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Dependence of radiation belt simulations to assumed radial diffusion rates tested for two empirical models of radial transport

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Radial diffusion is one of the dominant physical mechanisms that drives acceleration and loss of the radiation belt electrons, which makes it very important for nowcasting and forecasting space weather models. We investigate the sensitivity of the two parameterizations of the radial diffusion of Brautigam and Albert [2000] and Ozeke et al. [2014] on long-term radiation belt modeling using the Versatile Electron Radiation Belt (VERB). Following Brautigam and Albert [2000] and Ozeke et al. [2014], we first perform 1-D radial diffusion simulations. Comparison of the simulation results with observations shows that the difference between simulations with either radial diffusion parameterization is small. To take into account effects of local acceleration and loss, we perform 3-D simulations, including pitch-angle, energy and mixed diffusion. We found that the results of 3-D simulations are even less sensitive to the choice of parameterization of radial diffusion rates than the results of 1-D simulations at various energies (from 0.59 to 1.80 MeV). This result demonstrates that the inclusion of local acceleration and pitch-angle diffusion can provide a negative feedback effect, such that the result is largely indistinguishable simulations conducted with different radial diffusion parameterizations. We also perform a number of sensitivity tests by multiplying radial diffusion rates by constant factors and show that such an approach leads to unrealistic predictions of radiation belt dynamics.

References

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