The Tropospheric Biennial Oscillation in the East Asian Monsoon Region and Its Influence on the Precipitation in China and Large-Scale Atmospheric Circulation in East Asia

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1. Introduction

This study focuses on the TBO in the East Asian subtropical monsoon region. Based on a season-dependent EOF analysis approach, we have revealed the spatial-temporal evolutive characteristics of the TBO in the EAM region and its influence on the precipitation and the large-scale atmospheric circulation in China.

2. The biennial oscillation of the precipitation in China

The precipitation in China manifest a remarkable biennial signal. For interannual variability, about 70% stations over China indicate the dominance of a quasi-2-yr period. And the maximum TBO rainfall variability is located over the Yangtze River and Huaihe River valleys as well as South China. To reveal the seasonal evolution of the precipitation over China associated with the TBO, the S-EOF analysis is applied to the observed summer rainfall anomalies. Figure 1 shows the seasonal evolution of the first two TBO mode (a. S-EOF1, b. S-EOF2) derived from the precipitation anomalies over China associated with a first half cycle (from JJA0 to JJA1) of the TBO.

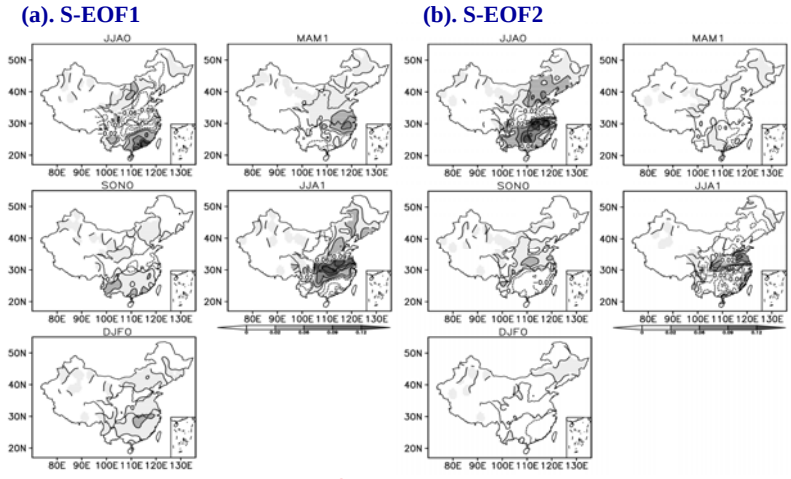

Fig. 1 The first two TBO mode

3. Possible TBO mechanisms in the EAM region

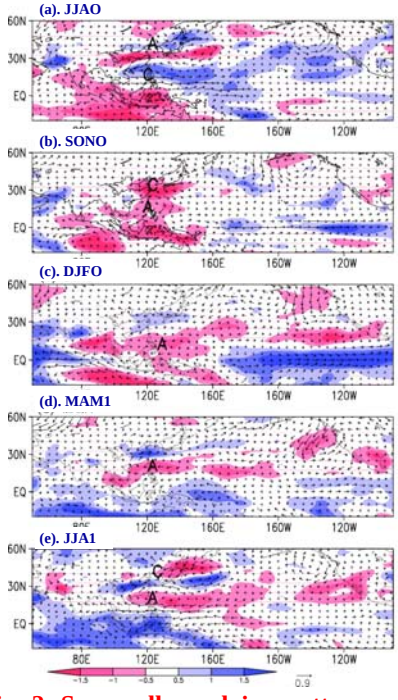

Fig. 2. Seasonally evolving patterns of 850-hPa wind (vector, m/s) and rainfall (shading, mm) anomalies associated with a first half cycle of the TBO regressed upon the S-EOF1 mode.

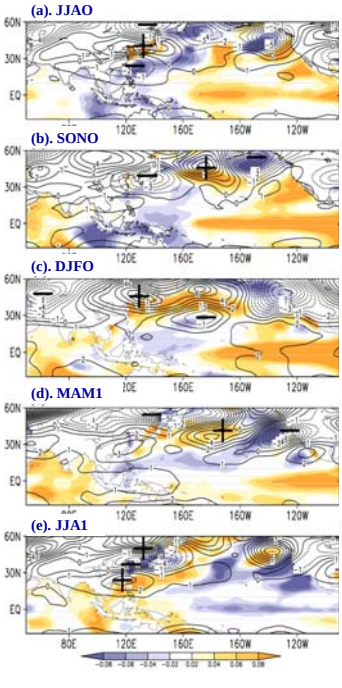

Fig. 3. Same as Figure 2, except for 500-hPa geopotential height (contours, dgpm)and SST (shading, ºC).

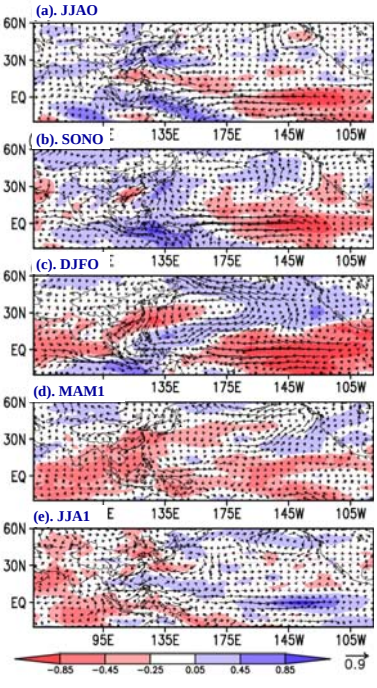

Fig.4. Same as Figure 2, except for the S-EOF2 mode.

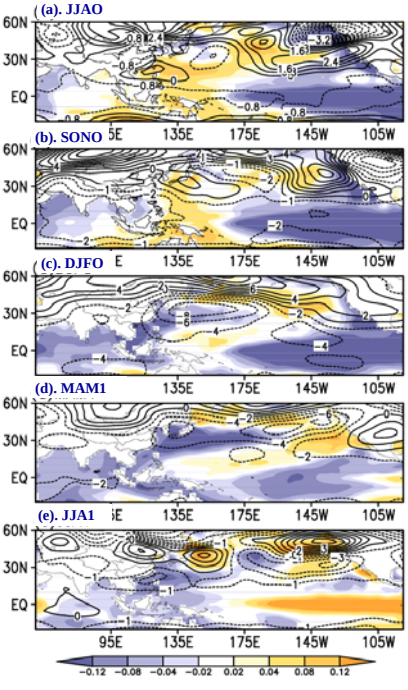

Fig.5. Same as Figure 3, except for the S-EOF2 mode.

The leading modes of the TBO in East Asia may be determined by the meridional teleconnection Rossby wave pattern extending from the WNP to the midlatitudes of East Asia that is forced by the heating source fluctuation over the WNP. And the cold air activity, which is associated the East Asian winter monsoon, may further influence the leading modes of the TBO through a modulation of the large-scale circulation over East Asia during the following boreal summer. The TBO in East Aisa depends on both the large-scale air-sea coupling over the tropical Indo-Pacific Ocean regions and the tropical-midlatitude interaction in the WNP-East Asia region. A fundamental element for the TBO in East Asia is the WNP monsoon. It is not only an important component of the TBO cycle in the tropics, but also serves as a major source of the TBO signal for the subtropical East Asia. The meridional teleconnection Rossby wave train over the WNP-East Asia region acts as a conveyer belt that transports the tropical TBO signal to the midlatitudes of East Asia, and produces the TBO footprints in the circulation and precipitation in East Asia. Furthermore, the cold air activity over the East Asia during summer also services as an important link in the chain events of the tropical-midlatitude interaction, with enhancing the role of the TBO modes in East Asia.