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Bounce-averaged diffusion coefficients in the Tsyganenko field model for oblique chorus waves

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The assessment of the importance of various acceleration and loss mechanisms of relativistic electrons is crucially important for predicting and understanding the dynamics of the radiation belts. It is commonly accepted that resonant wave-particle interactions play a major role in these processes. Bounce-averaged momentum, pitch-angle, and mixed diffusion coefficients, calculated using various models of spectral properties of waves and spatial distributions of plasma waves, are used in modern radiation belt codes as inputs. The diffusion coefficients for radiation belt models are usually computed using the quasi-linear theory and are bounce-averaged in the dipole magnetic field. During magnetic storms, however, the configuration and the value of the magnetic field are significantly changed, which may potentially influence the scattering rates. The purpose of this work is to estimate the role of a realistic magnetic field model on the bounce-averaged diffusion coefficients.

We present the results of computations of bounce-averaged quasi-linear momentum Dpp, pitch-angle $D\alpha\alpha$ and mixed pitch angle-momentum $D\alpha p$ diffusion coefficients in the Tsyganenko magnetic field model. We assume that electrons are scattered by oblique whistler mode chorus waves of Gaussian spread of wave power spectral density and wave normal angle outside the plasmasphere. The scattering rates are computed using the full electromagnetic dispersion relation and up to ± 5-order resonance condition including Landau resonance. The diffusion coefficients are calculated for quiet conditions (Kp=2) and storm-time conditions (Kp=6) for the day and night sides. We compare scattering rates bounce-averaged in the Tsyganenko field model with those in the dipole field and discuss the differences. The results are followed by a physical explanation of how the magnetic field model can change the bounce-averaged scattering rates. The calculations show that, during active conditions, the pitch-angle scattering by chorus waves in the realistic magnetic field can diffuse relativistic electrons to the loss cone not only on the day side, as was previously shown, but also on the night side. This explains the often observed microburst precipitation on the night side. Our study shows that while there are still a number of unknown parameters that determine scattering rates, inclusion of bounce-averaging in the realistic field will be crucially important for future radiation belt modeling.