Fast diffusion of ultra-relativistic electrons in the outer radiation belt: 17 March 2015 storm event

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In recent times, the radial diffusion mechanism has fallen out of favor as the dominant process of outer belt electron acceleration. In its place, energy diffusion enacted by higher frequency waves (local acceleration) has been shown to be the more significant process in most cases. However, radial diffusion driven by low-frequency waves likely plays the leading role in radiation belt acceleration events during the absence of intense VLF chorus. In this study, we present observations of the fast diffusion of ultra-relativistic outer belt electrons following the March 17, 2015 storm period. Several days after the storm main phase, during which a significant dropout occurred, very high energy electrons (3-8 MeV) re-appeared in the heart of the outer belt and were subsequently driven inward, apparently by strong ULF waves as observed with the Van Allen Probes fields instruments. We examine this fast diffusion rate along with the local and global distribution of relevant plasma waves to make the claim that the energization of ultra-relativistic electrons is driven primarily by low-frequency waves following the March 17, 2015 storm. Additionally, we compare this diffusion rate to previous periods of high geomagnetic activity to find that this ultra-fast radial diffusion of ultra-relativistic electrons is unique so far in the Van Allen Probes era. We conclude with the assertion that only event-specific studies can reveal the times in which local acceleration is dominant, and those times (such as the case examined here) when the observed acceleration is due entirely to strong inward ULF-driven radial diffusion.