

# Pacific Meridional Mode implicated as a prime driver of decadal summer temperature variability over Taiwan

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**Abstract:** This research investigates the association between the summer temperature in Taiwan (TST) and the Pacific Meridional Mode (the PMM), an anomalous north-south sea surface temperature gradient over the northeastern subtropical Pacific. It was found that when the PMM was in a positive (negative) phase, the summer temperature in Taiwan significantly increased (decreased) on a decadal timescale. The zonal circulation in the sub-tropical north Pacific and the subsidence in Taiwan were the physical mechanism in the linkage. Besides, During the PMM-positive phase, the frequency and duration of heat wave events become higher and longer. This linkage is expected to be provide heatwave exposure evaluation and so to develop adaption strategy.

## 1. EOF 1<sup>st</sup> mode of JJA temperature in Taiwan

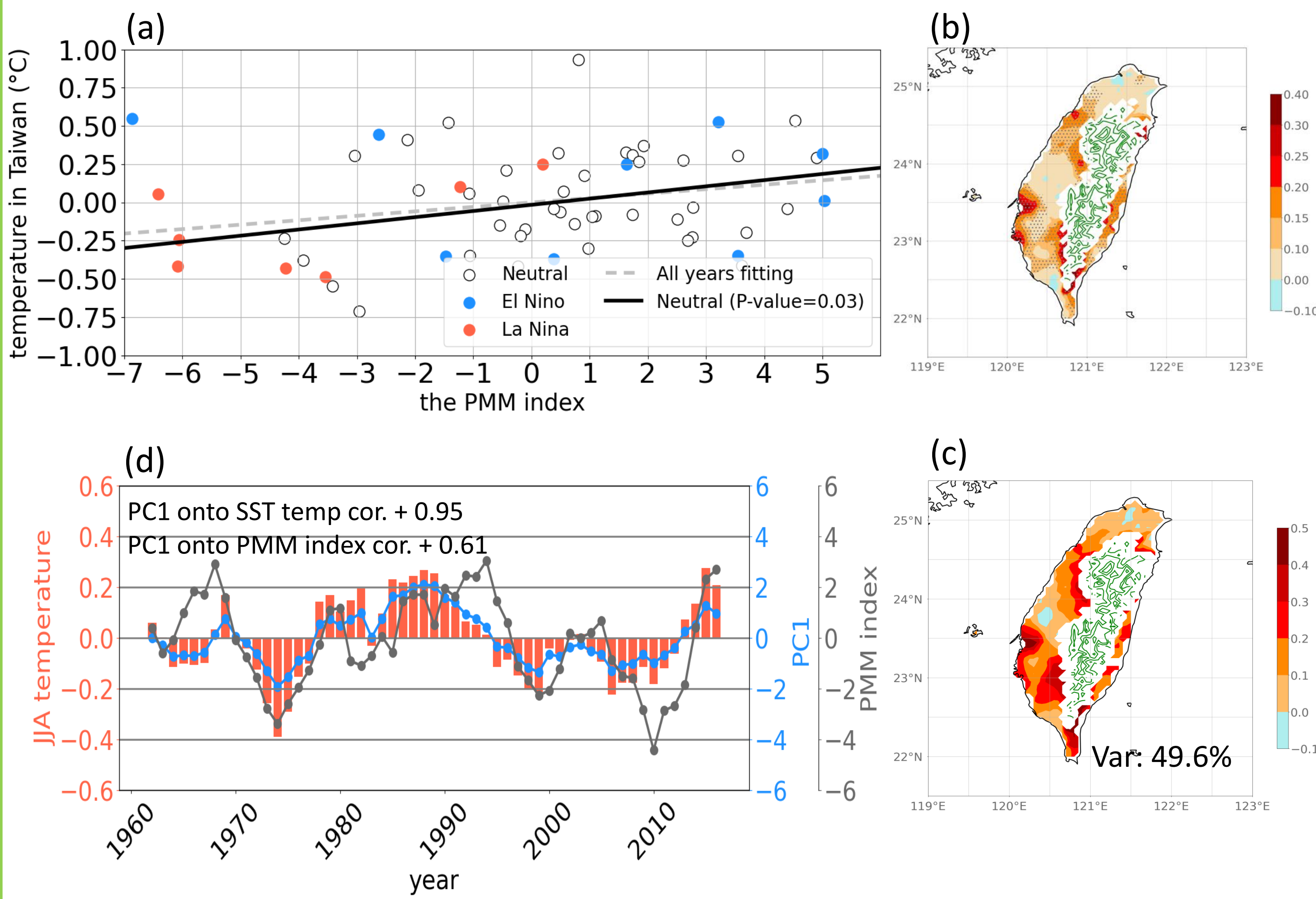


Figure 1 (b) represent correlation of JJA temperature in Taiwan onto the yearly time series of the standardized PMM index. The dots indicate significance at the 0.05 level. (c) the first EOF mode of JJA temperature in Taiwan. (d) the yearly time series of the PC 1 (blue line), the JJA standardized PMM index (black line) and JJA temperature in Taiwan (red bar).

- Effects on the JJA temperature in Taiwan: PMM > ENSO
- The JJA temperature, EOF PC1, and PMM index resemble each other.

## 2. The Analysis of North Pacific Circulation Field

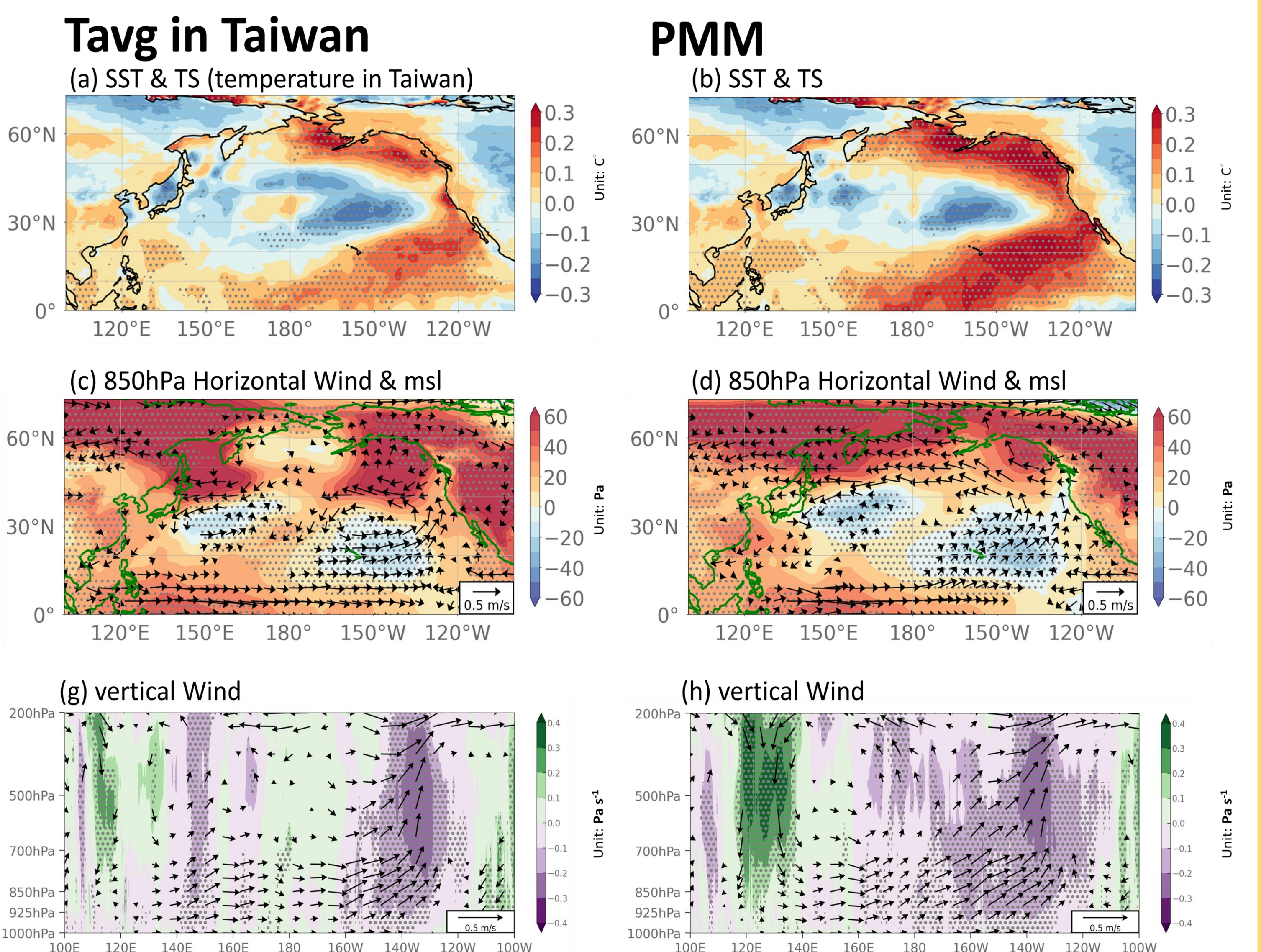


Figure 2 regression map of North Pacific Circulation Fields onto the summer temperature in Taiwan, (b) as (a) but onto the standardized PMM index.

- Taiwan's JJA temperatures ↑ is similar to the PMM ↑.
- The vertical circulation crossing the entire North Pacific → anomaly of high pressure in East Asia.

## 3. East Asia Circulation Field & heat budget analysis

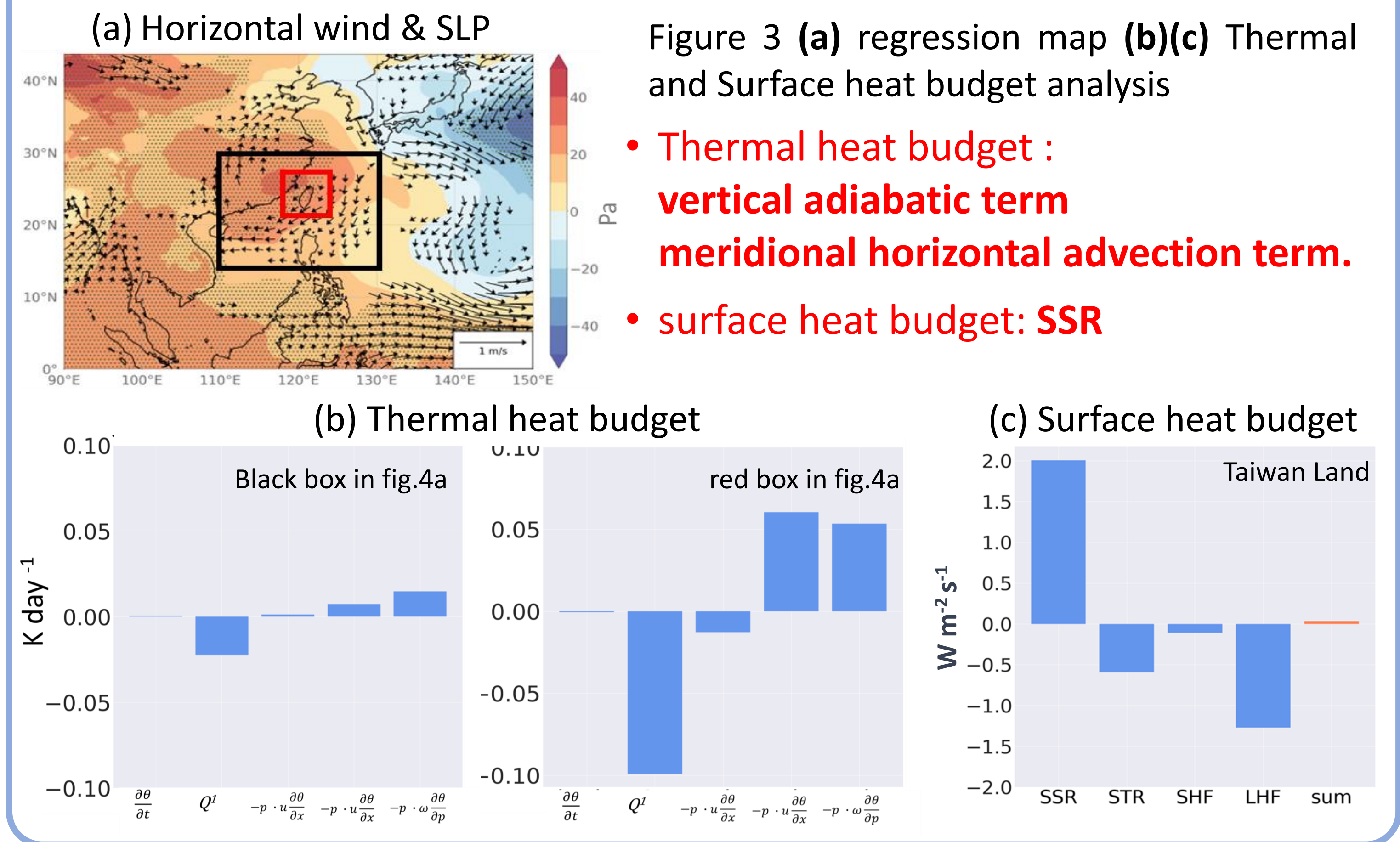


Figure 3 (a) regression map (b)(c) Thermal and Surface heat budget analysis

- Thermal heat budget : vertical adiabatic term meridional horizontal advection term.
- surface heat budget: SSR

## 4. The effect of PMM on heatwaves & exposure

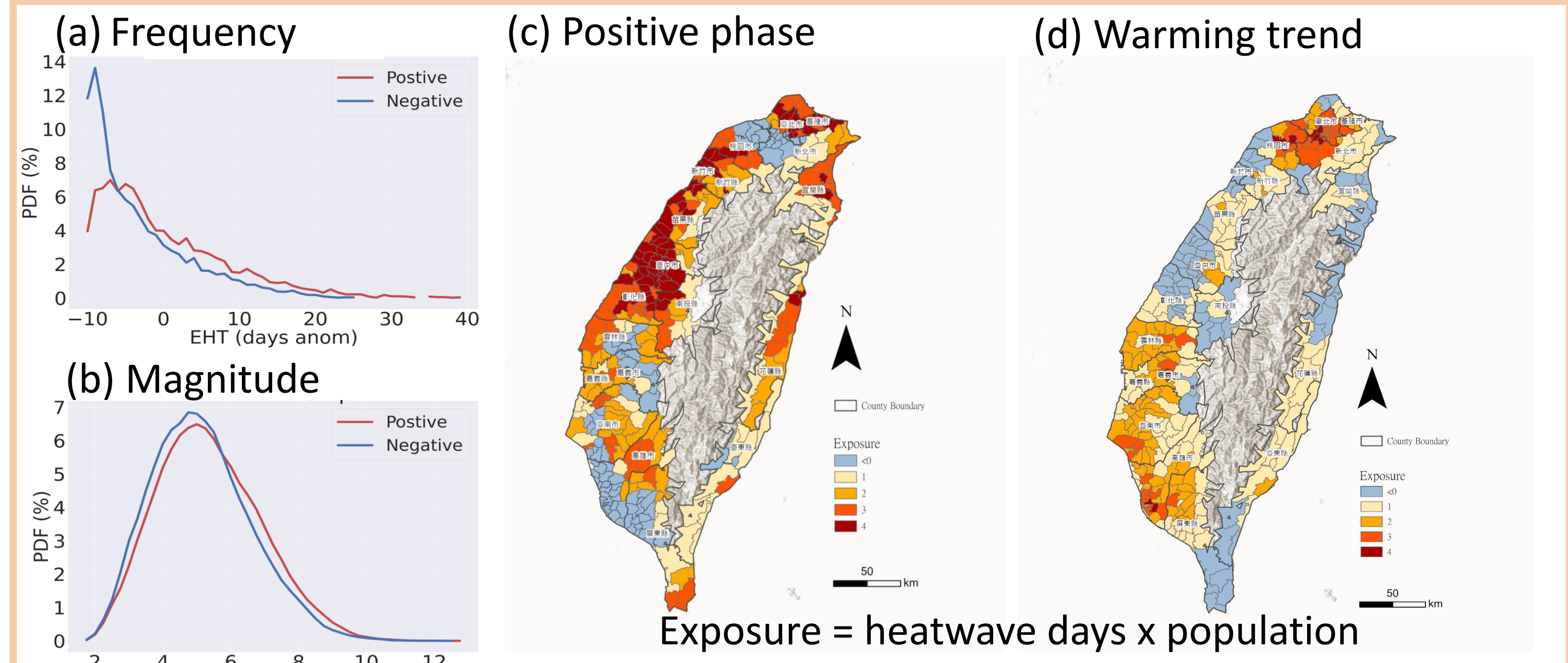
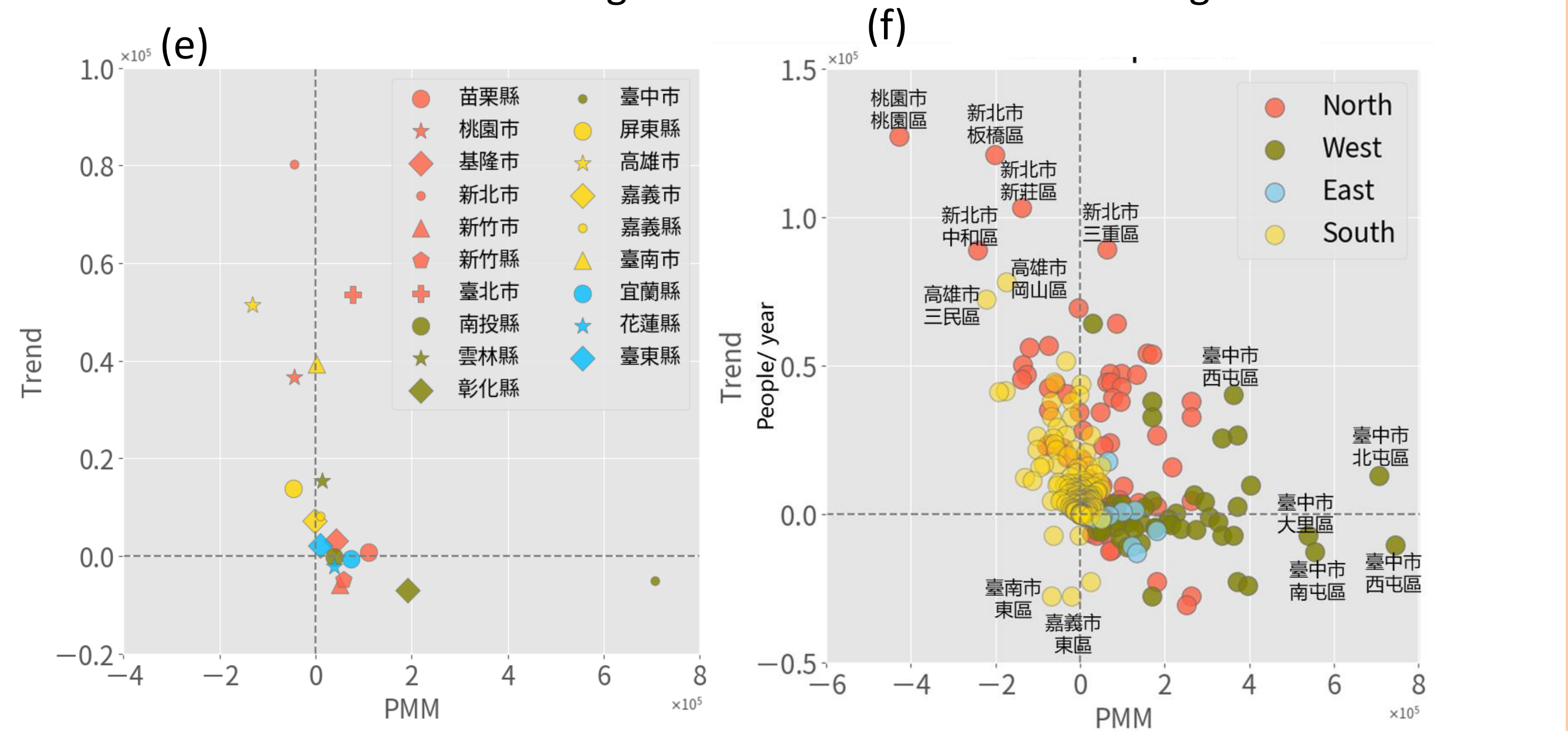


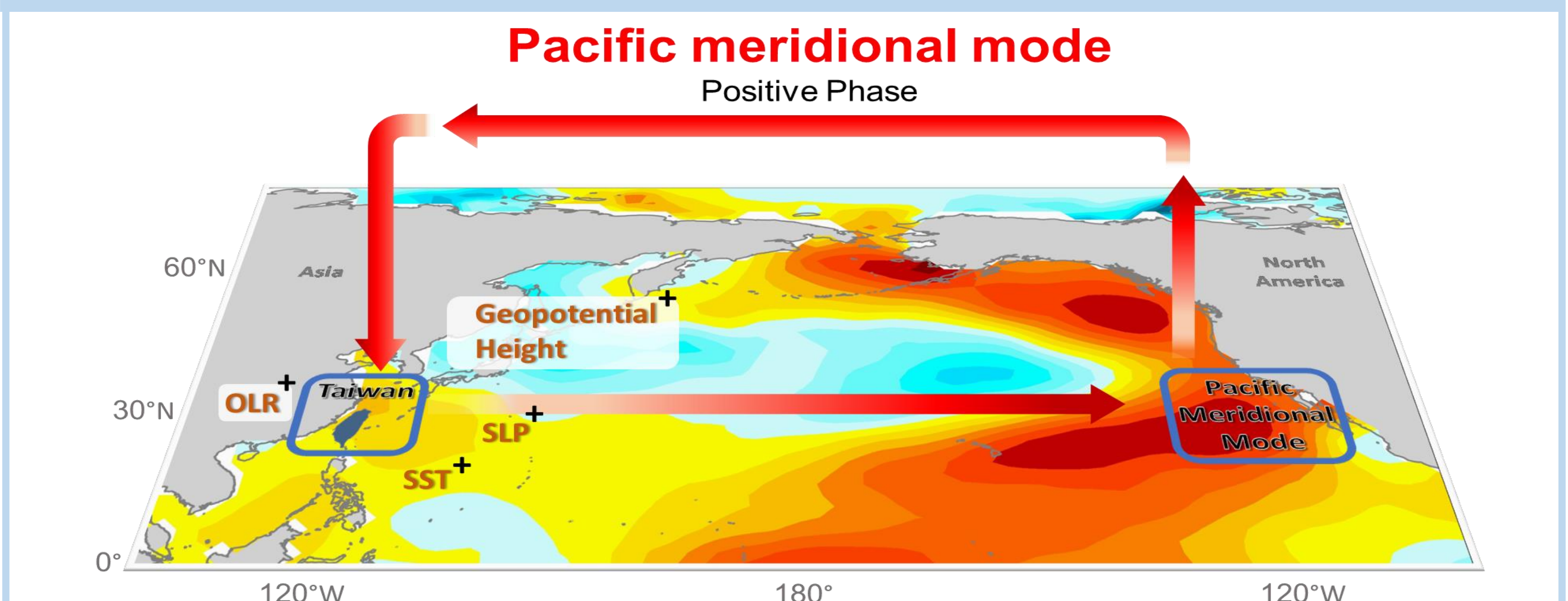
Figure 4 (a)(b) the distribution of the magnitude and frequency of heatwaves (referred to as CTX90pct). (c)(d) Map of Heatwave Exposure Distribution in Towns and district of Taiwan with strengthened PMM and with warming trend



(e) (f) scatterplots of Heatwave Exposure with strengthened PMM versus that with warming trend in counties, Towns and district of Taiwan.

- PMM pos+ : heat wave: frequency ↑ and intensity ↑
- exposure : northern > western > eastern > southern Taiwan.

## 5. Conclusion



- PMM+ : → vertical circulation crossing the North Pacific
- subsidence in Taiwan → JJA temperature + → the heatwave exposure +