Ionosonde Data
Products and Services

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Outline

• Introduction to *Realistic Ionosphere* (RION)
• Access to LGDC data resources
  – GIRO ionograms and ionogram-derived data
  – Assimilative IRI: GAMBIT
  – 4-channel Digisonde spectra and associated products
  – Ionospheric Irregularities
    • TID
    • IDI = Ionospheric Disturbance Index
Motivation for RION

**SUPPORT ROLE**

- Highly sensitive medium that reacts to variety of effects
  - “Forensic” investigations
    - Natural and artificial events
- HF Communications
  - Hard areas to reach
    - High latitudes... Arctic
  - Hard scenarios to tolerate
    - Covert & obstructive

**OBSTACLE ROLE**

- Unknown medium that disrupts systems
- Plasma Irregularities
  - Small scale
    - GNSS signal scintillation
  - Medium scale (TID)
    - “Silent killer” of PPP
  - Large/planetary scale
Realistic Ionosphere

RION is member of United Nations Space Weather Initiative
http://www.iswi-secretariat.org/

GIRO  IRTAM 3D  SkyLITE  TID Explorer  IDI

Measurements  Global Model  Plasma Drifts  TID Warnings  Disturbance Indicator

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Lowell GIRO Data Center: LGDC

[Diagram of the Lowell GIRO Data Center's Real-Time Data Dissemination System]

- **Data Traffic:**
  - CFS = Coarse frequency steps
  - DFT = Doppler frequency steps
  - DOP = Doppler observables
  - SKY = Sky map
  - TAV = Time-avg. parameters
  - TID = Time domain

- **Online Explorer Workstations:**
  - 245 registered organizations

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Legend

- **TXT** Plain text export is available (tabulated/csv)
- **Android** Unattended download via URL is available
- **Mirror** Database mirror is available for local installation
GAMBIT X for Ionosonde Data

FORTALEZA

Legend
- High confidence autoscaling
- Acceptable autoscaling
- Filled data gap
- Observation forecast past TOV
- IRI prediction (climate)
- Single-site local weather
- IRTAM global weather
- Local weather trend
- Global weather trend
- sunset
- sunrise
- tov
- zeroLine
DFT(4-CHANNEL)-DERIVED
4D plasma density in IRI

- Key features of ionosphere
  - D, E, F1, F2 layers
  - Valley between E and F layer
  - Topside section goes up to plasmasphere

- F2 layer most varying in time and space
  - Peak: NmF2 and hmF2
  - Shape: B0 (~half-thickness)

- F1, E, and D are Sun-controlled
IRTAM 24-hour Animations

\[ f_0F2 \quad h_mF2 \quad B0 \quad B1 \]

Used as input drivers to IRI density profile for 3D specification

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IRTAM Deviation Maps

HOW IONOSPHERE IS DIFFERENT FROM ITS QUIET-TIME STATE

\[ \Delta f_0 F2 \quad \Delta h_m F2 \quad \Delta B0 \quad \Delta B1 \]

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Radio Link: PQ052 -> JR055, 2450 kHz, ORDINARY, Query From: 2017-04-21 19:00:00 To: 2017-04-22 05:00:00

TID Amplitude, %

Universal Time, hours

TID Azimuth, deg CW

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Ionospheric Disturbance Indicators