Intraseasonal Variability in Sea Level Height in the Bay of Bengal: Remote vs. local wind forcing & Comparison with the NE Pacific Warm Pool

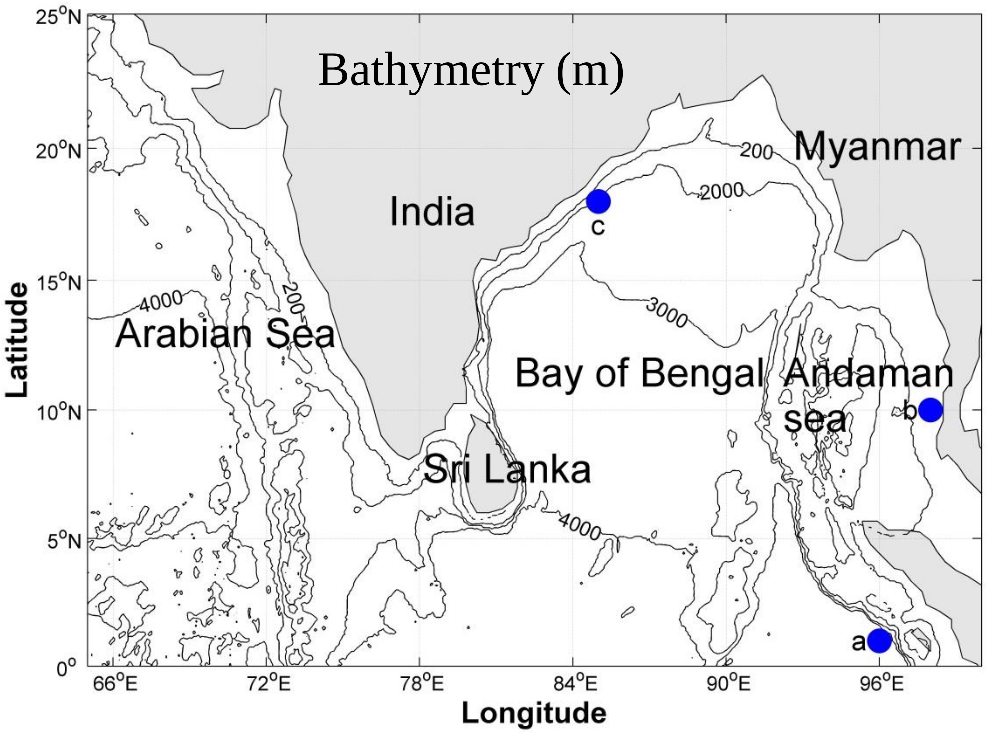
Shang-Ping Xie[1,3], Xuhua Cheng[2,3] , Julian P. McCreary[3]

1. Scripps Institution of Oceanography, UCSD

2. South China Sea Institute of Oceanology, China

3. International Pacific Research Center, University of Hawaii

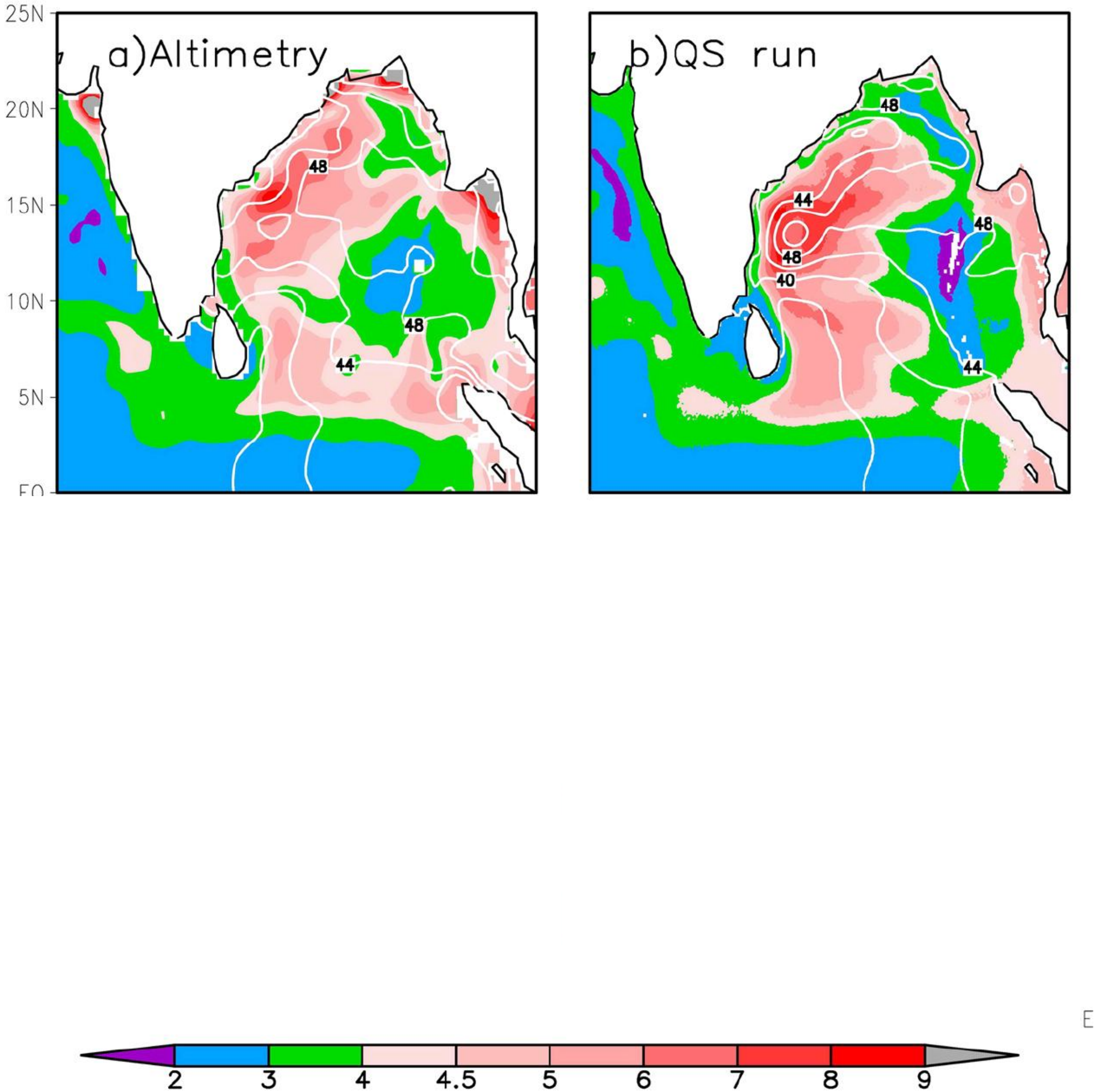
- Satellite altimetry enabled global observations of intraseasonal variability (ISV) in SSH;
- Satellite scatterometry enabled global observations of wind ISV, not available from ships;
- QuikSCAT forced ocean simulations enable investigations into sources of SSH ISV: local wind, wave propagation & hydrodynamic instability.



Data and method

- Weekly AVISO merged altimetry data
- Weekly QuikSCAT wind
- OFES QuikSCAT run with 3-daily wind
- OFES run with NCEP climatological wind

Band-pass filtered for intraseasonal signals (30-120 day)

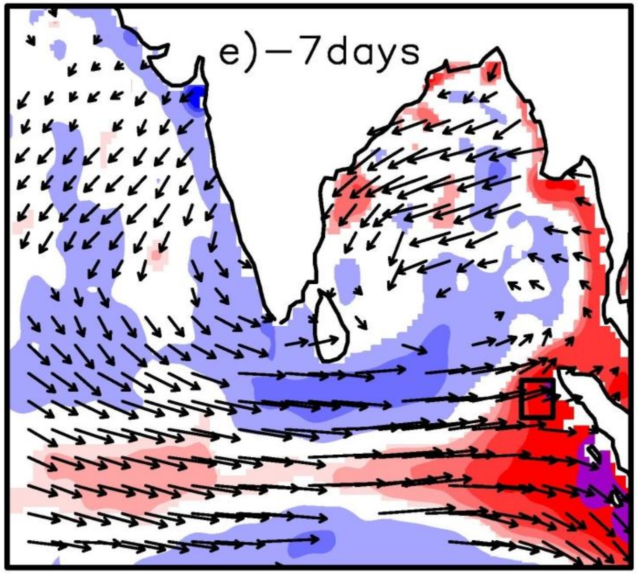


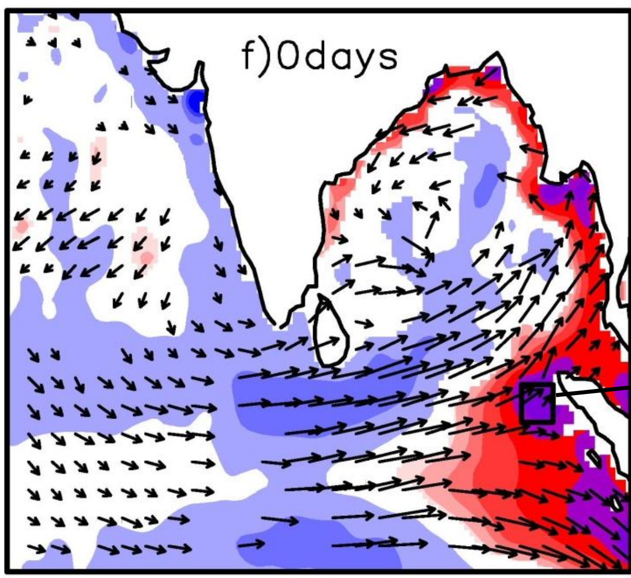
STD of intraseasonal sea level (cm)

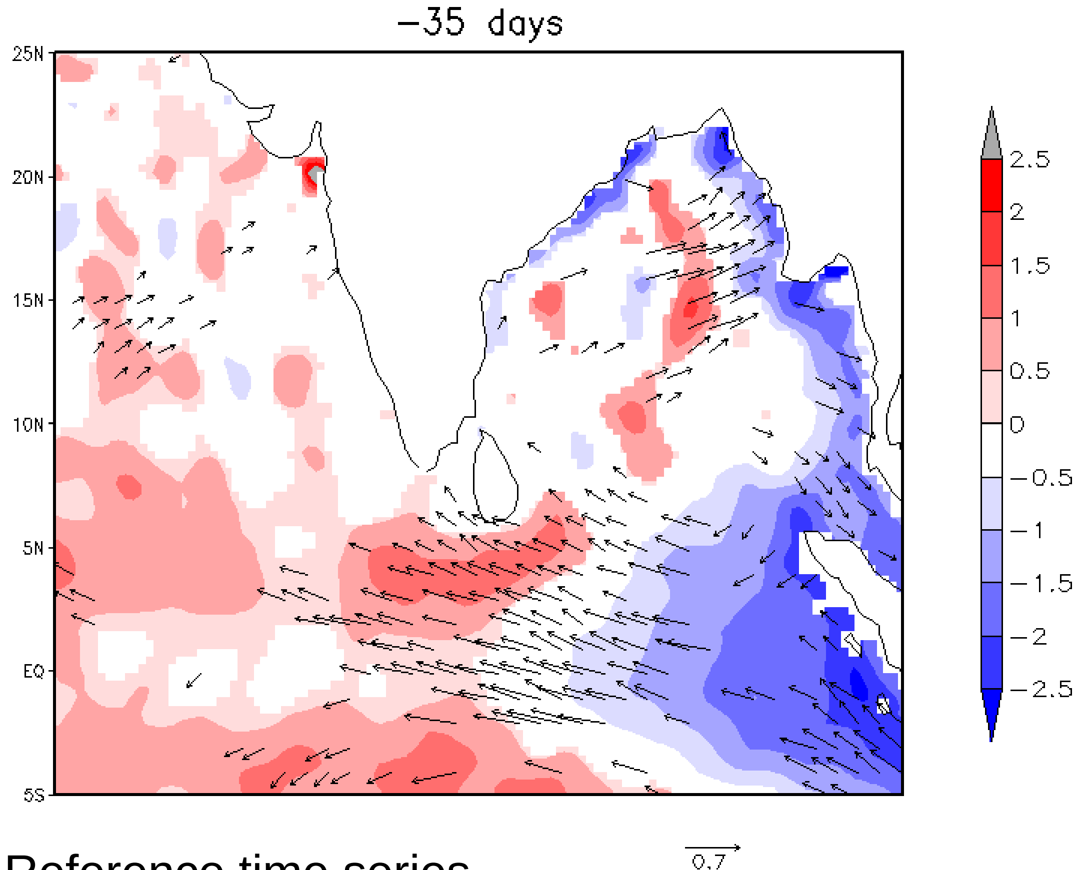
High variance

- ~ 5° N, w-forced
- Coast, w-forced
- Western BoB, internal generated

Coastal ISV : Regression analysis



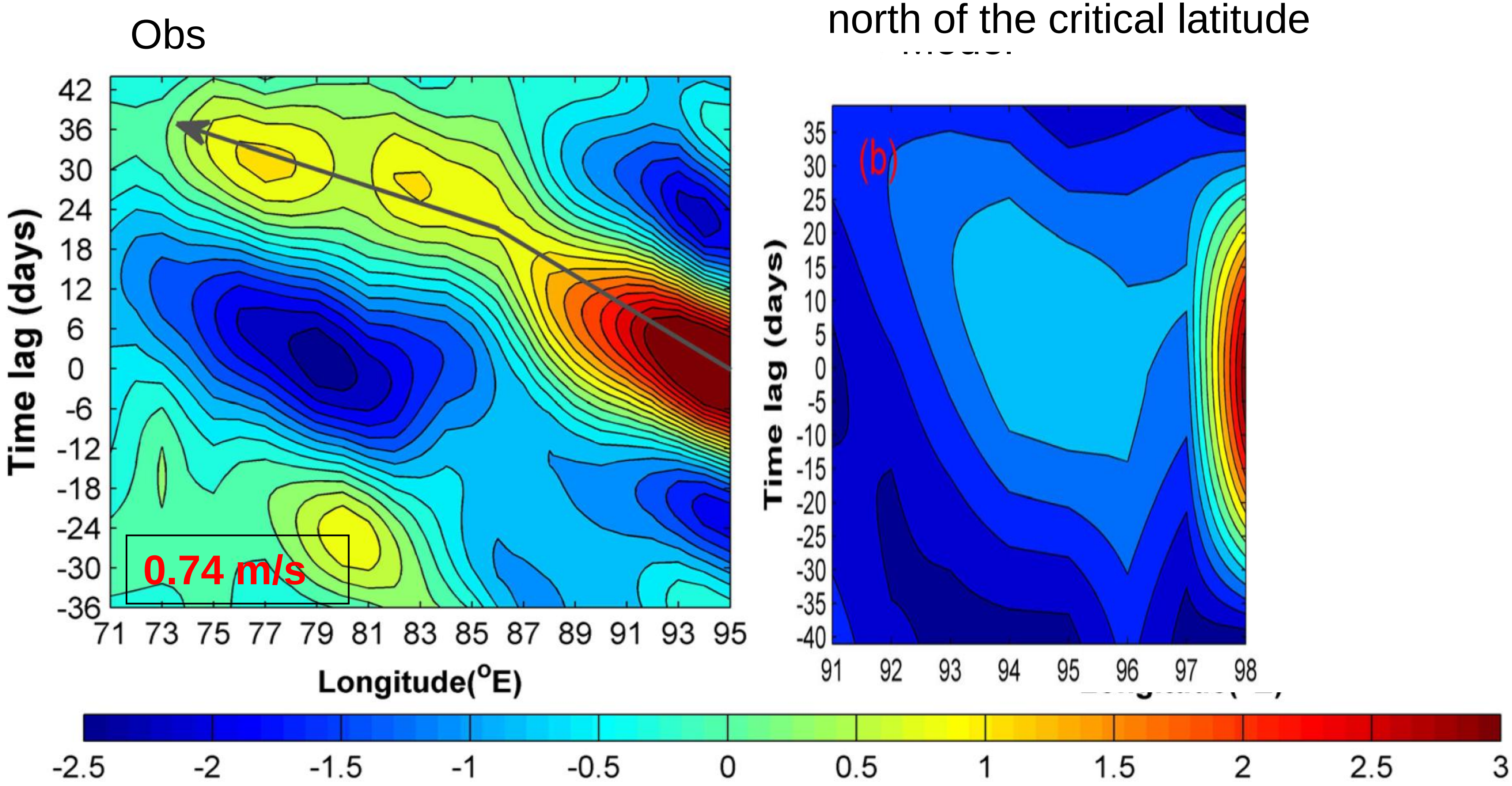




Reference time series

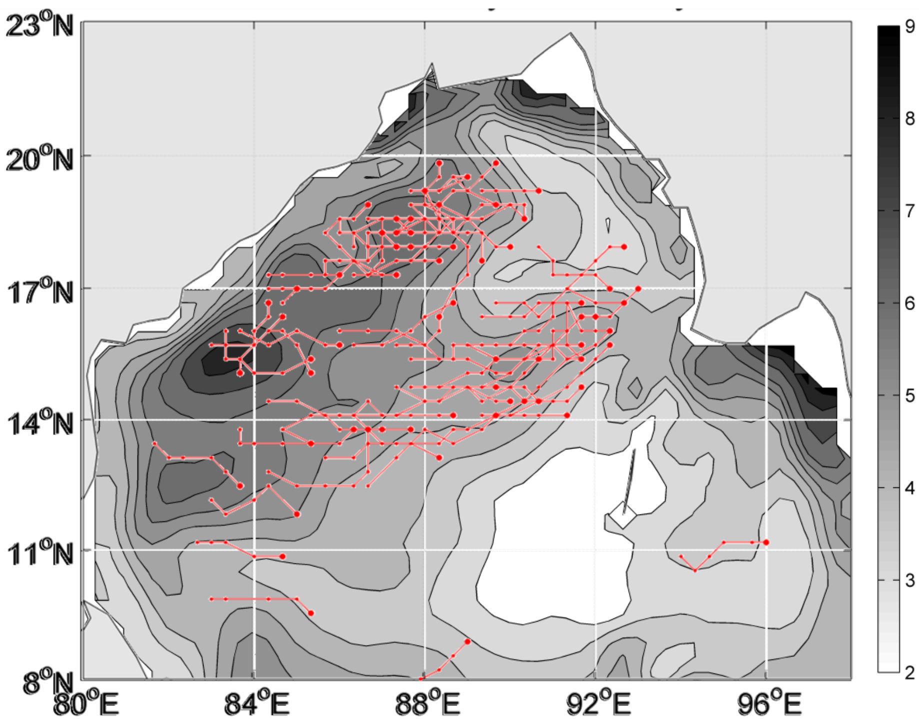
Rossby wave propagation along 5°N

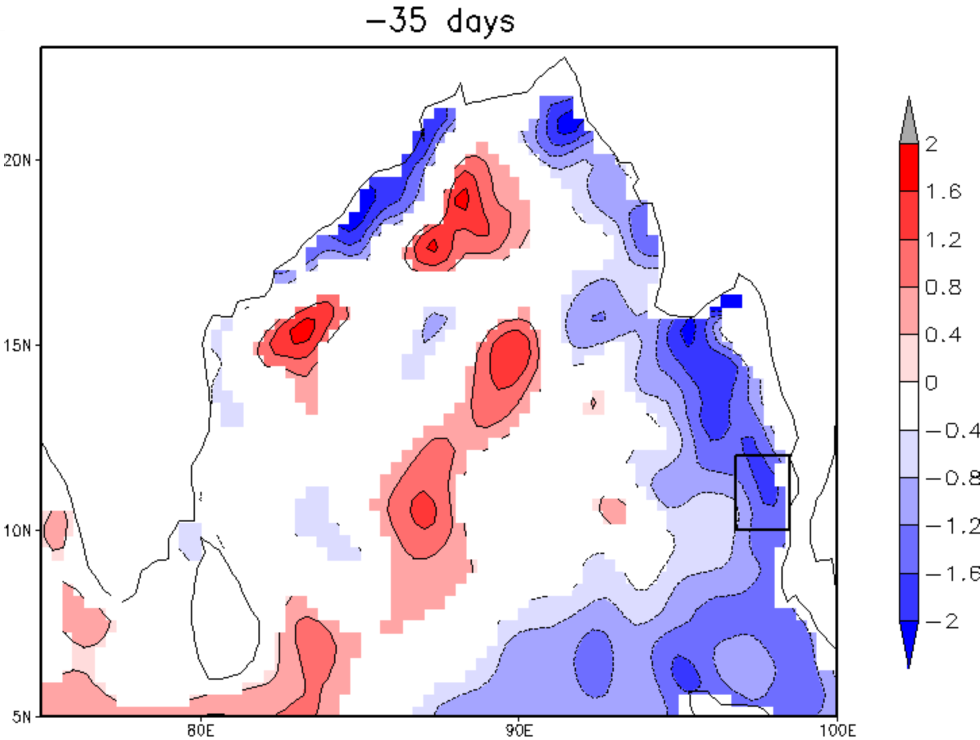
Coastally trapped at 15°N, north of the critical latitude



lagged regression of SSH (cm) upon the coastal time series

Origin of ISV in the northwestern BoB (eddy activity)





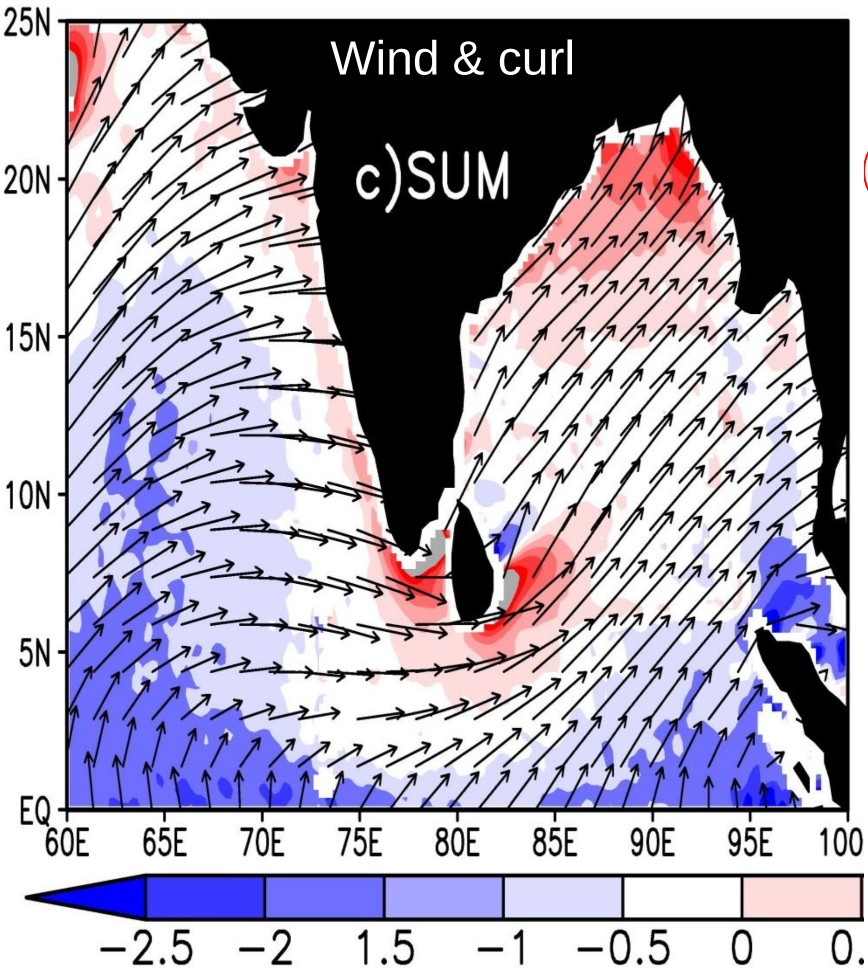
Tracks of anticyclonic eddies that last more than 30 days derived from altimetry data during 2000-2008.

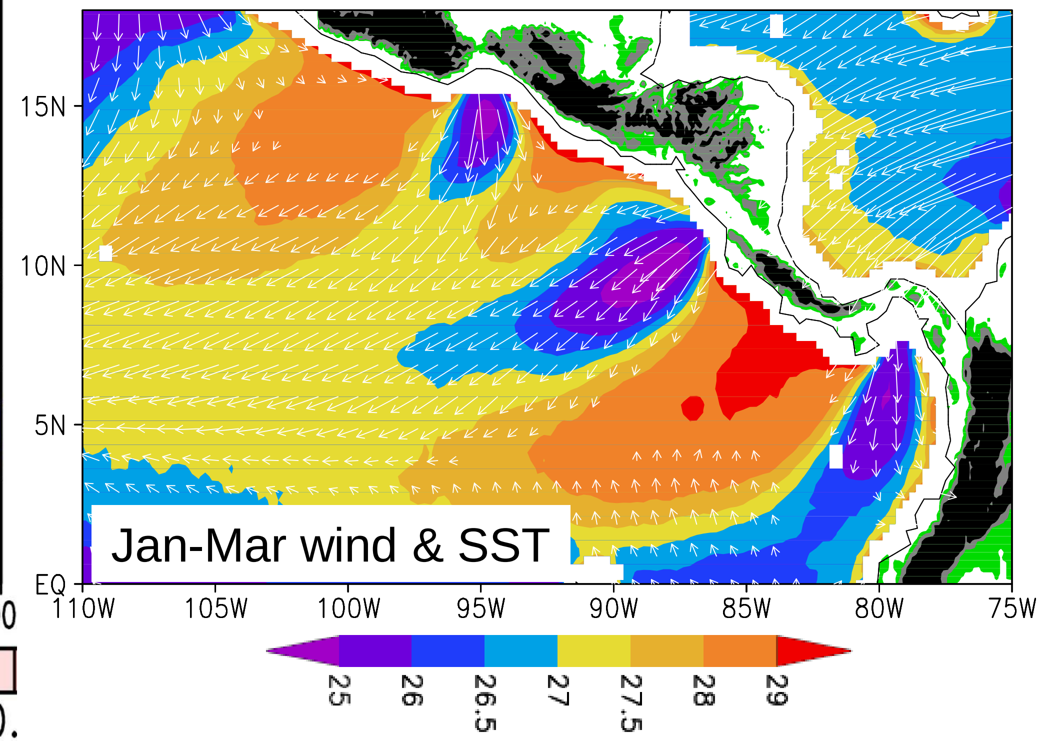
Both under the influence of MJO, via equatorial wind guide

1 Bay of Bengal: weak orographic forcing

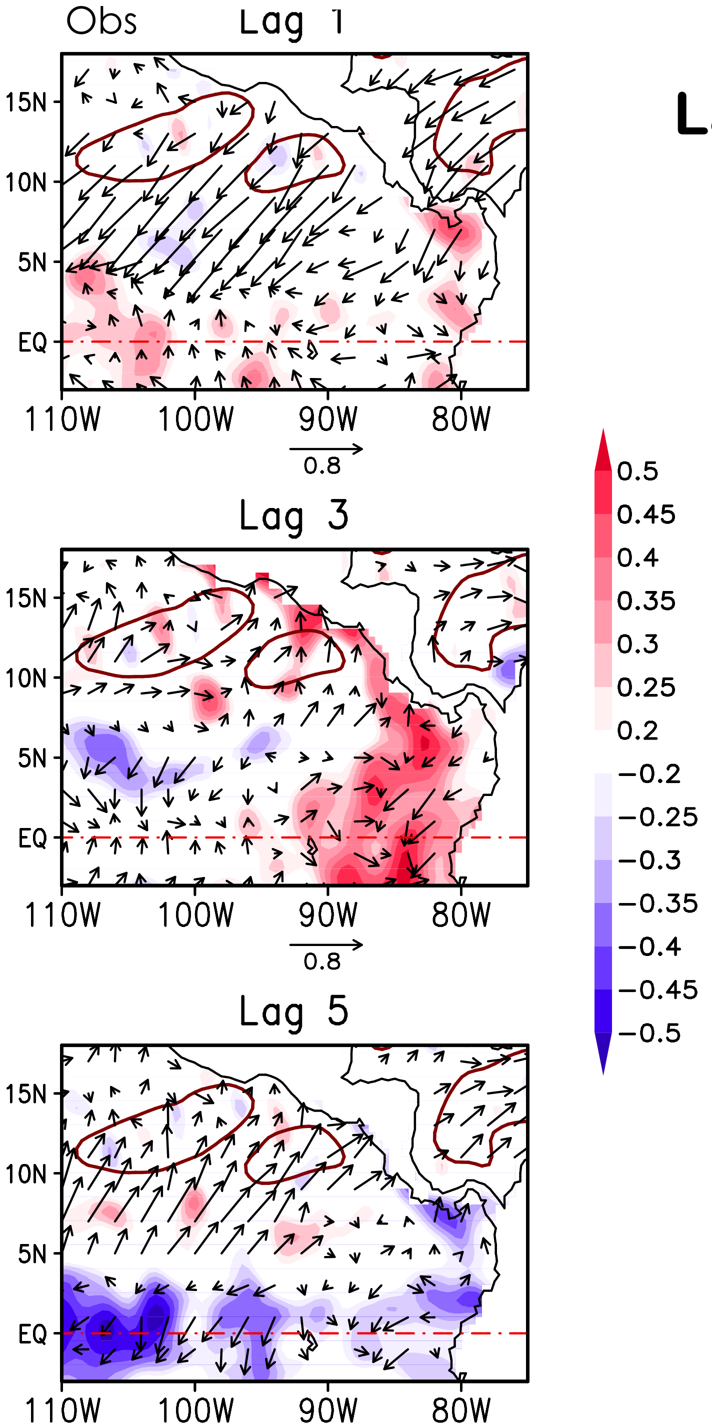
Comparative study at similar latitudes

2 Eastern Pacific: Strong orog. forcing





Xie et al. (2005, JC)



Lag Correlation w/ Global MJO index

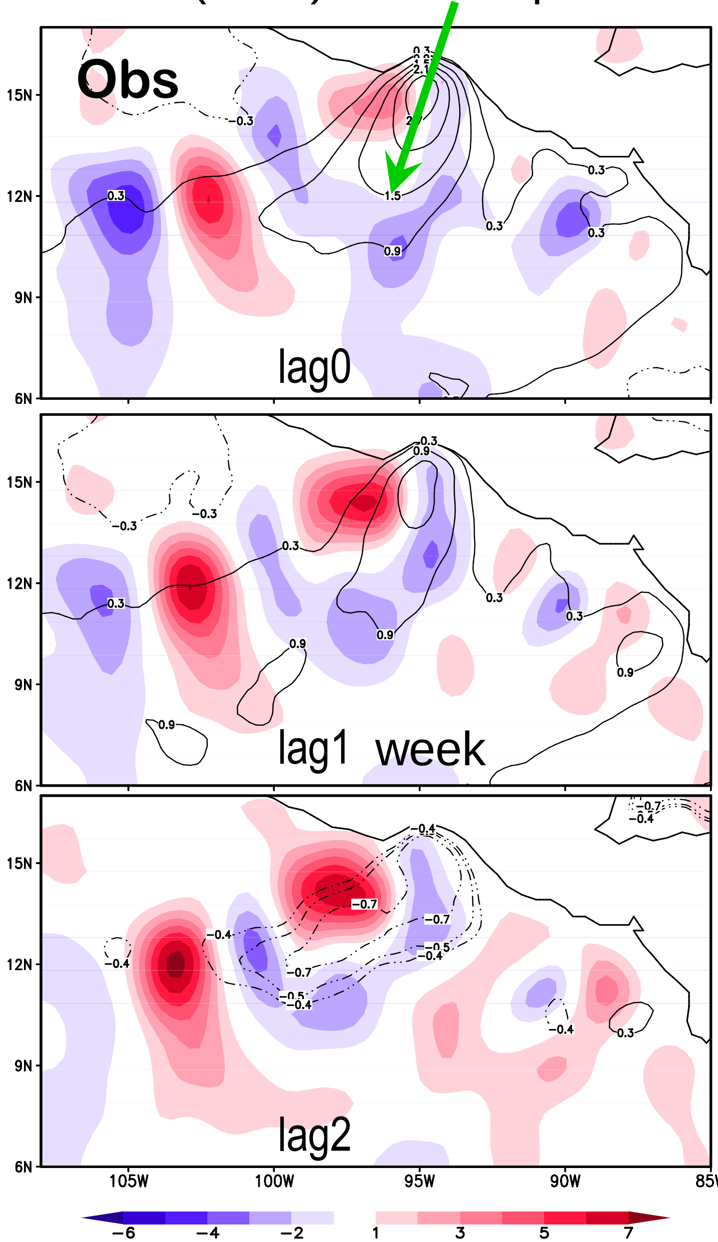
- **Global MJO Index** (provided by Eric Maloney) =: ***1st & 2nd EOF zonal wind*** averaged over ***5ºS-5ºN***
- **SSH** (col) & **(Tx, Ty)** in vector

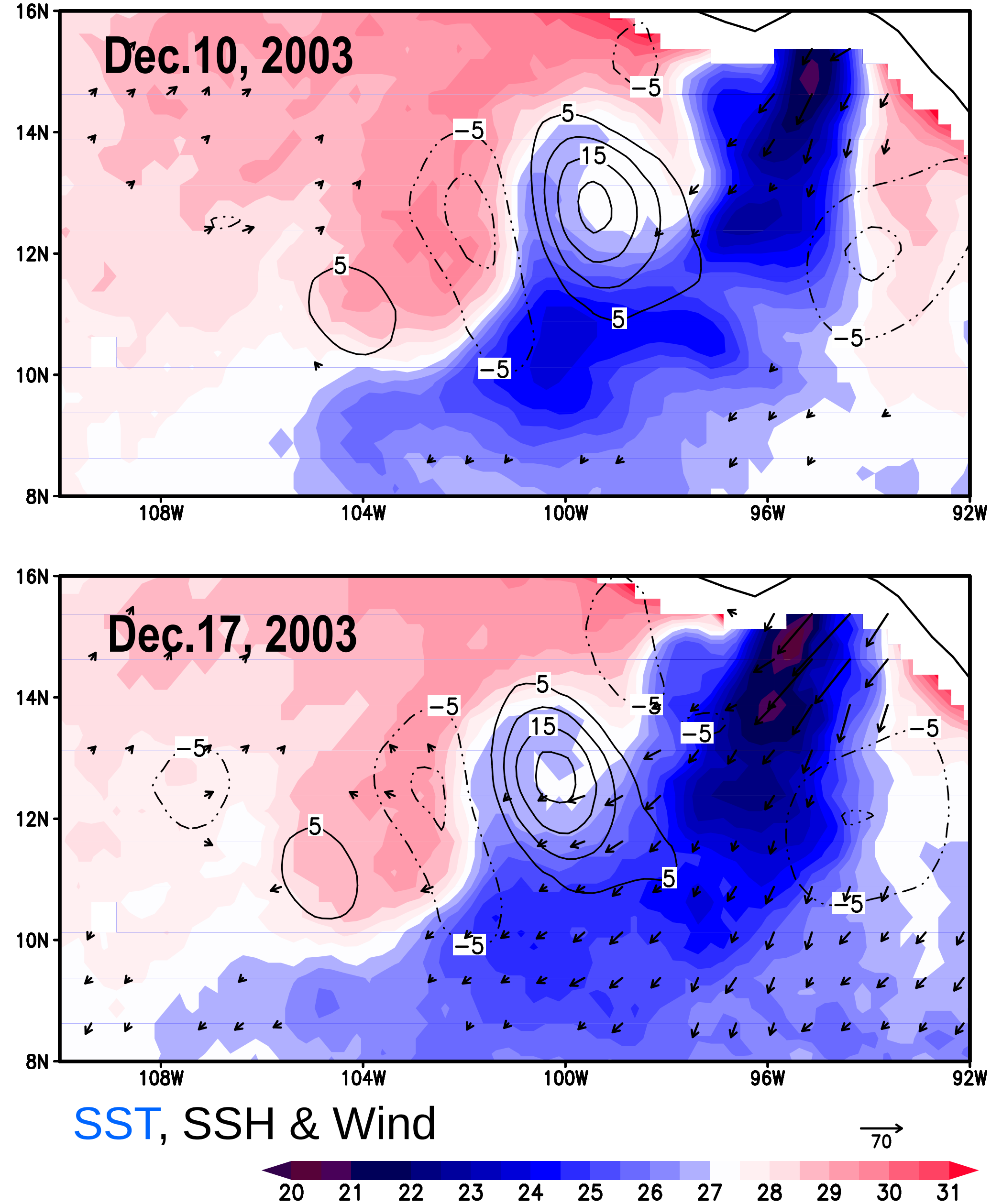
But Tehuantepec eddies are not significantly correlated with equatorial/coastal Kelvin waves.

High-wind composites

SST effect

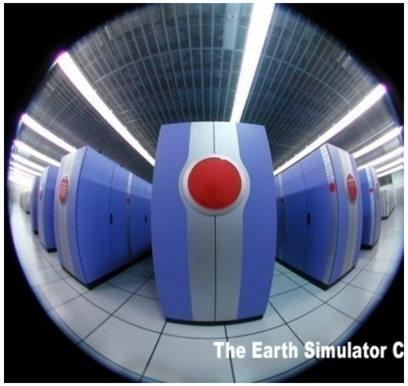
SSH (color) & Wind speed





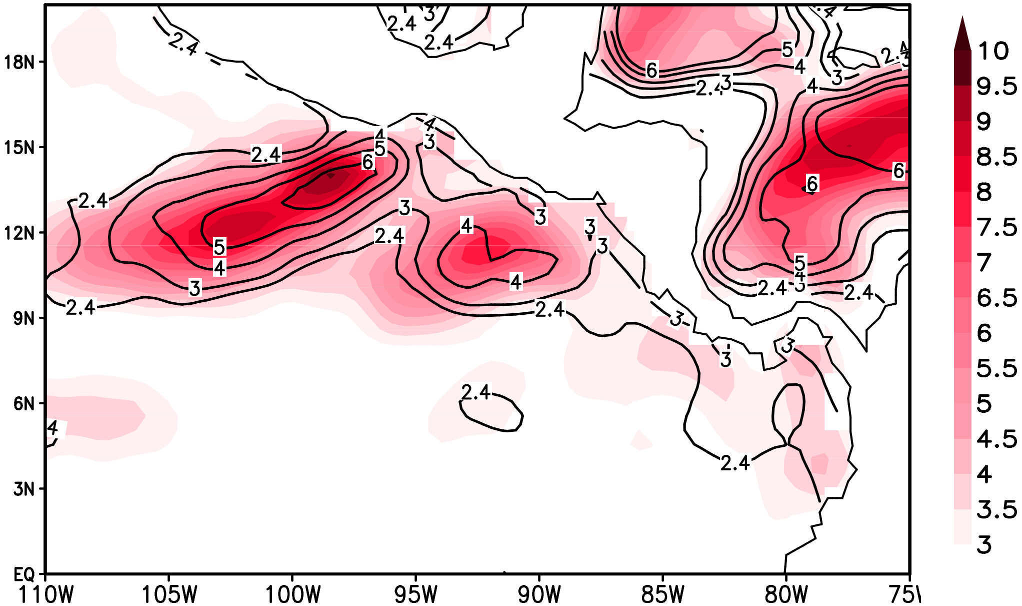
SST, SSH & Wind

Global, eddy-resolving (0.1º) hindcast (OFES) forced by QuikSCAT winds (1999 -)



Obs (color) vs OFES ISV

20-120-day SSHA STD (Nov-Feb)

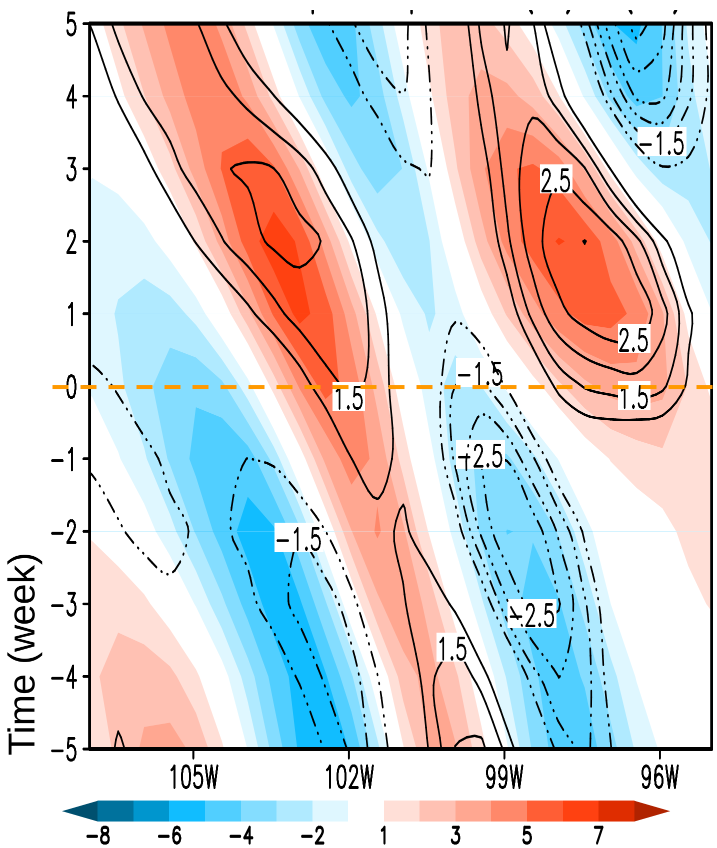


Model underestimates by 50%

← QSCAT: not enough resolution & misses high winds near coast.

High-wind Composite of SSHA

Obs (color) vs model (contour)



High wind

Summary

A synthesis of QuikSCAT, altimetry and high-res ocean model simulation, and a comparative study between the Bay of Bengal and NE Pacific, on the eastern boundaries of major ocean basins.

Bay of Bengal

•Strong MJO-forced equatorial/coastal Kelvin wave, and weak orographic/local wind forcing;

•Baroclinic/barotropic instabilities in the western basin.

NE Pacific warm pool

•Gap wind fluctuations dominate eddy shedding off Tehuantepec, which is further energized by baroclinic/barotropic instabilities;

•MJO-induced equatorial/coastal Kelvin waves are significant but their effect on offshore eddy shedding remains to be quantified.

Cheng, X., S.-P. Xie, J.P. McCreary, Y. Qi, and Y. Du, 2013: Intraseasonal variability of sea surface height in the Bay of Bengal. *J. Geophys. Res.-Oceans*, 118, 816-830, doi:10.1029/jgrc.20075.

Chang, C.-H., S.-P. Xie, N. Schneider, B. Qiu, J. Small, W. Zhuang, B. Taguchi, H. Sasaki, and X. Lin, 2012: East Pacific ocean eddies and their relationship to subseasonal variability in Central American wind jets. *J. Geophys. Res.-Oceans*., 117, C10001, doi:10.1029/2011JC007315.

Summary

- SSH ISV has large amplitudes along the eastern and northern coasts of the BoB in the western BoB, and in a zonal band along 5^oN.

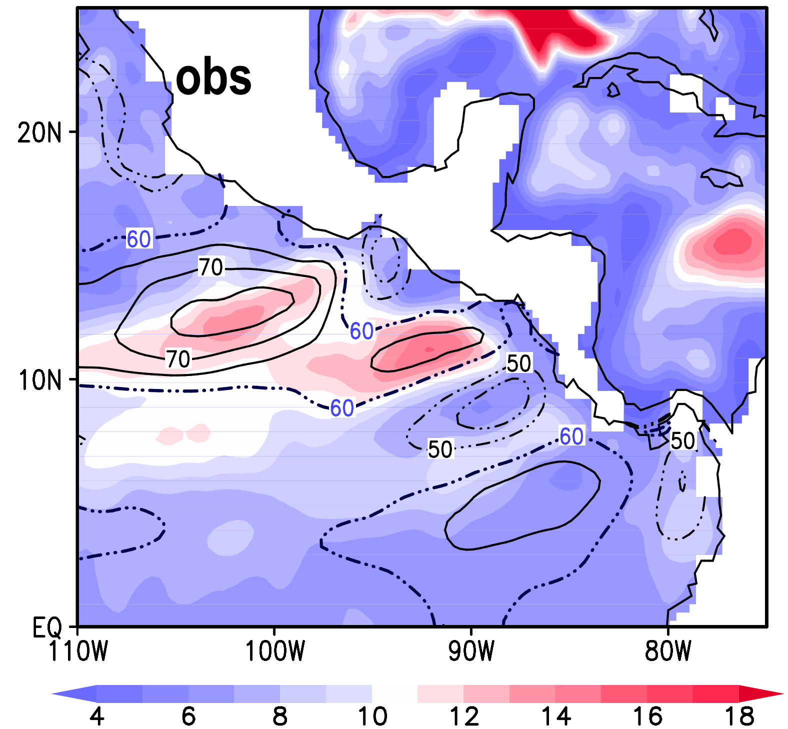
- SSH ISV along the coastal of BoB is caused by the trapped Kelvin waves which is triggered by equatorial MJO winds.

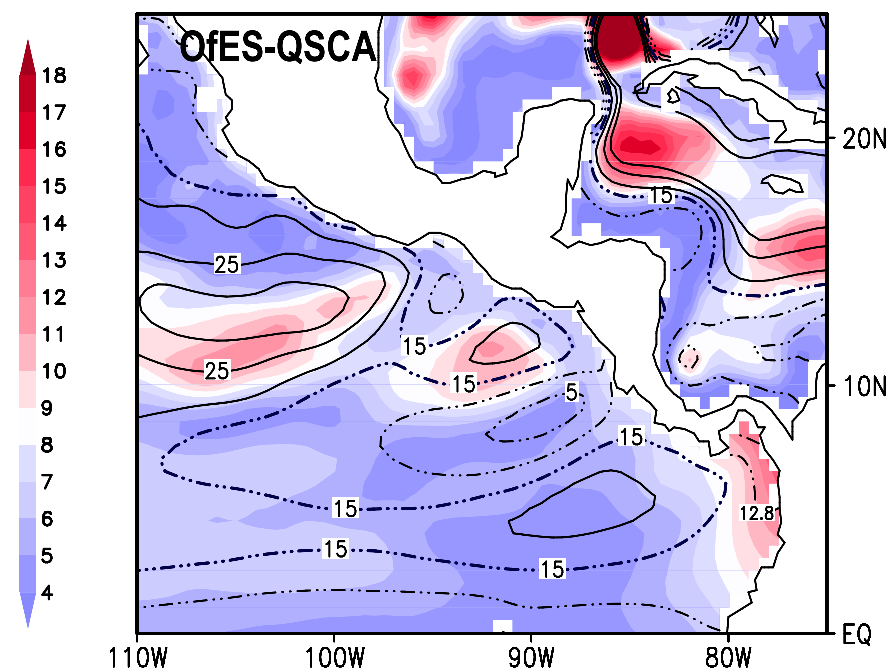
- High variance in the northwest BoB is related to the eddy activity and instabilities of the mean current.

Winter *SSH:*

Mean (contour) & STD (shade)

- QSCAT run captures high-variance bands but underestimate amplitudes (σ~20 vs. 14 cm)
- NCEP run fails to simulate patterns both in the mean and variance.





Presentation Outline

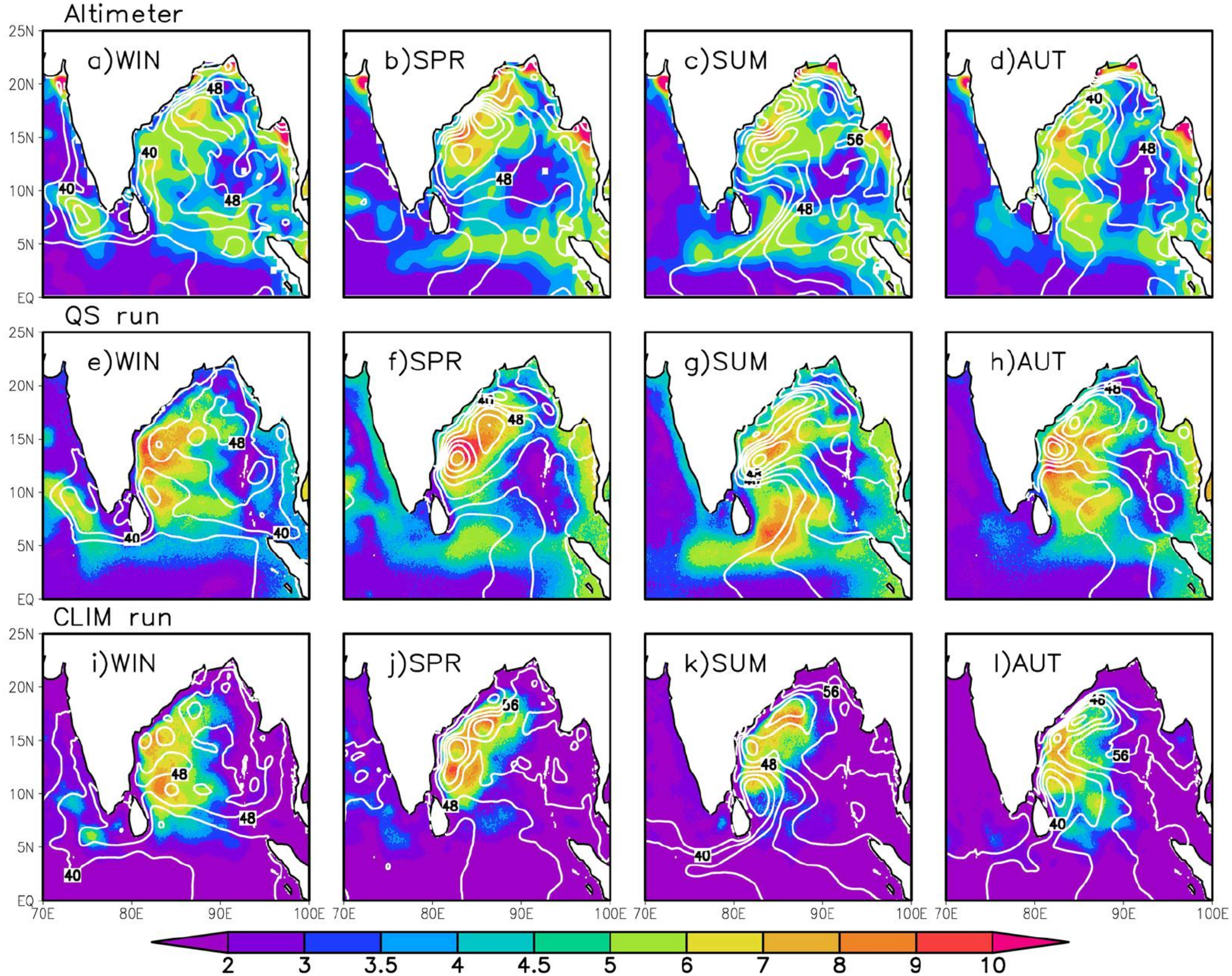
Introduction

Data and method

Results

Summary

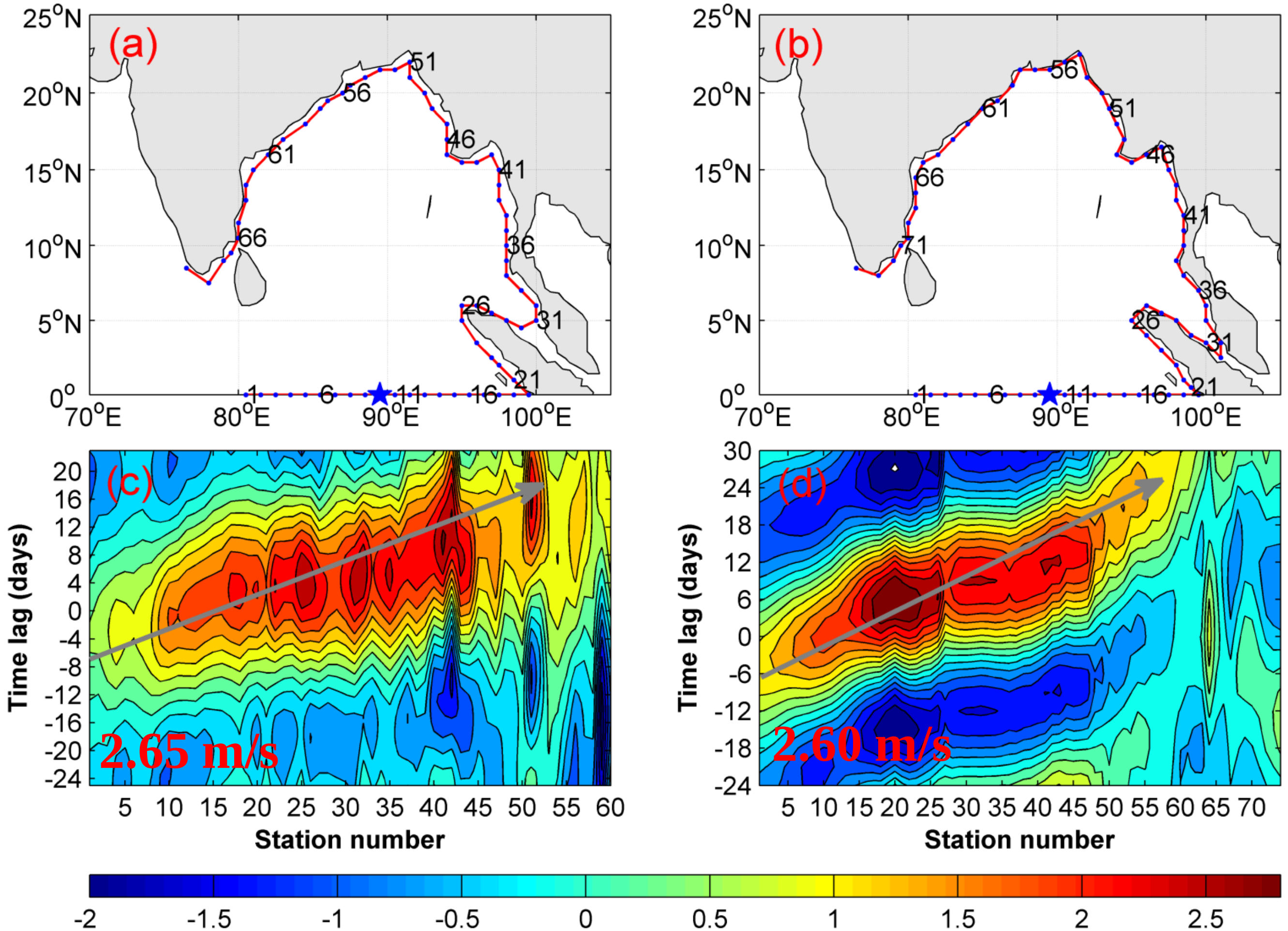
Features of intraseasonal SSH variability



ISV for winter, spring, summer and autumn

Origin of ISV along the coastal of BoB

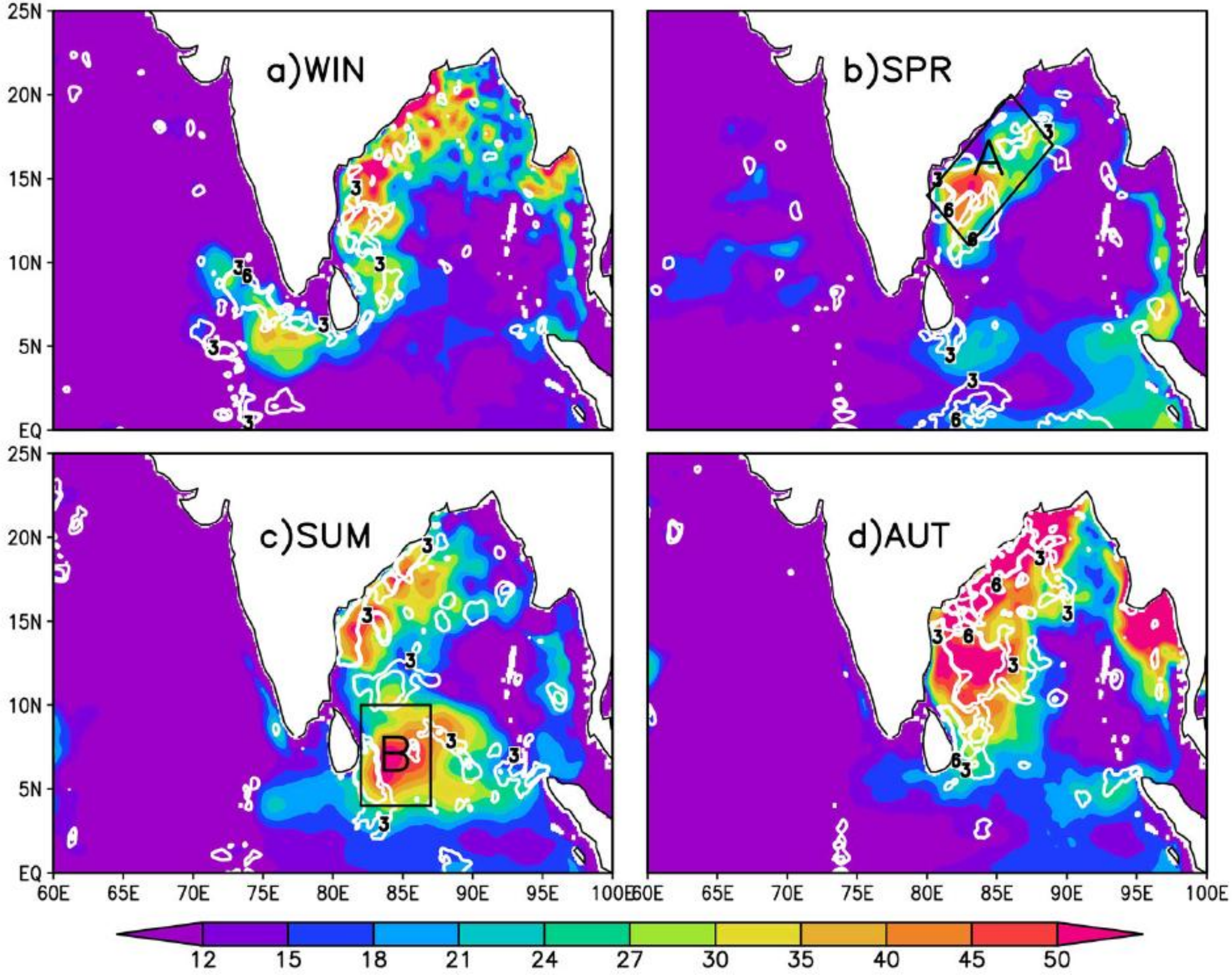
Kelvin wave propagation along the wave guides



Altimetric result

QS run result

Origin of ISV in the northwestern BoB Instability of mean current



Seasonal mean vertical integrated TEE (EKE+EPE, $\times 10^6$ cm^3/s^2) and the sum of T2 and T4 (cm^3/s^3, white contours).