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Estimating the human influence on recent hurricanes

Michael Wehner, Christina Patricola, and Mark Risser
Lawrence Berkeley National Laboratory, Berkeley, United States (mfwehner@lbl.gov)

Attribution of the human-induced climate change influence on the physical characteristics of individual extreme weather events has become an advanced science over the past decade. However, it is only recently that such quantification of anthropogenic influences on event magnitudes and probability of occurrence could be applied to very extreme storms such as hurricanes. We present results from two different classes of attribution studies for the impactful Atlantic hurricanes of 2017. The first is an analysis of the record rainfall amounts during Hurricane Harvey in the Houston, Texas area. We analyzed observed precipitation from the Global Historical Climatology Network with a covariate-based extreme value statistical analysis, accounting for both the external influence of global warming and the internal influence of ENSO. We found that human-induced climate change likely increased Hurricane Harvey's total rainfall by at least 19%, and likely increased the chances of the observed rainfall by a factor of at least 3.5. This suggests that changes exceeded Clausius-Clapeyron scaling, motivating attribution studies using dynamical climate models.

The second analysis consists of two sets of hindcast simulations of Hurricanes Katrina, Irma, and Maria using the Weather Research and Forecasting model (WRF) at 4.5 km resolution. The first uses realistic boundary and initial conditions and present-day greenhouse gas forcings while the second uses perturbed conditions and pre-industrial forcings to simulate counterfactual storms without anthropogenic influences. These simulations quantify the fraction of the tropical cyclone precipitation attributable to human activities and test for super Clausius-Clapeyron scaling. We will further quantify the human influence on maximum wind speed and central pressure minima for Katrina, Irma, and Maria.