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The uncertainty of East Asia summer rainfall among CMIP5 models

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Based on the results of 46 Coupled model intercomparison project phase 5 (CMIP5) models and empirical orthogonal function, we found that the leading diversity mode of East Asia summer rainfall among the models features dipole structure: intensified rainfall over south China and south of Japan, and weakened rainfall over North China. It explains more than 1/3 of the total intermodel variance. The air-sea interaction uncertainty over the tropical North Pacific is an important source leading to the leading diversity mode. Inadequate rainfall over the tropical Northwest Pacific excites wave activities propagate northwards and converges south of Japan in mid-troposphere. In mid-troposphere positive (negative) vorticity resides north (south) of rainfall diversity center. Correspondingly, the westerly resides over the rainfall diversity center. The westerly induces ascendance and the rainfall diversity as well as the ascendance-rainfall feedback.
Besides, the rainfall south of Japan induces rainfall change over North China, which in turn promotes the former rainfall. Anomalous latent heating associated with the rainfall induces anomalous northerly or northeasterly over North China. It brings dry air to North China, favors the weakened evaporation and consequently depresses the rainfall. The rainfall excites upper-troposphere vorticity response to the west, which excites wave activity propagates southeastwards and downwards. In mid-troposphere, the wave converges south of Japan and reinforces the westerly and the rainfall diversity there.