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Relativistic Electron Acceleration during High Intensity Auroral Activities: Maximum Energy Level Dependence

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Radiation belt relativistic (E > 0.6, > 2.0, and > 4.0 MeV) electron acceleration at geosynchronous orbit is studied for solar cycle 23 (1995-2008). High-intensity, long-duration, continuous AE activity (HILDCAA) events are considered as the basis of the analyses. Cluster-4 passes were examined for electromagnetic chorus waves in the 5 < L < 10 and 0 < MLT < 12 region. All the HILDCAA events under study were found to be characterized by enhanced whistler-mode chorus waves and flux enhancements of magnetospheric relativistic electrons of all three energies compared to the pre-event flux levels. The response of the energetic electrons to HILDCAAs was found to vary with solar cycle phase. The initial electron fluxes were lower for events occurring during the ascending and solar maximum (AMAX) phases than for events occurring during the descending and solar minimum (DMIN) phases. The flux increases for the DMIN-phase events were > 50% larger than for the AMAX-phase events. It is concluded that electrons are accelerated to relativistic energies most often and most efficiently during the DMIN-phases of the solar cycle. We propose two possible solar UV-related mechanisms to explain this solar cycle effect. Enhanced E > 0.6 MeV electron fluxes at geosynchronous orbit were first detected ∼1 day after the statistical onset of HILDCAAs, E > 2.0 MeV electrons after ∼1.5 days, and E > 4.0 MeV electrons after ∼2.5 days. We estimated acceleration and decay rates and timescales for the three energy levels, which will be provided for wave-particle investigators to attempt to match their models to empirically derived values.