AMATEUR RADIO: AN INTEGRAL TOOL IN MAGNETOSPHERIC AND ITM PHYSICS RESEARCH

N. A. Frissell[1], P. J. Erickson[2], K. V. Collins[3], G. W. Perry[4], S. R. Kaeppler[5], W. D. Engelke[6], and W. Liles[7]. [1]The University of Scranton, Scranton, PA, nathaniel.frissell@scranton.edu [2]Haystack Observatory, Massachusetts Institute of Technology, Westford, MA [3]Case Western Reserve University, Cleveland, OH [4]New Jersey Institute of Technology, Newark, NJ [5]Clemson University, Clemson, SC, [6]University of Alabama, Tuscaloosa, AL [7]HamSCI Community, Scranton, PA

Introduction: Amateur radio is pursued by a wide spectrum citizen audience including radio communicators, engineers, and scientists, with over 3 million licensed operators worldwide. This community routinely utilizes communications systems directly affected by ITM and magnetospheric processes, and its activities can make global-scale measurements critical to the advancement of this scientific field. The infrastructure for these measurements falls into two broad categories: amateur radio observing networks developed for amateur radio use, and citizen science instrumentation purpose-built for space science applications.

Amateur Radio Observing Networks*:* Since 2008, the amateur radio community has voluntarily built and operated multiple systems capable of making real-time observations of medium frequency (MF, 300 kHz – 3 MHz) and high frequency (HF, 3-30 MHz) amateur communications on a global scale and archiving these observations to central databases. These systems include the Reverse Beacon Network (RBN), Weak Signal Propagation Reporter Network (WSPRNet), and PSKReporter. Communications on these frequencies typically propagate via long-distance paths through the ionosphere and may be modulated by ionospheric processes and the coupled magnetospheric ITM systems. Data from these systems have already been used to study the global-scale ionospheric impacts of solar flares and geomagnetic storms [1] and solar eclipses [2]. Most recently, it has been demonstrated that these systems effectively observe traveling ionospheric disturbances (TIDs), paving the way for future large-scale statistical studies [3].

Purpose-Built Citizen Science Instrumentation: In order to obtain higher-quality and more diverse space physics measurements from the amateur radio community, radio capture systems specifically engineered for science applications are also useful. In this area, the Ham Radio Science Citizen Investigation (HamSCI) is developing the Personal Space Weather Station (PSWS) [4]. The PSWS is a ground-based, modular, multi-instrument system that includes a HF radio receiver instrument, GNSS TEC receiver and precision time and frequency reference, and ground magnetometer. The system is being designed with a cost point so that it can be owned by interested individuals to encourage wide-spread adoption and thereby provide high geospatial sampling from the network. The system relies on signals of opportunity, including those from NIST-operated standards stations WWV and WWVH [5], government-run chirp ionosondes [6], Coastal Ocean Radars (CODARs), and more.

Summary: Amateur radio has already proven itself as a viable resource for data driven space physics investigations. Amateur radio networks and efforts can provide an important set of global-scale measurements that can not only operate on their own but also jointly work alongside existing professional networks to greatly improve the geospatial and temporal observational coverage of the currently undersampled global ionosphere. When added to information provided by incoherent scatter radars (ISRs), SuperDARN, GNSS TEC networks, and ionosondes, amateur radio instrumentation will play an integral role in advancing magnetospheric and ITM science.

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