Quarter Mode Waves at L˜3: Initial Results of Observations and Simulations

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We have examined the diurnal variation of the local toroidal field line eigenfrequency at L=3 using cross-phase analysis of SAMNET and MEASURE ground magnetometer array data. On several days the eigenfrequency was remarkably low near the dawn terminator, when one end of the field line was in a dark ionosphere and the other end in a sunlit ionosphere. Later in the morning the eigenfrequency gradually increased to the normal daytime value. This type of diurnal eigenfrequency variation was found in both European and American meridians, and in several seasons (March, June, and December). Ionospheric Pedersen conductivities calculated using the IRI95 model show pronounced asymmetry between both ends of the field line at times when the extraordinary low eigenfrequency events appeared. Our results therefore suggest that quarter-wavelength mode waves are generated when ionospheric conductivities are asymmetric, reverting to half-wavelength mode as the dawn terminator passes both conjugate points.

Ground-based magnetometer measurements of local toroidal field line eigenfrequencies are often inverted to infer plasma mass density in the magnetosphere by assuming half-wavelength mode standing field line oscillations. However, the field line eigenfrequency also depends the ionospheric Pedersen conductivity. In particular, we find that there is a threshold of interhemispheric conductivity ratio for the quarter-wavelength mode to be established. Our results therefore show that cross-phase techniques can detect quarter-wavelength mode waves, when the inferred mass density may be over-estimated.