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East Asian summer monsoon circulation structure controlled by feedback of condensational heating

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The East Asian summer monsoon (EASM) features strong humid low-level southerly flows and abundant rainfall over the subtropical East Asia. This study identified how condensational heating generated by the EASM rainfall can affect the EASM circulation by contrasting two 10-member ensembles of atmospheric GCM experiments with CCM3/NCAR respectively with and without feedback of condensational heating over the East Asian domain. Major results inferred from the experiments are as follows. Condensational heating is found to absolutely dominate diabatic heating over East Asia. Exclusion of the feedback of condensational heating leads to a significant weakening of summertime tropospheric warming over land and thus a large reduction of the land-sea thermal contrast between entire Asian continent and surrounding oceans. Associated with this, the lower-level EASM flows are weakened, South Asian High at 200hPa migrates southward with reduced intensity and breaks over East Asia with southerly flows prevailing in the upper troposphere, in contrast to northerly flows in reality. Consequently, local EASM meridional cell disappears and the baroclinic structure featured by the EASM circulation that is dynamically determined by convective condensational heating over East Asia is altered to a barotropic structure. Therefore, it is concluded that the feedback of condensational heating acts to largely enhance lower-level flows of the EASM and essentially determine its baroclinic structure and meridional cell, once the solar radiation and inhomogeneity of the Earth's surface form low-level monsoon flows in East Asia by enhancing land-sea thermal contrast.