Geophysical Research Abstracts
Vol. 21, EGU2019-7565, 2019
EGU General Assembly 2019

A comparison of the substorm and storm-time observed values of the AE and Dst geomagnetic indices to their SuperMAG counterparts over the last four solar cycles

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Severe space weather events can impact satellite systems, power grids, aviation and global communication, leading to negative social and economic consequences. Geomagnetic indices such as the auroral electrojet (AE) index [1] and disturbance storm time (Dst) index [2] are commonly used to characterize space weather events and have been almost continuously observed for several solar cycles. SuperMAG [3], the collated full set of ground based magnetometer observations spanning the last four solar cycles, provides analogues to these geomagnetic indices. SME is an electrojet index which shares methodology with AE. SMR is a ring current index which shares methodology with Dst. Both SME and SMR are at higher spatial and temporal resolution than their traditional counterparts. Using the survival distribution [4], which accentuates the distribution tail of extreme values in a data sample, we can compare how the relevant indices perform as monitors of geomagnetic storm and substorm activity over the last four solar maxima. We provide a quantitative statistical characterization of how well these indices track large excursions in geomagnetic activity. Differences in the performance of AE, SME and DST, SMR can be subtle as they arise from a combination of higher sampling rates and the details of how the index is constructed. We use a simple model to elucidate how these differences arise and discuss the implications for how the indices are constructed.

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