

EGU21-370, updated on 23 Jan 2022

<https://doi.org/10.5194/egusphere-egu21-370>

EGU General Assembly 2021

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Droughts and Floods Captured by Land Water Storage in Chao Phraya River Basin during 2002-2017

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Frequent droughts and floods in the Chao Phraya river basin, which contributes about 66% to Thailand's GDP, have cost the country's socio-economic development in several ways. We quantified the Land Water Storage (LWS) in the basin using the three data products, i.e., two mascons and one spherical harmonic in terms of anomaly time series of equivalent water depth or volume, from the Gravity Recovery and Climate Experiment (GRACE) satellite data from April 2002 to June 2017. Since all three data products were highly correlated ($r > 0.9$), the arithmetic mean was used to avoid bias in any particular product. LWS showed a linear trend of 9.8 mm/yr equivalent to 1.6 km³/yr in the basin. The flood and drought events were also well captured by the LWS dynamics in the basin. The severe floods of 2011, primarily resulting from the heavy rainfall of 1439 mm, which was 143 % of the long-term average in the rainy season, led to a maximum value of 430 mm (68.8 km³) in the LWS anomaly during September 2011. The drought in March 2016 was also evident with a minimum LWS anomaly of -334 mm (-53.44 km³). All the multi-year flood and drought years were recorded in the LWS time series with a lag of up to two months from rainfall. Since the minimum rain during the dry periods (i.e., November to April) was almost consistent, the extreme events were supposed to be triggered mainly by the variable maximum rainfall occurring during the monsoon season. The methodology can be used for efficient water management and policymaking in the data-scarce river basins globally. Future work includes filling the data gap between GRACE and GRACE Follow-On data, followed by the assessment of anthropogenic impacts (i.e., groundwater abstraction and reservoir management) on water storage dynamics in the basin.