LONG-DISTANCE DETECTION OF ELF WAVES GENERATED VIA MODULATED HF HEATING OF THE AURORAL ELECTROJET

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The High-frequency Active Auroral Research Program (HAARP) HF transmitter in Gakona, Alaska robustly generates electromagnetic ELF/VLF signals via modulated heating of the lower ionosphere. ELF/VLF signals produced in this manner propagate to large distances in the Earth-ionosphere waveguide with relatively low attenuation. Between 0800 and 1200 UT on February 11, 2005, the HAARP HF transmitter modulated the auroral electrojet currents, generating ELF waves alternately at 575 and 2125 Hz, each for 60 minutes at a time. Each of the ELF signals produced were detected at an ELF/VLF receiver 35 km from the HAARP facility. The ELF/VLF receiver at Midway Atoll, located in the middle of the Pacific Ocean at a distance of 4500 km from the HAARP facility, detected the 2125 Hz transmission between 1100 and 1200 UT. This 4500 km ground distance separation between the ELF signal source and the receiver constitutes the largest distance at which HAARP-generated ELF/VLF waves have been detected to date. In this paper, we quantitatively assess the characteristics of the ELF/VLF source region using an Earth-ionosphere waveguide propagation model with realistic electromagnetic parameters together with the observed properties of the ELF signals detected both in the near field and in the far field. Near field measurements are used to calculate the relative excitation magnitudes and phases of a set of effective Hall and Pedersen dipoles, the radiation from which is shown to be consistent with far field observations for radiated power levels on the order of several tens of Watts. In addition, our results suggest that a single dipole located between 60 and 85 km altitude cannot accurately model the polarization ellipse observed in the far field at Midway Atoll, despite the 4500 km distance between the signal source and the receiver. This observation underscores the importance of the Earth-ionosphere waveguide mode-excitation process as it relates to a distributed body of radiating currents such as that present above the HAARP HF heater array.

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2. G - Ionospheric Radio and Propagation

3. (a) S-G/H1

4. C - Contributed Paper, Program chair: Paul Bernhardt and Wayne Scales

5. This paper belongs among other HAARP-related active experimental papers. I beleive S-G/H1 is the correct session. Please move me if I am wrong.