e-POP RRI radio science during the August 21, 2017 eclipse
USNC-URSI National Radio Science Meeting

Gareth W. Perry[(1)*], Paul A. Bernhardt[(2)], Robert A. Farrow[(3)], H. Gordon James[(1)], Andrew D. Howarth[(1)], and Andrew W. Yau[(1)]
(1) University of Calgary, Calgary, Alberta, Canada
(2) Naval Research Laboratory, Washington, D.C., USA
(3) Non-affiliated

We present the results of the Enhanced Polar Outflow Probe (e-POP) Radio Receiver Instrument (RRI) radio science experiment that was performed during the August 21, 2017 eclipse. e-POP RRI, on board the CAScade, Smallsat and Ionospheric Polar Explorer (CASSIOPE), is a digital receiver designed to study natural and artificial radio emissions between 10 Hz and 18 MHz.

CASSIOPE transited the path of totality of the August 21, 2017 eclipse approximately 9 minutes and 45 seconds after totality just east of Boise, Idaho. The spacecraft was moving along a north-to-south track at an altitude of approximately 650 km. RRI was operated in a crossed-dipole configuration and tuned to 14.2 MHz to record a transmitter located under the path of totality at Ammon, Idaho (43.57°N, -111.96°E, geographic). Subsequent to the eclipse, additional southbound baseline passes were performed for similar CASSIOPE tracks and identical RRI and HF transmitter settings from September 1 to 6, 2017.

During the eclipse, while CASSIOPE was north of 65° geographic latitude, the transmissions originating from Ammon and received by RRI were clear and coherent. However, while CASSIOPE was at the same latitudes during the subsequent baseline passes, Ammon's signal was significantly distorted and dissipated. For latitudes south of the path of totality, Ammon's transmissions were clear and relatively unperturbed as far south as 25° geographic latitude for the eclipse and baseline measurements.

RRI's data support the notion that a substantive density asymmetry in the meridian plane of the HF propagation conditions was generated by the eclipse. During the eclipse the critical frequency of the ionosphere coincident with the path of totality decreased, altering the northbound propagation characteristics. This allowed for Ammon's transmissions to be received by RRI unperturbed. The southbound propagation conditions during the eclipse and baseline conjunctions do not show such disparate characteristics between eclipse and non-eclipse conditions, however.

In addition to presenting these results, we will discuss the signatures of the eclipse on the Faraday rotation of Ammon's transmissions and present the results of ray tracing simulations to provide context and further insight into the effect of the

eclipse on the ionosphere and HF radio wave propagations in the North American sector.