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Transport of Electrons from the Earth's Outer Magnetosphere to the Near-Earth Seed Region

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As electrons are transported from the the Earth's outer magnetosphere they can be accelerated to energies of the order of keV when they reach the seed region located at about 10 R$_E$ radially from the Earth in the equatorial plane. As these seed electrons move closer to the Earth wave-particle interactions can cause further acceleration up to relativistic (MeV) energies. This process occurs mainly during the recovery phase of magnetic storms, when relativistic electron fluxes are usually observed to be enhanced over pre-storm values in the inner magnetosphere near geosynchronous orbit. In this study, the transport of electrons from the outer magnetosphere towards the seed region is examined. This is done by following electron trajectories from different starting points in a global model for the magnetospheric magnetic and electric fields. The electron particle trajectories are followed based on the guiding center approximation and both an empirical and an MHD model (BATS-R-US code) are used for the global magnetospheric fields. In regions where the local fields are very weak (e.g., near reconnection regions), non-adiabatic effects can be important and this is included when following electrons by switching from the guiding center approximation to a full trajectory calculation using the Lorentz force equation in these localized regions of space. It is found that when electrons transported from the deep magnetotail reach the vicnity of the seed region ($<$ 20 R$_E$ from Earth), temperatures of the order of 1 to 2 keV are reached through a combination of adiabatic and non-adiabatic acceleration processes. It is also found that a temperature anisotropy forms near the seed region with the perpendicular temperature reaching values as large as twice the parallel temperature. Implications of the electron distributions in terms of instabilities and further near-Earth (< 10 R$_E$) transport are discussed.