



Different ways of framing event attribution questions

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The Hadley Centre event attribution system has been used to estimate changes in the likelihood of different types of extreme events worldwide due to human influence on the climate. The basic approach involves estimating probabilities of events from ensembles of simulations with and without anthropogenic forcings. Attribution studies apply this approach to classes of events that only share one or more characteristics with the actual observed event. We examine the effect of changing the framing of the attribution question on estimated probabilities of extremes by defining different classes to describe the same event. Two case studies are considered. The first is an analysis of the warm and wet winter of 2015/16 in the UK using the Hadley Centre system as well as CMIP5 models. We find that human influence increases the likelihood of warm winters by a factor of 3 or more for events occurring under any atmospheric and oceanic conditions, but also for events with a similar circulation, or oceanic state to 2015/16. An increase in the likelihood of wet winters by a factor of 1.5 or more is estimated for the general case, but estimates conditioned on the observed state of the ocean are more uncertain. The second case study considers the hot and dry April of 2016 in Thailand. The presence of a strong El Niño in early 2016 provided favourable conditions for the event. Ensembles of simulations generated with the Hadley Centre system are used to estimate how the chances of exceeding the observed April mean temperature and rainfall are altered by the anthropogenic effect and the presence of a strong El Niño. We find that the record temperature in the region would not have occurred without the influence of both factors, which also increased the chances of low rainfall.