

Influence of freshwater plumes on intraseasonal
variability in the Bay of Bengal
— Moored observations and modeling perspectives

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Thanks to: Bob Weller, Tom Farrar, Amala Mahadevan (WHOI)



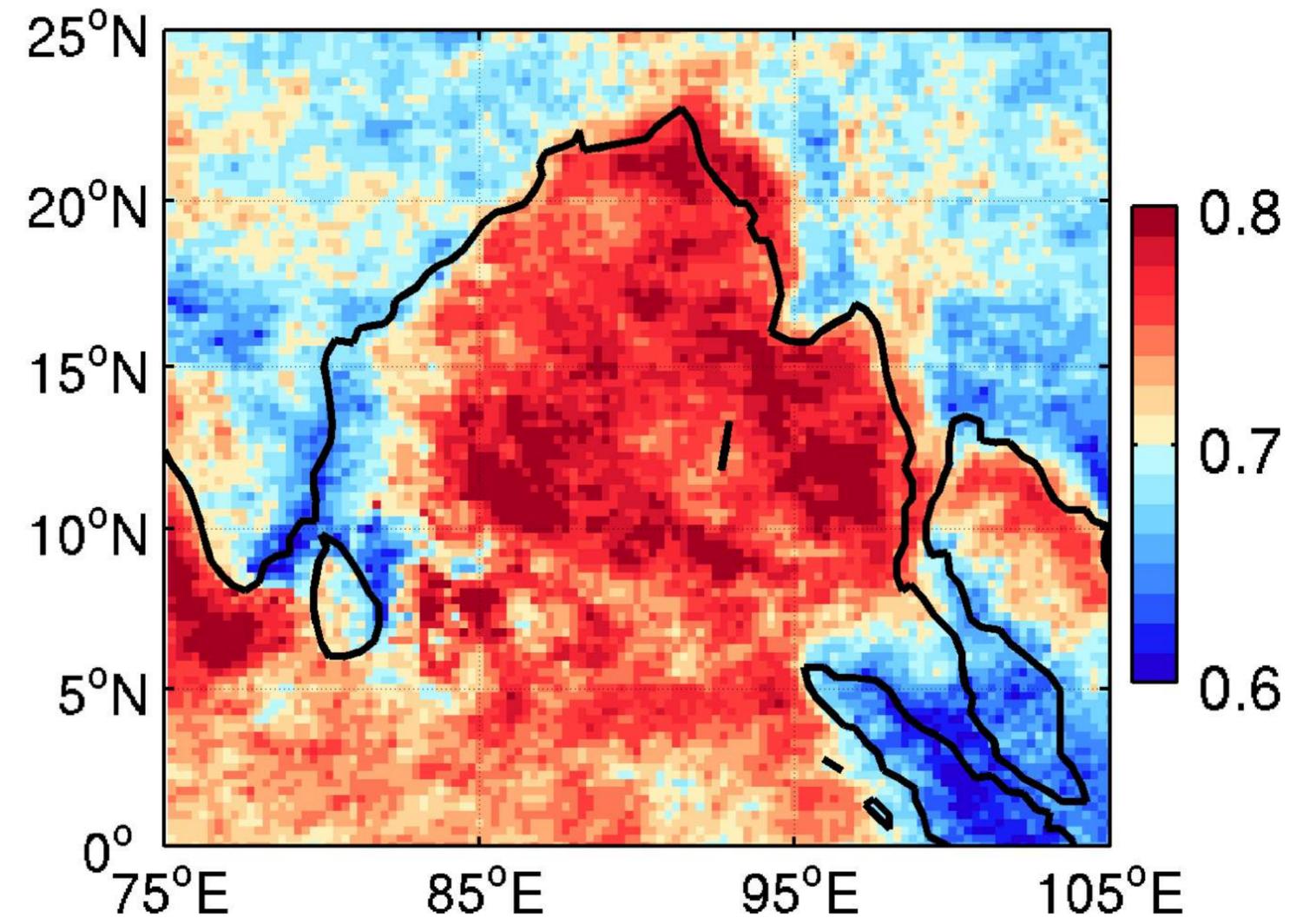
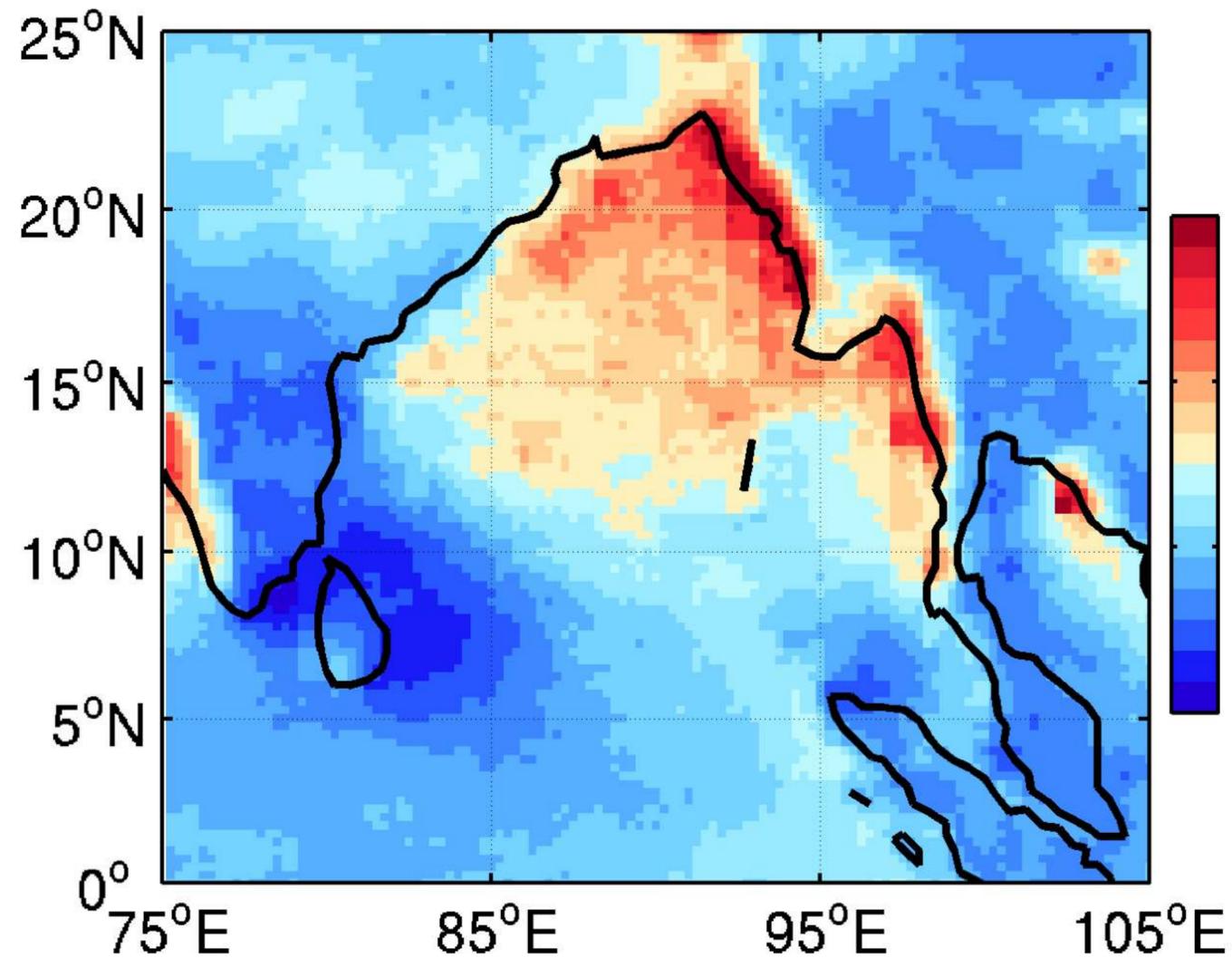
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IIT-Madras, Chennai
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JJAS Intraseasonal rainfall variability

(b) Rainfall std, 5-90d

(c) Ratio std: 5-90d to total

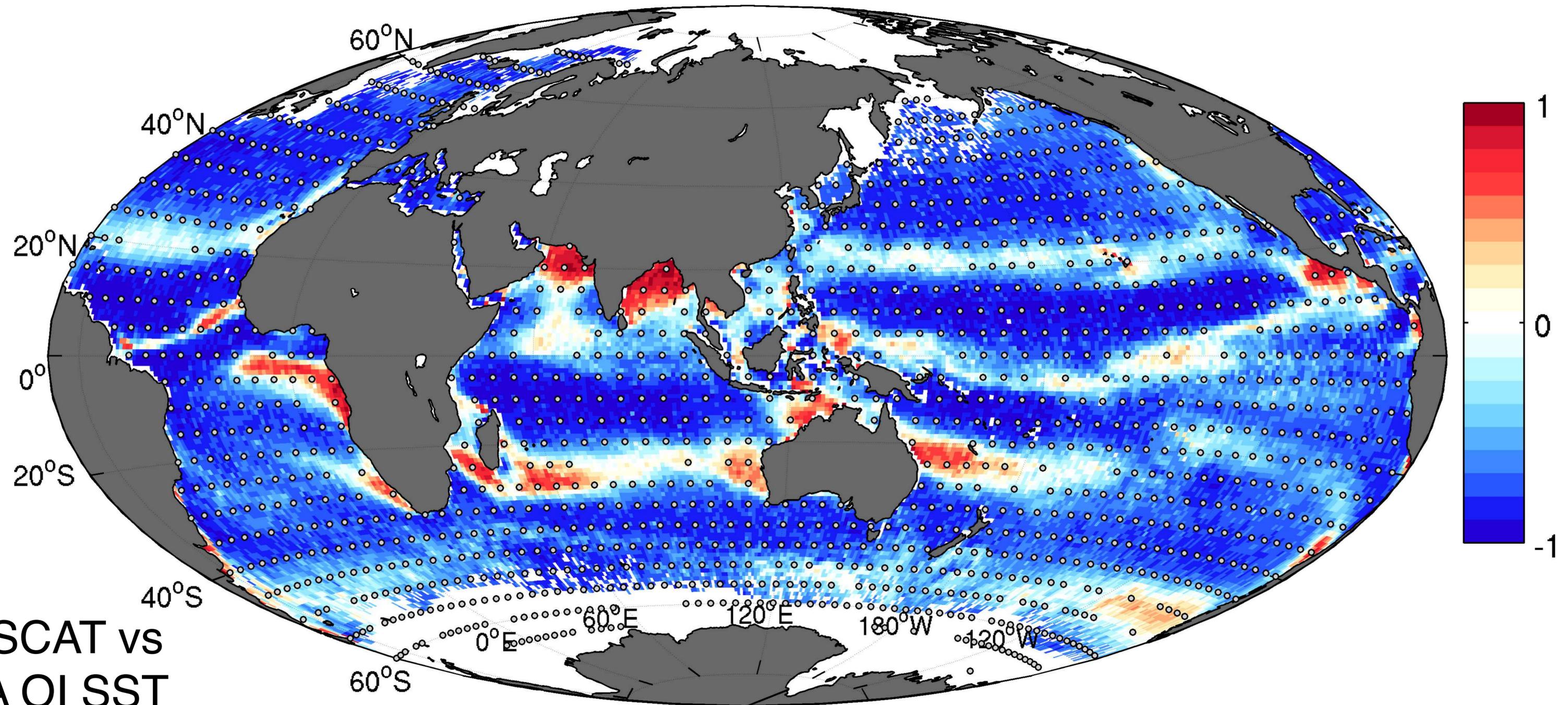


ISO rainfall a significant fraction of the total.

— Internal variability but to what extent is SST-driven?

“SST-driven” intraseasonal air-sea coupling

Correlation bet'n 10-60 day SST and WS in boreal summer; 2001-2009



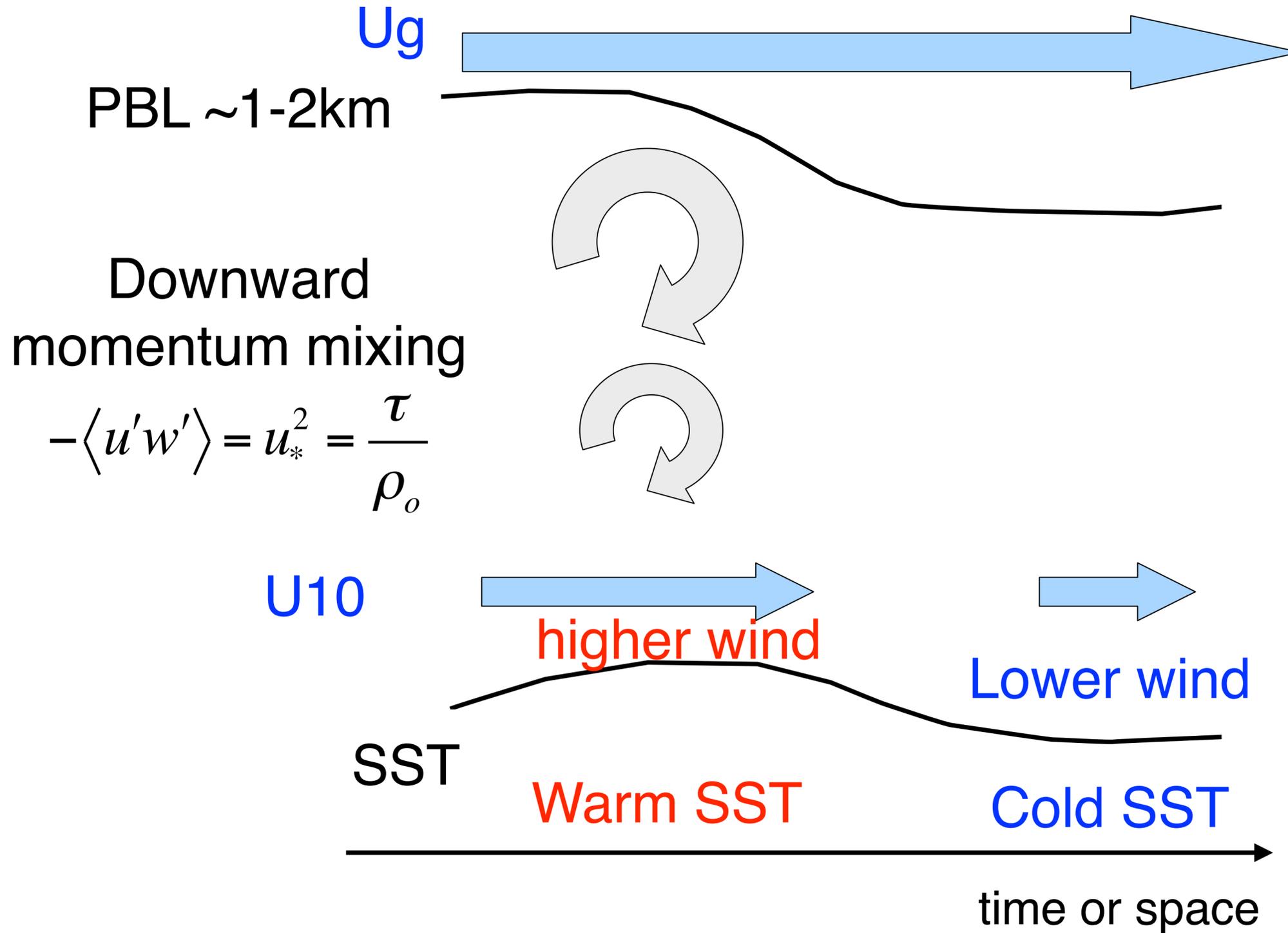
QuikSCAT vs
NOAA OI SST

-ve CORR: ISO wind forcing of the ocean

+ve CORR: SST forcing of ISO WS

SST forcing of intraseasonal convection

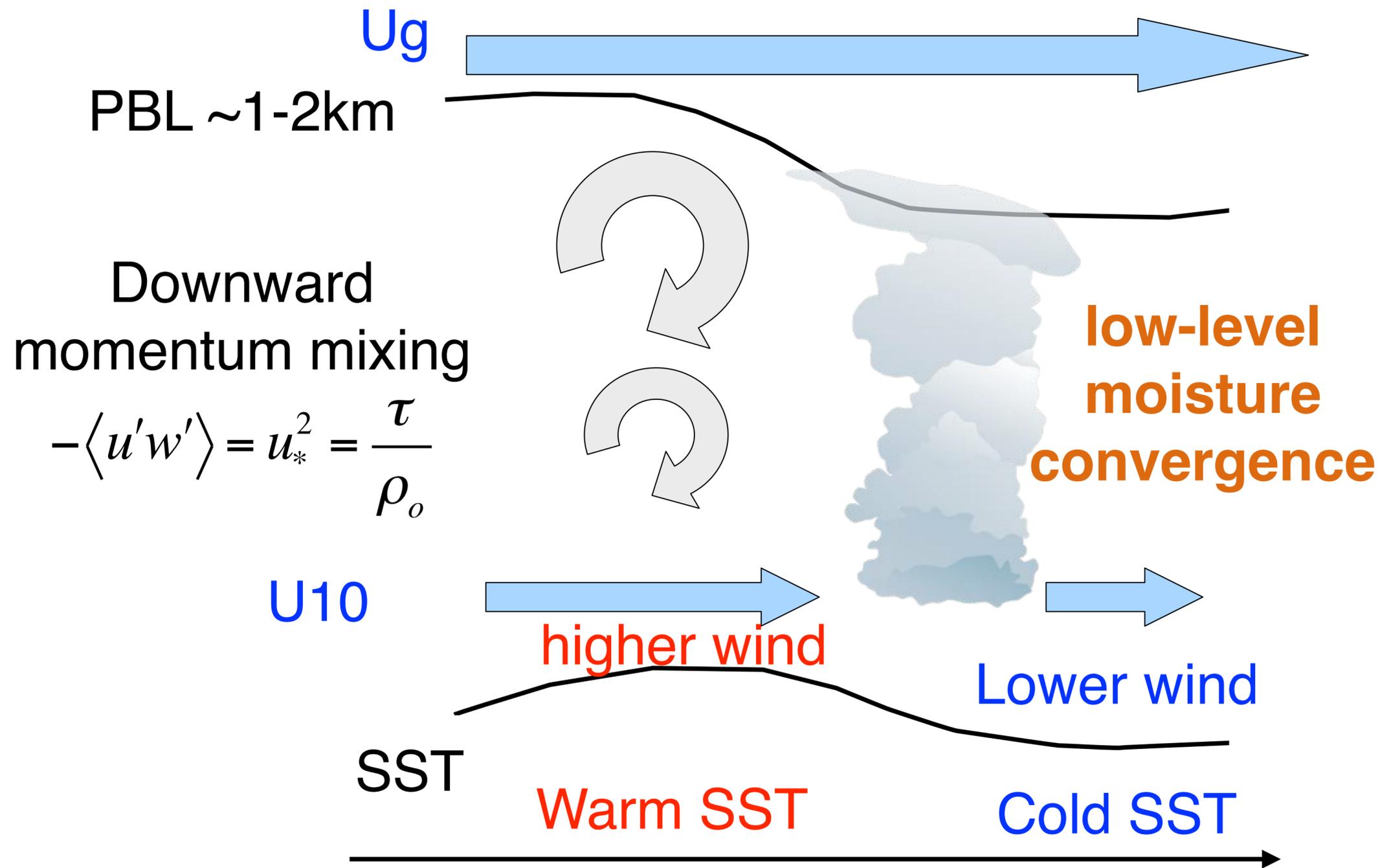
— Low-level (moisture) convergence in the planetary boundary layer



- 1-D turbulent boundary layer process
- A shallow ($< \text{PBL}$) and rapid adjustment (hrs to days)

SST forcing of intraseasonal convection

— Low-level (moisture) convergence in the planetary boundary layer



- Ekman momentum balance; Feliks et al. (2004); Minobe et al. (2008); Hsu and Li (2012)

$$f\hat{k} \times u = -\frac{1}{\rho_0} \nabla p - \varepsilon u$$

$$\rho_0 (\nabla \cdot \vec{u}) = -(\nabla^2 P) \varepsilon / (\varepsilon^2 + f^2)$$

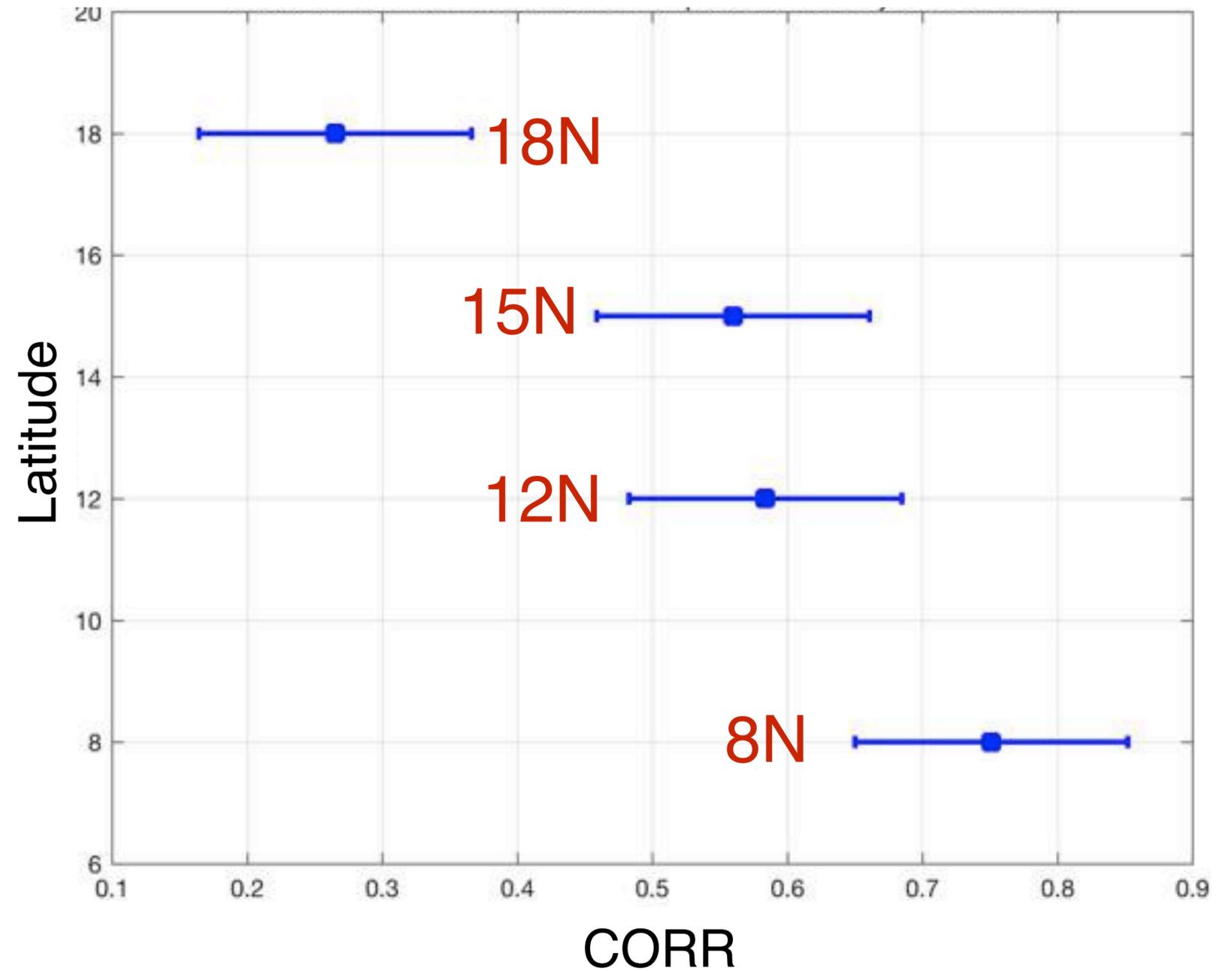
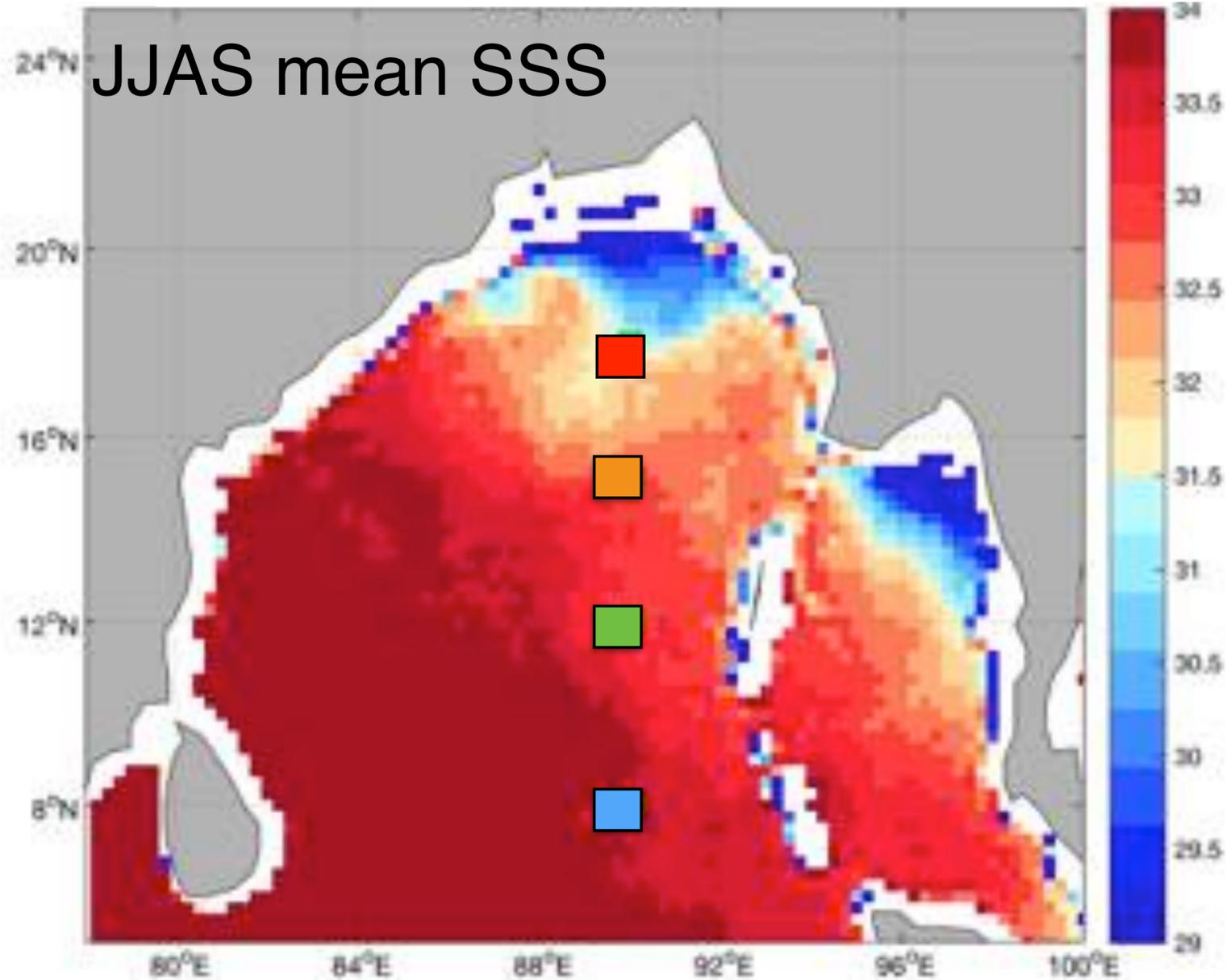
$$w(z) = \frac{1}{\rho_0} \left(\frac{\varepsilon z}{\varepsilon^2 + f^2} \right) \nabla^2 P$$

$$\text{SST}' \rightarrow \nabla^2 P \rightarrow \nabla \cdot u \rightarrow w'$$

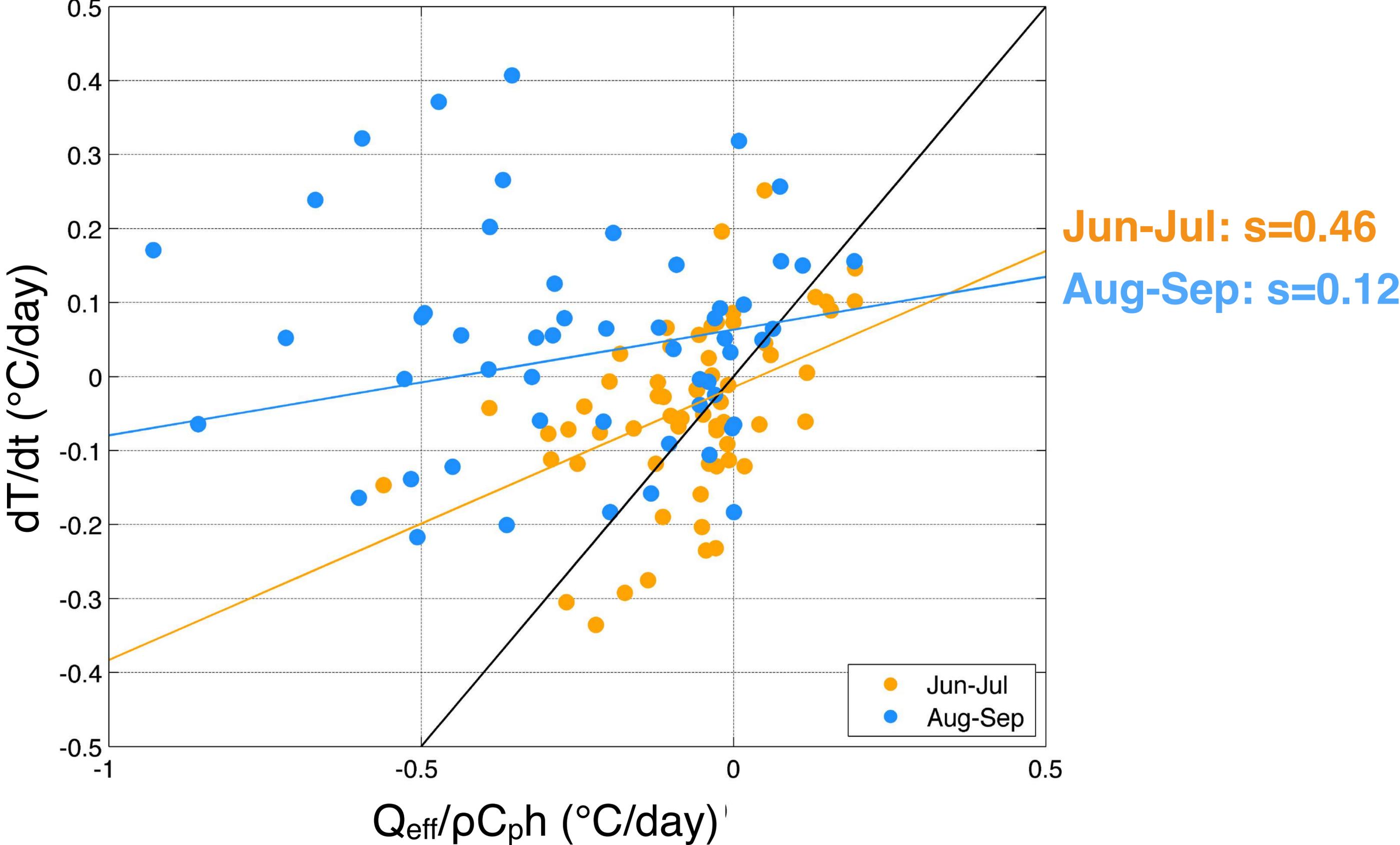
Moored observations at 90°E Summer of 2015

ASIRI and RAMA moorings

$$\underbrace{\frac{\partial T}{\partial t} = \frac{Q_{eff}}{\rho C_p h}}_{1-D} - \left[\left(u \frac{\partial T}{\partial x} + v \frac{\partial T}{\partial y} \right) + H \left(W_h + \frac{\partial h}{\partial t} \right) \frac{(T - T_h)}{h} \right] + R$$



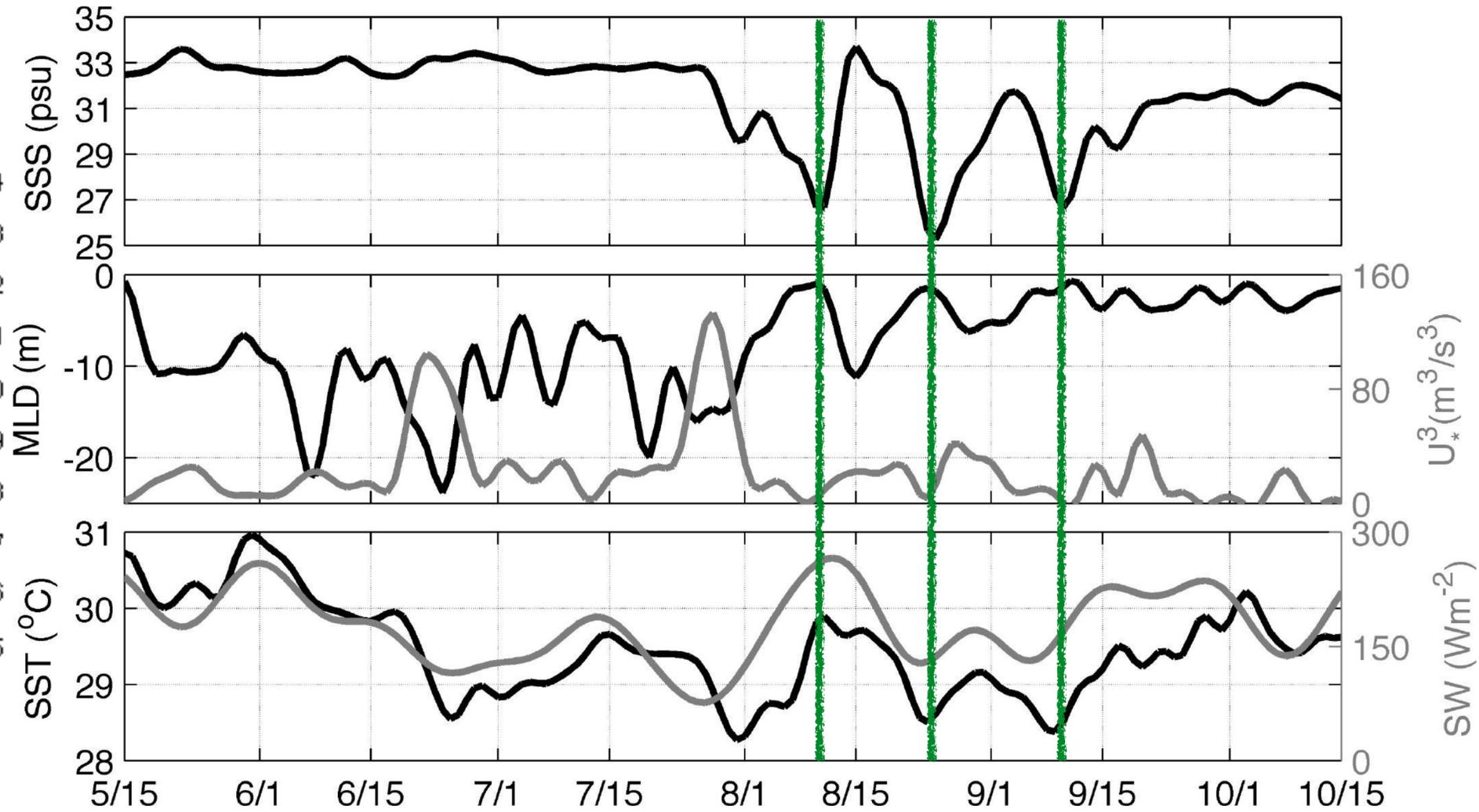
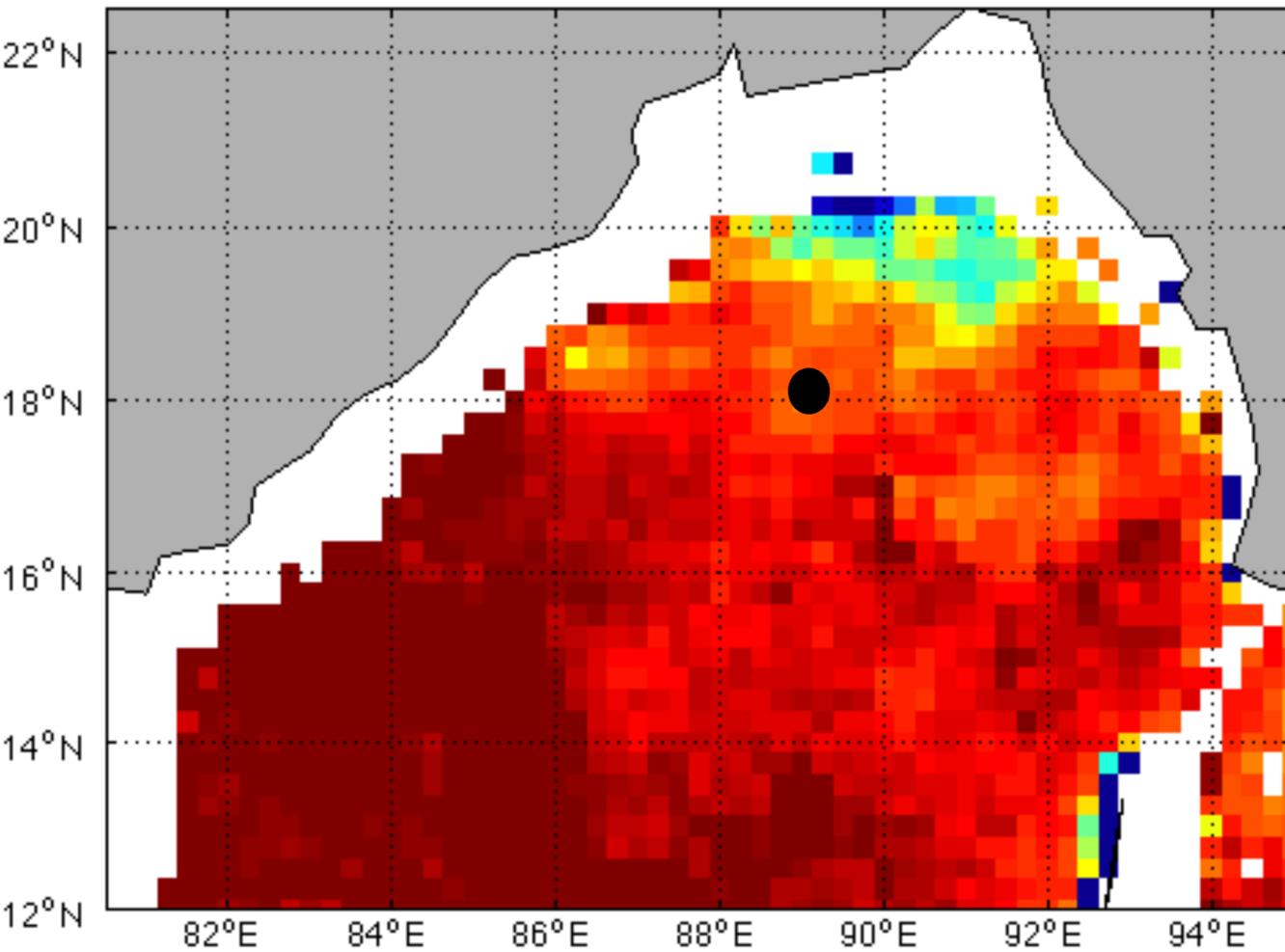
Early vs late summer ML temperature balance at 18°N, 2015



Freshwater intrusions in late summer monsoon at 18°N

SMAP SSS 2015

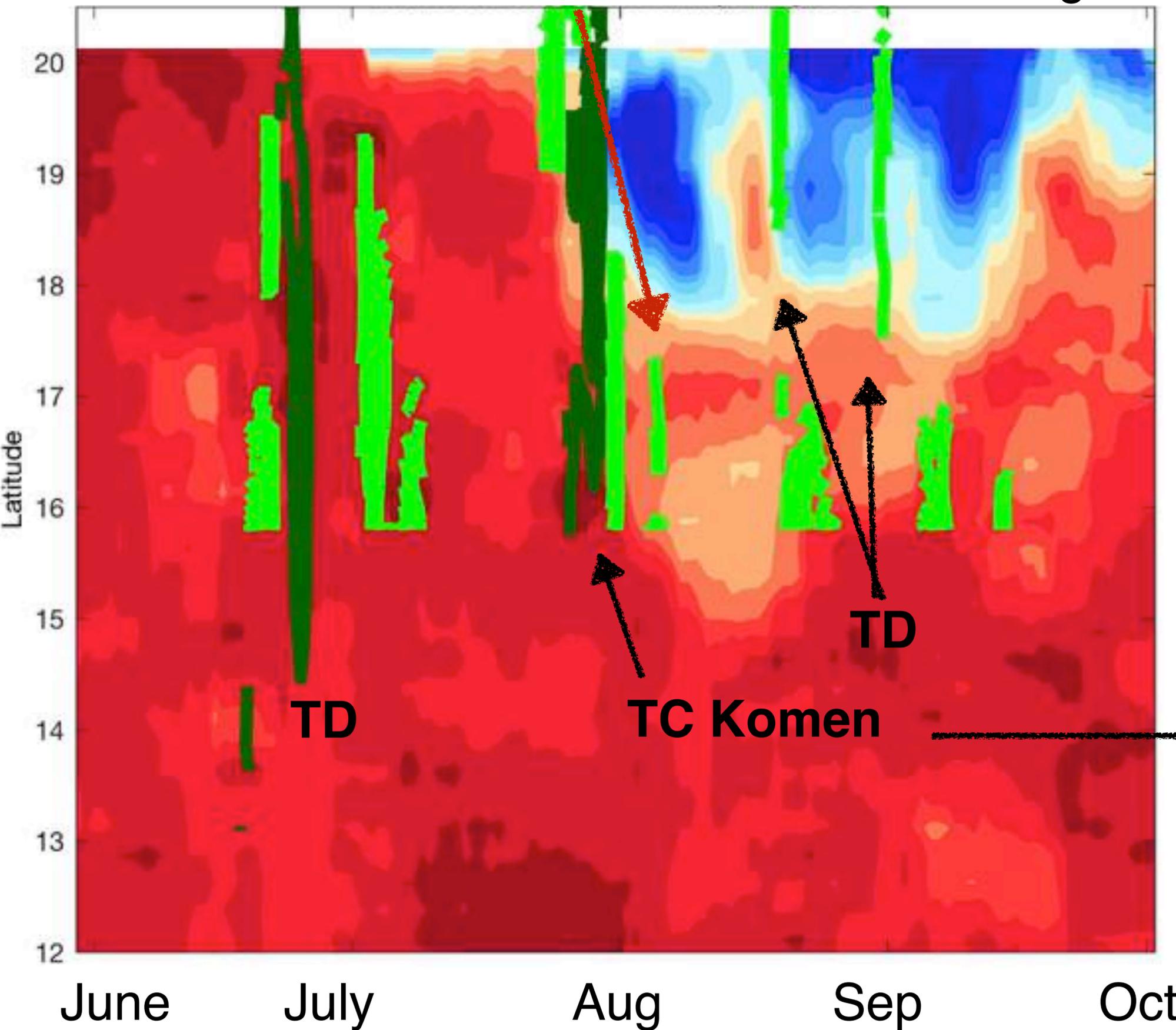
mon=7 day=25



2015

leading edge ~0.25 m/s

SSS along 90E

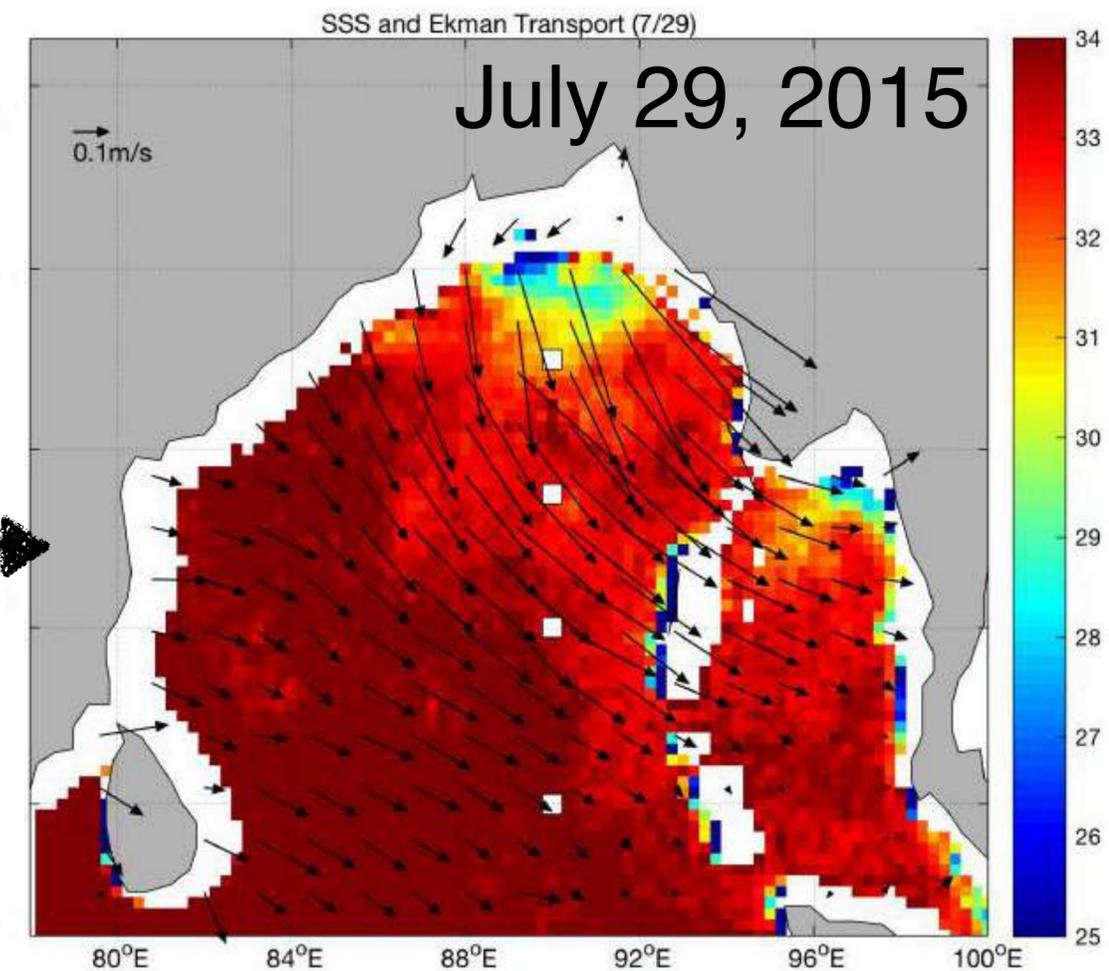


Arrival of freshwater plumes in 2015 summer

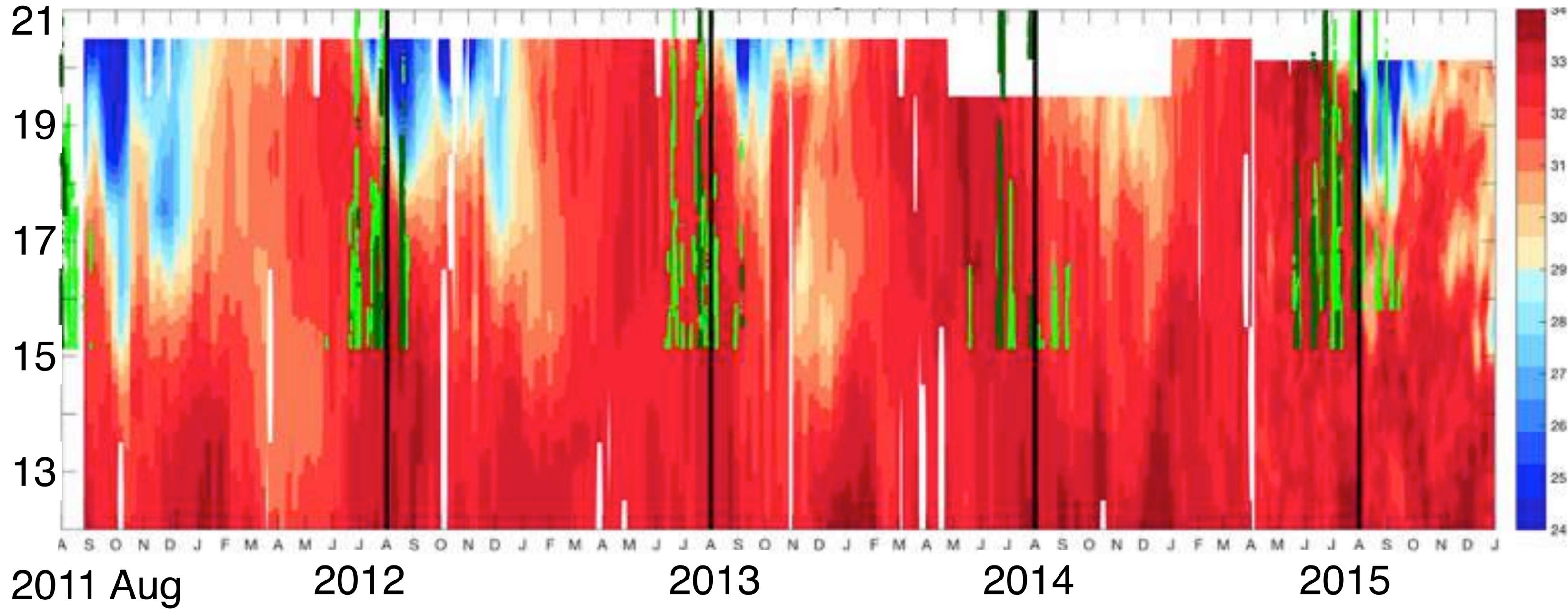
$$v_{Ek} = \frac{-\tau_x}{\rho_w} \cdot \frac{1}{\sqrt{A \cdot f}}$$

$V_{ek} = -0.1 \sim -0.2 \text{ m/s}$

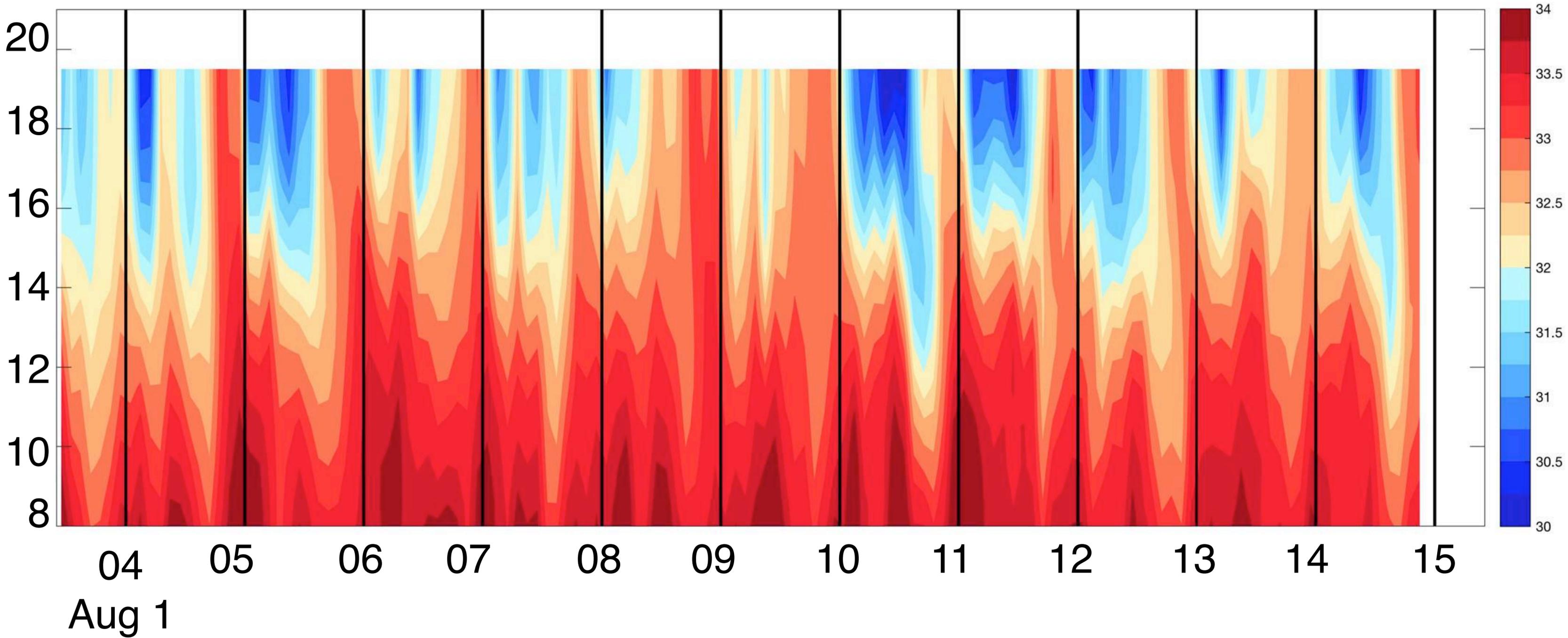
$V_{ek} = -0.2 \sim -0.3 \text{ m/s}$



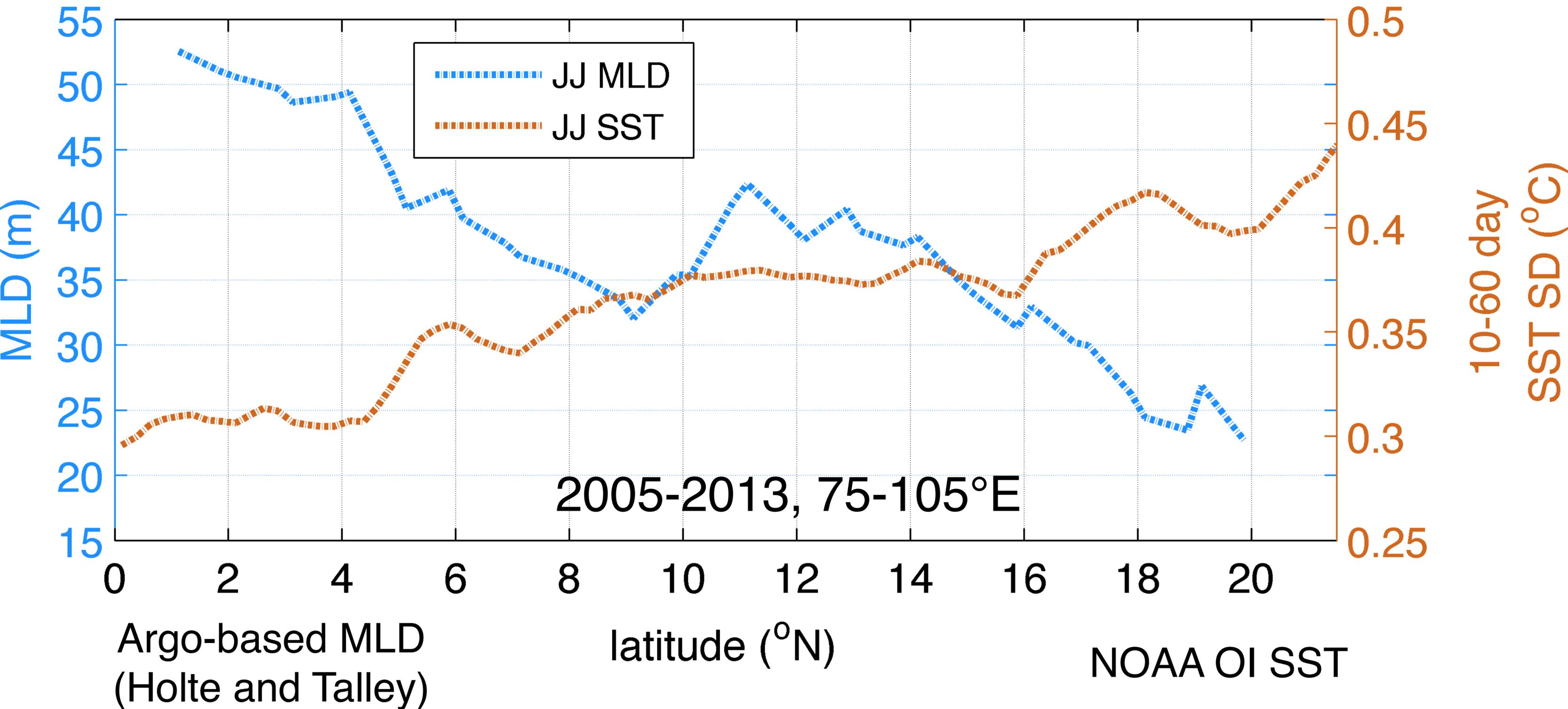
Arrival of freshwater plumes: 2011-2015 based on Aquarius/SMAP



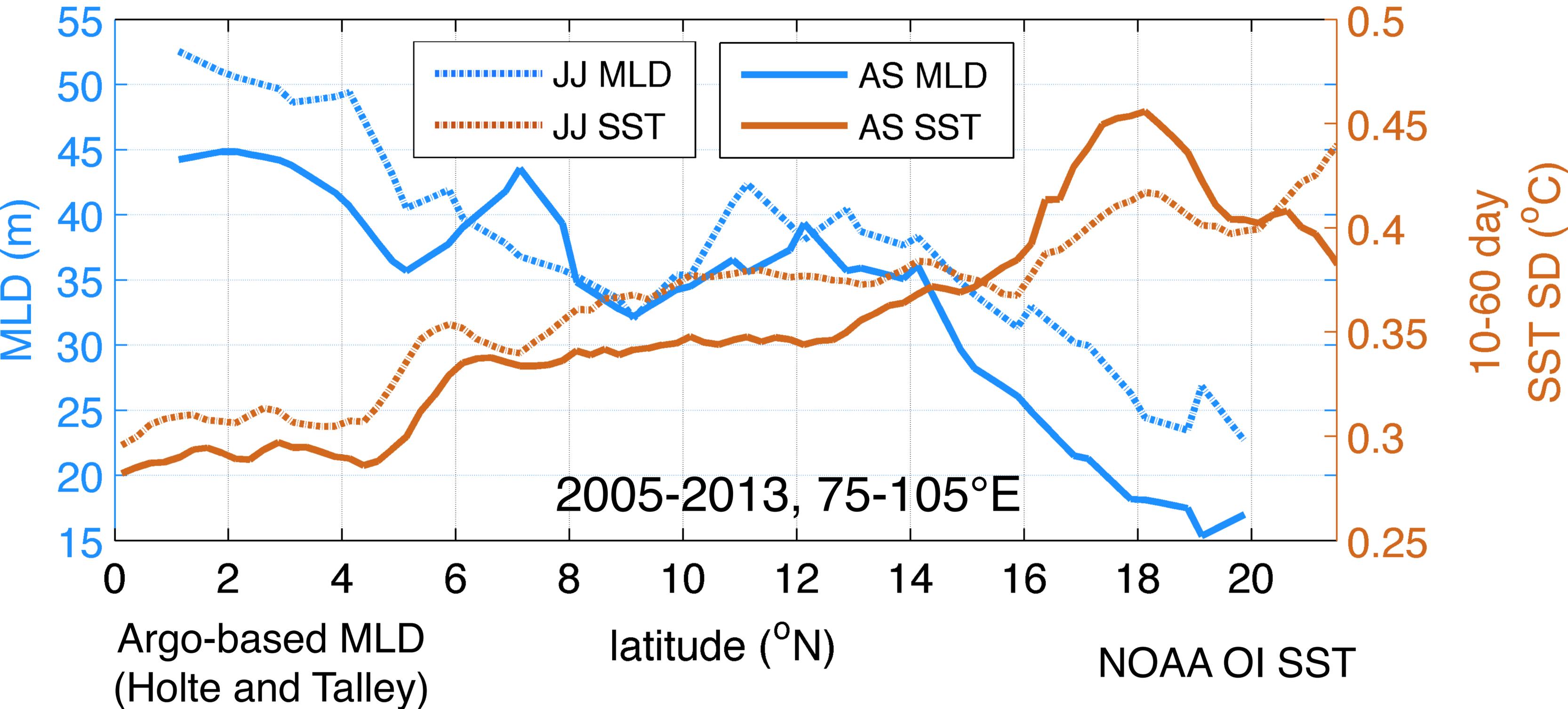
Arrival of freshwater plumes: 2004-2015 based on Argo 5m salinity (monthly)



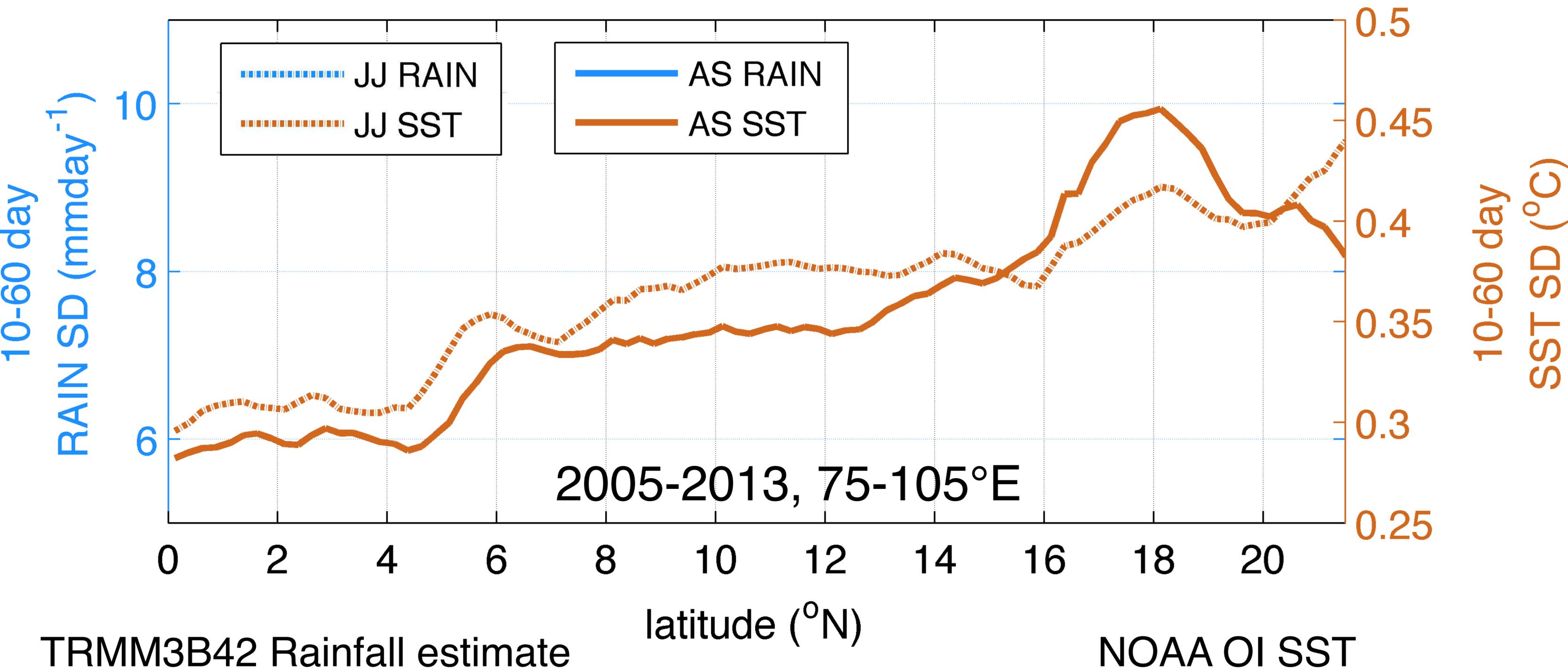
BoB MLD and intraseasonal SST variability



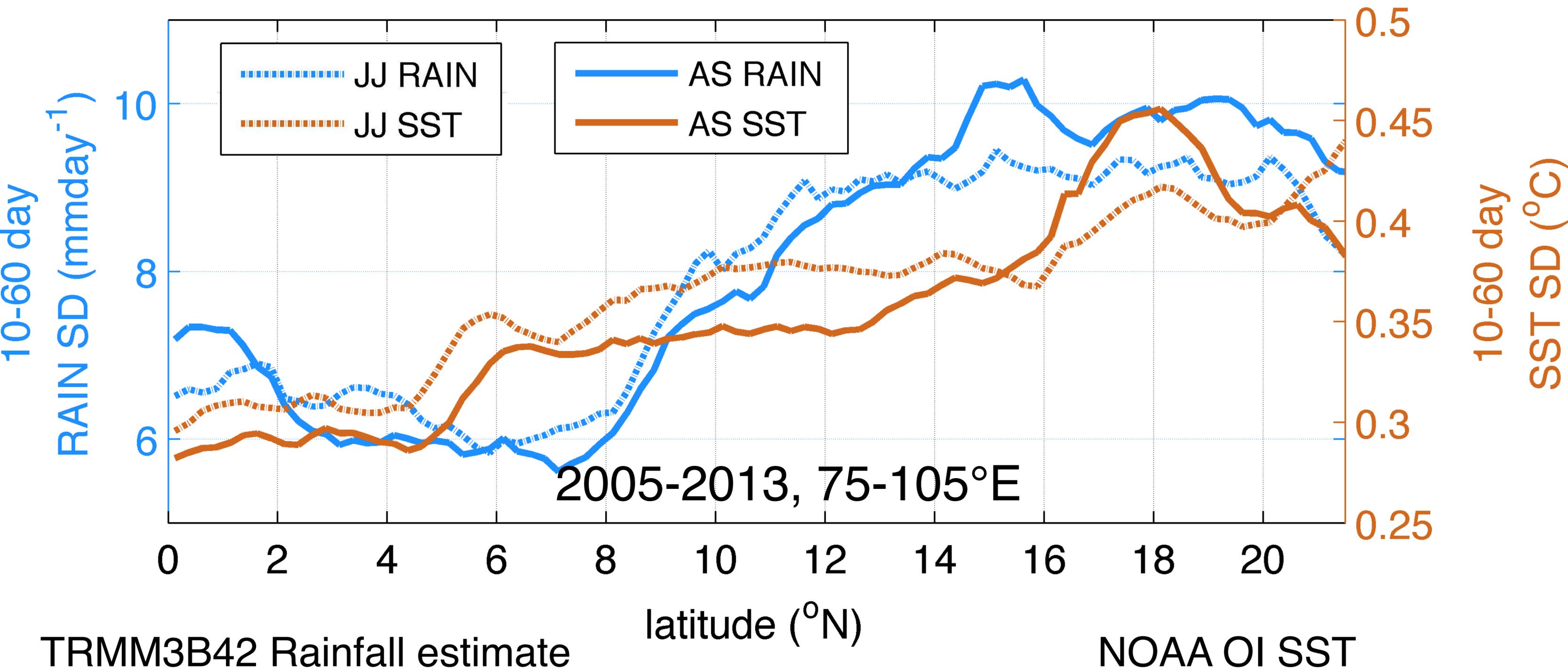
BoB MLD and intraseasonal SST variability

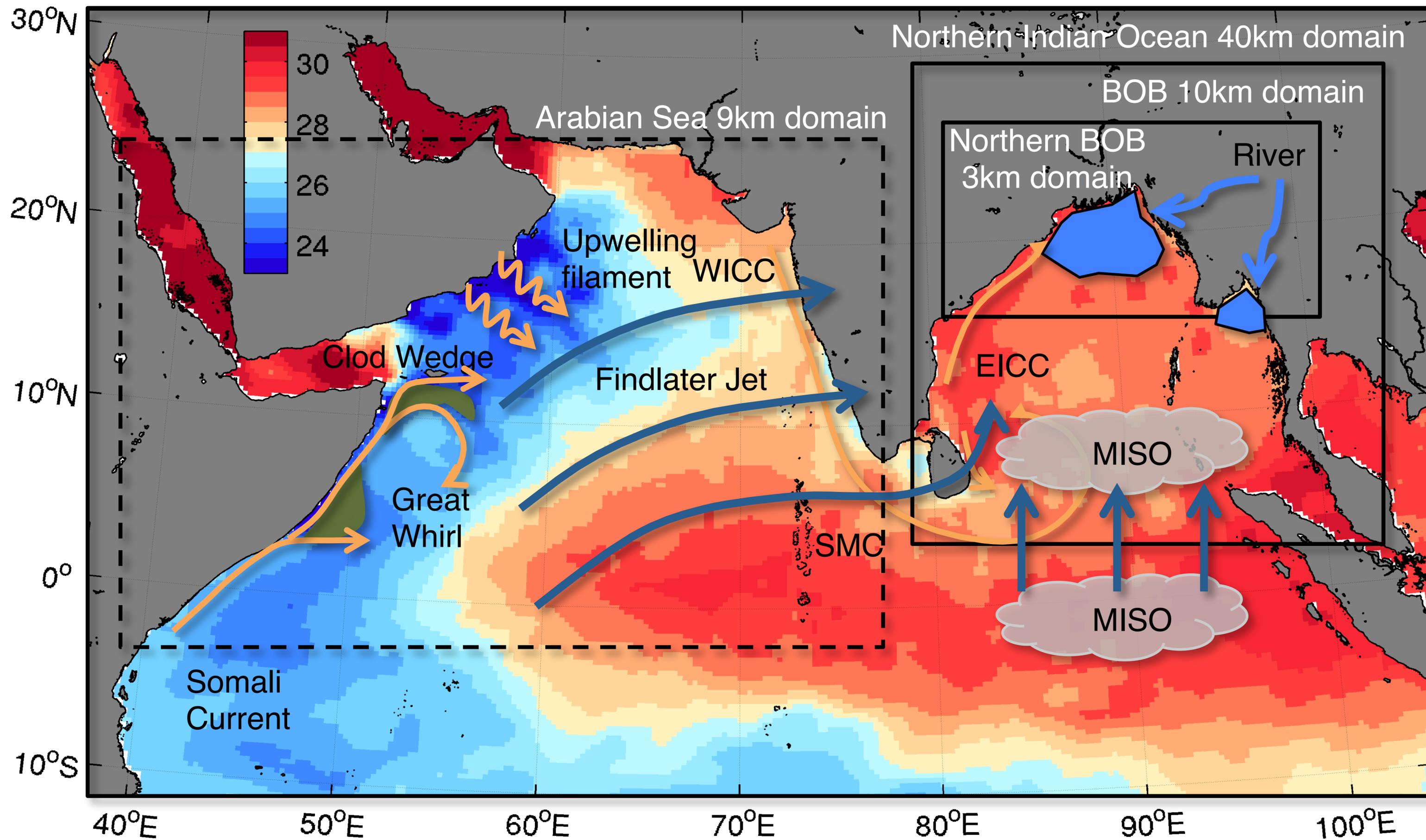


BoB intraseasonal SST and rainfall variability



BoB intraseasonal SST and rainfall variability





Summary

- Freshwater plumes play a key role in sub-seasonal and regional contrasts in ML stratification and heat balances:
 - Is there any systematic difference in the monsoon intraseasonal oscillation that is mediated by the freshwater distribution?
- (not today) Considerable remote influences from the equatorial Indian Ocean (IOD/ENSO) and the Arabian Sea (Findlater Jet, monsoon currents).
- Need a systematic examination of **local and remote controls of the BOB-MISO coupling**:
 - Numerical modeling and further data analysis are underway.