Scientists reveal evolutions and mechanisms of extreme precipitation along the Yangtze River during summer 2020

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Record-breaking, persistent, and sometimes heavy precipitation fell throughout the Yangtze River Valley (YRV) during June-July 2020. According to Prof. Tim Li, an Atmospheric Scientist at the School of

Ocean and Earth Science and Technology at the University of Hawaii at Manoa, the summer of 2020 was the wettest in the YRV since 1979. Prof. Li, along with climatologists from Nanjing University of Information Science and Technology and National Climate Center, China, conducted extensive research on 2020's extreme summer rainfall, just publishing their findings in *Advances of Atmospheric Sciences*.

Setting out to find the underlying cause of the strong 2020 YRV flood, researchers gained a better understanding of subseasonal and synoptic variabilities within the YRV. They hope that their data will lead to improved forecasting skill before and during monsoon season. To begin their analysis, Prof. Li noted that summer 2020 was preceded by a moderate central Pacific El Niño.

"Previous studies pointed out that on an inter-annual scale, YRV flooding often occurs during the decaying summer of a super El Niño." said Dr. Li. "On the subseasonal scale, the Meiyu rainbelt usually progresses northward from South to North China."

Results of the new research show that the main cause of 2020's extreme YRV rainfall was an unusual, persistent, and extremely strong western North Pacific anticyclone (WNPAC) south of the typical summer Meiyu front. This, alongside a subseasonal northeasterly flow north of the front from Northeast Asia (NEA) caused the front to swing north and south more frequently than an average summer.

Additionally, a La Niña-like SST anomaly (SSTA) in the equatorial Pacific and a warm SSTA in the tropical Indian Ocean maintained the exceptionally strong WNPAC. A fast phase transition from the previous season's El Niño, likely caused the La Niña-like SSTAs, while the latter arose from a combination of a year-to-year and an interdecadal global warming trend component.

"To better improve seasonal and extended-range forecast skill, one needs to consider the impact of the interdecadal component, interannual anomalies, El Niño evolution diversity, and the modulation of the synoptic-scale variability by the subseasonal modes." noted Prof. Li.

Furthermore, the persistent unusual northeasterly flow in NEA was part of a Rossby wave train in the mid-latitudes, driven by combined heating anomalies throughout India, the tropical eastern Pacific, and the tropical Atlantic.

Finally, researchers attributed the Meiyu front's frequent latitudinal swings to both the subseasonal and synoptic-scale motions in the region. These influences mentioned throughout the study increased the interannual background mean moisture, which increased rainfall variability and intensity during summer 2020.

"This study motivates us to consider a new strategy for subseasonal and seasonal predictions." said Prof. Li. "The fast transition of El Niño in earlier 2020 was possibly caused by the teleconnections from other ocean basins such as the tropical Atlantic and Indian Ocean."

Dr. Li also mentioned that inter-basin teleconnections have become a recent hot topic in the climate science community, suggesting a new area for further research.

More information: Liudan Ding et al, Subseasonal and Synoptic Variabilities of Precipitation over the Yangtze River Basin in the Summer of 2020, *Advances in Atmospheric Sciences* (2021). DOI: 10.1007/s00376-021-1133-8

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