Propagation characteristics of ionospheric hiss waves

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The plasmaspheric hiss is a structureless, broadband whistler mode emission in the frequency range of ∼100 Hz to ∼2 kHz. It is generally confined to the plasmashpere and plume regions at all magnetic local times and latitudes. The intensity of plasmashperic hiss is stronger at the dayside and the primary embryonic source of the plasmaspheric hiss is lower band chorus generated outside the plasmasphere. A portion of the plasmaspheric hiss can propagate down to the ionosphere and evolve into the low-altitude ionospheric hiss in the frequency range of ∼100 Hz to ∼1 kHz, which has been observed by Freja and DEMETER spacecraft.

In this study, we use nearly 6 years observations of DEMETER satellite to undertake a statistic study of the dependence of ionospheric hiss wave power on locations (in geomagnetic coordinates, including the South Atlantic Anomaly (SAA) region), local times (dayside and nightside), geomagnetic activity levels and seasons. The conclusion of the statistic study are: 1. The low altitude ionospheric hiss power is stronger at the dayside (same as plasmaspheric hiss), higher geomagnetic activity condition and local summer than local winter. 2. The wave power is confined near the region where the local proton cyclotron frequency f_{CH} is near the wave frequency.

To learn the mechanism of frequency-location dependence of ionosphreic hiss power, we choose a representative event near the SAA region to study the detailed wave propagation features. The intense hiss wave power concentrates over a narrow frequency band that decreases from about ∼600 Hz at the high latitude region to ∼300 Hz near the equator, which coincides to the variation of local proton cyclotron frequency f_{CH}. The waveform measurement shows that the wave propagates obliquely to the background magnetic filed and equatorward from high latitude region. This propagation mechanism has been explained as waveguide formed by the cut off frequency f_{cutoff} (nearly equal to the local f_{CH} in near the Demeter altitude) and the ionospheric particle density peak in Chen et al. [2017]. A ray tracing simulation has reproduced such wave propagation: the plasmaspheric hiss propagates down to the ionosphere at the high latitude region, and then is trapped in the waveguide and propagate to the equator with wave frequency near local f_{CH}.