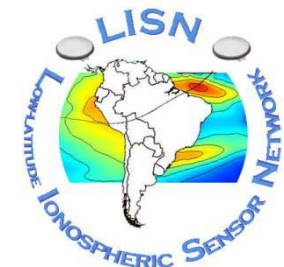
TEC wave Perturbations associated with TIDs

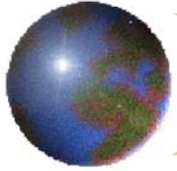
1 TEC unit fluctuations
seen moving from
Huancayo to Ancon
(westward direction).



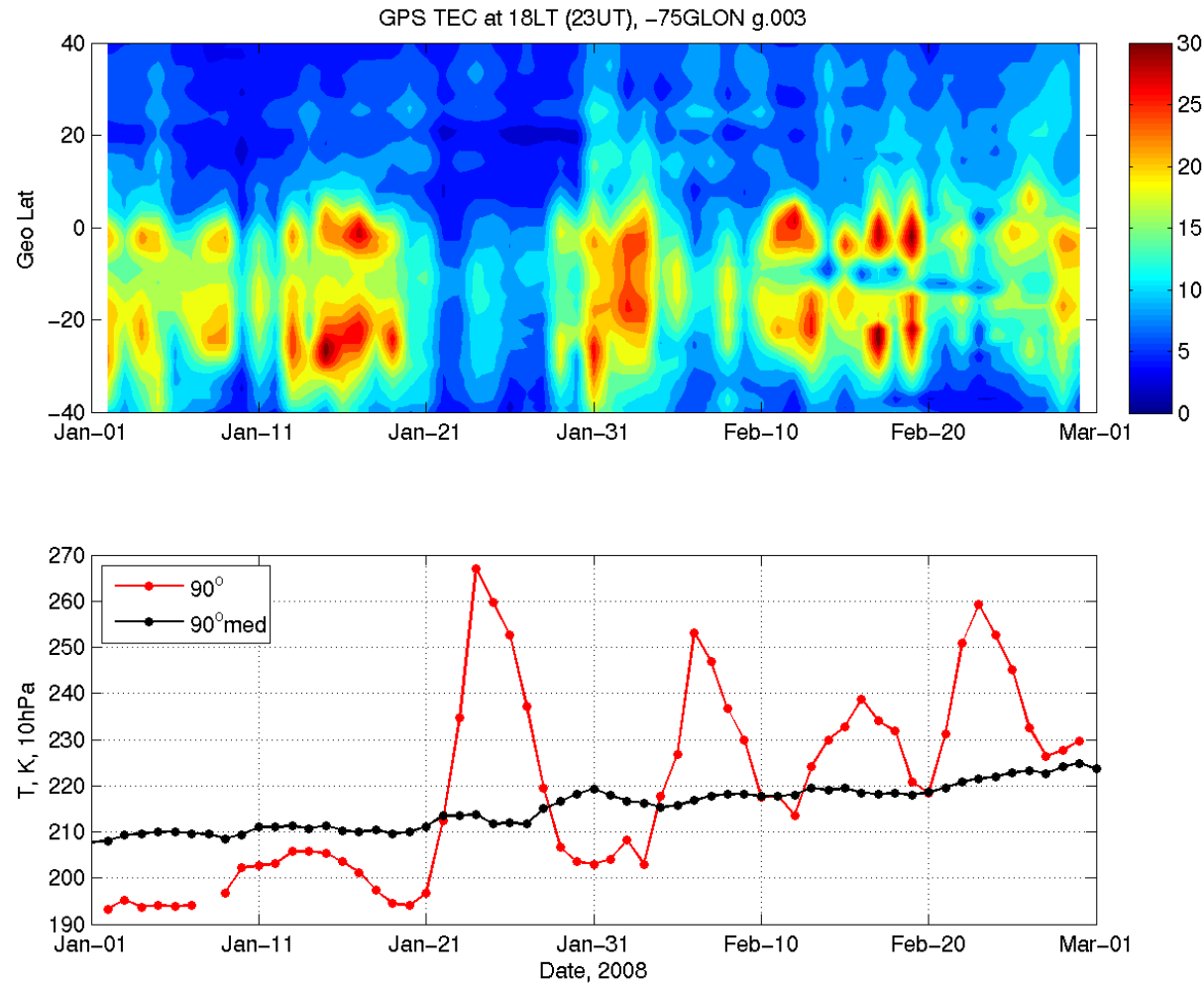
Ancon

Huancayo

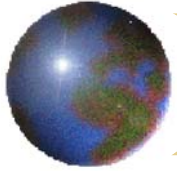




Stratospheric Warming Studies (L. Gonsharenko, A. Coster, W. Rideout)

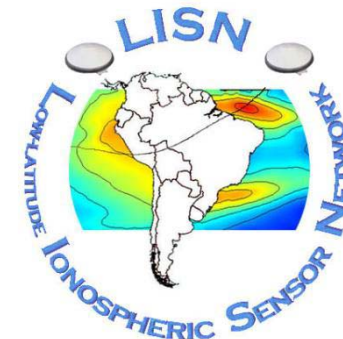
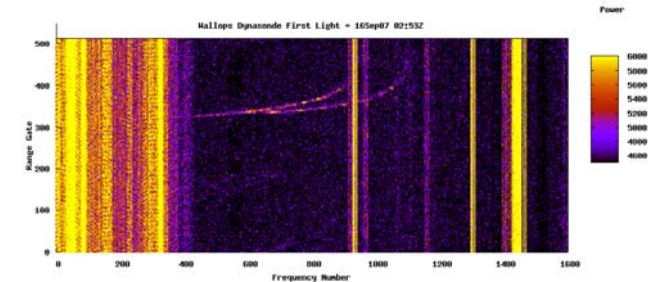


Every stratospheric warming event in 2008 is accompanied by a decrease in the electron density in the afternoon



Status of LISN

- ⊕ GPS Receivers
 - ❖ 35 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 in the process of being installed (Peru, Argentina)
 - ❖ All deployed by mid 2010
- ⊕ Magnetometers
 - ❖ All 5 constructed
 - ❖ 2 Installed
 - ❖ 3 by mid 2010
- ⊕ System installation complete December 2010
- ⊕ Internet Connectivity is the greatest challenge!





IHY Observatories Over Africa

- 13 units of MAGDAS
- 7 units of GPS including SCINDA,
- 4 units of AWESOME
- 20 units of SID monitors

data obtained from these facilities are being used to improve our understanding of space weather as it affects the performance of GNSS

Additional monitors:
3 units GPS from BC –
More planned under ICTP/BC partnership
Ionosondes planned

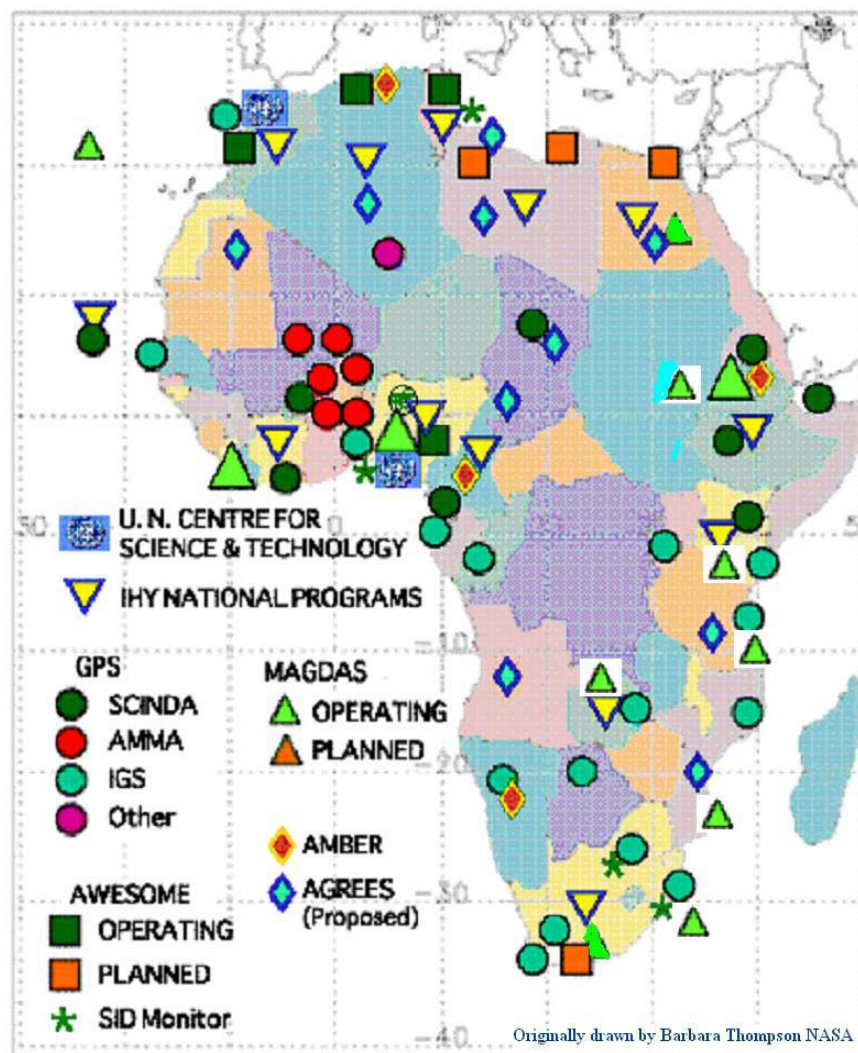
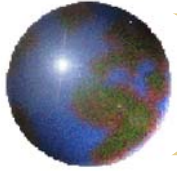


Figure Courtesy of Babatunde Rabi



SUMMARY

⊕ Motivation for LISN

- ⊞ Coordinated Measurements
- ⊞ Study electrodynamics of the low-latitude region
- ⊞ Develop tools to nowcast/forecast initiation of Spread F

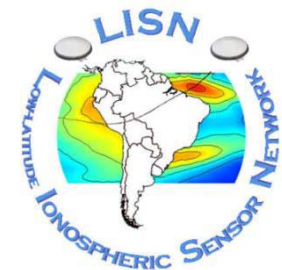
⊕ LISN Architecture

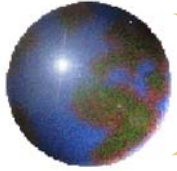
⊕ Examples of measurements and studies

⊕ Current Status

⊕ African LISN is a possibility

- ⊞ Coordination and collaboration most important





1st LISN Team Meeting – Jicamarca, Peru - August 07
31 Participants – 7 Countries



Thanks for **LISteNing!**