Comprehensive Observations of Substorm-Enhanced Plasmaspheric Hiss Generation, Propagation, and Dissipation

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Plasmaspheric hiss is an important whistler-mode emission shaping the Van Allen radiation belt environment. How the plasmaspheric hiss waves are generated, propagate, and dissipate remains under intense debate. With the five spacecraft of Van Allen Probes, Exploration of energization and Radiation in Geospace (Arase), and Geostationary Operational Environmental Satellites missions at widely spaced locations, we present here the first comprehensive observations of hiss waves growing from the substorm-injected electron instability, spreading within the plasmasphere, and dissipating over a large spatial scale. During substorms, hot electrons were injected energy-dispersively into the plasmasphere near the dawnside and, probably through a combination of linear and nonlinear cyclotron resonances, generated whistler-mode waves with globally drifting frequencies. These waves were able to propagate from the dawnside to the noonside, with the frequency-drifting feature retained. Approximately 5 hr of magnetic local time away from the source region in the dayside sector, the wave power was dissipated to e^{-4} of its original level.

Keywords: Plasmaspheric Hiss, Radiation Belt, Plasmasphere, Wave Generation, Wave Propagation, Wave Dissipation

