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Underestimating extremes due to random uncertainty

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As we attempt to infer a system's response to external driving from measurements, random errors in the measurement of the drivers can lead us to mistakenly infer a non-linear response. In particular, **we are likely to underestimate the system's response during extreme and rare driving conditions due to uncertainty in the drivers.** We demonstrate this phenomenon for extreme space weather and its impact on Earth's magnetosphere, where due to random errors in the measurements of solar wind drivers, there is a non-linear bias in the magnetosphere's response. We propose that the underlying statistical effect (related to the more well-known regression to the mean effect) is generalizable to the other fields that study different systems' responses to driving, like extreme climate studies.