Science Questions for a Personal Space Weather Station

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Geospace System / Ionosphere

Image Credit: NASA

Courtesy of Dec. 1983 QST
Space Weather Station Goals

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

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

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

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

GPS Disciplined Oscillator

Magnetometer

Computer
  (e.g. Single Board Computer)
- Local User Display
- Local Data Reduction
- Sends Data to Server

HamSCI Public Database

Internet

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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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| 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

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| 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 $\geq \sim 100$ km and with good spatial distribution for good orthogonality properties. |
## Objective 3

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

For more information, please visit the HamSCI project page:

http://hamsci.org/swstation