



## **Characteristics and mechanism of sub-seasonal zonal oscillation of western Pacific subtropical high and South Asian high**

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The Asian monsoon circulations, like the western Pacific subtropical high (WPSH) at 500hPa and South Asian high (SAH) in the upper level, demonstrate sub-seasonal zonal oscillation. The WPSH is characterized by anomalously westward extension of its western edge with anomalous low-level anti-cyclonic circulation over the coastal region prior and eastward retreat with low-level cyclonic anomalies afterward, contributing persistent heavy rainfall over the Middle-lower reaches of the Yangtze River Valley. The coastal SST anomalies linked with zonal movement of WPSH shows cooling phase to warming phase variations. A local air-sea interaction on sub-seasonal time-scale in the western North Pacific region, which may be responsible for generating WPSH's sub-seasonal zonal oscillation.

The SAH's eastward extension is featured by eastward propagation of wavetrain across the Eurasian continent. When the SAH extends to its easternmost position, a strong negative PV (positive geopotential height) center prevails to the east of the Tibetan Plateau at 200hPa. The causes of SAH's eastward extension are examined by performing potential vorticity (PV) diagnosis with emphasis on the joint role of diabatic heating feedback/rainfall and midlatitude wavetrain. The PV diagnosis indicates that the anomalous heating/rainfall and ascending motion generate negative PV anomalies at 200hPa directly over north China-east Mongolia. While anomalous cooling and descending motion produce positive PV anomalies over south China. Those south/north dipolar structure of PV generation indicates large value of meridional gradient of PV anomalies. As a consequence, the negative PV anomalies over the north lobe are transported southwardly by the advection of climatological northerly located to the east and southeast of the Tibetan Plateau.