

HamSCI: Today's Community and Future Directions

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The University of Scranton

ARRL/TAPR DCC
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HamSci Ham radio Science Citizen Investigation



hamsci.org/dayton2017



Founder/Lead HamSci Organizer:
Dr. Nathaniel A. Frissell, W2NAF
The University of Scranton

A collective that allows university researchers to collaborate with the amateur radio community in scientific investigations.

Objectives:

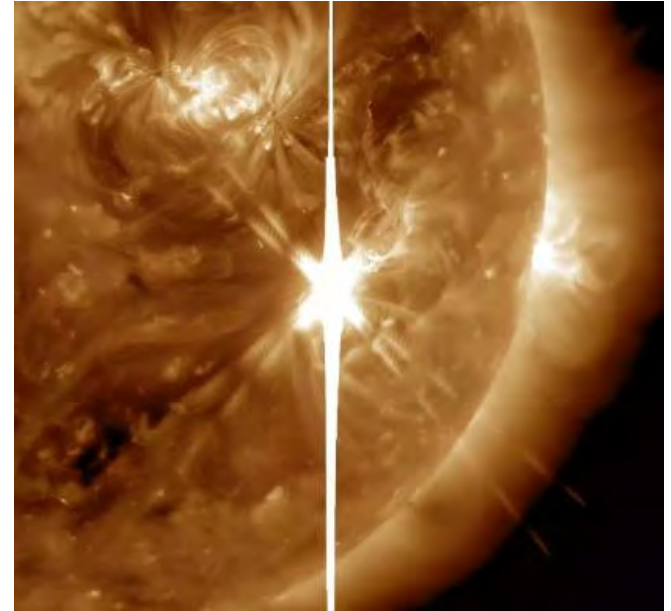
1. **Advance** scientific research and understanding through amateur radio activities.
2. **Encourage** the development of new technologies to support this research.
3. **Provide** educational opportunities for the amateur radio community and the general public.

Large citizen science community organized through e-mail lists, regular telecons, and the annual HamSci workshop. See <https://hamsci.org/get-involved>.

What are the science goals we are after?

Broadly, we are interested in any scientific question of interest to the amateur radio community or to the field of space physics. Examples include:

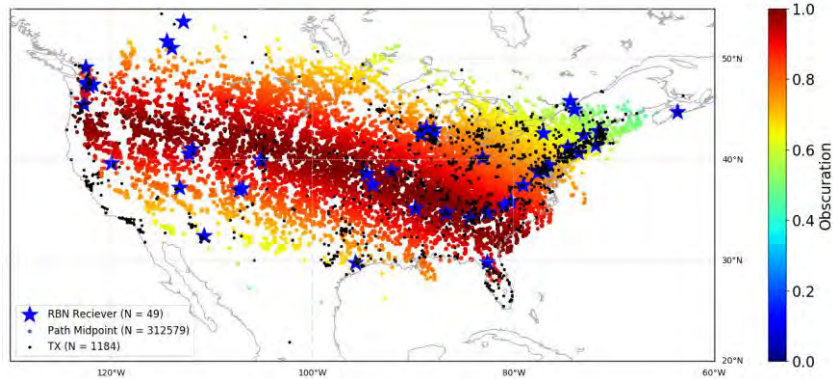
- Solar Flare Impacts
- Geomagnetic/Ionospheric Storms
- Internal Ionospheric Electrodynamics
- Short time scale/small spatial scale ionospheric variability
- Connections with Lower Atmosphere



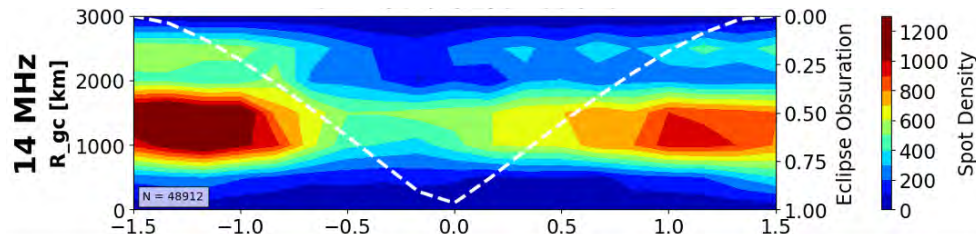
NASA SDO Observation of X9.3 Solar Flare on Sept 6, 2017. Flares such as this one can cause HF radio blackouts.

2017 Solar Eclipse QSO Party

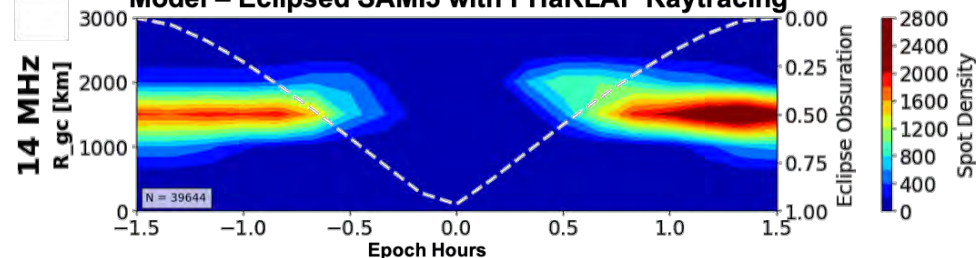
RBN Amateur Radio Observations



RBN Amateur Radio Observations

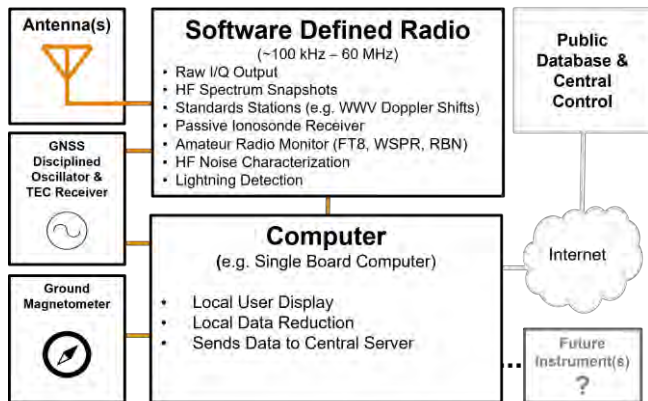


Model – Eclipsed SAMI3 with PHaRLAP Raytracing



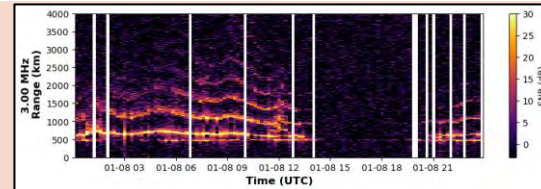
[Frissell et al., 2018, <https://doi.org/10.1029/2018GL077324>]

Personal Space Weather Station



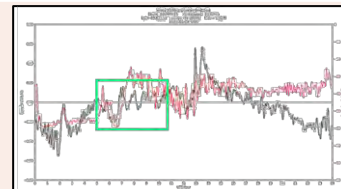
TangerineSDR

WA2DFI, N5EG, N8UR, KV0S, AB4EJ, N1HAC, AA8K, N4XWE, W2NAF, KC3PVE, W1PJE, Juha Vierinen, et al.



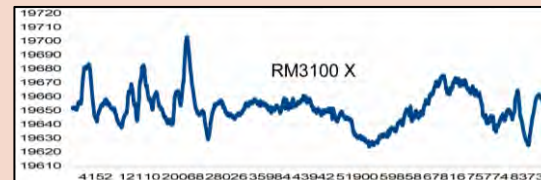
Grape PSWS

KD8OXT, AD8Y, N8OBJ, KB3UMD, WA5FRF, KD2UHN, NQ6Z, AB4EJ, W2NAF, K4BSE, KD8CGH, W7LUX, KE8QEP, et al.



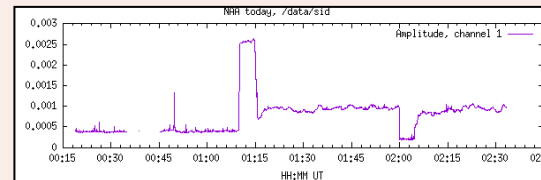
Magnetometer Module

KD0EAG, K2KGJ, KD2MCR, KE8QEP, WA2DFI, KV0S, W2NAF, et al.



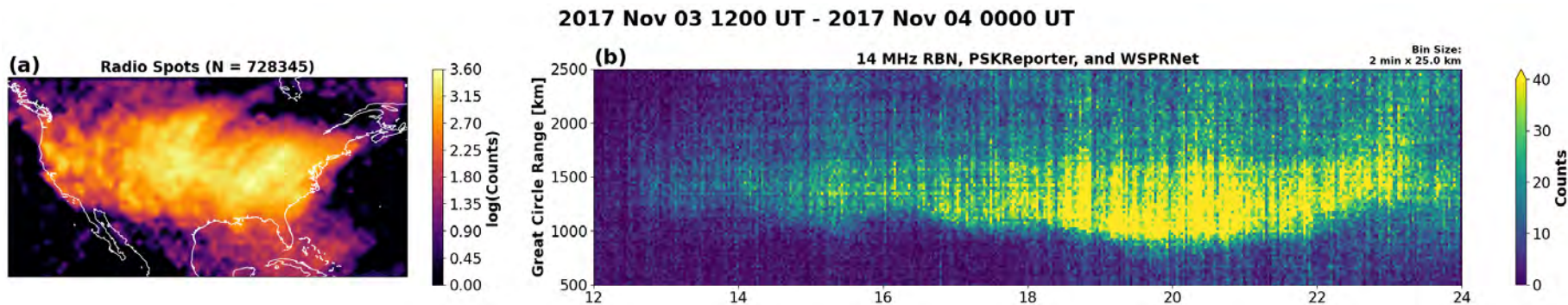
VLF RX

KC3EEY, WA2DFI, N5EG, N1HAC, et al.



TIDs as a Frontier Research Topic

- Traveling Ionospheric Disturbances (TIDs) both affect HF radio propagation **and** are a key to understanding the relationship between the ionosphere, the lower atmosphere, and space.
- From an operational perspective, there are few (if any) TID predictive models in the unclassified domain that can be effectively used.
- From a science perspective, a properly developed empirical TID model can aid in identifying which physics drivers of TIDs are most important.



TID Studies: NASA SWO2R & NSF CAREER

NASA SWO2R (2 years, 2021-2023)

Enabling Space Weather Research with Global Scale Amateur Radio Datasets

PI: N. Frissell W2NAF, Co-Is: T. Atkison, W. Engelke AB4EJ, and P. Erickson W1PJE

- Development of automated TID detection and parameter extraction algorithms.
- Develop empirical TID models that use geophysical indices as independent variables and model the probability of TID occurrence signatures in terrestrial HF communications.
- Validate models for the 7 and 14 MHz bands in the continental US and mainland Europe.
- Deposit RBN/PSKReporter/WSPRNet data into public NASA data repositories.



NSF CAREER (5 years, 2021-2026)

CAREER: Amateur Radio as a Tool for Studying Traveling Ionospheric Disturbances and Atmosphere-Ionosphere Coupling

PI: N. Frissell W2NAF

- Identify the amount of TIDs observed by HF communications systems that are and are not associated with geomagnetic activity.
- Determine the ability of data from amateur radio to fill TID observational gaps and be scientifically useful.
- Establish TID longitudinal dependence on the 2D stratospheric polar vortex configuration.
- Test the multistep vertical coupling paradigm of AGWs/TIDs theorized in the latest physics-based models.



Other HamSCI or Community Projects

- **Festivals of Frequency Measurement** (KD8OXT, AD8Y)
- **WWV Modulation Experiment** (KD8OXT, AD8Y, WA5FRF, NQ6Z, W0DAS, N0RGT, et al...)
- **WSPRDaemon / WSPRNet Noise and Propagation Studies** (AI6VN and G3ZIL)
- **Simulation and Comparison of Weak-Signal VHF Propagation** (KE8KCT and Kate Duncan)
- **e-POP RRI Observations of the ARRL FMTs** (KD2SAK et al.)
- **40 m Trans-Pacific Propagation Studies** (N6NC et al.)

and many more...



The screenshot shows the HamSCI website with the following content:

- Navigation:** About, Projects, Get Involved, People, Resources, Data, Meetings, Publications and Presentations.
- Header Image:** Silhouettes of people at a radio station with the text "HamSCI: Ham Radio Science Citizen Investigation".
- Project Description:** "Ham Radio Science Citizen Investigation" with three bullet points:
 - Advance scientific research and understanding through amateur radio activities.
 - Encourage the development of new technologies to support this research.
 - Provide educational opportunities for the amateur community and the general public.
- Quick Links:**
 - Personal Space Weather Station
 - Eclipse and Frequency Measurement Festivals
 - 2021 HamSCI Workshop
- Main Article:** "40th annual ARRL and TAPR Digital Communications Conference (DCC) Call for Papers"
 - Wednesday, July 14, 2021 - 08:30
 - Submitted 2 months 5 hours ago by w2nrf
 - The 40th annual ARRL and TAPR Digital Communications Conference (DCC) will take place September 17-18, 2021. Due to the coronavirus pandemic, this year's conference will be held online. Registered DCC attendees participating via Zoom will be able to interact with presenters and other attendees via a chat room as well as raise a virtual hand to ask questions. Click here to register (you don't need a Zoom account to register). Non-registered DCC attendees can watch the live stream for free on YouTube and can chat and ask questions via the moderator monitoring the channel. No registration is required for YouTube access (the YouTube URL will be announced and posted on this webpage preceding the DCC). DCC registration is free for TAPR members and \$30 for non-members. Members receive a 100% discount at checkout. Click here to register. Non-members who would like to join TAPR and receive the free DCC pass can simply add TAPR membership and DCC registration to their shopping carts. After checkout, they will receive the free DCC pass when their membership is processed.
 - Call for Papers and Speakers: Technical papers are being solicited for presentation. Papers will also be published in the Conference Proceedings. Authors do not need to participate in the conference to have their papers included in the Proceedings. The submission deadline is August 15, 2020. Submit papers via email to Maty Weisberg, K8ITL: maty@arrl.org. Papers will be published exactly as submitted, and authors will retain all rights.
 - [Read more](#)

HamSCI Google Group

- The HamSCI Google Group now has over 450 members!
- Join by visiting <https://hamsci.org/get-involved>
- Open discussion for all things related to HamSCI.

Get Involved | HamSCI

hamsci.org/get-involved

HamSCI About Projects **Get Involved** People Resources Data Meetings Publications and Presentations

Get Involved

HamSCI Stations

HamSCI works with scientists and radio amateurs around the world to collect data.

HamSCI Google Group

Participate in the HamSCI Community by joining the **HamSCI Google Group**. The HamSCI Google Group is an e-mail discussion forum to facilitate communication between hams, the professional space and atmospheric science communities, and anyone else interested. When requesting to join, please include some information about who you are and why you would like to join. Participation is governed by the **HamSCI Community Participation Guidelines**. This group is moderated by Nathaniel Frissell W2NAF, Kristina Collins KD8OXT, and David Kazdan AD8Y. Questions may be directed to hamsci@hamsci.org.

[Visit the HamSCI Google Group](#)

TangerineSDR TAPR Listserv

The TangerineSDR listserv is run by TAPR and directly supports the engineering work for the SDR-based HamSCI Personal Space Weather Station. This listserv is more engineering focused than the HamSCI Google Group, which is more science-focused. Visit <https://tangerinesdr.com/> to join this listserv.

HamSCI Zoom Telecons

TangerineSDR Telecon



Engineering telecon to support the TangerineSDR and magnetometer board development.

Mondays at 9 PM Eastern

Grape Telecon



Telecon to support engineering and science related to the Grape (low-cost) Personal Space Weather Station.

Thursdays at 10 AM Eastern

HamSCI Telecon



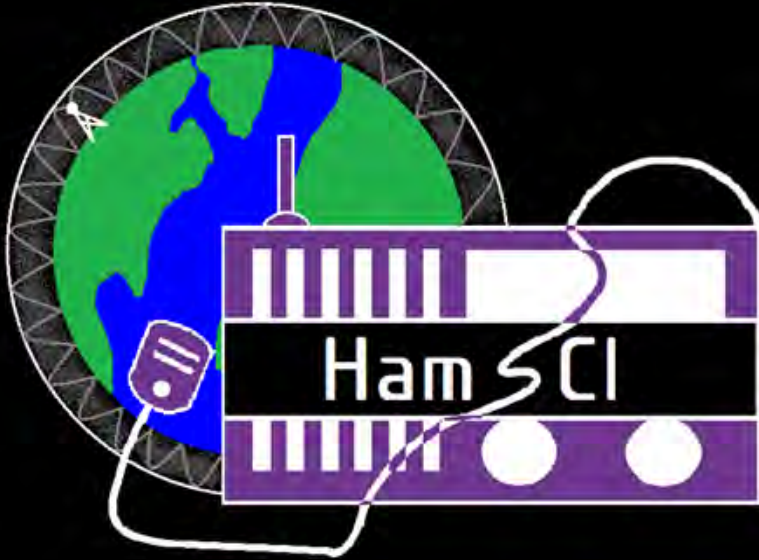
Science-focused telecon open to all HamSCI topics.

Every other Thursday at 3 PM Eastern during the academic year

Zoom links and calendar at <http://hamsci.org/get-involved>.

HamSCI Workshop 2022 – Hopefully in person!

HamSCI Workshop 2022



Scranton, PA
March 18-19, 2022

We welcome papers related to:

- Development of the PSWS
- Ionospheric Science
- Atmospheric Science
- Radio Science
- Space Weather
- Radio Astronomy

Theme: The Weather Connection

Watch hamsci.org/hamsci2022 and
ARRL news for details.

Acknowledgments

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- support of NSF Grants AGS-2002278, AGS-1932997, AGS-1932972, and AGS-2045755.
- support of the NASA SWO2R and Citizen Science Programs.
- support of Amateur Radio Digital Communication (ARDC).
- amateur radio community volunteers who have contributed to HamSCI projects.
- amateur radio community who voluntarily produced and provided the HF radio observations used in this paper, especially the operators of the Reverse Beacon Network (RBN, reversebeacon.net), the Weak Signal Propagation Reporting Network (WSPRNet, wspnnet.org), PSKReporter (pskreporter.info) qrz.com, and hamcall.net.
- use of the Free Open Source Software projects used in this analysis: Ubuntu Linux, python (van Rossum, 1995), matplotlib (Hunter, 2007), NumPy (Oliphant, 2007), SciPy (Jones et al., 2001), pandas (McKinney, 2010), xarray (Hoyer & Hamman, 2017), iPython (Pérez & Granger, 2007), and others (e.g., Millman & Aivazis, 2011).

Thank You!
