Science Questions for a Personal Space Weather Station

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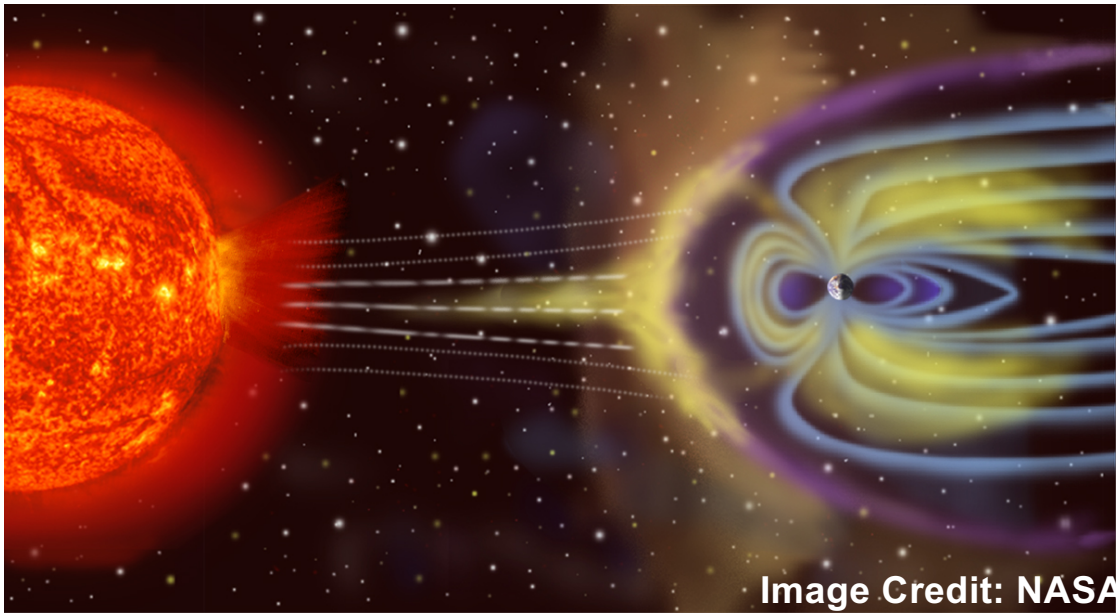
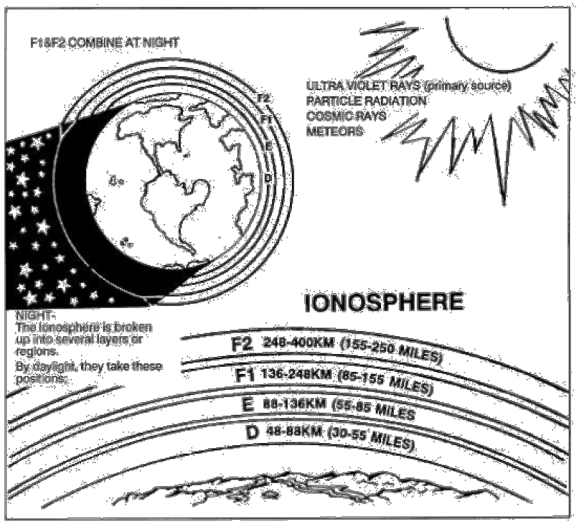
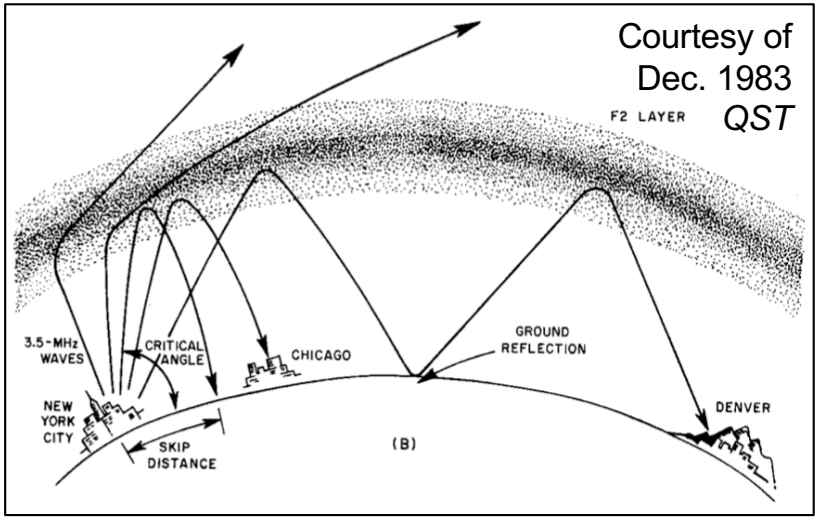
Geospace System / Ionosphere







Space Weather Station Goals

As hams building a Personal SW Station, what do we want to do?

Operations

Hams:

- Know the best frequencies for working DX
- Understand the RFI Environment
- Communicate better during emergencies

Research

Scientists:

- Better sample the environment
- Better understand near-Earth Space
- Advance Scientific Understanding

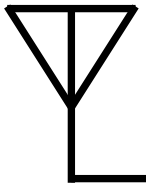
Personal Terrestrial WX Station

- Multi-instrument
- Internet Connected
- Easy Set-Up
- Reasonable Cost

Ambient Weather WS-2902

Personal Space Weather Station

Antenna



GPS Disciplined Oscillator

Magnetometer

Software Defined Radio

- Radio Beacon Monitor
  - RBN, PSKReporter, WSPR, Beacons
- HF Noise Characterizer
- GPS TEC Receiver
- Traveling Ionospheric Disturbance Detector

Computer
(e.g. Single Board Computer)

- Local User Display
- Local Data Reduction
- Sends Data to Server

HamSCI Public Database

Internet

Target Specifications

- Useful to ham radio, space science, and space weather communities.
- $100 to $500 (??) price range (accessible)
- Modular Instrument Design
  - Easy ability to add or remove instruments, especially in software architecture
- Small footprint
- Nice User Interface/Local Display
- Standard format to send data back to a central repository
- Open community-driven design

What can we sense from the ground?

- **Radio Signals through Ionosphere**
  - Electron Density

- **Ground Magnetic Field**
  - Currents in the ionosphere, magnetosphere

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Objective 1

Investigation Objectives	Science Questions	Functional Requirements
Characterize the ionospheric and geomagnetic response to space weather events with sources both below and above the ionosphere.	•What are the characteristic temporal and spatial scales of magnetic fluctuations in near-Earth space during geomagnetic disturbances? •How does ionospheric density vary as a function of location, altitude, and time in response to space weather disturbances associated with driving events such as solar flares, geomagnetic storms, substorms, and lower atmosphere perturbations?	•Determine the vector ground magnetic field for identification of geomagnetic disturbances and micropulsations (e.g. ULF variations). •Receive transmissions from controlled sources (digital_rf-based) or signals of opportunity (e.g., CODAR).

Objective 2

Investigation Objectives	Science Questions	Functional Requirements
Characterize ionospheric variability and identify its sources during both quiet and disturbed times.	•What are the characteristics (wavelength, period, direction of travel, location, altitude) of traveling ionospheric disturbances (TIDs)? •What is the location and nature of sources that drive TIDs, such as lower atmosphere winds/tides and upper atmosphere forcing? •What is the location and nature of ionospheric variability that is not associated with TIDs? •How do the location and nature of ionospheric variability sources change from quiet to disturbed times?	Make measurements on a minimum of two transmit-receive paths (three stations) with lengths >= ~100 km and with good spatial distribution for good orthogonality properties.

Objective 3

Investigation Objectives	Science Questions	Functional Requirements
Determine the impact of space weather events and ionospheric variability on terrestrial HF communications systems.	•What propagation paths are open/closed for given space weather conditions? •What is the dominant propagation mode (i.e. single hop, double hop, ducting?) for given space weather conditions? •What are ionospheric variability effects on HF communications signal parameters such as amplitude/phase scintillation, channel fading, and polarization?	Receive swept-frequency sounder signals from appropriate polarized or non-polarized signals of opportunity such as Digisonde or chirp sounders.

Thank you!

For more information, please visit the HamSCI project page:

http://hamsci.org/swstation

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