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Extreme value statistics in the solar wind: an application to correlated Lévy processes

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The interplay between the solar wind and the Earth's magnetosphere is a longstanding and challenging problem. An estimate of the energy influx into the magnetosphere is given by the Akasofu ϵ parameter. Extreme values of this parameter are of interest not only for magnetospheric response, but also for the design of satellites, space stations and considerations of astronaut safety. For the ϵ time series derived from ACE spacecraft measurements for the years $2000 - 2007$, we find that its distribution of extreme values over time windows of about 18 hours and longer can be accurately described by parametric models based on the mathematical theory of generalized extreme value statistics. These models predict that significantly larger values than observed to date can be expected during any 50-year period. While our findings seem to suggest that correlations and/or non-stationarities do not play a significant role for the extreme value statistics of the Akasofu ϵ parameter, we show that the contrary is in fact true. To isolate the effect of correlations and finite observation periods, we also consider the distribution of *maximal changes* in the ϵ parameter and compare it to the extreme value statistics of a recently proposed fractional Lévy motion-type model. However, we find that fractional Lévy motion does not reliably capture the extremal behavior of the ϵ time series.