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Can global warming strengthen the East Asian Summer Monsoon?

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The Indian summer monsoon (ISM) tends to be intensified in a global warming scenario with a weakened linkage with El Niño-Southern Oscillation (ENSO), but how the East Asian summer monsoon (EASM) responds to is still an open question. This study investigates the responses of the EASM from observations, theoretical and modeling perspectives. Observational and theoretical evidences demonstrate that in contrast to the dramatic global warming trend within the past fifty years, the regional-mean EASM rainfall is basically dominant by considerable inter-annual to decadal fluctuations, concurrent with enhanced precipitation over the middle-lower reaches of the Yangtze River-southern Japan and suppressed rainfall amount over South China Sea-Philippine Sea. From 1958 through 2008, the EASM circulation exhibits a southward shift in its major components (the subtropical westerly jet stream, the western Pacific subtropical high, the subtropical Meiyu-Baiu-Changma front and the tropical monsoon trough). Such a southward shift is quite likely or in part due to the meridional asymmetric warming with most prominent surface warming in the mid-high latitudes (45°–60°N) which induces a weakened meridional thermal contrast over East Asia. Another notable feature is the enhanced ENSO-EASM relationship within the past fifty decades, which is opposite to the ISM. Fourteen state-of-the-art coupled models from Intergovernmental Panel on Climate Change (IPCC) show that the EASM strength does not respond any pronounced trend to the global warming A1B forcing (with atmospheric CO2 concentration of 720 ppm) but inter-annual to decadal variations in 21st century (2000–2099). These results indicate that the primary response of the EASM to a warming climate may be the position change instead of the intensity change and such position change may lead to spatial co-existence of floods and droughts over East Asia as observed in the past half century.