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## Anthropogenic Influences on the Extremely Dry and Hot Summer of 2020 in Southern China and Projected Changes in the Likelihood of the Event

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During summer 2020, Southern China experienced an extremely dry and hot summer, which was identified as one of the top ten domestic weather and climate extreme events in 2020 by China Meteorological Administration. Summer mean precipitation, surface air temperature (TAS), and number of hot days (NHD) were about 25% dryer, 1.5°C warmer, and 11 days larger than the 1981–2010 normal. These are the 4<sup>th</sup> largest precipitation deficit, the highest TAS, and the 2<sup>nd</sup> highest NHD in the 1961–2020 record. The large-scale circulation anomalies over the West Pacific increased the likelihood of these extremely event. Anthropogenic influences on this event were investigated using 525-member ensembles of the atmosphere-only HadGEM3-GA6 model and the multi-model ensembles from the Coupled Model Intercomparison Project Phase 6 (CMIP6). Anthropogenic forcings doubled (increased by 11%) the probability of precipitation deficits, and increased occurrence more than 10 times for both TAS anomaly (1.25 probability higher) and NHD anomaly (300% probability higher) in HadGEM3-GA6 (CMIP6). That means that the 2020-like TAS and NHD anomalies would not occur without anthropogenic forcings, and there is weak evidence that human influences decrease rainfall over Southern China. However, the precipitation deficit increased the likelihood of exceeding the observed thresholds for both TAS and NHD by about 17 (4) and 9 (11) times in HadGEM3-GA6 (CMIP6), respectively. Under SSP2-4.5 and SSP5-8.5 scenarios in the future, 2020-like hot but wet extreme events increase in magnitude and frequency, while the frequency of dry events declines.