The holistic correlations of the Asian-Pacific summer monsoon system

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The interactions among the Asian-Pacific monsoon subsystems have significant impacts on the climatic regimes in the monsoon region and even the whole world. Using the meteorological data, including precipitation, wind vector and water vapor transport, etc., the holistic correlations of the Asian-Pacific summer monsoon system have been studied in detail. It is found that the Asian-Pacific summer monsoon emerges the decreasing characteristics on the interdecadal timescale during recent 55 years, especially the subsystem of East Asian summer monsoon (EASM). While on the interannual timescale, the subsystems of the Asian-Pacific summer monsoon have synchronous variability with the cycle of two-to-three-year (Fig.1), and the water vapor transport which represents the summer monsoon is more significantly consistent than 850hPa wind field (Fig.2). The second EOF modes of the sea level pressure and the vertical integrated atmospheric heat source also exhibit the same characteristics of holistic consistency on the interannual timescale. In other word, when the Indian summer monsoon (ISM) is anomalous strong, the monsoon rainfall belt will be strong and northerly anomaly, bringing more precipitation in the northern-central Indian continent. EASM is also stronger than normal in the same year, with northward moving of the western Pacific subtropical high (WPSH), which pushes the monsoon belt northward to northern China. Because of the WPSH's northerly anomaly and the ISM's anomalous easterly extension, an anomalous cyclone circulation occurs over the western North Pacific in 10°N-30°N, that is, the inter tropic convergence zone (ITCZ) is much stronger and more easterly than normal, making more precipitation than normal here. But all of them will turn into weaker than normal in the next year.

The tropospheric biennial oscillation (TBO) may be an inherent cycle in the Asian-Pacific summer monsoon system, which is closely associated with the

atmosphere-ocean interaction over the warm ocean surfaces, mainly reflecting a kind of the influence of the ENSO event on the Asian-Pacific summer monsoon system (Fig.3&4).

Keywords: Asian-Pacific summer monsoon; Indian summer monsoon (ISM); East Asian summer monsoon (EASM); western North Pacific summer monsoon (WNPSM); teleconnection; tropospheric biennial oscillation (TBO)



Fig.1 The first(left) and second(right) EOF eigenvector of the 850hPa wind vector (upper) and corresponding time coefficient from 1951 to 2005 (bottom)



Fig.2 The first(left) and second(right) EOF eigenvector of the vertical integrated summer water vapor transport (upper) and corresponding time coefficient from 1951 to 2005 (bottom)



Fig. 3 Composite SST seasonal evolutions in the strong monsoon years (a, DJF piror to the strong monsoon years; b, MAM; c, SON; d, DJF; and the dash boxes denote the Nino-3 region and the IOD key areas, respectively)



Fig.4 Schematic diagram of ocean-atmosphere interaction in the positive TBO period of the Asian-Pacific summer monsoon (the green shaded areas denote the positive correlation with the Asian-Pacific summer monsoon rainfall; the black arrows denote the 85hPa atmospheric circulation anomaly; the gray areas denote anomalous water vapor convergence; and the red/blue curves denote SST anomaly)