Commercial Space Weather Products for Real-Time and Forecast Applications

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USU Space Weather Center Partnerships

Utah State University Space Weather Center

- Space Environment Technologies
- USU GAIM Team
- Space Environment Corporation
Partnership Members

• **USU SWC**

• **GAIM**

• **SET**

• **SEC**
  – V. Eccles, S. Sojka, and D. Rice
New 2011 Real-Time and Forecast Products

- real-time/forecast HF availability for Japanese emergency responders
- real-time point-to-point global HF propagation
- real-time airline dispatcher route planning HF availability
- real-time GPS correction maps for single- and dual-frequency users
- real-time radiation dose rates for aviation users
- real-time Dst ring current indices
- real-time/forecast solar and geomagnetic indices that drive the JB2008 thermospheric density model for LEO satellite operations
- real-time charging and discharging for GEO comm satellites
GAIM-GM global Run:

- 357 global TEC stations (IGS network) used in real-time at USU Space Weather Center
- Up to 10,000 measurements assimilated every 15-min
GAIM-GM regional (High Resolution) Run:

- 424 USTEC stations (CORS network) used in real-time at USU Space Weather Center
- Up to 10,000 measurements assimilated every 15-min
HF Communications Support

• SWC combines models and utilities to provide HF propagation information

  – GAIM Ionosphere
  – ABBYNORMAL D-Region absorption maps
  – HASEL Ray-Tracing Model
  – Great Circle Signal Strength (GCSS)
  – Near Vertical Incidence Skywave (NVIS)
ABBYNORMAL*
Data-Driven D-Region Model

- Global D-Region electron densities from 40 to 130 km combined with GAIM ionosphere
- Calculates signal absorption for HF propagation codes.

*ABsorption BY the D and E Region of HF Signals with NORMAL Incidence
NVIS for Japan

- SWC HF communications for Japan emergency conditions

Maximum Frequency (MHz) for Near Vertical Incidence Skywave

Signal Strength Absorption of NVIS HF Communication

USU Space Weather Center

[Graphs showing changes in NVIS Max Frequency (MHz) and Signal Absorption of NVIS (dB) over time in UTC and JST.]
Global HF Comm for Japan

3.5 MHz Signal Strength

HF Comm @ 3.5 MHz (85 meters)
Illumination footprint for Japan on 2011/04/22 16:00UT
USU Space Weather Center

14.1 MHz Signal Strength

HF Comm @ 14.1 MHz (21 meters)
Illumination footprint for Japan on 2011/04/22 16:00UT
USU Space Weather Center
GPS Corrections

- The conventional Klobuchar correction is updated about every 6 days and thus cannot track changing conditions
- GAIM tracks changing conditions and shows storm effects
GAIM Requirements for Corrections

- To calculate corrections for GPS in North America, two overlapping higher-resolution regional grids are included.
- Grid coverage is shown below, with an example of the resultant GAIM ionosphere showing ingested data sites.
GAIM Correction Example

- Fixes for moderately disturbed day were calculated with Colorado Springs GPS data, 30 second resolution
- Single frequency corrections and dual frequency estimates are compared; the nominal site position is at the origin

AMC2 2010/284
GAIM Correction Analysis

- In all cases, the GAIM corrections improved the average daily fix compared to the Klobuchar corrections.

- In most cases, the GAIM corrections provided fixes comparable to the dual frequency fix.

- Similar results were obtained for other test sites during the period considered.
Summary

- Poster by Meehan et al. provides more details about our new products

- 3 press releases will be available this week

- First space weather app (iPhone) and new iPad release
  - 120 real-time data sets
  - Provided by 17 institutions /organizations