1A.6 INTERANNUAL RELATIONSHIPS BETWEEN THE TROPICAL SST AND SUMMERTIMEANTICYCLONE OVER THE WESTERN PACIFIC

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1. Introduction

Accompanying with El Niño, the low-level anomalous anticyclone (AAC) over the tropical western North Pacific (WNP) persists from El Niño developing September-October-November, SON(0) through JJA(1). The anomalous western North Pacific anticyclone (WNPAC) is attributed to a Rossby wave response to WNP cold sea surface temperature anomaly (SSTA) maintained by Wind-Evaporation-SST (WES) feedback, which involves monsoon northeasterly (e.g., Wang et al., 2000).

However, the monsoon northeasterly retreats in boreal summer. Some studies proposed that IO SST acts like a capacitor to maintain the WNPAC (Xie et al. 2016). Others proposed that the interbasin contrast between IO warming and West Pacific cooling contributes to the WNPAC (Wang et al. 2013).

An analysis by Chung et al. (2011) showed summertime WNPAC follows ENSO evolution at two distinct time scales. The AAC in 2–3 year oscillation resides in the sinking branch of the local Hadley circulation because of enhanced convection over the Maritime Continent. The AAC in 3–5 year oscillation is a Rossby wave response to a persistent regional cold SSTA over its southeastern flank. It is conceived that the WNPAC in JJA(1) is maintained by different mechanisms under different conditions of ENSO. This study analyzes the evolution of SST distribution and AAC in different kinds of El Niño decaying summer.

2. Data and Classification of El Niño

The reanalysis data is combined from monthly data of the 40-yr European Centre for Medium-Range Weather Forecasts (ECMWF) Re-Analysis (ERA-40) and ECMWF Re-Analysis Interim (ERA-Interim). The horizontal grid size of ERA-Interim is linearly interpolated from 1.5° by 1.5° to 2.5° by 2.5° to be consistent with that of ERA-40. We average values during 1979Jan to 2002Aug from each product, and obtain a longer dataset covering from 1958Jan to 2016Dec. To represent the large-scale atmospheric heating, vertically-integrated (surface to 100-hPa) apparent moisture sink (Q2) is calculated from the 6-hourly reanalysis data. Sea surface temperature (SST) data is from National Oceanic and Atmospheric Administration’s Extended Reconstructed SST (ERSST) version 4. Anomaly is calculated as the deviation from monthly mean of 1958-2016 climatology, the linear trend is removed, and 3-month running mean is applied.

El Niño events from 1958-2016 are identified based on Oceanic Niño Index (ONI). If ONI remains above 0.3K in the following year, the event is defined as prolonged. The rest with positive (negative) ONI in JJA(1) are slow- (fast-) decay type. The only excluded event is 2002/03, because its ONI dropped below zero in decaying April-May-June, but turned positive again in June-July-August.

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3. Results

3.1 Fast-decay events and Slow-decay events

In the field of 850-hPa anomalous stream function, during D(0)JF(1) and MAM(1), WES feedback connects WNP SSTA with WNPAC, as the cold SSTA and atmospheric cooling are anchored at the southeastern flank of the AAC by equatorial ENSO heating. In addition, the contrast of SST between cold WNP and warm IO excites equatorial easterlies, provides off-equatorial negative vorticity, and extends WNPAC toward IO. In fast-decay events, a fast transition from El Niño to La Niña occurs by JJA(1), convection over Maritime Continent is enhanced, so the local anomalous Hadley Cell is the dominant mechanism maintaining the persistent subsiding AAC over WNP (Chung et al. 2011).

For slow-decay events, similar to the fast-decay events, WES feedback maintains the WNPAC in D(0)JF(1) and MAM(1), but in the absence of warm IO, the AAC is limited within WNP area. The WNPAC moves northward in JJA(1) as the background northeasterly retreats poleward, while the relative position among AAC/cold SSTA/atmospheric cooling and equatorial SSTA/heating suggests WES as the dominant maintenance mechanism.

For both fast-decay and slow-decay events, the IO SSTA appears to play a secondary role for maintaining WNPAC AAC In JJA(1).

3.2 Prolonged events

In prolonged events, AAC does not form until MAM(1). By JJA(1), the AAC extends from northern IO to WNP and further northeastward. The strong El Niño supports WES as an important forcing. Although the warm IO SST is significant in JJA(1), the accompanying convective activity is not enhanced. The role of IO SST is unclear.

4. Summary

By composite analysis, summertime WNPAC was attributed to both SST patterns of Tropical Pacific and Indian Ocean (IO). In JJA(1), the WNPAC in fast-decay events is maintained by local Hadley cell subsidence. WES feedback seems to be applicable in slow-decay and prolonged events, but the forced WNPAC migrates northward with monsoon’s seasonal march. The significant warm SSTA over IO in JJA(1) only appears in the prolonged events, which may help establish cross-basin easterly by SST gradient between IO and WNP, and strengthens WNPAC circulation.

Reference

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Types	**Fast-decay**	**Slow-decay**	**Prolonged**
El Niño years	1958-59 1963-64 1969-70 1972-73 1977-78 1987-88 1994-95 1997-98 2002-03 2006-07 2009-10 2015-16	1965-66 1979-80 1982-83 1991-92 2004-05	1968-69 1976-77 1986-87 2014-15

Table 1. The classification of El Niño events.

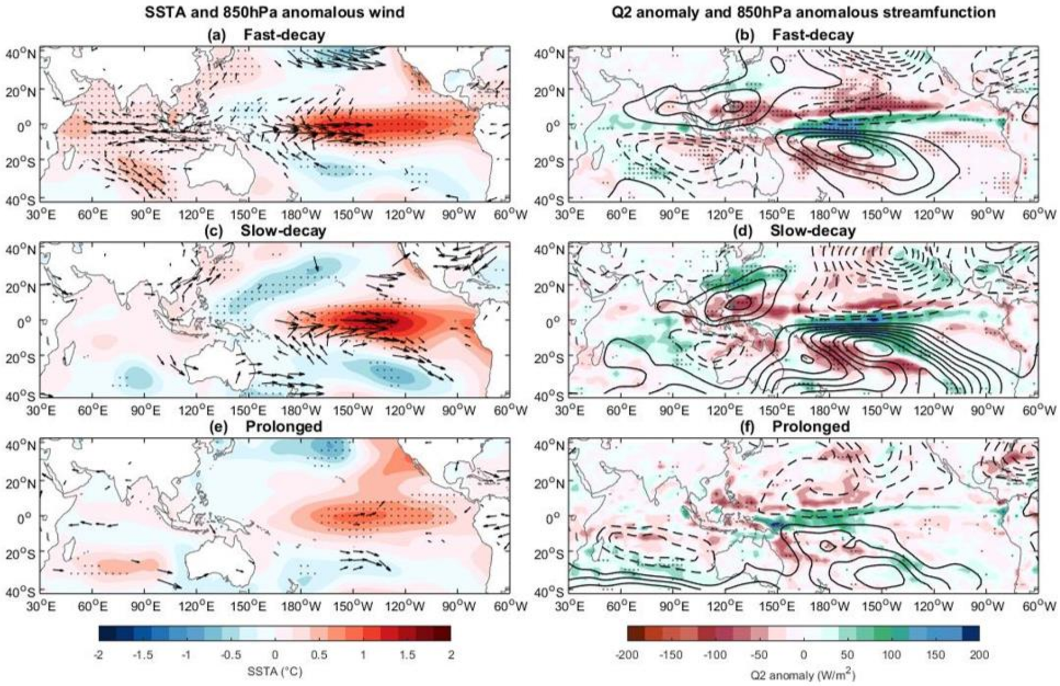

Figure 1 Composite fields of SSTA (shading of a, c, e), 850hPa anomalous wind ($p<0.1$) (vector of a, c, e), Q2 anomaly (shading of b, d, f) and 850hPa anomalous stream function (contour of b, d, f) in fast-decay (a, b), slow-decay (c, d) and prolonged (e, f) events in D(0)JF(1). Dotted area stands for SSTA ($p<0.05$) and Q2 anomaly ($p<0.05$).

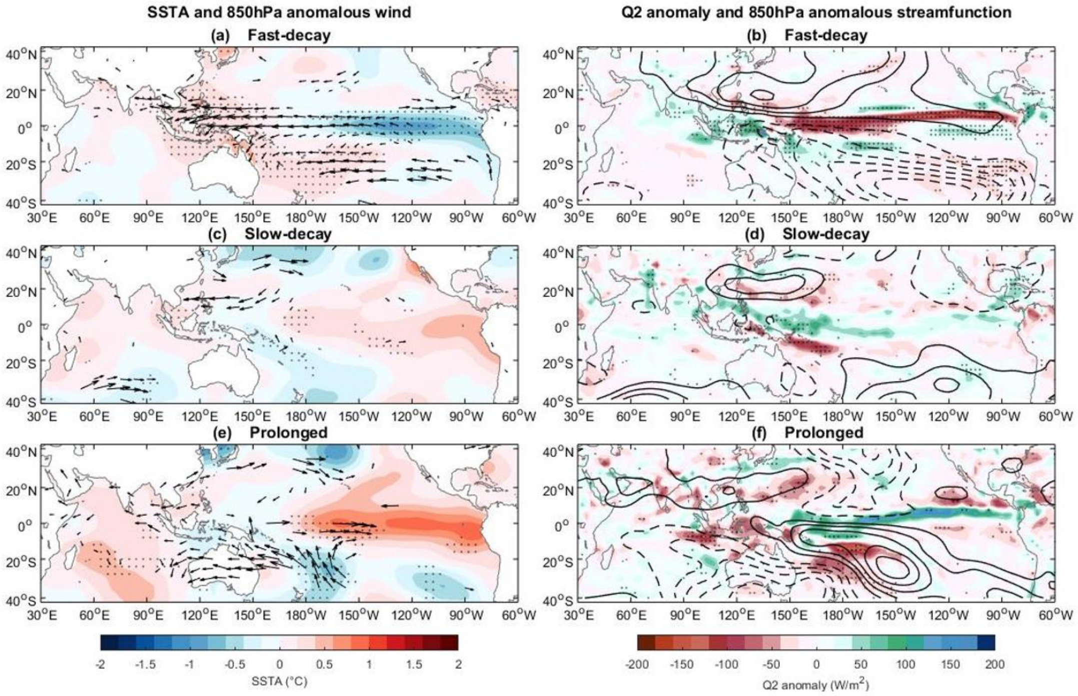

Figure 2 The same as in Figure 1 but composite fields for JJA(1).