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Three-dimensional ray tracing of VLF waves in an asymmetric magnetospheric environment containing a plasmaspheric plume

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A three dimensional ray tracing of whistler-mode chorus is performed in a realistic magnetosphere using the HOTRAY code. Millions of rays are launched with varying starting MLT (0000-1400) and L-shell (3.5-7.5), with varying initial wave frequency (0.1 fce -0.5 fce), and varying initial wave vector direction (covering all possible directions). Landau damping due to suprathermal electron is taken into account to evaluate ray life time. A variety of important propagation characteristics are revealed associated with azimuthal density gradients and a plasmaspheric plume. Specifically, whistler mode chorus originating from a broad region on the dayside can propagate into the plasmasphere. After entry into the plasmasphere, waves can propagate eastward in MLT and merge to form hiss. This explains how chorus generated on the dayside can contribute to plasmaspheric hiss in the dusk sector. A subset of waves entering the plasmasphere can even propagate globally onto the nightside. We also investigate the effects of varying the width of the plasmaspheric plume, which corresponds to different phases of a geomagnetic storm, on these global propagation characteristics of whistler-mode waves.