Mechanisms of Arabian Sea mini warm pool formation in an OGCM

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National Workshop on "ARMEX Data Analysis & Modelling",
April-20, 2006, NIO, Goa

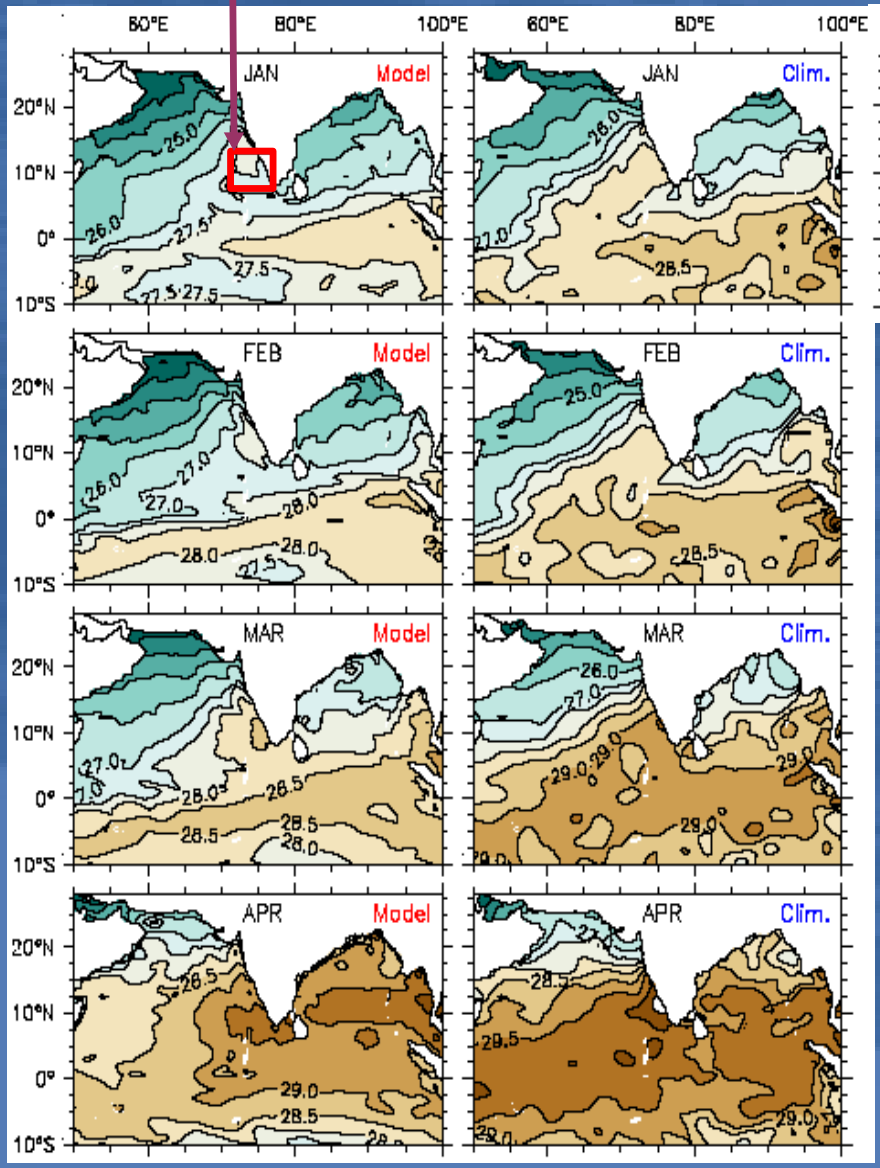
Funded by INDOMOD (DOD) & ARMEX(DST)

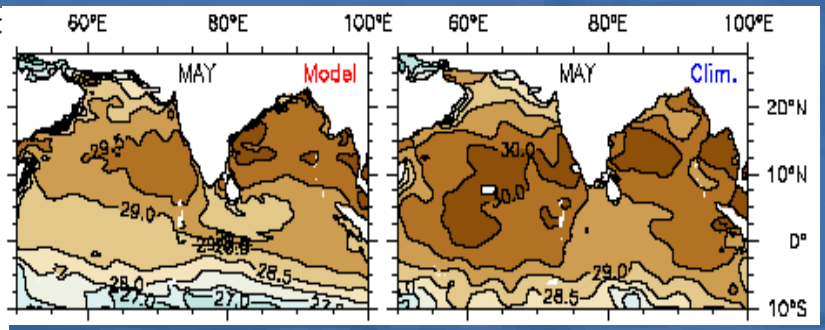
1. Model for Indian Ocean : Configuration

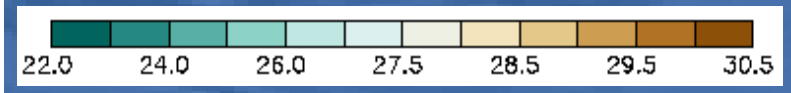
Model	GFDL's recent version of MOM4	
Model Domain	30ºE-120ºE & 30ºS-30ºN	
Resolution	0.25º in Horiz. & 5 m in the upper 60 m with 40 levels	
Boundaries	solid boundaries on West & North	
	open boundaries with sponge layer on South & East	
Forcing	Wind, Ta and q	ERA-15 (OMIP), daily Clim.
	Precipitation	CMAP, daily Clim. (from pentad)
	Runoff	UNESCO, monthly Clim.
Penetration	SeaWiFS Chl climatology	
IC	Clim. Temp. & Salinity during January (Levitus, 1998)	
	with zero velocities	
Simulation	7 year run and results from 7th year is presented here	

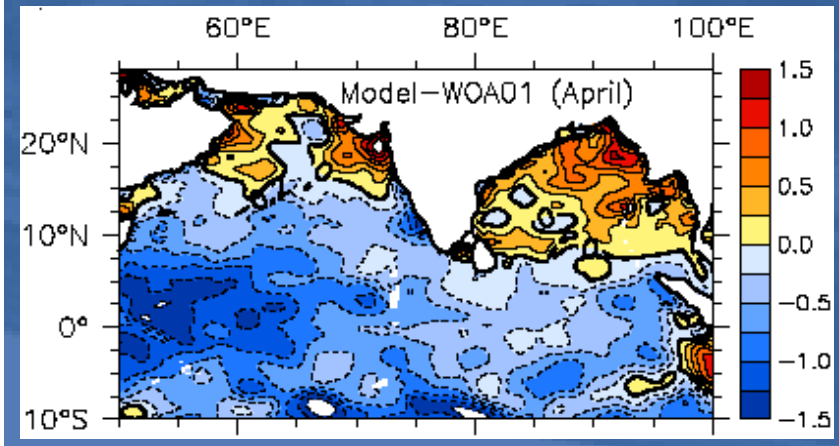
SEAS

2. Model : SST (ºC)

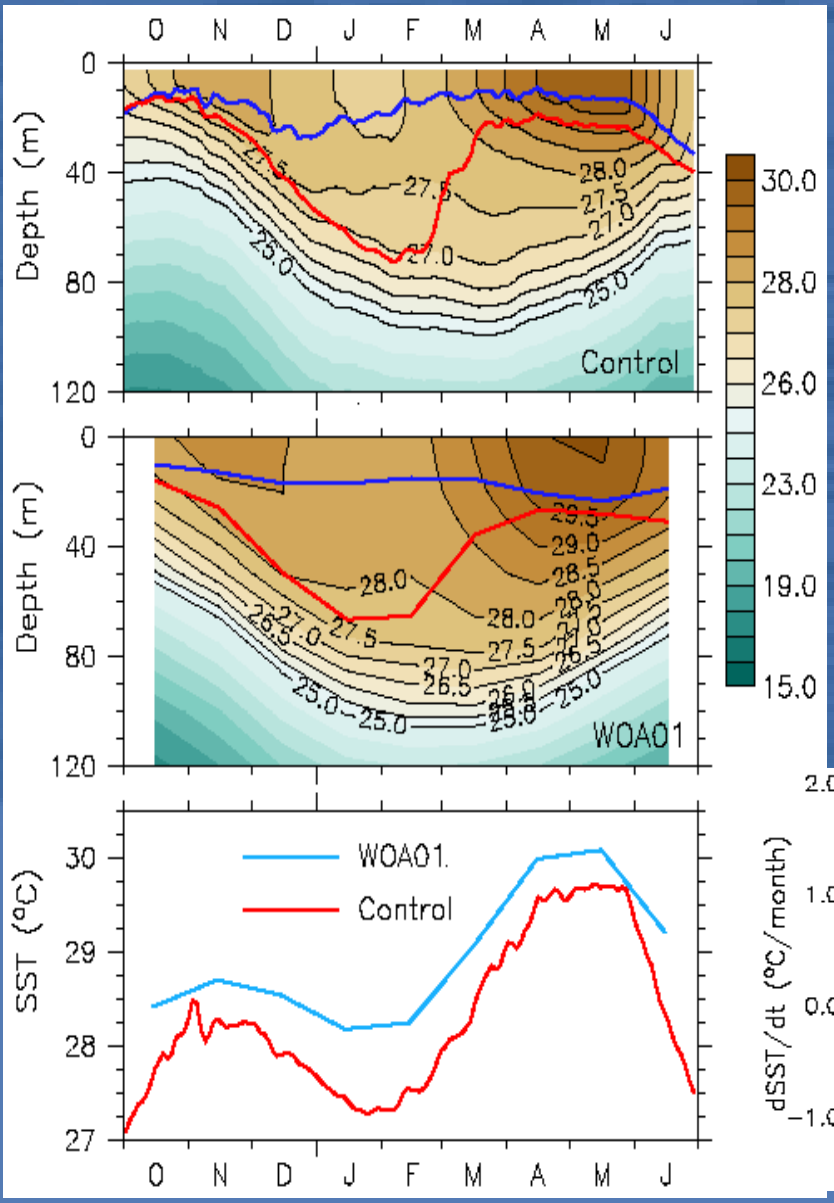








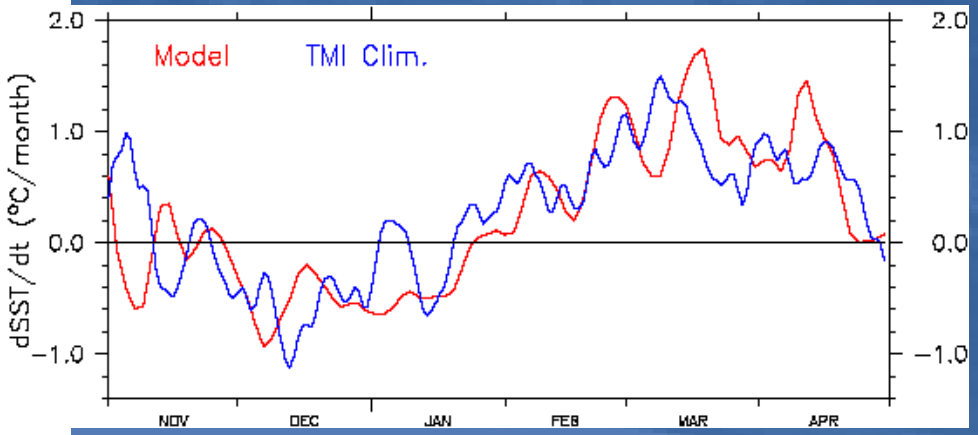
2. Model : Temperature (ºC)



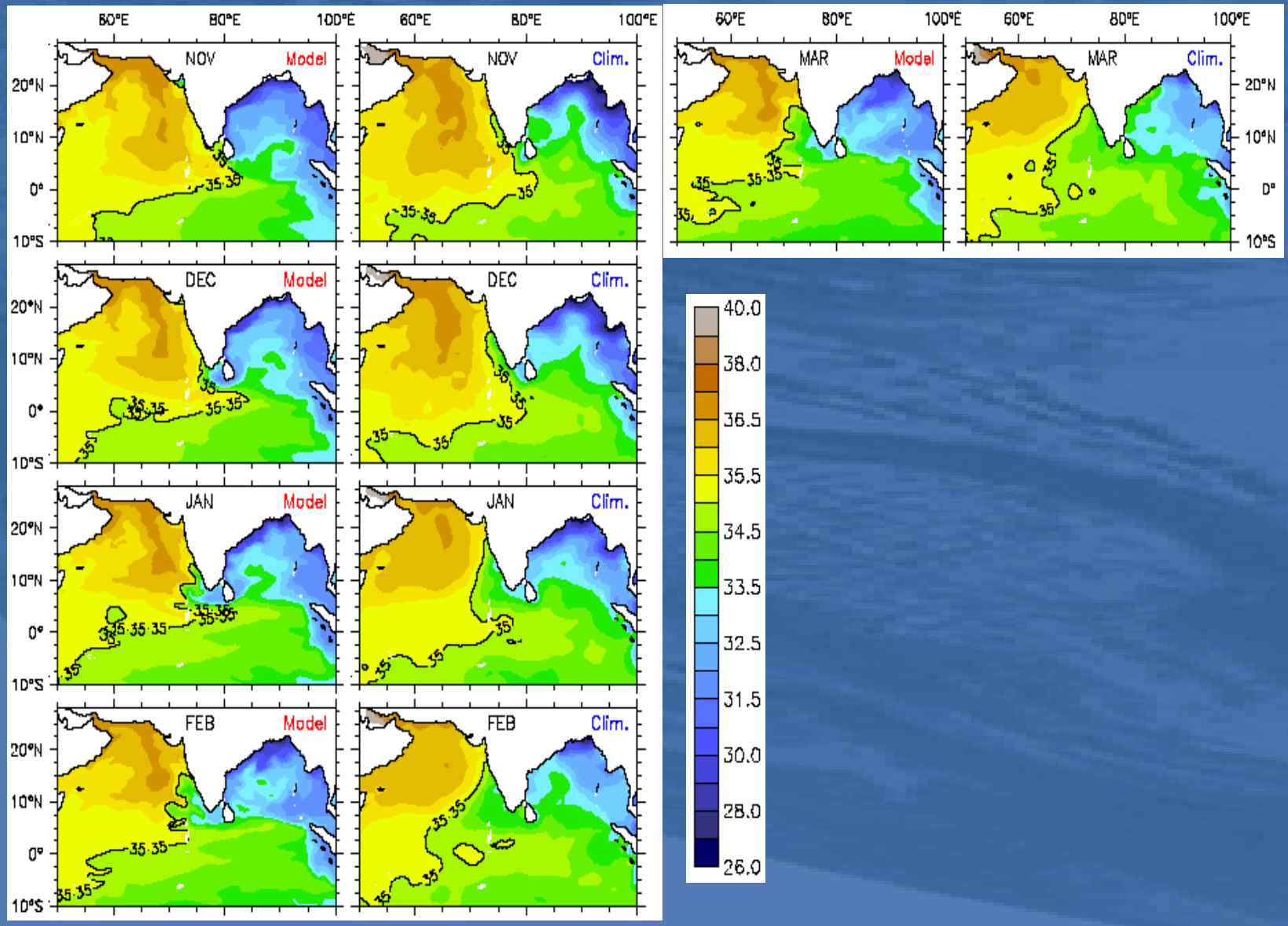
Temp. & SST averaged over SEAS

Spring warming

Model : 2.36ºC
TMI Clim. (1999-2005) : 2.33ºC



2. Model : Sea Surface Salinity (psu)



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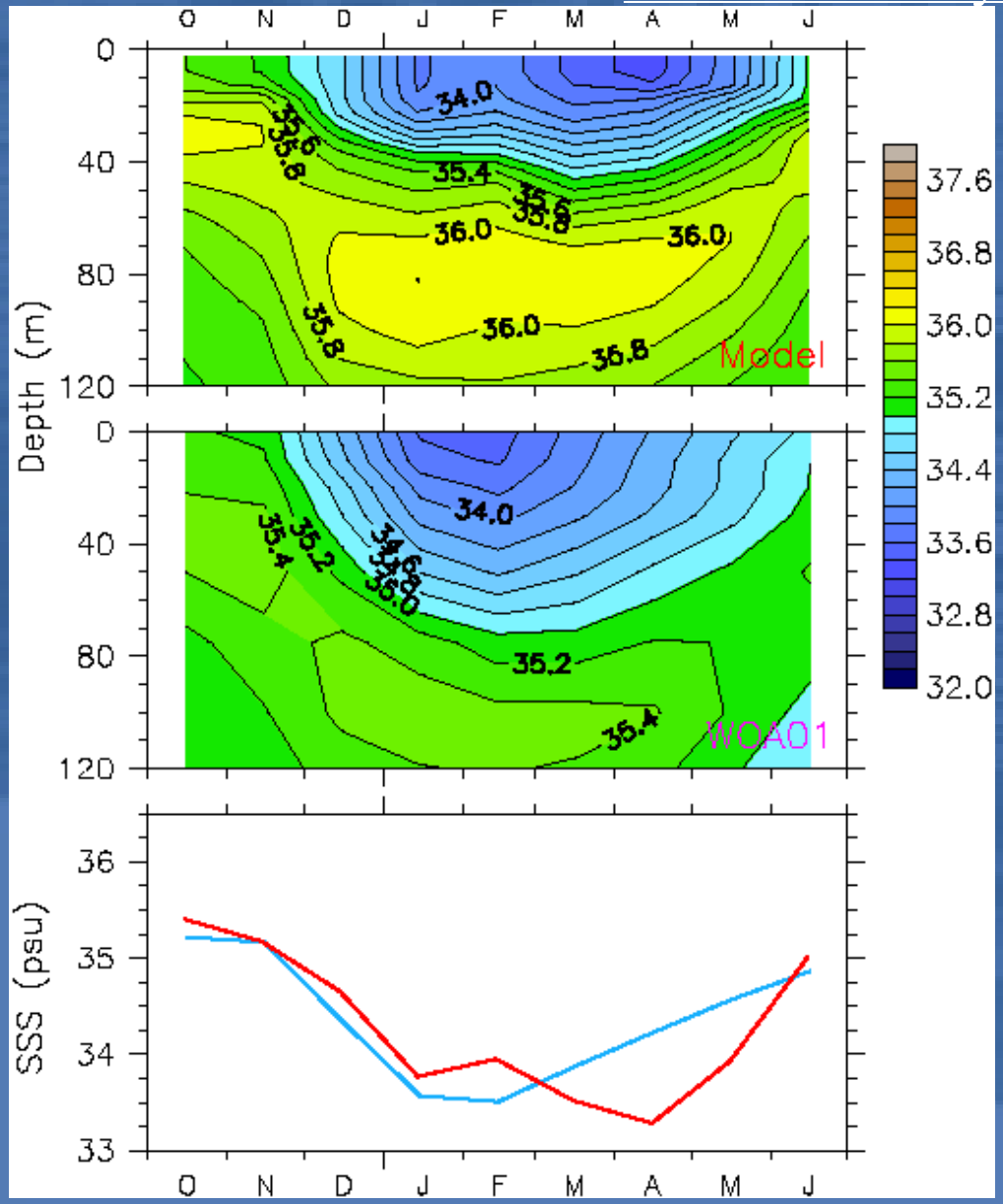
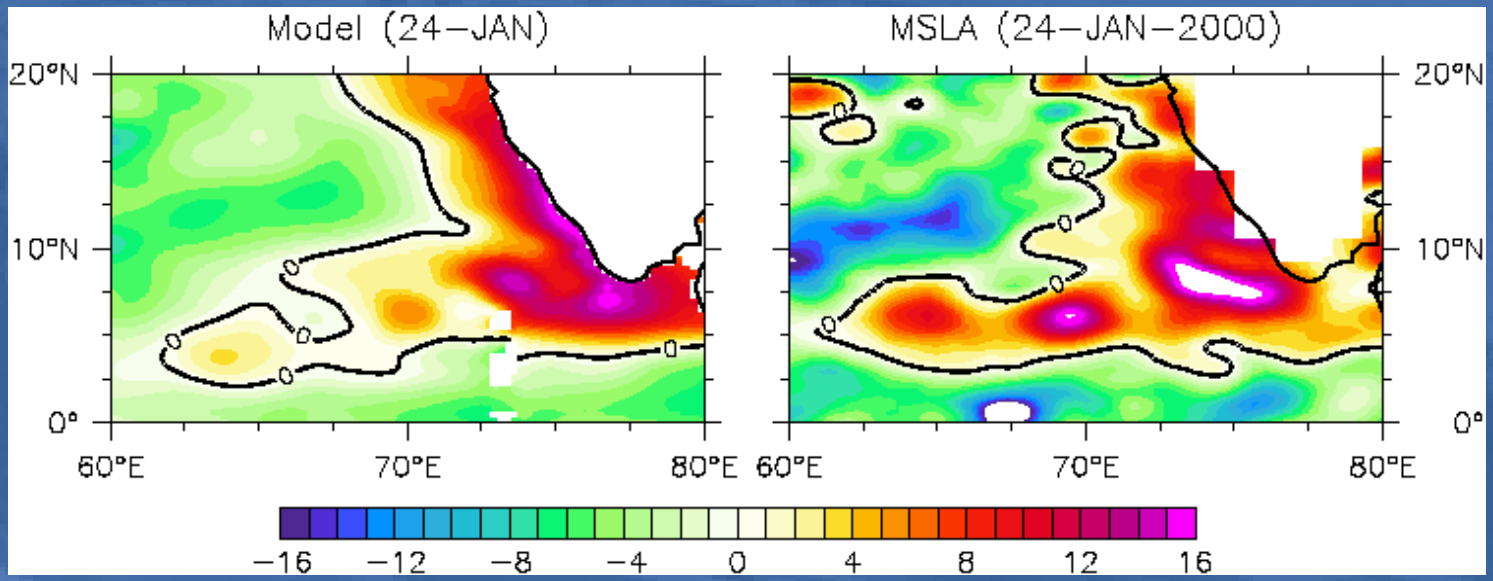


Monthly Salinity and SSS at 76ºE & 8ºN

2. Model : Sea Level Anomaly (cm)



3. Mechanisms

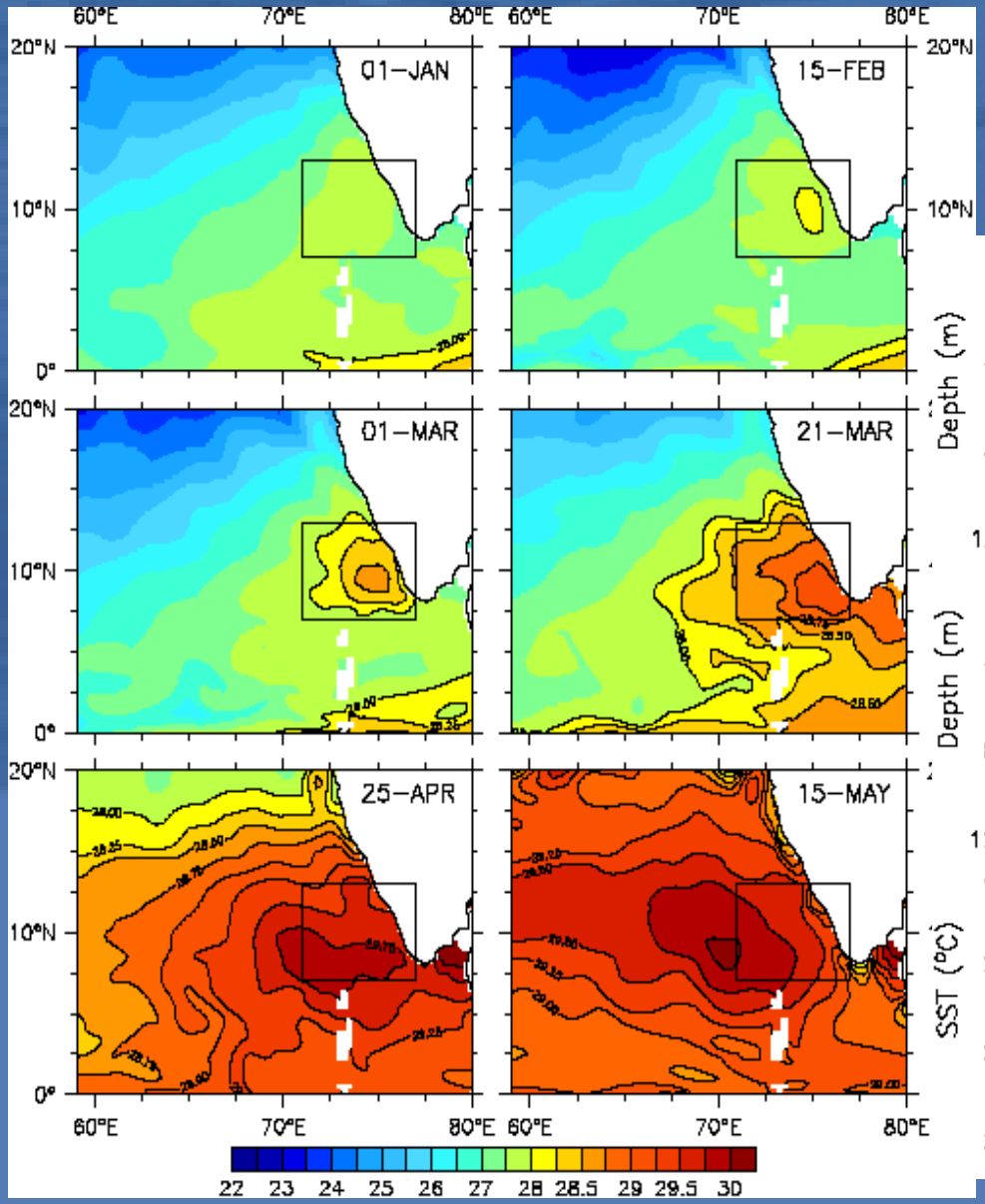
Mechanisms proposed by earlier studies ...

1. Near-surface stratification and barrier layer due to the presence of low-saline water from BoB (Shenoi et al.; Rao et al.)

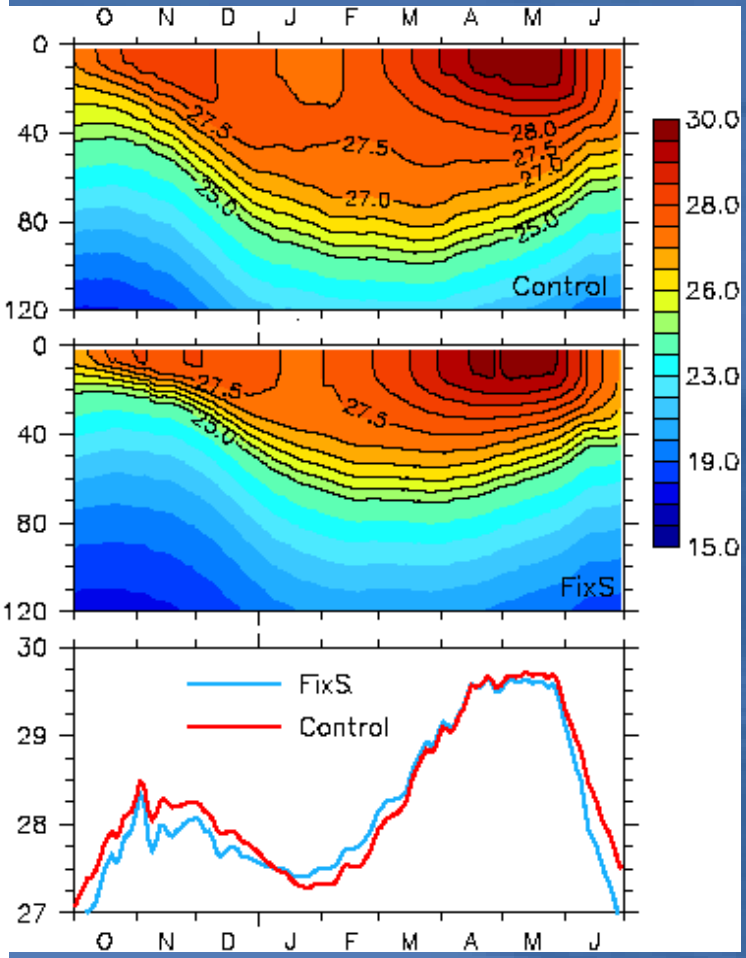
2. Heating from Tinv within the barrier layer (Durand et al.)

Is the near-surface stratification necessary for the formation of mini warm pool ??

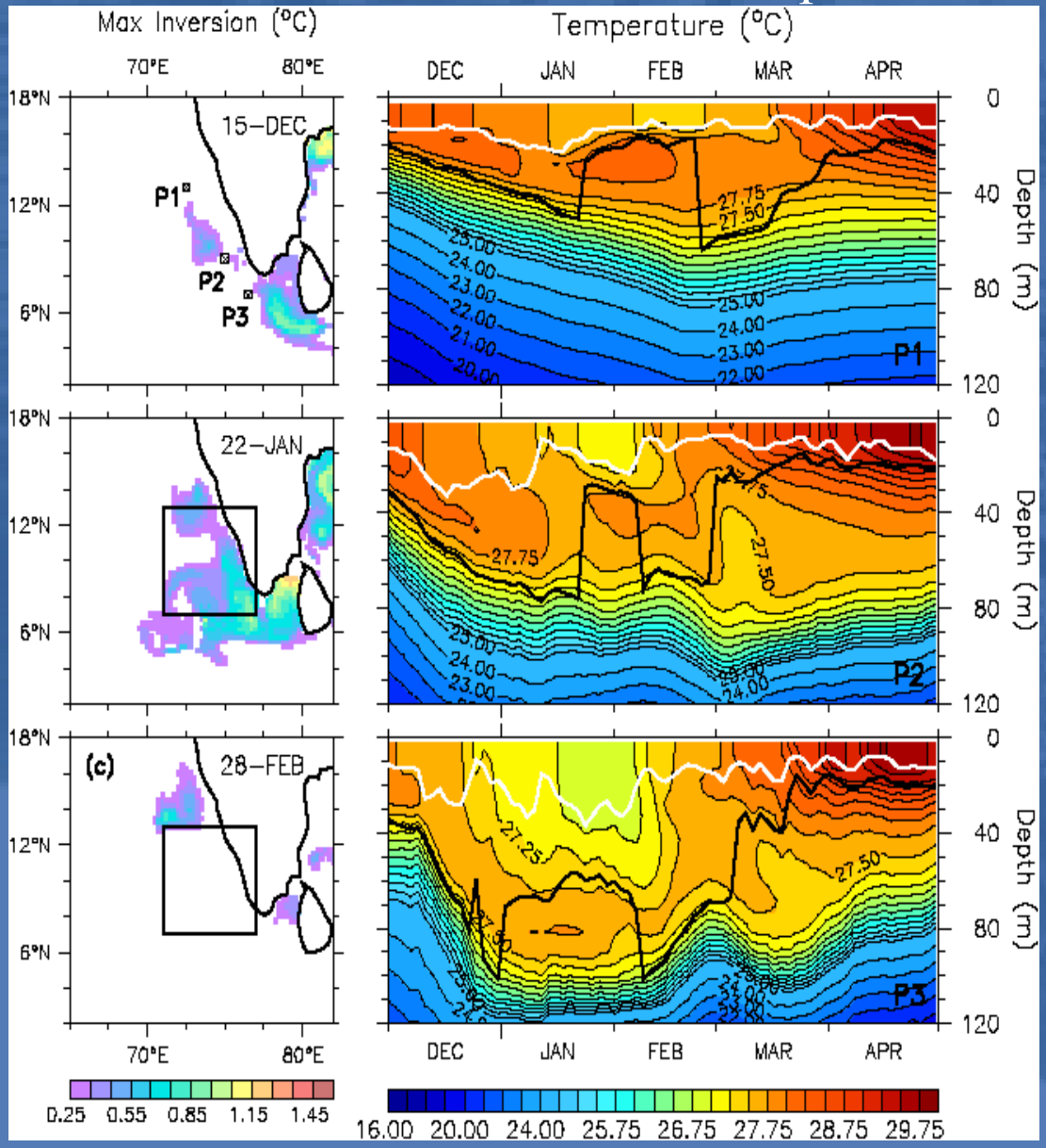
3. Mechanisms : Effect of Salinity Stratification



Fixed Salinity (35psu) Experiment



3. Mechanisms : Temperature Inversion

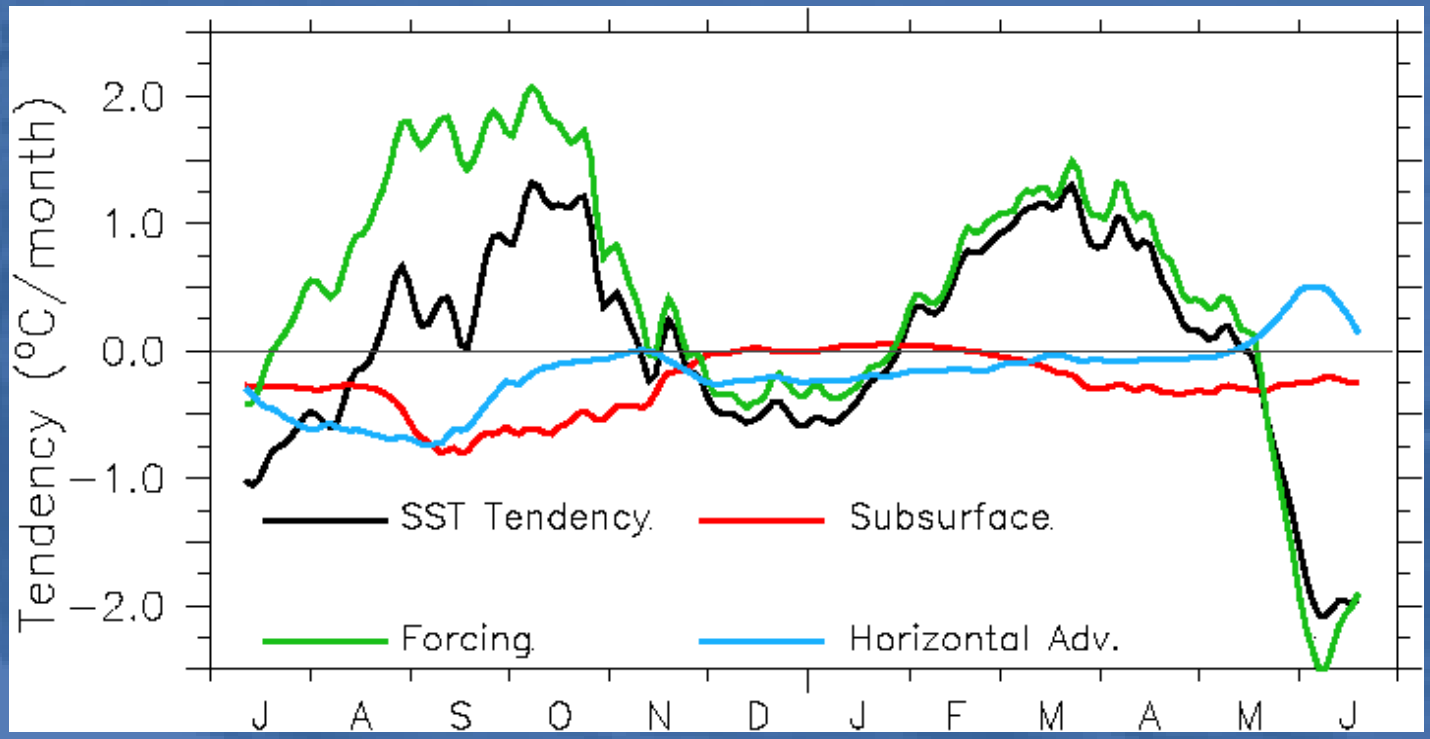


Inversions form as deep as ~80 m.

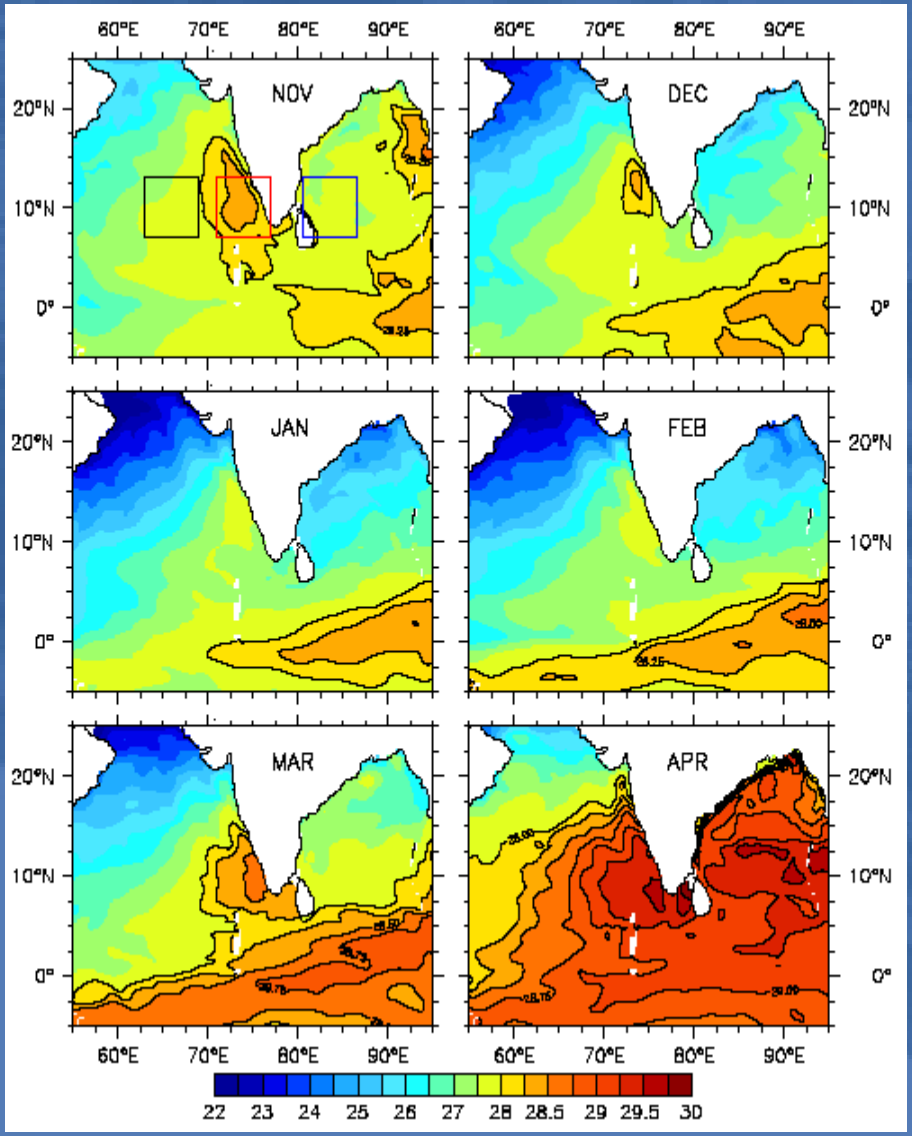
Over SEAS, mixed layer never deepens to the inversion layer.

Inversion are destroyed by surface warming.

3. Mechanisms : Mixed Layer Heat Budget



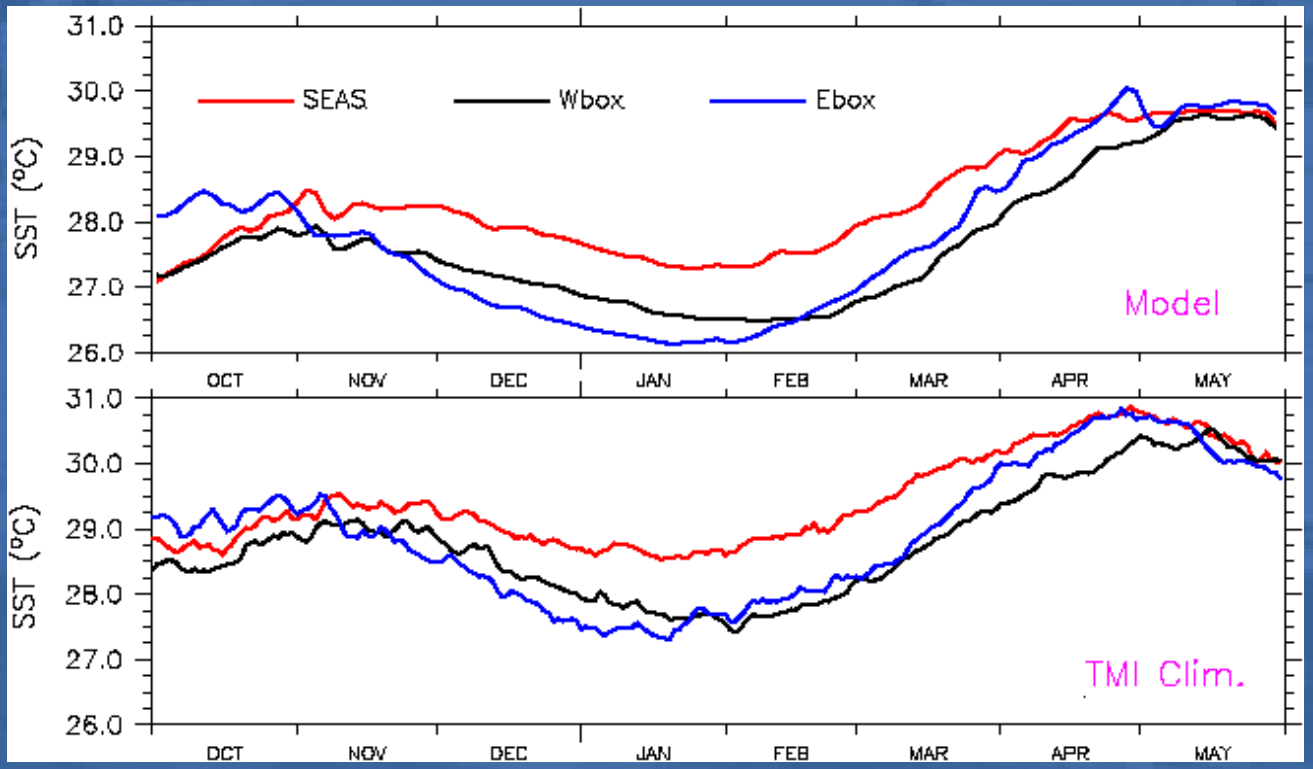
3. Mechanisms : Preconditioning ??



SEAS cools by lesser amount during winter

SEAS starts spring warming from higher SSTs during mid-Feb.

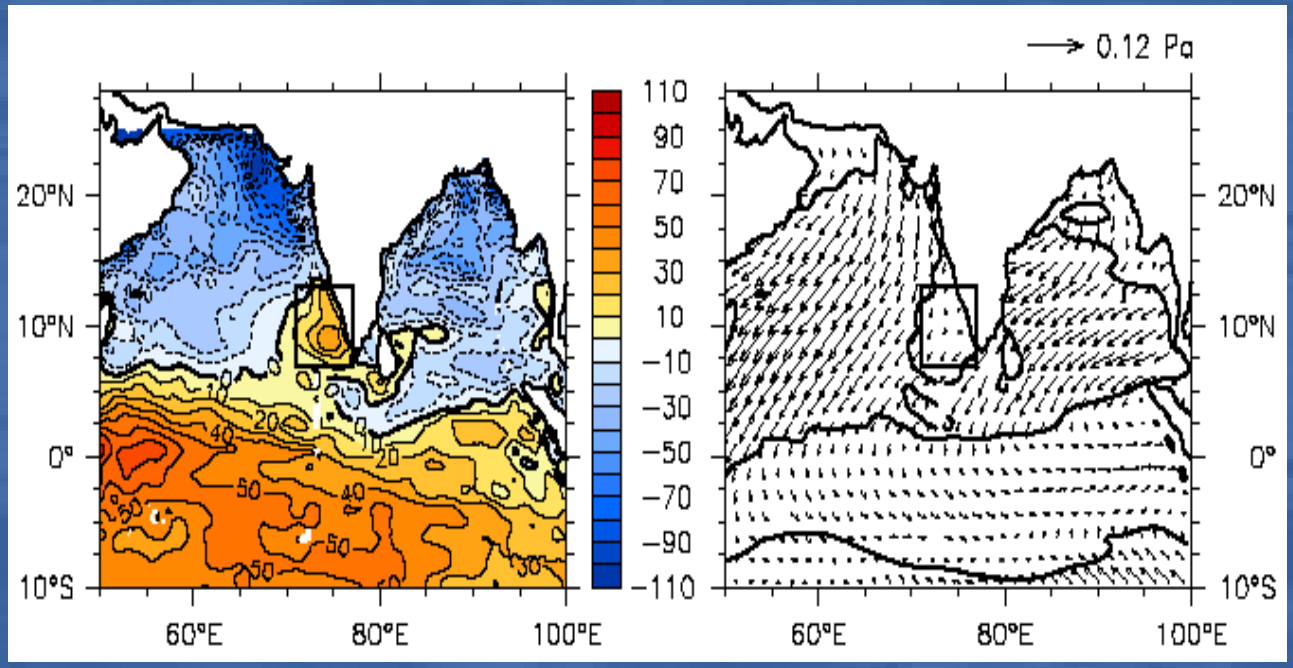
3. Mechanisms : Preconditioning ??



Why is the winter cooling lesser over SEAS ??

3. Mechanisms : Effect of Orography and Winds

Net Heat Flux (W/m2) | Wind Stress (Pa)



Fields averaged over November-February period.

What is the impact of this low winter cooling on spring warming ?

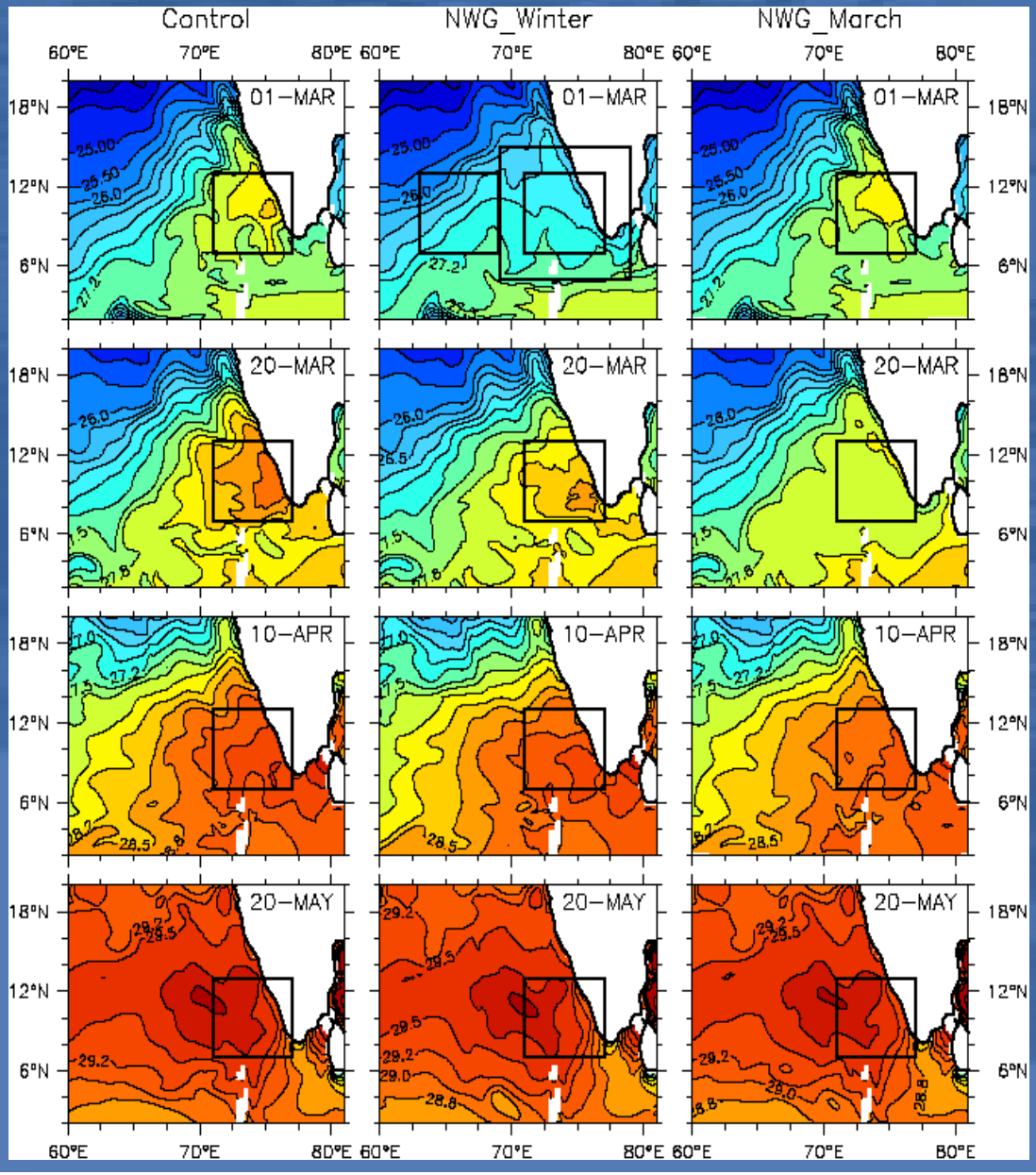
3. Mechanisms : Effect of Orography and Winds

Model Experiments

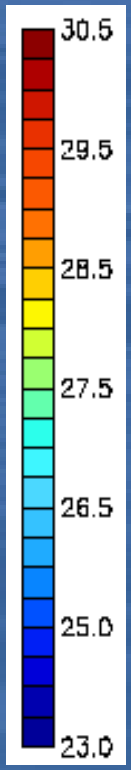
NWG_Winter - WIND, air temperature, and specific humidity over SEAS are replaced by mean value over Wbox during **Nov-Feb** period

NWG_March – Same as NWG_winter, but the forcing fields are modified only for the month of **March**

3. Mechanisms : Effect of Orography and Winds



SST (ºC)



4. Results

An OGCM of the Indian Ocean provides an excellent simulation of the Arabian Sea Mini Warm Pool and the associated salinity and ocean circulation.

The intrusion of low salinity water from the Bay of Bengal into the SEAS is ***not*** a necessary condition for the formation of ASMWP in the model.

The high SST over SEAS during November-February is because of the low winter monsoon winds. The winds are low due to the orographic effect of Western Ghats

The localized patch of high SST over SEAS results from local air-sea fluxes. The winter-time atmosphere-ocean conditions do not control the spring warming of SEAS SSTs.

The "Model SEAS" behaves as a "heat-dominated" regime where the SST adjusts within few days/week to the atmospheric forcing and oceanic stratification plays only a secondary role, because of very low winds.


Thank You