Accuracy of the RPI plasmaspheric electron density profiles

Xueqin Huang[1], Bodo W. Reinisch[1], Gary Sales[1], and James L. Green[2]
[1]University of Massachusetts Lowell Center for Atmospheric Research
600 Suffolk Street, Lowell MA 01854
[2]Goddard Space Flight Center, NASA

Profile inversion techniques have been developed to derive electron density profiles in the plasmasphere [Reinisch et al., GRL, 28, 1167, 2001] and the polar cap [Nsumei et al., JGR, in press, 2003] from echo traces on the plasmagrams recorded by the radio plasma imager (RPI) on the IMAGE satellite. Our analysis of the long-range discrete echo traces indicates propagation of the electromagnetic waves along the magnetic field line through the satellite location. This field-aligned propagation for frequencies above the electron plasma frequency could be caused by refraction and/or ducting due to field-aligned irregularities. To investigate which of these mechanisms dominates the guiding process, we are using ray-tracing techniques and simple duct shapes with adjustable parameters. The simulations are then compared with the discrete X-mode echo traces observed on the RPI plasmagrams, and the absence of O-mode echoes. If the refraction in a medium of changing electron density and magnetic field strength is the dominant guiding factor, the wave will be reflected at the location where the wave frequency equals the cutoff frequency of the magneto-plasma. If ducting is responsible for the field-aligned propagation, reflection will occur slightly before this location, depending on the percentage density enhancement of the duct walls. Results of these simulations and reference to the observed echoes will provide answers regarding the accuracy of the RPI electron density profiles, explain the observed field guidance, and, if applicable, determine the duct shape parameters.

1) Commission: G/H
Session: Remote Sensing from Space

2) New knowledge:
New ray-tracing program for the magnetosphere to simulate RPI observations

3) Relationship to previous work
a) Ray-tracing determines actual ray paths while previous work assumed field-aligned propagation
b) Objective is to explain the observed field-aligned propagation for $f > f_N$