

Predicting Relativistic Electrons inside Outer Van Allen Radiation Belt

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ABSTRACT

Relativistic electrons trapped in the Earth's outer radiation belt manifest a highly dynamic and event-specific nature. These electrons, sometimes also called “killer” electrons due to their very high—up to several megaelectron-volt (MeV)—kinetic energies, present a very hazardous radiation environment for spaceborne electronics. Therefore, forecasting MeV electrons inside outer radiation belt has long been a critical and challenging task for the space weather community. Recently, the vital roles of electron resonance with electromagnetic waves (including such as chorus and electromagnetic ion cyclotron) have been widely recognized; however, difficulties remain for current diffusion radiation belt models to reproduce the behavior of MeV electrons during individual geomagnetic storms. Recently, a new predictive model has been developed for MeV electrons over a wide range of L-shells inside the outer radiation belt. This new model uses NOAA POES satellite observations from low-Earth-orbits (LEOs) as inputs to reliably nowcast (multiple hours) and forecast (> 1 day) energizations and decays of MeV electron distributions during storms. Performance of this predictive model is quantified by long-term in situ data from Van Allen Probes and LANL GEO satellites. This work adds new science significance to an existing LEO space infrastructure, and provides a practical and powerful tool to the whole space community.