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Earth’s radiation belts contain highly energetic electrons whose flux varies due to varying acceleration and loss processes. These dynamics are strongly influenced by wave-particle interactions in the magnetosphere, which regulate how electrons gain or lose energy. Plasma density is a key parameter controlling these interactions because it affects wave propagation, wave growth, and resonance conditions between waves and energetic electrons. However, plasma density measurements remain incomplete in many regions of the radiation belts, limiting our ability to fully characterize these processes. In this study, we use observations from the Van Allen Probes to investigate plasma density conditions across Earth’s radiation belts. Electron density is derived using measurements from the EMFISIS instrument, which provides the upper hybrid resonance frequency. From this quantity we determine the electron plasma frequency (fpe) and calculate the ratio fpe/fce, where fce is the electron cyclotron frequency determined by the local magnetic field strength. This ratio provides a measure of the plasma environment that regulates wave-particle interactions. We map the spatial distribution of fpe/fce throughout the magnetosphere by binning observations across L-shell and Magnetic Local Time (MLT). Polar occurrence maps are generated to examine the prevalence of different ratio ranges and identify regions with distinct plasma density regimes. Preliminary results reveal clear spatial variations in plasma density across L-shell and MLT, with certain regions exhibiting higher fpe/fce values corresponding to higher plasma density environments. These results provide insight into the plasma conditions that regulate wave-particle interactions in the radiation belts and help identify regions where electron acceleration or loss processes may be most effective. Improved characterization of plasma density distributions contributes to a better understanding of the physical mechanisms governing radiation belt variability.
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