The Simpson Neutron Monitor Network. S. Seunarine[1], [1]Department of Physics, University of Wisconsin-River Falls, 410 S. 3rd Street, River Falls, WI 54022 (surujhdeo.seunarine@uwrf.edu).

Introduction: Cosmic rays arrive at Earth carrying information on the large-scale structure of the heliosphere, local space environment and solar activity. Cosmic rays with enough energy to initiate a particle air shower carry some of that information to ground level. A neutron monitor is a ground-based particle detector, designed to record the nucleonic component in these showers, typically the ones initiated by Galactic cosmic rays and solar energetic particles interacting in the Earth's atmosphere [1]. Because of the relatively large detector volume achieved by ground-based stations, neutron monitors remain the state-of-the-art instrumentation for measuring >1GV cosmic rays. The energy threshold for producing the nucleonic component is lower than that for the muonic component and it reflects the range of energies affected by solar and heliospheric phenomena. Worldwide, neutron monitors have been operated for seven decades, with stations strategically located to provide complementary data based on local rigidity cutoffs. The rich data set, spanning multiple decades, provide information on cosmic ray modulation over many solar cycles. Viewed as a network [2] the collection of neutron monitors provide data required for spectral and anisotropy studies.

The US owned and operated neutron monitor network, Figure 1, now called the Simpson Neutron Monitor Network in honor of its inventor John Simpson, is operated and maintained by the Universities of New Hampshire, Delaware and Wisconsin-River Falls. A goal of the project is to place the US stations under one umbrella for a comprehensive system of neutron monitors covering the United States, Canada, Antarctica, and Greenland, which will more effectively address science goals and operations needs.

Science Goals: The Simpson Neutron Monitor Network scientists and their international collaborators are pursuing multiple science goals:

1) Extending the science capabilities of a neutron monitor station through the development of electronics that measures time delays between neutron detections of a full array of proportional tubes in a neutron monitor. It has been shown that this data provides primary spectral information from a single station [4].

2) Implement a Forbush Decrease and Interplanetary Magnetic Field prediction model for Interplanetary Corona Mass Ejections and Geomagnetic Storms.

3) Throughout the prolonged deep solar minima of the past two solar cycles, the GCR intensity reached record high levels at Earth. We will examine data from long-
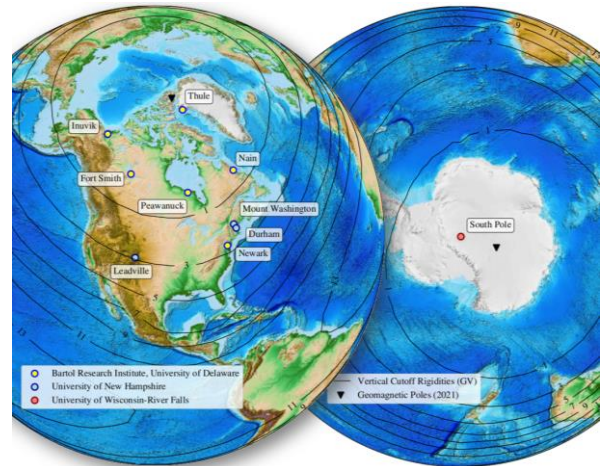

Figure 1: Stations in the Simpson Neutron Monitor Network. Details on each station and real-time data can be found at the Neutron Monitor Database [3]

running neutron monitors and other sources to evaluate the GCR intensity and consequent ground-level rates during these epochs.

4) Understand and model the transport of solar energetic particles from their release point to 1 AU using the anisotropy behavior of well-connected Ground Level Enhancements.

5) Investigate the spectra and composition of Solar Energetic Particles using co-located instruments with different yield functions.

Broader Impacts Targets: The data product from the Simpson Neutron Monitor Network is valuable to a diverse community of users. They provide real time data for radiation dosimetry at aircraft altitudes and serve national space weather objectives including a variety if interests in the impacts of cosmic radiation on human activity and infrastructure.

References: [1] Simpson, J. A. (2000) Space Science Reviews, 93, 11–32. [2] Moraal, H. et al (2000) Space Science Reviews 93, 285–303. [3] https://www.nmdb.eu/station/usa/ [4] Evenson, P. et al (2001) PoS, ICRC2021, 1240