

## **Summer monsoon and tropical cyclone rainfall in mainland China and Taiwan since the middle 20th century**

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In this study we examine the long-term trend and decadal variations of rainfall in the China summer monsoon region over the last six decades. The rainfall is also partitioned into tropical cyclone (TC)-related and monsoon-related (non-TC) categories to determine their respective roles in these variations, with a particular focus on extreme rainfall events. The two big islands off the southeastern and southern coast of the Chinese continent, Taiwan and Hainan Island, are most affected by TC activities. Our main results are summarized below: The two principal China summer rainfall EOFs, the South China pattern and the Tri-pole pattern, have strong decadal signals and no discernible linear trends. Rainfall frequency in northern China shows a decreasing trend, mostly related to the reduction of light rain, which has been suggested to be a result of global warming. The southern coastal region also shows a decreasing trend, but it is mainly due to a decrease in typhoon rainfall frequency. Non-typhoon rainfall frequency actually has an increasing trend. The amount and frequency of the two leading EOFs of extreme (90th percentile in intensity) rainfall both show strong decadal signals that are much more prominent than the linear trends. The linear trends in South China average to about 2% increase per decade, ranging from around 20% over 63 years in the middle and lower Yangzi Valley, and slightly less than 10% near the southern coastal regions. However, during the first decade of the 21st century the extreme rainfall in the Yangzi and southern coastal region was decreasing, while in Taiwan the increasing trend continued. In Hainan Island the non-typhoon extreme rainfall also continued the increasing trend. The linear trends of typhoon rainfall indicate a decrease in frequency, up to 1.5 day per decade in the southern coastal region, and an increase in intensity, up to 5 mm/day or more per decade in Taiwan and Northeast China. The net result is a decreasing trend of up to 30 mm or more per decade in typhoon rainfall south of around 22°N -25°N, and a slower increasing trend to the north. Increase of the extreme rainfall in Taiwan accelerated noticeably in the first decade of the 21st century. On the other hand, the extreme rainfall in Hainan Island decreased over the entire 63-year period. They are both due to localized typhoon activities that masked the underlying moderate increases of the extreme monsoon rainfall.