Inconsecutive ‘Sandwich Structure’ Pattern for High Temperature Warm Water in the Western Pacific Warm Pool

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Abstract An inconsecutive high frequency distribution with ‘Sandwich Structure’ pattern for high temperature warm water (HTWW) warmer than 29℃ in the western Pacific warm pool (WPWP) was found using Tropical Rainfall Measuring Mission (TRMM) sea surface temperature (SST) data, a relatively high resolution data in space. This phenomenon only shows up in boreal summer (June to September), and becomes obvious when WPWP SST is higher than 29℃. As observed, East Asian summer monsoon (EASM) impinges on Philippine Islands in June, which has important impact on the formation and maintenance of the ‘Sandwich Structure’. Winds affect the distribution of SST in two ways: one by increasing the local latent heat flux, and the other way is transporting cold water towards southeast of Philippine Islands.

Characteristics of ‘Sandwich Structure’ pattern of HTWW in WPWP

The ‘Sandwich Structure’ only shows up in boreal summer and reaches its peak in July and August, which can only be observed in SST frequency distribution higher than 29℃. The phenomenon becomes more obvious when we pick higher SST as criterion.

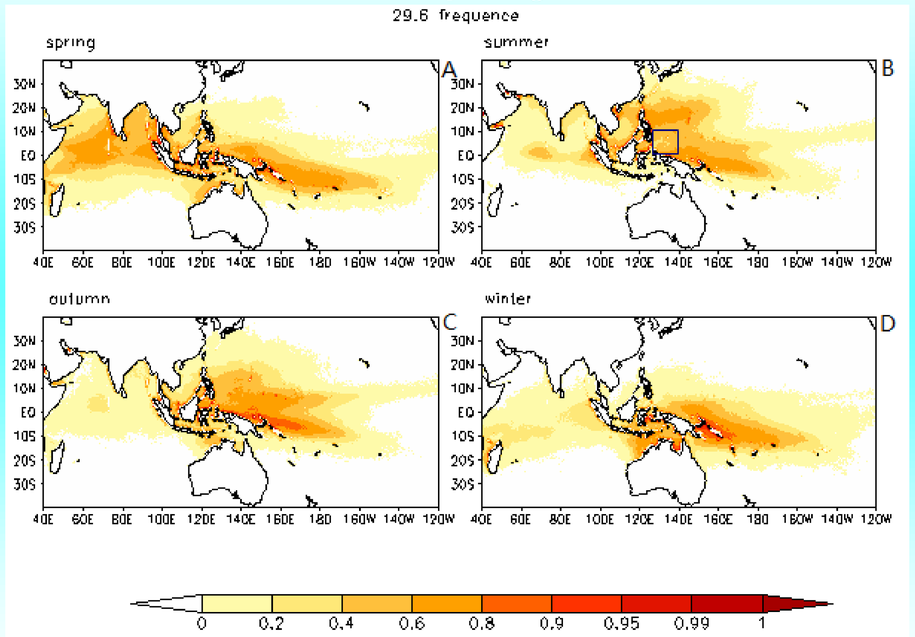

Figure 1. Climatologically frequency distribution of SST higher than 29.6℃ from spring to winter in turns (A to D). The pane in the summer panel denotes the relatively low frequency area plugging into two high frequency regions in the north and southeast, which constitute the ‘Sandwich Structure’ pattern.

Seasonal and interannual variability

The low frequency area indices (box in Fig.1b) in southeast of Philippine Islands appear to have double-peak in a seasonal cycle. The ‘Sandwich Structure’ shows up in July and August as the area indices decreases, which is remarkable when SST chosen is higher than 29℃ (the blue line), again implying that this is a special characteristic of HTWW.

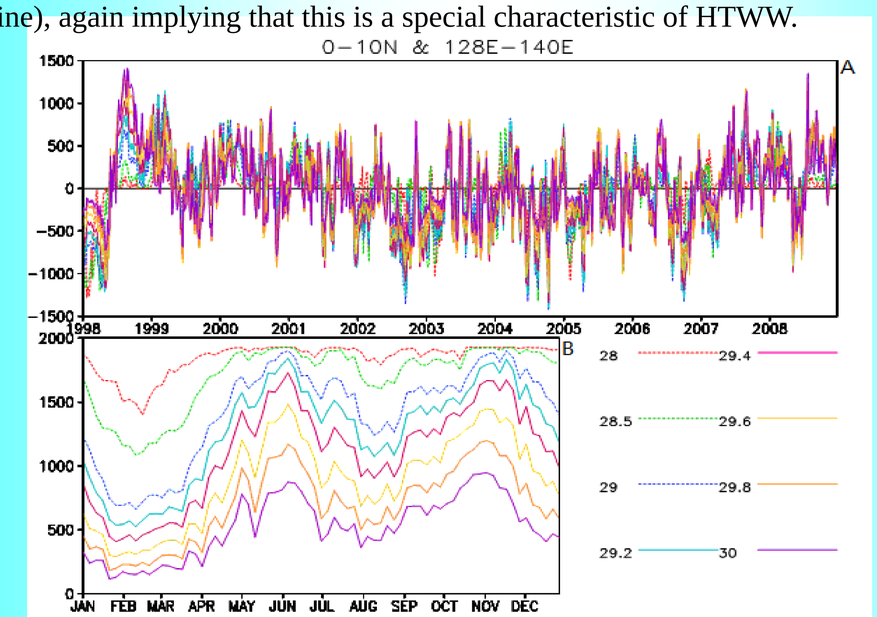

Figure 3. The variation of panted mean area indexes (the number of grids surrounded) anomaly where SST is higher than a certain value from 28℃ to 30℃ in the area between 0-10° N and 128° E-140° E from 1998 to 2008 (A) and the climatologically mean variation of area indexes (B)

Formation of the ‘Sandwich Structure’

The variations of low frequency area indices resemble those of SCS a lot in boreal summer, which indicates that EASM may also play important roles in the formation of the ‘Sandwich Structure’. The correlation of area indices in the two areas during boreal summer varies from 0.39 to 0.61, which increases when SST picked as criterion rises (Table 1). The correlation coefficients between the indices of SCSSM defined by Wang et al (2005), and the low frequency area indices varies from -0.36 to -0.60, which also decreases as SST rises (Table 1). All of these imply that EASM may possibly have significant impact on the ‘Sandwich Structure’.

Table 1. The correlation coefficients between the area indices in Fig. 3 and SCS area indices when SST picked is higher than a certain value. The latter is the correlation coefficients between the area indices in Fig. 3 and SCSSM indices.

SST(℃)	Correlation coefficients of two area indices	Correlation coefficients between area indices and SCSSM indices
28	0.390	-0.358
28.5	0.408	-0.463
29	0.452	-0.569
29.2	0.502	-0.591
29.4	0.550	-0.603
29.6	0.592	**-0.635**
29.8	**0.612**	-0.624
30	0.611	-0.601

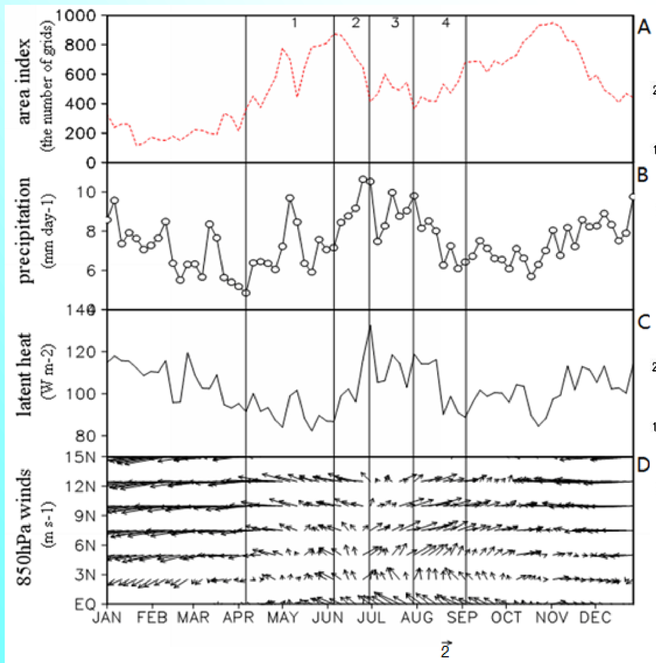

Figure 4. Climatologically mean of 30℃ area index (A, red dashed line), precipitation (B, mm day^{-1}, denoted by small circle) and latent heat (C, W m^{-2}, black line) averaged in the area between 0-10° N and 128° E-140° E. Arrow means 850hPa winds (m s^{-1}) averaged between 0 and 10N (D).

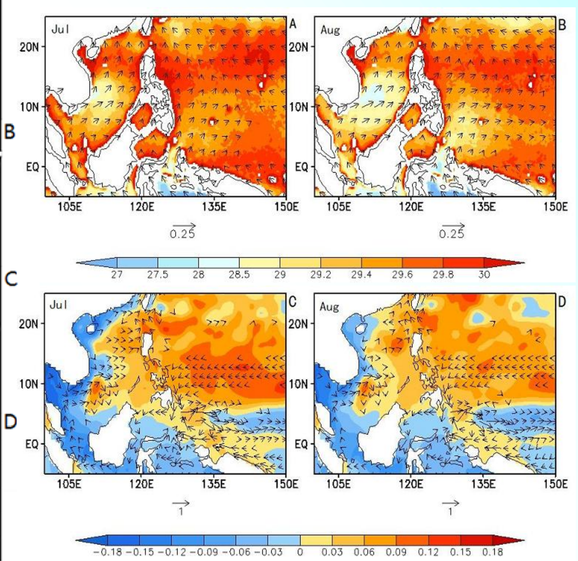

Figure 8. Spatial distribution of climatologically mean SST (℃), sea surface wind stress (N/m2) ,SSH (m) and ocean current (m s-1)in July (A,C) and August (B,D). In A and B, Shading for SST and arrow means sea surface wind stress. In C and D, Shading for SSH and arrow means ocean current.