Coupled Ocean-Atmosphere Interaction in the Northern Indian Ocean:

Motivation and Proposed Research

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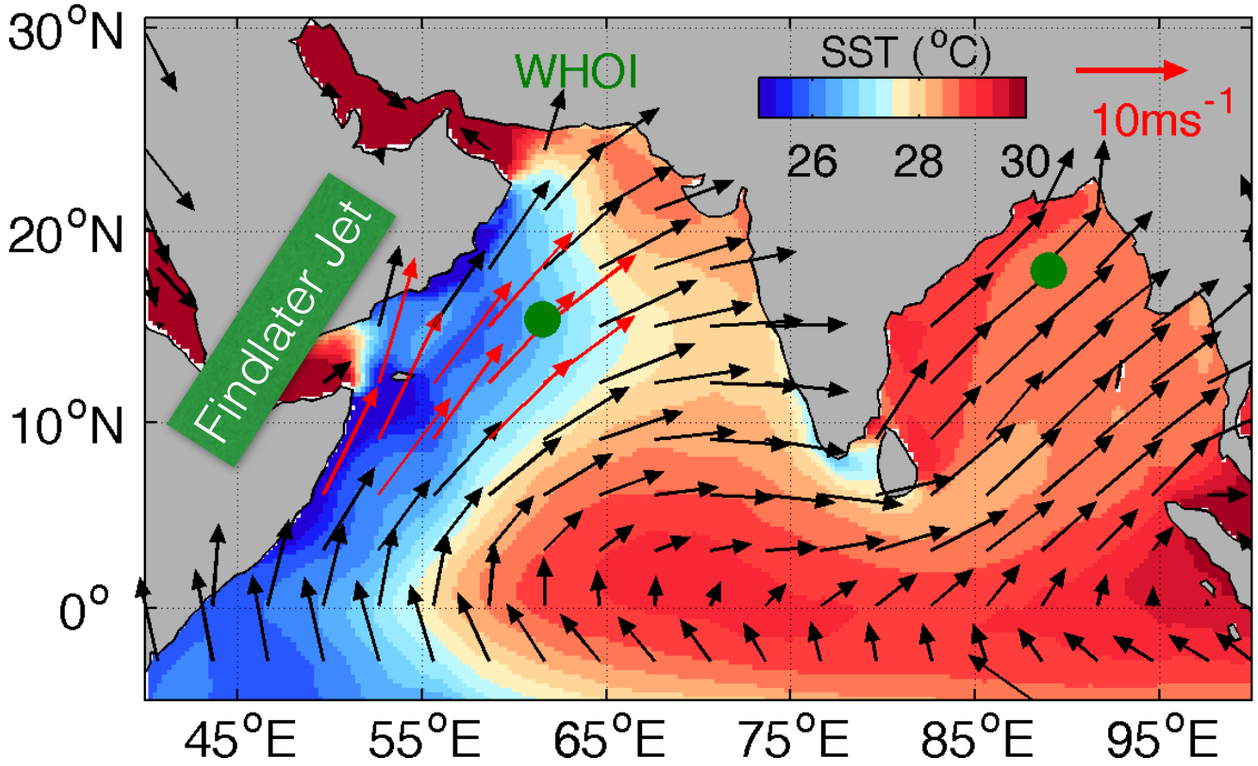
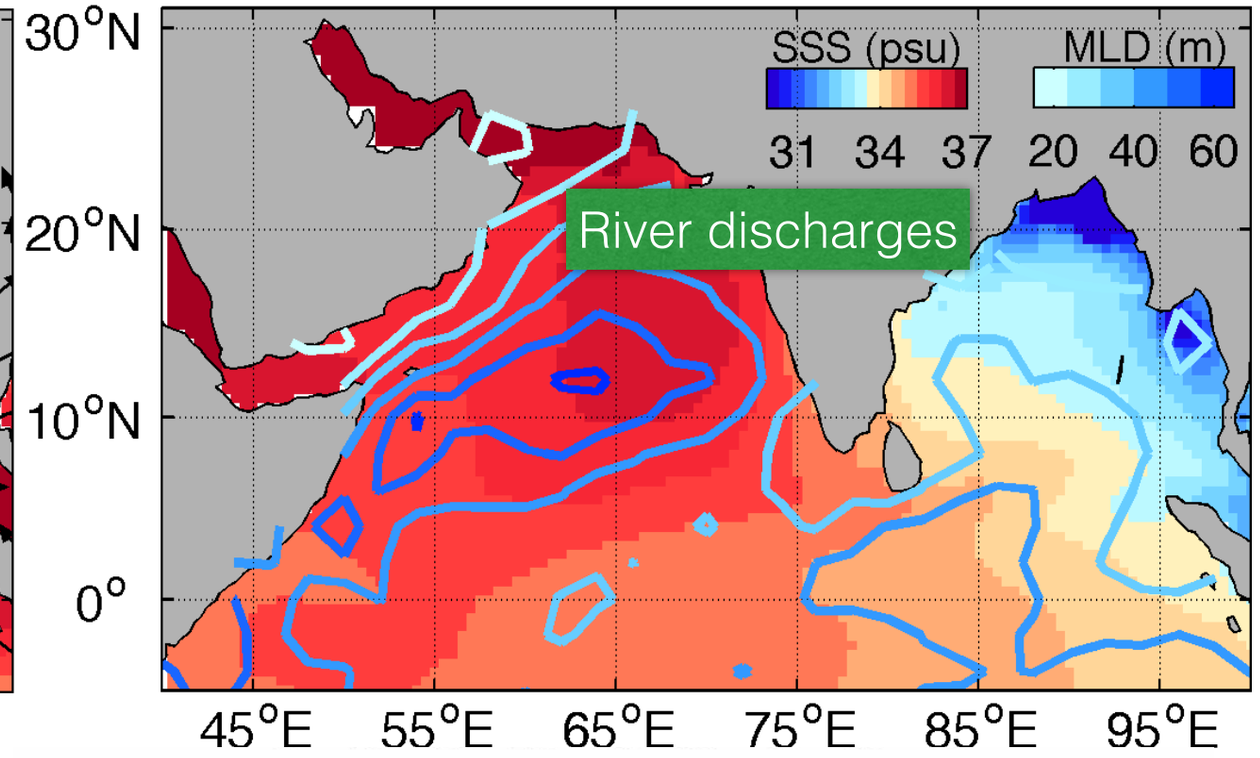
Arabian Sea and Bay of Bengal

Summer Climatology: SST & wind

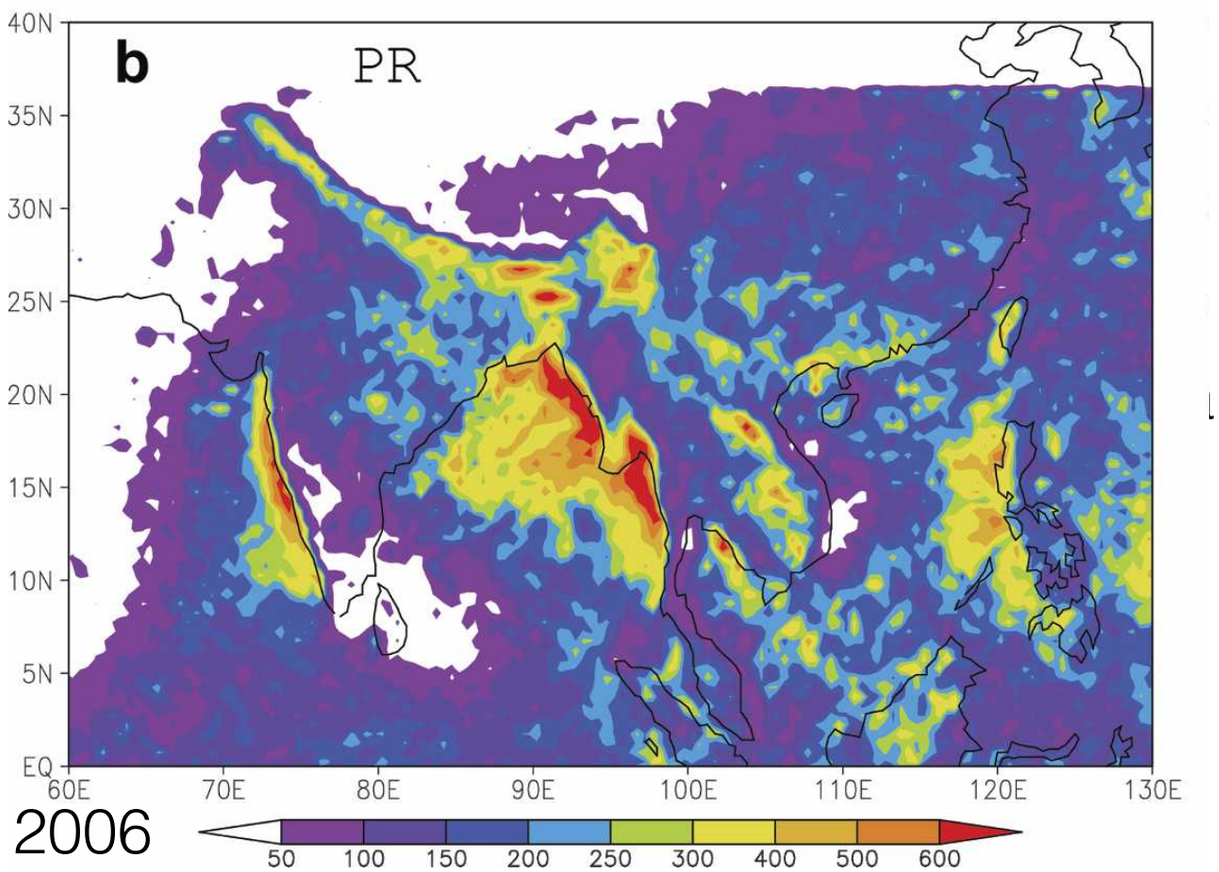


Summer Climatology: SSS & MLD



Arabian Sea

- Cold, salty, deep ML by the Findlater Jet
- Unstable boundary current, coastal upwelling, and strong eddy activity
- A strong boundary layer air-sea coupling
  - affecting energetics of the current system, the low-level structure of the FJ, and the monsoon rainfall

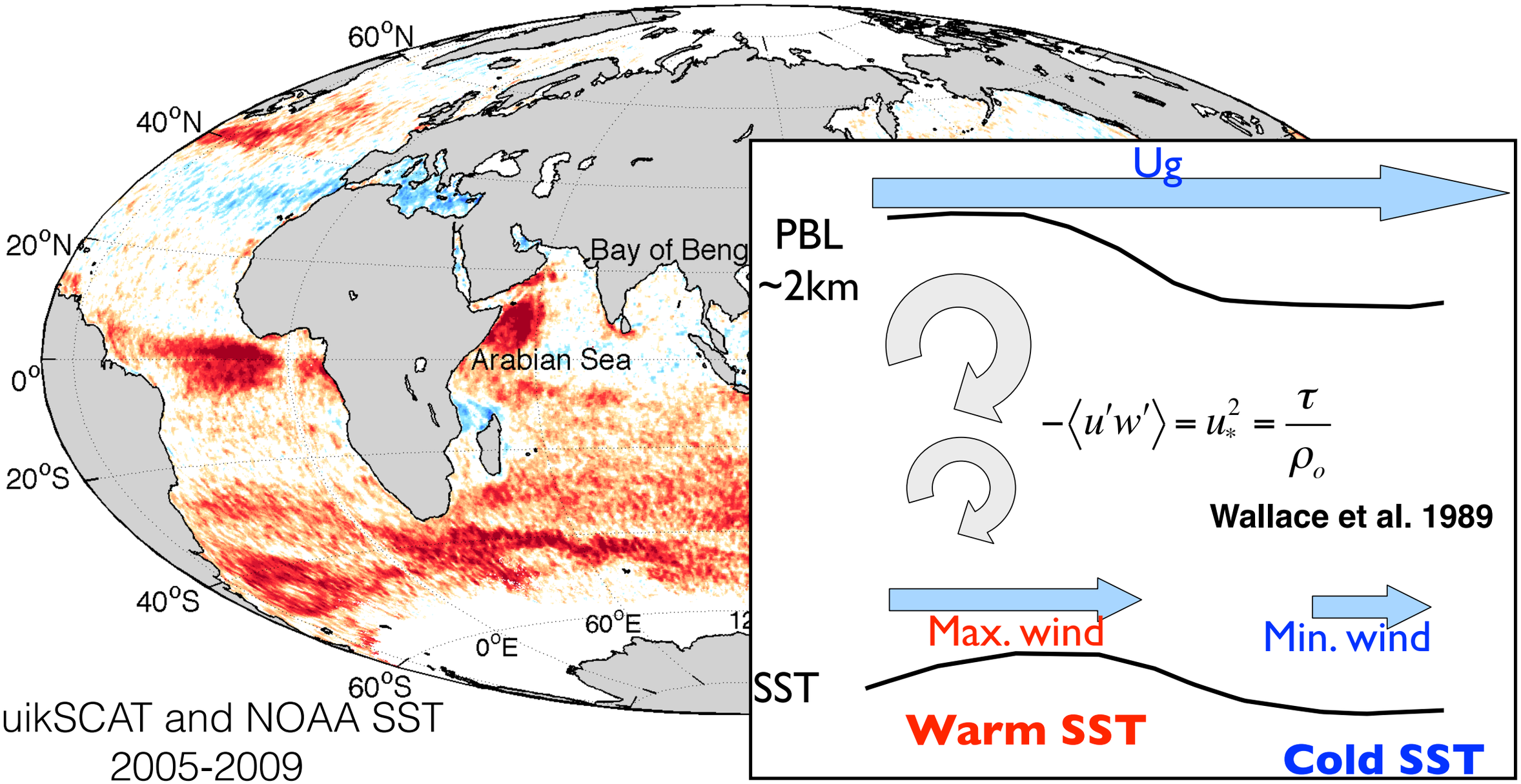


Xie et al. 2006

Oceanic forcing of the atmosphere

on oceanic mesoscales

Correlation between zonally high-pass (10°) filtered SST and WS



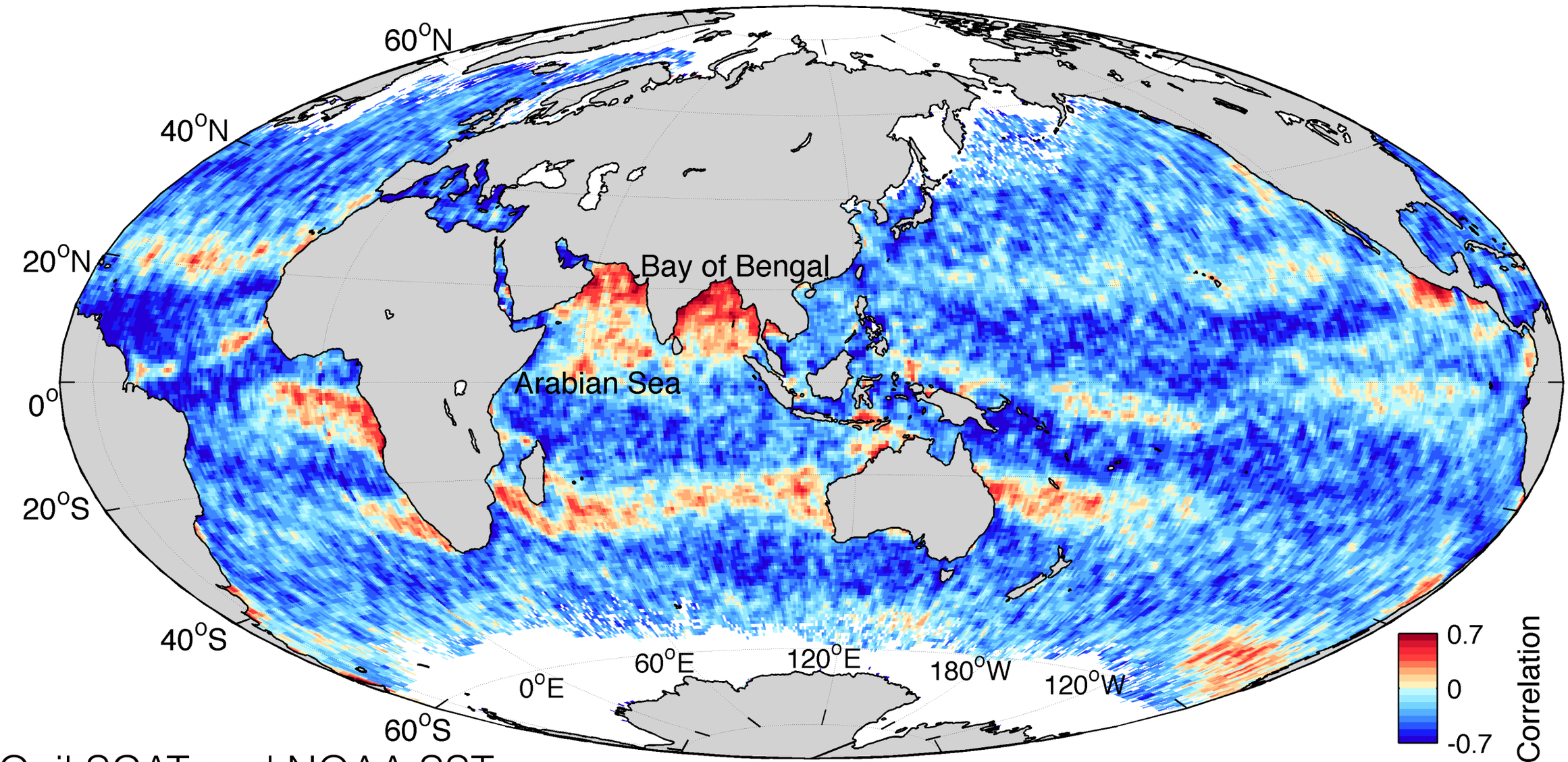
QuikSCAT and NOAA SST
2005-2009

- Warm mesoscale SSTs lower stability of the MABL and increase surface wind.
- Western AS supports the strong mesoscale *SST-driven* air-sea coupling.
  - Mesoscale SST forces the mesoscale wind, convergence and curl.

Oceanic forcing of the atmosphere

on intraseasonal time-scales

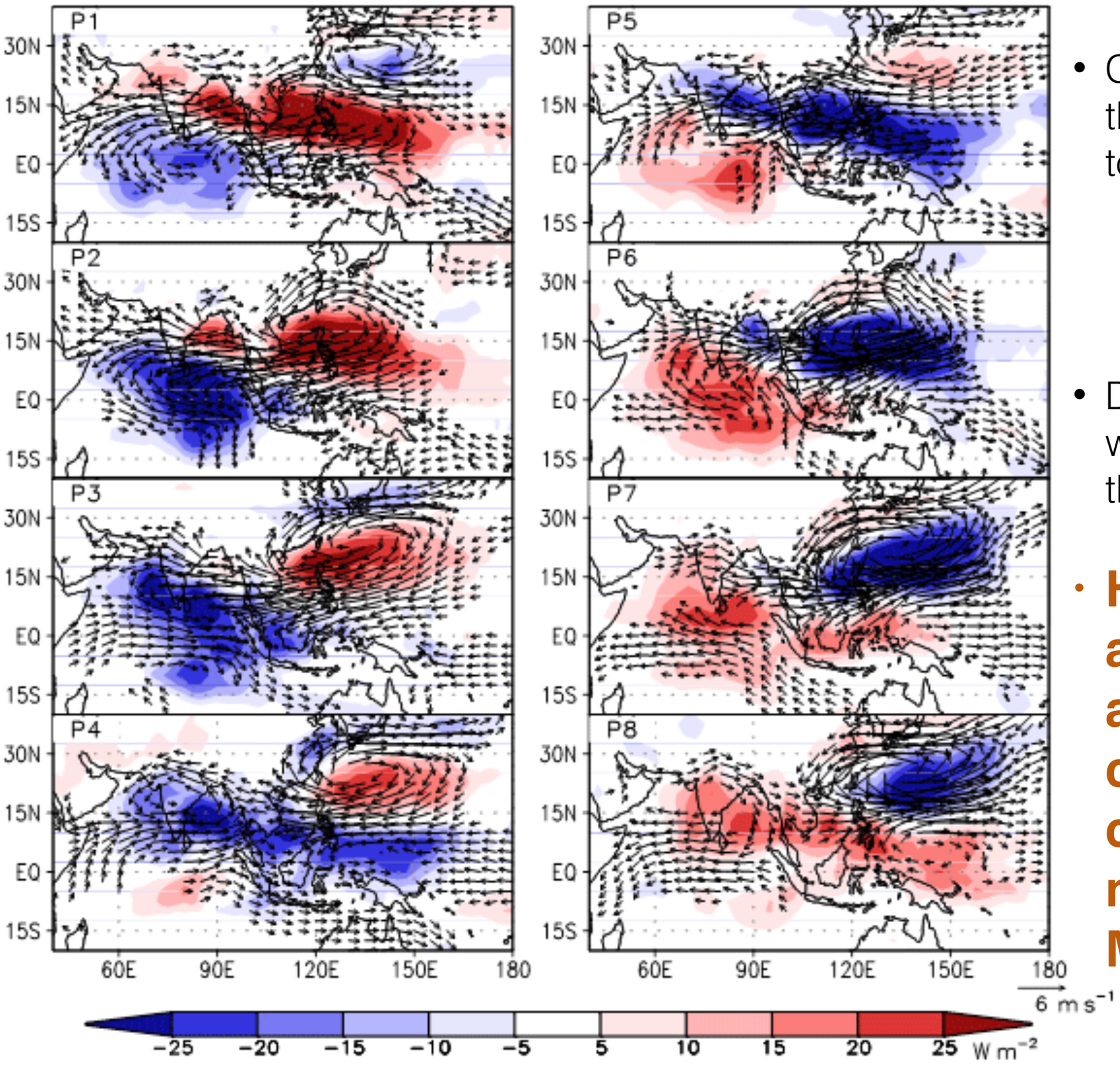
Correlation between 10-90 day SST and WS



QuikSCAT and NOAA SST
2005-2009

- BOB and the northern AS supports a strong intraseasonal air-sea coupling
  - Intraseasonal SST forces the intraseasonal wind speed.

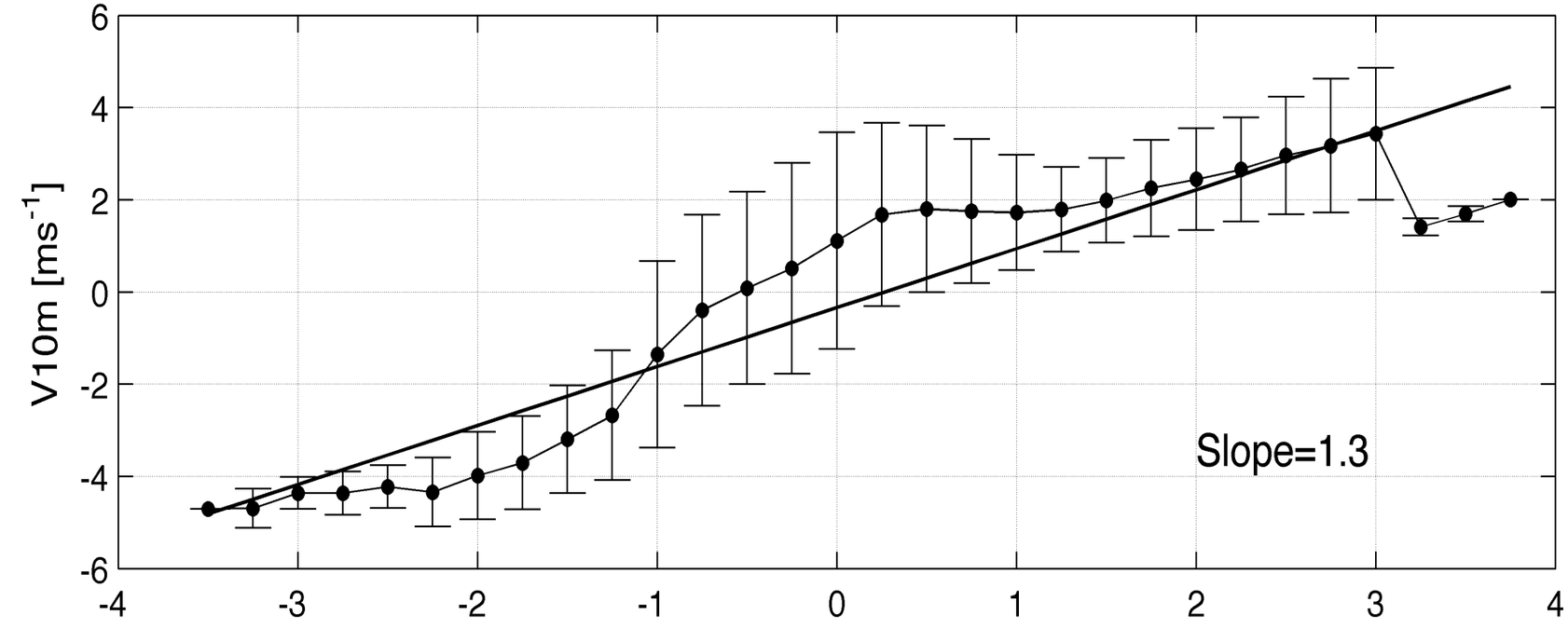
Monsoon intraseasonal oscillation (MISO)

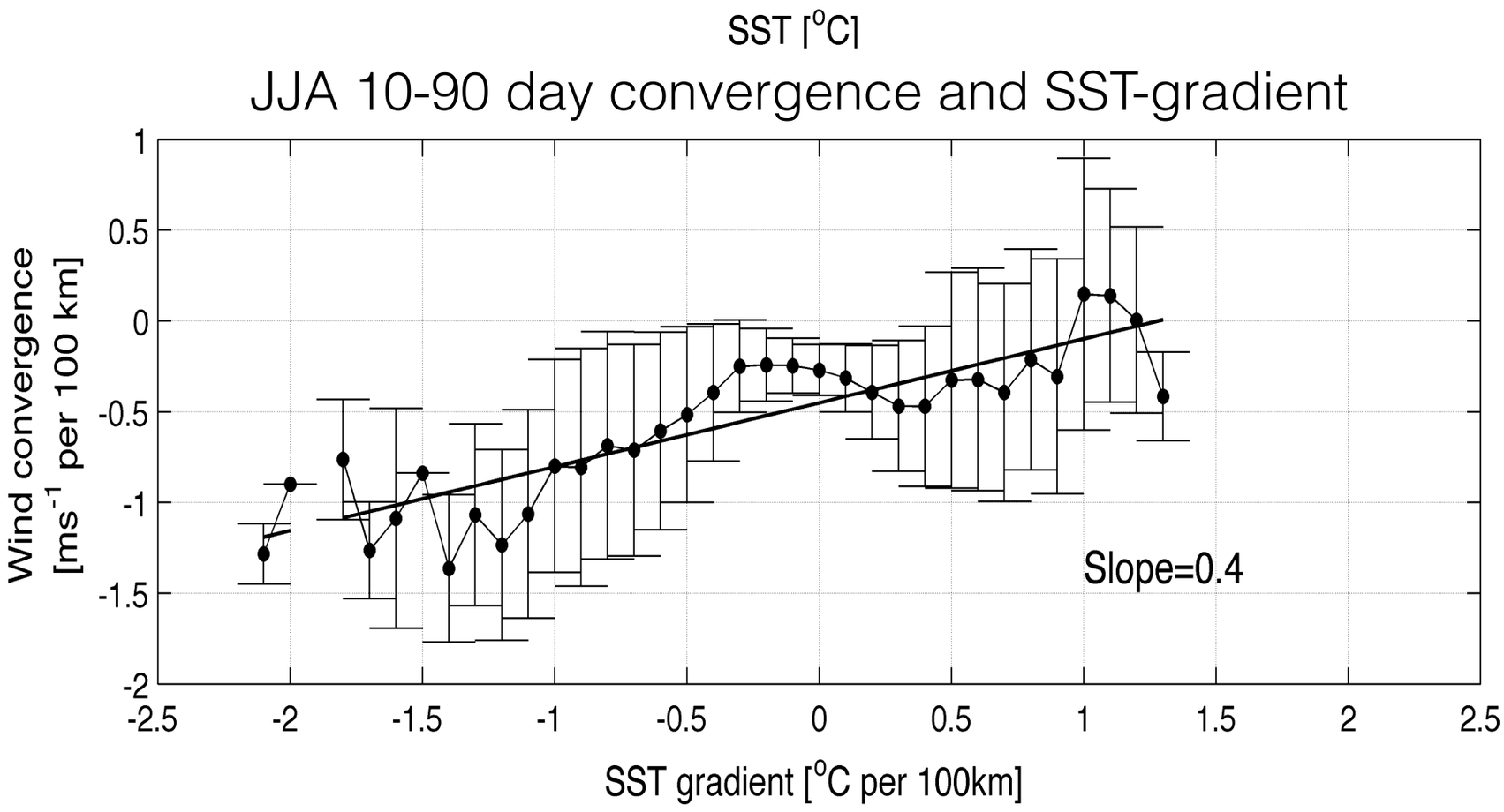


- Convective anomalies from the equatorial IO propagate toward India and BOB.
  - Paired with the suppressed convective anomalies to the north
- Dry phase with easterly wind, raising SST prior to the organized convection.
- **How boundary-layer air-sea coupling affects the ISO convection-SST coupling and the northward march of MISO?**

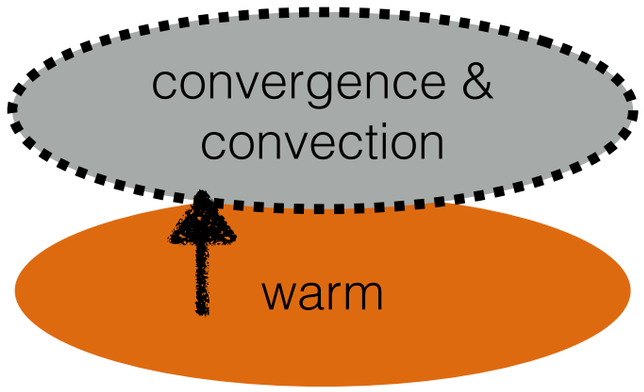
Lee et al. 2013 (see also Suhas et al. 2012)

MISO northward march influenced by intraseasonal SST-wind coupling





- SST warming leads to northward wind
- Convergence to the north (Shankar et al. 2007): ➜ Northward propagation of the convection



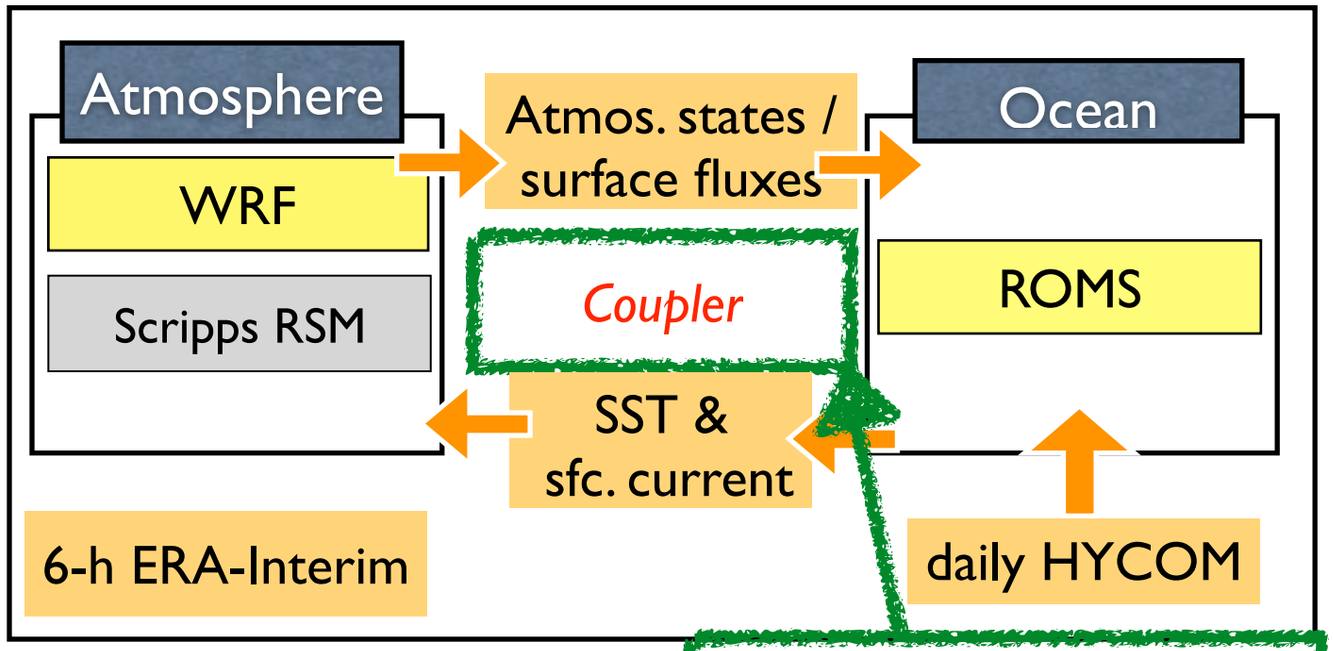
How intraseasonal BOB air-sea coupling influenced by

#1. diurnal variability of the upper ocean temperature

#2. freshwater distribution?

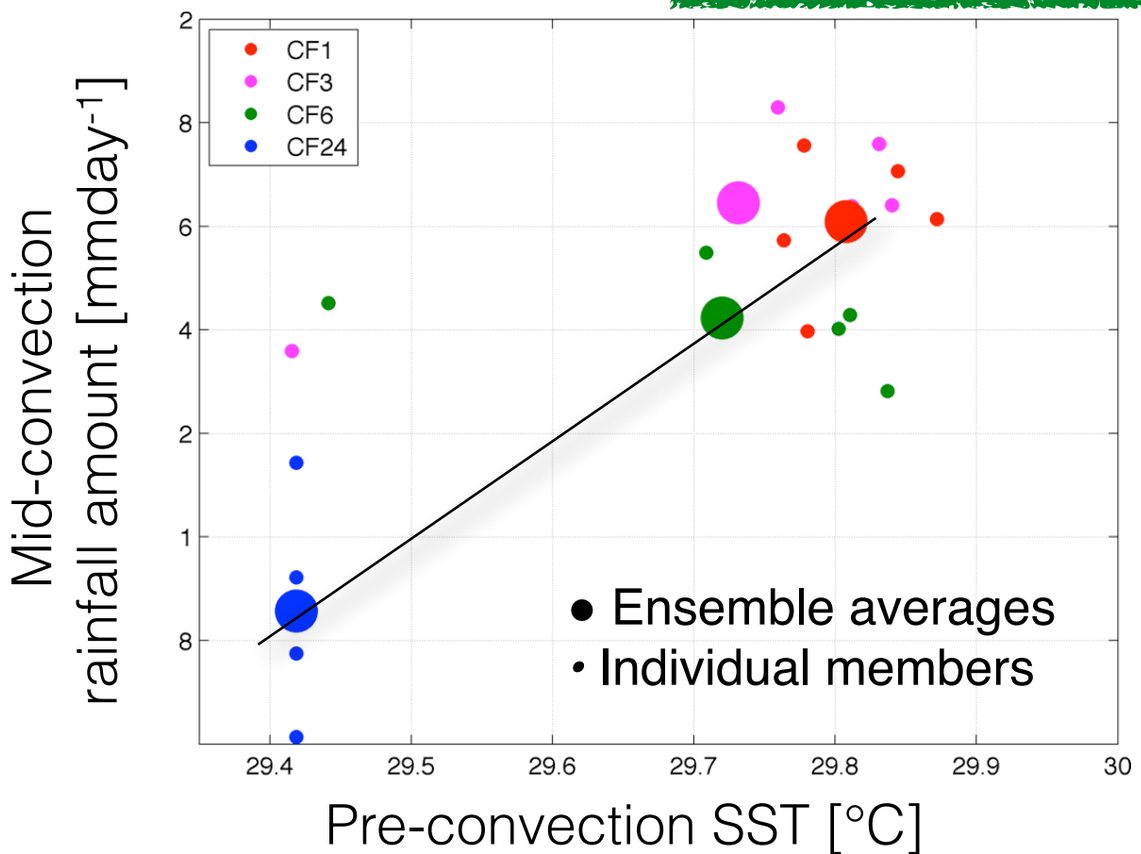
Impact of diurnal SST variability on the MJO convection during DYNAMO

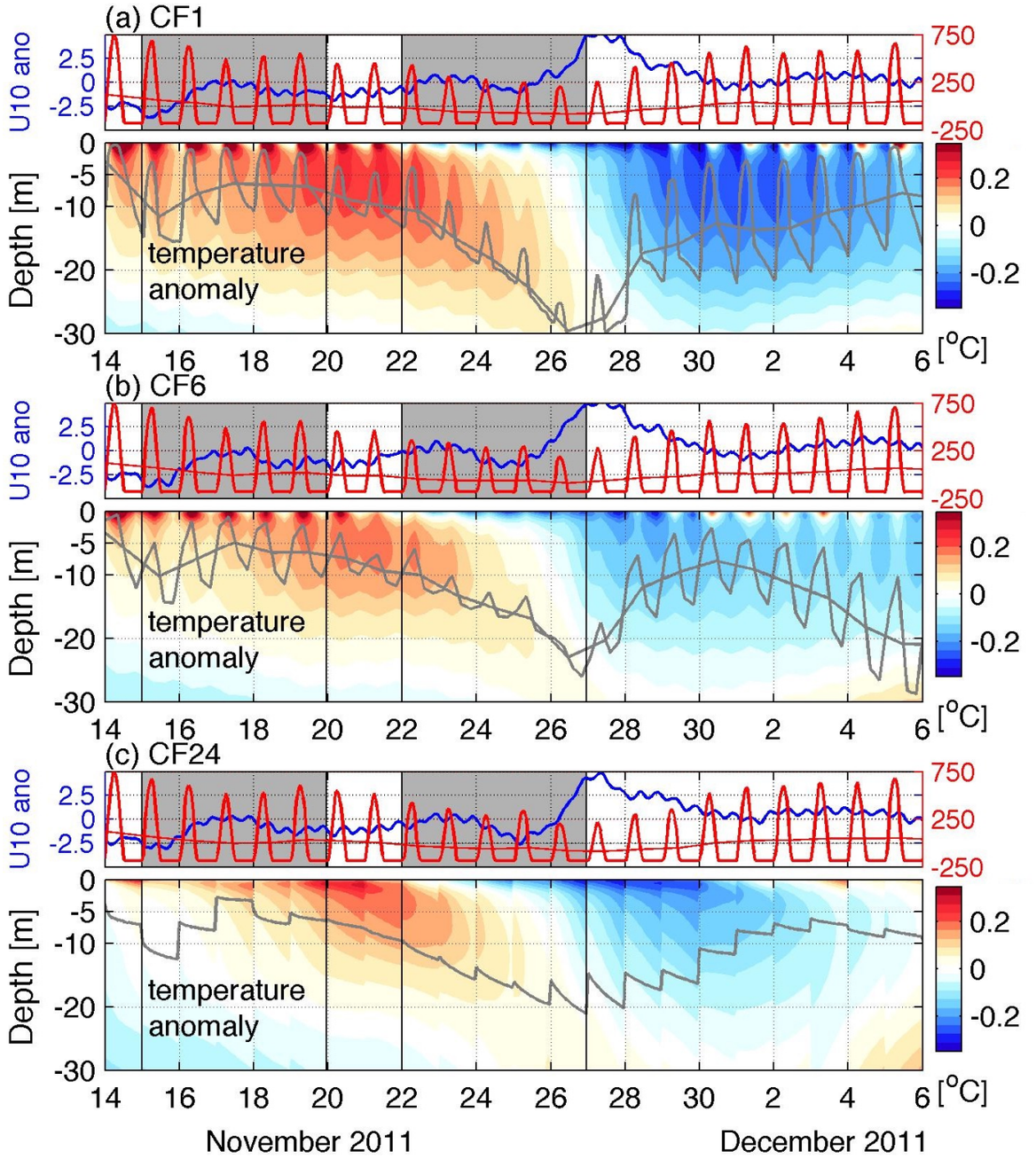
SCOAR coupled model



Varied coupling Frequencies
CF1, CF3, CF6, CF24

40 km O-A resolutions



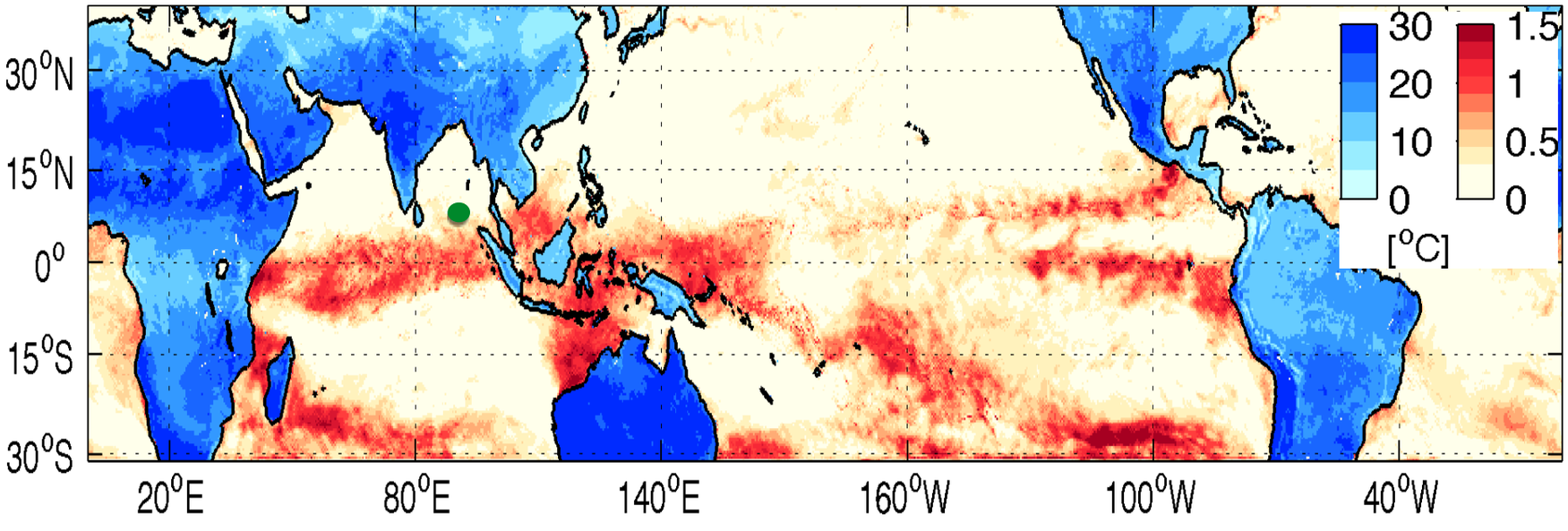


Enhanced diurnal and intraseasonal SST variability

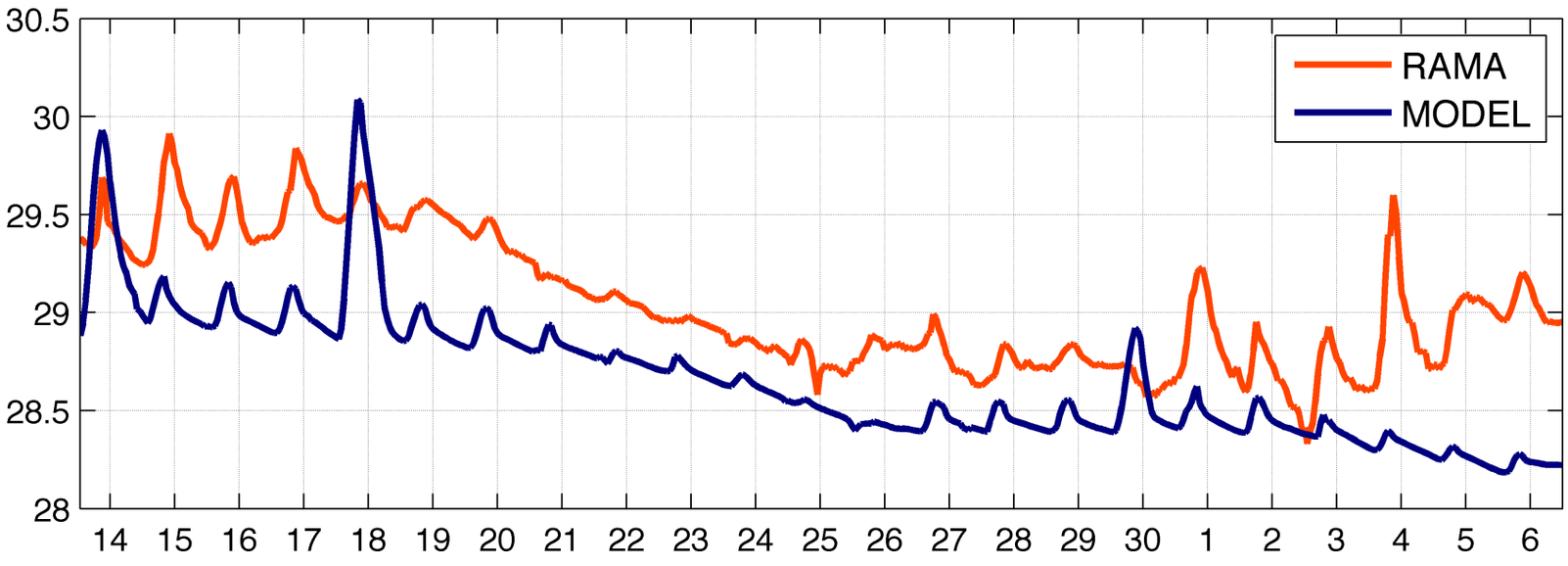
Seo et al. (2014): Coupled impacts of the diurnal cycle of sea surface temperature on the Madden-Julian Oscillation. J. Climate.

Diurnal SST variability in Bay of Bengal

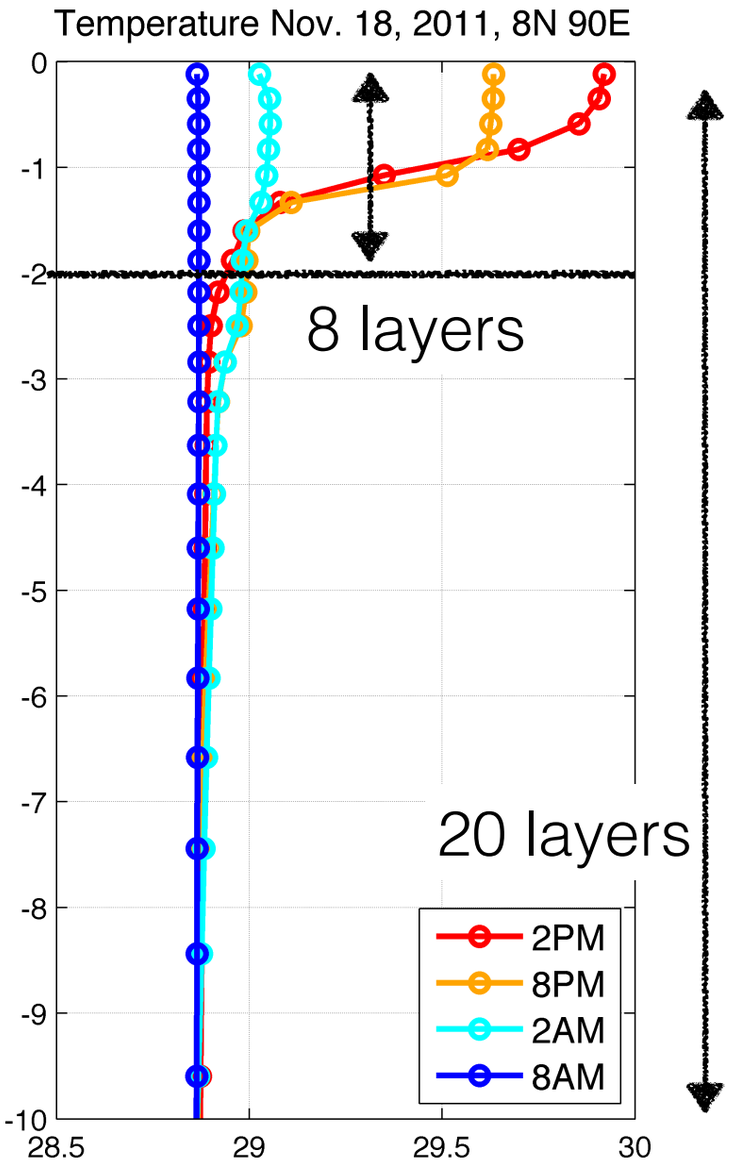
dSST in boreal winter (Nov 15 — Nov 19, 2011)



RAMA and model @ 90E 8N



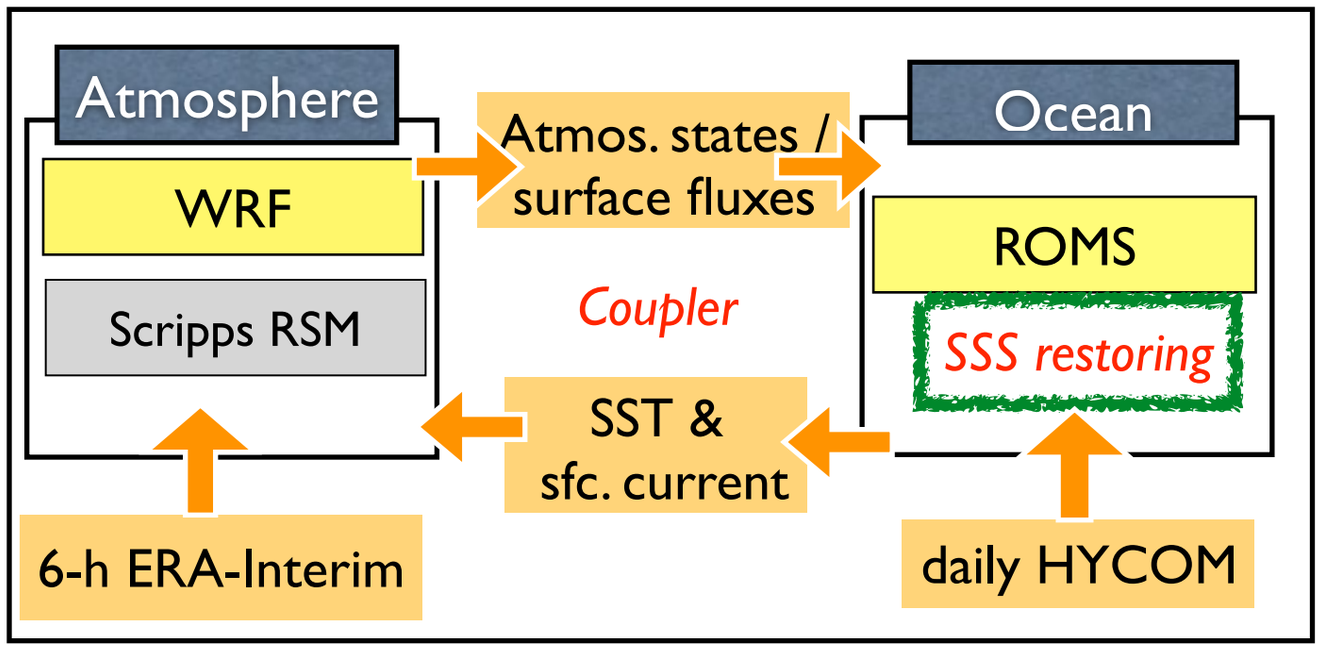
Occasional strong diurnal SST events even in winter

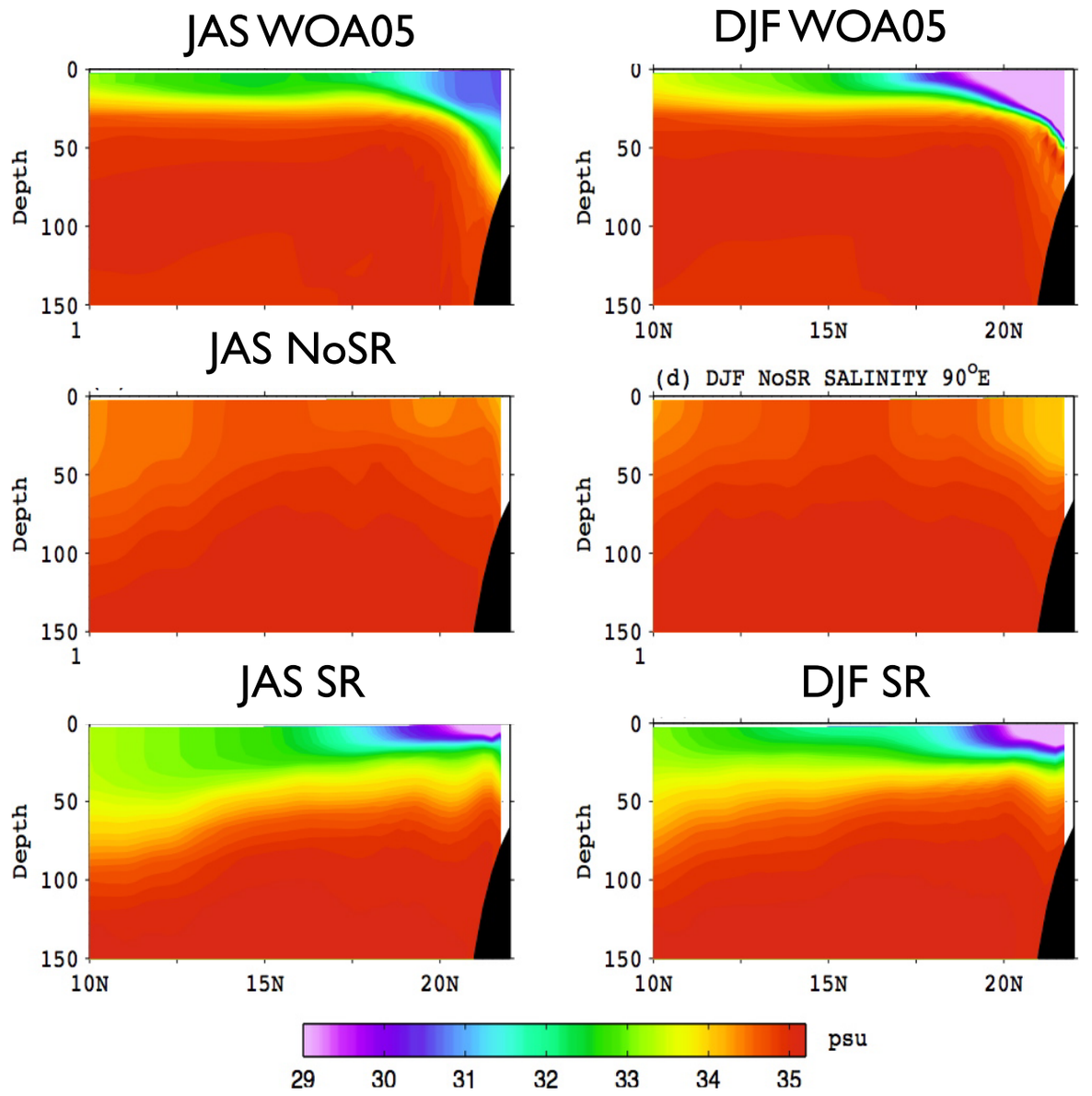


High vertical resolution is a key to capture diurnal warm layer

River discharges influence the monsoon wind and rainfall

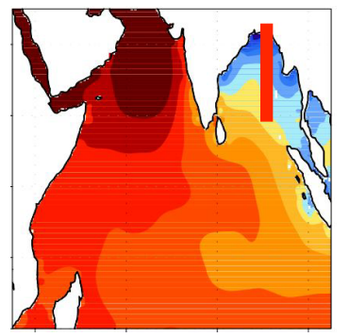
SCOAR coupled model



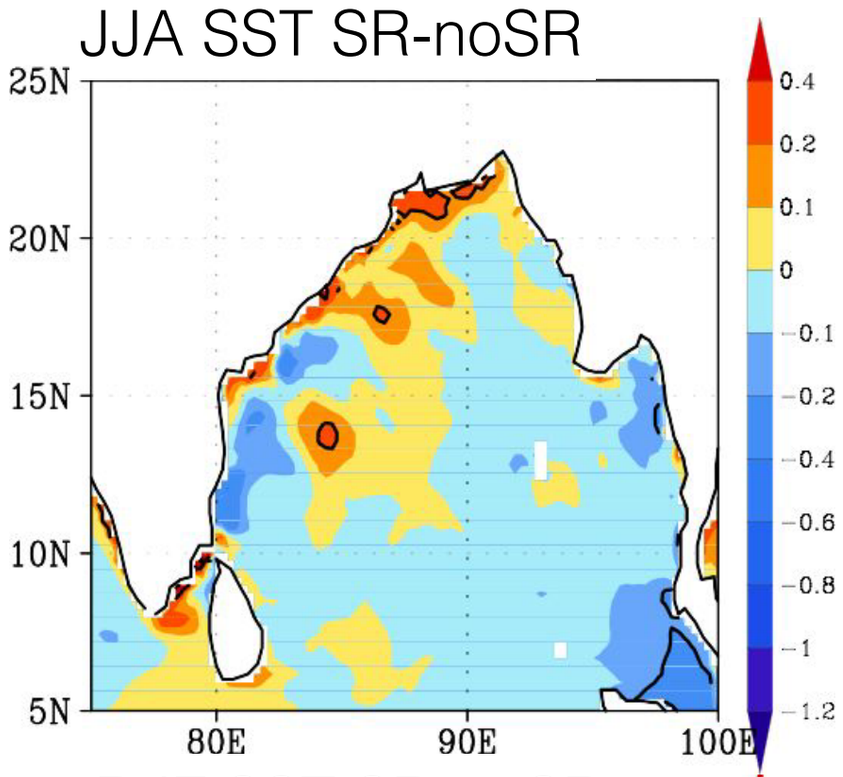


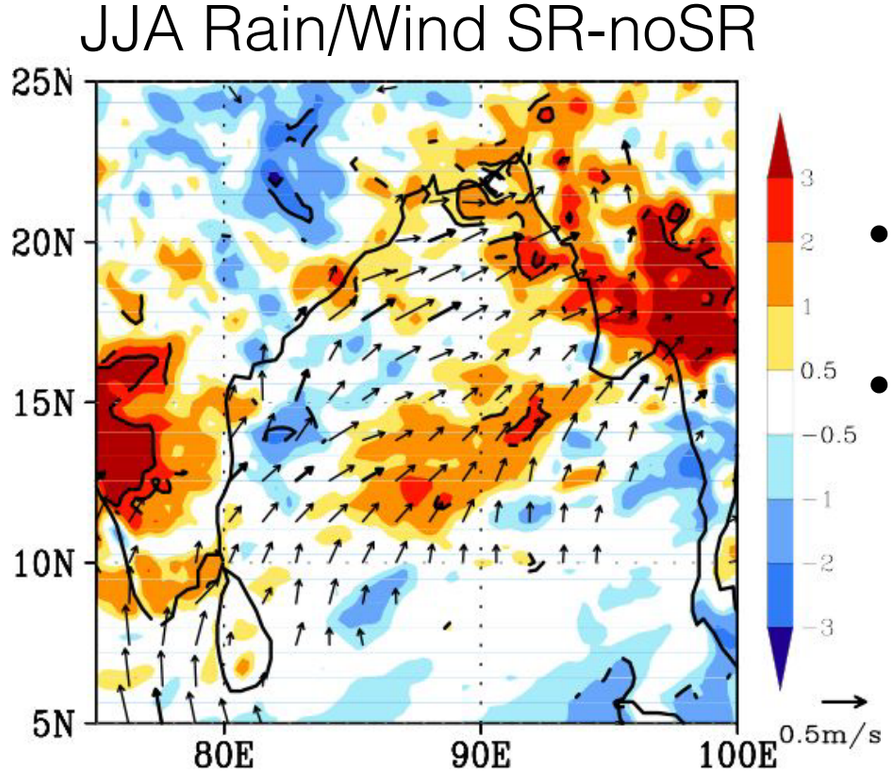
- SCOAR regional coupled model for the Indian Ocean
- A crude representation of river discharge thru SSS restoring in the ocean model.

Seo et al. 2009: Seasonal effects of Indian Ocean freshwater forcing in a regional coupled model. J. Climate

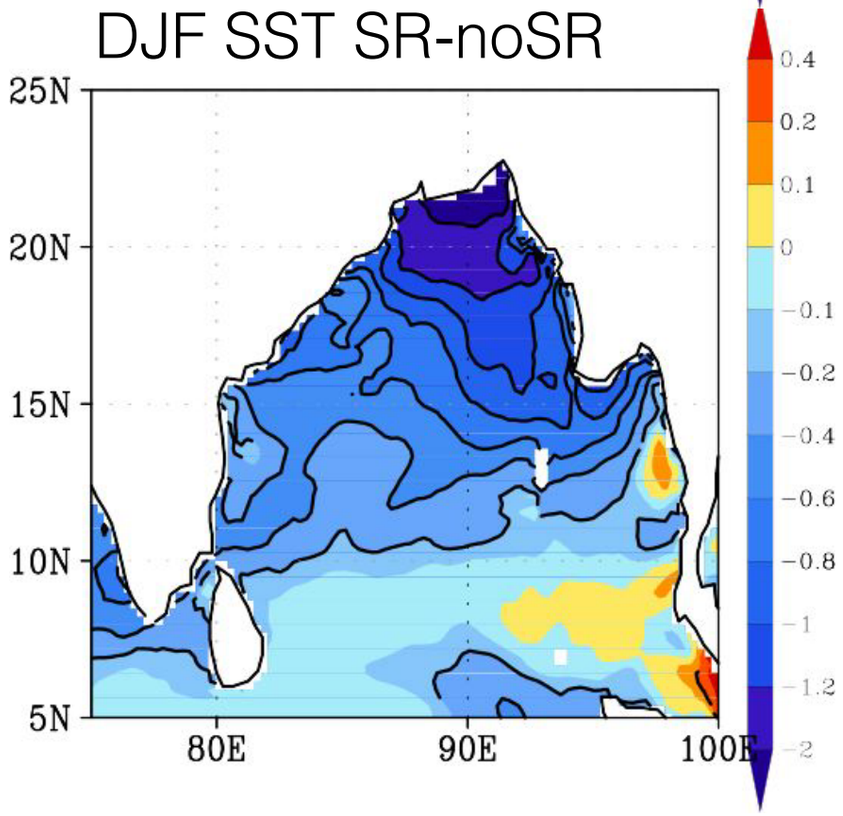


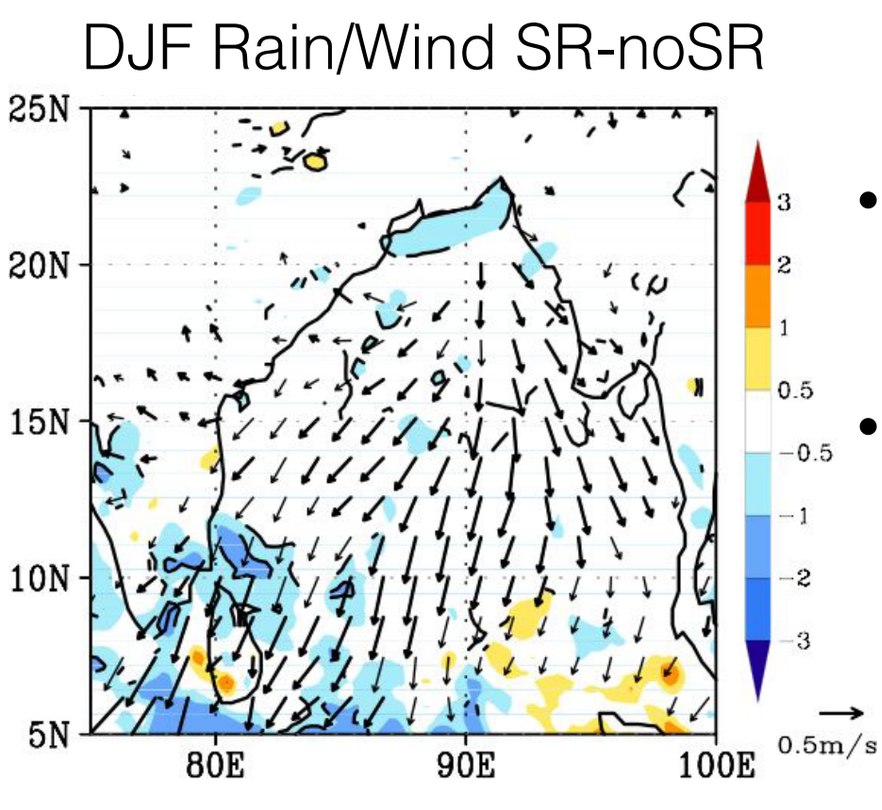
River discharges affect SST and strengthen the monsoon winds





- Modest SST warming in summer
- Enhanced mean southwesterly monsoon wind and rainfall





- Extensive surface cooling limited in the surface layer
- Strong winter monsoon wind in response to cooling

Summary & Research Plan

- In BOB, air-sea coupling is strong on intraseasonal time-scale.
  - BOB SST ISV influences the northward march of wind, low-level convergence, and deep convection on intraseasonal time-scale.
  - ML processes are modulated by river discharges and diurnal cycle.
  - Combined and relative effects on the SST-MISO coupling?

- From ASIRI measurements, I am interested in knowing the observed spatio/temporal structure of the ML stratification and air-sea flux on diurnal, sub-monthly, and intraseasonal time-scales.

- Regional coupled model simulations will quantify the modulation of ML process and address important rectified effect and predictability on
  1. the ML heat content, budget, and air-sea flux
  2. the MISO convection and monsoon active/break cycles

Thanks!

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