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Evolution of relativistic electrons in the radiation belt during geomagnetic storms

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The adiabatic and non-adiabatic behavior of relativistic electrons in the outer radiation belt during strong geomagnetic storms is studied using data from multiple observational platforms simultaneously: the Van Allen Probes, ARASE, and THEMIS satellites. The analysis of electron fluxes shows an enhancement of relativistic electrons during the recovery phase after the strong depletion occurred during the main phase of storms. The maximum electron flux appears at the L-shell well described by the Tverskaya relation.[1,2] In order to study whether the adiabatic mechanisms are relevant to explain the behavior of relativistic electrons, we first analyzed the electron spectra and found that they fit well to a power-law function. For a fixed L-shell, the power-law index is commonly conserved during the pre-storm time, increases during the main phase, and decreases during the recovery phase. The long time conservation of the slope of the electron spectra can be considered as evidence of a dominant contribution of adiabatic processes, as it is difficult to explain this effect by other processes such as acceleration and losses of relativistic electrons.[3] Nonetheless, the strong changes observed in the electron spectra slope related to the storm phases can be related to different processes leading to the electron loss or acceleration, such as the interaction with ULF waves.

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References

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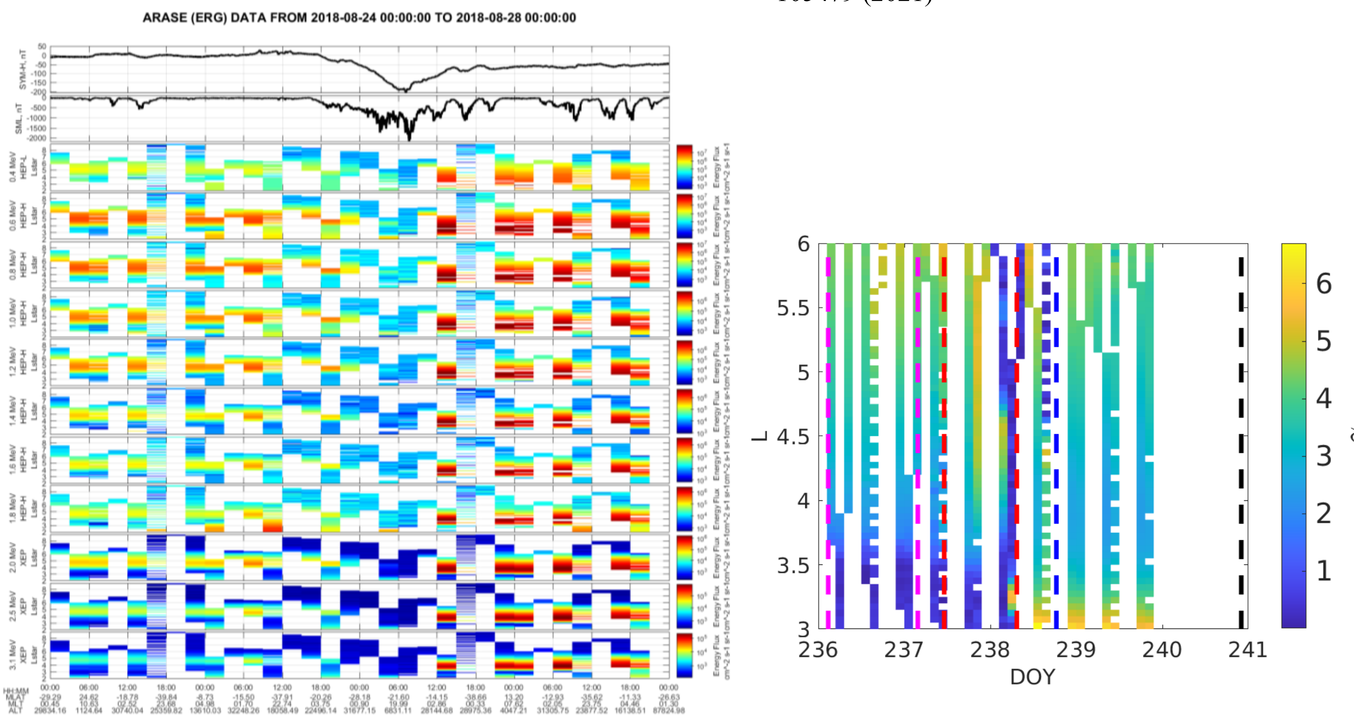

Figure 1. Depletion of energetic electron fluxes during the main phase of the August 24, 2018 geomagnetic storm, and appearance of a new outer radiation belt during the recovery phase (left), and the conservation of the power index for a fixed L-shell (right) obtained using the ARASE satellite data.