

This annual event brings together the amateur radio community and professional scientists.

# A Synopsis of the 2021 HamSCI Virtual Workshop

## What Is HamSCI?

Following the long tradition of amateur radio's support of scientific research, HamSCI (Ham Radio Science Citizen Investigation) promotes projects such as the Solar Eclipse QSO Party and development of the Personal Space Weather Station. The HamSCI community fosters collaboration between professional researchers and hams. It doesn't own or manage projects, but assists in developing standards and agreements with the following objectives:

- ✓ 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

In June of this year, hams worldwide helped assess the effects of a solar eclipse in the Arctic by making frequency measurements during the event (<https://hamsci.org/june-2021-eclipse-festival-frequency-measurement>)

If you're interested in radio-related science and assisting research in ways unique to amateur radio, read about the HamSCI Google Group at <https://hamsci.org/get-involved>.

## Phil Erickson, W1PJE

This year's HamSCI Workshop was held on March 19 and 20, 2021, via Zoom. The event was managed by Dr. Nathaniel A. Frissell, W2NAF, of The University of Scranton, as well as many other team members, and included guest speakers, poster presentations, and demonstrations.

## The Theme

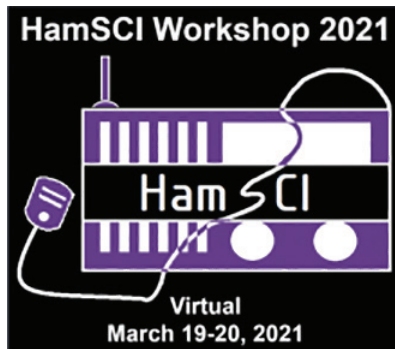
The event theme was "midlatitude ionospheric science." Ionospheric scientists conduct studies on variations in the charged part of Earth's upper atmosphere, which includes the same electrons that refract HF radio signals used by amateur radio operators worldwide. The midlatitude portion of the ionosphere is roughly located between 30° and 60° magnetic latitude, where the vast majority of radio amateurs operate, and covers the entire continental US. The midlatitude ionosphere has historically been considered less "active" than the high-latitude auroral regions, or the low-latitude equatorial zone, and has received less scientific attention. However, the bulk of humanity lives at these latitudes, and major vulnerabilities to space weather disturbances are found there. These are increasingly vital to understand in today's communication-dependent society. Some of these disturbances, such as fading and multipath propagation, will be well-known effects to radio amateurs operating HF communications links.

## Speakers and Presentations

A review of midlatitude ionospheric physics was given by Dr. J. Michael Ruohoniemi of Virginia Polytechnic Institute and State University (Virginia Tech), which involved some unresolved scientific questions on the midlatitude ionosphere's behavior. He discussed how the amateur radio community can contribute to advancing scientific understanding and technical capabilities. Dr. Ruohoniemi runs several National Science Foundation-sponsored radars within the Super Dual Auroral Radar Network (SuperDARN), an international scientific initiative. This initiative studies the ionosphere at midlatitudes and polar regions using more than 30 low-power HF radars.

Joe Dzekevich, K1YOW, presented "Amateur Radio Observations and the Science of Midlatitude Sporadic E." He looked at the effects of terrestrial tropospheric weather on propagation, showing how disturbances in the troposphere and gradients in the jet stream can create atmospheric gravity waves in the lower atmosphere. These can aid in the formation of sporadic-E propagation, such as we experienced during 2021 Field Day. (Read "Upper-Level Lows and 6-Meter Sporadic E," by Joe Dzekevich, K1YOW, in the December 2017 issue of *QST* for more information.)

The workshop's keynote address on the history of radio was given by Dr. Elizabeth Bruton of the Science Museum in London, England. She discussed the history, science, technology, and licensing of radio amateur communities from the early 1900s to the present. Dr. Bruton also explored how individuals and communities contributed to "citizen science" long before the term entered popular usage in the 1990s.



Twenty-nine poster sessions covered a variety of amateur radio-related topics. A full list of these sessions can be found at <https://hamsci.org/hamsci-2021-program>. Kristina Collins, KD8OXT, described frequency measurements made by amateurs during a solar eclipse in December 2020. Other posters covered The Great Collegiate Shortwave Listening Contest by discussing *WSPRnet* (Weak Signal Propagation Reporter) to characterize sporadic-E propagation, open-source HF propagation prediction tools, geocaching in the ionosphere, and enhancing NASA's Radio JOVE project, as well as a history of antenna technology at Arecibo Observatory, presented by Jim Breakall, WA3FET.

Virtual oral presentations were given by researchers from the NASA Goddard Space Flight Center, MIT Haystack Observatory, University of Oslo, University of Bath, Case Western Reserve University, Dartmouth College, The University of Alabama, Clemson University, New Jersey Institute of Technology, The University of Scranton, and others.

All of the presentations, including video recordings of the speakers, are available at <http://hamsci.org/hamsci-2021-program>. Publications from the 2018, 2019, and 2020 workshops are available at <https://hamsci.org/meetings>.

## HamSCI Personal Space Weather Station

The HamSCI workshop also served as a team meeting for the HamSCI Personal Space Weather Station project ([www.hamsci.org/psws](http://www.hamsci.org/psws)). This project seeks to harness the power of a carefully designed amateur radio network of software-defined radio (SDR) receivers and other instruments to better understand and measure the upper levels of Earth's atmosphere.

This project is a joint venture between HamSCI and other entities, including Case Western Reserve University, The University of Alabama, and the Tucson

Amateur Packet Radio (TAPR) collective, a non-profit organization of operators who are interested in advancing the state of the art of radio. TAPR (<https://tapr.org>) is leading hardware and software design, implementation, and testing.

For the scientific community, the project intends to produce precise measurements that are time-tagged by UTC-synchronized clocks to measure propagation, signal variations,

frequency broadening, and related subjects. HamSCI will process and study this information, which will also be used in scientific publications and existing worldwide professional scientific networks of instruments, providing much more information on the ionosphere than can be determined from any individual measurement system.

For the amateur radio community, plans include developing monitors of radio propagation in a long-term and real-time sense that can help operators determine the best bands and modes for regional and DX communications from their own location.

## Making a Difference with Radio

Ham radio benefits from the improved understanding of phenomena like sporadic-E propagation, aurora, and how space weather affects the geomagnetic field's stability. Science benefits in return, as thousands of hams collect useful data used in geophysics research programs at universities and other institutions.

As part of amateur radio's "Basis and purpose" in FCC Part §97.1, HamSCI is a great way for amateur radio operators to "advance the radio art" by creating innovative systems and conducting experiments. In the process, we learn more about the physical world and radio propagation, which we use on the air every day.

Phil Erickson, W1PJE, is an Amateur Extra-class licensee; an Associate Director at MIT Haystack Observatory; a member of ARRL, Tucson Amateur Packet Radio (TAPR), and the Radio Society of Great Britain (RSGB), and is Vice President of the Nashoba Valley Amateur Radio Club in Pepperell, Massachusetts. He leads the Atmospheric and Geospace Sciences Group at MIT Haystack Observatory for studies of the ionosphere, neutral atmosphere, and other aspects of near-Earth space. Phil is also on the science steering board for the HamSCI amateur-professional scientific collective. He enjoys all aspects of radio propagation and communication. Phil can be reached at [w1pje@arrl.net](mailto:w1pje@arrl.net).

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