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The role of the selection problem and non-Gaussianity in attribution of single events to climate change

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In attempts to attribute a single event to climate change we compare the probability distributions of the quantity under consideration for current and pre-industrial conditions. In this paper we discuss some methodological issues and challenges of this approach connected to the selection problem and deviations from Gaussianity.

The distributions used for event attribution will typically be calculated from large ensembles produced by a climate model and require large computational resources. Here we apply a simple alternative to generate ensembles of surrogate fields based on observations. This algorithm can be seen as a field extension of bootstrapping as it produces surrogate fields with the same spatial and temporal structure as the target field. In this study the surrogate method together with analytical considerations will be used as a test-bed for event attribution to inform us about methodological issues that should be considered before comprehensive climate models are invoked.

In particular, we study the influence of the selection problem, which in this context expresses the problem that when an event has been observed it is not obvious how the probability distributions should be defined. Should we look for similar events in the immediate neighborhood of the observation or in an extended area? We show that this choice will have serious effects on the distributions and conclusions.

We also demonstrate that deviations from Gaussianity can have a large influence on the conclusions and that it is important that the ensembles trustfully represent the features that contributes to the extreme events under consideration. In particular we show that the Fractional Attributable Risk has very different behavior for heavy-tailed distributions than for Gaussian distributions. In the example chosen, European heat waves, important features include the seasonal variation in skewness.