



## **Characterization of extreme flood and drought events in Singapore and investigation of their relationships with ENSO**

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Flood and drought are hydrologic extreme events that have significant impact on human and natural systems. Characterization of flood and drought in terms of their start, duration and strength, and investigation of the impact of natural climate variability (i.e. ENSO) and anthropogenic climate change on them can help decision makers to facilitate adaptations to mitigate potential enormous economic costs. To date, numerous studies in this area have been conducted, however, they are primarily focused on extra-tropical regions. Therefore, this study presented a detailed framework to characterize flood and drought events in a tropical urban city-state (i.e. Singapore), based on daily data from 26 precipitation stations. Flood and drought events are extracted from standardized precipitation anomalies from monthly to seasonal time scales. Frequency, duration and magnitude of flood and drought at all the stations are analyzed based on crossing theory. In addition, spatial variation of flood and drought characteristics in Singapore is investigated using ordinary kriging method. Lastly, the impact of ENSO condition on flood and drought characteristics is analyzed using regional regression method. The results show that Singapore can be prone to extreme flood and drought events at both monthly and seasonal time scales. ENSO has significant influence on flood and drought characteristics in Singapore, but mainly during the South West Monsoon season. During the El Niño phase, drought can become more extreme. The results have implications for water management practices in Singapore.