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The Impact of Layer Perturbation Potential Energy on the East Asian Summer Monsoon

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The relationship between the 1000–850-hPa layer perturbation potential energy (LPPE) as the difference in local potential energy between the actual state and the reference state and the East Asian summer monsoon (EASM) is analyzed using reanalysis and observational datasets. The results show that the EASM variability is closely related to the first-order moment term of LPPE (LPPE1) from the preceding March to the boreal summer over three key regions: the eastern Indian Ocean, subtropical central Pacific, and midlatitude East Asia. The LPPE1 pattern (-2, +, +), with negative values over the eastern Indian Ocean, positive values over the subtropical central Pacific, and positive values over East Asia, corresponds to negative LPPE1 anomalies over the south of the EASM region but positive LPPE1 anomalies over the north of the EASM region, which lead to an anomalous downward branch over the southern region but an upward branch over the northern region. The anomalous vertical motion affects the local meridional circulation over East Asia that leads to a southwesterly wind anomaly over East Asia (south of 30N) at 850 hPa and anomalous downward motion over 100–120E (along 25–35N), resulting in a stronger EASM, more kinetic energy over the EASM region, and less boreal summer rainfall in the middle and lower reaches of the Yangtze River valley (24–36N, 90–125E). These LPPE1 anomalies in the eastern Indian Ocean and subtropical central Pacific appear to be connected to changes in local sea surface temperature through the release of latent heat.