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Clustering of Fast Coronal Mass Ejections during Solar Cycles 23 and 24 and Implications for CME–CME Interactions

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Coronal Mass Ejections (CMEs) and their interplanetary counterparts (ICMEs) are the major sources for strong space weather disturbances. We present a study of statistical properties of fast CMEs (v≥1000 km/s) that occurred during solar cycles 23 and 24. We apply the Max Spectrum and the declustering threshold time methods. The Max Spectrum can detect the predominant clusters, and the declustering threshold time method provides details on the typical clustering properties and timescales. Our analysis shows that during the different phases of solar cycles 23 and 24, fast CMEs preferentially occur as isolated events and in clusters with, on average, two members. However, clusters with more members appear, particularly during the maximum phases of the solar cycles. During different solar cycle phases, the typical declustering timescales of fast CMEs are τ_c =28-32 hrs, irrespective of the very different occurrence frequencies of CMEs during a solar minimum and maximum. These findings suggest that τ_c for extreme events may reflect the characteristic energy build-up time for large flare and CME-prolific active regions. Statistically associating the clustering properties of fast CMEs with the disturbance storm time index at Earth suggests that fast CMEs occurring in clusters tend to produce larger geomagnetic storms than isolated fast CMEs. Our results highlight the importance of CME-CME interaction and their impact on Space Weather.