U.S. AIR FORCE

AFWA - CCMC/SWRC Partnership

Mr. Horner
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A3N

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Aim High…Fly, Fight, Win

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Purpose

AIR FORCE WEATHER AGENCY

- To outline the space weather mission at AFWA and explore opportunities for further collaboration with CCMC/SWRC

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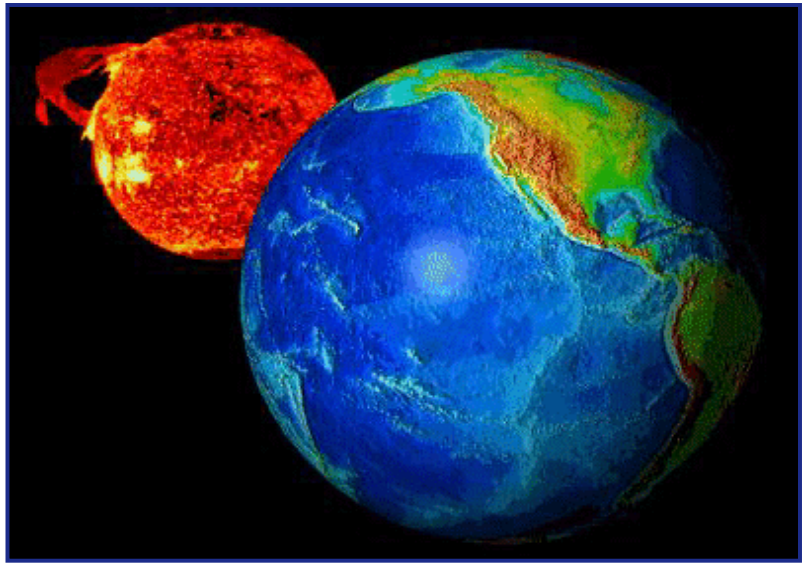
Overview

- AFWA Space Weather
  - Operations
  - Models/Applications
  - Net-Centric Data Access
  - Integration Team
  - Training Materials
  - Needs
- AFWA – CCMC/SWRC Collaboration
- Summary

AFWA Space Weather Operations

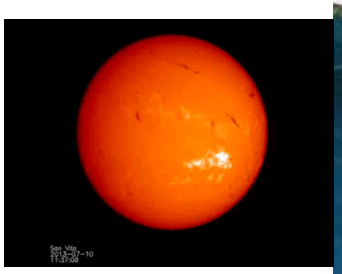
- **AFWA's Space Weather Flight**
  - **DoD's primary 24/7 space weather operations center**
  - **Provides mission-tailored analyses, forecasts and warnings of system-impacting space weather to National agencies and DoD operators, warfighters and decision makers**



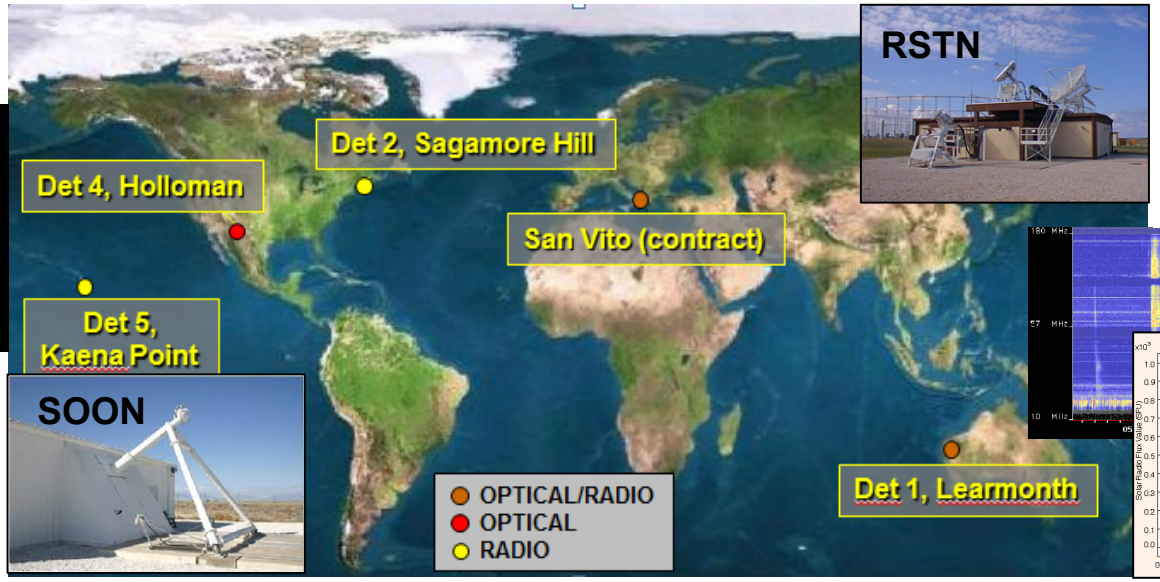
Space Weather Operations Center

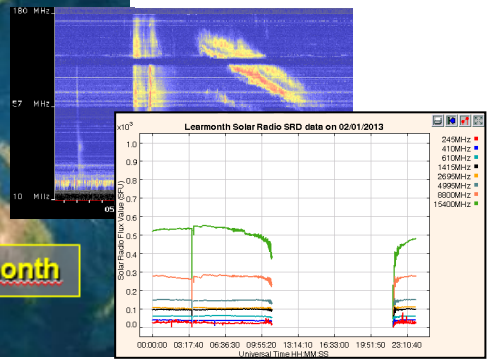
AFWA Space Weather Operations

- **Solar Electro-Optical Network—sunrise to sunset patrol (global network provides 24-hour coverage)**
  - **Monitors the solar environment**
  - **Records and analyzes the data obtained**
  - **Disseminates data to SpaceWOC and other users**



San Vito
SOON
H-α image

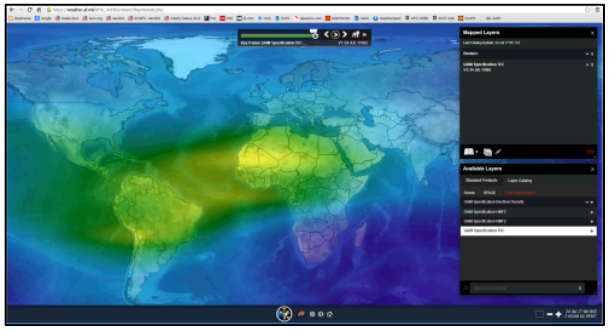




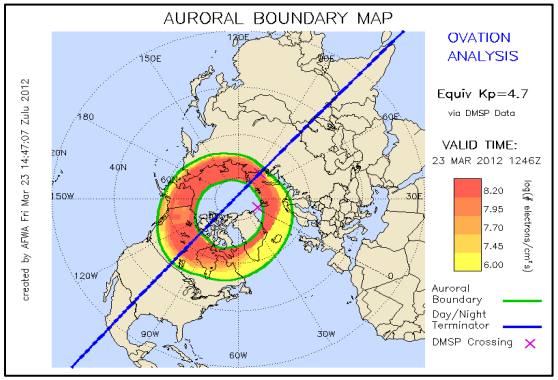
Learmonth
RIMS
and SRS data

AFWA Space Weather Models/Applications

- Primary Models/Tools
  - Global Assimilation of Ionospheric Measurements - Gauss Markov (GAIM-GM) model
  - Radiation Belt Models
    - Magnetospheric Specification & Forecast Model (MSFM)
    - Radiation Belt Environment (RBE)
    - Relativistic Electron Prediction (REP)
  - Key Products
    - HF Comm Illumination
    - HF Comm Point-to-Point
    - Estimated GPS Error Maps
    - Auroral Oval



GAIM-GM



Auroral Oval

AFWA Space Weather Net-Centric Data Access

- **Net-Centric data is now available on AFW-WEBS for the ap/Ap indices**

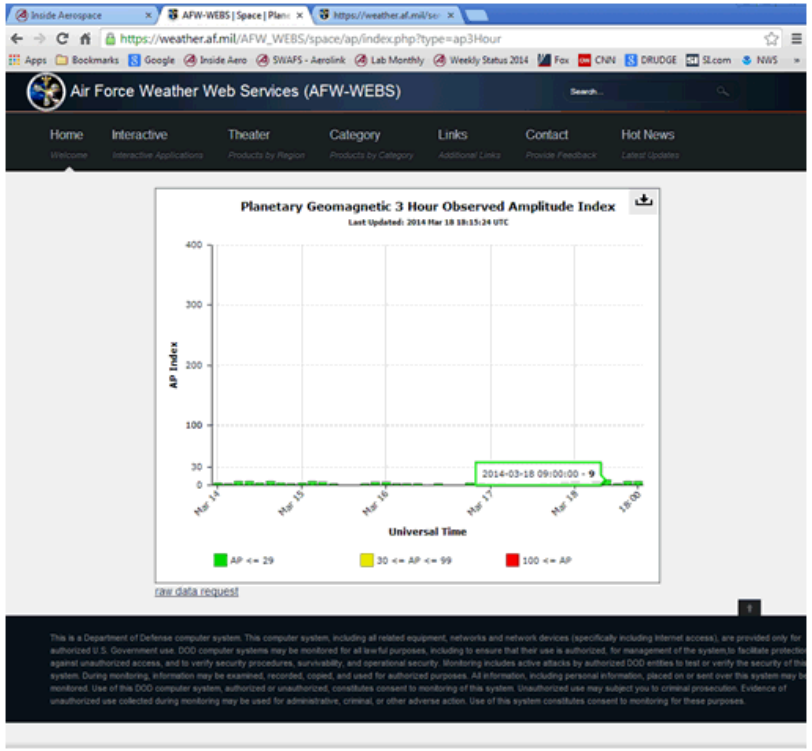


Image of Raw ap Data Values Pulled On-Demand from AFWA's Database

AFWA Space Weather Integration Team

- **Operational GAIM metrics developed by AFWA's Space Weather Integration Team and displayed on SWITWEB**

16th WS
Space Weather Integration Team Web (SWITWEB)

Prototypes Menu

Ionosphere Prototypes
Java Loopers
- GAIM
- IFM
- GAIM/IFM Difference
- IRI

Metrics Pages
- RMS Error Graph
- Data Usage Maps

Solar Telescope Prototypes
Optical Networks
- GONG
- SOON

Radio Networks
- RSTN:SRS - Sagamore Hill
- RSTN:SRS - San Vito
- RSTN:SRS - Learmonth
- RSTN:SRS - Kaena Point

Rules-of-Thumb Prototypes
- Proton Predictor

Satellite Charging
- Main Page

Welcome to the 16th WS Space Weather Integration Team website. This site hosts all the existing prototypes that the team is developing. This page changes regularly...so check back often to see the great work going on with the team.

Remember...all products on this page are prototypes only. They are not supported 24/7. However, if you notice a particular product misbehaving please let us know and we will do our best to resolve the issue.

Use the links to the left to navigate to our prototypes. Please feel free to make any suggestions or comments to the team.

Team Publications

2014
Comparisons of GAIM-GM 2.9.0_p3 to GAIM-GM 3.0.3 - Jones & Dr. Shaikh
Sensitivity of GAIM-GM to Variations in Kp Input - Jones & Dr. Shaikh
AMS Poster 2014 - Jones
An empirical model of solar indices and hemispheric power based on DMSP/SSUSI data - Dr. Shaikh & Jones

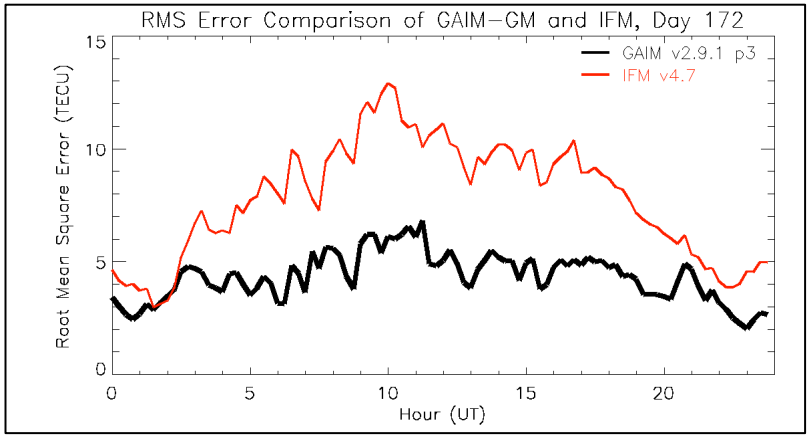
2013
AGU Presentation 2013 - Jones
AGU Presentation on VLF waves 2013 - Dr Shaikh & Jones
Empirical Model of Solar Indices - Dr. Shaikh and Jones
AMS Presentation 2013 - Jones
Auroral Oval Boundary Model Study - Jones

2012
Case Study and Comparisons of GAIM Model Specification Iteration - Jones
Impact of Station Inclusion on Accuracy of Disturbance Storm Time (Dst) Index - Jones

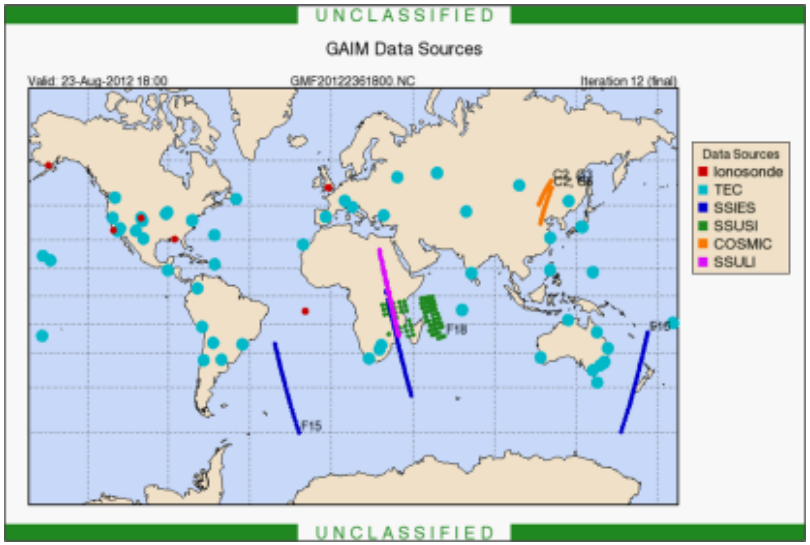
SWITWEB Main Page

AFWA Space Weather Integration Team

- **Root mean square error metrics of operational models**
  - **Based upon GPS TEC measurements not assimilated by the model**
- **Data usage metrics (all assimilated observations)**



RMSE of GAIM and IFM



GAIM Data Usage

AFWA Space Weather Training Material

- **Available on the Air Force Weather Knowledge Center (AFWKC):**

1. ***Solar X-Ray Flares & HF Communications***
2. ***Equatorial Scintillation and UHF SATCOM***
3. ***Solar Maximum Refresher Training***
4. ***Space Weather – Layers of the Sun***
5. ***Space Weather – Active Regions***
6. ***COMET Space Weather Basics Webcast***

AFW Knowledge Center

AFWA Space Weather Needs

- Better Characterization and Forecasting of the Magnetosphere
  - Physics-based models
  - Real-time, assimilative models
- Validation and Verification of Models/Applications
  - Quantitative assessments of model/application accuracies
- Coupled Models
- Ensembles
- Space Weather Sensors
  - New satellites and more ground-sites

AFWA-CCMC/SWRC Collaboration

- **Enthusiastic about strengthening the AFWA-CCMC/SWRC partnership and exploring additional avenues for collaboration:**
  - **Leveraging data and new forecasting tools from the Integrated Space Weather Analysis (iSWA) application**
  - **Developing operational metrics/model performance validations**
  - **Exploring methods for generating space weather ensembles**
  - **Collaborating on space weather training development and the exchange of resources between SWRC and AFWKC**
  - **Assisting AFIT student projects/research**
  - **Providing operational advocacy for satellites with space weather sensors, particularly NASA-managed satellites**

Summary

- The partnership between AFWA and CCMC/SWRC is one of several ongoing collaborations key to advancing space weather analysis and forecasting
  - AFWA provides operational feedback and select access to space weather data
  - CCMC/SWRC provides tools, metrics, and expertise
- Space weather R2O and O2R is a team effort
  - We must continue to work jointly together to improve space weather analysis and forecast capabilities