

Anthropogenic greenhouse gas contribution to flood risk in England and Wales in autumn 2000

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Interest in attributing the risk of damaging weather-related events to anthropogenic climate change is increasing. Yet climate models used to study the attribution problem typically do not resolve the weather systems associated with damaging events such as the UK floods of October and November 2000. Occurring during the wettest autumn in England and Wales since records began in 1766, these floods damaged nearly 10,000 properties across that region, disrupted services severely, and caused insured losses estimated at £1.3 billion. Although the flooding was deemed a 'wake-up call' to the impacts of climate change at the time, such claims are typically supported only by general thermodynamic arguments that suggest increased extreme precipitation under global warming but fail to account fully for the complex hydrometeorology associated with flooding. Here we present a multi-step, physically based 'probabilistic event attribution' framework showing that it is very likely that global anthropogenic greenhouse gas emissions substantially increased the risk of flood occurrence in England and Wales in autumn 2000. Using publicly volunteered distributed computing, we generate several thousand seasonal-forecast-resolution climate model simulations of autumn 2000 weather, both under realistic conditions, and under conditions as they might have been had these greenhouse gas emissions and the resulting large-scale warming never occurred. Results are fed into a precipitation-runoff model that is used to simulate severe daily river runoff events in England and Wales (proxy indicators of flood events). The precise magnitude of the anthropogenic contribution remains uncertain, but in nine out of ten cases our model results indicate that twentieth-century anthropogenic greenhouse gas emissions increased the risk of floods occurring in England and Wales in autumn 2000 by more than 20%, and in two out of three cases by more than 90%.