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Interdecadal shift in the relationship between the East Asian summer monsoon and tropical SST

J. Li (1), R. Ding (1), Z. Wu (2), J. Feng (1), and K. Ha (3)

(1) LASG, Institute of Atmospheric Physics, Chinese Academy of Sciences, LASG, Beijing, China (ljp@lasg.iap.ac.cn, 86 10 82995172), (2) Meteorological Research Division, Environment Canada, Dorval, Quebec, Canada, (3) Division of Earth Environmental System, Pusan National University, Busan, Korea

Interdecadal shift in the interannual relationship between the East Asian summer monsoon (EASM) and the tropical sea surface temperature (SST) anomalies (SSTA) is investigated. The result shows that a notable feature is the enhanced relationship between the previous winter El Niño–Southern Oscillation (ENSO) and the following EASM in the past 60 years, which is opposite to the weakening relationship between the Indian summer monsoon (ISM) and ENSO since 1970s. It is also found that pronounced changes in the interannual relationship between the EASM and summer SSTA over the tropical Indian Ocean (IO) happen in the late 1970s. Besides, an enhanced relationship between the previous autumn-winter SSTA over western tropical IO and the following EASM occurs in the late 1970s.

The observational and numerical evidences manifest that spring North Atlantic Oscillation (NAO) may exert notable impacts on the enhancement of the EASM–ENSO relationship. Anomalous spring NAO induces a tripole SSTA pattern in North Atlantic which persists into ensuring summer. The tripole SSTA excites downstream teleconnections of a distinct Rossby wave train prevailing over the northern Eurasia and a simple Gill-Matsuno-type quadrupole response over western Pacific. The former modulates the blocking highs over the Ural Mountain and the Okhotsk Sea. The latter enhances the linkage between the western Pacific subtropical high (WPSH) and ENSO. The co-effects of the two teleconnection patterns help to strengthen (or weaken) the subtropical Meiyu-Baiu-Changma front, the primary rain-bearing system of the EASM. As such, spring NAO is tied to the strengthened connection between ENSO and the EASM.

It can be seen from the correlations of the EASM index (EASMI) with the summer IO SSTA between 1953–1975 and 1978–2000 that the SSTA pattern similar to the positive Indian Ocean Dipole (IOD) shows a strongly positive correlation with the EASMI in 1953–1975, but in 1978–2000, significant negative correlation appears in the northern IO and the IOD-like correlation pattern disappears. The summer strong IOD events in 1953–1975 can cause a weaker-than-normal western North Pacific (WNP) subtropical high, which tends to favor a strong EASM. In 1978–2000, the connection between the summer IOD and the WNP circulation is disrupted by the climate shift. Instead, the northern IO shows a close connection with the WNP circulation in 1978–2000. The warming over the northern IO is associated with the significant enhanced 500 hPa geopotential height and an anomalous anticyclone over the WNP. The change in the IO–EASM relationship is attributed to the interdecadal change of the background state of the ocean–atmosphere system and the interaction between the ENSO and IO. It is indicated that the strengthened ENSO–EASM relationship has likely also contributed to the strengthened relationship between the northern IO and the EASM in 1978–2000.

What causes the enhanced relationship between the previous autumn-winter SSTA over western tropical IO and the following EASM since in the late 1970s awaits further investigation.