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A conditional approach to determining the effect of anthropogenic climate change on very rare events.

Michael Wehner (1), Pardeep Pall (1), Colin Zarzycki (2), and Daithi Stone (1)

(1) Lawrence Berkeley National Laboratory, Berkeley, United States, (2) National Center for Atmospheric Research, Boulder, United States

Probabilistic extreme event attribution is especially difficult for weather events that are caused by extremely rare large-scale meteorological patterns. Traditional modeling techniques have involved using ensembles of climate models, either fully coupled or with prescribed ocean and sea ice. Ensemble sizes for the latter case ranges from several 100 to tens of thousand. However, even if the simulations are constrained by the observed ocean state, the requisite large-scale meteorological pattern may not occur frequently enough or even at all in free running climate model simulations. We present a method to ensure that simulated events similar to the observed event are modeled with enough fidelity that robust statistics can be determined given the large scale meteorological conditions. By initializing suitably constrained short term ensemble hindcasts of both the actual weather system and a counterfactual weather system where the human interference in the climate system is removed, the human contribution to the magnitude of the event can be determined. However, the change (if any) in the probability of an event of the observed magnitude is conditional not only on the state of the ocean/sea ice system but also on the prescribed initial conditions determined by the causal large scale meteorological pattern. We will discuss the implications of this technique through two examples; the 2013 Colorado flood and the 2014 Typhoon Haiyan.