High power HF radio waves interacting with the ionosphere provide aeronomers with a unique space-based laboratory capability. Operating ground transmitters in conjunction with satellite detection allows novel measurements not previously attempted. The Enhanced Polar Outlfow Probe (e-POP) suite of instruments and particularly the ePOP Radio Receiver Instrument (RRI) on board the Canadian CASSIOPE satellite offer a unique combination diagnostics appropriate for studying linear and non-linear plasma effects generated high-power HF waves in the ionosphere.

The first Arecibo Observatory (AO) HF heating experiments were conducted during the second week of November 2015. At the end of the campaign e-POP's orbit was conducive to receiving the signal from 5.125 MHz AO HF facility (co-located with the 430 MHz incoherent scatter radar). The HF transmitters were used to broadcast an FMCW chirp waveform. Two nights of data were collected; each pass was approximately five minutes in duration. The data collected from e-POP were analyzed using over-the-horizon radar techniques to produce range and Doppler positions for the CASSIOPE satellite.

The first results from this novel dataset are presented. These data were first used to provide a highly accurate measurement of the antenna pattern produced by the 305 meter Arecibo main dish. The transmitted waveform was recorded at both the Arecibo control room and by the RRI. These dual measurements provide an insight for how the ionosphere distorts the signal through received phase and time delays. Additionally, the recorded e-POP signals provide an opportunity to study non linear wave propagation and scattering effects seen at Arecibo and other HF heating facilities.

This research is sponsored by the NRL 6.1 base program.