

EGU24-2663, updated on 19 May 2024

<https://doi.org/10.5194/egusphere-egu24-2663>

EGU General Assembly 2024

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Projected Increase in Probability of East Asian Heavy Rainy Summer in the 21st Century by CMIP5 Models

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In the summer of 1998, heavy rainfall persisted throughout the summer and resulted in a severe prolonged flooding event over East Asia. Will a similar rainy summer happen again? To date, many studies have investigated projected changes in the seasonality or daily extreme precipitation events over East Asia; however, few studies have focused on the changes in extreme summer-averaged East Asian rainfall. This type of summer is referred to as a “heavy rainy summer (HRS)” in this study, and an investigation of future changes in its probability is performed by analyzing CMIP5 model outputs in historical climate simulation (HIST) and under RCP4.5 and RCP8.5.

All models project increased probabilities of HRS by a factor of two to three. The projected East Asian summer rainfall (EASR) ($EASR_{RCP5} - EASR_{HIST}$) in both climatology and HRS is expected to intensify significantly. The increased EASR could be attributed to significantly intensified water vapor transport (WVT) originating from the tropical Indian Ocean (TIO) and the eastern subtropical North Pacific (SNP), which is a result of the thermodynamic component. The WVT from the TIO would supply more moisture for EASR because of its stronger intensity and faster rate of increase. Meanwhile, the EASR anomaly in HRS relative to climatology ($EASR_{HRS} - EASR_{CLM}$) would increase by approximately 11%–33%. In HIST, the associated WVT anomaly, caused only by the dynamic component, converges moisture from adjacent land and ocean. However, under the RCPs, the WVT anomaly from the TIO, resulted from the thermodynamic component, would appear and increase by a factor of three to be comparable to the WVT anomaly from the eastern SNP. The latter would result from the dynamic component but increase by only half.