

ANTHROPOGENIC IMPACTS ON THE EXCEPTIONAL PRECIPITATION OF 2018 IN THE MID-ATLANTIC UNITED STATES

JONATHAN M. WINTER, HUANPING HUANG, ERICH C. OSTERBERG, AND JUSTIN S. MANKIN

This document is a supplement to “Anthropogenic Impacts on the Exceptional Precipitation of 2018 in the Mid-Atlantic United States,” by Jonathan M. Winter, Huanping Huang, Erich C. Osterberg, and Justin S. Mankin (*Bull. Amer. Meteor. Soc.*, **101**, S5–S10) • ©2020 American Meteorological Society • Corresponding author: Jonathan M. Winter, jonathan.m.winter@dartmouth.edu • DOI:10.1175/BAMS-D-19-0172.2

We use the time-evolving ensemble mean and 1920–50 climatological ensemble mean magnitude to create an ensemble of total and extreme precipitation times series for 1920–2018 without late-twentieth-century (1951–2018) forcing. We assess the validity of this methodology by using a different representation of anthropogenic forcing. Specifically, we analyze the change in the probability of total and extreme precipitation similar to 2018 between 1984–2033 and 1920–69. We use historical (1920–69) simulations, and combine historical (1984–2005) and future (2006–33) simulations forced with RCP 8.5, to create forty 50-yr time series for 1920–69 and 1984–2033. We pool all forty 50-yr LENS ensemble members for 1920–69 to create a 2,000-yr distribution of total precipitation and extreme precipitation. We calculate the 1-in-99 year

total precipitation and 4-in-99 year extreme precipitation thresholds from the 1920–69 distributions, and find the probability of exceeding the 1920–69 thresholds in the 2,000-yr distributions for 1984–2033. We then determine the fraction attributable risk and risk ratio, as well as bootstrap the 2,000-yr distributions to determine the confidence intervals (CI) for both.

We find that anthropogenic forcing is responsible for 73% of LENS 1-in-99 year January to September total precipitation occurrences, increasing the risk of total precipitation similar to 2018 by 3.7 times (Table S1). In addition, 41% of 4-in-99 year May to September extreme precipitation occurrences and 69% of combined 1-in-99 year total precipitation and 4-in-99 year extreme precipitation occurrences are attributable to the LENS anthropogenic forcing (Table S1).

TABLE S1. LENS 1920–69 and 1984–2033 probability of mid-Atlantic total and extreme precipitation similar to 2018, and resulting risk ratio (RR) and fraction attributable risk (FAR).

Precipitation condition	1920–69 (P_0)	1984–2033 (P_1)	RR (95% CI)	FAR (95% CI)
Total Jan–Sep	1.00%	3.70%	3.70 (2.14, 5.64)	0.73 (0.61, 0.85)
Extreme May–Sep	4.00%	6.80%	1.70 (1.22, 2.15)	0.41 (0.22, 0.57)
Total Jan–Sep and extreme May–Sep	0.25%	0.80%	3.20 (1.04, 11.70)	0.69 (0.08, 0.96)

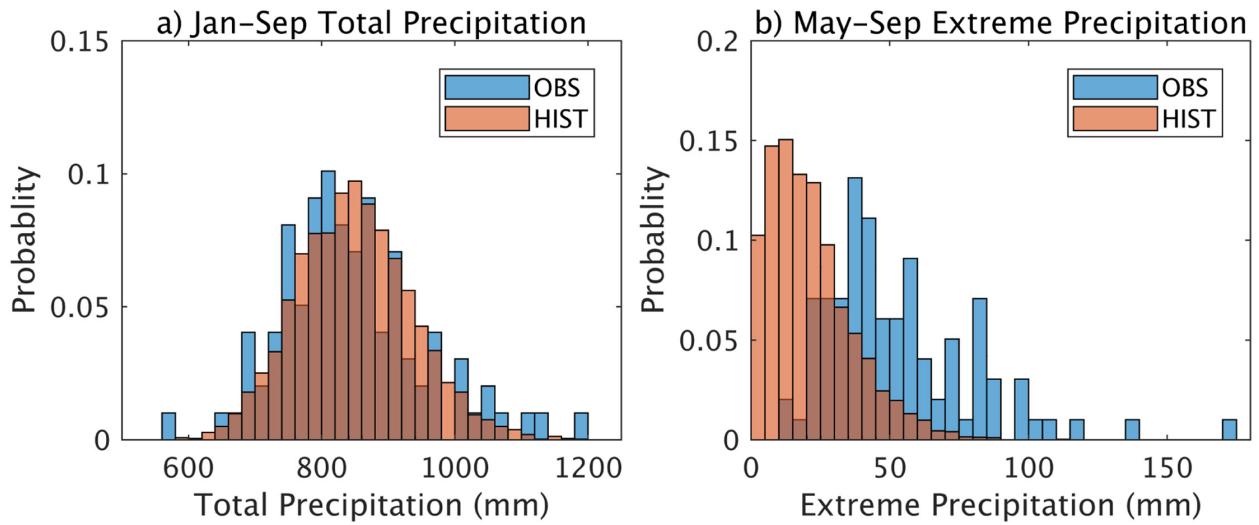


FIG. S1. Regionally averaged GHCN-D observed (OBS) and LENS historical (HIST) (a) January to September total precipitation probability and (b) May to September extreme precipitation probability.