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# Significant influences of global mean temperature and ENSO on extreme rainfall over Southeast Asia

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Along with the increasing concerns on the consequences of global warming, and the accumulating records of disaster related to heavy rainfall events in Southeast Asia, this study investigates whether a direct link can be detected between the rising global mean temperature, as well as the El Niño–Southern Oscillation (ENSO), and extreme rainfall over the region. The maximum likelihood modeling that allows incorporating covariates on the location parameter of the generalized extreme value (GEV) distribution is employed. The GEV model is fitted to annual and seasonal rainfall extremes, which were taken from a high-resolution gauge-based gridded daily precipitation data covering a span of 57 years (1951–2007). Nonstationarities in extreme rainfall are detected over the central parts of Indochina Peninsula, eastern coasts of central Vietnam, northwest of the Sumatra Island, inland portions of Borneo Island, and on the northeastern and southwestern coasts of the Philippines. These nonstationarities in extreme rainfall are directly linked to near-surface global mean temperature and ENSO. In particular, the study reveals that a kelvin increase in global mean temperature anomaly can lead to an increase of 30% to even greater than 45% in annual maximum 1-day rainfall, which were observed pronouncedly over central Vietnam, southern coast of Myanmar, northwestern sections of Thailand, northwestern tip of Sumatra, central portions of Malaysia, and the Visayas island in central Philippines. Furthermore, a pronounced ENSO influence manifested on the seasonal maximum 1-day rainfall; a northward progression of 10%–15% drier condition over Southeast Asia as the El Niño develops from summer to winter is revealed. It is important therefore, to consider the results obtained here for water resources management as well as for adaptation planning to minimize the potential adverse impact of global warming, particularly on extreme rainfall and its associated flood risk over the region.

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