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Fast-track extreme event attribution: How fast can we disentangle thermodynamic (forced) and dynamic (internal) contributions?

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Within the last decade, extreme weather event attribution has emerged as a new field of science and garnered increasing attention from the wider scientific community and the public. Numerous methods have been put forward to determine the contribution of anthropogenic climate change to individual extreme weather events. So far nearly all such analyses were done months after an event has happened.

First, we present our newly established method which can assess the fraction of attributable risk (FAR) of a severe weather event due to an external driver in real-time. The method builds on a large ensemble of atmosphere-only GCM/RCM simulations forced by seasonal forecast sea surface temperatures (SSTs). Taking the UK 2013/14 winter floods as an example, we demonstrate that the change in risk for heavy rainfall during the England floods due to anthropogenic climate change is of similar magnitude using either observed or seasonal forecast SSTs.

While FAR is assumed to be independent from event-specific dynamic contributions due to anomalous circulation patterns as a first approximation, the risk of an event to occur under current conditions is clearly a function of the state of the atmosphere. The shorter the event, the more it is a result of chaotic internal weather variability. Hence we are interested to (1) attribute the event to thermodynamic and dynamic causes and to (2) establish a sensible time-scale for which we can make a useful and potentially robust attribution statement with regard to event-specific dynamics.

Having tested the dynamic response of our model to SST conditions in January 2014, we find that observed SSTs are required to establish a discernible link between anomalous ocean temperatures and the atmospheric circulation over the North Atlantic in general and the UK in particular. However, for extreme events occurring under strongly anomalous SST patterns, associated with known low-frequency climate modes such as El Nino or La Nina, forecast SSTs can provide sufficient guidance to determine the dynamic contribution to the event on the basis of monthly mean values. No such link can be made (North Atlantic/Western Europe region) for shorter time-scales, unless the observed state of the circulation is taken as reference for the model analysis (e.g. Christidis et al. 2014).

We present results from our most recent attribution analysis for the December 2015 UK floods (Storm Desmond and Eva), during which we find a robust teleconnection link between Pacific SSTs and North Atlantic Jetstream anomalies. This is true for both experiments, with forecast and observed SSTs. We propose a fast and simple analysis method based on the comparison of current climatological circulation patterns with actual and natural conditions. Alternative methods are discussed and analysed regarding their potential for fast-track attribution of the role of dynamics. Also, we briefly revisit the issue of internal vs forced dynamic contributions.