

SIMULTANEOUS DUCTING OF SLOW-Z-MODE WAVES NEAR THE PLASMA FREQUENCY AND X-MODE IONOSPHERIC ECHOES

H.G. James

Communications Research Centre Canada, Ottawa ON K2H8S2, Canada; gordon.james@crc.ca

ABSTRACT

Comparatively strong, dispersed pulses were observed in the quasioleostatic Z mode during the OEDIPUS-C (OC) two-point propagation experiment. When surveys of these Z waves are aligned with histories of local density, measured two ways, and of X-mode ionospheric echoes, a strong positive correlation among these observables emerges at density depletions, assumed to be **B**-field aligned. The depletions lie in the range 6 to 25%, and have cross-field dimensions of a few kilometers. These ducts are similar in width to previous OC reports, albeit 10 times deeper. OEDIPUS confirms the tendency of the slow-Z mode to be ducted.

TEXT

Comparatively strong pulses were observed at frequencies f just above the plasma frequency f_p during the OEDIPUS-C (OC) two-point propagation experiment in the auroral ionosphere in 1995. The received pulses were highly distended with respect to the emitted 300- μ s pulses and had a range of delays up to at least 15 ms. The 1200-m separation of the transmitter and receiver was along a direction about 5° away from the Earth's magnetic field.

The waves are interpreted as quasioleostatic Z-mode propagation with dispersion surfaces close to those of the Langmuir solutions in wave-vector space, albeit at somewhat lower values of refractive index, of about 50. When mission-length surveys of the above Z waves are aligned with histories of f_p at the payload, measured two ways, and of the strength of X-mode ionospheric reflection echoes, a strong positive correlation among the observable set is found at localized relative depletions of the ambient density. Together these data are taken to manifest the effects of field-aligned density depletions. The magnitudes of the density depletions are found to lie in the range 6 to 25%, and to have cross-field dimensions of a few kilometers. In comparison with previous analyses of ionospheric echoes on OC [1], the present duct dimensions are of the same order as the previous ones, while the depletions are 10 times deeper.

The spectrum of the strong two-point Z-mode transmission is like that recorded at similar f , f_p , and f_c values in the OEDIPUS-A experiment in 1989 [2]. That experiment showed that slow-Z mode propagation was strongly ducted over a 900-m path between an HF emitter and its synchronized receiver. The OEDIPUS results confirm the propensity of slow-Z mode to be ducted. Establishing the parameters of ducts that guide Z-mode waves will aid future possible analyses of wave-growth mechanisms in inhomogeneous plasmas.

REFERENCES

- [1] H.G. James, "Ionospheric duct parameters from a dual-payload radio-frequency sounder", J. Geophys. Res., vol. 105, pp. 20,909-20,918, 2000.
- [2] H.G. James, "Guided Z mode propagation observed in the OEDIPUS-A tethered rocket experiment", J. Geophys. Res., vol. 96, pp. 17,865 - 17,878, 1991.