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Storyline attribution and projection of the 2020 spatially compounding flood-heat event in southern China

Yang Chen
Chinese Academy of Meteorological Sciences, China (ychen@cma.gov.cn)

Attribution of compound events informs preparedness for emerging hazards. However, the task remains challenging because of complex space-time interactions amongst extremes, climate models' deficiency in reproducing dynamics of various scales, and uncertainties in dynamic aspects of climate change.
During June-July 2020, a historic flood hit the Yangtze River Valley and to its south the hottest summer since 1961 was observed, leading to disproportionate socioeconomic and environmental impacts to southern China. For attributing the recording-breaking spatially compounding event, we conduct a storyline attribution analysis by designing a series of simulation experiments via a weather forecast model, with large-scale dynamics equally constrained and thermodynamics of the climate system modified. We report that given the large-scale dynamic setup, anthropogenic influence has exacerbated the 2020 extreme Mei-yu rainfall by ~6.5% and warmed the southern co-occurring seasonal heat by ~1□. The framework further details human influence on key elements to the two extremes individually and their coupling in space. If the same compound event unfolds in the 2090s, it is plausible to expect the monsoonal rainfall extremes ~14% wetter and the accompanying South China heat ~2.1°C warmer than observed.
This method opens an avenue for attribution of low-likelihood, dynamically-driven, spatially and temporally compounding events.