The Virtues of Parameterizing Plasmaspheric Hiss (And Other Inner Magnetosphere Wave Modes) by Plasmapause Location

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The terrestrial plasmasphere is filled with an incoherent superposition of whistler mode waves. This superposition is referred to as plasmaspheric hiss. Hiss is known to cause pitch angle scattering of electrons with energies from ~10 keV to ~1 MeV, often leading to the loss of these particles to the atmosphere. Electrons in this energy range act as a seed population for more energetic radiation belt electrons. Therefore, plasmaspheric hiss directly impacts radiation belt dynamics.

Hiss is a whistler-mode wave, and its growth and propagation characteristics depend strongly on plasma density. In the inner magnetosphere, this implies that the location of the plasmapause (often a steep density gradient) should strongly influence hiss wave power distributions.

Yet hiss wave power distributions are traditionally parameterized by geomagnetic indices and L-parameter in both observational studies and radiation belt simulations. This is problematic for accurate representation of hiss because the plasmaspheric density distribution is only statistically related to geomagnetic indices and L-parameter, with significant variance.

Using Van Allen Probes data, we find that parameterizing hiss wave power using: (a) the location of the plasmapause with respect to Earth; and (b) distance away from the plasmapause produces highly repeatable hiss wave power distributions with characteristics obscured by traditional parameterizations. Specifically: (1) the largest hiss wave power is localized to a narrow spatial region; (2) this peak power occurs at a consistent stand-off distance Earthward of the plasmapause.

We discuss these results, their implications for modeling radiation belt dynamics, and the results of applying similar plasmasphere parameterizations to other inner magnetospheric wave modes.