An attribution framework to calculate climate change impacts on hurricane seasons

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Abstract

Significant advances have been made in attribution frameworks to quantify climate change impacts on individual extreme events including devastating hurricanes. Here we present the results of a hindcast attribution methodology, previously developed and tested in CESM for individual Atlantic hurricanes (i.e., Florence and Dorian), throughout the entire 2020 hurricane season. A variable-resolution configuration of the Community Atmosphere Model (CAM) with a high-resolution domain over the North Atlantic Ocean is used to quantify the impact of human-induced climate change on the season's hurricane precipitation characteristics. Short 7-day ensemble hindcasts are initialized every 3 days starting June 1 through November 30 resulting in 1220 individual simulations. Hindcasts that are initialized with NOAA atmospheric and ocean analyses are referred to as the "actual" ensemble since they are meant to simulate the actual conditions during the 2020 season. An additional set of "counterfactual" ensemble hindcasts are also completed in which the seasonal average warming fingerprint for the 3D thermodynamic atmospheric is removed from the initial conditions, the boundary conditions are adjusted to remove the SST fingerprint using the CESM Large Ensemble, and greenhouse gas concentrations are set to 1850 values. This work demonstrates that human-induced climate change increased the extreme precipitation rates and accumulations by 5-11% for the entire 2020 hurricane season. This represents the first study to objectively apply the hindcast attribution method to all storms of a given hurricane season, regardless of intensity or coastal impact, suggesting a pathway toward operational forecast attribution frameworks.

Keywords: attribution, hurricanes, extreme precipitation, season

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