Influence of the Tibetan Plateau on the Asian Climate

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The influence of a large-scale orography on climate depends not only on its mechanical forcing and thermal forcing which it exerts on the atmosphere, but also on the background atmospheric circulation. This presentation provides a review on the traditional relevant theoretical studies, as well as the application of Potential vorticity theorem in the research.

Empirical Orthogonal Function analysis demonstrates in winter the Tibetan Plateau possesses two leading heating modes. However, Diagnosis and numerical modeling indicate that these heating modes result from the relevant dominant atmospheric circulations, in particular the Northern Atlantic Oscillation and the North Pacific Oscillation. The prevailing effect of the mechanical forcing of the Tibetan Plateau in wintertime generates a dipole type of circulation, in which the anticyclonic gyre in middle and high latitudes contributes to the warm air of the inland area to the west, and the cold air of the seashore area to the east, of the northeast Asia. Whereas the cyclonic gyre in low latitudes contributes to the formation of prolonged dry season over middle and south Asia and moist climate over southeastern Asia. Such a dipole circulation also generates a unique persistent rainfall in early spring (PRES) over South China.

The thermal forcing of the Tibetan Plateau on the lower tropospheric circulation looks like a Sensible Heat driven Air Pump (SHAP). In spring the SHAP contributes to the seasonal abrupt change of the Asian circulation, and anchors the earliest Asian summer monsoon onset at the eastern Bay of Bengal. In summer, this pumping, together with the thermal forcing over the Iran Plateau, produces a bimodality in the South Asian High activity in the upper troposphere, which is closely related with the climate anomaly patterns over South and East Asia.

Because the isentropic surfaces in the middle and lower troposphere intersect with the Tibetan Plateau, in summertime, the Plateau becomes a strong negative vorticity source of the atmosphere, and affects the surrounding climate and even the northern hemispheric circulation via energy dispersion of the Rossby Wave.