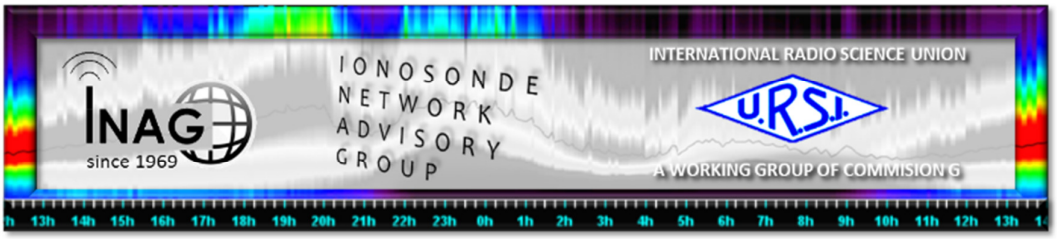


Ionosonde Networks in ISWI

United Nations International Space Weather Initiative (ISWI)

:

01/08/2018

Welcome to INAG Newsletter 2018-01!

Let us draw your attention to...
ionosonde networks participating in United Nations ISWI:

ISWI is a program of international cooperation to advance the space weather science by a combination of instrument deployment, analysis and interpretation of space weather data from the deployed instruments in conjunction with space data, and communicate the results to the public and students.

http://www.iswi-secretariat.org/

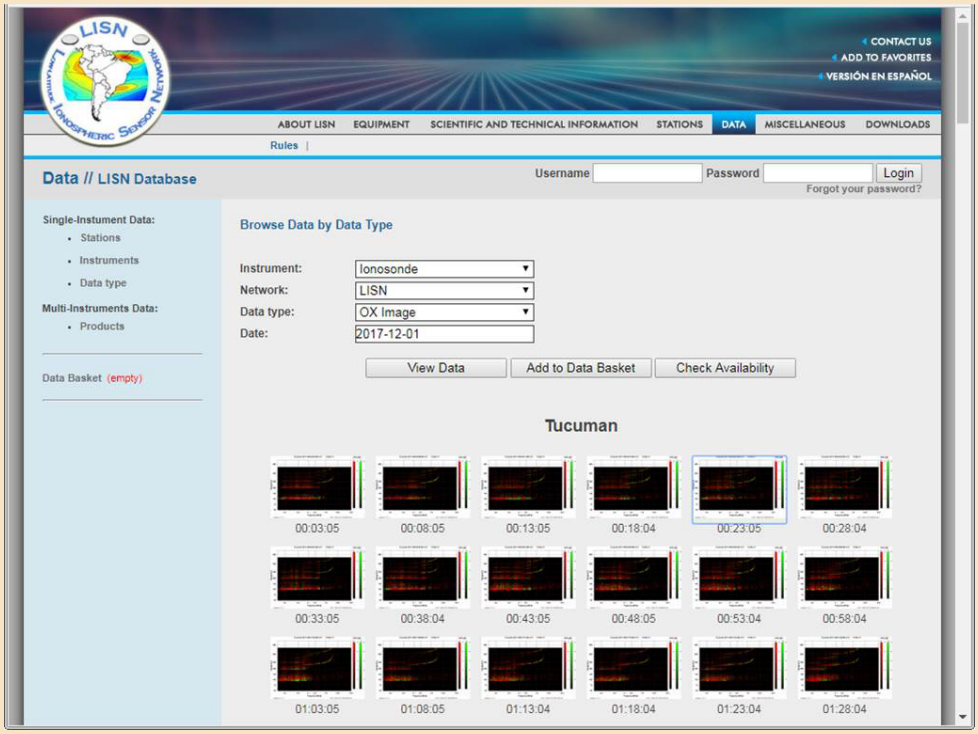
Low-latitude Ionospheric Sensor Network (LISN)

1

Year joined ISWI: 2010

PI: *Dr. Cesar Valladares* (UT Dallas; Boston College) United States

LISN is a distributed observatory dedicated to monitor and specify the conditions of the equatorial and low-latitude ionosphere over South America. LISN was designed to conduct studies of the low– latitude ionosphere over South America and to provide a nowcast and then, using data ingestion techniques, provide a forecast of the background ionosphere and the formation of irregularities and scintillations. LISN presently manages 47 GPS receivers, 5 magnetometers and 4 vertical incidence pulsed ionospheric radar (VIPIR) ionosondes with the near-real-time capability. The network latest ionograms are available at LISN web portal.



Realistic Ionosphere (RI)

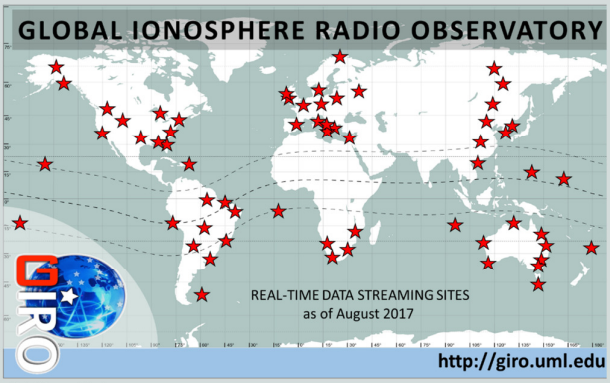
Year joined ISWI: 2017

PI: *Prof.Dr. Bodo Reinisch* (Lowell Digisonde International, UML) United States

Co-PI: *Prof.Dr. Ivan Galkin* (UML) United States

The **Realistic Ionosphere (RI)** provides accurate and prompt nowcast of the 3D global plasma density distribution in the subpeak ionosphere. It includes several sensing, modeling, and computer science components:

- **GIRO: Global Ionosphere Radio Observatory** [1]
  A multi-nation coordinated network of ionosondes providing near-real-time (nRT) low-latency measured data of the subpeak ionospheric plasma density, including raw and derived data products:



Data latency < 7 min

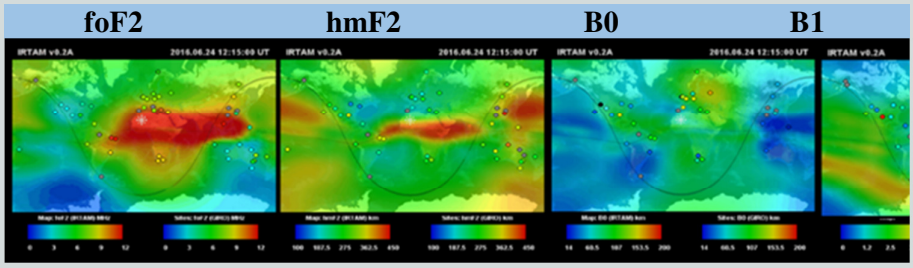
- vertical and oblique ionogram data and displays,
- ionogram-derived autoscaled and validated records of electron density profiles, and standard URSI characteristics (foF2, hmF2, etc.),
- skymaps of signal propagation,
- plasma drift bulk velocities,
- local tilts of the ionosphere, and
- measurements of Traveling Ionospheric Disturbances (TIDs).

Open Data Portal: giro.uml.edu

- **IRTAM 3D: IRI-based Real Time Assimilative Model** [2]
  A global 3D empirical nowcast of the ionospheric plasma density based on a Real-Time IRI technique of smooth transformation of the background International Reference Ionosphere (IRI) climatological model [3] into the optimal match with GIRO measurements. The IRTAM 3D updates are issued every 15 minutes with a 7.5 minute latency from the GIRO start of ionogram measurements.

  Latest 24-hours of IRTAM Ionosphere: 24-hour animated global maps
  Retrospective IRTAM database: GAMBIT Consortium and open source

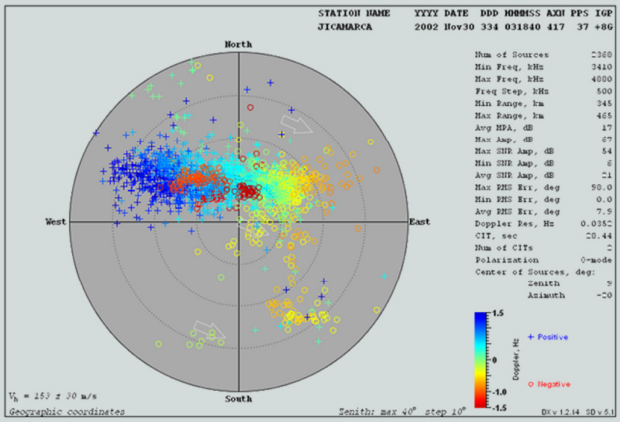
GAMBIT-X.



- **TID Explorer (TIDx)** [4,5]
  Based on Doppler-Frequency-Angular Sounding (FAS) sensing method [6] between two Digisonde DPS4D instruments, TID Explorer provides nowcast and forecast of traveling ionospheric disturbances: natural or artificial phenomena associated with the wave-like perturbation of plasma density in response to propagation of the acoustic gravity waves in the neutral atmosphere. The FAS method allows full specification of the TID ensemble, including its amplitude, period, and the **K** vector of propagation.

  Pilot TID Warning system is operational at tid.space.noa.gr based on the network of DPS4D observatories in Europe.

- **Sky-LITE: Skymapping for Local Ionosphere Tilt Evaluation** [7]
  Use of HF skymapping technology for a wide-angle sensing of the ionospheric plasma structures to determine local tilts of isodensity surfaces in the ionosphere.



- **RayTRIX: Ray-Tracing through Realistic Ionosphere eXplorer** [6]
  Signal raytracing through the ionospheric channel specified by IRTAM, Sky-

LITE and TIDx.

- **LGDC: Lowell GIRO Data Center**
  A collection of computer software, database engines, and computer infrastructure for computations associated with RI nowcast and warning services, and open international data access for academia, students, radio enthusiasts, and space weather applications. Over 600 million records of sounding data available over GIRO Web Portal. Online interactive data explorer workstations with capability to submit derived and annotation value-added information to LGDC.

Data Access

GIRO Web Portal with Open Data policy and Rules of the Road.

References

1. *Reinisch, B. W., and I. A. Galkin*. **Global ionospheric radio observatory (GIRO)**, EPS, 63, 377-381, doi:10.5047/eps.2011.03.001, 2011.
2. *Galkin, I.A., B.W. Reinisch, X. Huang, and D. Bilitza*. **Assimilation of GIRO Data into a Real-Time IRI**Radio Science, 47, RS0L07, doi:10.1029/2011RS004952, 2012.
3. *Reinisch, B.W., I.A. Galkin, A. Belehaki, et al*. **Pilot ionosonde network for identification of travelling ionospheric disturbances**, submitted to Radio Science (2017).
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5. *Verhulst, T., D. Altadill, J. Mielich, B. Reinisch, I. Galkin, A. Mouzakis, A. Belehaki, D. Buresova, S. Stankov, E. Blanch, D. Kouba*. **Vertical and oblique HF sounding with a network of synchronised ionosondes**, Adv. Space Res., doi:10.1016/j.asr.2017.06.033, 2017.
6. *Paznukhov, V.V., V.G. Galushko, and B.W. Reinisch*. **Digisonde observations of TIDs with frequency and angular sounding technique**, Adv. Space. Res., 49(4), 700-710, doi:10.1016/j.asr.2011.11.012, 2012.
7. *Huang, X. and B.W. Reinisch*. **Real time HF raytracing through a tilted ionosphere**, Radio Sci., 41(5), RS5S47, 10.1029/2005RS003378, 2006.

A friendly reminder: please join us during the URSI Atlantic Radio Science Meeting in 2018 at the session S-G7 **"Sensor networks for ionospheric weather nowcast"**.

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UMass Lowell: GIRO
INAG Chair

John Bosco Habarulema
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INAG Co-Chair

Baiqi Ning
IGG CAS, Beijing, China
INAG Co-Chair

and **Kehe Wang**, SWS BOM Australia, INAG Bulletin Editor

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