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The High-Energy Tail of Energetic Electron Precipitation

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Precipitating plasma sheet, ring current, and radiation belt electrons will affect the ionization level and composition of the neutral atmosphere. Knowledge gaps remain regarding the frequency, intensity, and energy spectrum of the Medium Energy Electron (MEE) precipitation ($gtrsim$30 keV). In particular, the understanding and predictive capabilities of the high-energy tail ($gtrsim$300 keV) are, in general, poor. This study builds on a recently published statistical analysis based on loss cone electron flux estimates on MEPED observations on board the POES/Metop satellites over a full solar cycle from 2004-2014. Data from the Northern and Southern Hemispheres (55-70°N/S) were combined in daily flux estimates. Flux peaks above the 90th percentile of the >43 kev flux were identified. The 33% highest and lowest associated responses in the >292 keV fluxes were labeled “E3 events” and “E1 events”, respectively, resulting in 55 events of each type. It was evident that high geomagnetic activity increases the probability of E3 events. While no single solar wind parameter nor geomagnetic index was able to identify the type of event, Kp and Dst possessed the best predictive capabilities. By detailed examination of the 55 E1 and 55 E3 events, this follow-up study shows that the Kp-index partly classifies a different subset of E1 and E3 events compared to the Dst-index. This makes a combined determination of the limits Dst $\geq$ -26 and $\leq$ -48 nT and Kp $\leq$ 33 and $\geq$ 40, highly effective. Knowing the solar wind driver modifies the combined Kp and Dst limits slightly and correctly labels 85% of events. Despite their differences, common features become apparent for the ambiguous events: a persistent southward Bz alongside sustained substorm onset activity will generate high-energy tail electron precipitation. The concurrent criteria provide insight into when and why high-energy tail electron precipitation occurs.

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