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Human influences on spatially compounding flooding and heatwave events in China and future increasing risks

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Attribution of high-impact weather events to anthropogenic climate change is important for disentangling long-term trends from natural variability and estimating potential future impacts. Up to this point, most attribution studies have focused on univariate drivers, despite the fact that many impacts are related to multiple compounding weather and climate drivers. For instance, co-occurring climate extremes in neighbouring regions can lead to very large combined impacts. Yet, attribution of spatially compounding events with different hazards poses a great challenge. Here, we present a comprehensive framework for compound event attribution to disentangle the effects of natural variability and anthropogenic climate change on the event. Taking the 2020 spatially compounding heavy precipitation and heatwave event in China as a showcase, we find that the respective dynamic and thermodynamic contributions to the intensity of this event are 51% (35–67%) and 39% (18–59%), and anthropogenic climate change has increased the occurrence probability of similar events at least 10-fold. We estimate that compared to the current climate, such events will become 10 times and 14 times more likely until the middle and end of the 21st century, respectively, under a high-emissions scenario. This increase in likelihood can be substantially reduced (to seven times more likely) under a low-emissions scenario. Our study demonstrates the effect of anthropogenic climate change on high-impact compound extreme events and highlights the urgent need to reduce greenhouse gas emissions.