

Modeling China Sea Circulation: Kuroshio-Seas transport

J. Gan

Collaborators: A. Cheung, Z. Liu and L. Liang



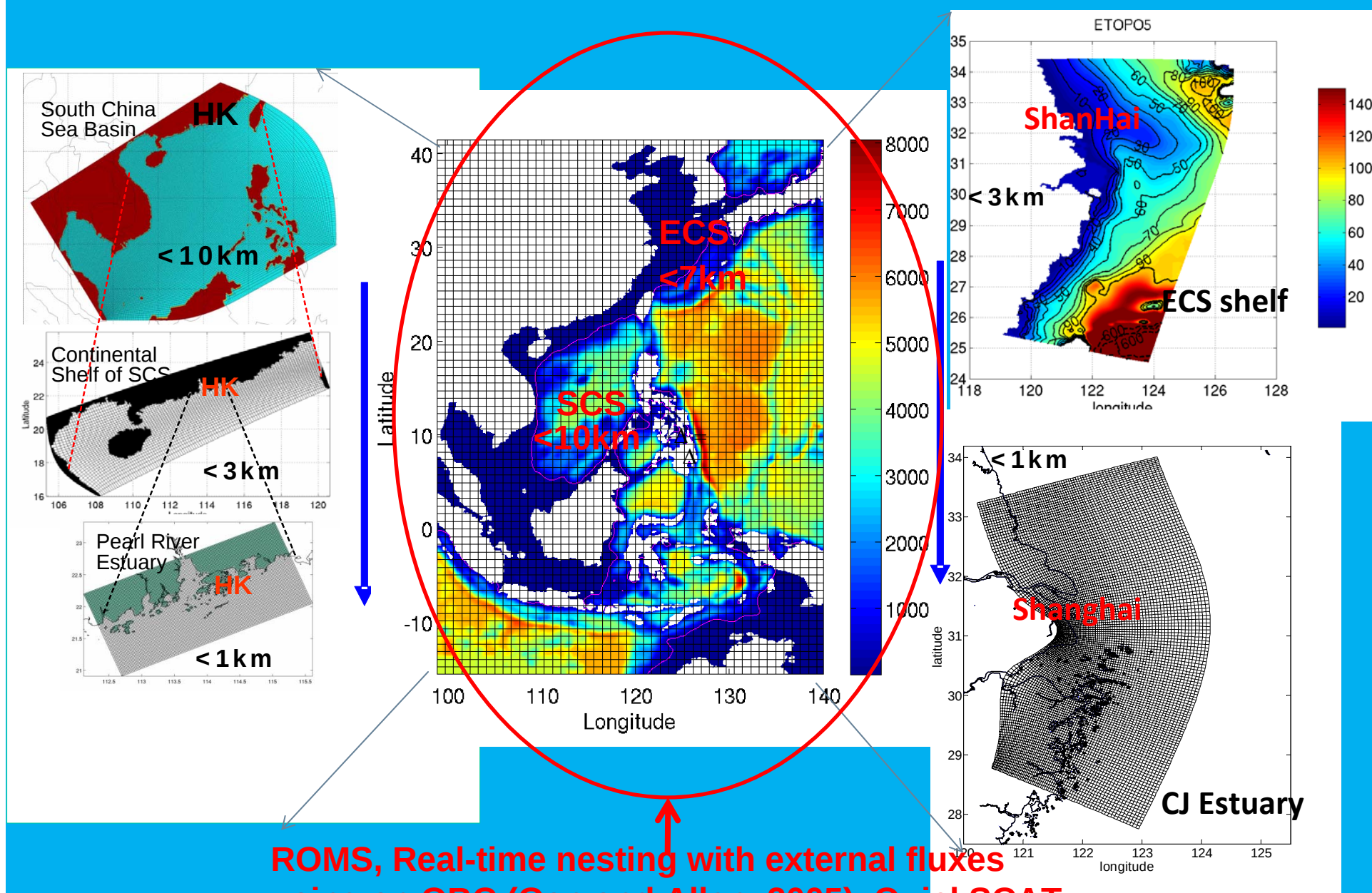
香港科技大學
THE HONG KONG
UNIVERSITY OF SCIENCE
AND TECHNOLOGY



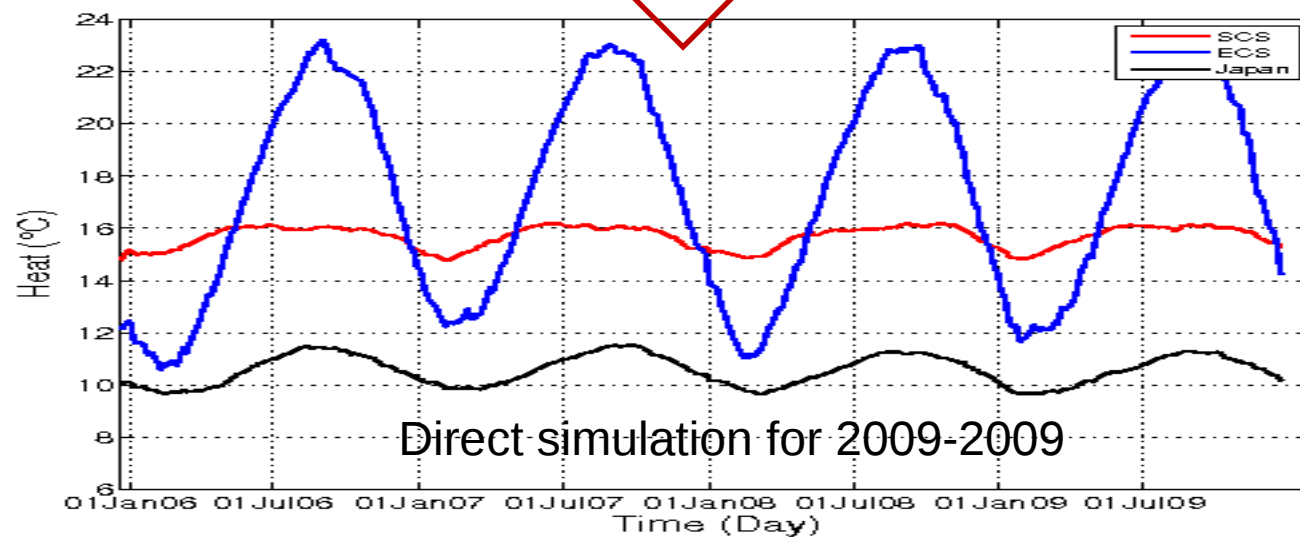
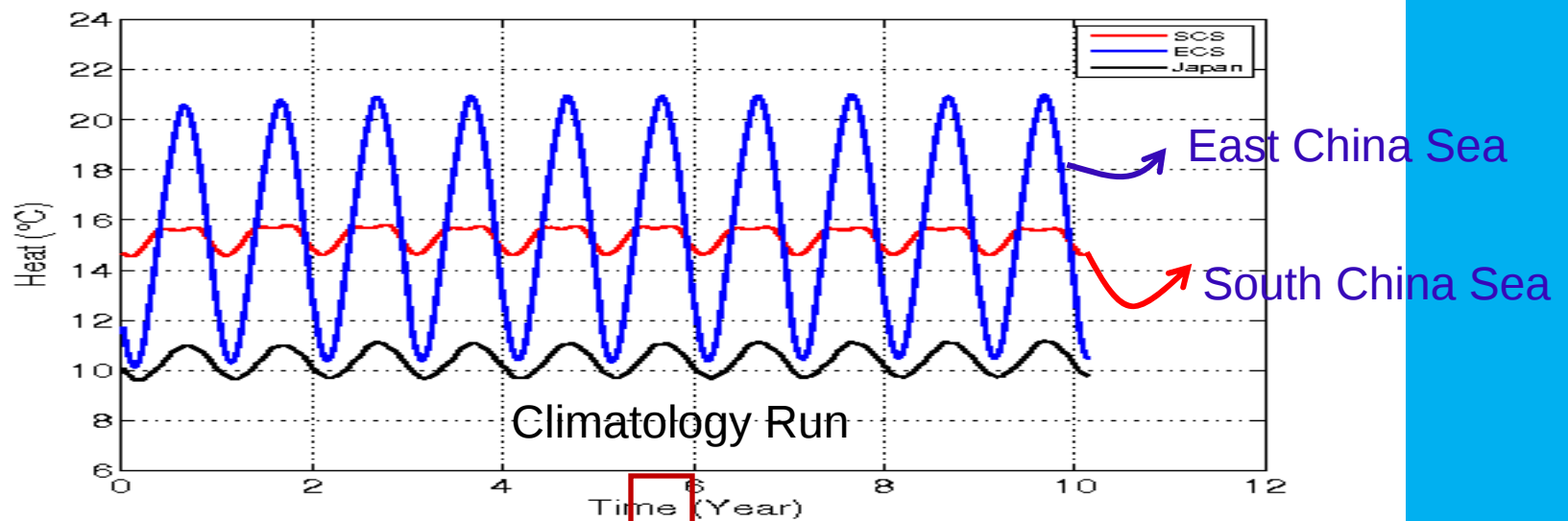
Outline:

- General circulation and model-observation comparisons in CS
- Kuroshio-East China Sea Transport
- Discussion

HKUST China Sea Multi-Scale Modeling System



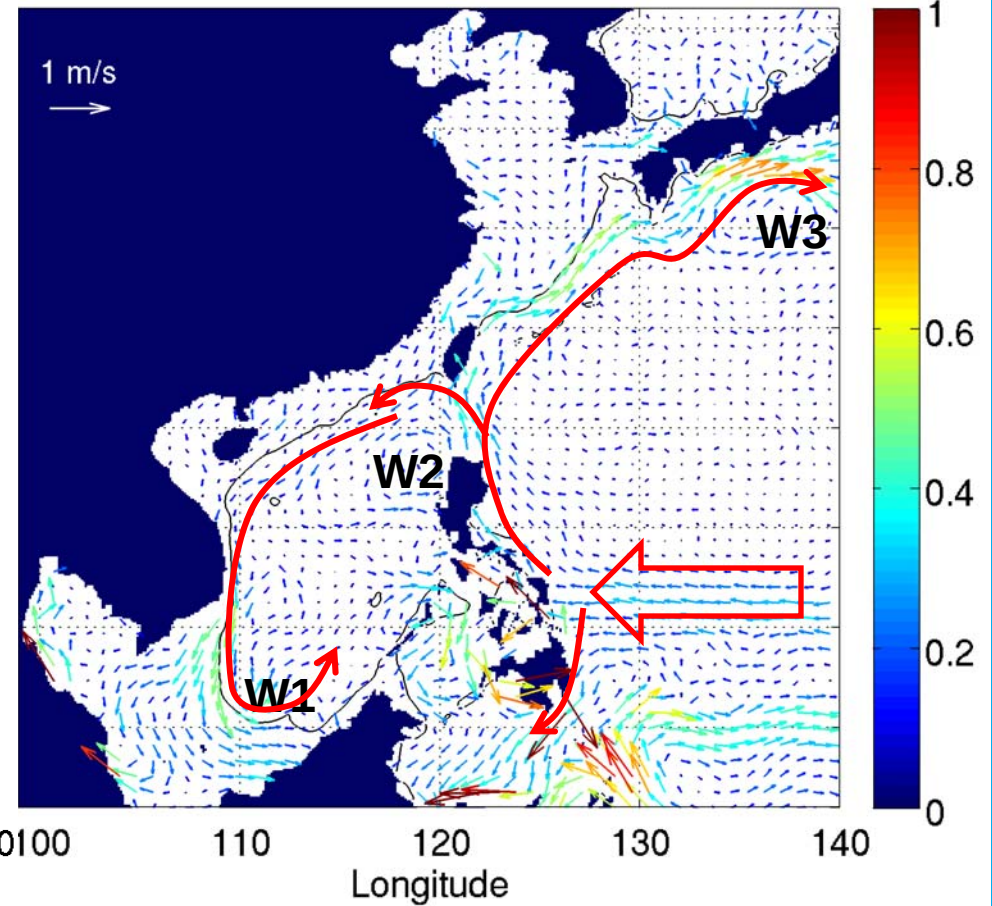
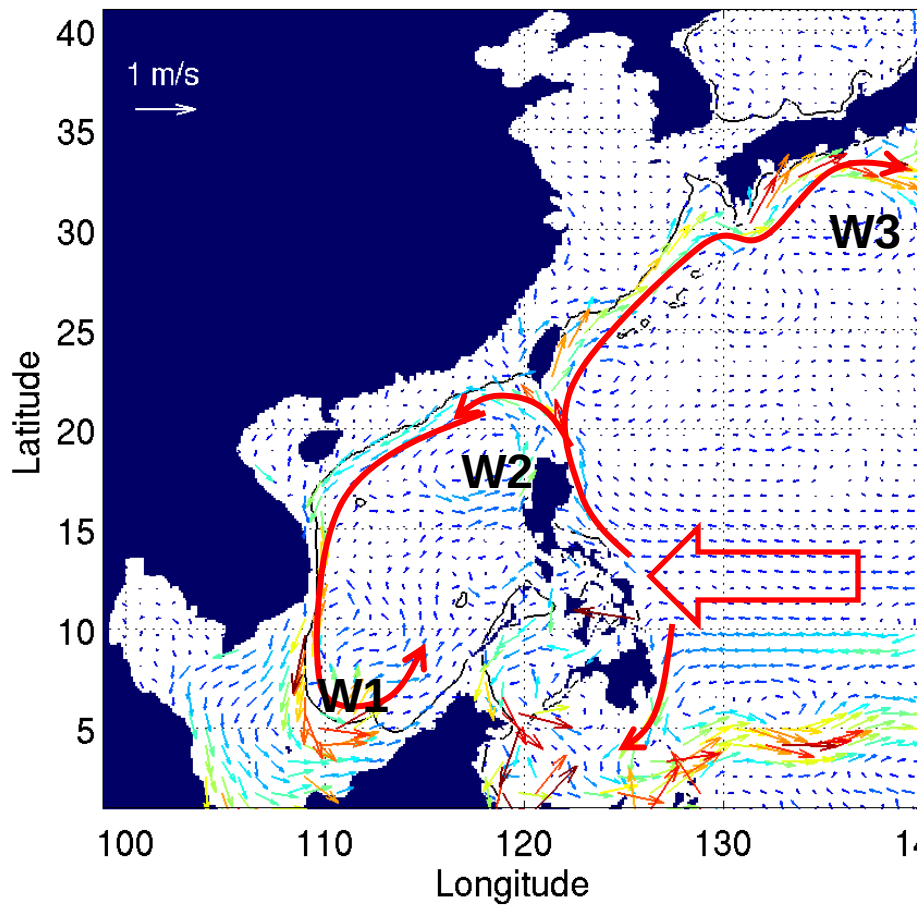
ROMS, Real-time nesting with external fluxes using an OBC (Gan and Allen, 2005), QuickSCAT wind and NCEP atmosphere fluxes



Winter (2007-2009)
Surface geostrophic velocity

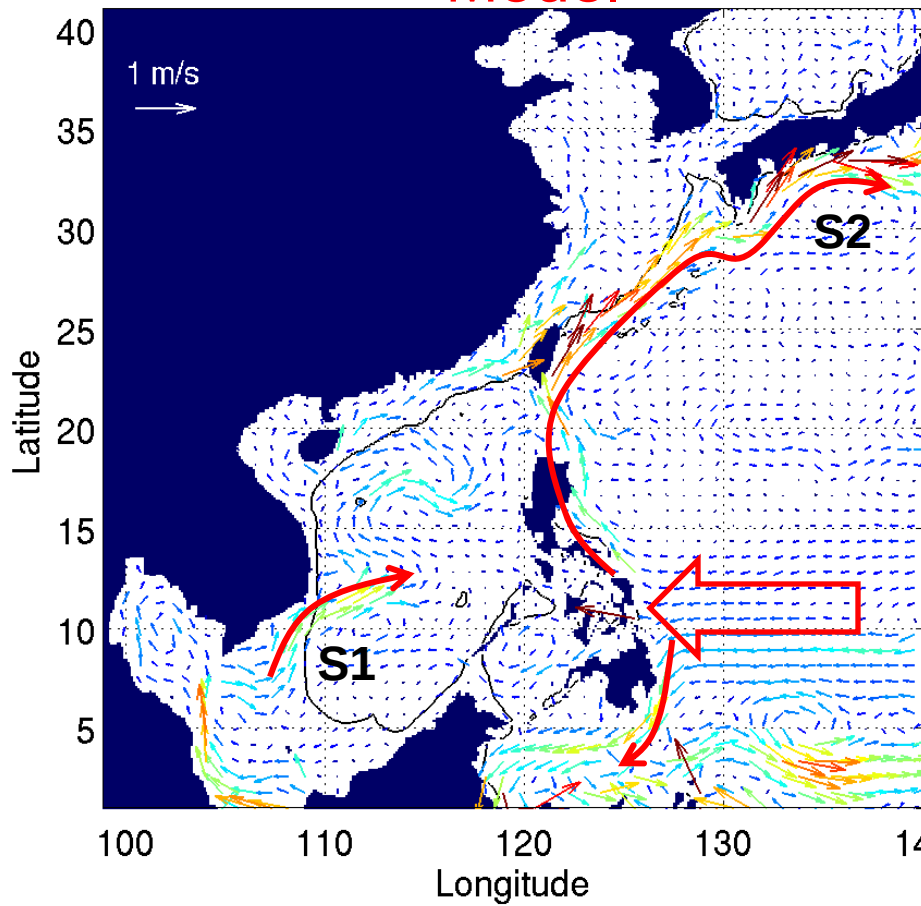
Model

Observation

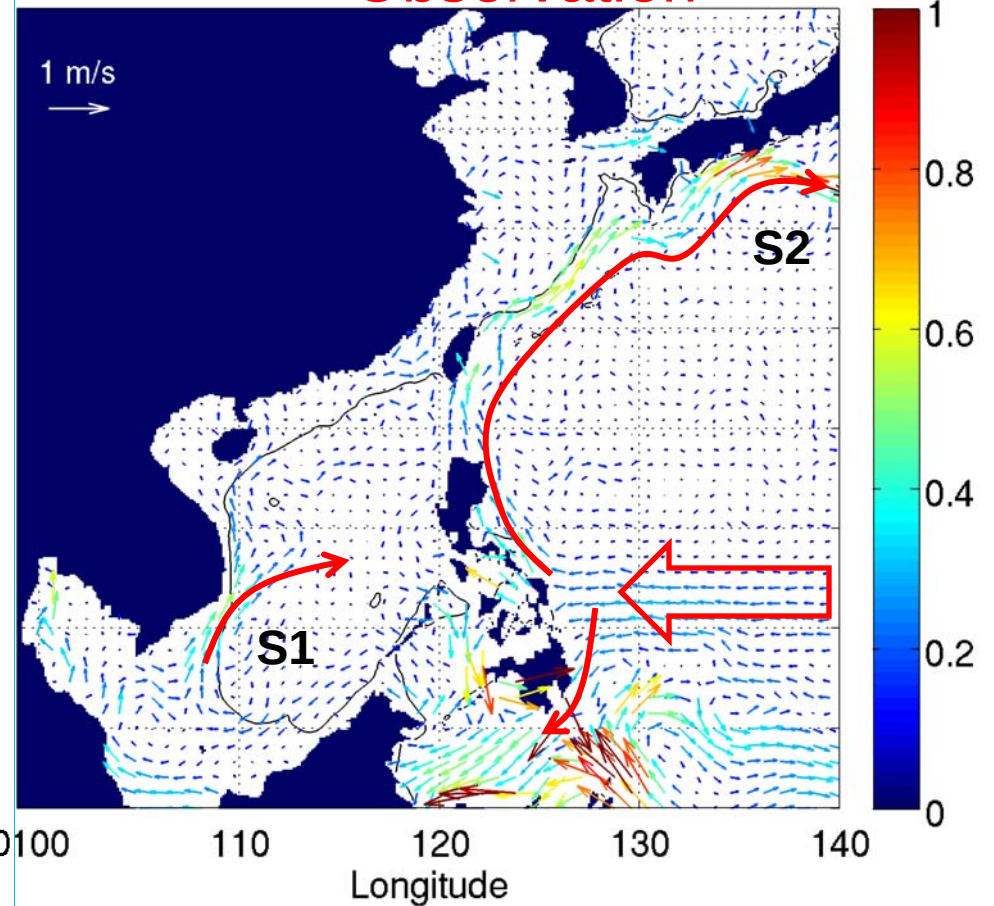


Summer (2007-2009)
Surface geostrophic velocity

Model



Observation

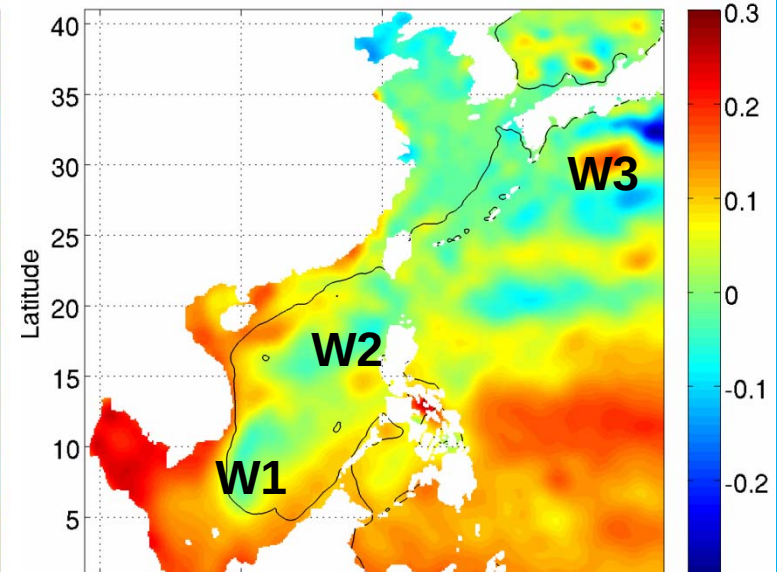
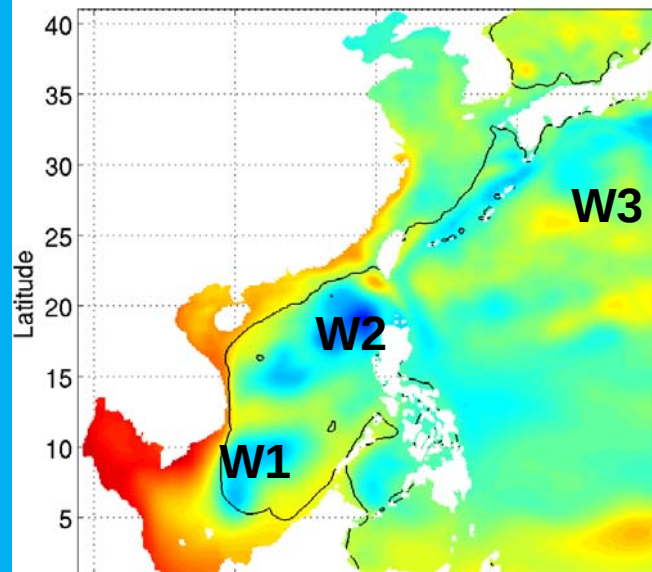


Modeled

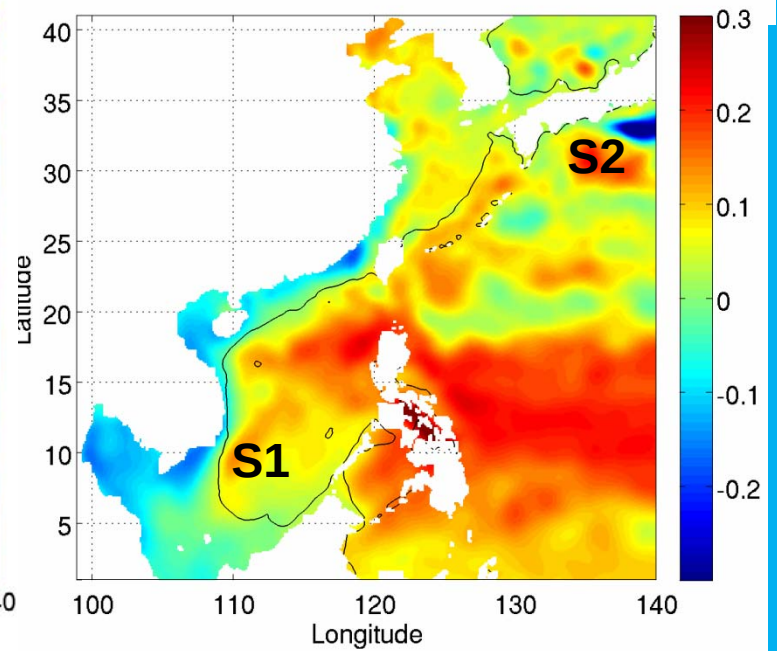
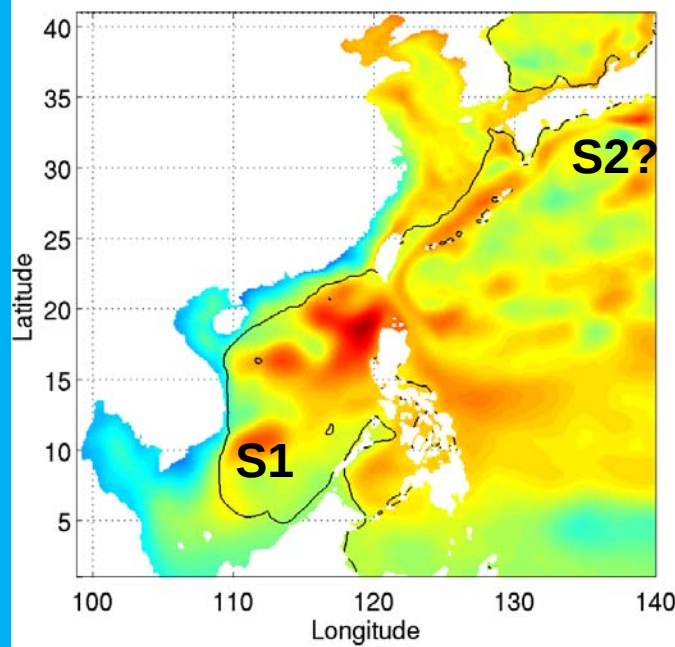
Observation

winter

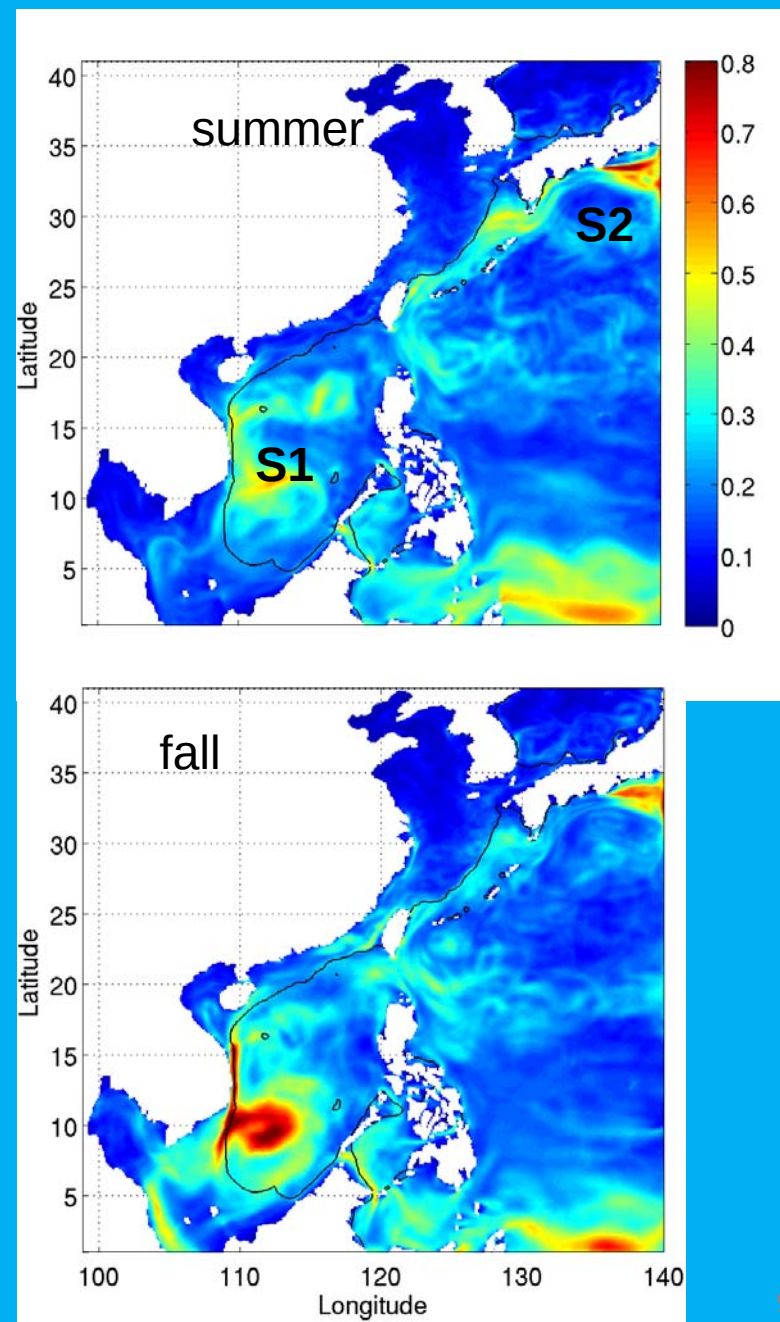
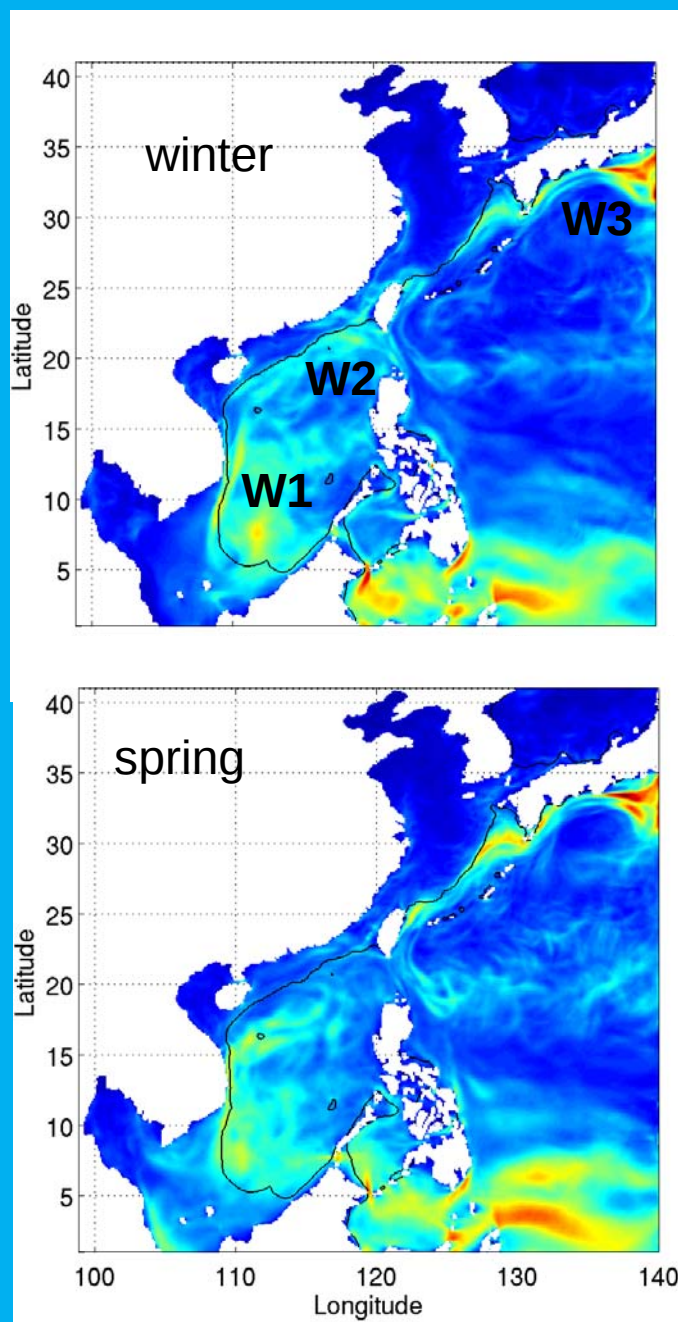
(2007-2009)

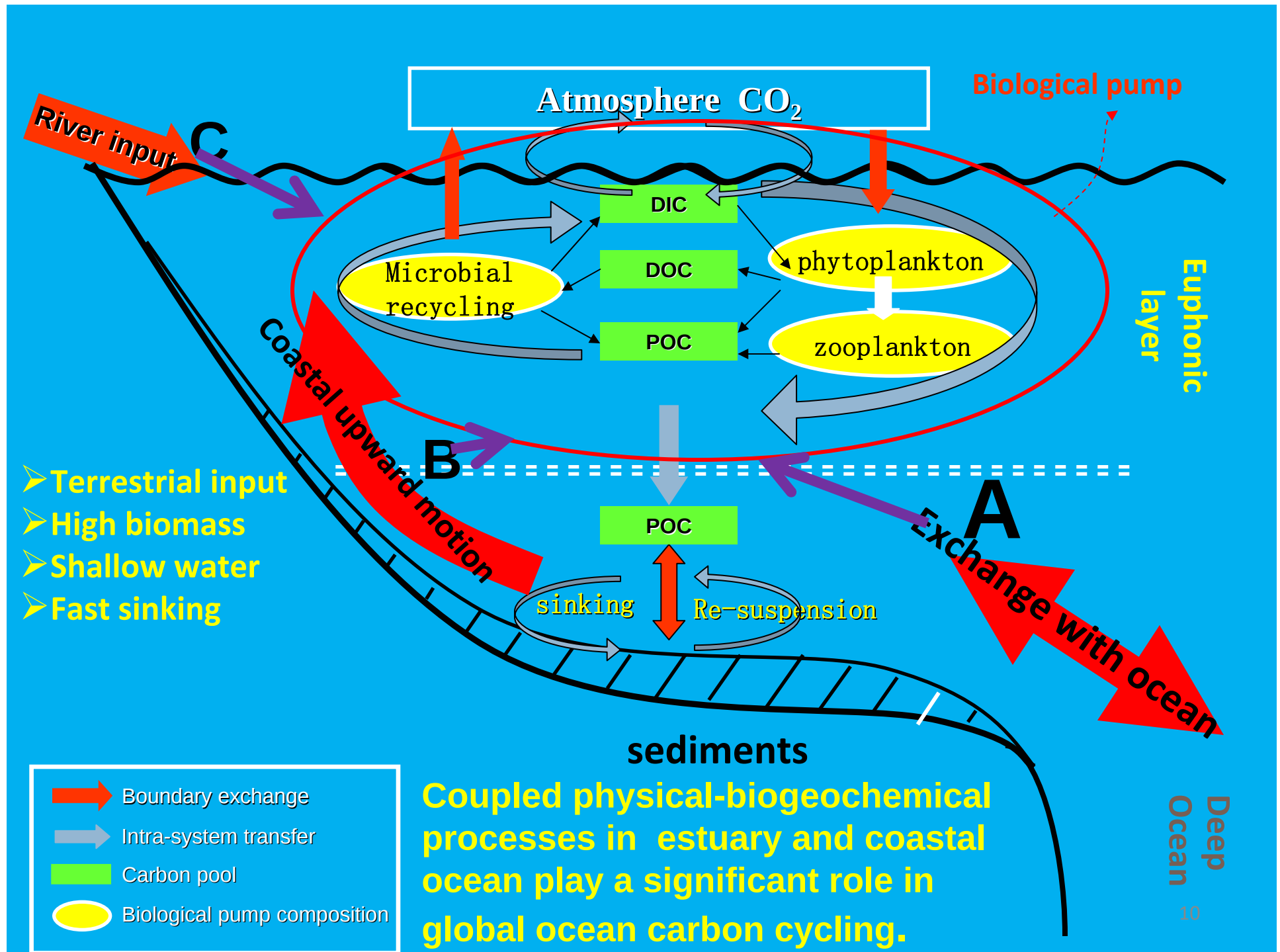


summer

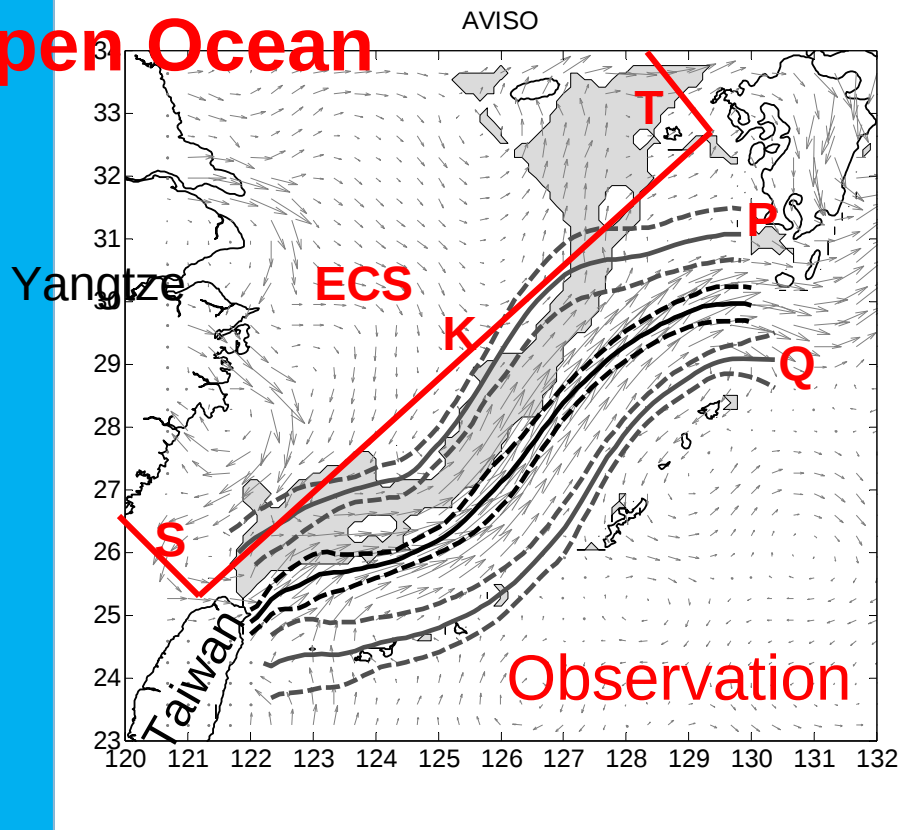
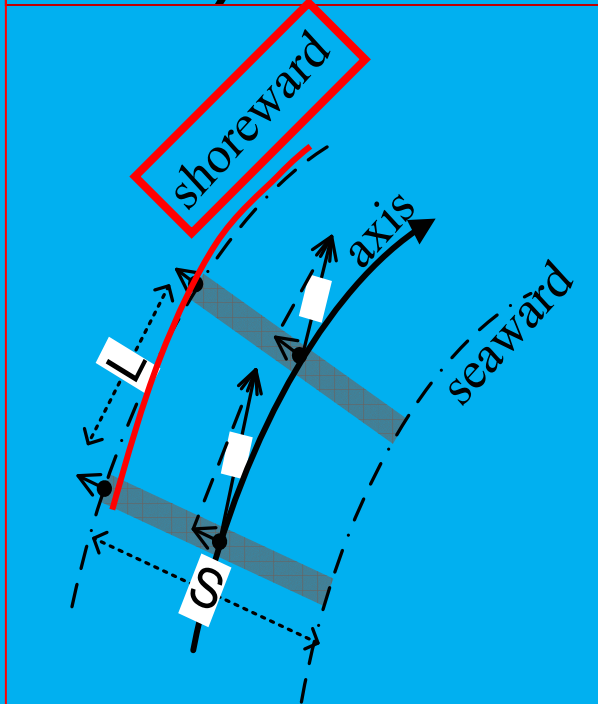
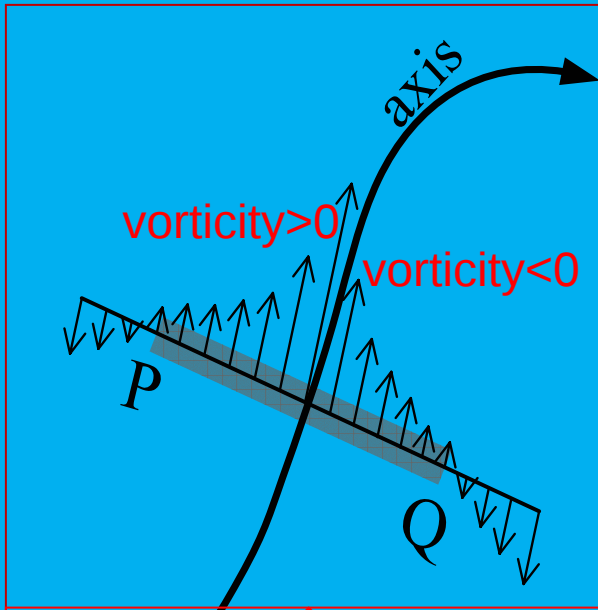


Modeled total velocity sd

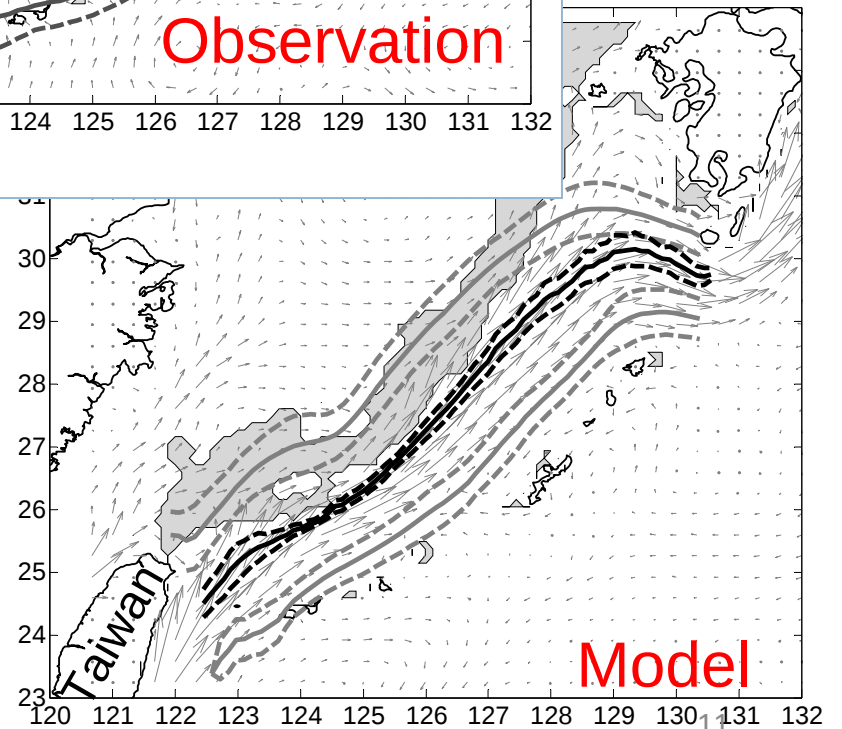




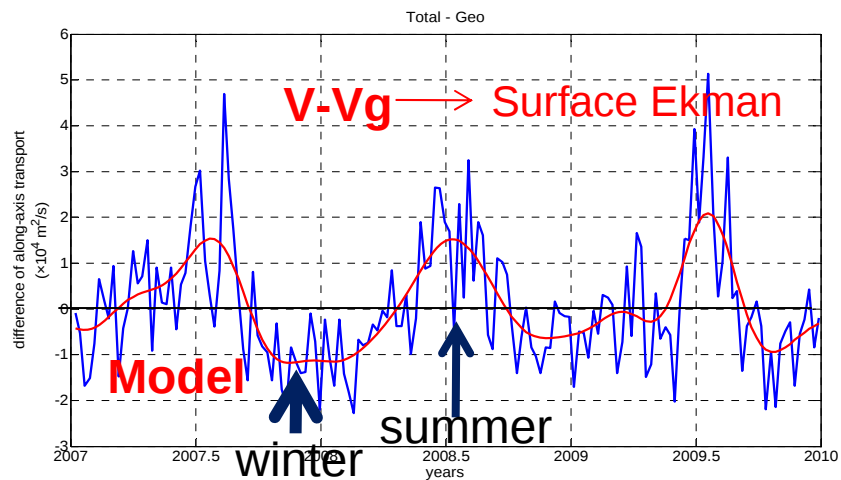
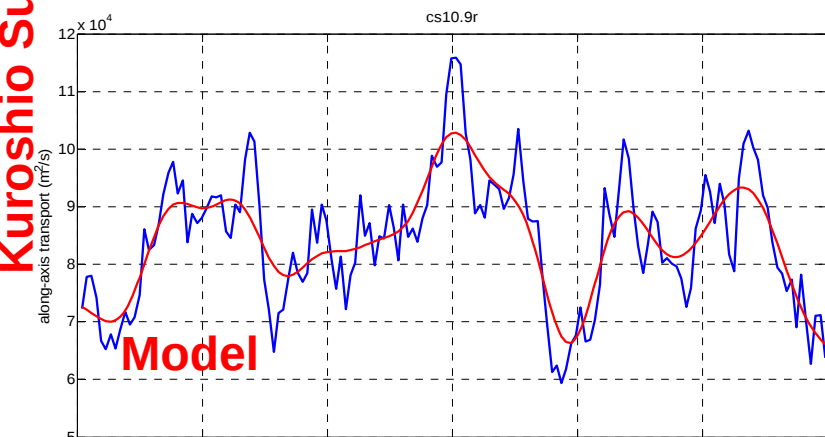
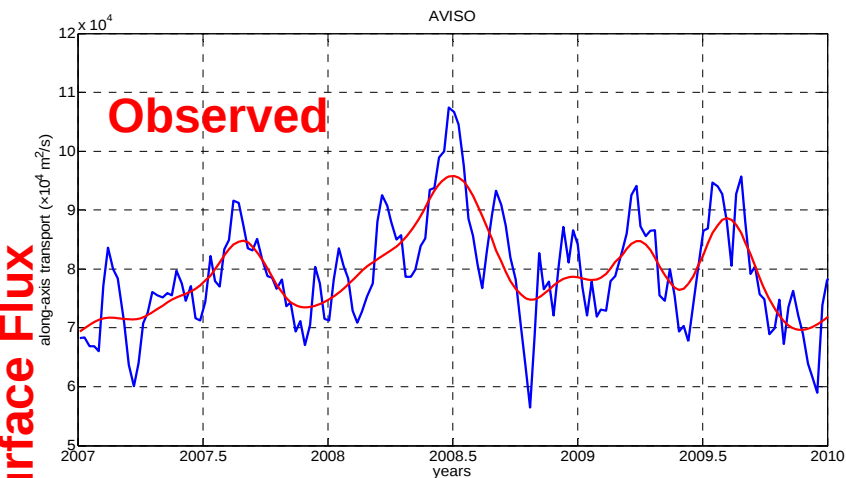
A: Exchange with Open Ocean



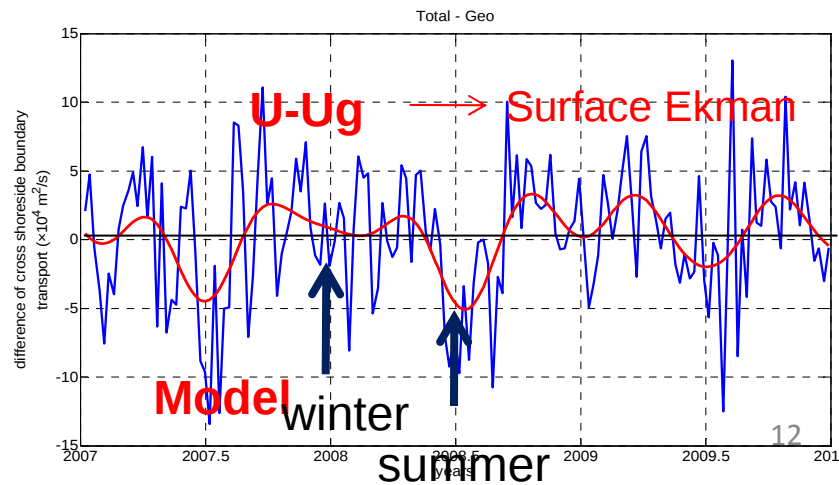
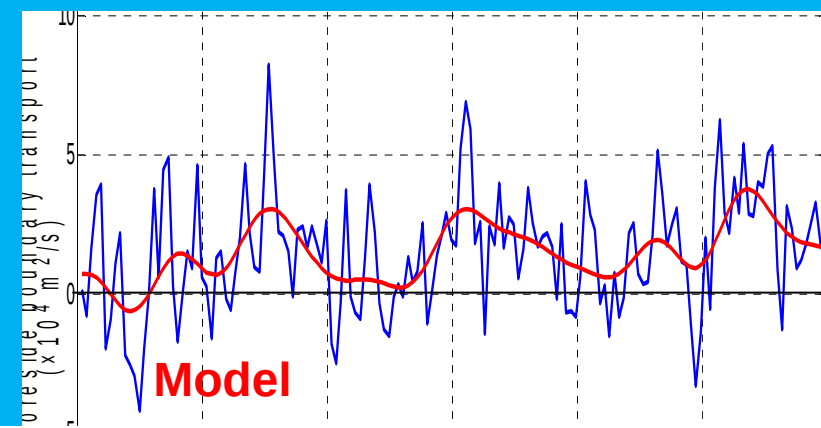
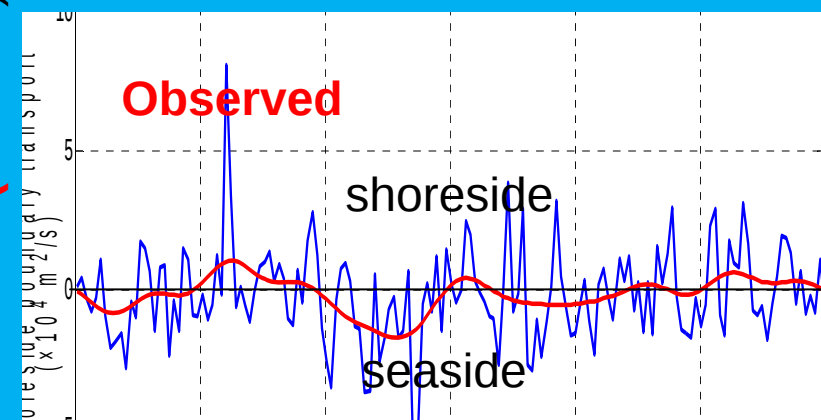
2007-2009
average

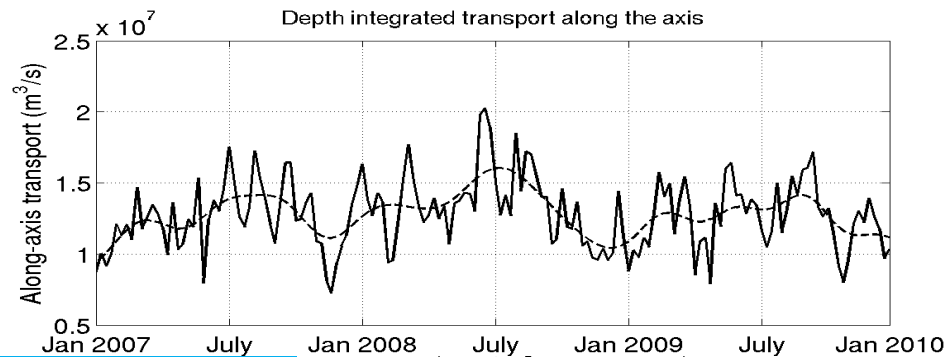


Kuroshio Surface Flux

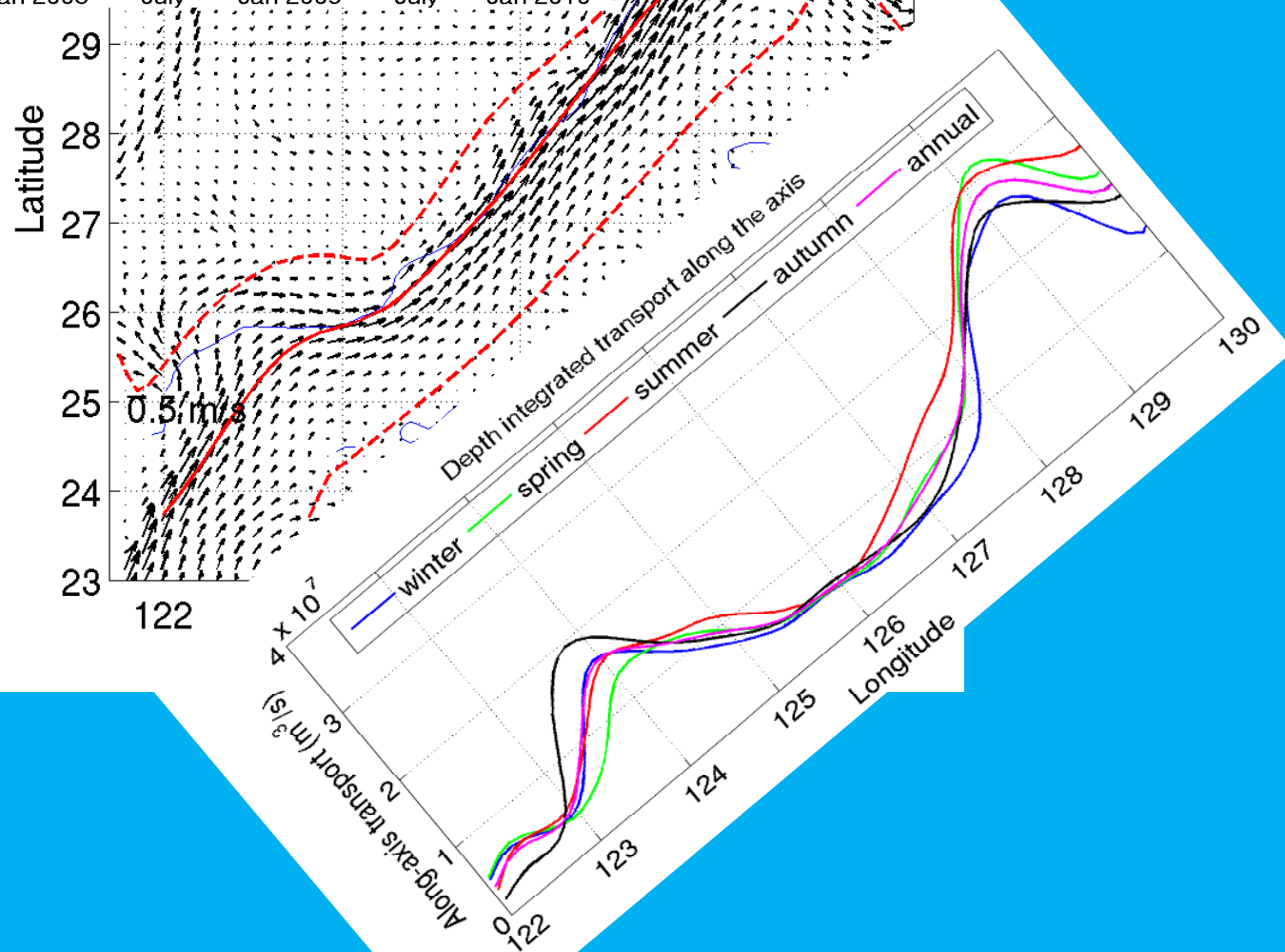


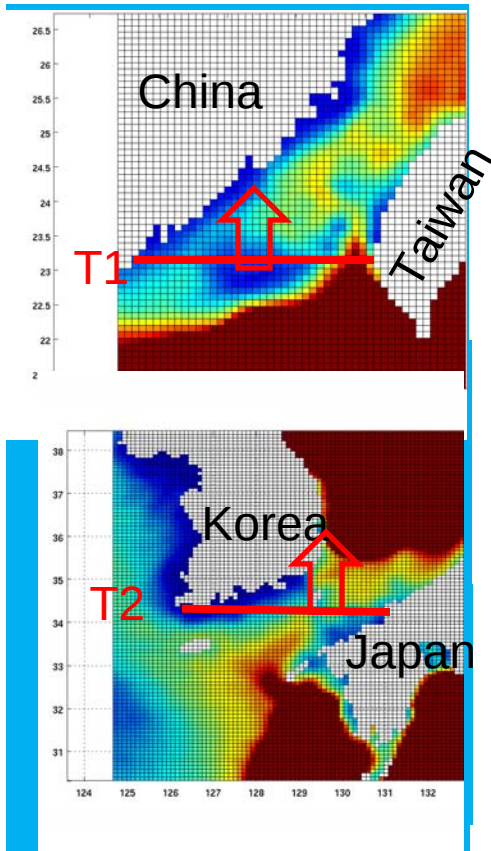
Kuroshio Shoreward Intrusion (Surface)



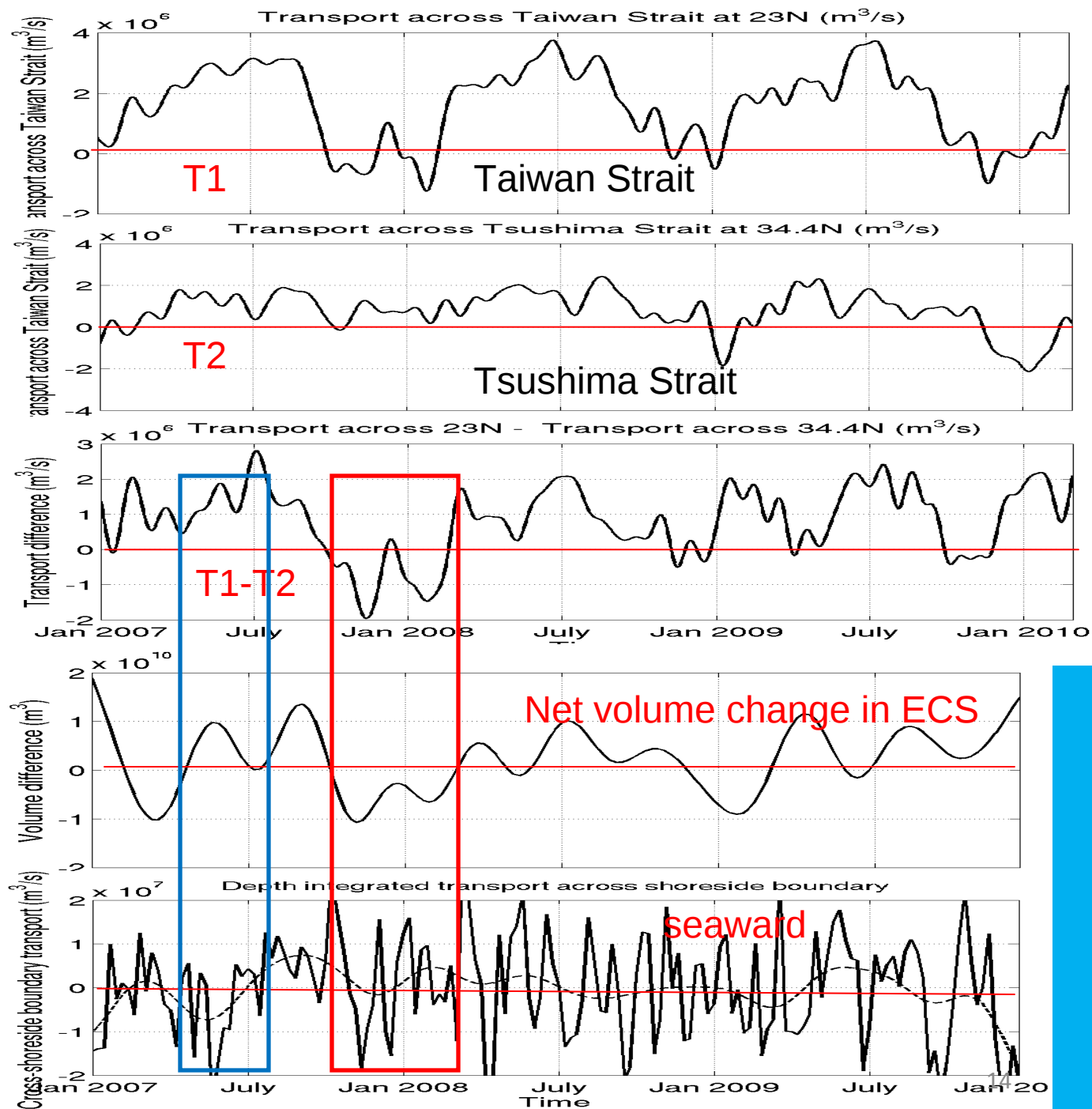


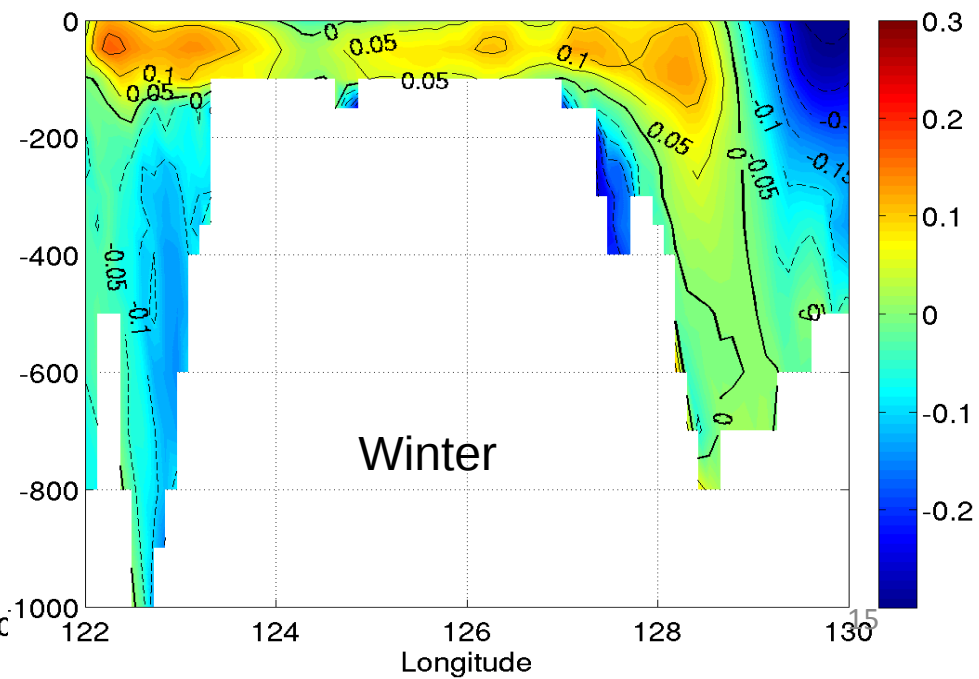
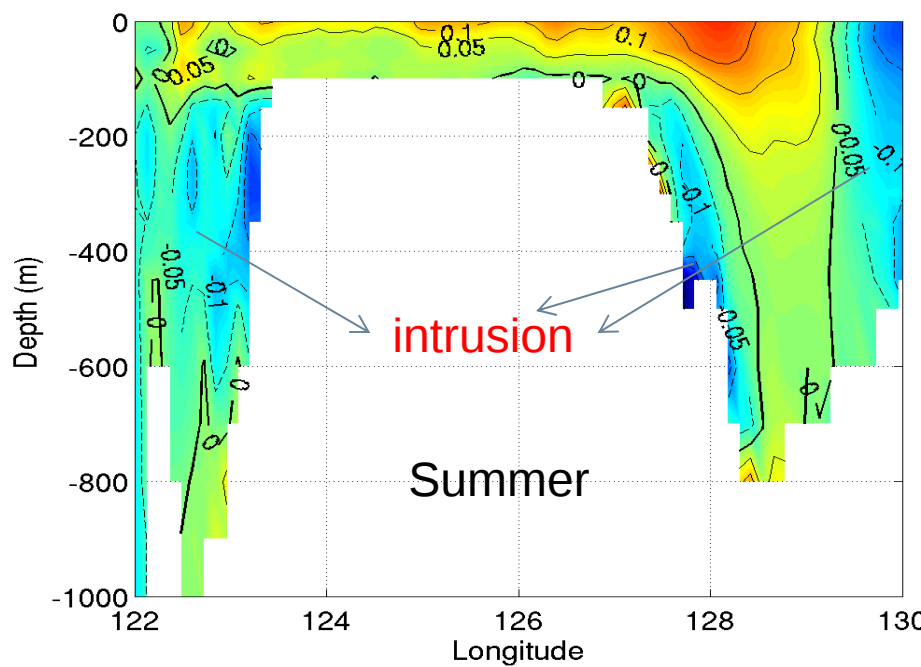
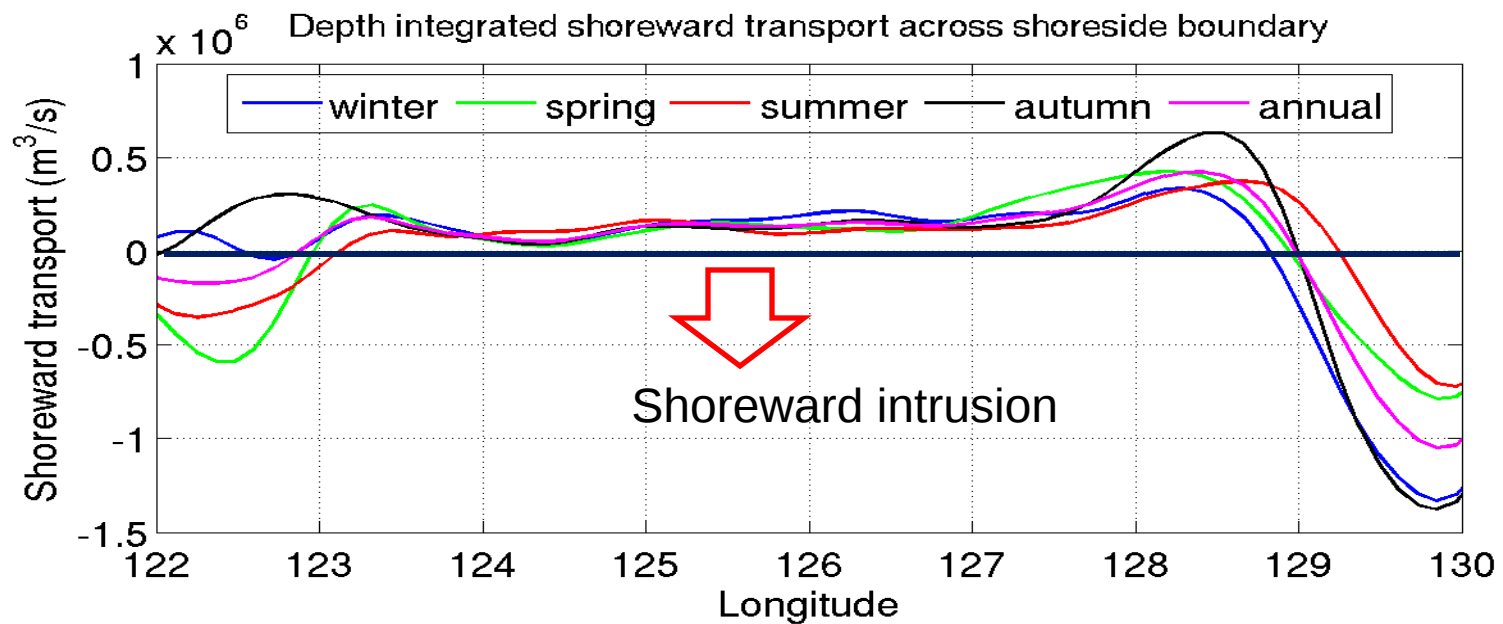
erature ($^{\circ}\text{C}$)

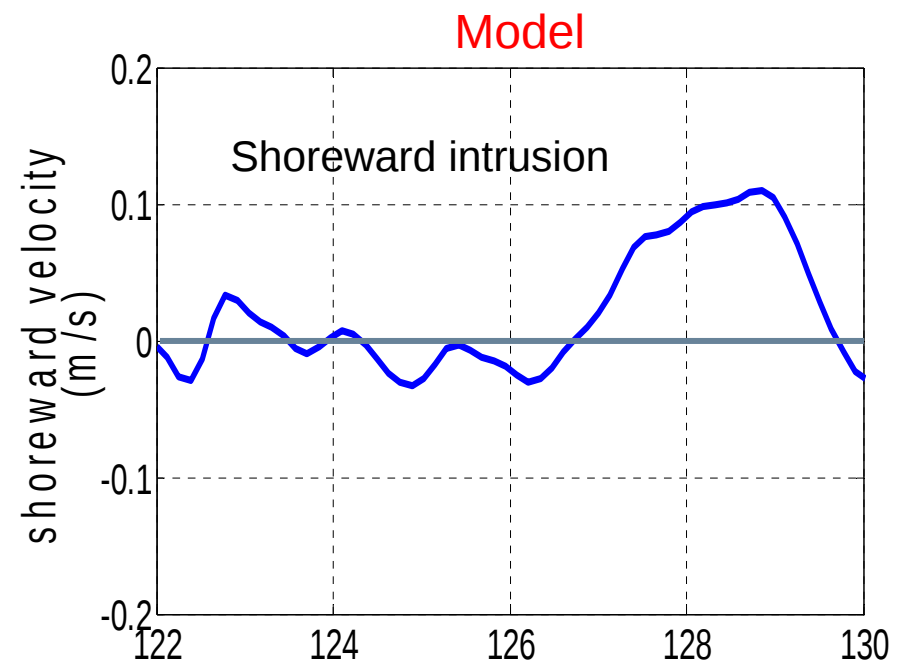
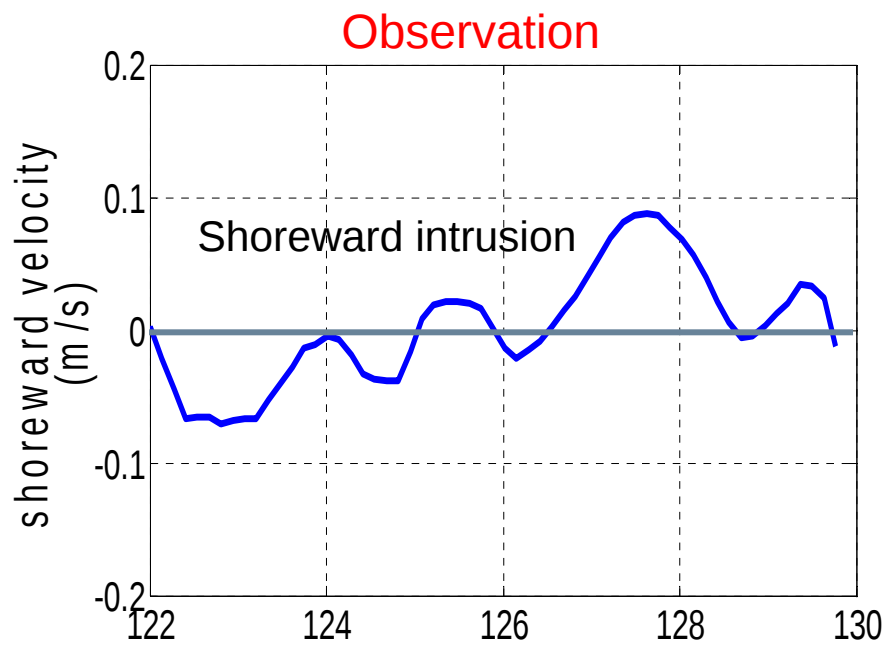


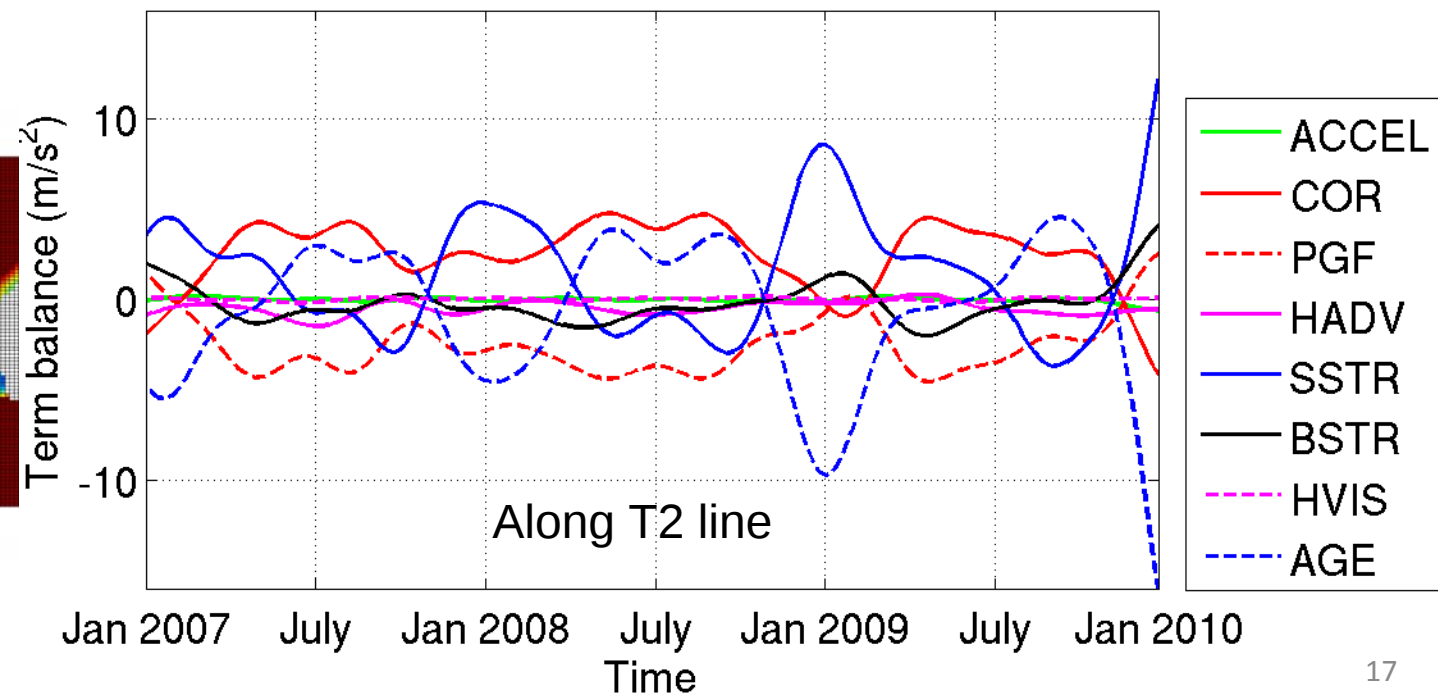
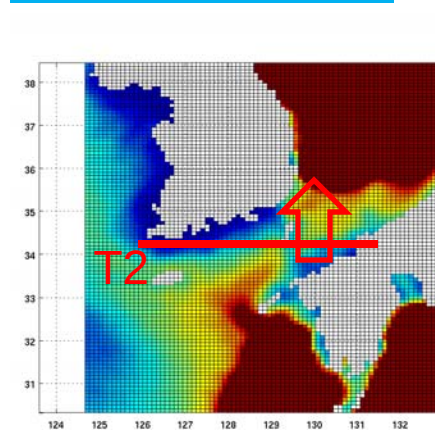
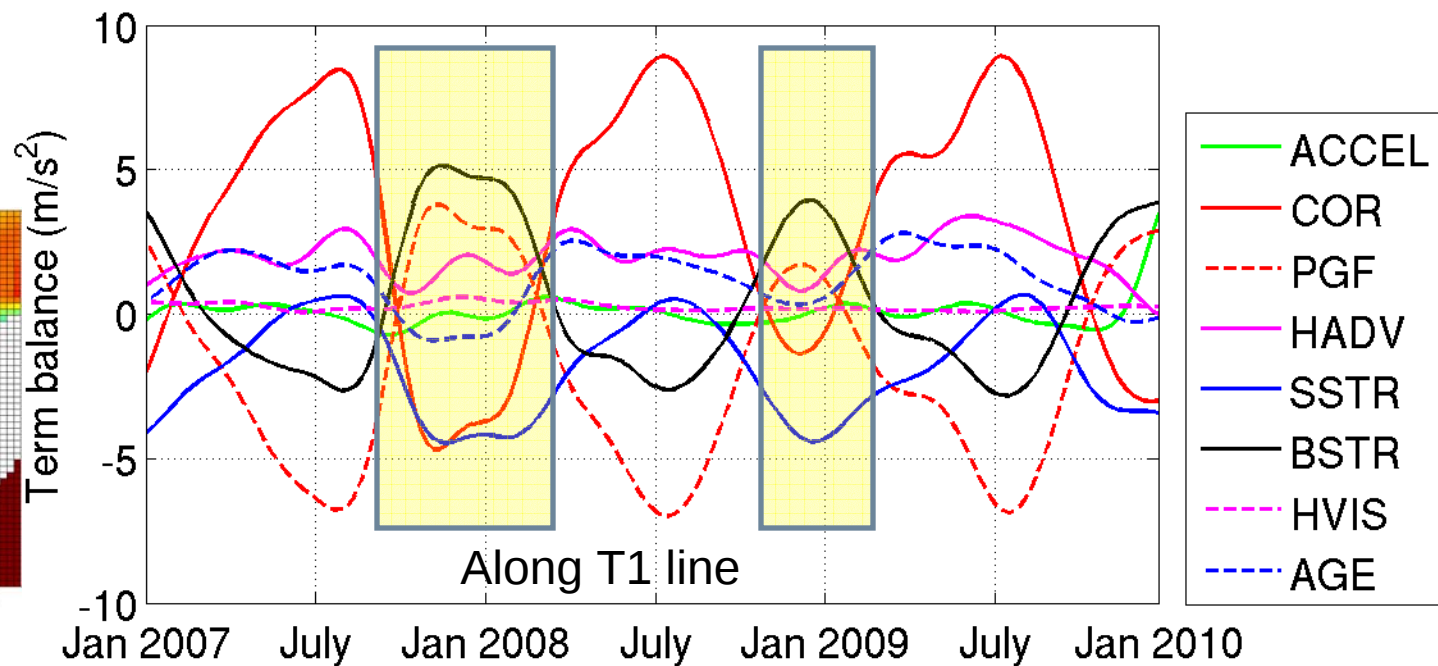
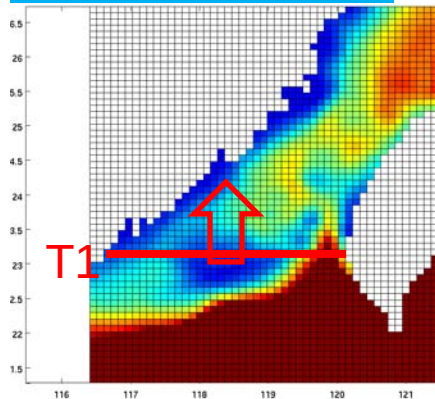
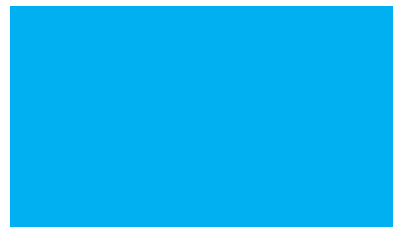


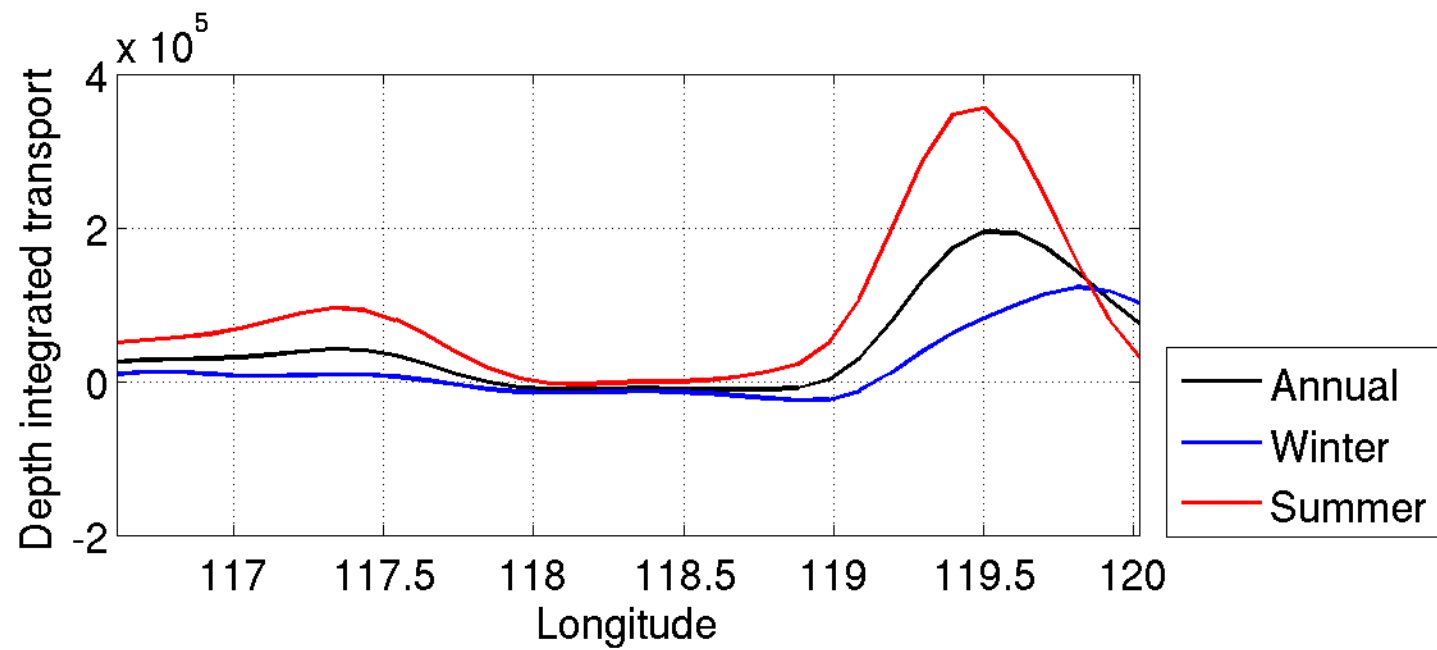
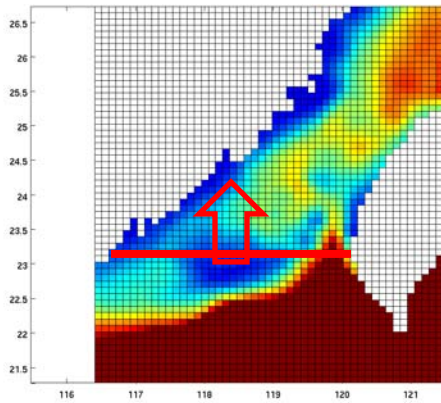
Intrusion of Kuroshio









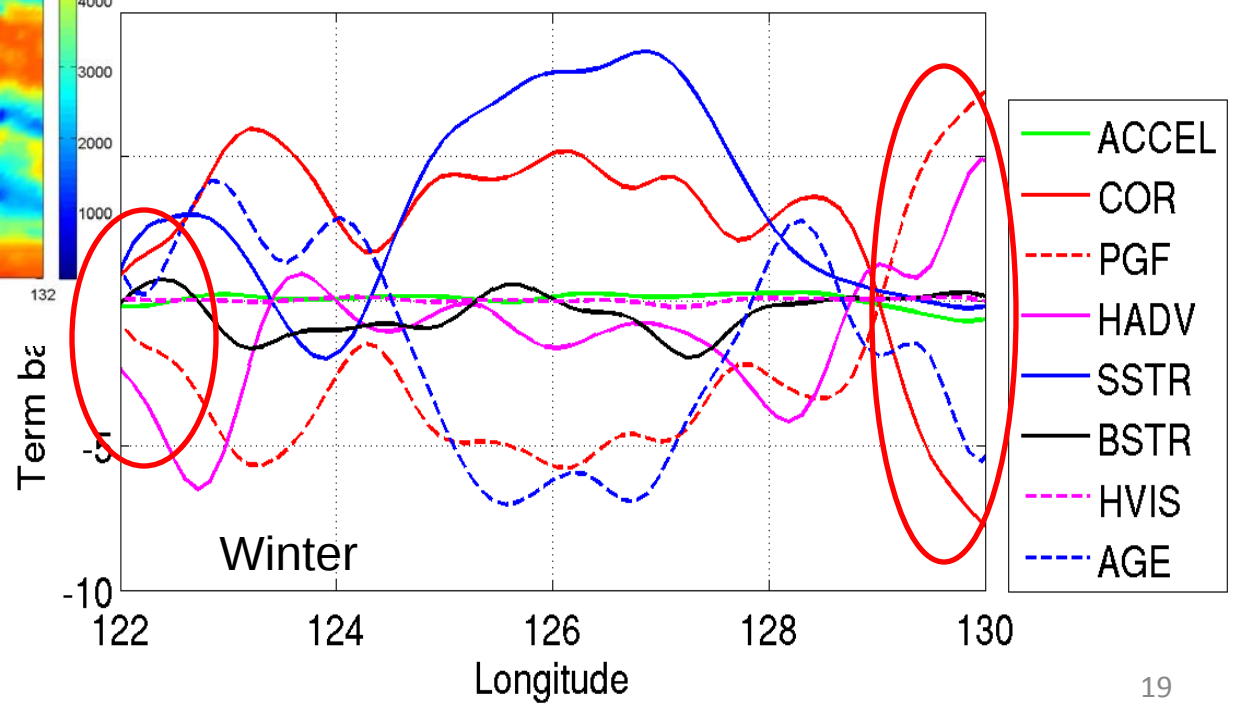
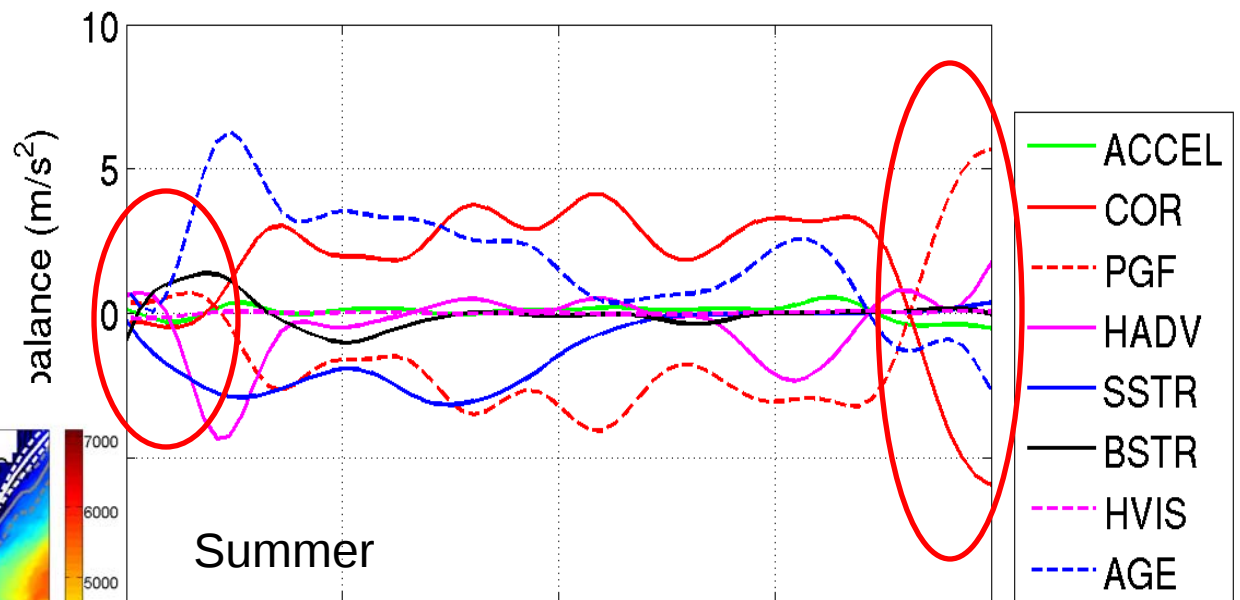
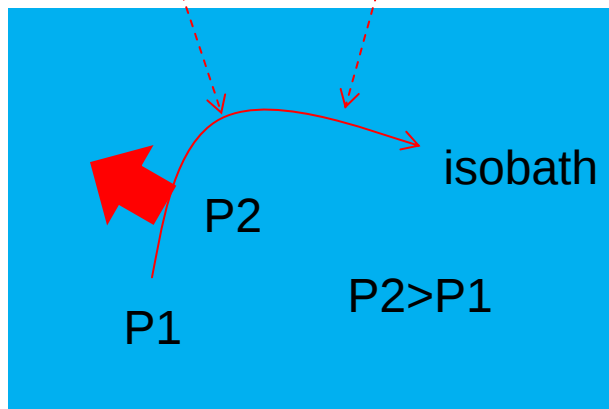
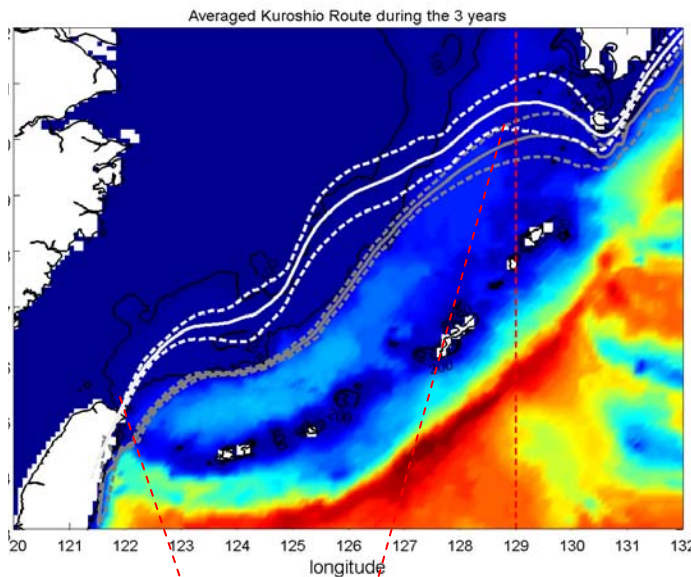


Mainland

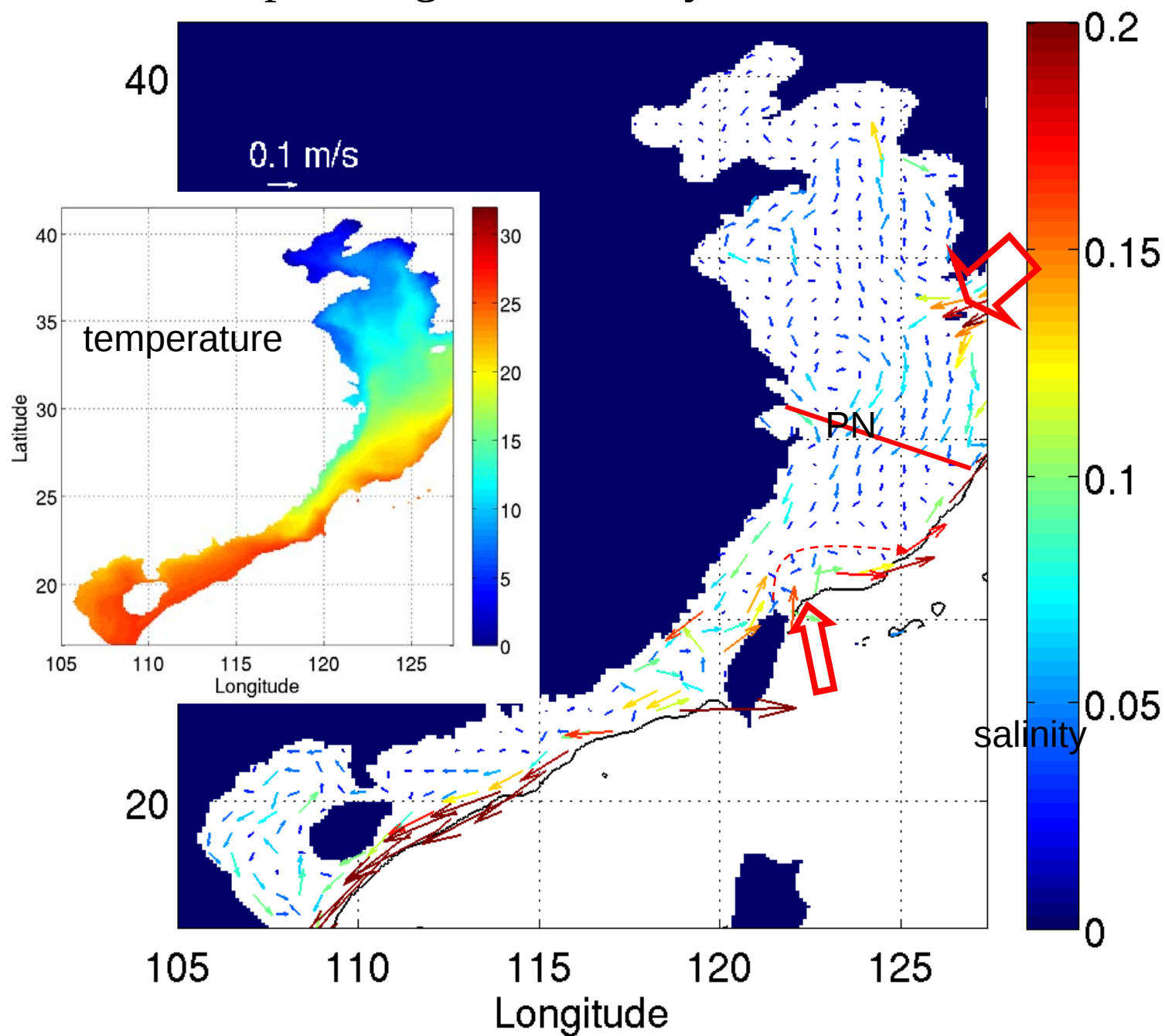
Taiwan Strait

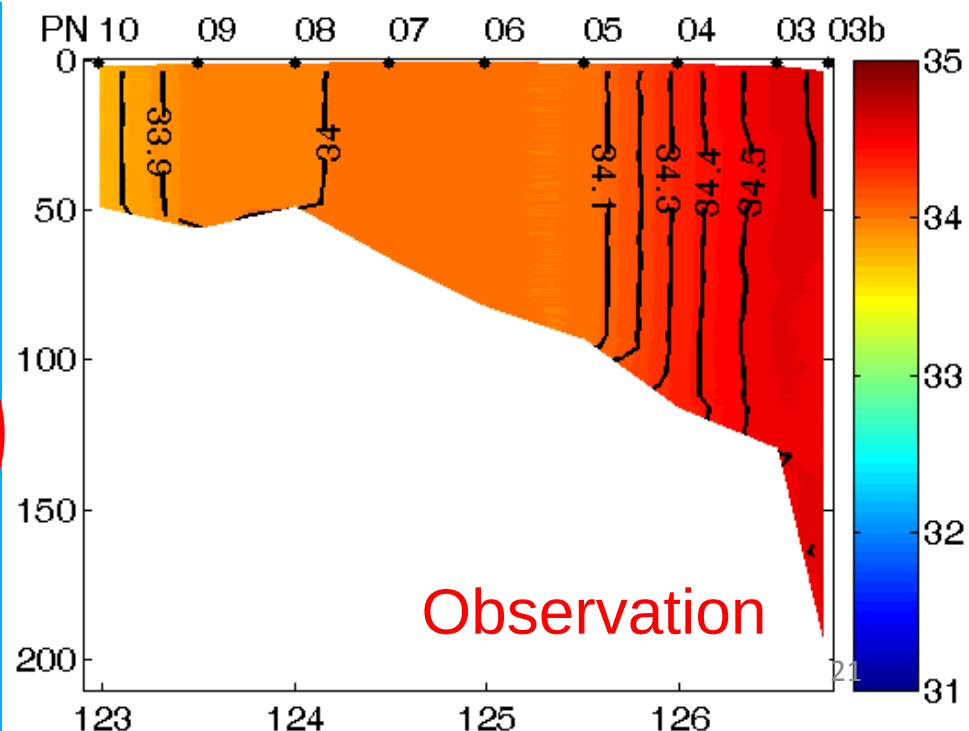
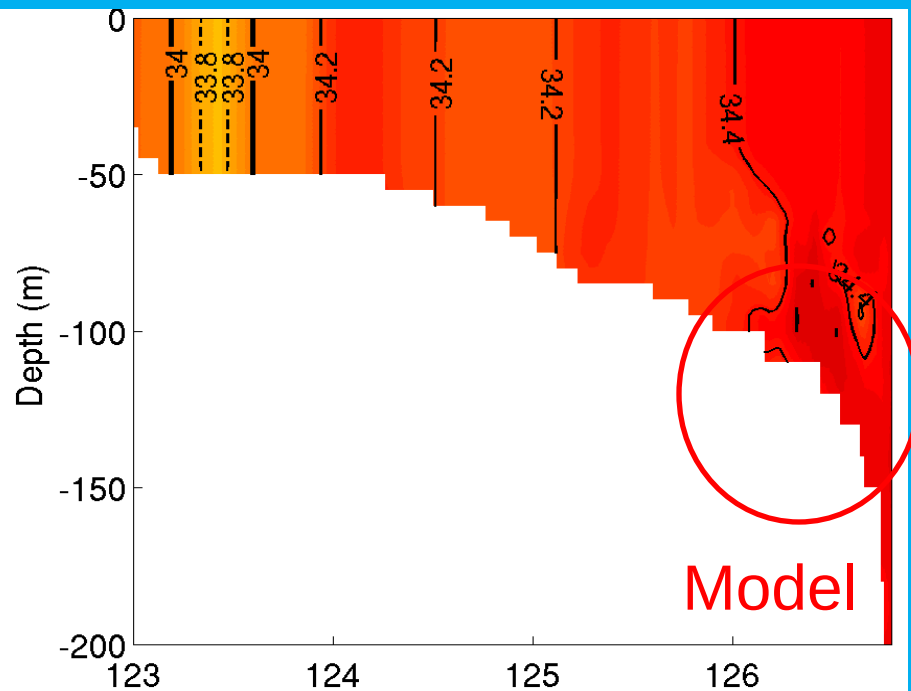
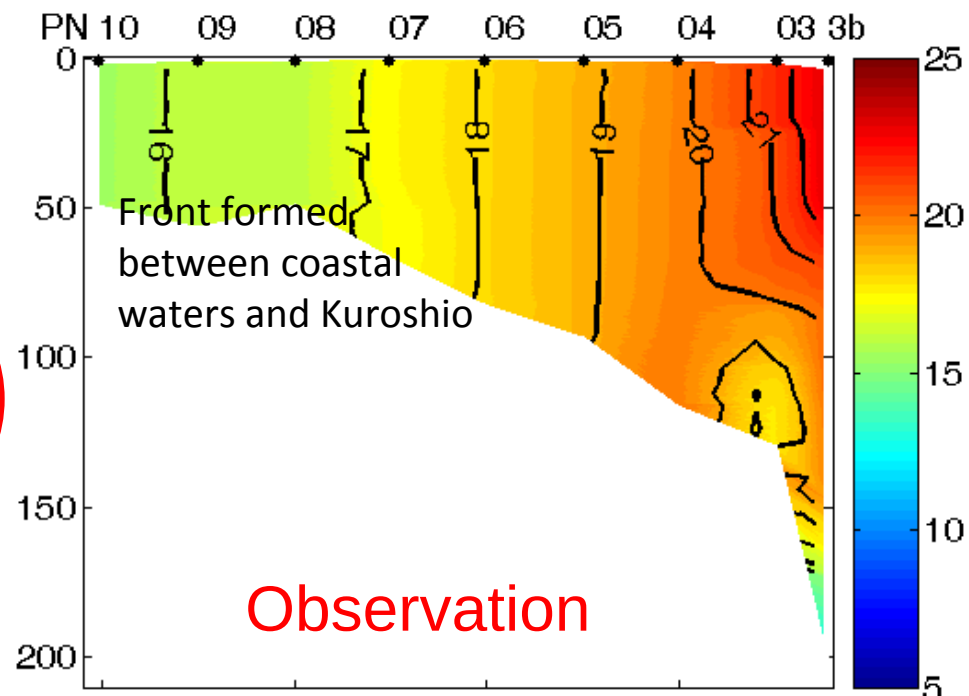
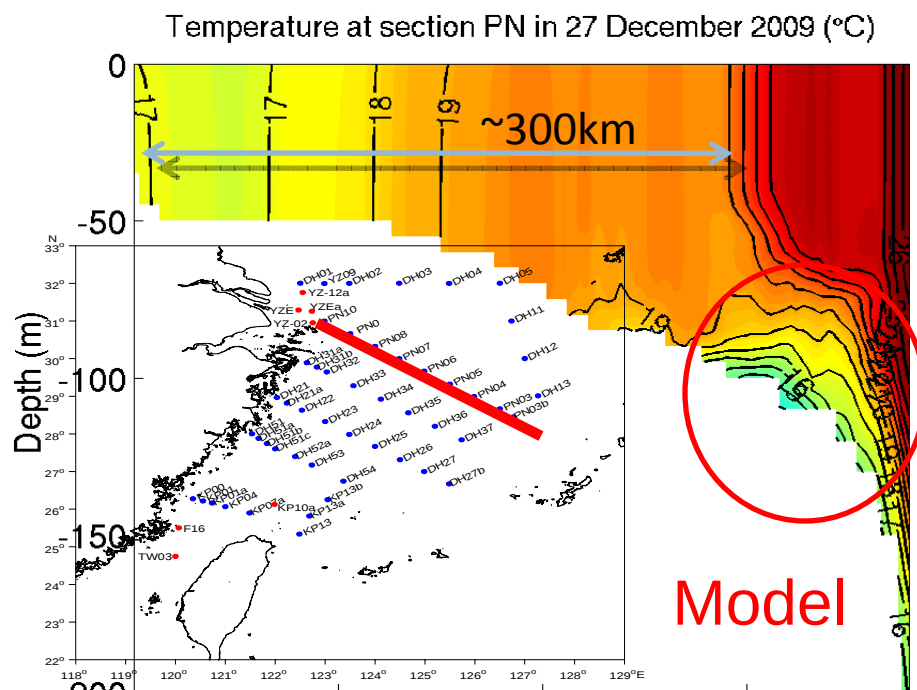
Taiwan Island

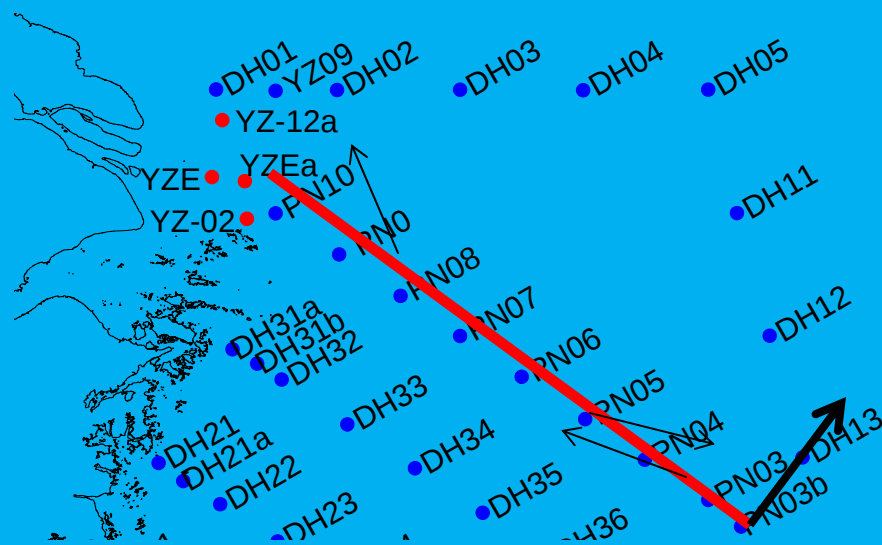
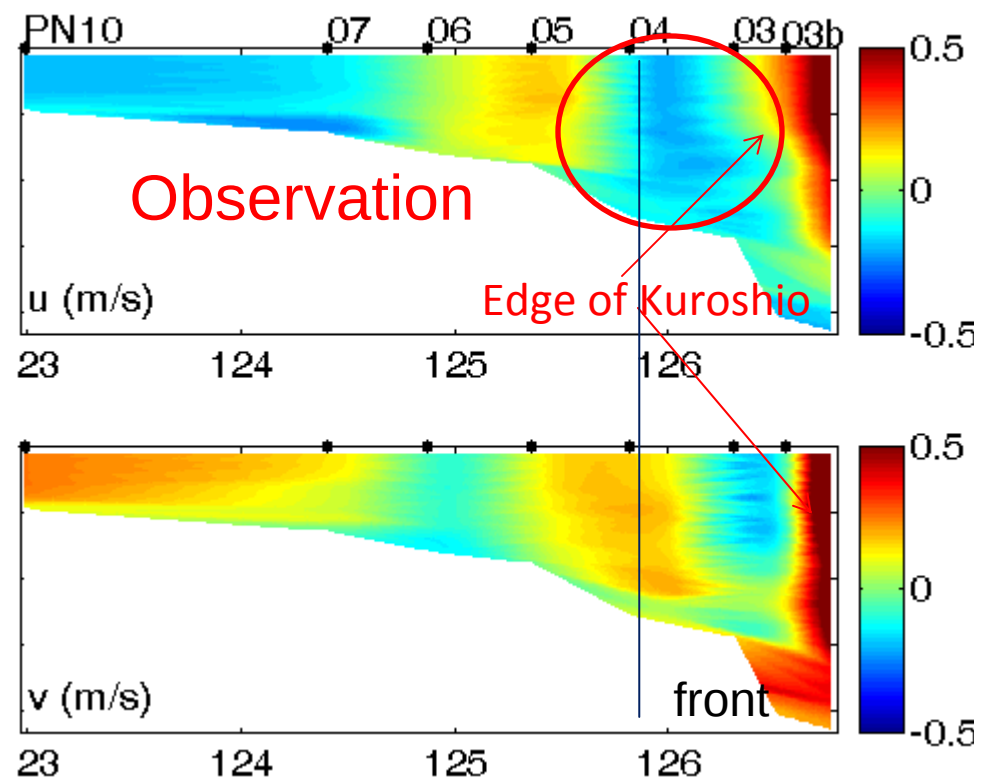
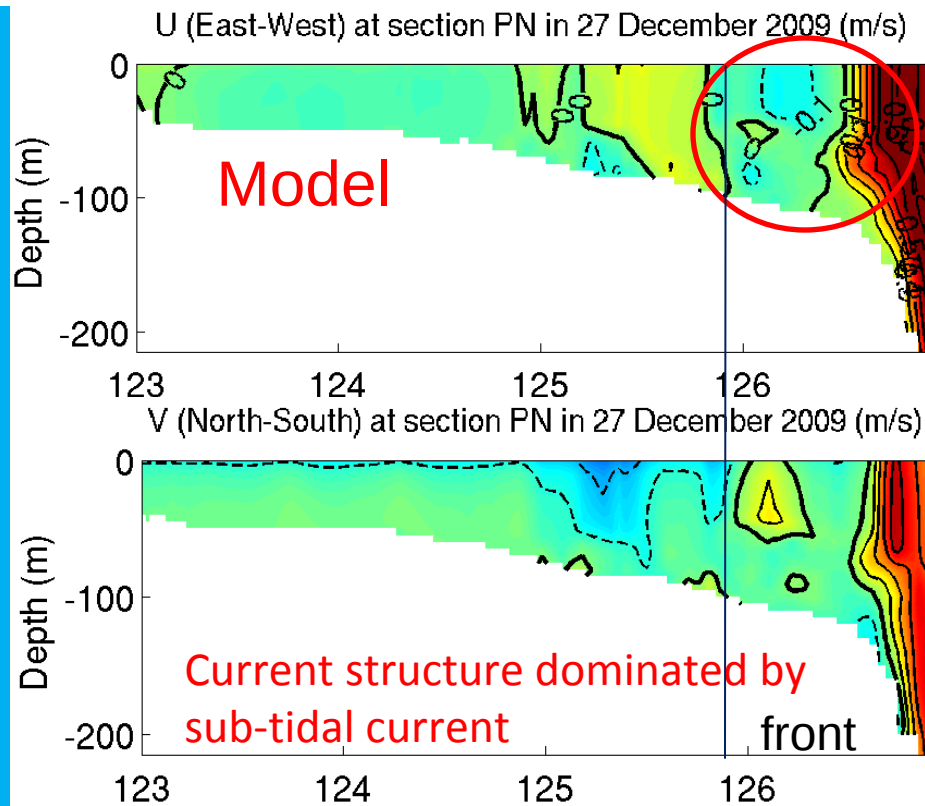
$P_{\text{downstream}} > P_{\text{upstream}}$,
intrusion occurs where
isobaths are concave
and Kuroshio turns
anticyclonically.



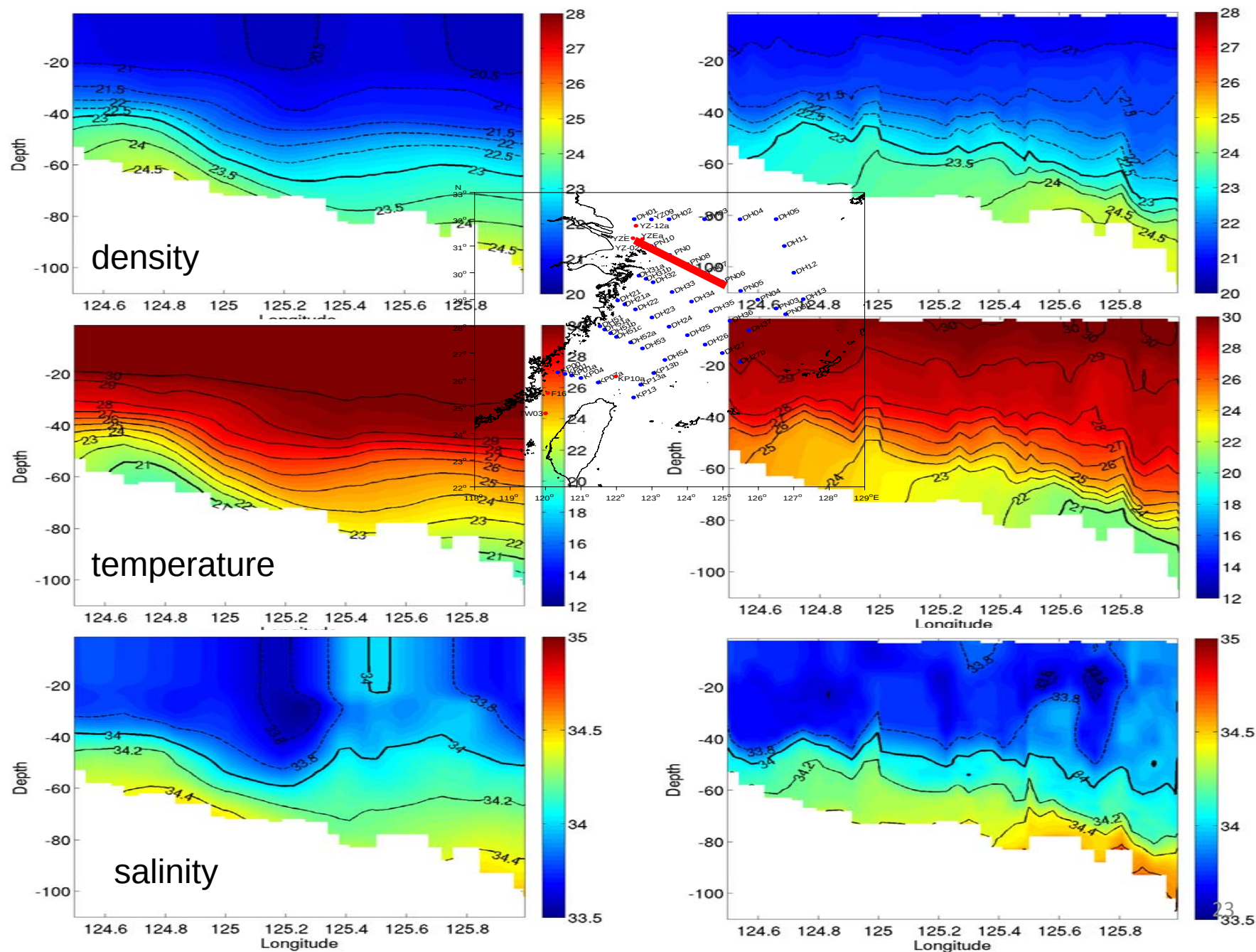
Depth integrated velocity averaged from Dec. 2009 to Feb. 2009



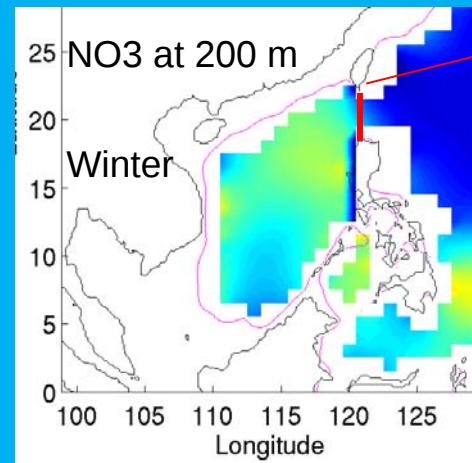
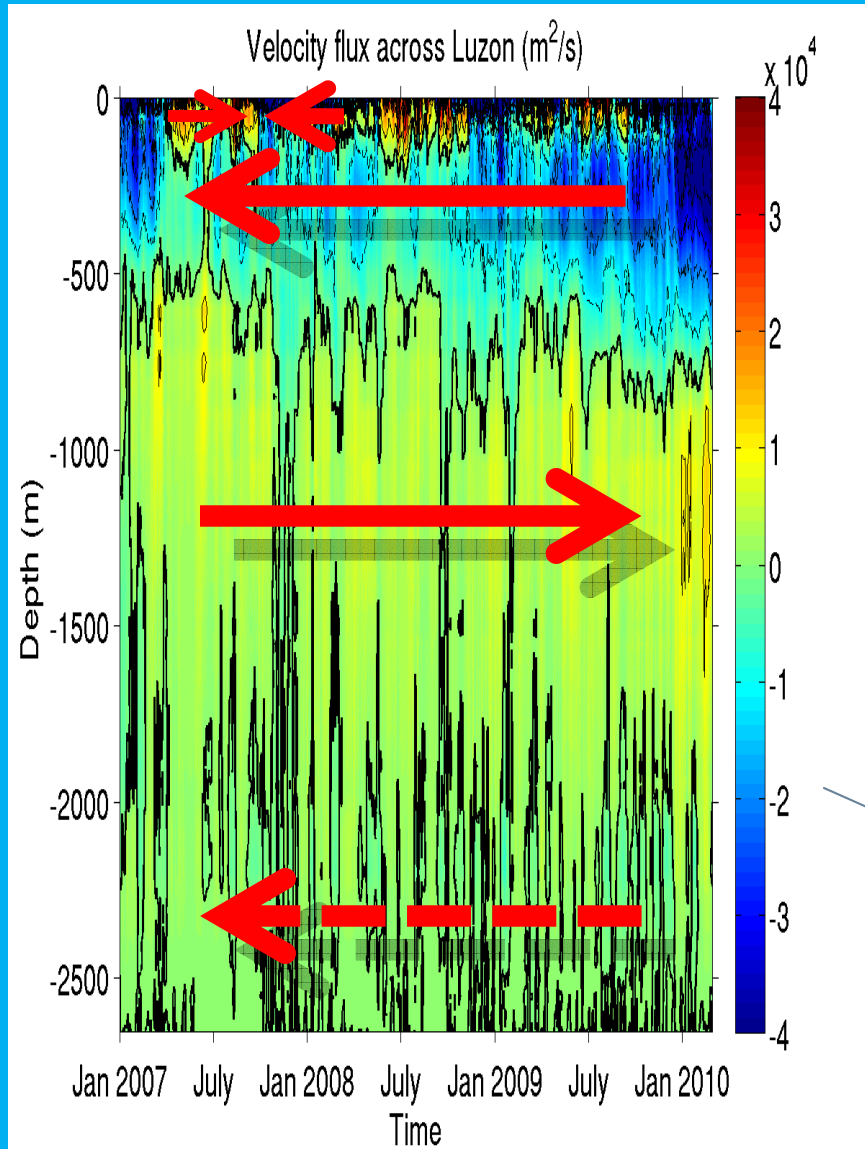




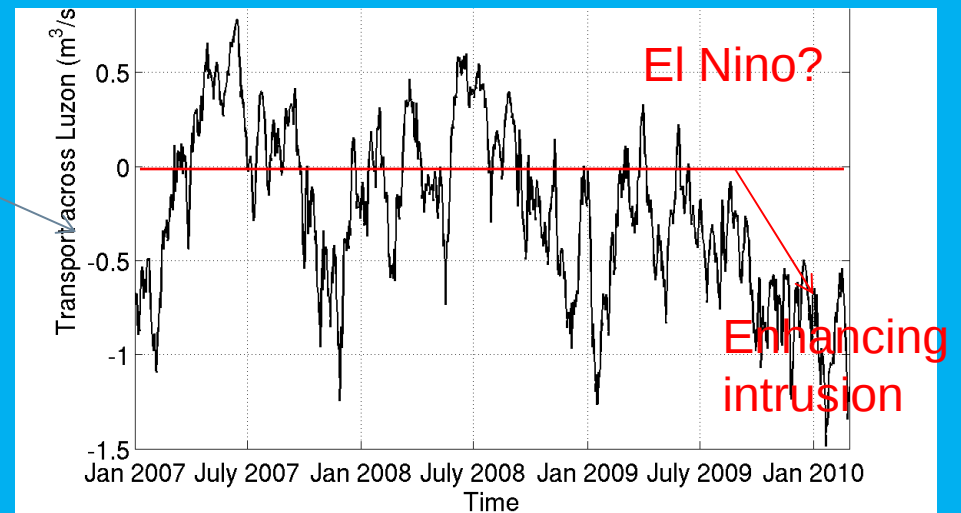
MVP PN07 – PN04



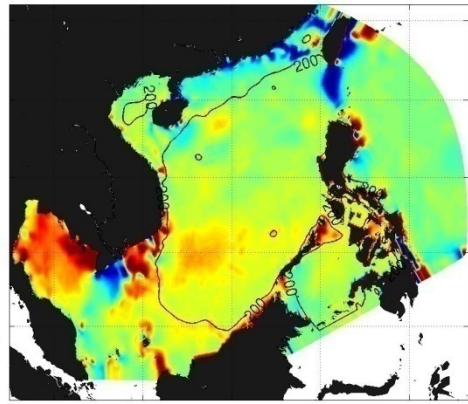
Inter-annual variation of Luzon transport



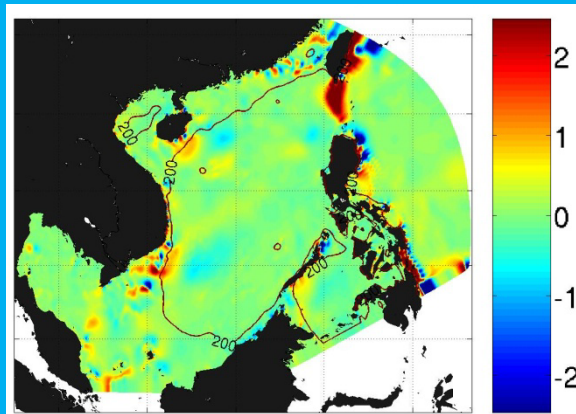
Luzon Strait



Ageostrophic
term

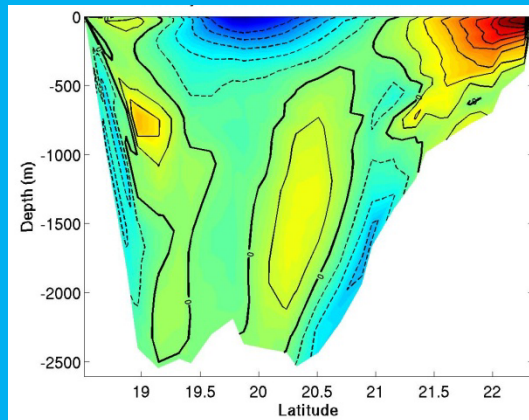


Nonlinear
advection
term



DIFF.

Intrusive current at Luzon Strait

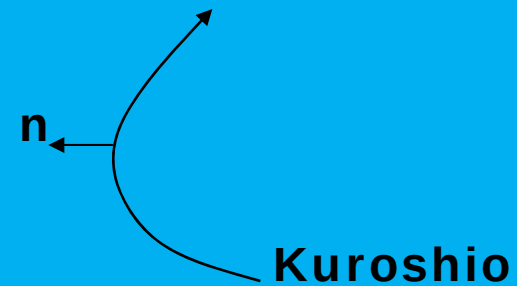


Dynamics of Intrusion

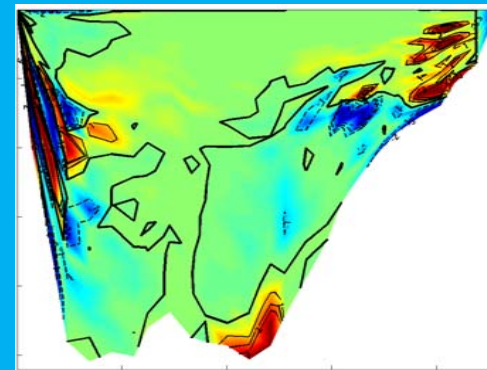
$$\frac{V_k^2}{R} + fV_k + \frac{1}{\rho_o} \frac{\partial P}{\partial n} = 0$$

$$(AGE)_k = 1/\rho_o \partial P / \partial n + fV_k > 0$$

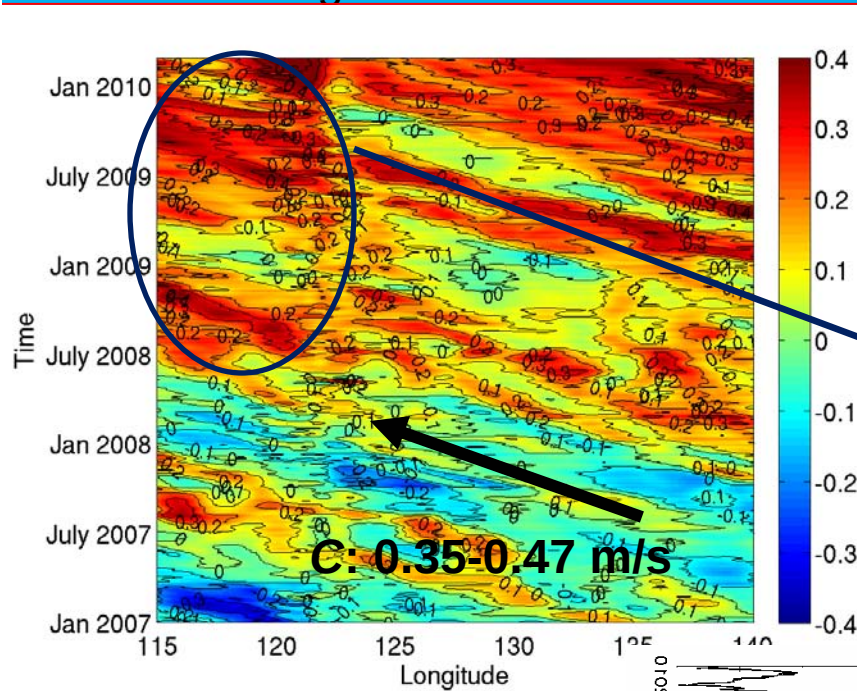
$$V_k^2/R < 0 \text{ or } R < 0$$



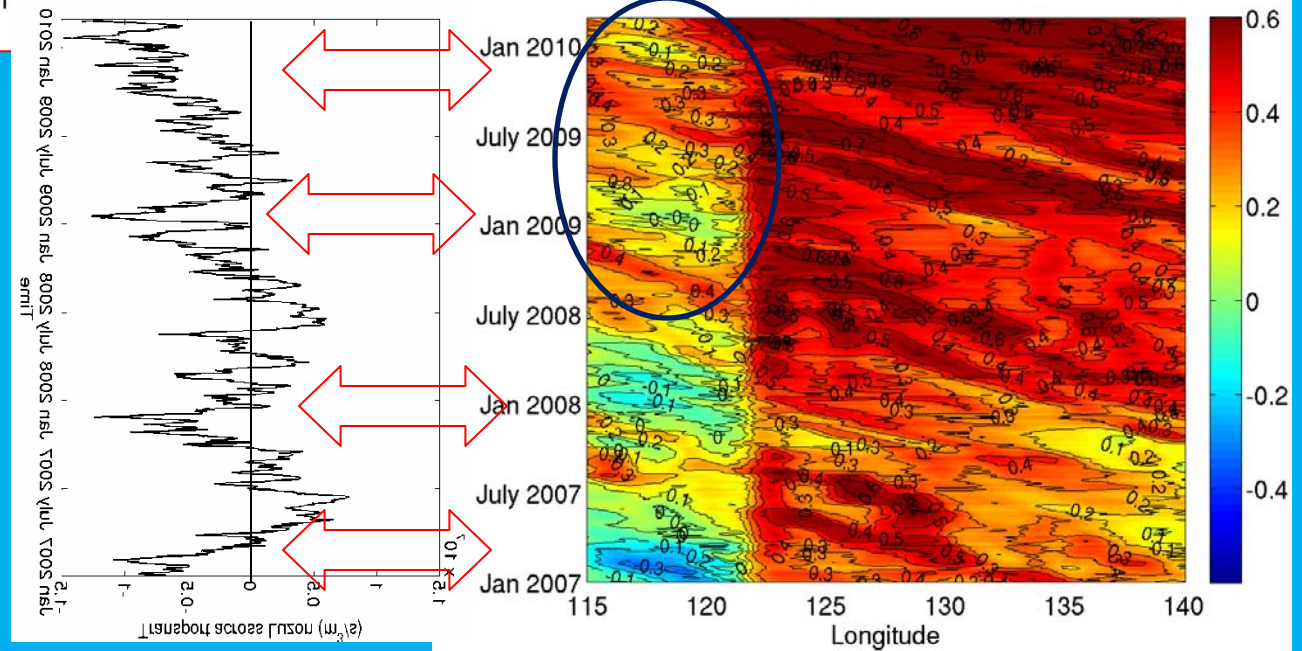
Mean net normal PGF
(>0, westward)



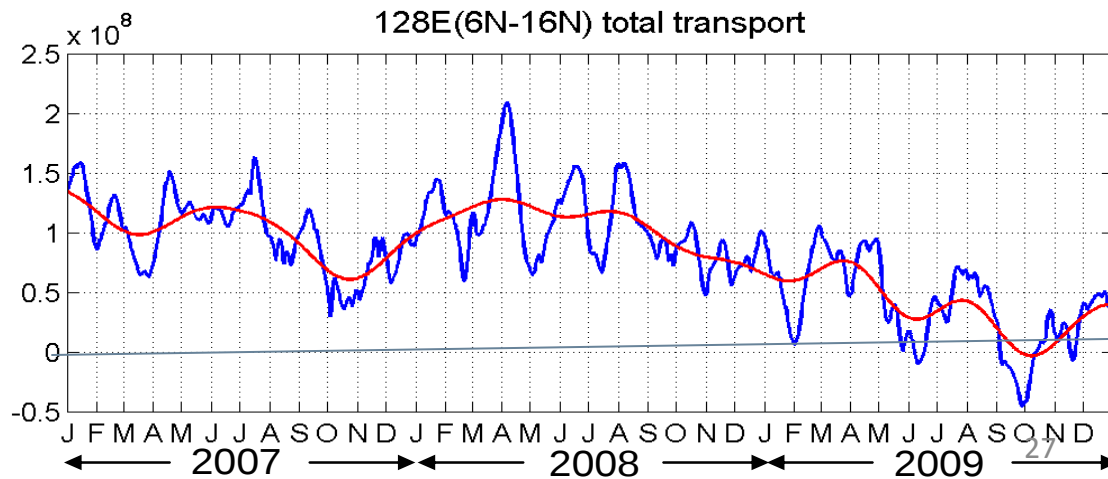
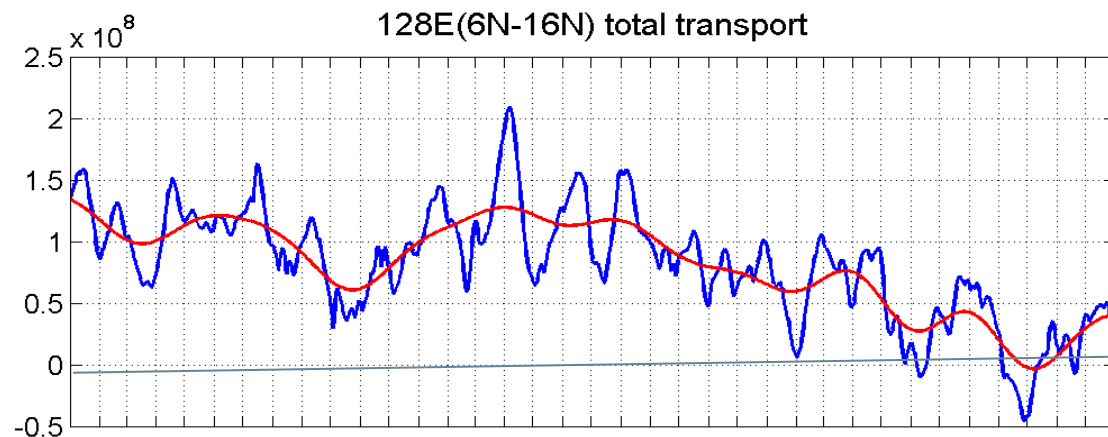
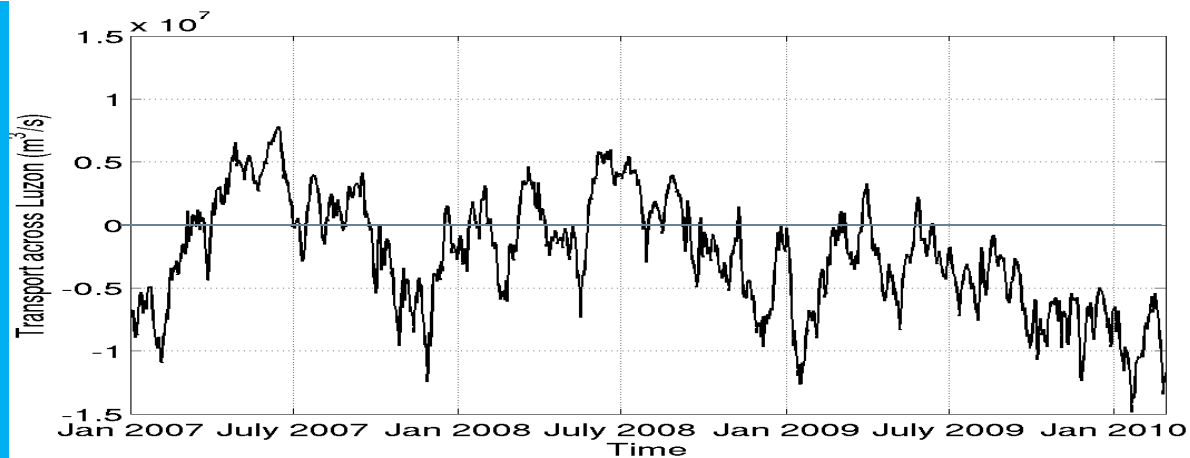
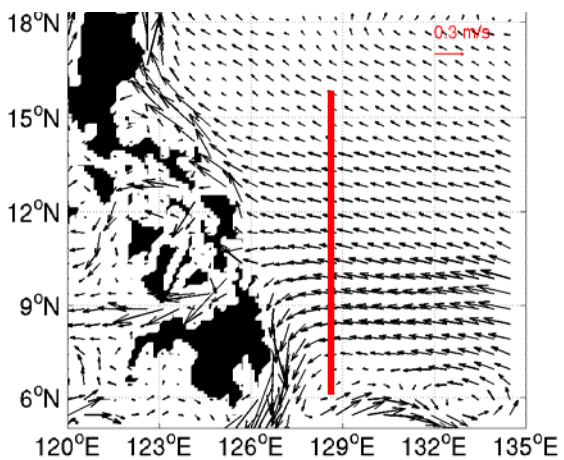
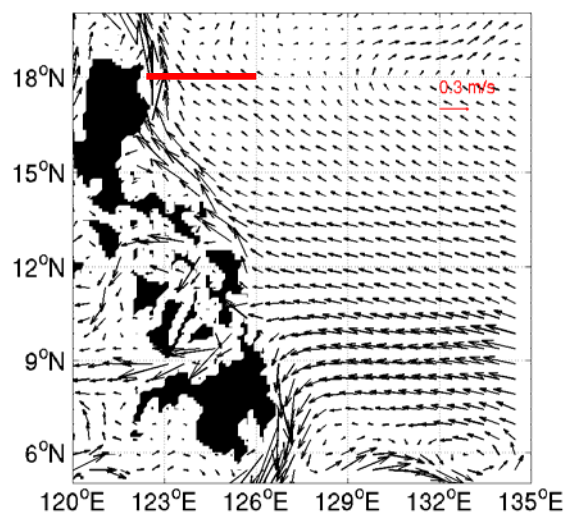
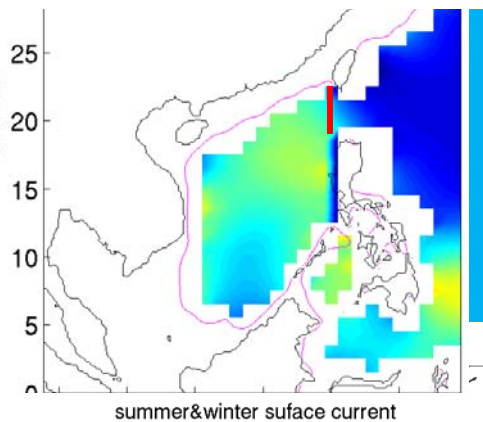
SSHA along 20 N as function of time

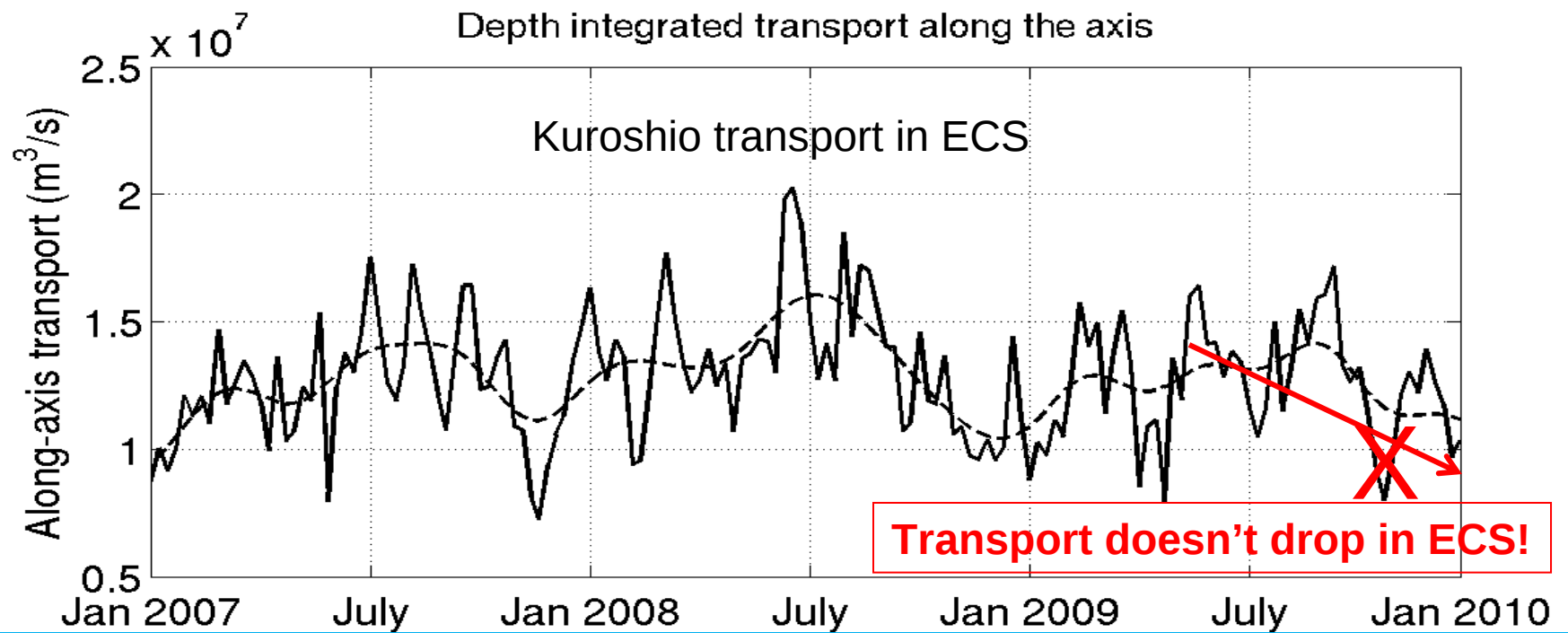


SSHA > 0, KU geostrophically weakened and intrusion is enhanced.



Surface elevation along 20 N as function of time

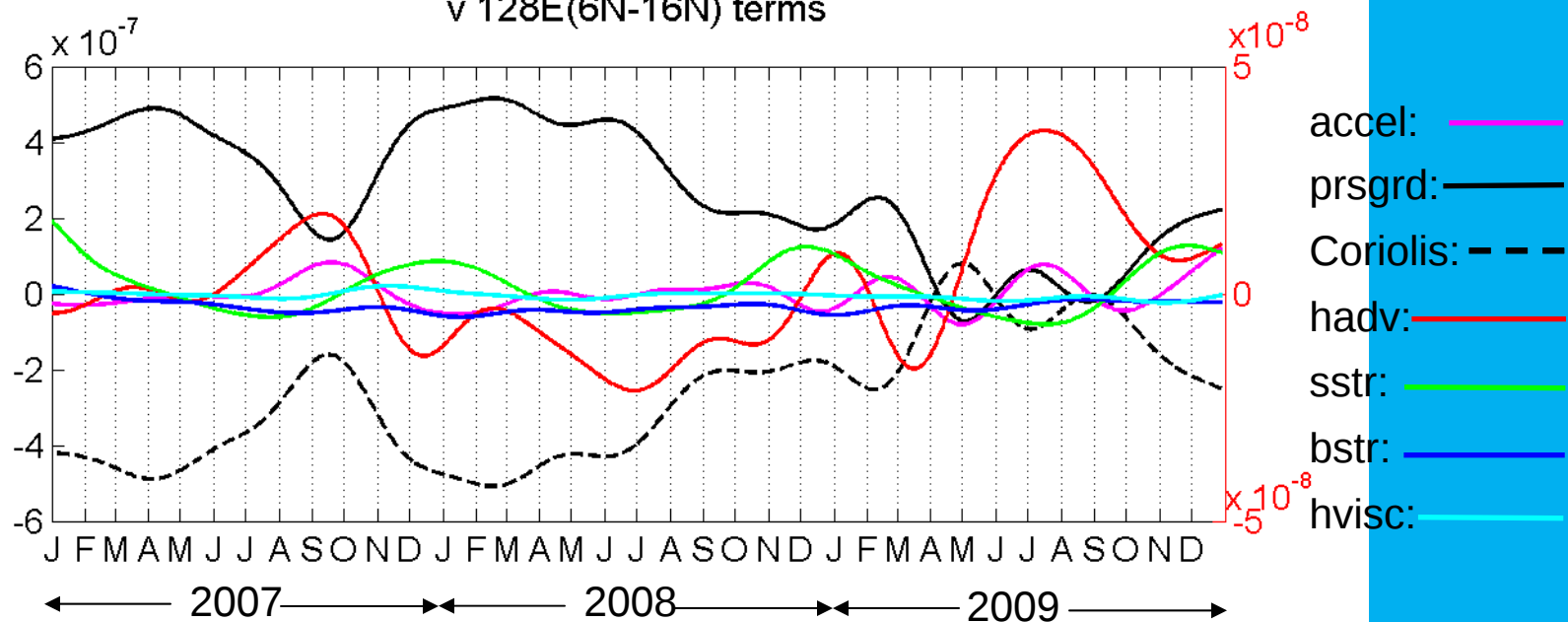




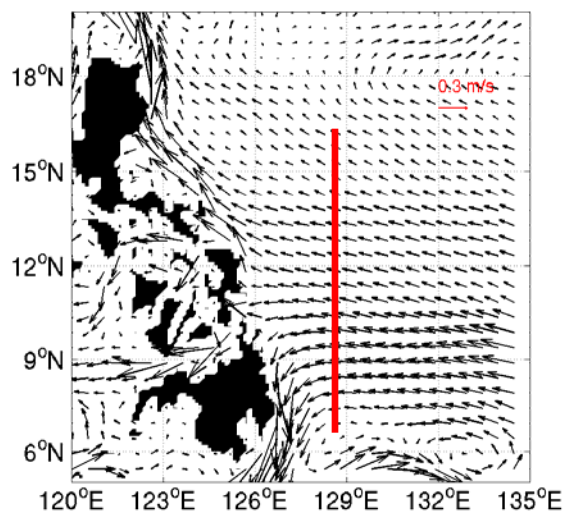
Summary

Validated China Sea circulation model shows highly time- and space-coherent transport in the directions along and cross Kuroshio at the edge of China Sea.

90days filter v 128E(6N-16N) terms



summer&winter surface current



Relax of wind stress leads to
decrease of meridional pressure
gradient

Seasonal and annual averages transport

	Winter	Spring	Summer	Fall	Annul
Taiwan Strait	0.61	2.24	3.03	0.56	1.6
Tsushima Strait	-0.08	-1.38	-1.32	-0.64	-0.86
Shoreside	3.70	1.59	-0.07	0.39	1.4
NET	4.23	2.45	1.64	0.31	2.14

