

EGU21-12258

<https://doi.org/10.5194/egusphere-egu21-12258>

EGU General Assembly 2021

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Trends in mean and extreme rainfall over Mainland Southeast Asia associated with warming-driven trends in evaporation

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Rain-gauge datasets indicate strong increases in both annual mean and extreme precipitation over large parts of the Mainland Southeast Asia (MSEA) including Vietnam and the northwestern part of the peninsula over the last 40 years. Increasing precipitation is associated with increased monsoon intensity in southeast Asia and a northward shift of the monsoon activity centre towards MSEA. Warming-driven evaporation increases over the three main oceanic moisture sources - the Arabian Sea, the Bay of Bengal, and the South China Sea- may partially explain increasing precipitation in large parts of MSEA. Changes in the patterns of the two main modes of natural variability in the tropical Indian Ocean – the Indian Ocean Basin Mode (IOBM) and the Indian Ocean Dipole (IOD) – contribute to surface warming in these oceanic moisture source regions supplying precipitation to MSEA. Climate model projections show robust wide-spread trends in wet season precipitation with increasing frequency and intensity of extreme precipitation events throughout MSEA over the 21st century. Similar to observations, the projected precipitation trends are associated with strong warming-driven increases in evaporation in all major oceanic moisture sources supplying precipitation to MSEA.