

# A Study on Premonitory Sign of ENSO

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## Motive

The ENSO prediction has attracted focus of many scientists around the world, However ENSO prediction still there were some uncertainty and unresolved.

The North Pacific Subtropical Mode Water (STMW) was chosen to identify the possible contribution of the combined mid-latitude air-sea variability to the SST variability over the Eastern Equatorial Pacific.

## Outline

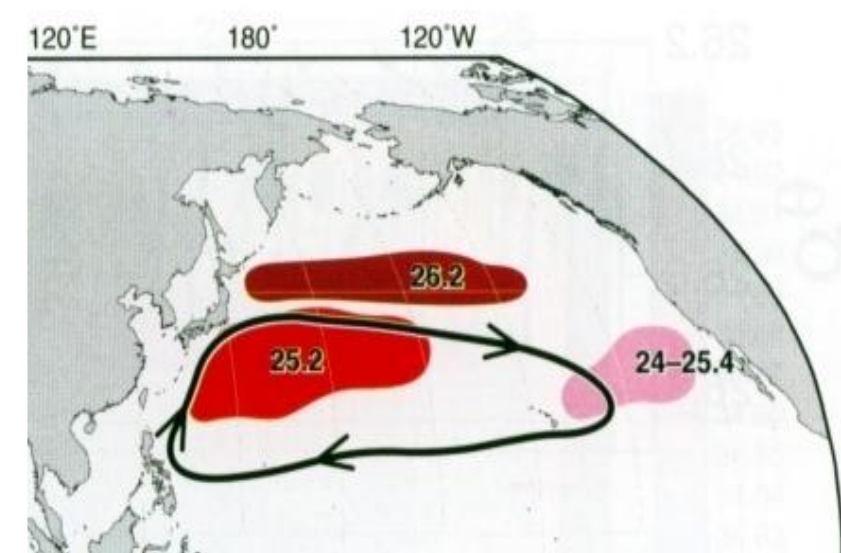
1. Subtropical Mode Water (STMW)
2. The relationship between STMW and ENSO
3. The different between strong and weak STMW years with upper ocean temperature, wind stress and ocean current
4. Conclusions

## Data and methodology

- Data: Simple Ocean Data Assimilation (SODA) from 1970 to 2001, horizontal resolution of  $0.5^\circ \times 0.5^\circ$ , with 40 standard depth levels to 5374m.
- Methodology: Potential vorticity is calculated through the temperature and salinity dataset by the P-vector method.

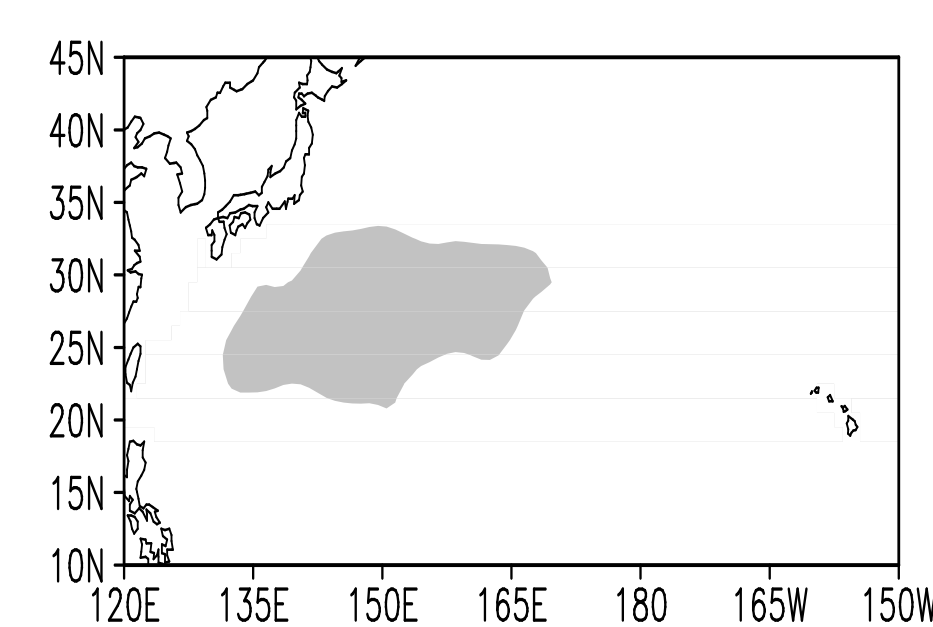
$$PV = \frac{f \Delta \sigma_\theta}{\rho \Delta z} \quad \text{or} \quad PV = f \frac{\Delta T}{\Delta z}$$

## Brief overview of STMW

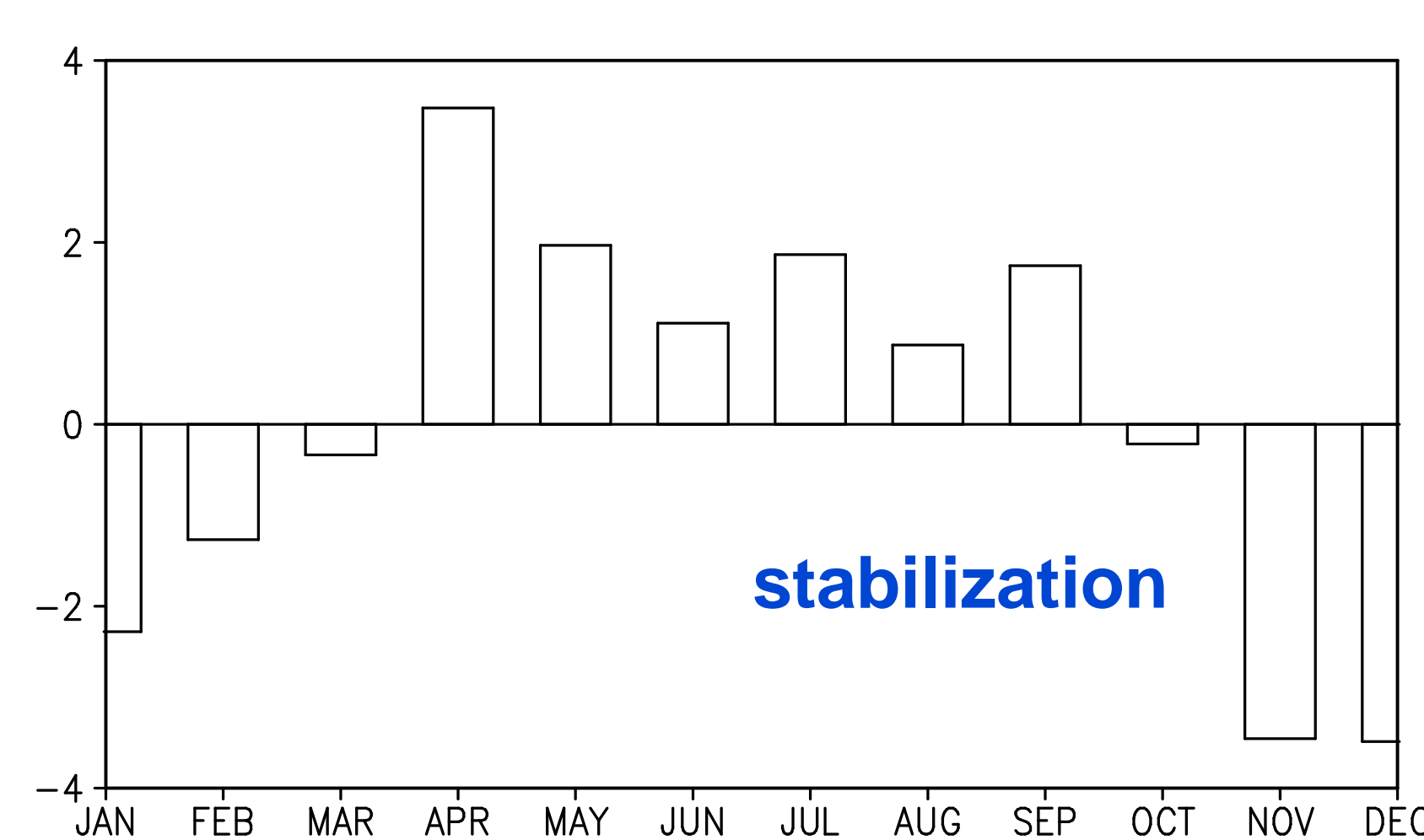


➤ Talley 1988 (Levitus)  
 $pv \leq 2.0 \times 10^{-10} m^{-1} s^{-1}$   
140°E-170°E  
strongest ( $25.4\sigma_\theta$ )

STMW:  $PV < 2.0 \times 10^{-10} m^{-1} s^{-1}$   
located Sub-sea surface (160-200m) or  $25.4\sigma$   
(Levitus, Talley)

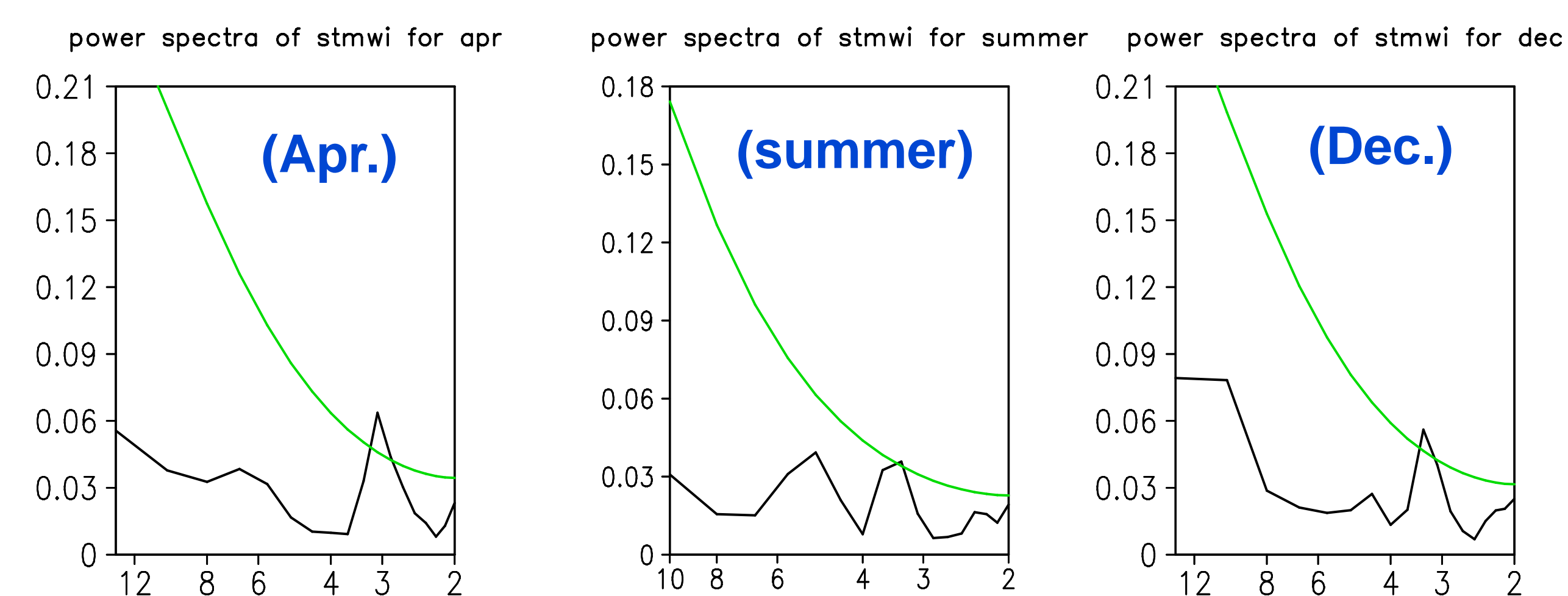


The North Pacific Subtropical Mode Water (STMW) was calculated  
The monthly STMW index is defined as the volume of the water



Seasonal variation of STMW

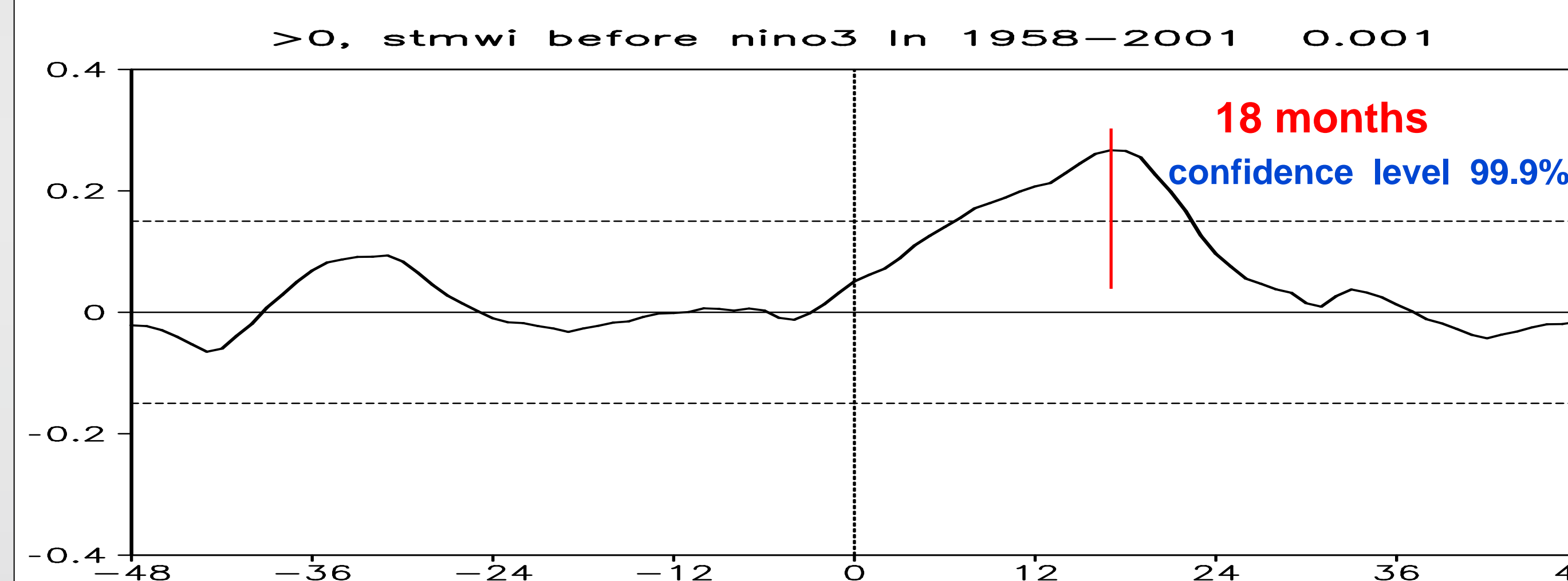
## Power spectra of STMW



The quasi-3yr period is dominant for STMW in the spectra

- In order to understand the relationship between STMW and SSTA over the eastern equatorial Pacific, the lead-lag correlation between the monthly STMW index and the Nino.3 index were calculated based on 528 monthly data during 1958-2001.

Lead or Lag Correlation between STMW and Nino.3 index  
the peak of correlation occurs at lag 18 months for Nino.3 index based on 528 months during 1958-2001

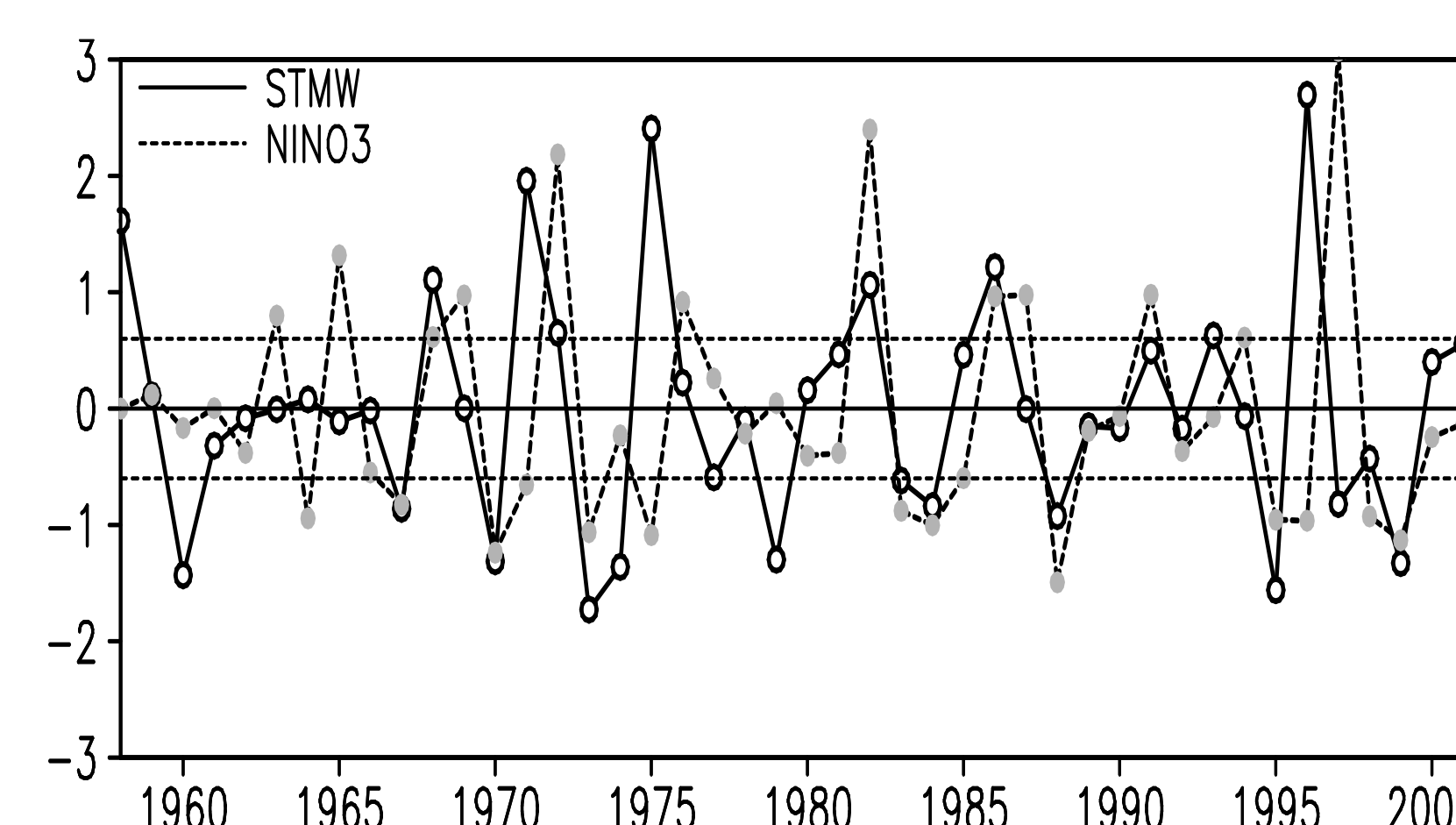


The correlation peak showed that the STMW leads the Nino3 index by 18 months (exceeding the 99.9% confidence level), It means that a positive (negative) STMW anomaly may be a premonitory sign of a warm (cold) SSTA over the eastern equatorial Pacific.

when removing the decadal trend of the two series (n=35), the coefficient increases from 0.36 to 0.61 and exceeds the 99.9% significance level ( $r=0.53$ ).

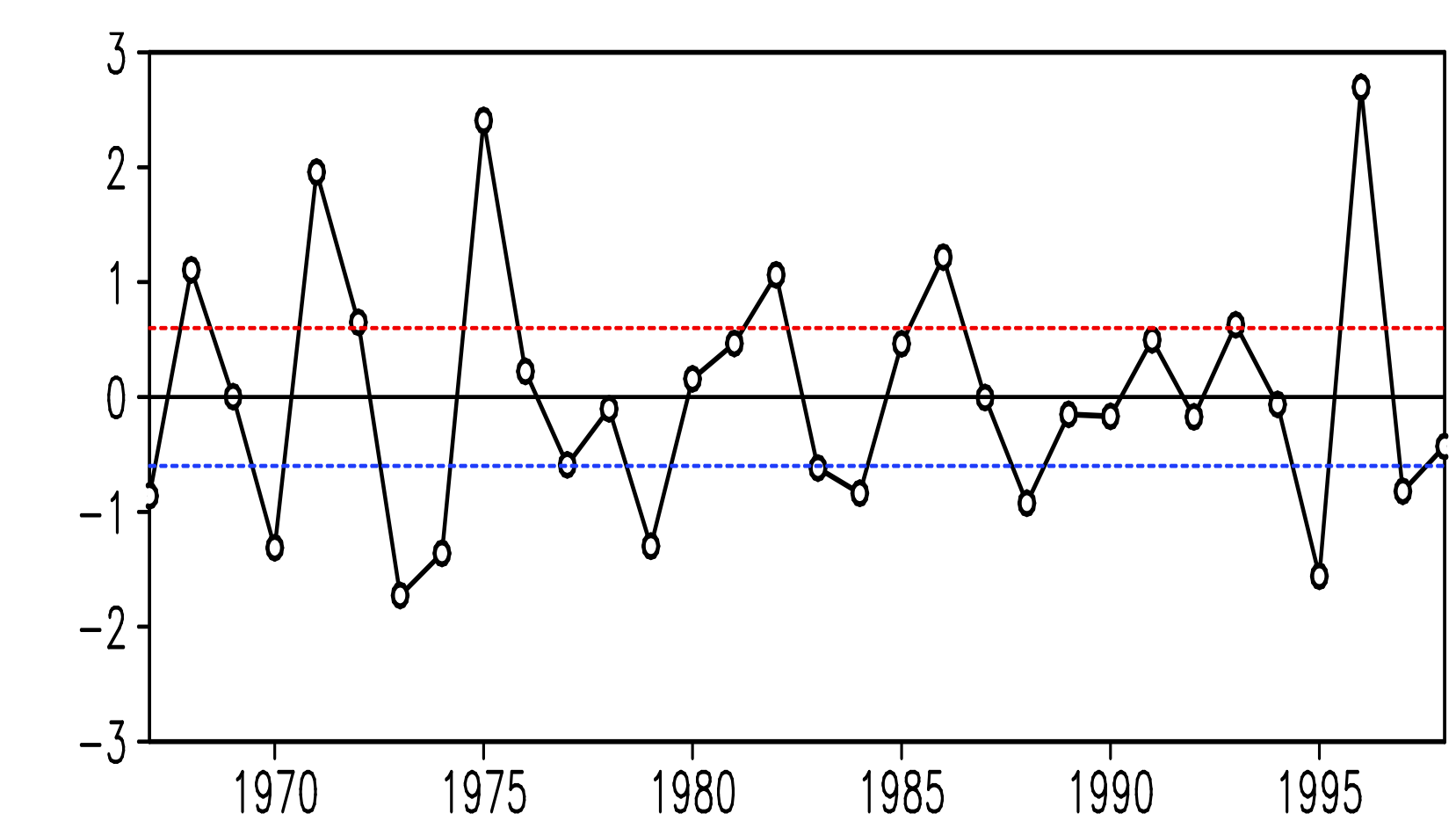
It means summer STMW and the winter Nino3 index of the following year (18 months later) is more significant in inter-annual time scale. So, to focus on this time scale.

## Summer STMW index and Nino.3 index (NDJ) of standard deviation



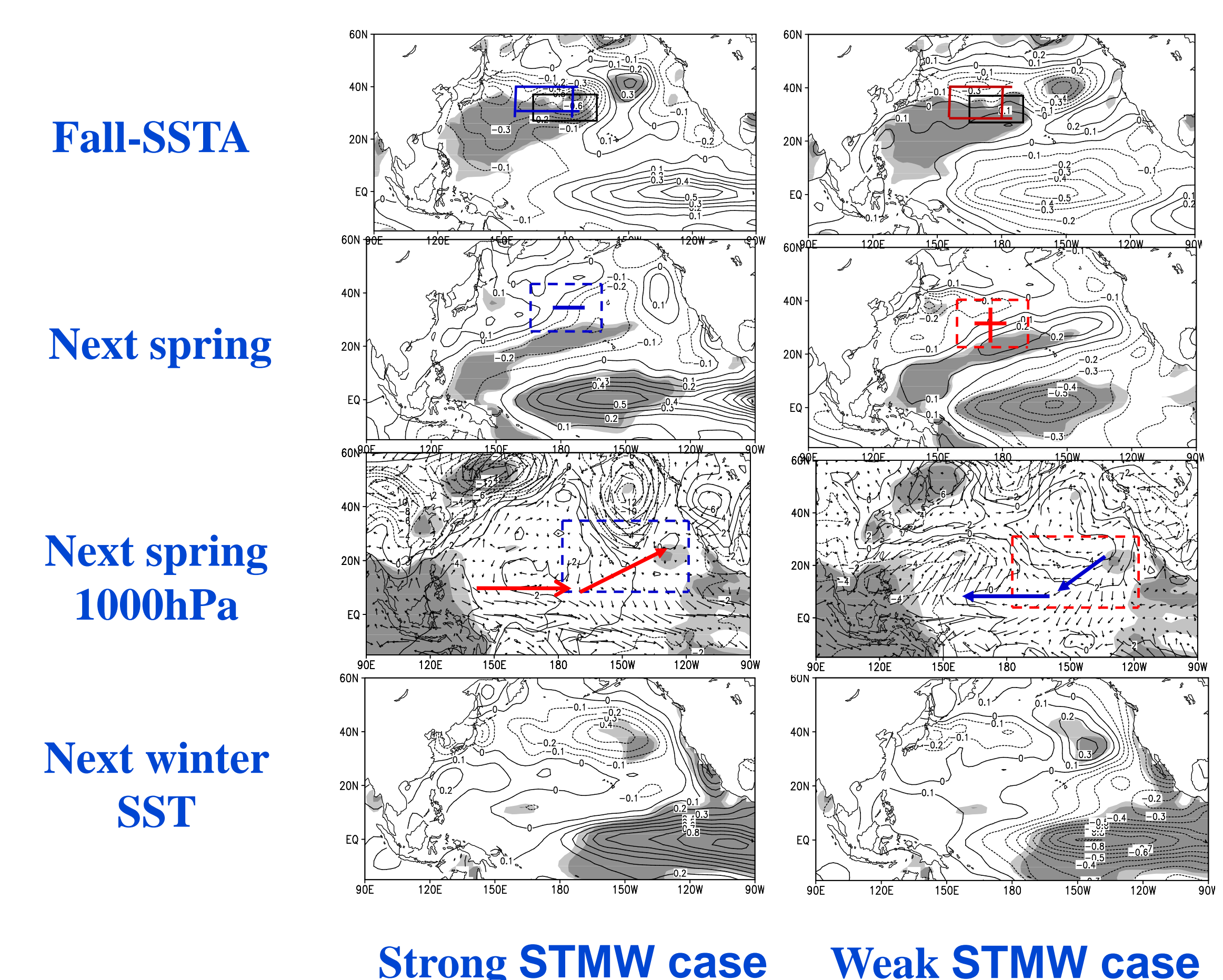
Removed decade and keeping inter-annual variability for the summer STMW index and winter Nino3 index by a high-pass filtering step.

## Summer STMW during 1968-2001



Removed decade and keeping inter-annual variability

## Examination of the air-sea interaction For Strong (weak) STMW case composition



The tropics adjust to these anomalies through coupled dynamics, producing ENSO-like pattern of variability.

## Conclusions

1. The quasi-3yr period is dominant for STMW in the spectra;
2. The positive (negative) STMW anomaly in summer which means there will be El Nino (La Nina) event in later 18 months ( next winter);
3. Summer STMW aspect should be useful to forecasting the occurrence of ENSO.

Thanks for your attention!

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North Pacific premonitory sign of the ENSO event, *Geophys. Res. Lett.*, 36, L03818, doi:10.1029/2008GL036597