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Detecting the impact of climate change on rainfall associated with North Atlantic hurricanes

Kevin Reed (1), Alyssa Stansfield (1), Michael Wehner (2), and Colin Zarzycki (3)

(1) School of Marine and Atmospheric Sciences, Stony Brook University, Stony Brook, United States (kevin.a.reed@stonybrook.edu), (2) Computational Research Division, Lawrence Berkeley National Laboratory, Berkeley, United States, (3) Department of Meteorology and Atmospheric Science, Penn State University, State College, United States

High-resolution (i.e. grid spacing less than 30 km) climate models are becoming skilled tools to evaluate tropical cyclone (TC) characteristics in past, current, and future climate conditions. The Community Atmosphere Model version 5 (CAM5) at high horizontal resolutions (∼28 km grid spacing) has been used to study the impact of future climate change on global and regional TC activity. However, previous CAM5 analysis has traditionally focused on evaluating TC frequency, duration, and intensity in traditional decadal climate simulations.

The goal of this work is to better understand climate impacts on TC precipitation in various configurations of high-resolution CAM5 run at horizontal grid spacings of approximately 28 km forced with prescribed sea-surface temperatures (SSTs) and greenhouse gas concentrations for past, present, and future climates. This analysis will focus on the evaluation of rainfall associated with TCs in short 7-day ensemble forecasts of recent devastating events (e.g., Hurricane Florence in 2018). These forecast simulations are initialized with atmospheric analyses from NOAA's Global Forecast System (GFS) before the time of interest (e.g., landfall) for the individual storm, and an ensemble is created through parameter perturbations in the CAM5 physics parameterizations to provide a large sampling of uncertainties in storm characteristics. This ensemble of simulations is referred to as standard forecasts. A second suite of ensembles are completed using alternate initial conditions where the large-scale climate change signal to date has been removed, representing a "world that could have been" scenario referred to as modified forecasts. Through comparison of the standard and modified forecast ensembles for each storm, the impact of climate change on individual TC rainfall can be quantified and compared to full conventional decadal (AMIP-style) simulations that analyze TCs using interannual statistics over hundreds of TCs.