
Wave-particle interactions in the radiation belts

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Résumé

In this talk, we first discuss the coupling we observe between the plasma density of the inner magnetosphere and the whistler wave activity, which drastically affects the dynamics of the electron radiation belts. We show the whistler-mode hiss waves, in their variety of forms (e.g. plasmaspheric hiss, low frequency hiss, exohiss, and hiss localized to plasmaspheric plumes.) have their properties strongly coupled with the ambient electron density. Hiss wave power is found to correlate with the radial profile of the dynamically changing plasmasphere. This has significant implications for the way that whistler-mode wave statistics are built and used for the modeling of their consecutive effects on radiation belt electrons for a wide energy range. During substorms, for instance, low energy electron injections from the magnetotail cause complex variations of the electron density and the wave amplitudes, modifying significantly the scattering rates induced by wave-particle interactions. We then present an in-depth study of the radiation belts for various events and focus on the characterization of the tri-dimensional (L, energy, and pitch angle) structure of the radiation belts. We exhibit its main characteristic based on both numerical results and global observations from the NASA Van Allen Probes using the Magnetic Electron and Ion Spectrometer (MagEIS) flux measurements of the radiation belts. Observations are compared with event-driven Fokker-Planck simulations of pitch angle diffusion from wave-particle interactions. The computation of wave-particle interactions fully accounts for the ambient properties, with a high temporal and spatial resolution of the satellite data-driven wave and plasma properties. We compute how fast the slot region forms gradually between the two radiation belts from wave-particle interactions during long and quiet storm recovery, contributing to depopulate the close-Earth magnetosphere of the energetic electrons injected by the storm. These results are expected to have significant implication in our understanding of the role of whistler waves and, more generally, in radiation belt modeling and space weather.

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