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TITLE: Attribution of extreme rainfall from Hurricane Harvey, August 2017

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ABSTRACT:

During August 25?30, 2017, Hurricane Harvey stalled over Texas and caused extreme precipitation, particularly over Houston and the surrounding area on August 26?28. This resulted in extensive flooding with over 80 fatalities and large economic costs. It was an extremely rare event: the return period of the highest observed three-day precipitation amount, 1043.4 mm 3dy?1 at Baytown, is more than 9000 years (97.5% one-sided confidence interval) and return periods exceeded 1000 yr (750 mm 3dy?1) over a large area in the current climate. Observations since 1880 over the region show a clear positive trend in the intensity of extreme precipitation of between 12% and 22%, roughly two times the increase of the moisture holding capacity of the atmosphere expected for 1 °C warming according to the Clausius?Clapeyron (CC) relation. This would indicate that the moisture flux was increased by both the moisture content and stronger winds or updrafts driven by the heat of condensation of the moisture. We also analysed extreme rainfall in the Houston area in three ensembles of 25 km resolution models. The first also shows 2 × CC scaling, the second 1 × CC scaling and the third did not have a realistic representation of extreme rainfall on the Gulf Coast. Extrapolating these results to the 2017 event, we conclude that global warming made the precipitation about 15% (8%?19%) more intense, or equivalently made such an event three (1.5?5) times more likely. This analysis makes clear that extreme rainfall events along the Gulf Coast are on the rise. And while fortifying Houston to fully withstand the impact of an event as extreme as Hurricane Harvey may not be economically feasible, it is critical that information regarding the increasing risk of extreme rainfall events in general should be part of the discussion about future improvements to Houston's flood protection system.

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