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Assessing the reliability of probabilistic event attribution

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Abstract

High-impact extreme events bring questions about the role of human-driven climate change in their occurrence. The field of event attribution aims to answer these questions. However, some fundamental aspects of this rapidly developing field remain open, including whether attribution metrics and model-estimated event probabilities are reliable. We use large ensembles of climate simulations in a perfect (in-model) and imperfect (out-of-model) framework to define extreme events, calculate their probabilities, and evaluate the reliability of the event probability or change in probability. We show that estimates of an event's return period vary enough between models that the specific probability values cannot often be considered reliable. Model-estimated relative changes in event probability are generally more reliable than the event probabilities themselves. Conclusions about whether there is an attributable increase (or decrease) in event probability are more often reliable for variables with large signal-to-noise ratios such as hot extremes. Overall, we show that it cannot be assumed that model-estimated event attribution metrics and their components are reliable and recommend that event attribution results be presented in a generally qualitative format.

Keywords

extreme events, attribution, reliability, large ensembles