A 'decoupled' Modelling Approach to study Climate Scale Interactions in the Indo-Pacific Tropical Basins

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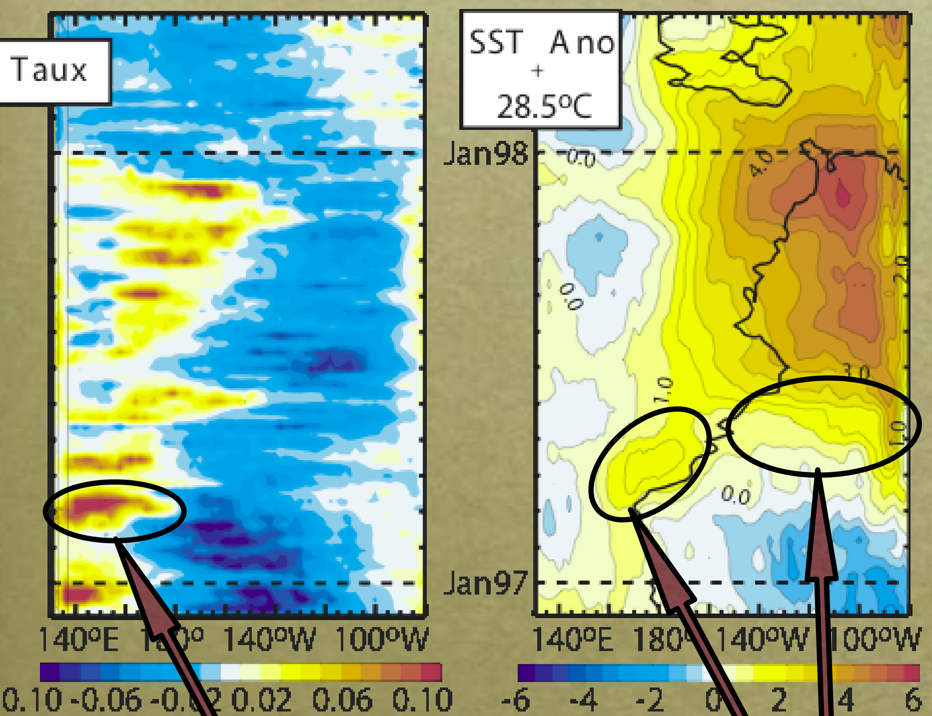
Outline

- ***Previous results***
  - *Pacific basin: Role of the March 1997 WWE on the 1997-98 El Niño onset*
  - *Indian basin: Role of an MJO event in the termination of the 1994 Indian ‘Dipole’ Event*
- ***Perspectives***
  - *Influence of intraseasonal oscillations on the variability in the Indian sector during boreal summer*

Role of the March 1997 WWE on the El Niño onset

<u>***Observations***</u>



March 1997 WWE

Central and eastern Pacific warming

<u>***Strategy***</u>

1- <u>The March 1997 WWE oceanic impact using an ocean model</u>

-REF$_{oce}$: Observed wind forcing

-NWE$_{oce}$: March WWE removed

2- <u>The atmospheric response to the March 1997 WWE oceanic impact</u>

-REF$_{atm}$:Atmospheric ensemble forced with REF$_{oce}$ SST

-NWE$_{atm}$:Atmospheric ensemble forced with NWE$_{oce}$ SST

3- <u>The fully coupled response to a strong WWE using a CGCM</u>

Oceanic response to the March 1997 WWE

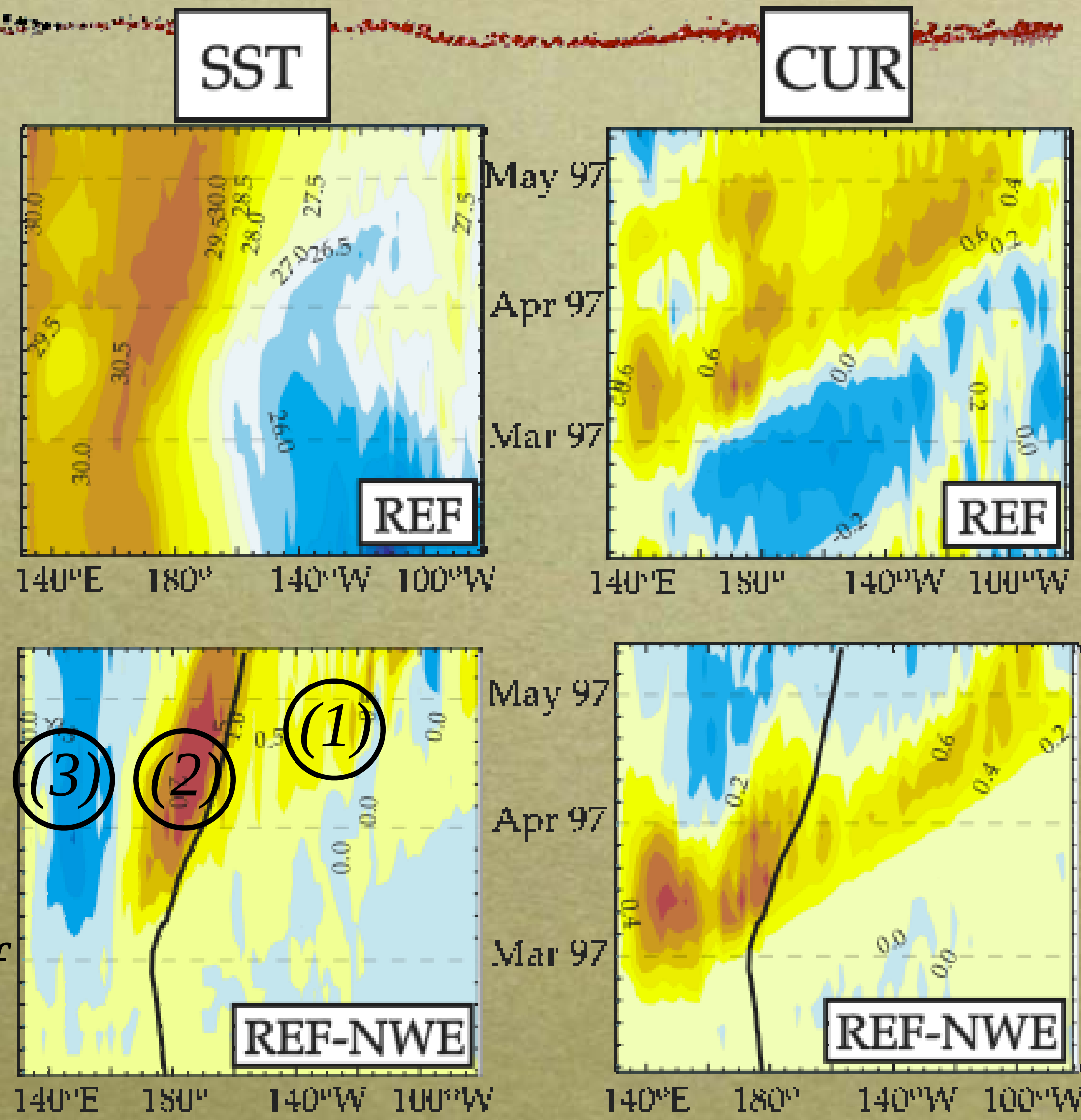
<u>Three SST responses</u>:

(1) weak warming along the Kelvin wave path

(2) rapid displacement of the eastern edge of the warm pool

(3) cooling over the far western Pacific

Contribute to the initiation of the El Niño onset



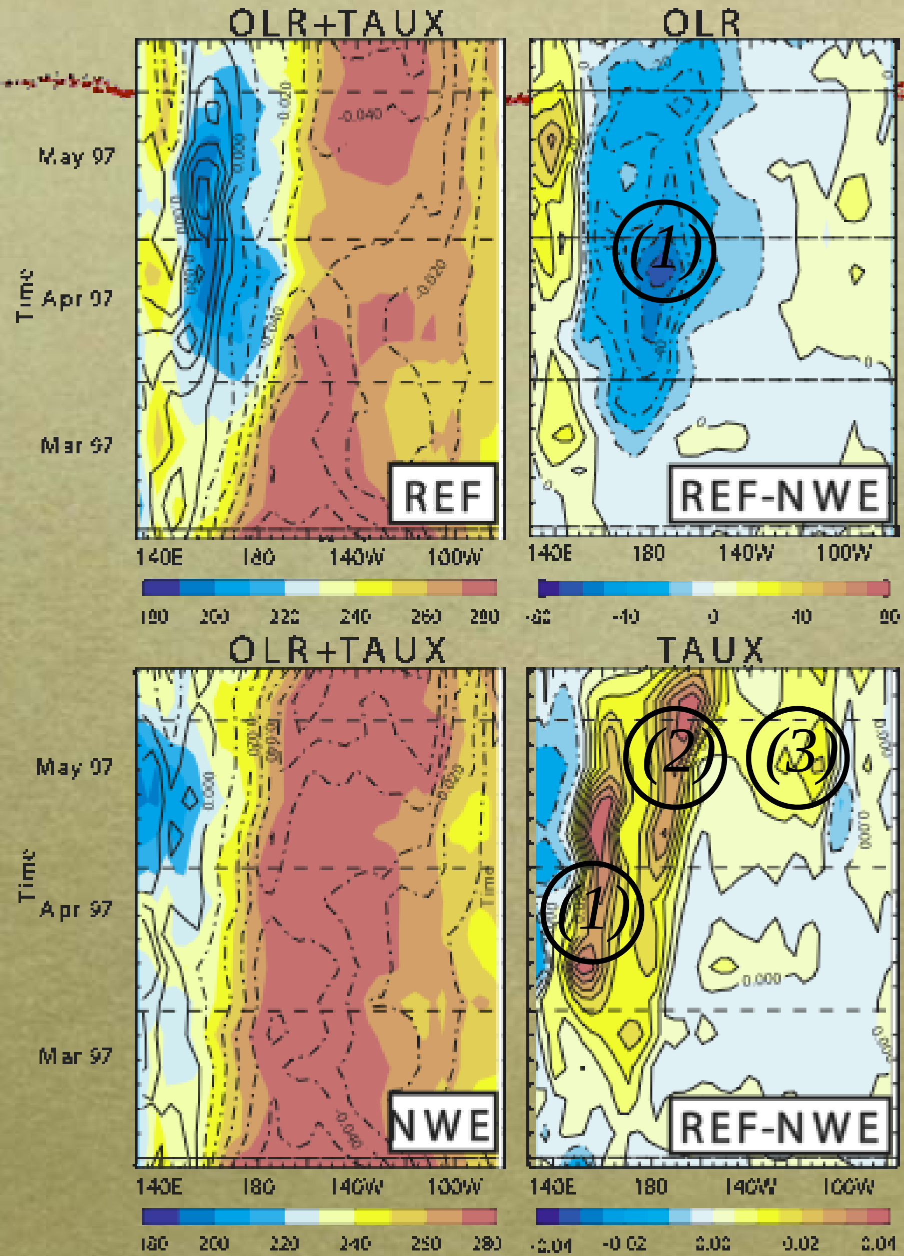
Atmospheric response to the M97 WWE oceanic impact

<u>*Three atmospheric responses*</u>*:*

(1) Eastward shift of the western Pacific convective activity associated with a strong WWE activity in April and May

(2) Reduction of the trade winds along the eastern edge of the warm pool

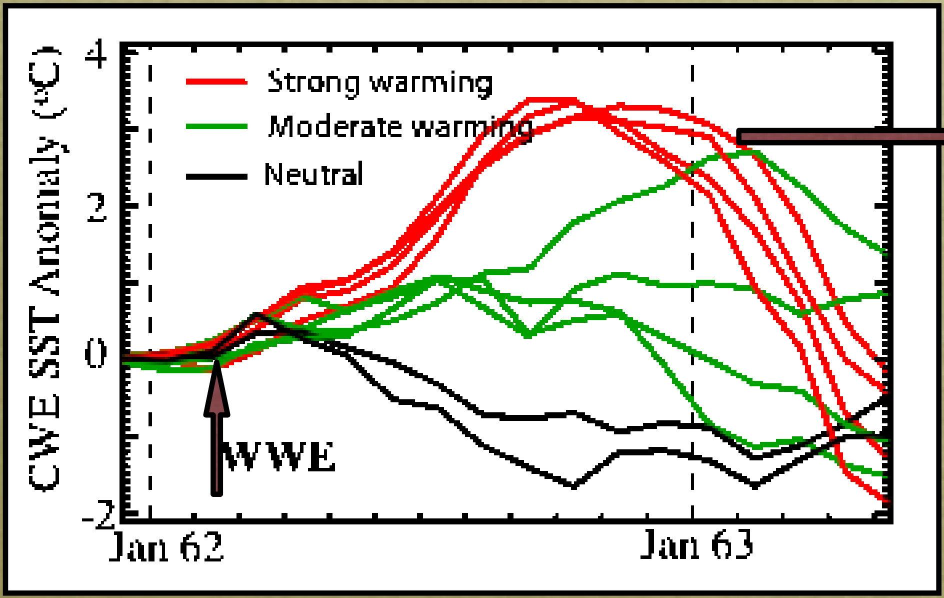
(3) Reduction of the trade winds along the Kelvin wave path

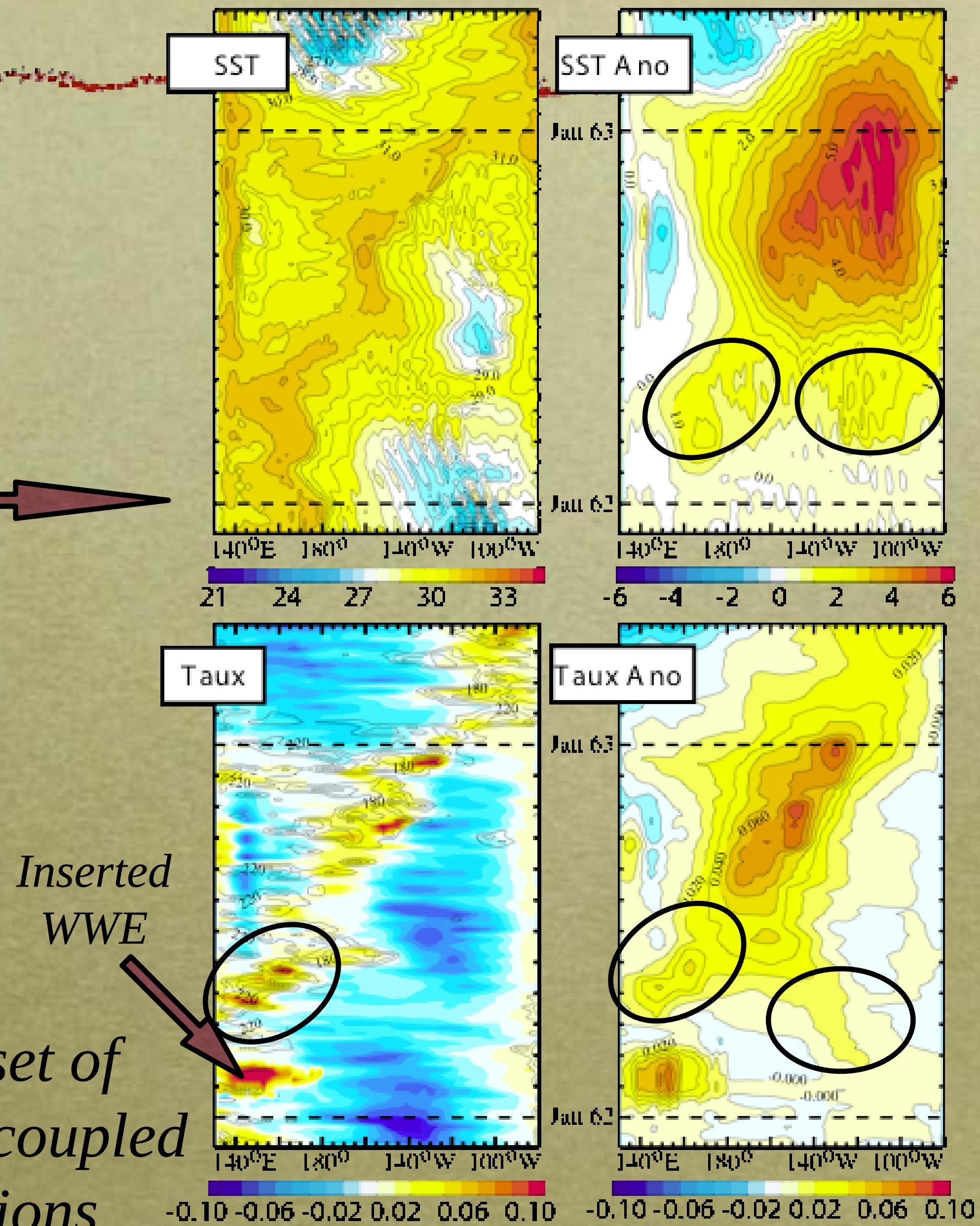


→ *Atmospheric response acts to amplify the initial oceanic impact*

Fully coupled response to a strong WWE

Addition of a strong WWE in HadAM3-OPA CGCM:

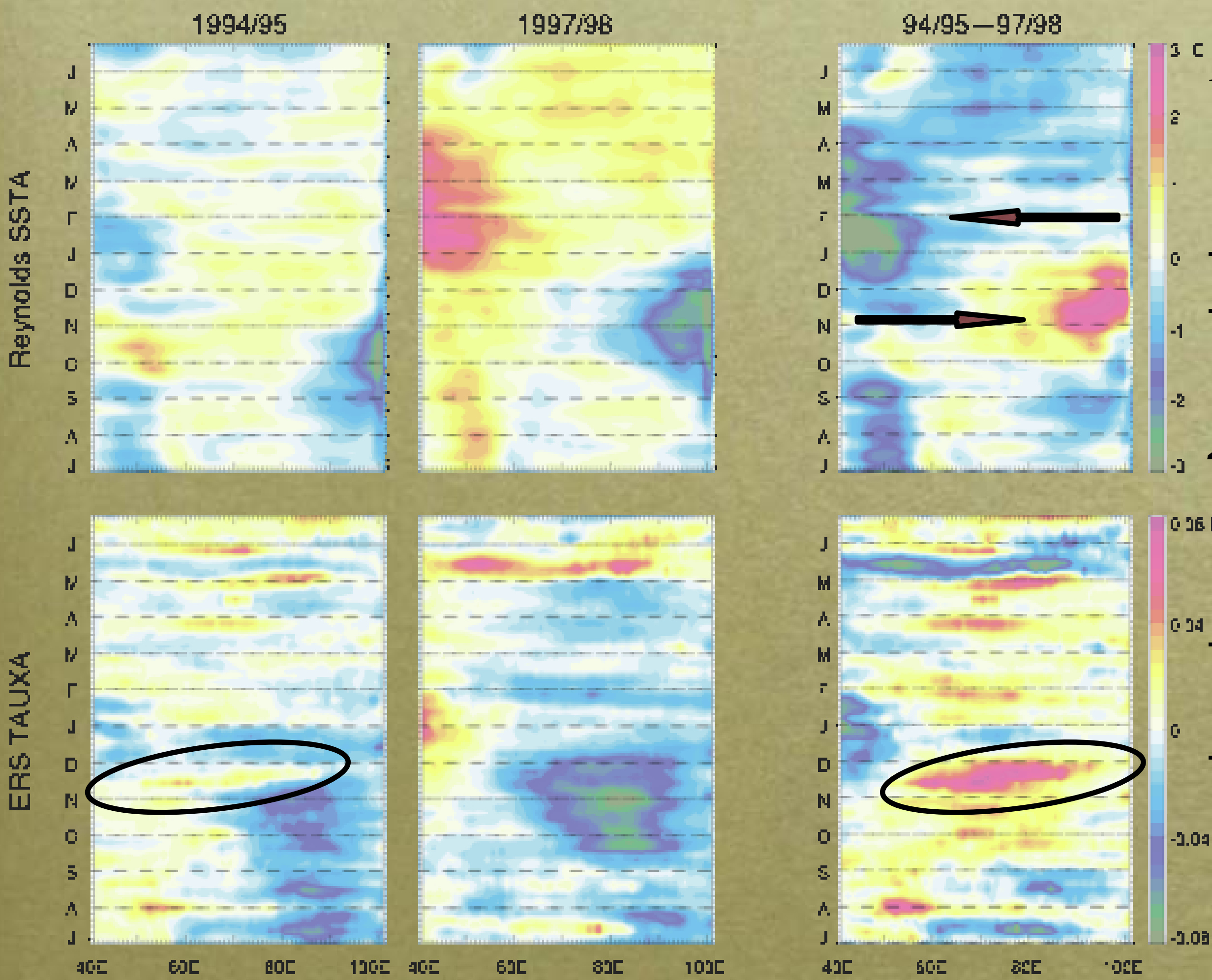




Strong WWEs favor the onset of intense El Niño events trough coupled ocean-atmosphere interactions

Role of an MJO event in the termination of the 1994 Indian 'Dipole' Event

Observations



Strategy

1- <u>*Study the Nov 1994 MJO oceanic impact using an ocean model*</u>

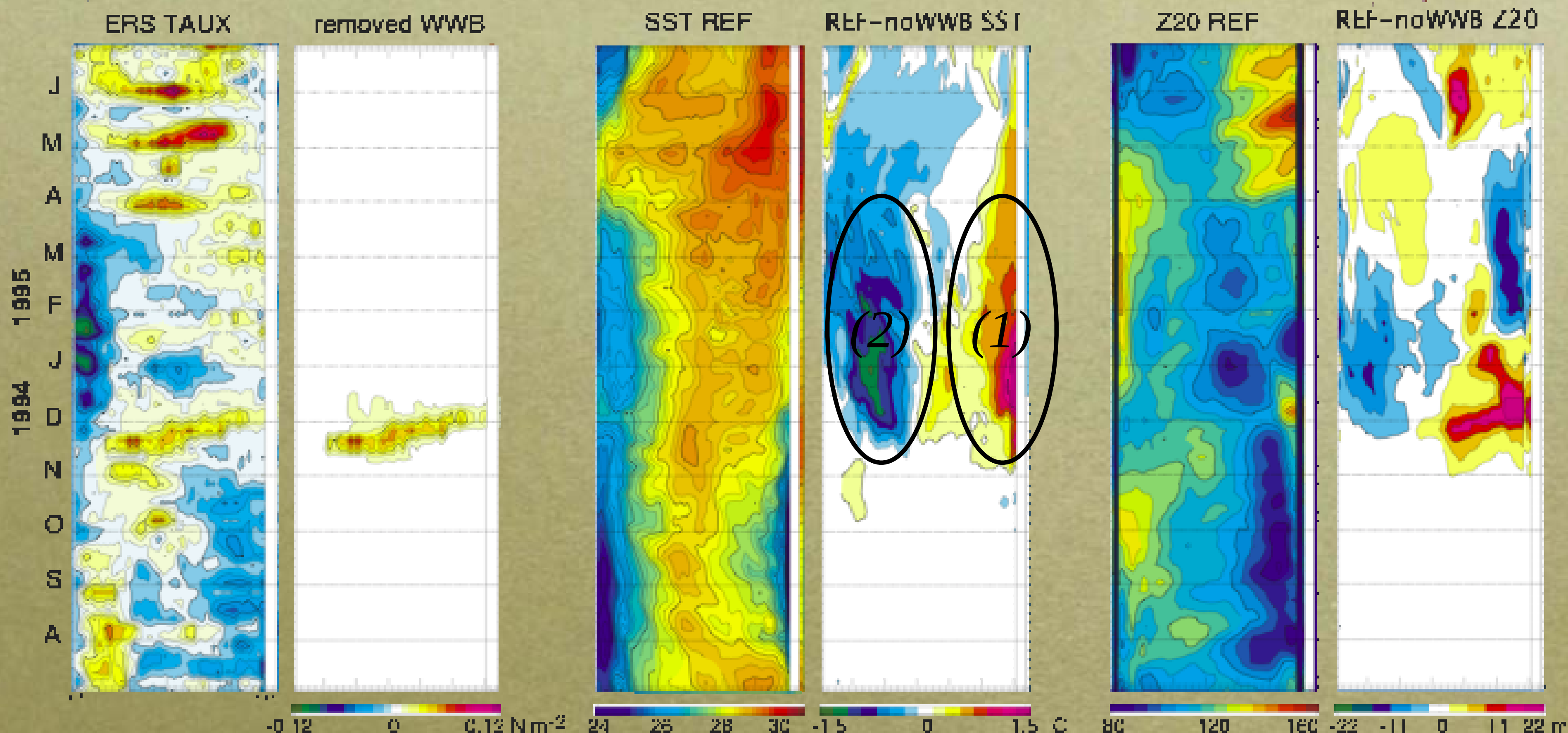
-REF$_{oce}$: Observed wind forcing
-noWWB$_{oce}$: March WWE removed

2- <u>*Study the atmospheric response to the Nov 1994 MJO oceanic impact*</u>

-REF$_{atm}$:Atmospheric ensemble forced with REF$_{oce}$ SST
-noWWB$_{atm}$:Atmospheric ensemble forced with noWWB$_{oce}$ SST

Fischer et al. in preparation

Oceanic response to the November 1994 WWE



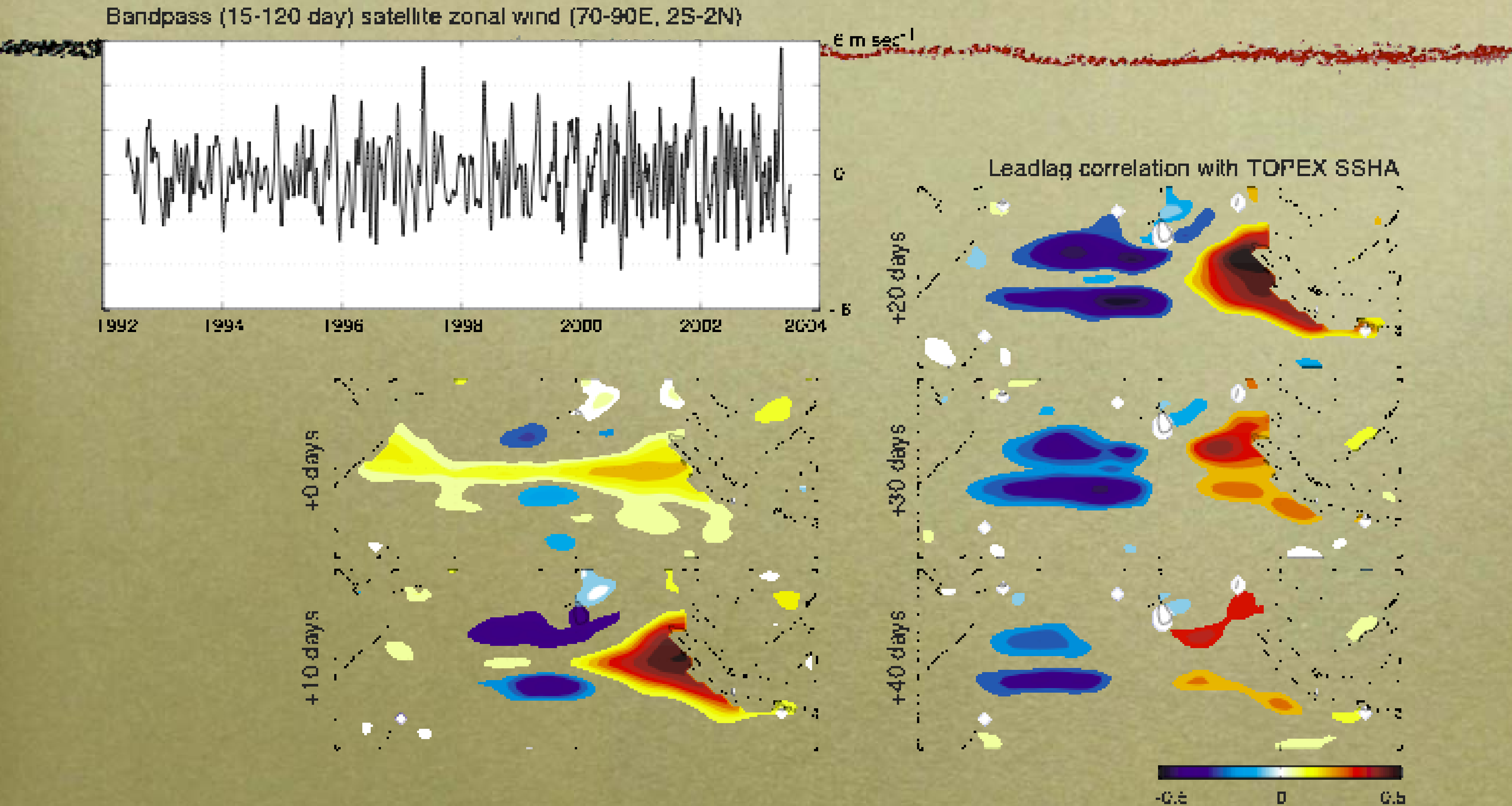
<u>Two main SST responses</u>:

(1) warming of the eastern indian ocean (~1.5°C)
(horizontal advection + downwelling)

(2) cooling of the western indian ocean (~-1.5°C)
(borizontal advection)

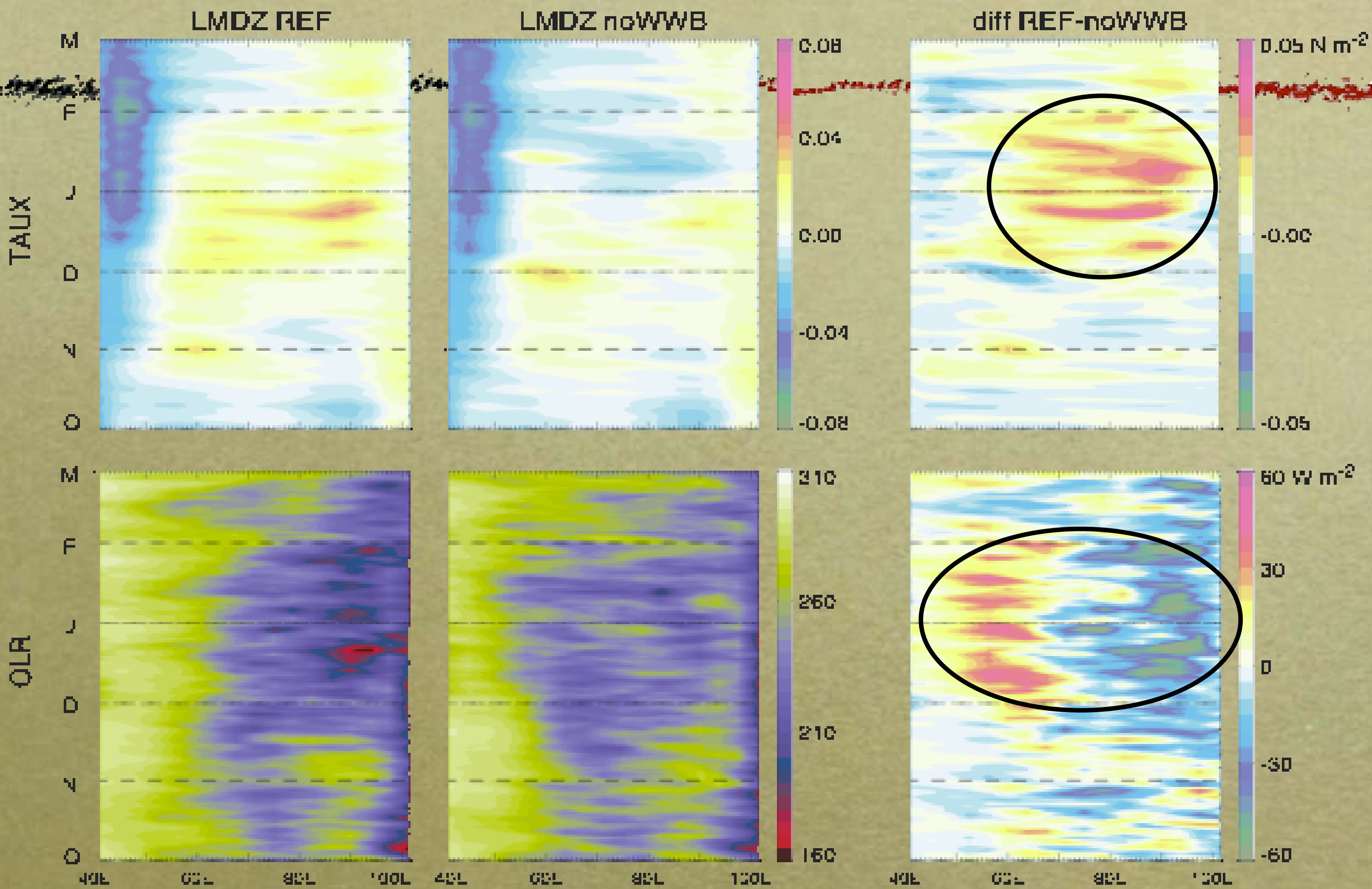
Without the WWE, the 1994 IOD would have lasted longer

Oceanic response to the November 1994 WWE



Observational evidence of the influence of equatorial WWEs on the thermocline depth variability in the Indian Ocean

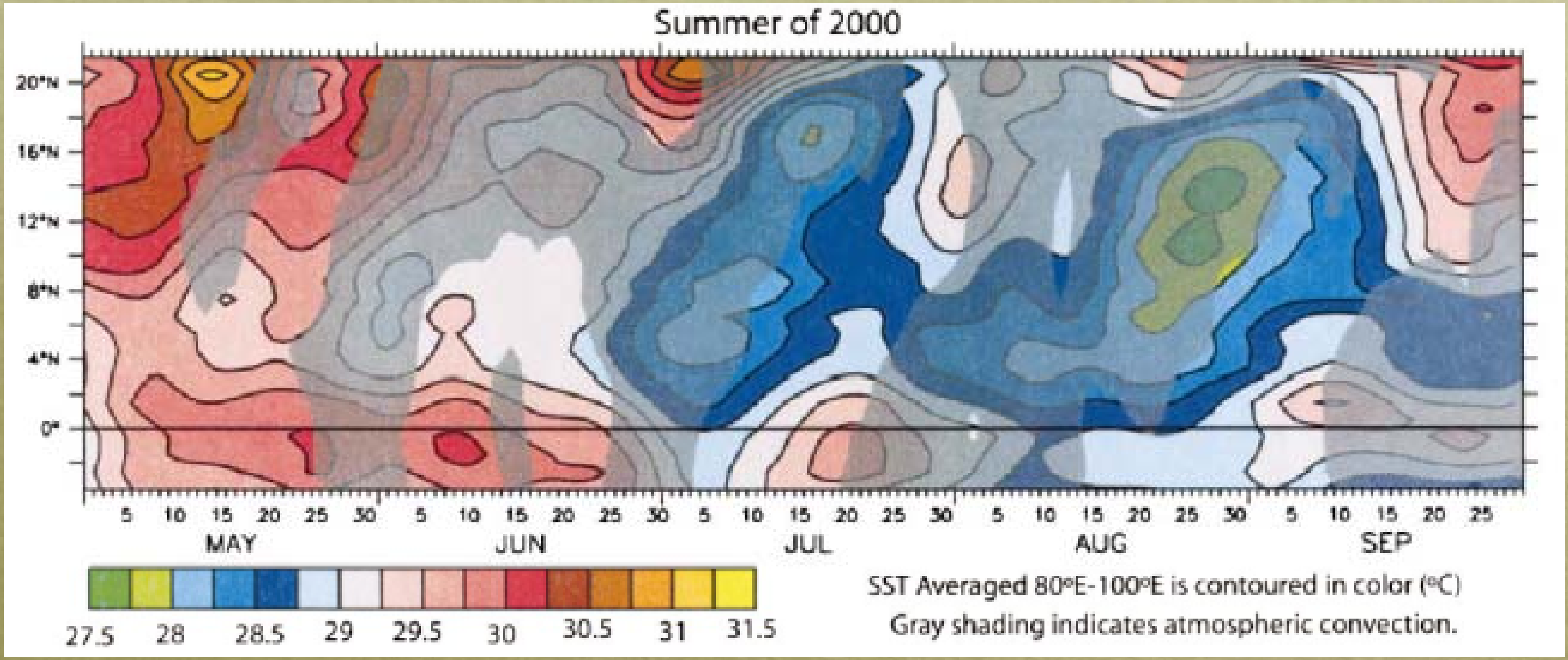
Atmospheric response to the N94 WWE oceanic impact



Atmospheric response: eastward shift of convection associated with a wind shift from westerly to easterly

Hasten the transition back to climatological conditions

Influence of intraseasonal oscillations on the variability in the Indo-Pacific sector during boreal summer



Vecchi and Harrison 2002

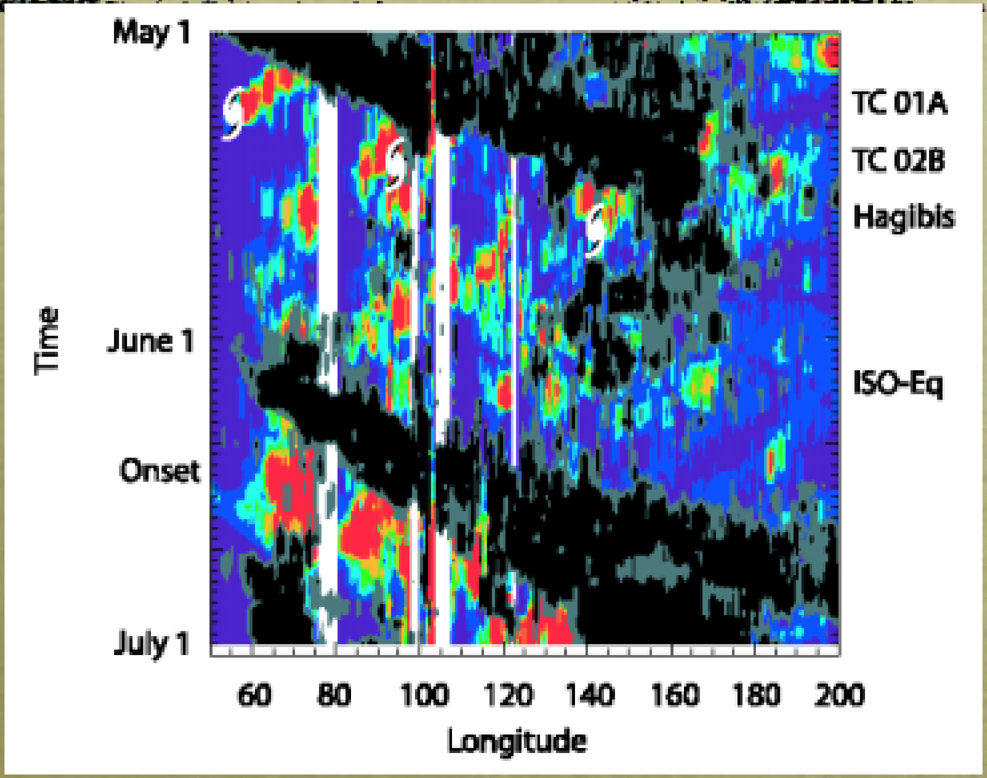
Large intraseasonal SST variability in the northern Bay of Bengal (1-2°C)

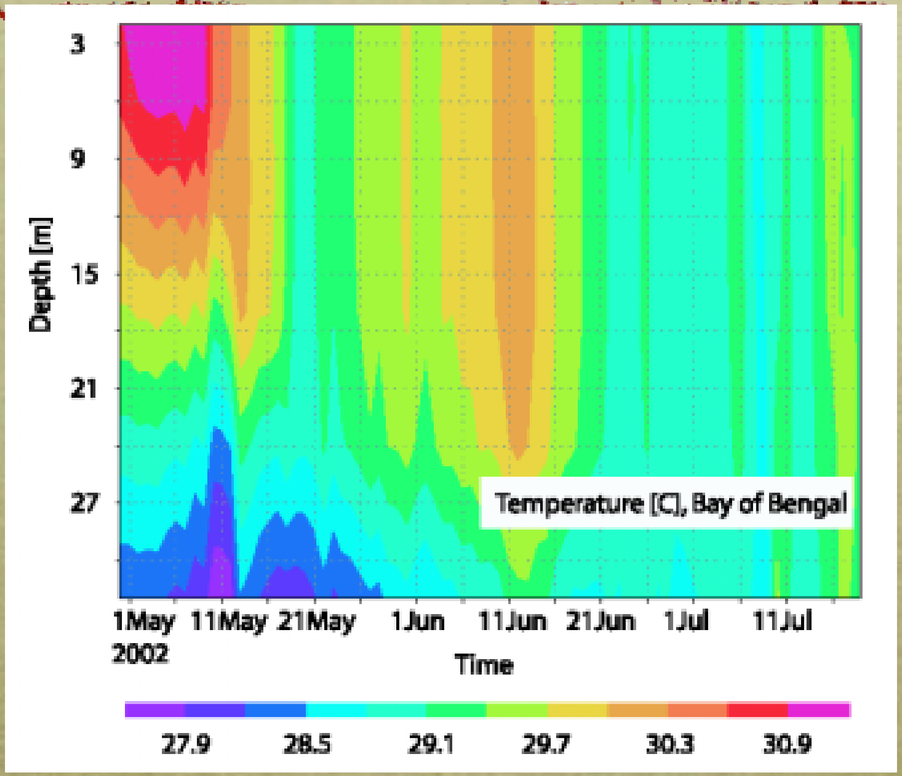
Potential coupled air-sea interactions playing a role in monsoon variability

Perspectives

- *Study the oceanic mechanisms controlling the subseasonal SST variability in the Bay of Bengal (and the Arabian Sea) using ocean model*
- *Study the atmospheric response to this subseasonal SST variability using an atmospheric model*
- *Suggest coupled air-sea interactions that could modulate the timing and dynamics of active-break periods in the Indian monsoon*

Influence of intraseasonal oscillations on the variability in the Indo-Pacific sector during boreal summer





Flatau et al. 2003

Early May propagation of an ISO lead to intense SST decreases in the Bay of Bengal → *Delay of the monsoon onset in 2002*