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Phase space density analysis of outer radiation belt electron energization and loss during geoeffective and non-geoeffective sheath regions

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The energetic electron content in the Van Allen radiation belts surrounding the Earth can vary dramatically on timescales from minutes to days, and these electrons present a hazard for spacecraft traversing the belts. The outer belt response to solar wind driving is however yet largely unpredictable. Here we investigate the driving of the belts by sheath regions preceding interplanetary coronal mass ejections. Electron dynamics in the belts is governed by various competing acceleration, transport and loss processes. We analyzed electron phase space density to compare the energization and loss mechanisms during a geoeffective and a non-geoeffective sheath region. These two case studies indicate that ULF-driven inward and outward radial transport, together with the incursions of the magnetopause, play a key role in causing the outer belt electron flux variations. Chorus waves also likely contribute to energization during the geoeffective event. A global picture of the wave activity is achieved through a chorus proxy utilizing POES measurements. We highlight that also the non-geoeffective sheath presented distinct changes in outer belt electron fluxes, which is also evidenced by our statistical study of outer belt electron fluxes during sheath events. While not as intense as during geoeffective sheaths, significant changes in outer belt electron fluxes occur also during sheaths that do not cause major geomagnetic disturbances.