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Solar Wind Drivers of Storm-Time Radiation Belt Variations

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It is an outstanding question why some storms result in an increase of the outer radiation belt electron fluxes, while others deplete them or produce no change. One approach to this problem is to look at differences in the large-scale solar wind storm drivers. The drivers have traditionally been classified to Stream Interaction Regions (SIRs) and Interplanetary Coronal Mass Ejections (ICMEs). However, ICMEs and SIRs are complex structures: SIRs consist of a slow stream followed by a turbulent, higher pressure interface region and then a faster stream. The core of the ICME is an ejecta. If the mass ejection is fast enough, it can drive a shock in front of it. This leads to the formation of a sheath region between the interplanetary shock and the leading edge of the ejecta. Fast streams that are integral part of SIR may or may not follow the ICME. The solar wind properties, and hence, the magnetospheric driving of different substructures in SIRs and ICMEs are very distinct. In this work we will investigate the radiation belt response to different storm drivers by combining near-Earth solar wind observations, long-term geosynchronous observations from GOES spanning over 1.5 solar cycles (1995-2013) and the state-of-the art Van Allen Probe data. Our study uses superposed epoch analysis with multiple reference times and we expand/contract each solar wind substructure to the population mean. This novel approach allows us to determine the typical evolution of the electron fluxes during each solar wind structure. Our results show that the separation of the effects from different parts of the ICME and SIRs will be crucial for understanding how radiation belt electrons react to different solar wind driving conditions.