HamSCI Personal Space Weather Station: Overview and Project Update

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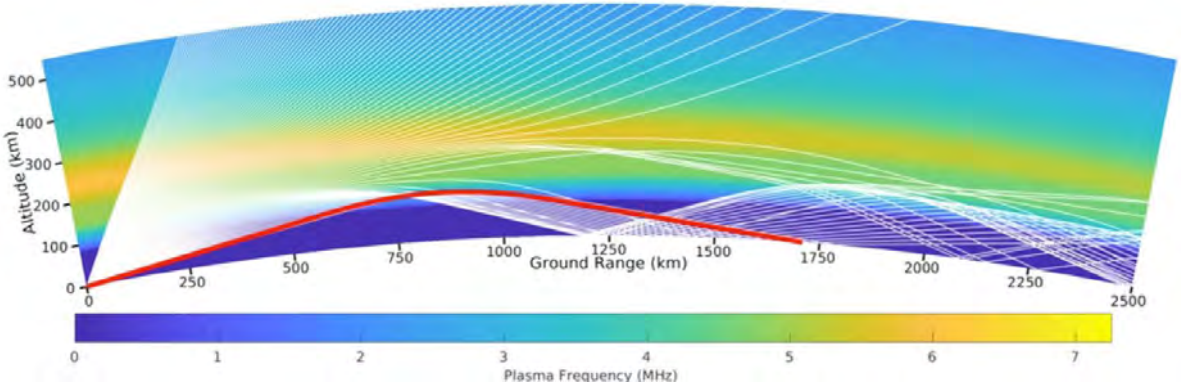
Ham Radio Frequencies and Modes

	Frequency	Wavelength
LF	135 kHz	2,200 m
MF	473 kHz	630 m
	1.8 MHz	160 m
HF	3.5 MHz	80 m
	7 MHz	40 m
	10 MHz	30 m
	14 MHz	20 m
	18 MHz	17 m
	21 MHz	15 m
	24 MHz	12 m
	28 MHz	10 m
VHF+	50 MHz	6 m
	And more…	

PHaRLAP Raytrace

1600 UT 21 Aug 2017 14.03 MHz - Eclipsed SAMI3

TX: AA2MF (Florida) RX: WE9V (Wisconsin)



- Hams routinely use HF-VHF transionospheric links.
- Often ~100 W into dipole antennas.
- Common HF Modes
  - Digital: FT8, PSK31, WSPRNet, RTTY
  - Morse Code / Continuous Wave (CW)
  - Phone: Single Side Band (SSB)

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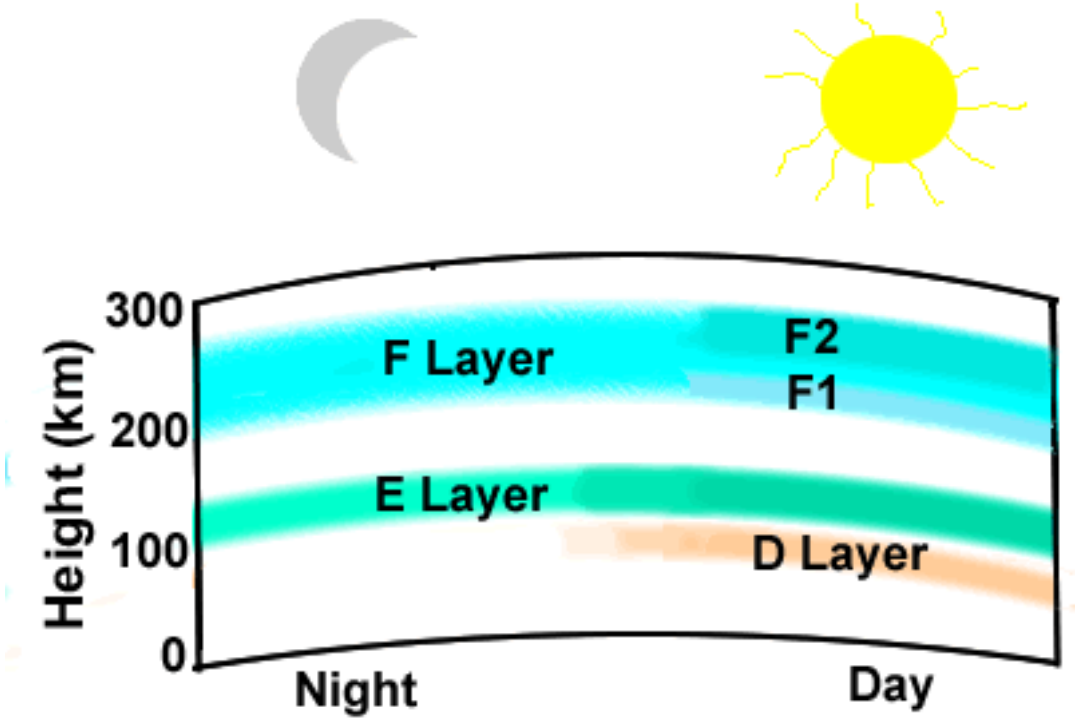
The Ionosphere



https://commons.wikimedia.org/wiki/File:IonosphereLayers-NPS.gif

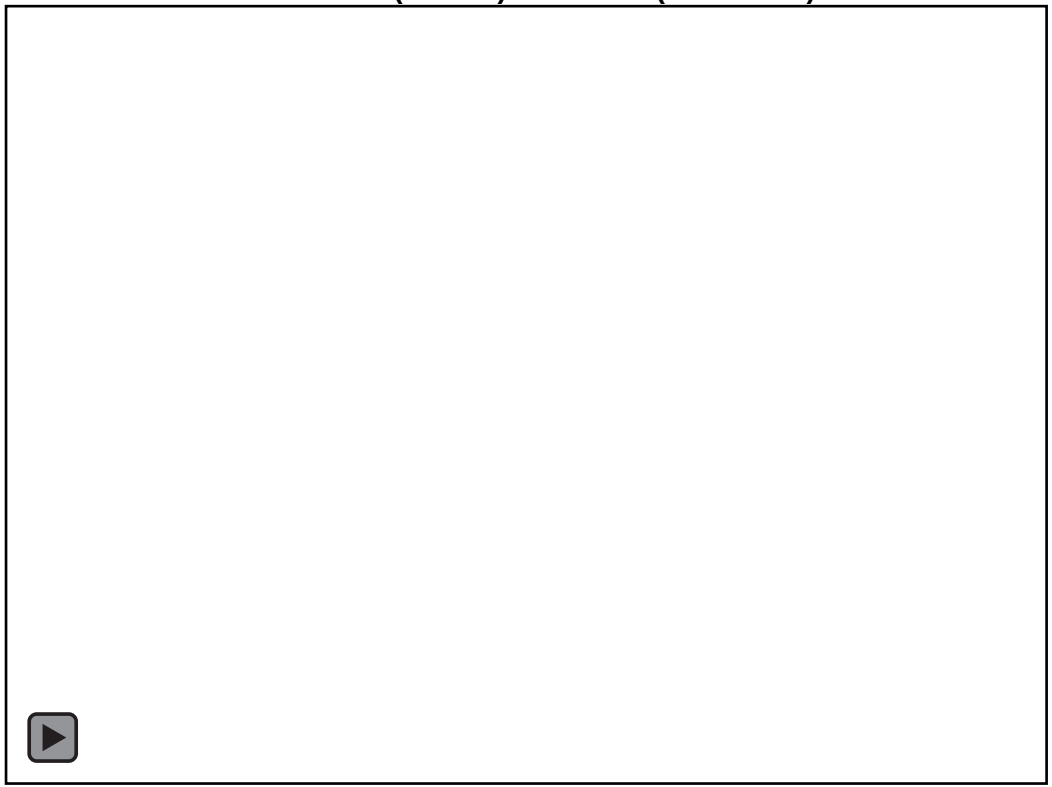
SAMI3-PHaRLAP Raytrace

~~1600 – 2200 UT 14.03 MHz~~

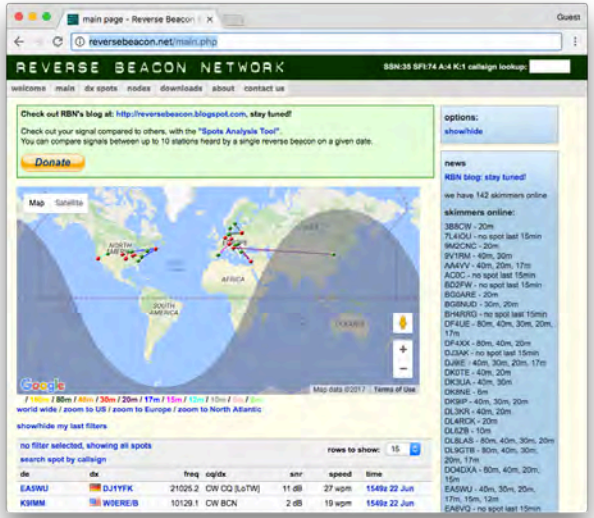
TX: AA2MF (Florida) RX: WE9V (Wisconsin)

Non-Eclipsed

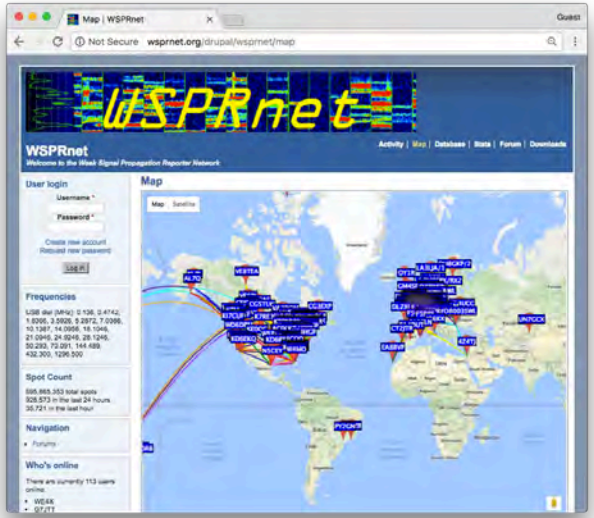
Eclipsed



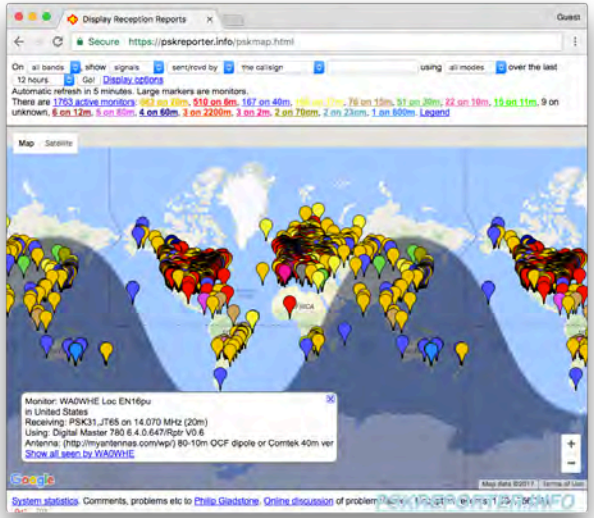
Ham Radio Observation Networks



Reverse Beacon Network (RBN)
reversebeacon.net



WSPRNet
wsprnet.org

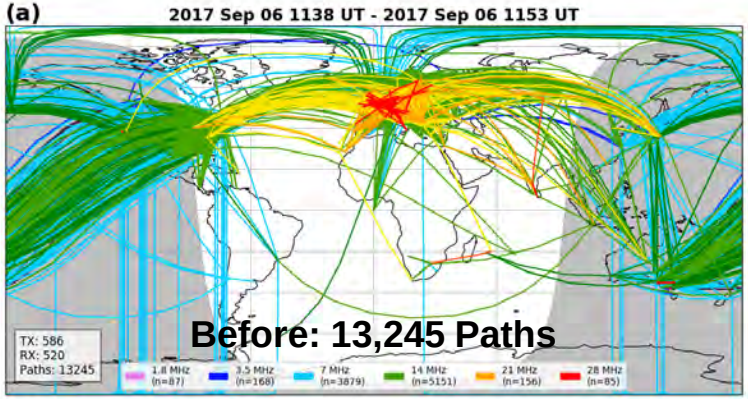


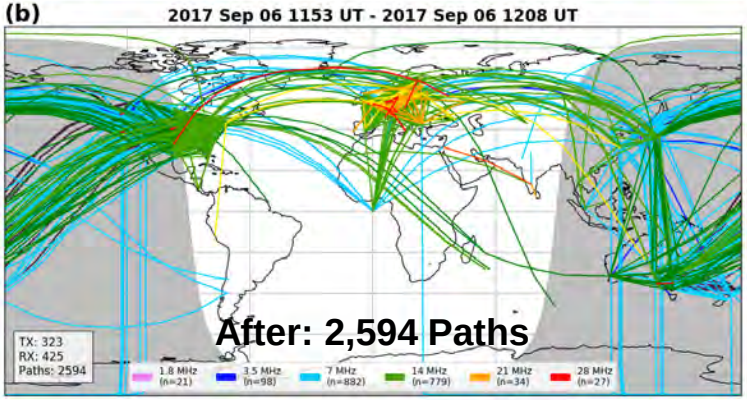
PSKReporter
pskreporter.info

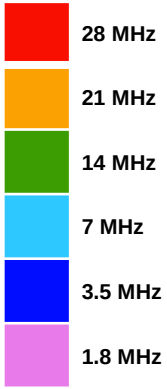
- Quasi-Global
- Organic/Community Run
- Unique & Quasi-random geospatial sampling

- Data back to 2008 (A whole Solar Cycle!)
- Available in real-time!

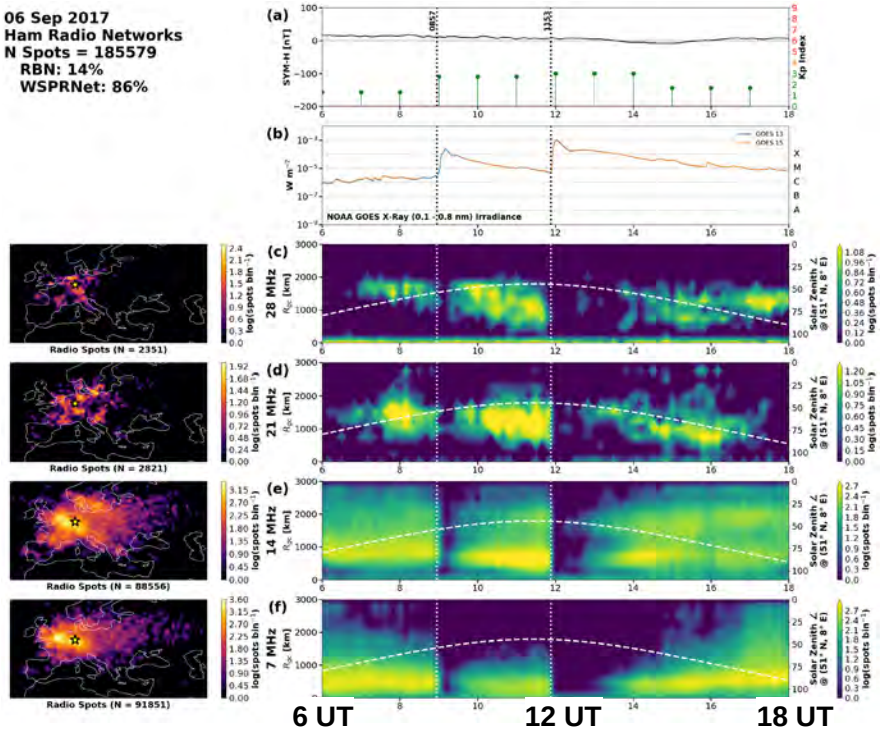
Ham Radio HF Response to Solar Flares







6 Sept 2017 1153 UT X9.3 Flare



(*Frissell et al.*, 2019, https://doi.org/10.1029/2018SW002008)

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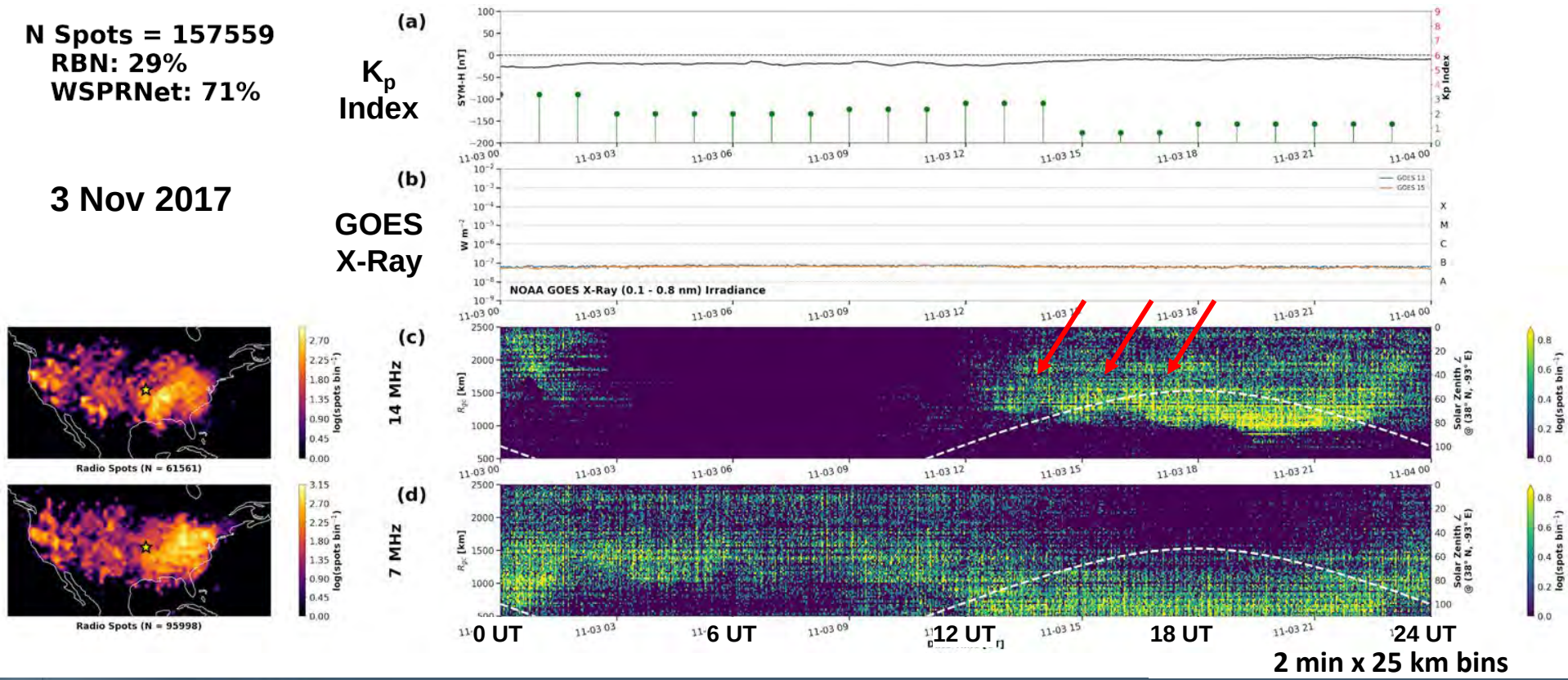
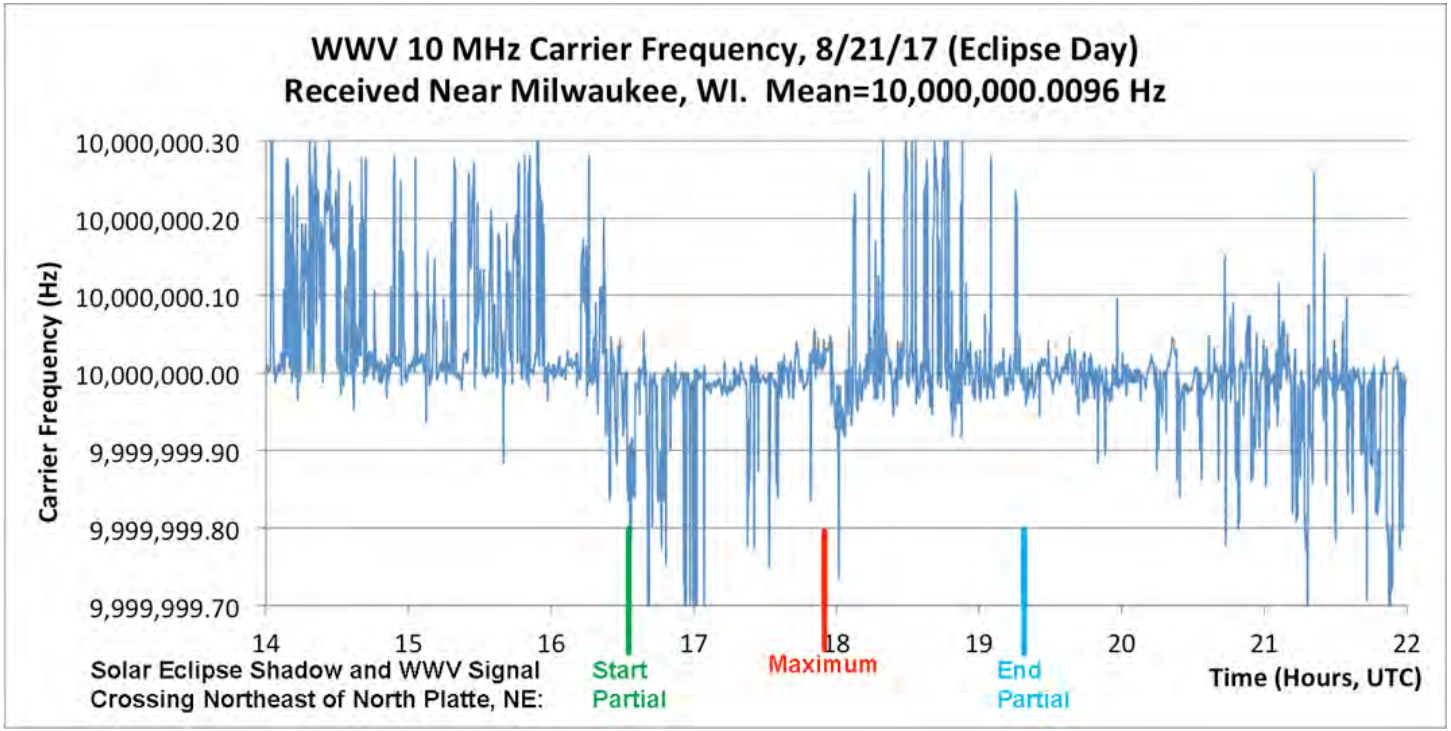
Ham Radio View of Traveling Ionospheric Disturbances

N Spots = 157559
RBN: 29%
WSPRNet: 71%

3 Nov 2017



WWV/CHU Standards Monitor



Steve Reyer, WA9VNJ

Can we do better?

- This is all great, but ham radio receiver networks weren't designed for science.
- What if we could create a network of Personal Space Weather Stations that were designed for both science (and ham radio!) from the ground up?
- That is the idea behind the HamSCI Personal Space Weather Station project.

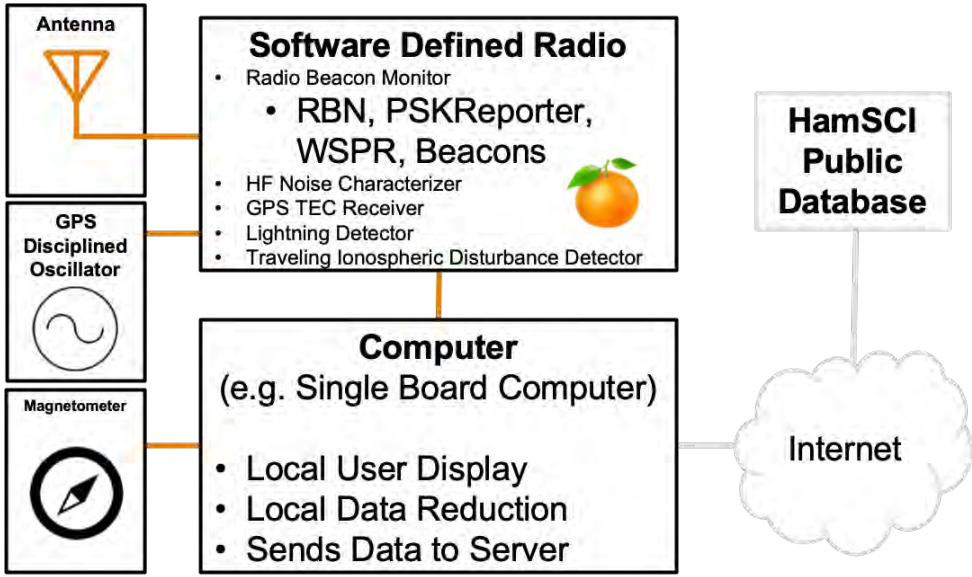
Personal Terrestrial WX Station

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

Ambient Weather WS-2902

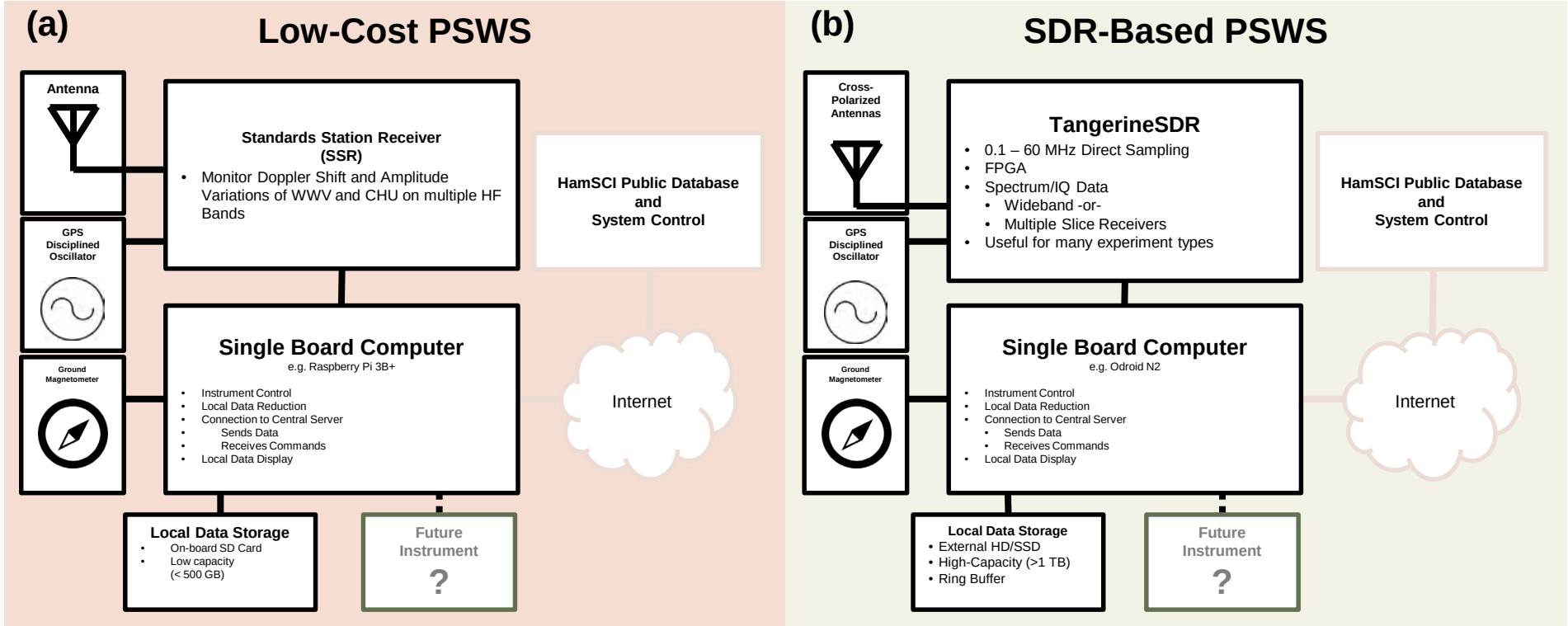
Personal Space Weather Station

- **Useful to ham radio, space science, and space weather communities.**
- **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**



http://hamsci.org/psws

Personal Space Weather Station



PSWS Teams

University of Scranton
- **Nathaniel Frissell W2NAF (PI)**
- Dev Joshi (Post-Doc)

Responsibilities
- Lead Institution
- HamSCI Lead
- Radio Science Lead

TAPR & Zephyr Engineering
- **Scotty Cowling WA2DFI (Chief Architect)**
- Tom McDermott (RF Board)
- John Ackerman N8UR (Clock Module)
- David Witten KD0EAG (Magnetometer)
- David Larsen KV0S (Website)

Responsibilities
- TangerineSDR (High Performance)
- Data Engine
- Ground Magnetometer

University of Alabama
- **Bill Engelke AB4EJ (Chief Architect)**
- Travis Atkison (PI)

Responsibilities
- Central Database
- Central Control Software
- Local Control Software

Case Western Reserve University
Case Amateur Radio Club W8EDU
- **Soumyajit Mandal (PI)**
- Kristina Collins KD8OXT
- John Gibbons N8OBJ
- Rob Wiesler AC8YV
- **David Kazdan AD8Y (Co-Lead)**
- Matt McConnell KC8AWM
- Skylar Dannhoff KD9JPX
- Aidan Montare KB3UMD

Responsibilities
- Low Cost PSWS System

MIT Haystack Observatory
- **Phil Erickson W1PJE**

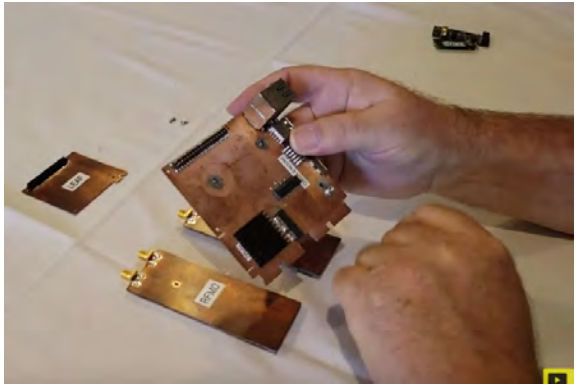
Responsibilities
- Science Collaborator

New Jersey Institute of Technology
- **Hyomin Kim KD2MCR (PI)**
- Gareth Perry KD2SAK
- Andy Gerrard KD2MCQ

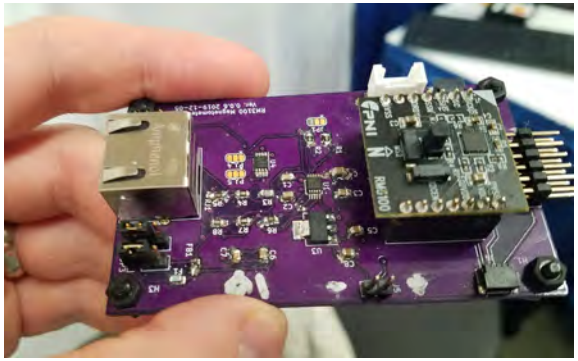
Responsibilities
- Ground Mag Oversight & Testing
- Science Collaborators

Current Progress

- **We are well on our way!**
- **Where can I see the latest?**
  - TangerineSDR Website – https://tangerinesdr.com/
  - Specification Documents
  - Listserv
  - Monday Night Telecons
  - Mockup of TangerineSDR
- For the rest of this morning, we will hear project updates from the individual PSWS Teams.



Scotty WA2DFI explaining the TangerineSDR board mockup
https://youtu.be/81MlpIpB7Mo



David KD0EAG showing magnetometer prototype at 2020 HamCation in Orlando, FL

Thank you!

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