

EGU24-7608, updated on 20 May 2024

<https://doi.org/10.5194/egusphere-egu24-7608>

EGU General Assembly 2024

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Future projection of East Asian Summer Monsoon precipitation under 1.5°C, 2°C, and 3°C global warming levels

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The East Asian summer monsoon (EASM) is an influential climate system that contributes to approximately 70% of the annual precipitation in the Asia region. Extensive research has been conducted on monsoon changes in response to future climate. In this study, we analyzed the characteristics of the EASM considering specific global warming level (GWL) using Coupled Model Inter-comparison Project 6 (CMIP6) simulations. The 30 CMIP6 models effectively captured the migration of the monsoon in present-day (PD), showing a pattern correlation coefficient of 0.91, which represents an improvement over values reported in previous studies. Dividing the monsoon period into P1 (first primary peak; 33-41 pentad) and P2 (from P1 to the withdrawal; 42-50 pentad), the frequency and amount of weak to moderate precipitation rates are predominantly higher in P2, while the frequency and amount of moderate to extreme precipitation rates are notably higher in P1. The CMIP6 models project a significant increase in precipitation under a warming climate, accompanied by a longer duration due to earlier onset and delayed termination. Under the three GWLs, the projected precipitation frequency decreases below moderate precipitation rates, while it significantly increases above strong precipitation rates. Additionally, the precipitation tendencies in both P1 and P2 are similar to those of the total period, with significant changes evident at the 3.0 °C GWL. These precipitation changes are associated with an increase in precipitation amount above the 97th percentile and influence the future changes in the EASM under a warmer climate.