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Transmission of Waves from a High-Frequency Ionospheric Heater to the Topside Ionosphere

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In the first year of operation of the ePOP instruments on the Canadian small satellite CASSIOPE, a number of passes were recorded during which the Radio Receiver Instrument (RRI) measured radiation from powerful high-frequency ground transmitters that act as ionospheric heaters. In the case of measurements of transionospheric propagation from the Sura heating facility in Russia, located at 56.15°N, 46.10°E, RRI reception of heater waves was accompanied by the operation of the trifrequency Coherent Electromagnetic Radio Tomography (CERTO) beacon on the satellite radiating at 150, 400 and 1067 MHz. CERTO waves, detected at three ground receivers near Sura, allowed total electron content to be measured continuously along the three different paths between CASSIOPE and the three ground sites. Subsequent tomographic processing provided the ionospheric electron density distribution as a function of latitude and altitude. With this density model tool in hand, ray-tracing was applied to the prediction at the spacecraft of various properties of the HF waves from the Sura heater. When compared with the observations, the predictions validate the relevance of geometric-optics principles in transionospheric propagation.

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