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EMIC waves parameterization in the long-term VERB code simulation

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EMIC waves play an important role in the dynamics of ultra-relativistic electron population in the radiation belts. Recently we showed that, a long-term 3-D simulation of electron distribution function based on the Fokker-Planck equation significantly overestimates electron fluxes without considering EMIC waves activity. As EMIC waves are very sporadic, developing a parametrization of such wave properties is a challenging task. Currently, there are no dynamic, activity-dependent models of EMIC waves that can be used in the long-term simulations, which makes the quantitative modeling of the radiation belts dynamics incomplete.

In this study, we compared long-term simulations performed with the Versatile Electron Radiation Belt (VERB) code and the Van Allen Probes observations. The model includes radial, energy, pitch-angle and mixed diffusion, losses into the atmosphere, and magnetopause shadowing. We included scattering by hiss and chorus based on a recently developed statistical models of VLF/ELF waves. We considered the relativistic ($\sim$0.5-1 MeV) and ultra-relativistic (>3 MeV) electrons. One year of relativistic electron measurements were well reproduced by the simulation during a period of the various geomagnetic activity. However, in order to accurately reproduce the dynamics of ultra-relativistic population, additional loss mechanisms are required.

We investigated EMIC wave occurrence depending on solar wind parameters and geomagnetic indices. Using the obtained dependence we found that modeling with EMIC waves provided a better agreement with the observations.