东亚夏季风对热带海温变化的响应及机理研究

于甜甜，陈文，冯娟，黄平 yutiantian@mail.iap.ac.cn

Center for Monsoon System Research, Institute of Atmospheric Physics, Chinese Academy of Sciences, Beijing 100029, China

The Interdecadal Change of the Relationship Between North Indian Ocean SST and Tropical North Atlantic SST

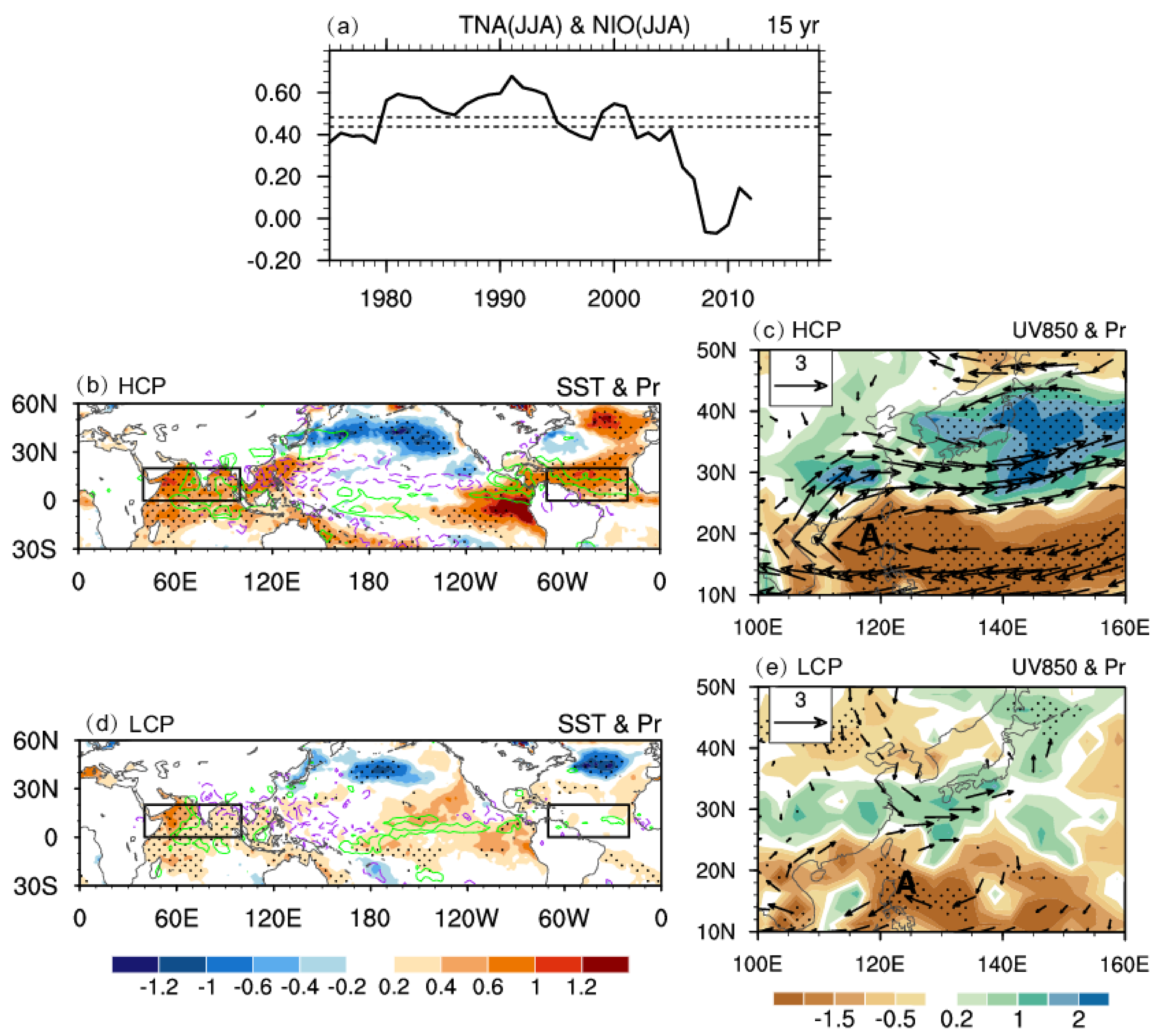

FIGURE 1. (a) 15-year sliding correlation coefficients of the JJA TNA index with the NIO index. The dashed lines indicate the 90% and 95% confidence levels, respectively. Composite differences of JJA SST anomalies (°C), precipitation anomalies (shading; mm/day) and 850-hPa wind anomalies (vectors; m s $^{-1}$) between positive and negative cases during (b, c) High Correlation Period (HCP) and (d, e) Low Correlation Period (LCP) during 1980–2020. The green (purple) contour lines in (b, d) represent the positive (negative) precipitation anomalies, respectively. The contour interval is 2 mm/ day. The dots indicate the composite differences are above the 95% confidence levels. The boxes shown are the NIO (0°–20°N, 40°E−100°E) and TNA (0°–20°N, 70°W–20°W) regions, respectively. Winds anomalies exceeding the 95% confidence level are shown. The letters "A" indicate the anticyclonic anomalies.

The summertime North Indian Ocean (NIO) and tropical North Atlantic (TNA) sea surface temperature (SST) anomalies exert important impacts on the East Asian summer monsoon (EASM). The NIO–TNA SST relationship experiences an obvious interdecadal change around the early 2000s. The NIO and TNA SST correlation is positive and significant before the early 2000s, while this connection becomes weak and insignificant after that. This interdecadal change is closely associated with the changes in the El Niño-Southern Oscillation (ENSO) intensity.

Weakened influence of ENSO on the East Asian summer monsoon since the early 2000s

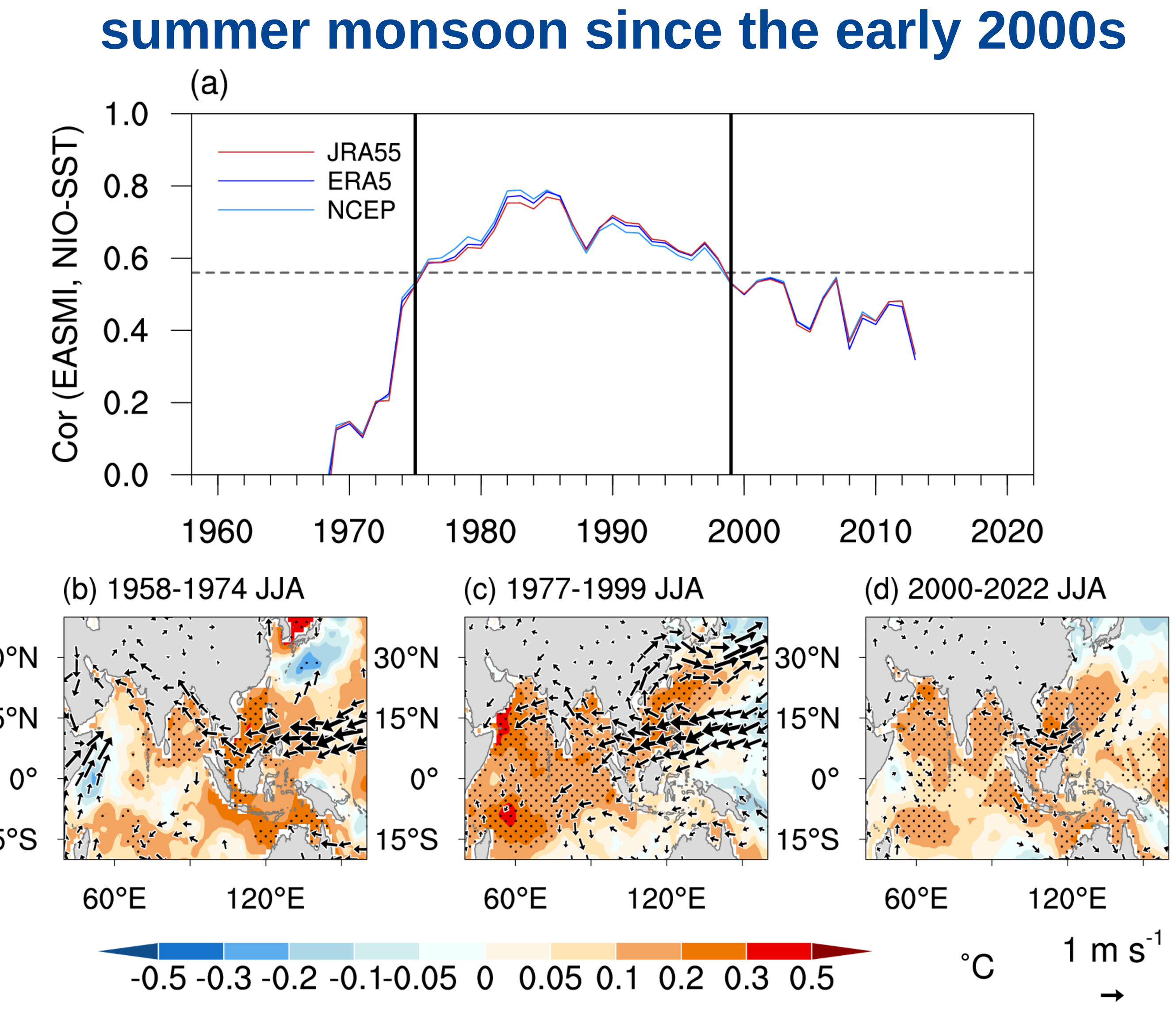

FIGURE 3. **Recent interdecadal changes in the impacts of ENSO on the EASM.** a The 19-yr sliding correlation between the JJA mean EASMI and NIO-SST index over the region (5°–25°N, 40°–100°E) based on the JRA55, ERA5 and NCEP datasets. b–d SST anomalies (shading) and 850-hPa wind anomalies (vectors) regressed onto the Niño-3.4 index during (b) 1958–1974, (c) 1977–1999 and (d) 2000–2022. SST anomalies exceeding the 95% confidence level are dotted, and only significant wind anomalies are shown.

Recent interdecadal changes in the Tropospheric Biennial Oscillation of the East Asian summer monsoon

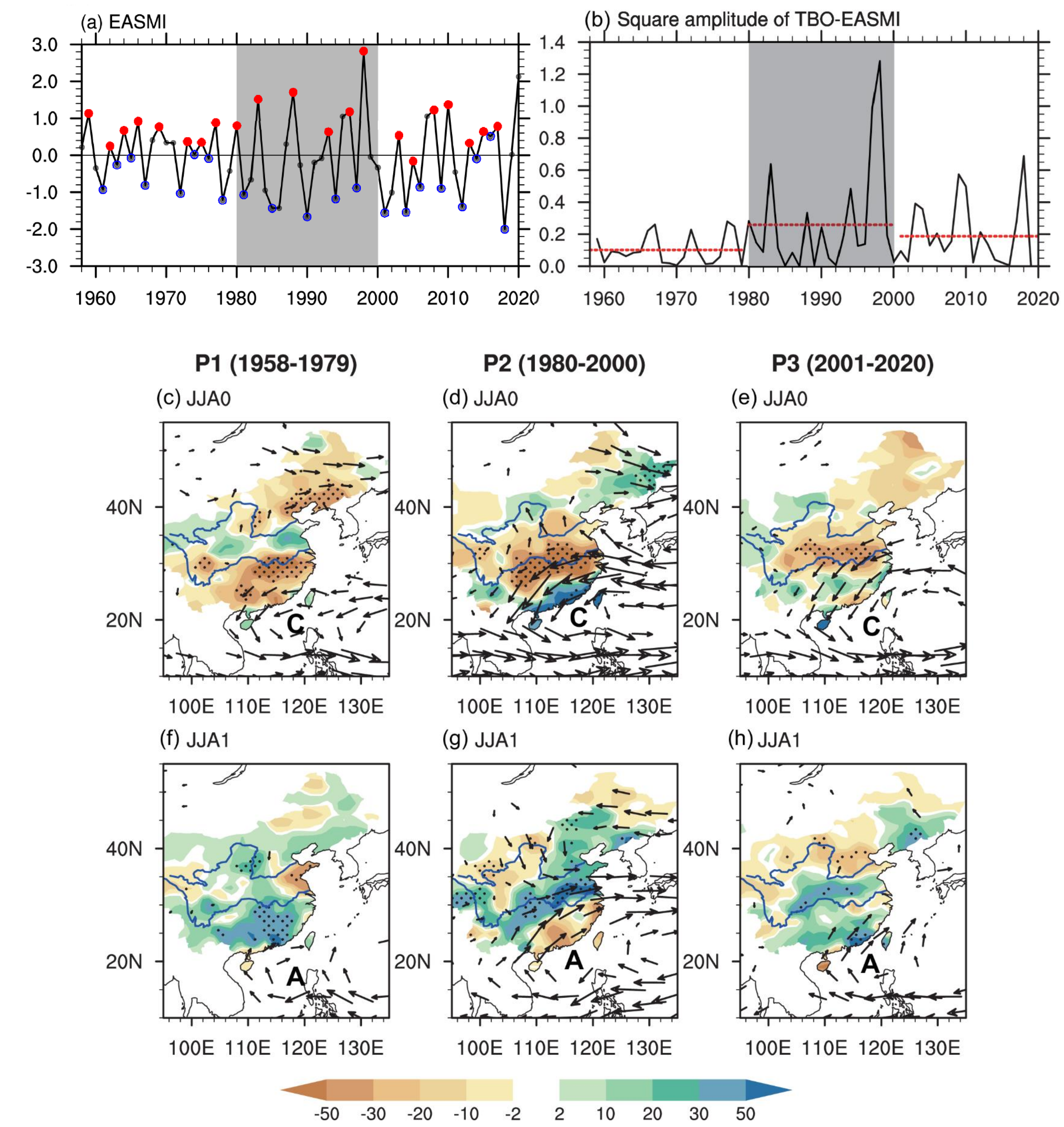

FIGURE 2. (a) Time series of the summer (JJA) mean EASM index in the period 1958–2020. Solid dots indicate strong (red) and weak (blue) TBO years when the EASM is stronger or weaker than the preceding and following years, respectively. (b) Square amplitude of the TBO bandpass-filtered EASM index. The red lines indicate the amplitude averaged during P1 (1958–1979), P2 (1980–2000) and P3 (2001–2020). (c-h) Differences in 850-hPa wind anomalies (vectors; m s−1) and summer rainfall of 160 stations over China (contours; mm/month) between the composites of the weak and strong TBO cases in JJA(0) and JJA (1) during (c, f) P1, (d, g) P2 and (e, h) P3, respectively. Dots indicate composite differences significant at the 95% confidence level. Wind anomalies exceeding the 95% confidence level are shown. The letters "A" and "C" indicate the anticyclonic and cyclonic anomalies, respectively.

This paper focuses on the interdecadal changes in the biennial EASM transition related to the Tropospheric Biennial Oscillation (TBO), which has major impacts on East Asian climate. During 1958–2020, the TBO signal in the EASM exhibits noticeable interdecadal changes around the late 1970s and late 1990s. Among the three periods [1958–1979 (P1), 1980–2000 (P2), 2001–2020 (P3)], the TBO signal is the strongest in P2 and the weakest in P1. Further analysis indicates that the regime shifts in ENSO properties, including intensity, period, and location of ENSO-related SST anomalies, play a crucial role.

ENSO was identified as the dominant factor influencing the EASM, especially after the mid-1970s when the tropical Indian Ocean (TIO) response remarkably strengthened. Here, we find that the influence of ENSO on the EASM has been diminishing since the early 2000s. The EASM in wind anomalies associated with the positive phase of ENSO undergoes a dramatic transition from an anticyclone over the western North Pacific (WNPAC) in July to a cyclone over the western North Pacific (WNP) in August, accompanied by generally opposite rainfall anomalies. These weakened EASM responses are closely linked to the changes in ENSO's rate of decay around the early 2000s.

Yu, T., Feng, J., Chen, W., Hu, K., & Chen, S. (2022). Enhanced tropospheric biennial oscillation of the East Asian summer monsoon since the late-1970s. *Journal of Climate*, 35(5): 1613–1628.

Yu, T., Chen, W., Huang, P., Feng, J., & Jiang, N. (2022). Recent interdecadal changes in the Tropospheric Biennial Oscillation of the East Asian summer monsoon. *Atmospheric Research*, 277: 106301.

Yu, T., Feng, J., Chen, W., & Chen, S. (2022). The interdecadal change of the relationship between North Indian Ocean and tropical North Atlantic SST. *Journal of Geophysical Research: Atmospheres*, 127(16)