



**The Abdus Salam
International Centre for Theoretical Physics**



SMR/1849-31

**Conference and School on Predictability of Natural Disasters for our
Planet in Danger. A System View; Theory, Models, Data Analysis**

25 June - 6 July, 2007

**Predictability of ENSO
Part II: Further Exploration of Stochastic
Forcing of ENSO-Role of the Pacific
Meridional Mode (MM)**

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Predictability of ENSO

Part II: Further Exploration of Stochastic Forcing of ENSO —Role of the Pacific Meridional Mode (MM)

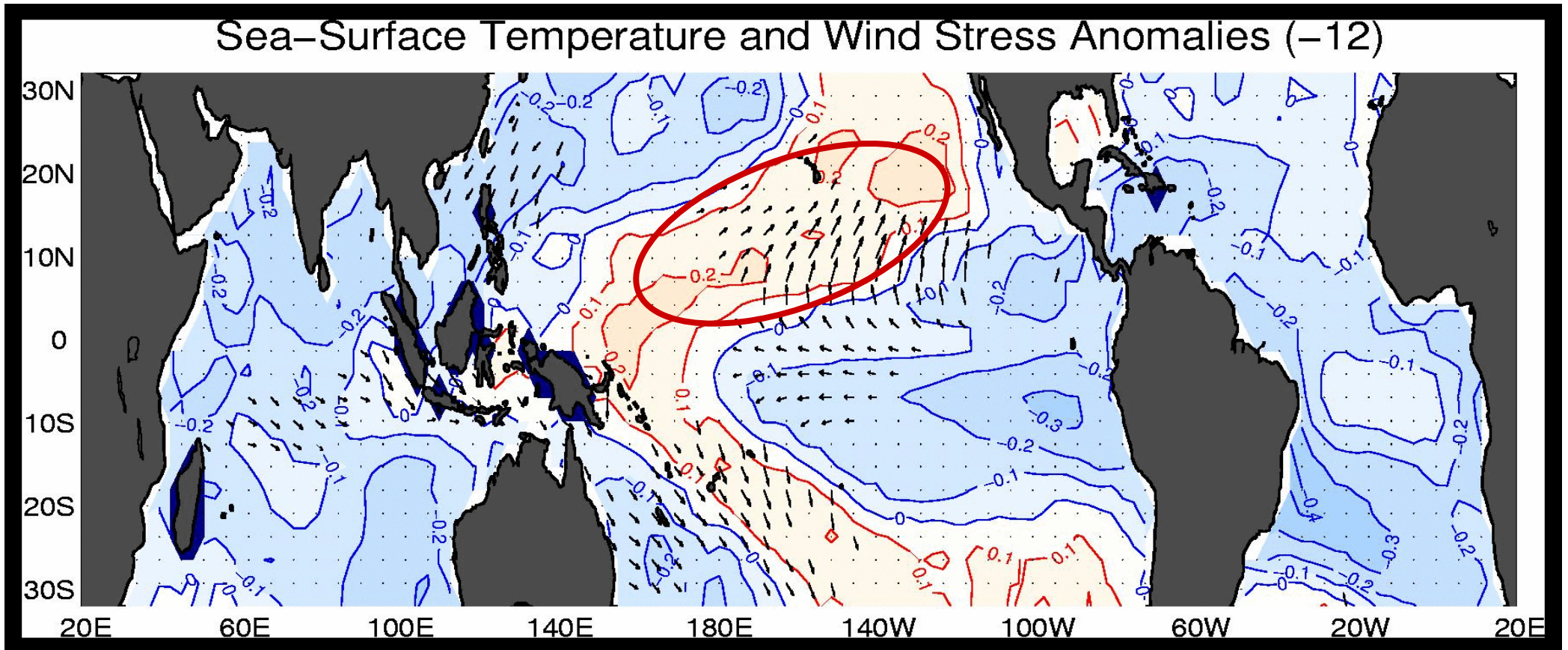
Ping Chang

TAMU

A Presentation Given at the Conference & School on Predictability of Natural Disasters for our Planet in Danger. A System View: Theory, Model, Data Analysis

ICTP, Trieste, Italy, July, 2007

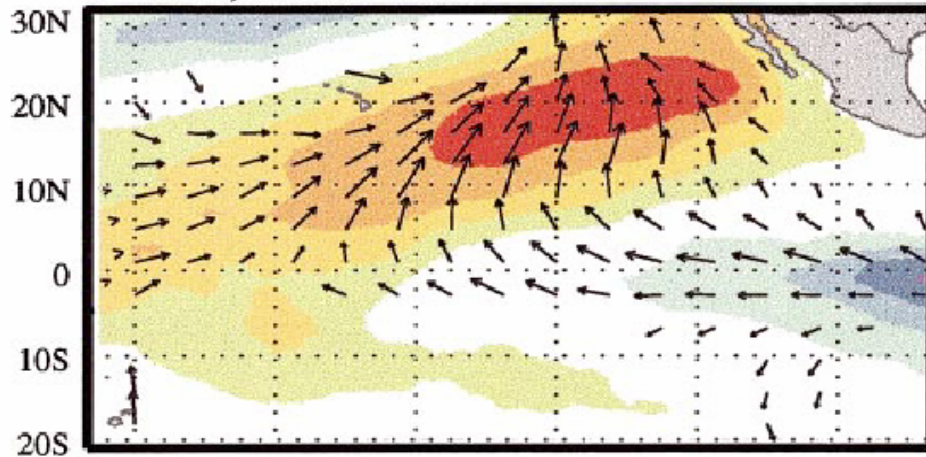
ENSO Evolution



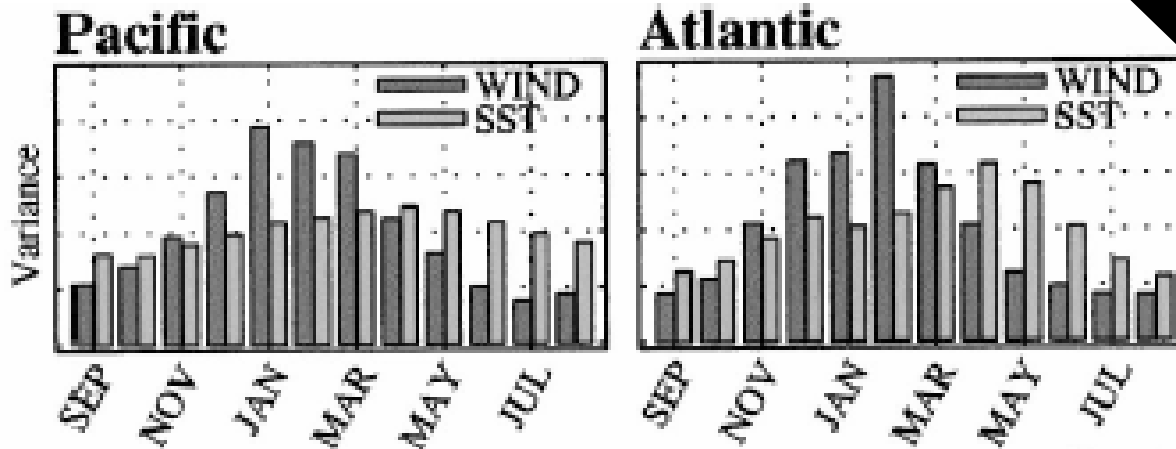
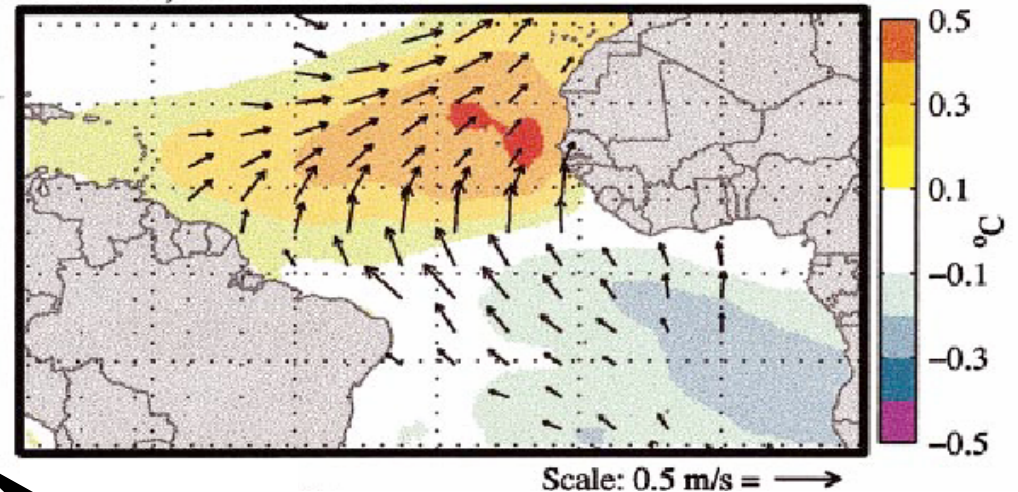
Lag Correlations between Reynolds SST/ERA-40 Wind and Niño3 (1968-2001)

Meridional Mode (MM)

a. SST, 10m Winds



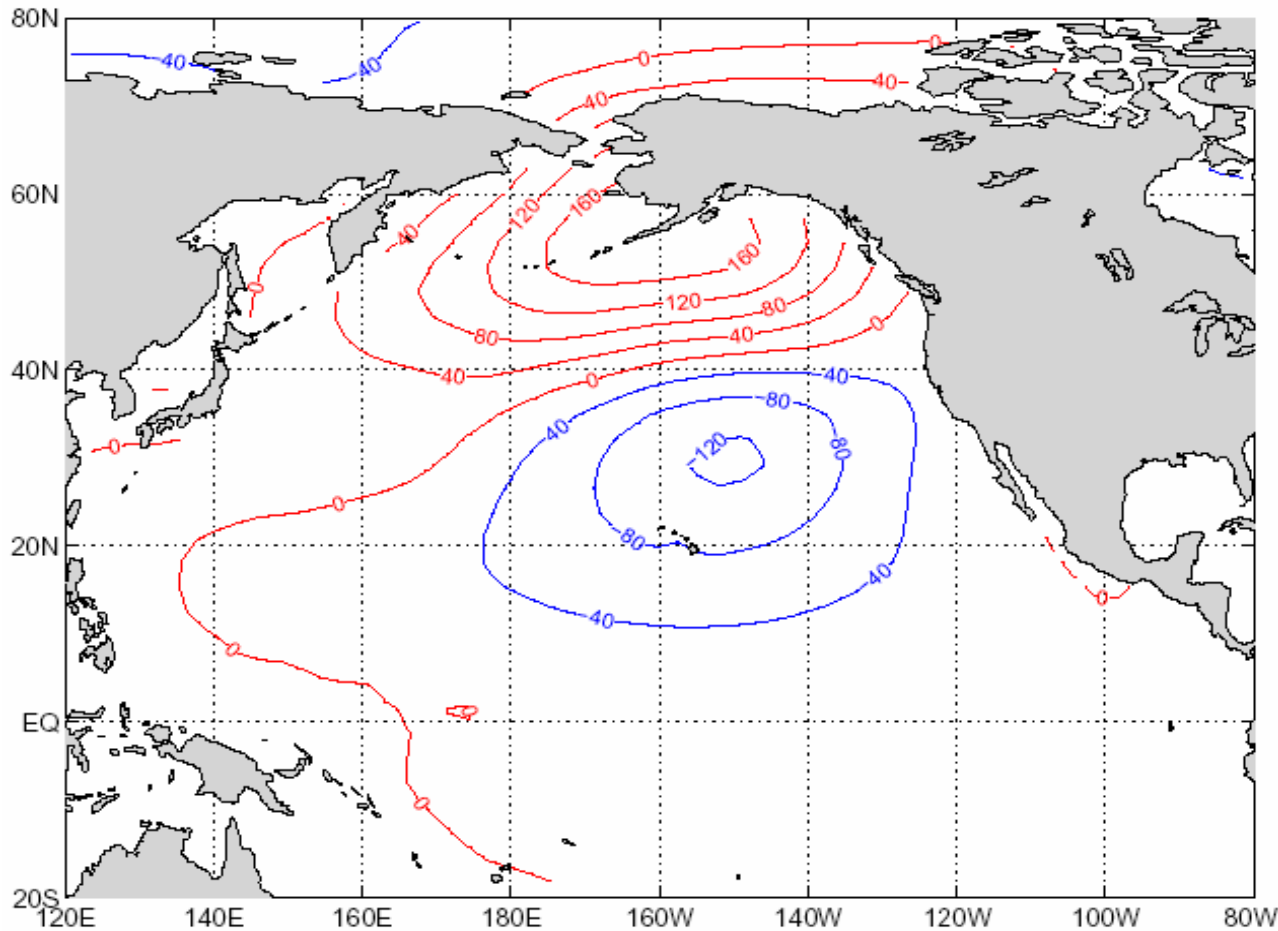
b. SST, 10m Winds



Chiang and Vimont (2004) postulate that "the MM is an effective conduit for extratropical atmospheric influence on the tropics."

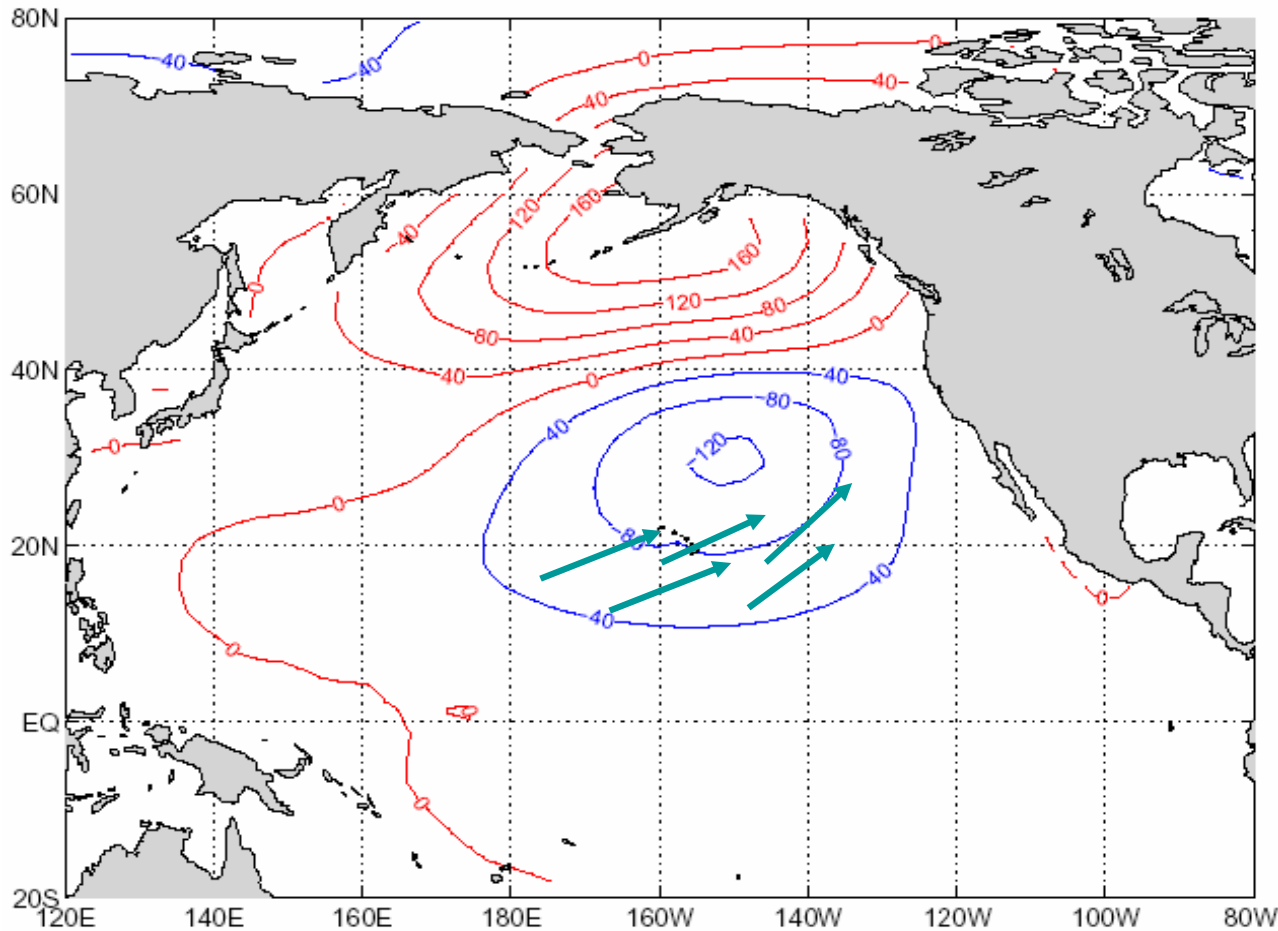
(Chiang & Vimont, 2004)

Seasonal Foot Printing Mechanism (Vimont et al.)



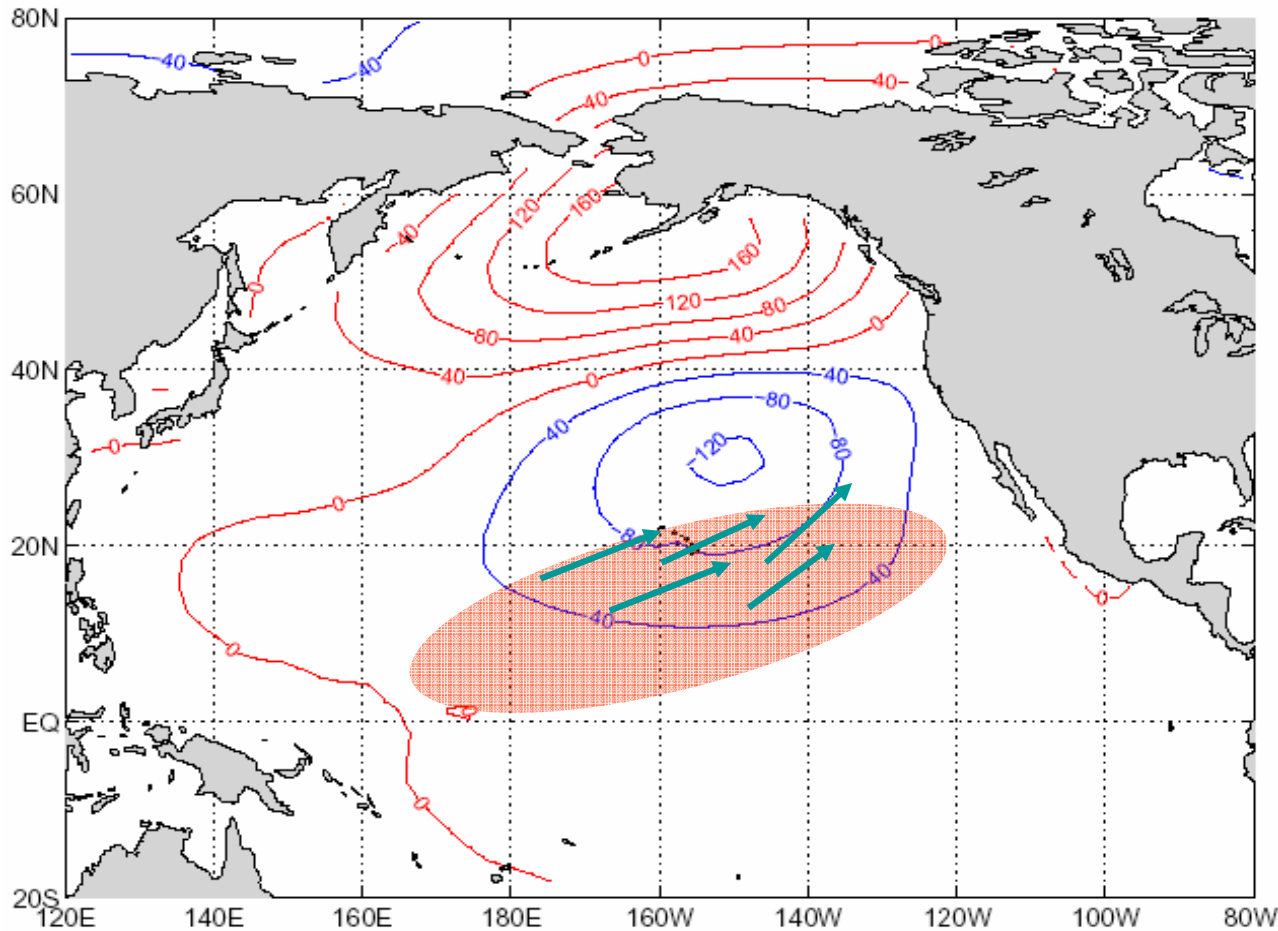
• NPO in NDJ (-1)
↓

Seasonal Foot Printing Mechanism (Vimont et al.)



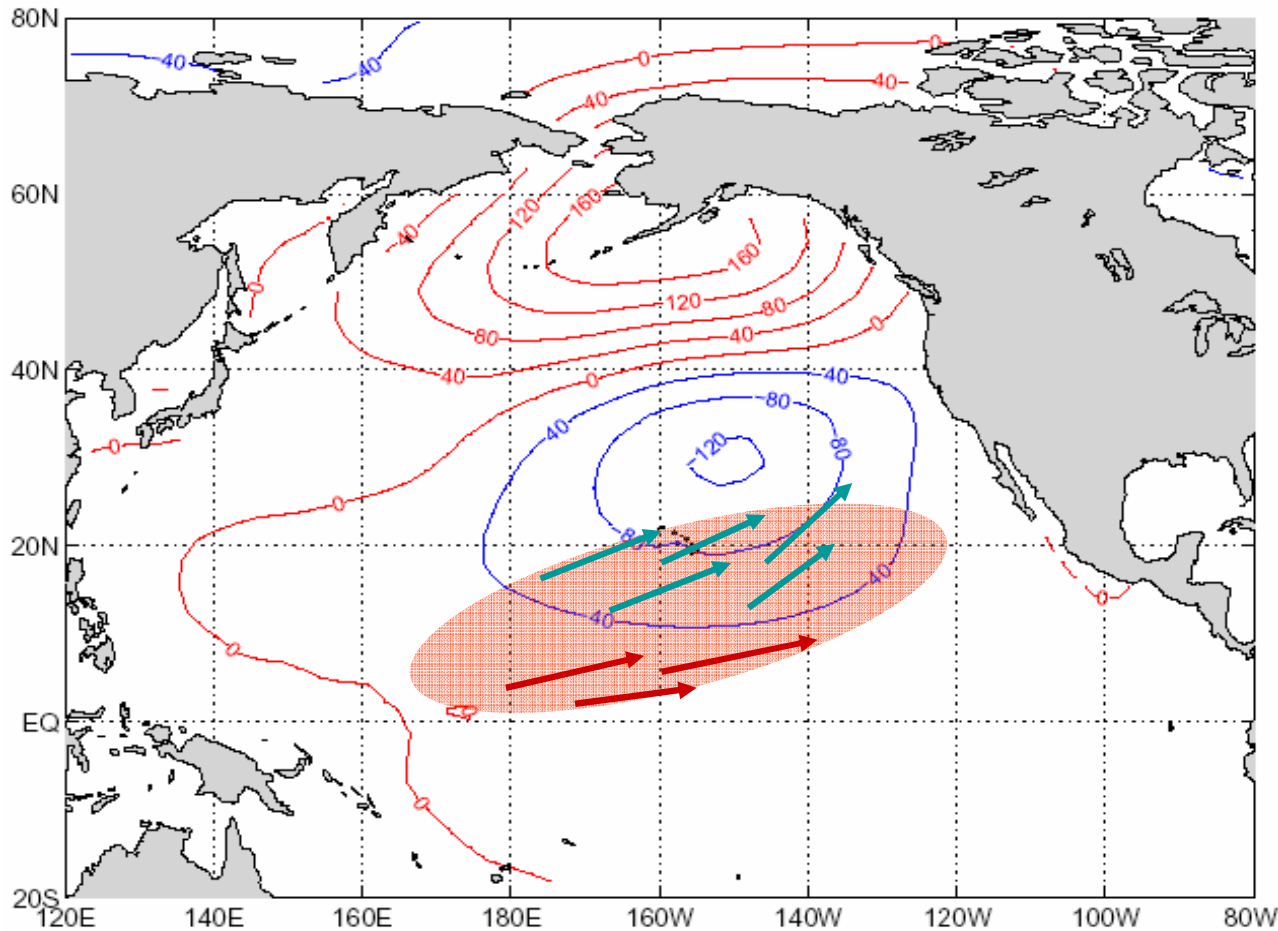
- *NPO in NDJ (-1)*
↓
- *Winds & Heat Flux*
↓

Seasonal Foot Printing Mechanism (Vimont et al.)



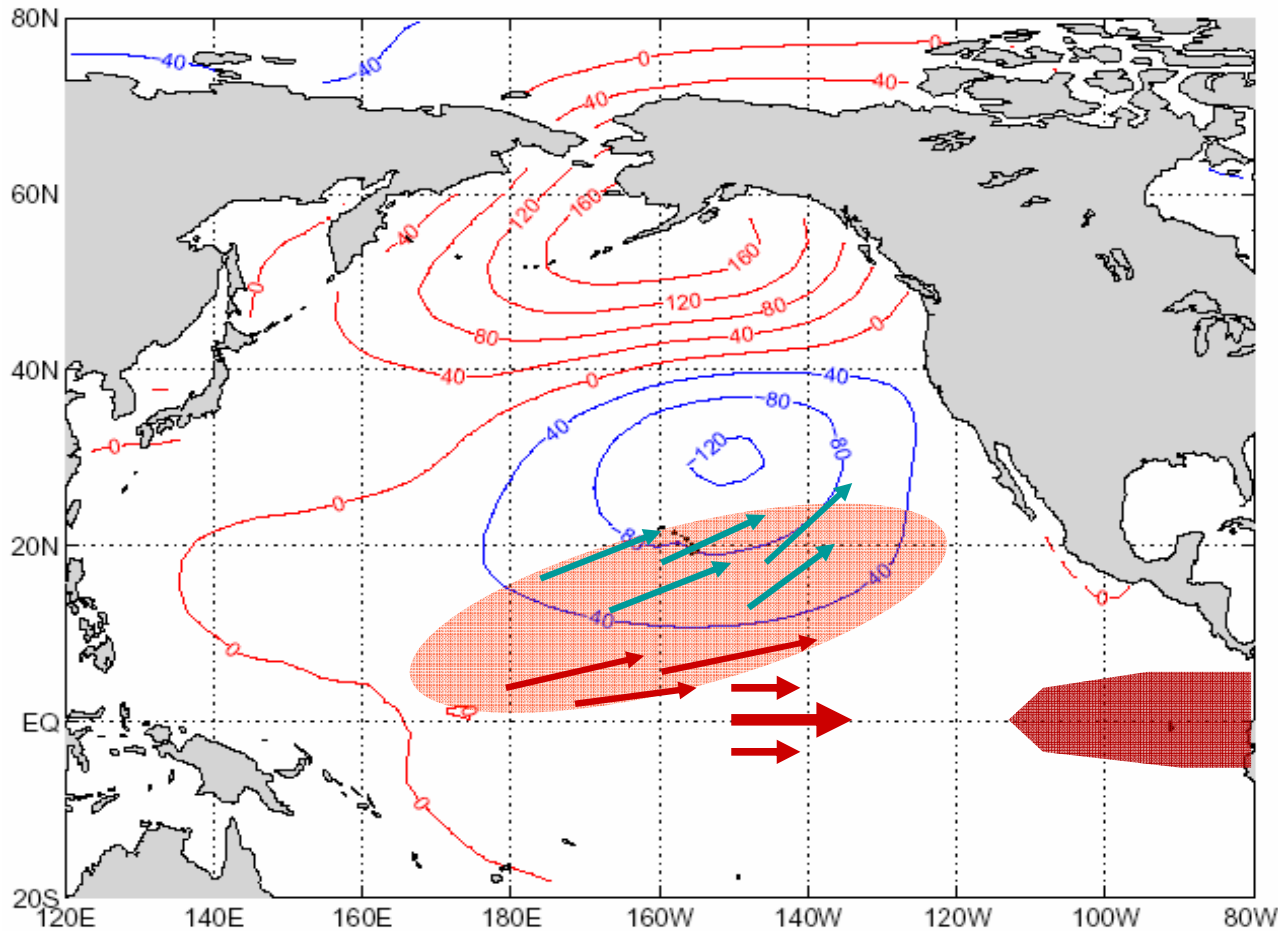
- *NPO in NDJ (-1)*
↓
- *Winds & Heat Flux*
↓
- *SST in MAM (0)*
↓

Seasonal Foot Printing Mechanism (Vimont et al.)



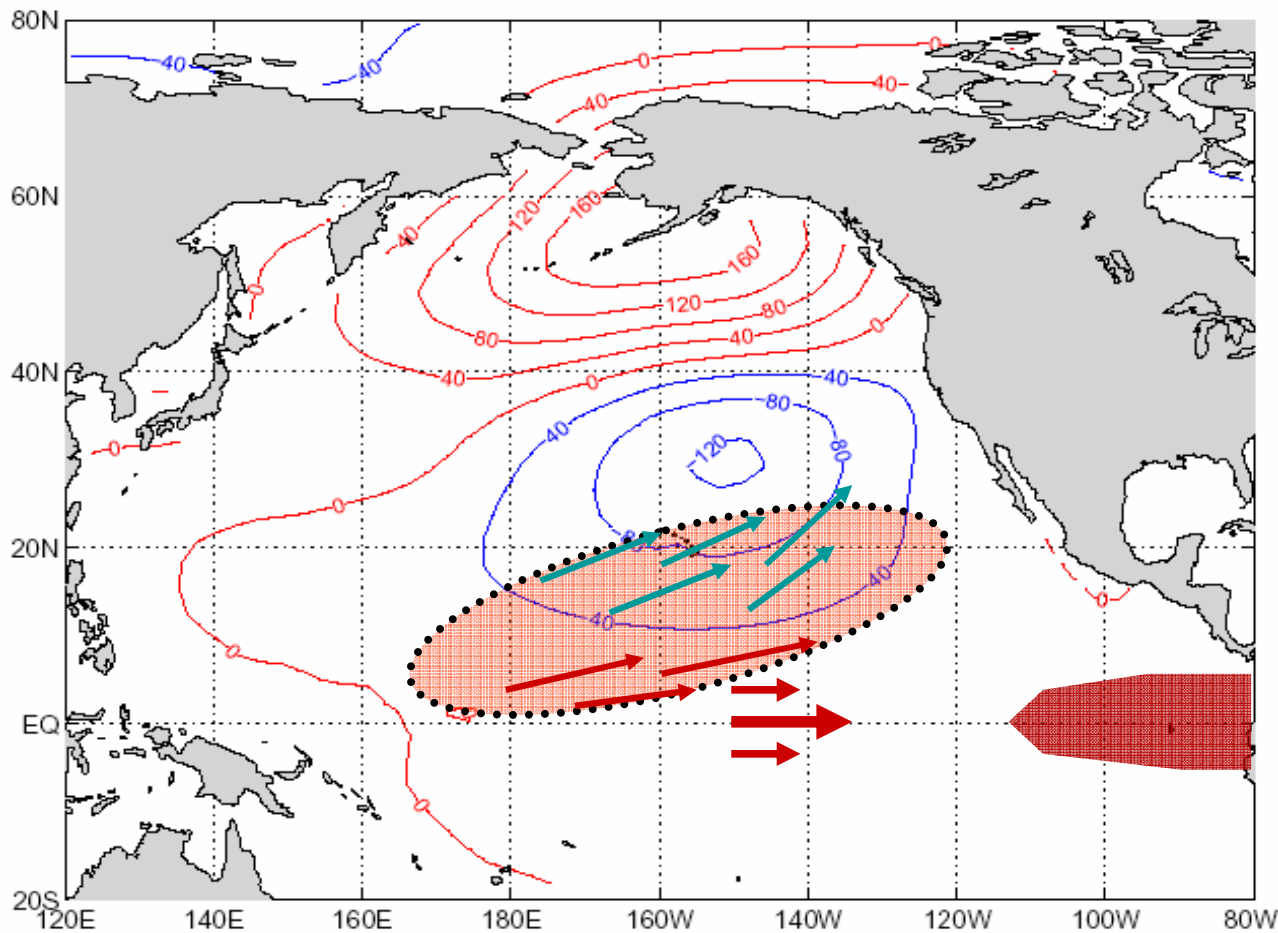
- *NPO in NDJ (-1)*
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- *SST in MAM (0)*
↓
- *Tropical Winds*
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Seasonal Foot Printing Mechanism (Vimont et al.)



- *NPO in NDJ (-1)*
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- *Winds & Heat Flux*
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- *SST in MAM (0)*
↓
- *Tropical Winds*
↓
- *Bjerknes Feedback*
↓
- *El Niño in NDJ(0)*

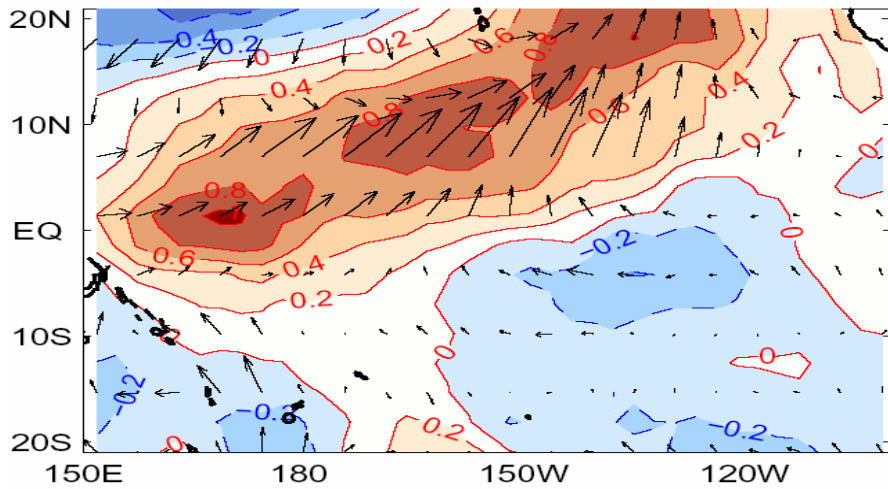
Seasonal Foot Printing Mechanism (Vimont et al.)



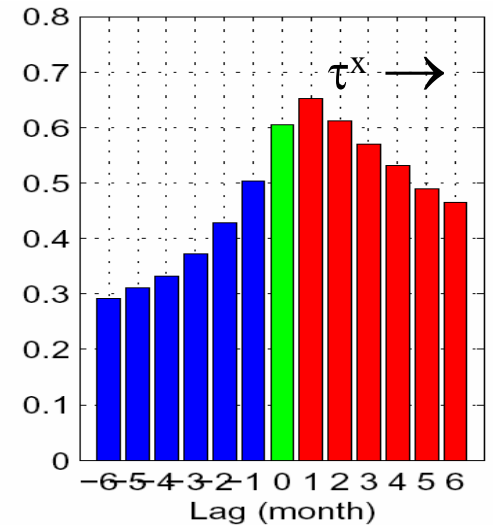
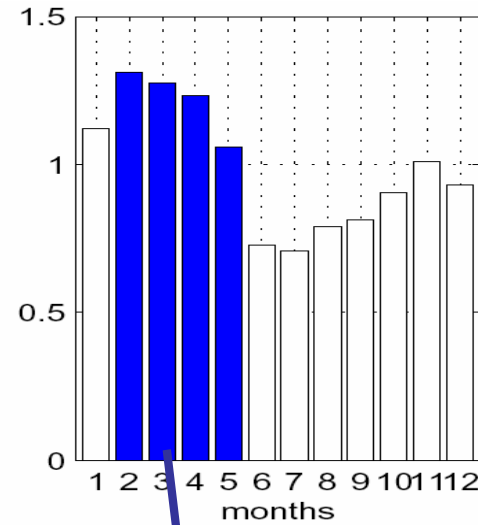
- *NPO in NDJ (-1)*
↓
- *Winds & Heat Flux*
↓
- *SST in MAM (0)*
↓
- *Tropical Winds*
↓
- *Bjerknes Feedback*
↓
- *El Niño in NDJ(0)*

Pacific “Meridional Mode” → ENSO

1st MCA non-ENSO MAM (47%)

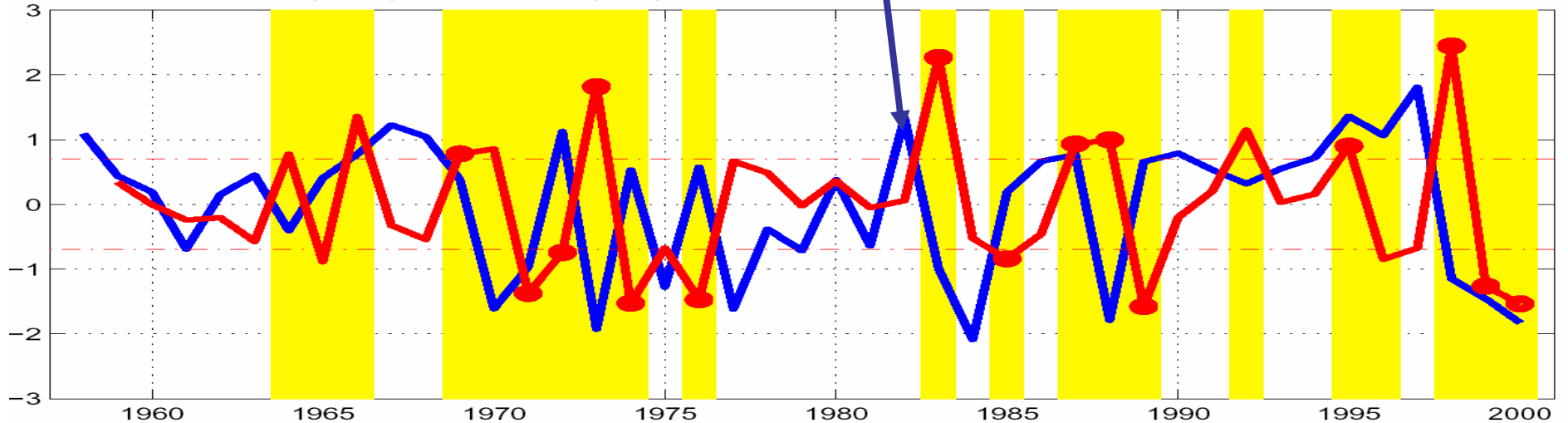


Seasonality of lag-corr. of

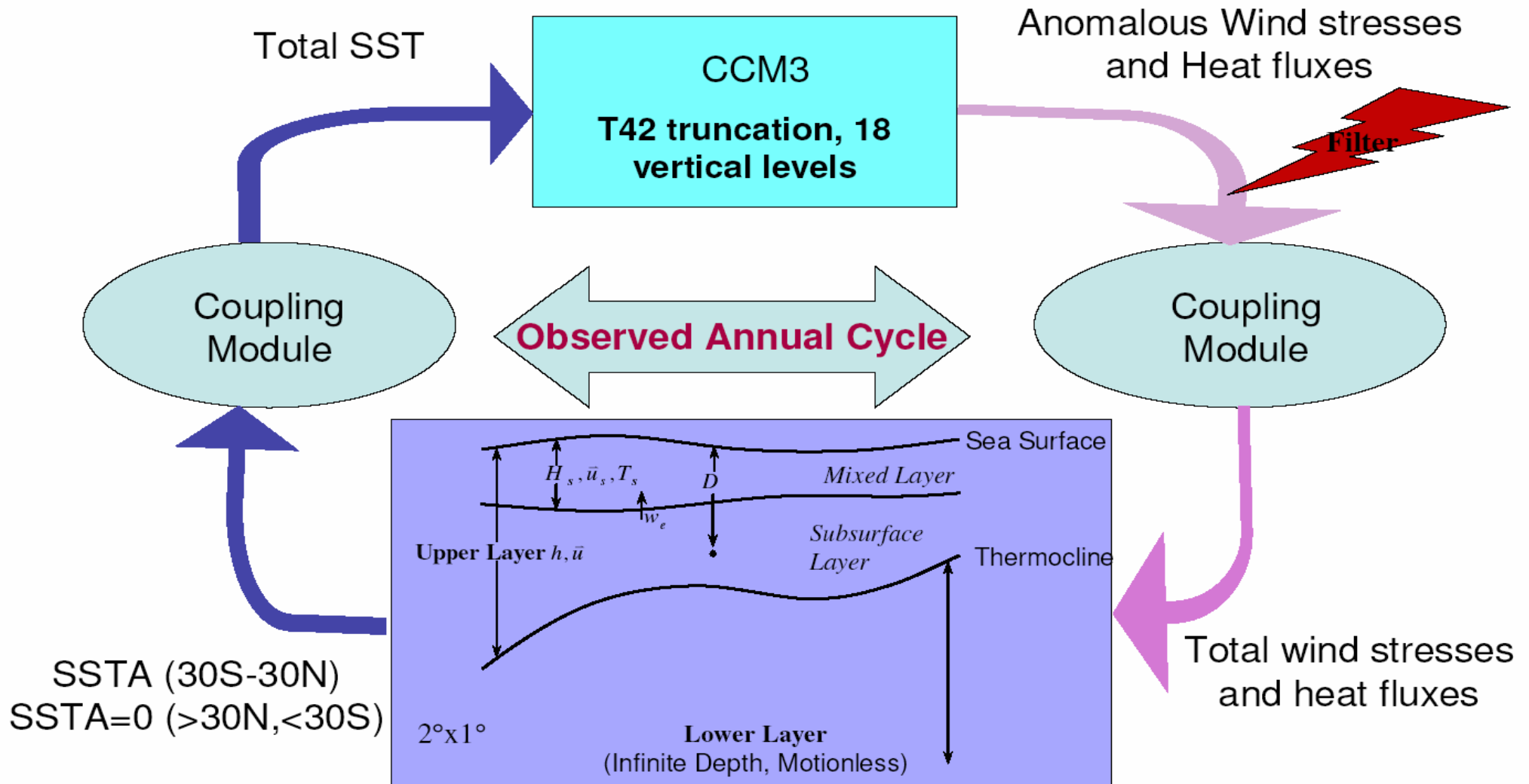


FMAM⁰ Tauxi (blue), NDJ¹ CTI (red): Cor=0.653

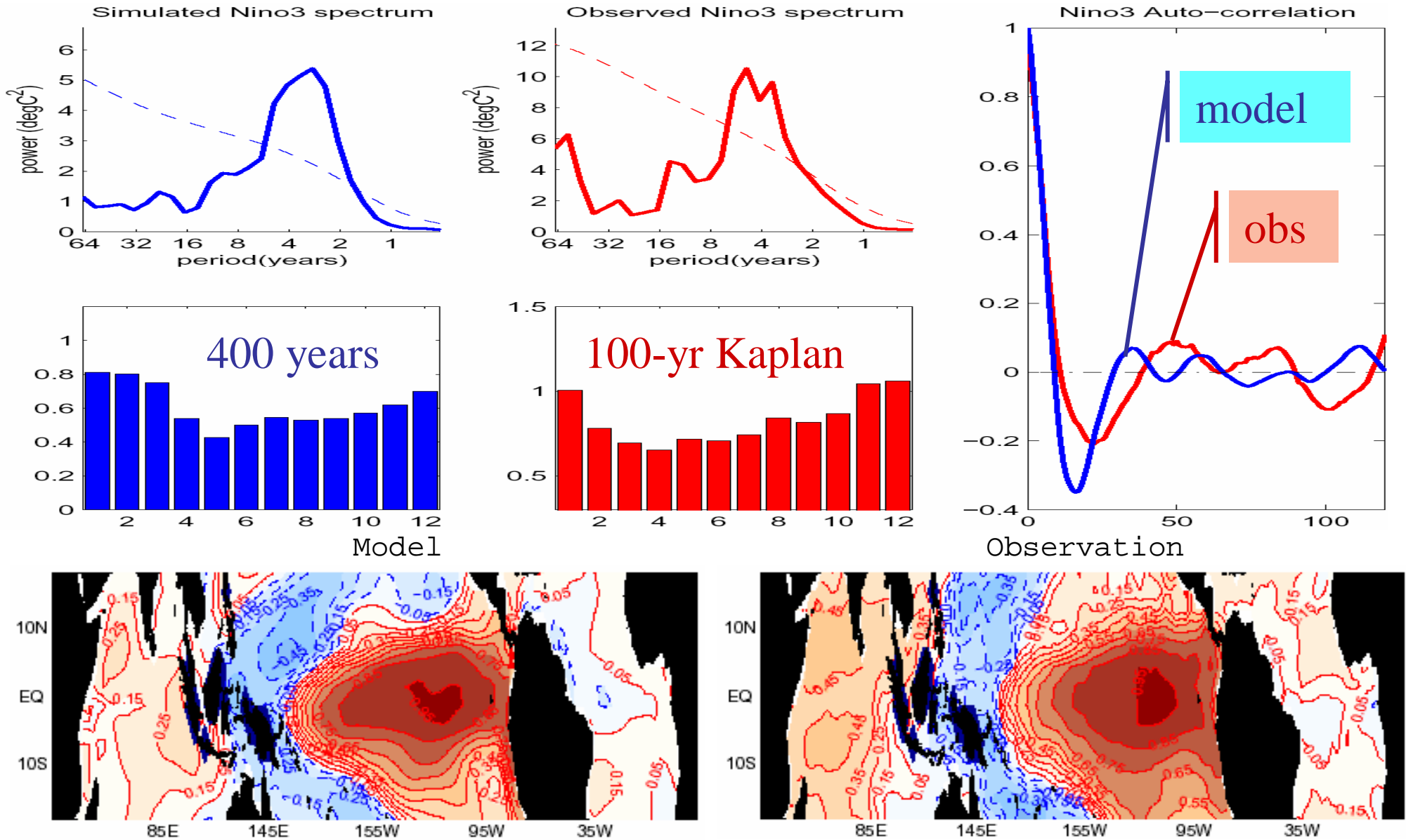
FMAM¹ Taux, NDJ¹ CTI: Cor=-0.202



CCM3-RGO Coupled Model

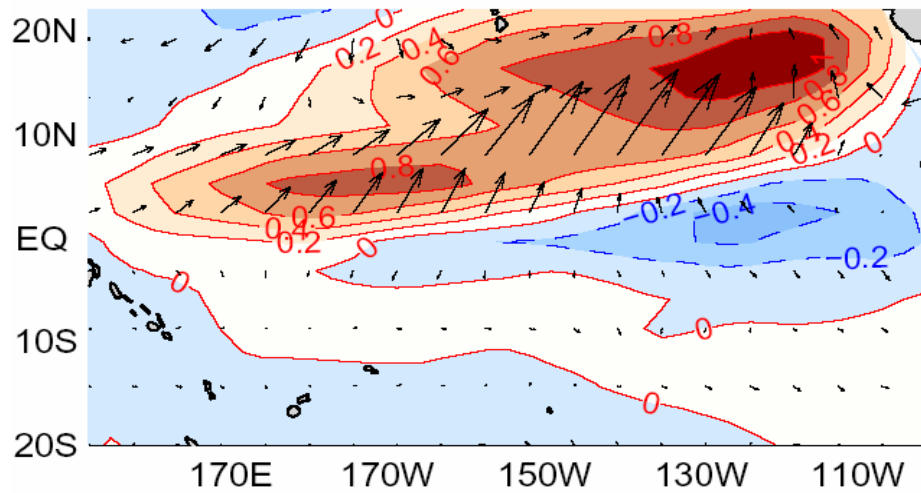


Simulated vs Observed ENSO

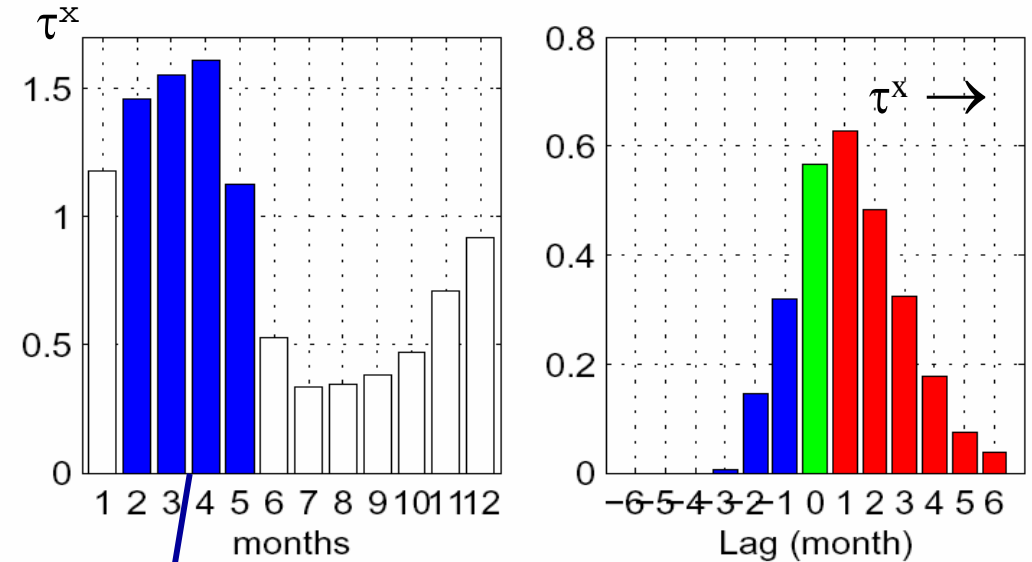


The MM in CCM3-RGO Simulation

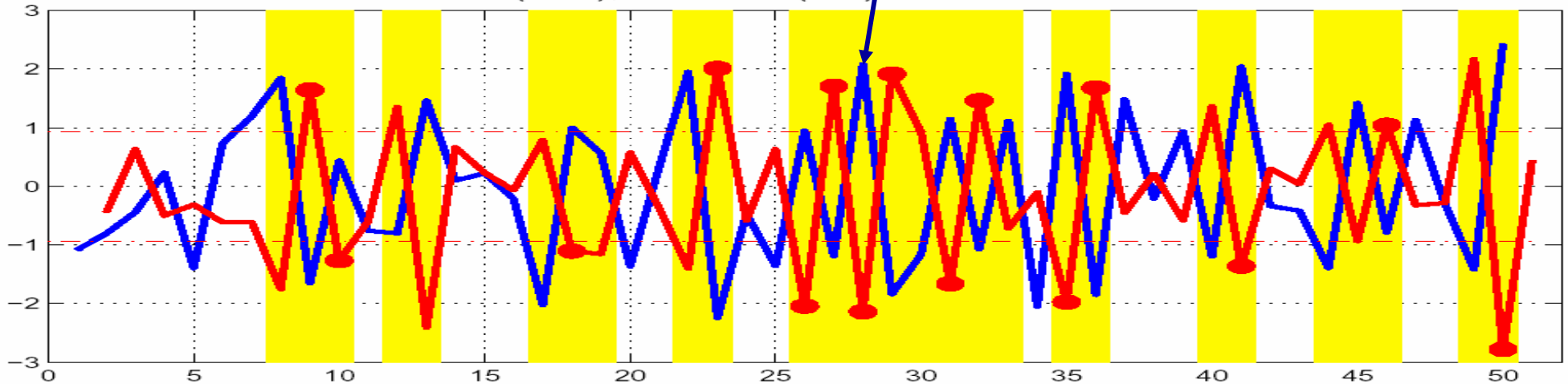
1st MCA non-ENSO MAM (54%)
Control



Seasonality of lag-corr. of SST & τ^x



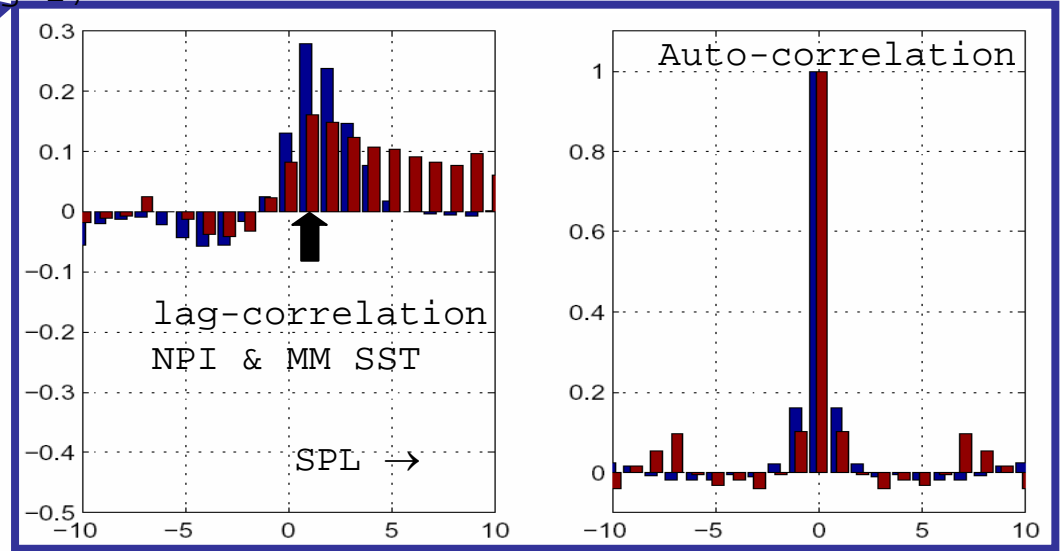
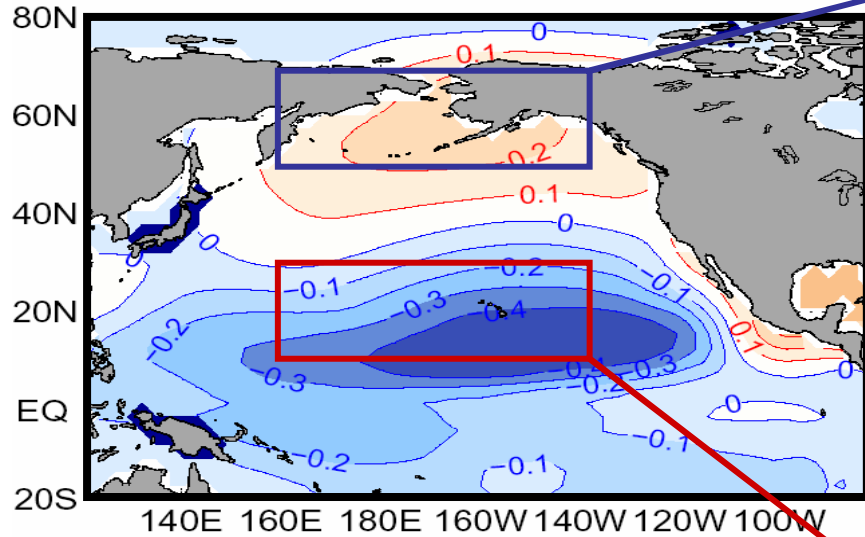
FMAM⁰ Taux (blue), NDJ¹ CTI (red): Cor=0.50 FMAM¹ Taux



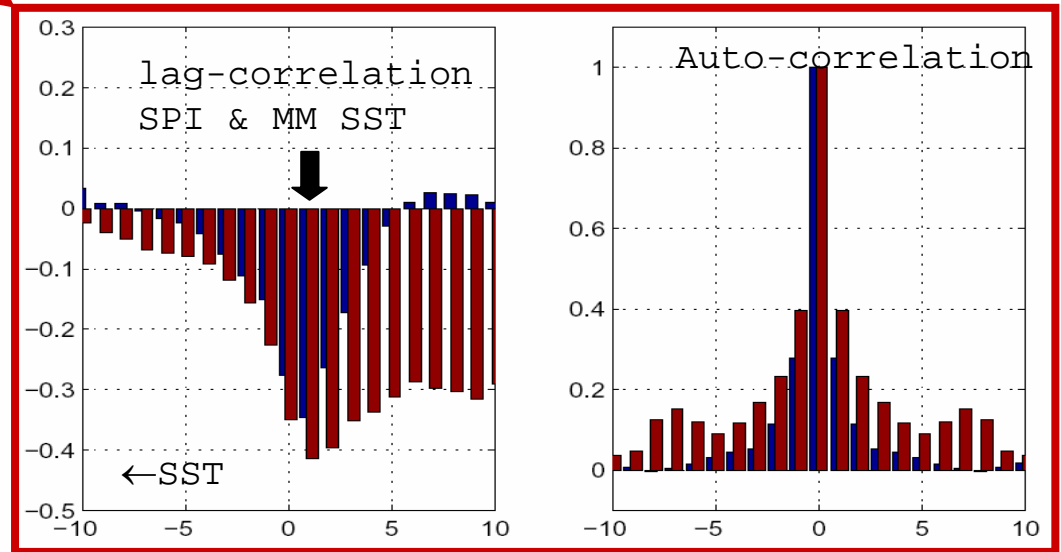
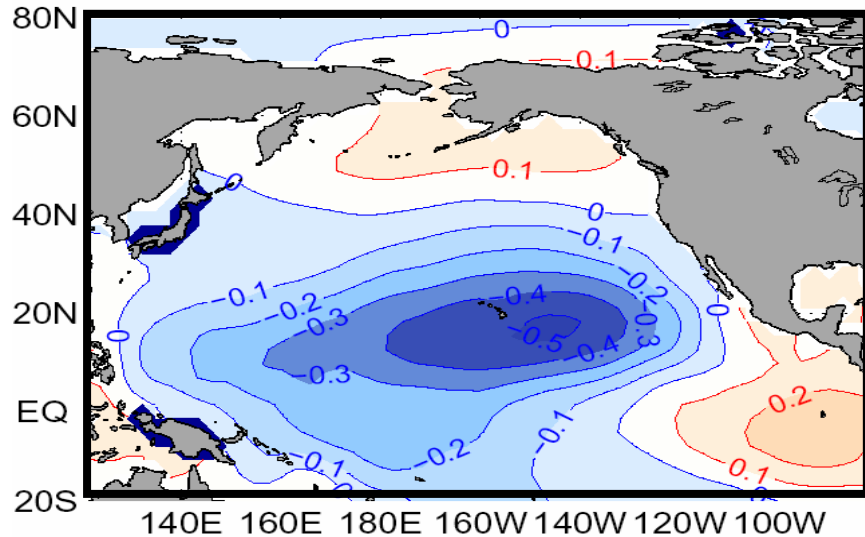
A sample from 400-year record

MM \Leftrightarrow NPO: Correlation of MM SST & SLP

400-year simulation (ENSO removed, lag=1)

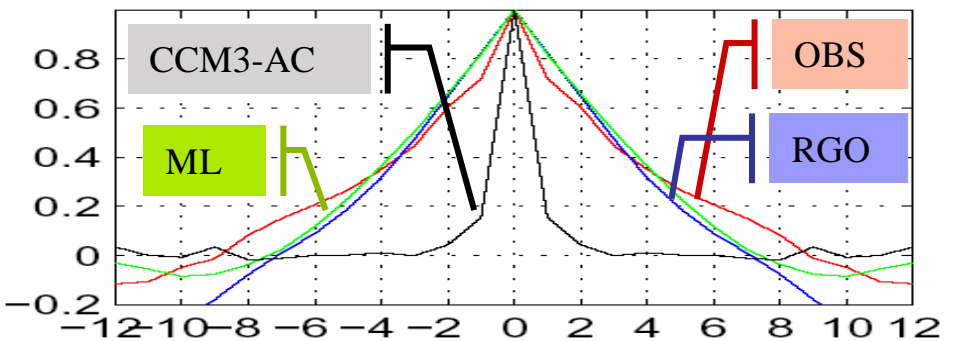
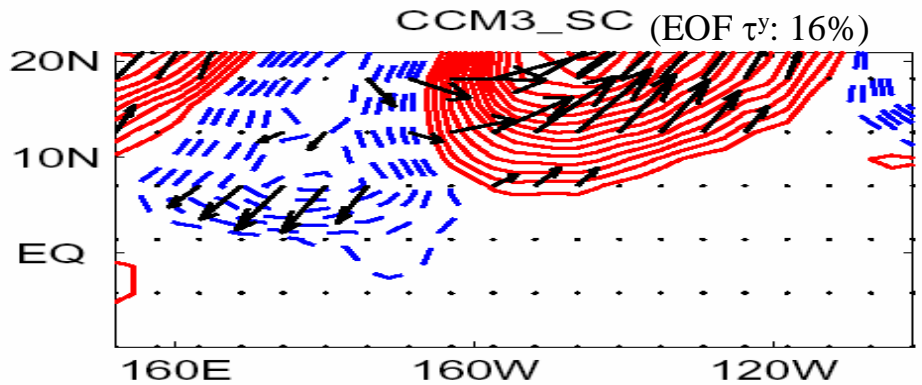
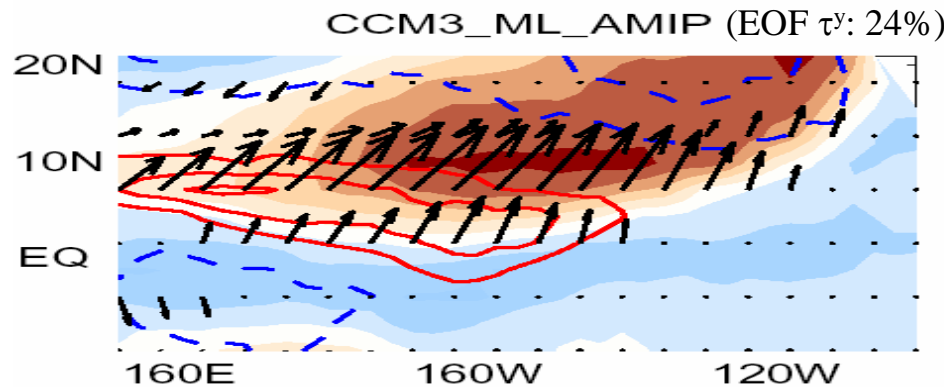
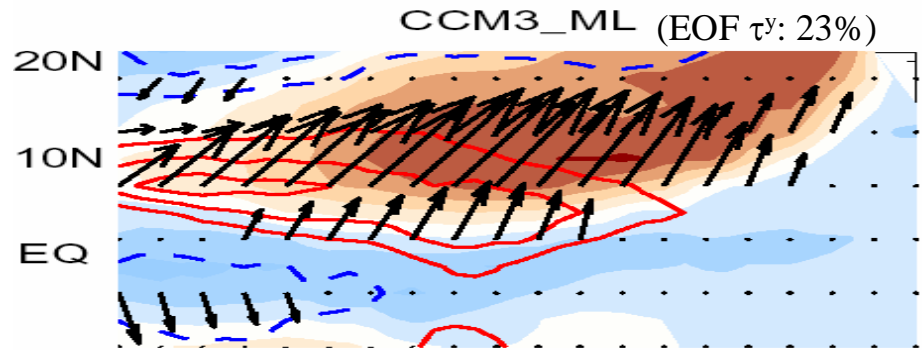
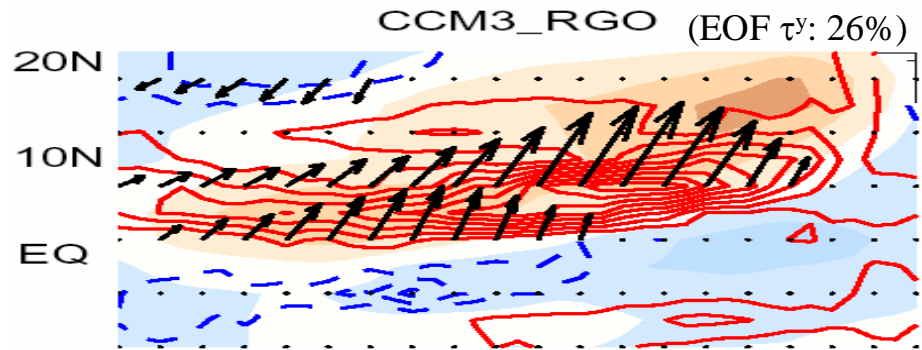


45-year ERA40 (ENSO removed, lag=1)



Is MM an independent coupled mode?

CCM3 coupled to a slab ocean can reproduce both the spatial and temporal structures of the MM. Since the slab ocean has no ocean dynamics required by ENSO, the MM must be intrinsic to the thermodynamic coupling between the ocean and atmosphere.



Questions

It is remarkable that both observational and modeling analyses yield similar SST pattern leading to the onset of ENSO. They all bear a close resemblance to the Pacific MM. This raises the following questions:

- 1) What is so special about the MM?
- 2) Why ENSO is particularly sensitive to MM forcing?
- 3) What role does the MM play in ENSO predictability?