Review of Probability Estimation of March 1989-like event ..

Overview: The authors attempted to assess the likelihood of a reoccurrence of the March 1989 storm using the Dst index as a proxy.

Comments: The authors have used the pyextremes Python package to model the occurrence of large storms based on threshold levels of the Dst and provided a lot of explanation of the methodology but without any new insights. There is a lot or repetition about the importance for the insurance industry and I was expecting to see some sort of economic analysis, but there is little or no novel results in this paper. The paper is very poorly referenced, shows little understanding of what the use of extreme value statistics is about and has not provided any new information on either the geomagnetic or the economic impact. It seems unclear what the purpose of the paper is.

For example, a return period of a known size is usually the rank order appearance of the already measured event. If the March 89 storm is the ranking event in the Dst index, which Figure 1 indicates, then it is a one-in-70 year event (as Dst starts from 1957) by definition. You don't need to use EVT to provide an estimated return period of 72 years – that is the length of the input record!

EVT tries to provide answers about events are that *not* in the record. There also has to be some level of understanding of the limitations of the method. Figure 6 shows the 1000 year return period but this is not really to be believed given there's only 70 years of data and the Sun's activity levels are clearly not stationary on 1000 year timescales - something which is not mentioned in the paper.

There have been a number of recent papers such as Rogers et al (2021) and Chapman et al (2020) which do a far better job at detailing the extreme events and likelihoods. This is the sort of level of research that is now required in this area.

The references are incomplete. There are several cited that are not in the reference list and the reference to Thomson et al (2011) is completely incorrect. Also note that Thomson *et al.* and Love (and Rogers *et al.*) were looking at ground magnetic fields rather than a global proxy like Dst.

The tables are not correctly formatted and the Figures show 'datetime' which is not actually a word but a Python package label.

Finally, the 2013 RAE report by Cannon et al will soon be updated and should provide fresh insight into the evolving risks and mitigations that are being researched in relation to space weather impacts on technology.

References:

P. Canon: https://raeng.org.uk/media/2iclimo5/space_weather_summary_report.pdf

Rogers, N.C., James A. Wild, Emma F. Eastoe, Jesper W. Gjerloev and Alan W. P. Thomson, A global climatological model of extreme geomagnetic field fluctuations, J. Space Weather Space Clim., 10 (2020) 5, doi: https://doi.org/10.1051/swsc/2020008

Chapman, S. C., McIntosh, S. W., Leamon, R. J., & Watkins, N. W. (2020). Quantifying the solar cycle modulation of extreme space weather. Geophysical Research Letters, 47(11), e2020GL087795.