

Taiwan summer temperature linked to the Pacific Meridional Mode

Chieh-Ting Tsai^{1,2}, Wan-Ling Tseng², Yi-Chi Wang¹

International Degree Program in Climate Change And Sustainable Development National Taiwan University, Taipei, Taiwan¹
Research Center for Environmental Changes, Anthropogenic Climate Change Center Academia Sinica, Taipei, Taiwan²

E-mail: k2175379yy@gmail.com

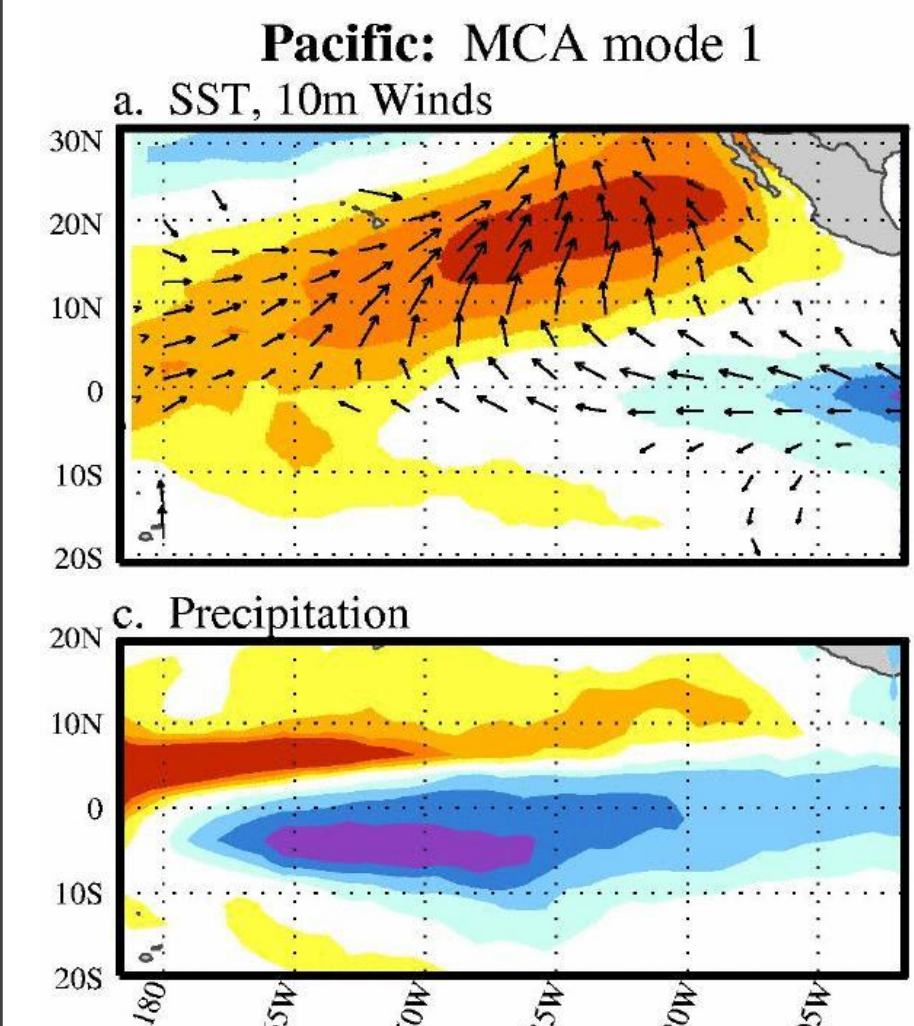
Abstract

This study investigates the association between the Taiwan summer temperature (TST) and the Pacific meridional Mode (PMM), an anomalous north-south sea surface temperature gradient over the northeastern subtropical Pacific, during 1960-2018. It's found that when the PMM was in the positive state, the summer temperature in Taiwan significantly increased. And the reverse happened during its negative phase. When the ENSO signal was removed, the correlation between the two was higher. During the PMM positive phase, Taiwan and the adjacent area became hotter and drier.

Monthly Data source:

- TCCIP 5km average temperature (JJA data averaged) (1960-2018)
- NOAA OLR, ERSST (1960-2018), PMM Index (1974-2018)
- ECMWF ERA5 Mean SLP, component of wind u/ v (1960-2018)

The Pacific meridional Mode (the PMM)



- Region:** Tropical and subtropical eastern Pacific Ocean.
 - Properties:** During the positive (negative) PMM phase, positive (negative) SST anomalies prevail in the northwestern (southeastern) part.
 - Impact:** TC activities, anticyclone, precipitation... in WNP. (Zheng et al.2016, 2017; Gao et al. 2018)
- Calculation Method:**
- Maximum Covariance Analysis (MCA)
 - sea surface temperature
 - the zonal and meridional components of the 10m wind field (1950-2005)
 - The seasonal cycle is removed, data are detrended, a three-month running mean is applied to the data
 - The linear fit to the Cold Tongue Index is subtracted from each spatial point. (2004 Chiang, J. C. H., and D. J. Vimont)

The correlation between TST and the PMM

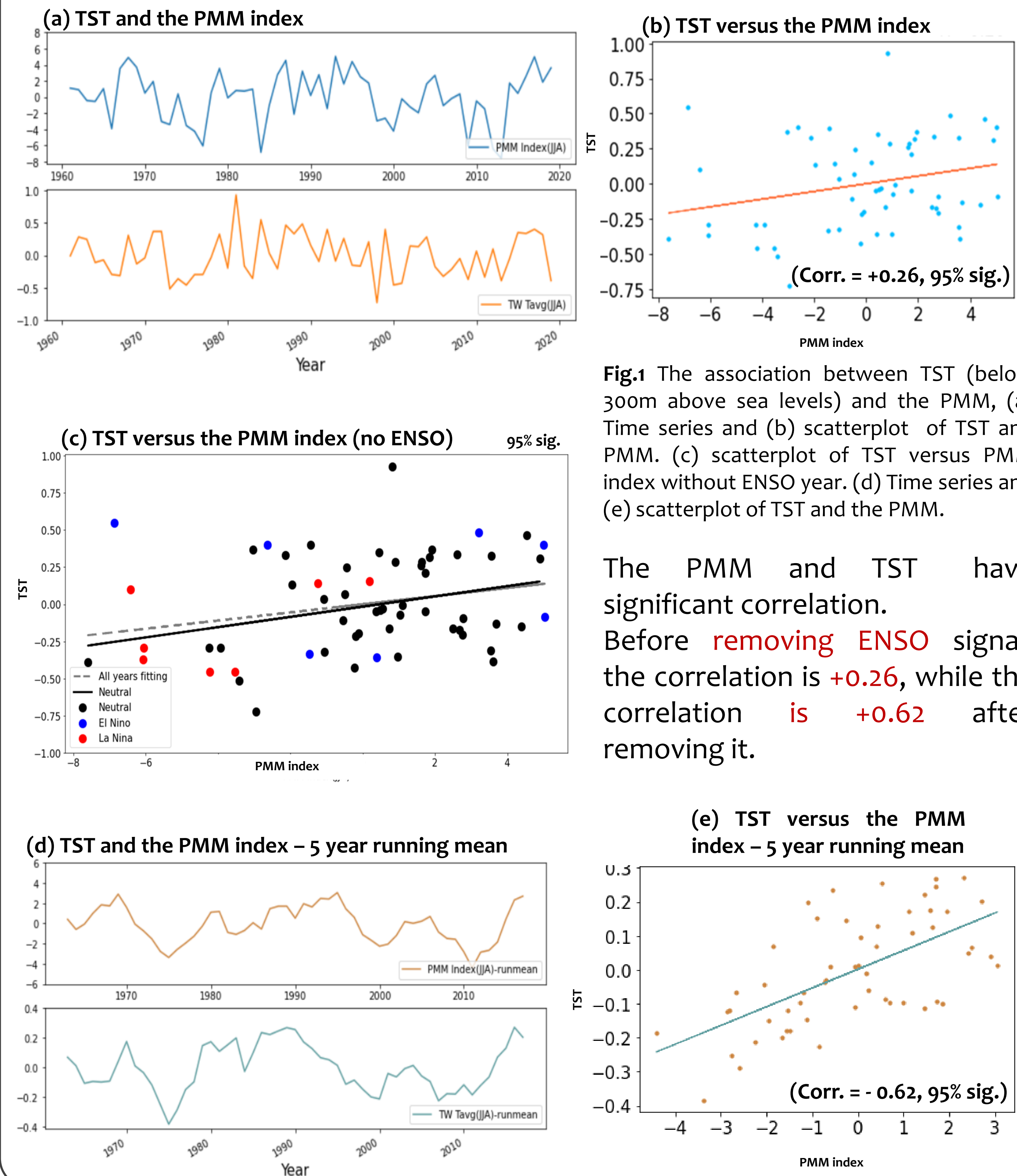


Fig.1 The association between TST (below 300m above sea levels) and the PMM, (a) Time series and (b) scatterplot of TST and PMM. (c) scatterplot of TST versus PMM index without ENSO year. (d) Time series and (e) scatterplot of TST and the PMM.

The PMM and TST have significant correlation. Before removing ENSO signal, the correlation is +0.26, while the correlation is +0.62 after removing it.

The Correlation Map between TST and the PMM

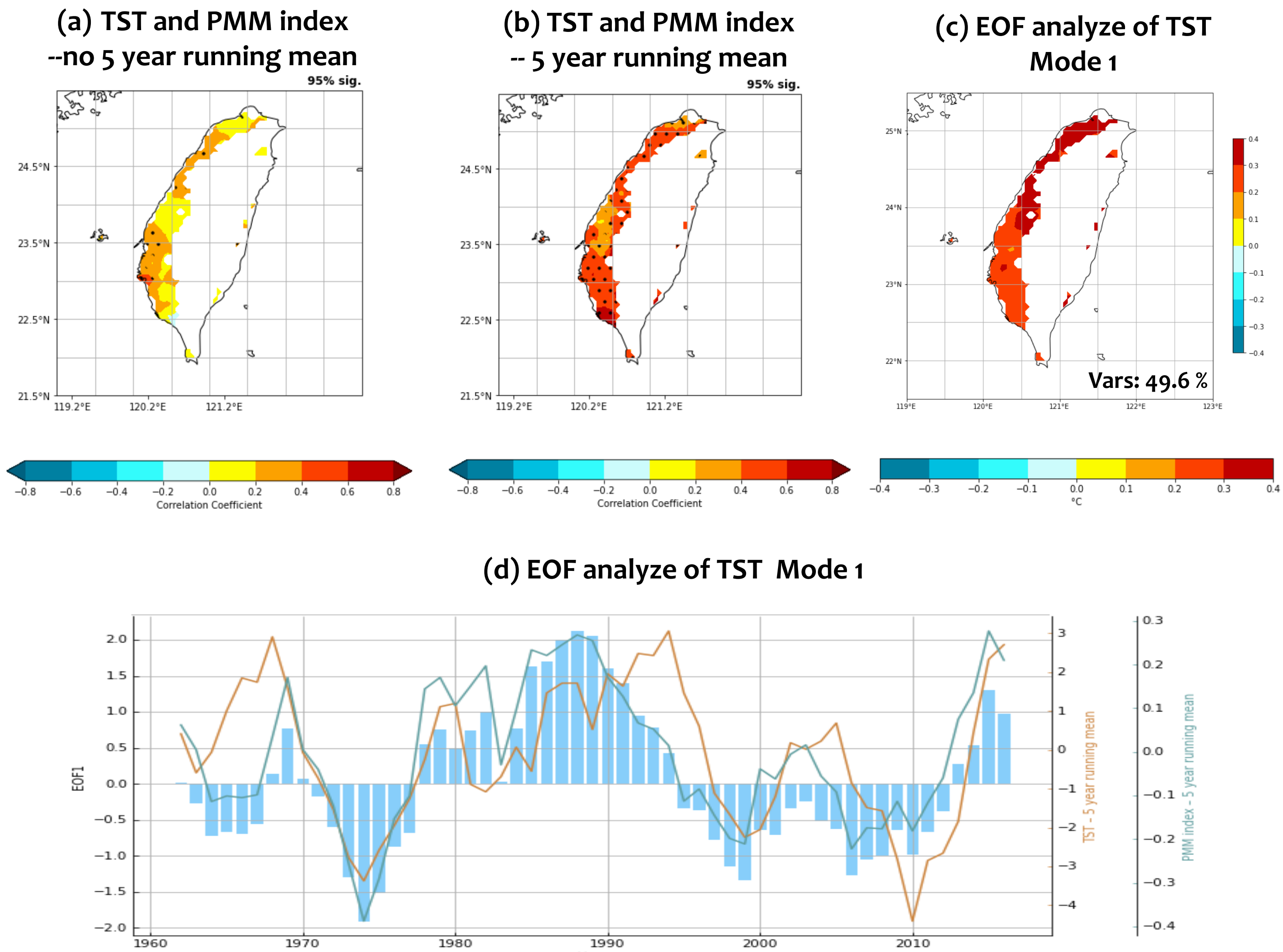


Fig.2 Correlation maps of TST (below 300m above sea levels) and PMM index (a) without calculating 5 year running mean (b) calculating 5 year running mean. (c) EOF analyze of TST Mode 1 Map. (d) Time series of EOF analyze Mode 1 (blue bar) and TST(yellow line) and the PMM(green line).

- All the region in Taiwan have positive correlation with the PMM index, especially in northern and southwest parts.
- The pattern of EOF mode 1 is similar with the time series of TST and PMM index -- 5 year running mean .

Possible processes underlying the PMM-TST association

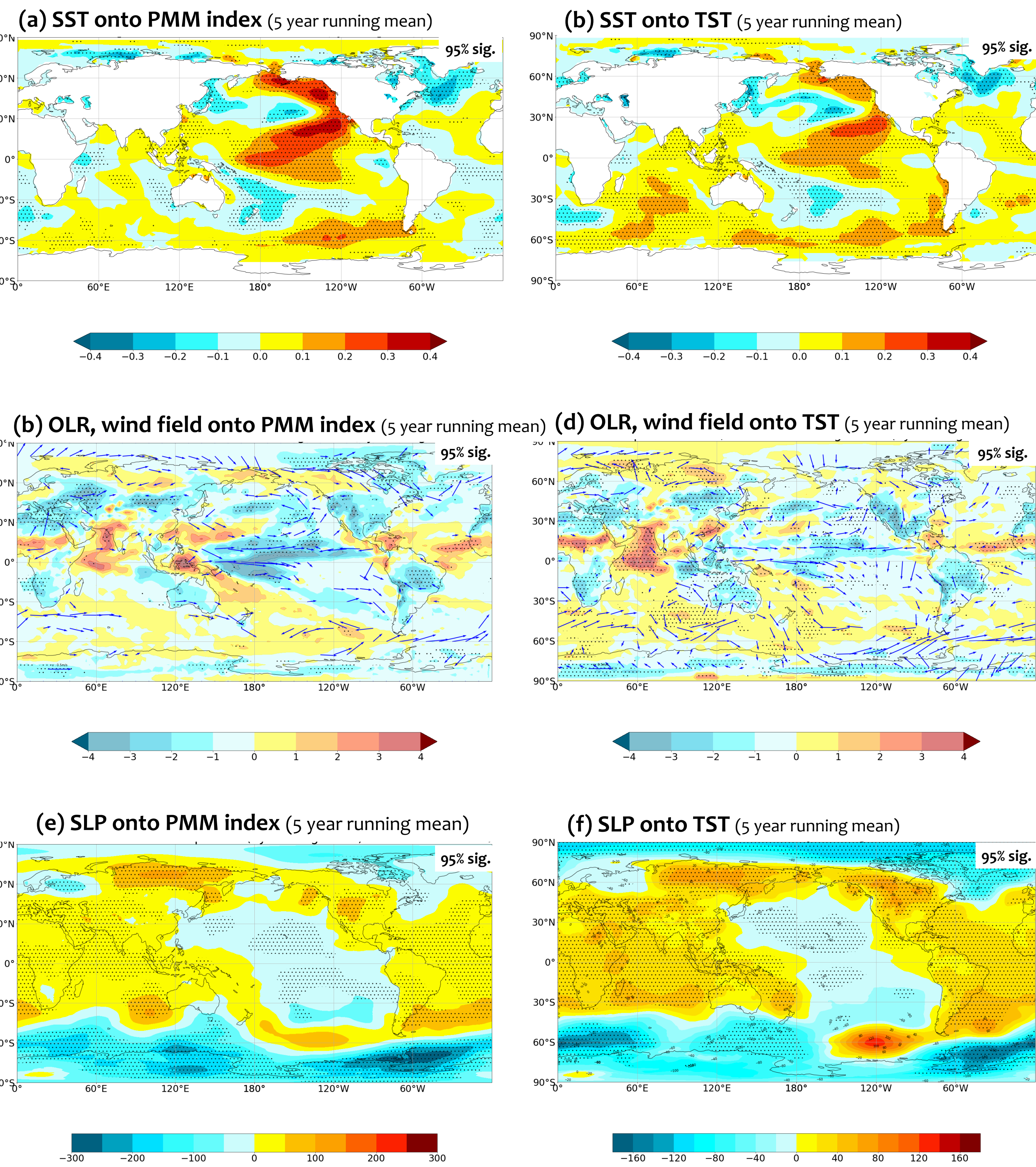


Fig.3 Regression of 5 year running mean (a) detrended SST onto standardized PMM index (b) detrended SST onto standardized TST (c) detrended OLR, wind field onto standardized PMM index (d) detrended OLR, wind field onto standardized TST (e) detrended SLP onto standardized PMM index (f) detrended SLP onto standardized TST. All the TST data above is below 300m above sea levels.

When the PMM is in the positive phrase, SST, OLR, SLP in the adjacent area of Taiwan had positive regression onto the PMM and TST .