The role of the East Asian monsoon (EAM) in the responses of the marine environment in the East China Sea (ECS) to the East Asian climatic jump around 1976/77

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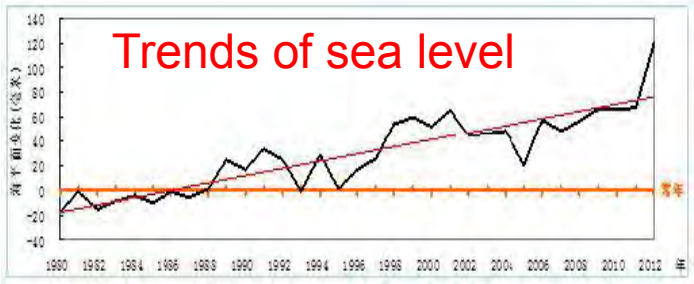
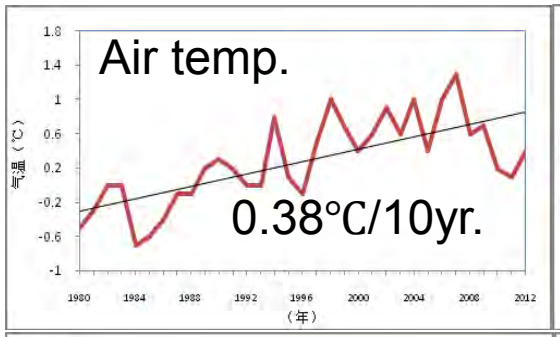
Outline

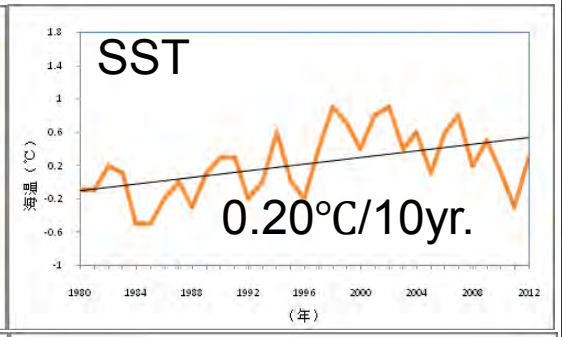
- **1. Background**
- **2. Model, data and experiment desgins**
- **3. The ECS responses to the climatic jump of EAM around 1976/77**
- **4. Conclusion**

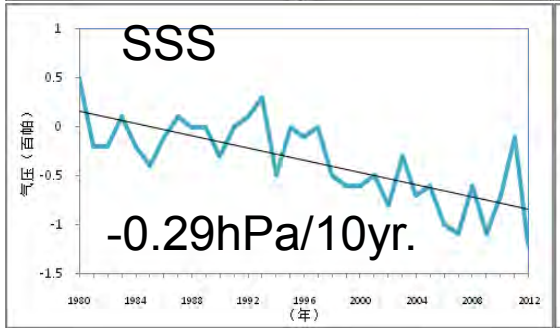
1. Background

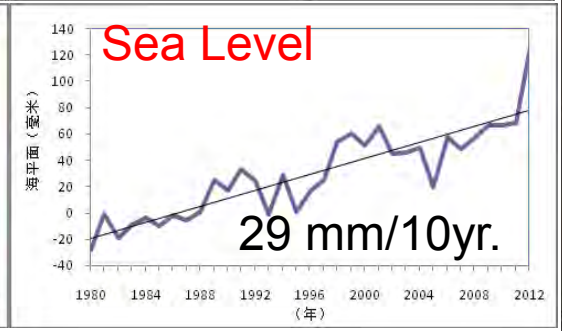


Trends of China coastal sea level during the periods of 1980-2012, 2.9 mm/yr.

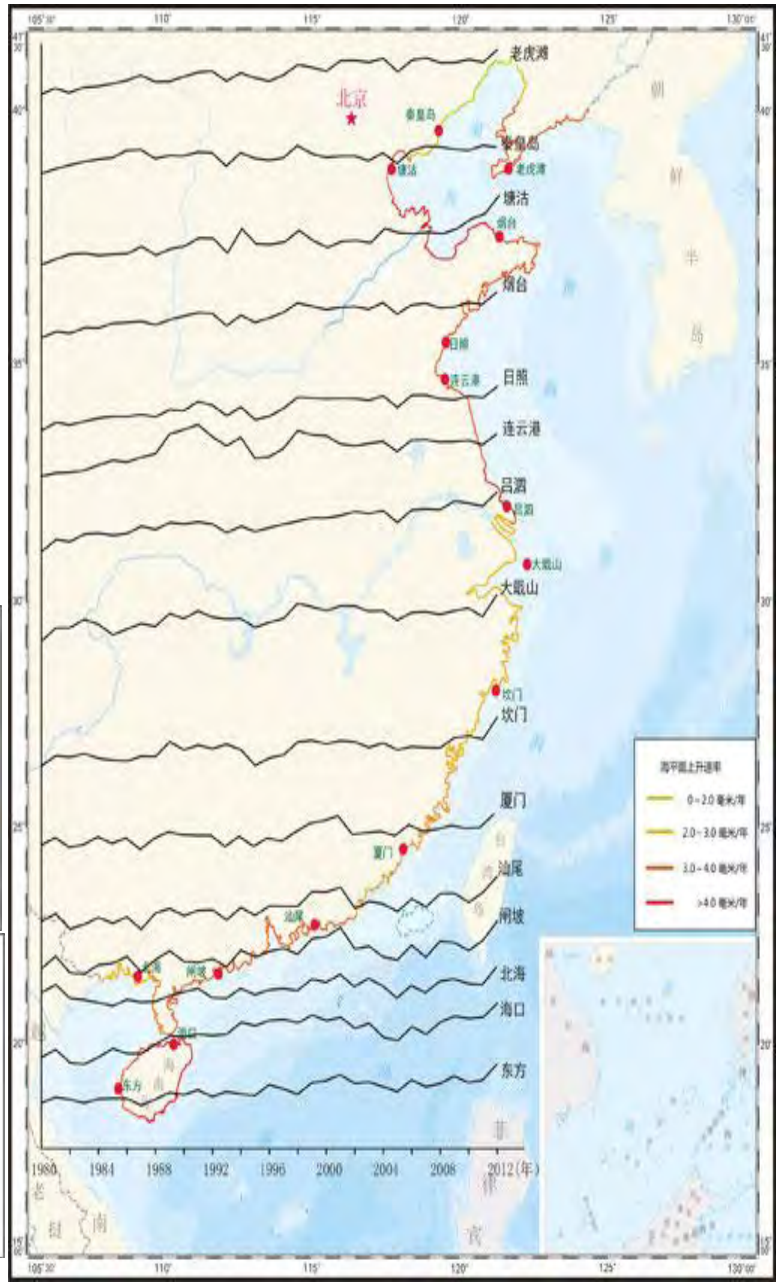




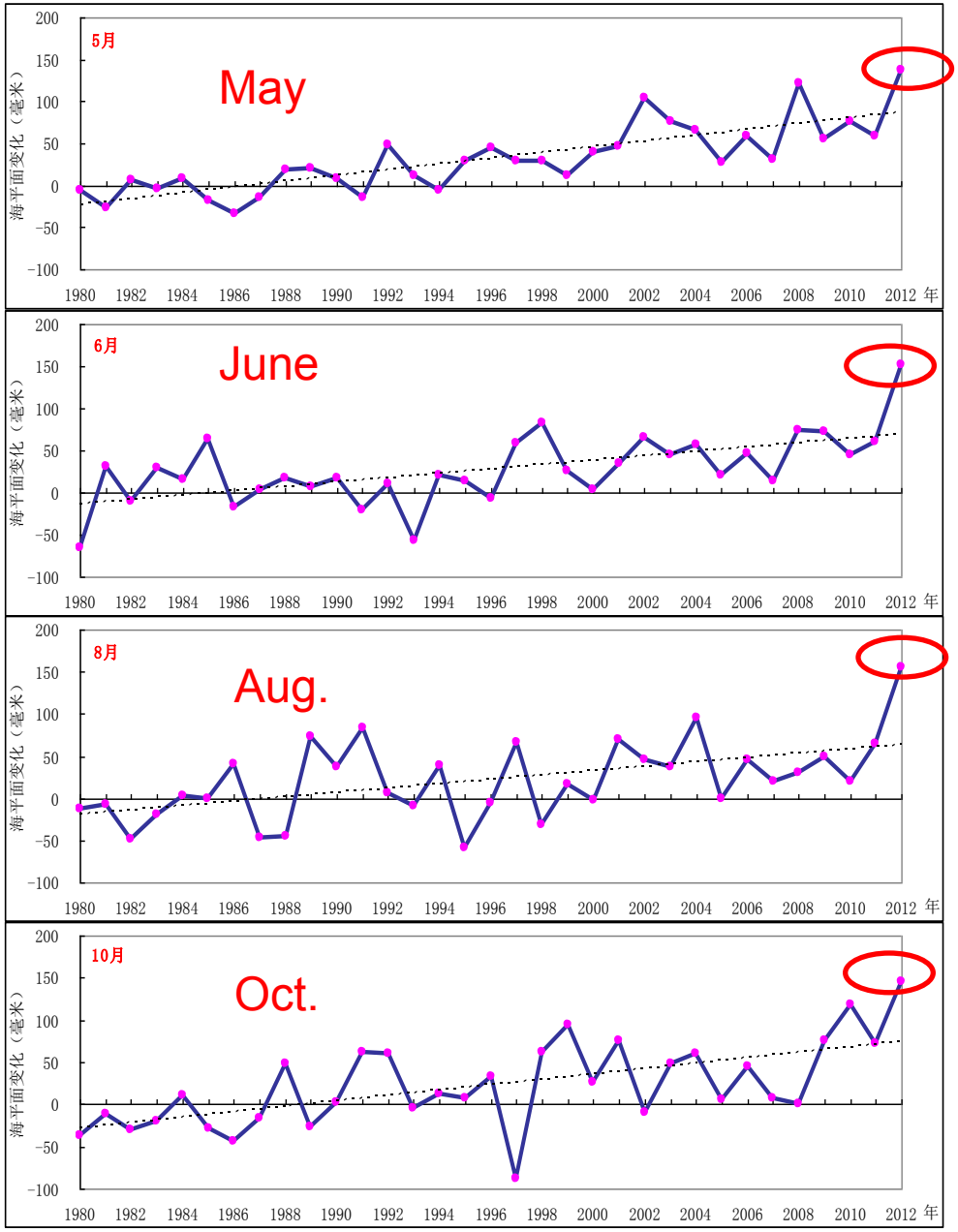




From Chinese Sea Level Bulletin 2012



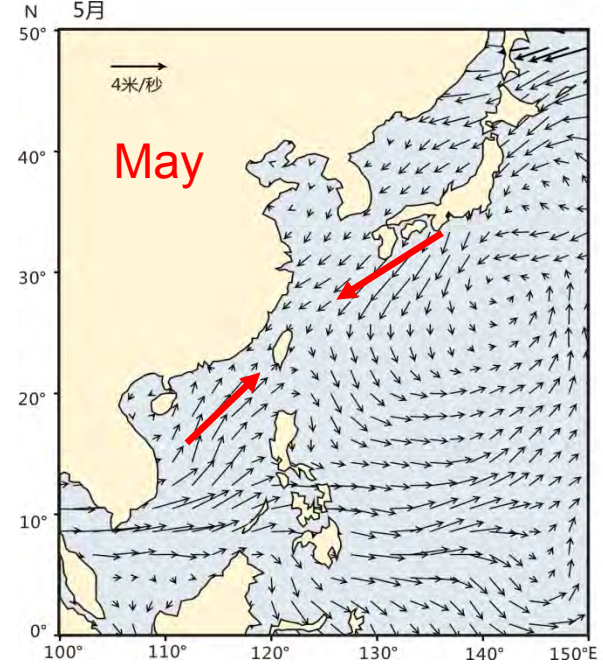
Variations of observed China coastal sea level in the periods of 1980-2012.

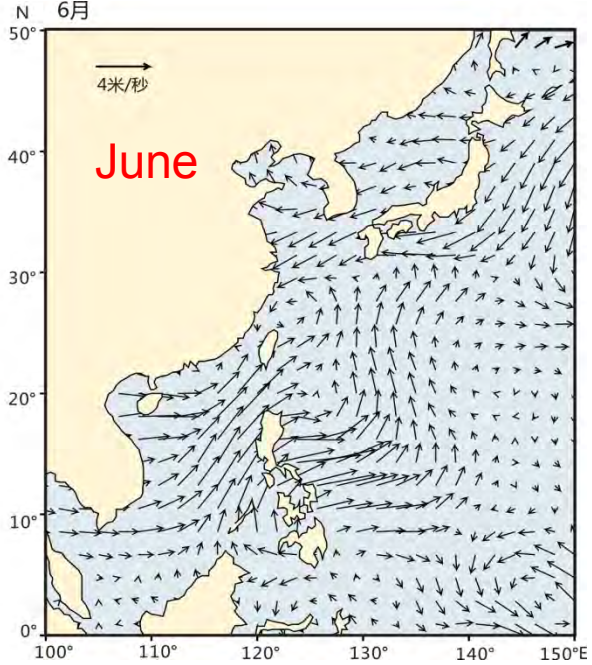


In 2012, China coastal Sea Level (SL) reached the highest in the past decades.
The mean SL anomaly is 122mm.

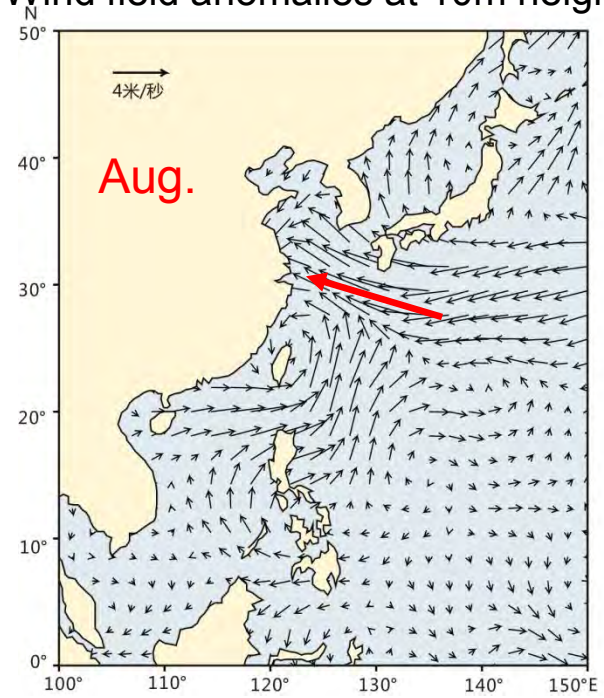
Why?

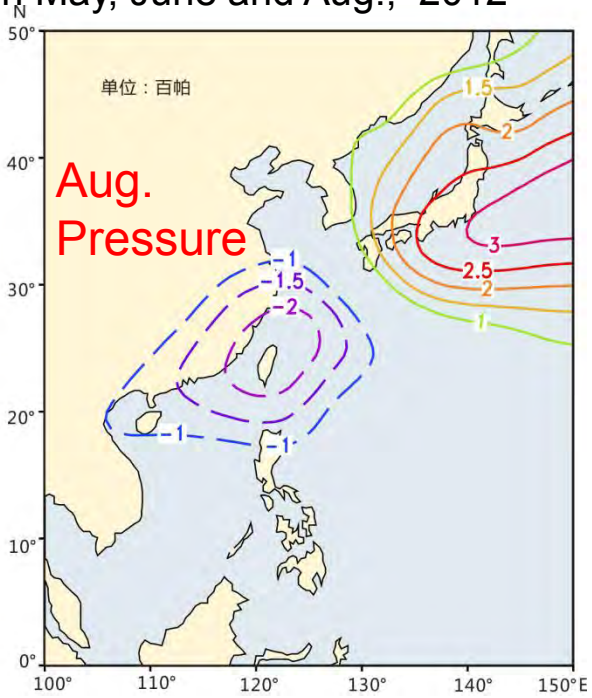
Is there any special impact factor, except ocean warming etc.?





Wind field anomalies at 10m height in May, June and Aug., 2012

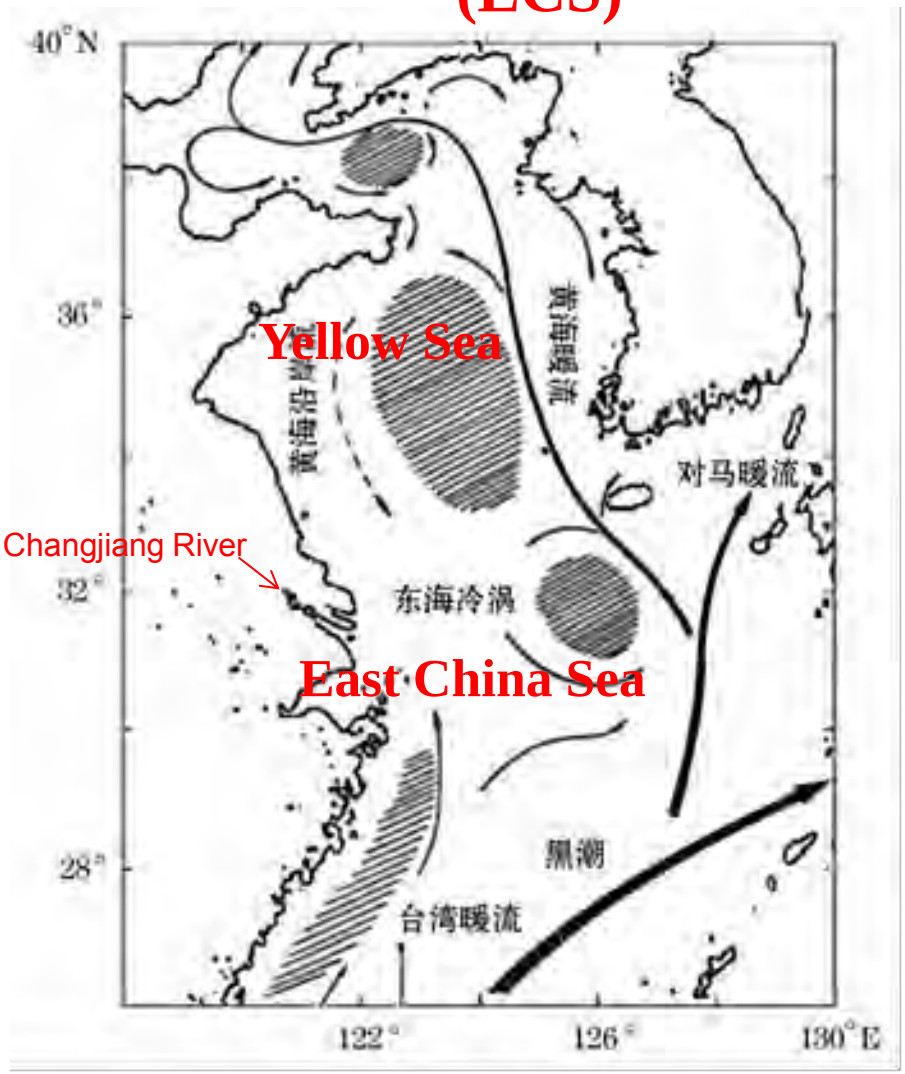




An explanation in Chinese Sea Level Bulletin 2012:
wind pattern caused SL particular high.

How could the wind field play a great role in the variations of sea level?

Yellow Sea (YS) and East China Sea (ECS)

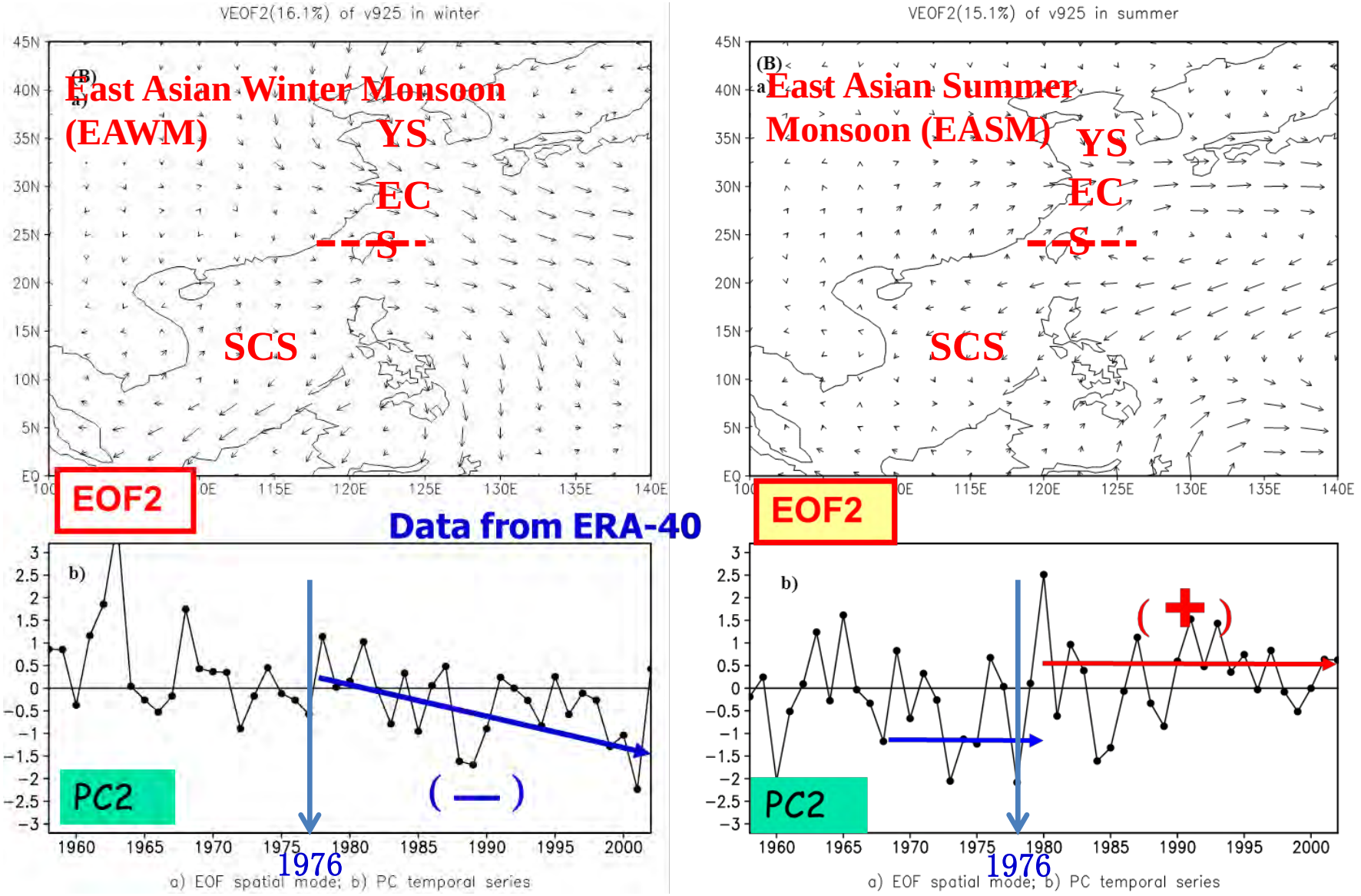


An issue was proposed:

What's the role of the EAM in the variations of the China coastal marine environment, e.g., currents, SST, SSS and sea surface height (SSH)?

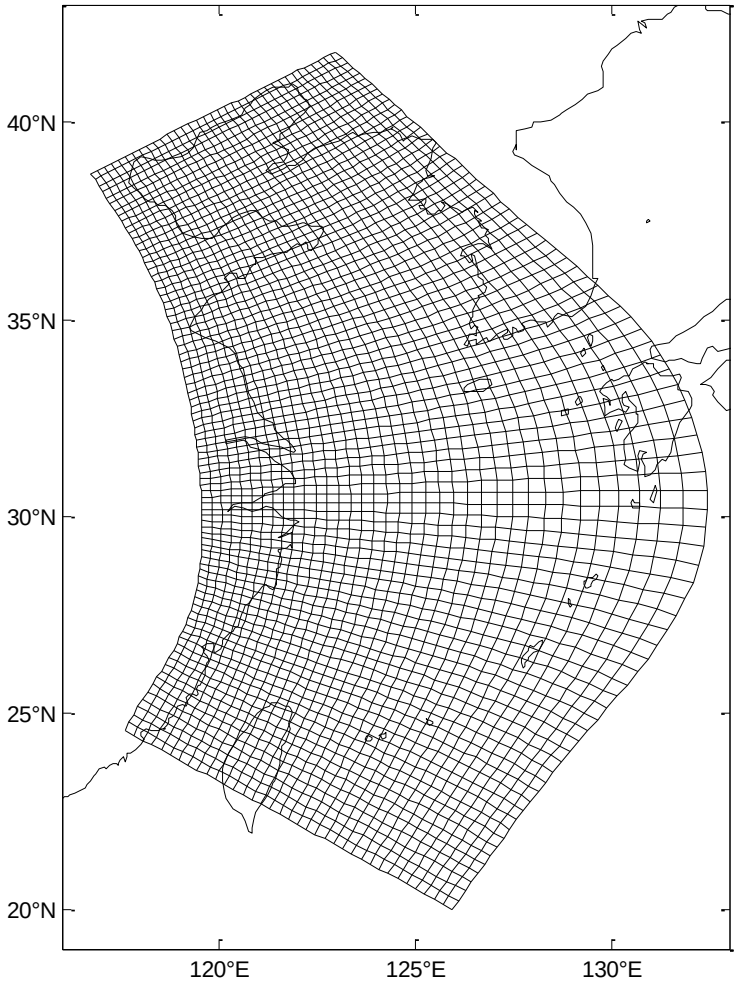
Due to the typical transition of the EAM around 1976/77, the impact of the EAM climatic jump on the SSH, SST, SSS, Currents of the China coastal area such as ECS are explored, here.

But why we focus on the ECS?



EASM and **EAWM** experienced a climatic jump after 1976/77 and became weakening.(Cai, et al., 2010, 2011). The figure shows that the impacts of EAM on the YS/ECS and SCS are different.

2.Model, data and experiment designs



Model domain for the experiment

2.1 Regional Ocean Modeling System (ROMS)

2.2 Data：

- Oceanic reanalysis data (Boundary & climatological): SODA, CORA;
- Atmospheric reanalysis data (Forcing): COADS05, SODA;
- Other data: ETOPO2; TPXO7; Runoff of Changjiang River
- Resolution: horizontal: 5-15km (144×336); vertical: 24 level

2.3 Experiment Designs

(1) The period of 1971-2000 represents the climatological state and the period of 1958-1976 and 1977-2000 represent before and after the EAM climatic shift around 1976/77, respectively.

(2) Climatological mean marine environment, e.g., ocean currents, SST, SSS, SSH results were forced by mean sea surface wind stresses for the above three periods.

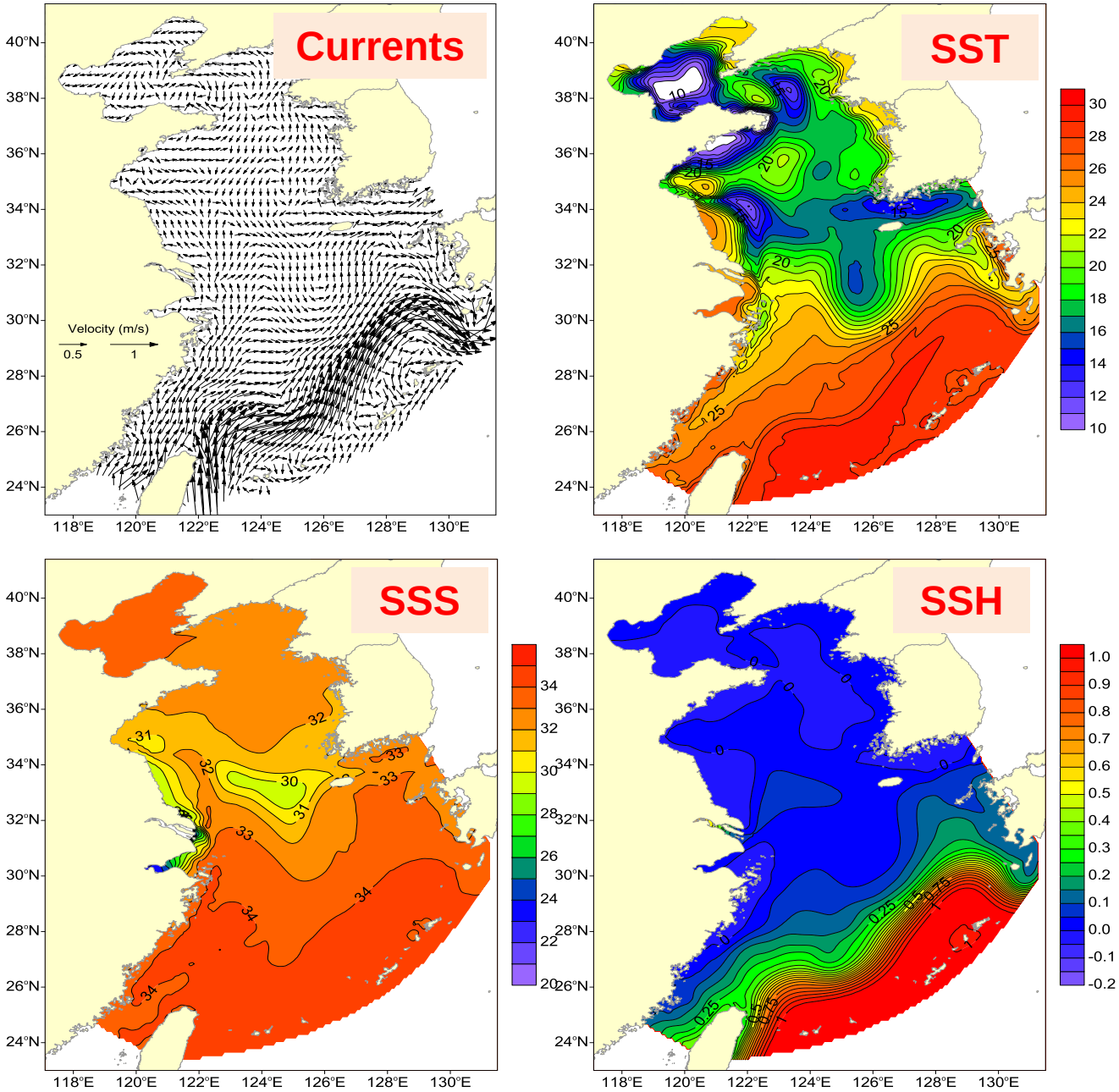
(3) Differences between the periods of 1977-2000 and 1958-1976

3. Modeling the ECS marine environment responses to the climatic jump of EAM around 1976/77

Experiment schemes

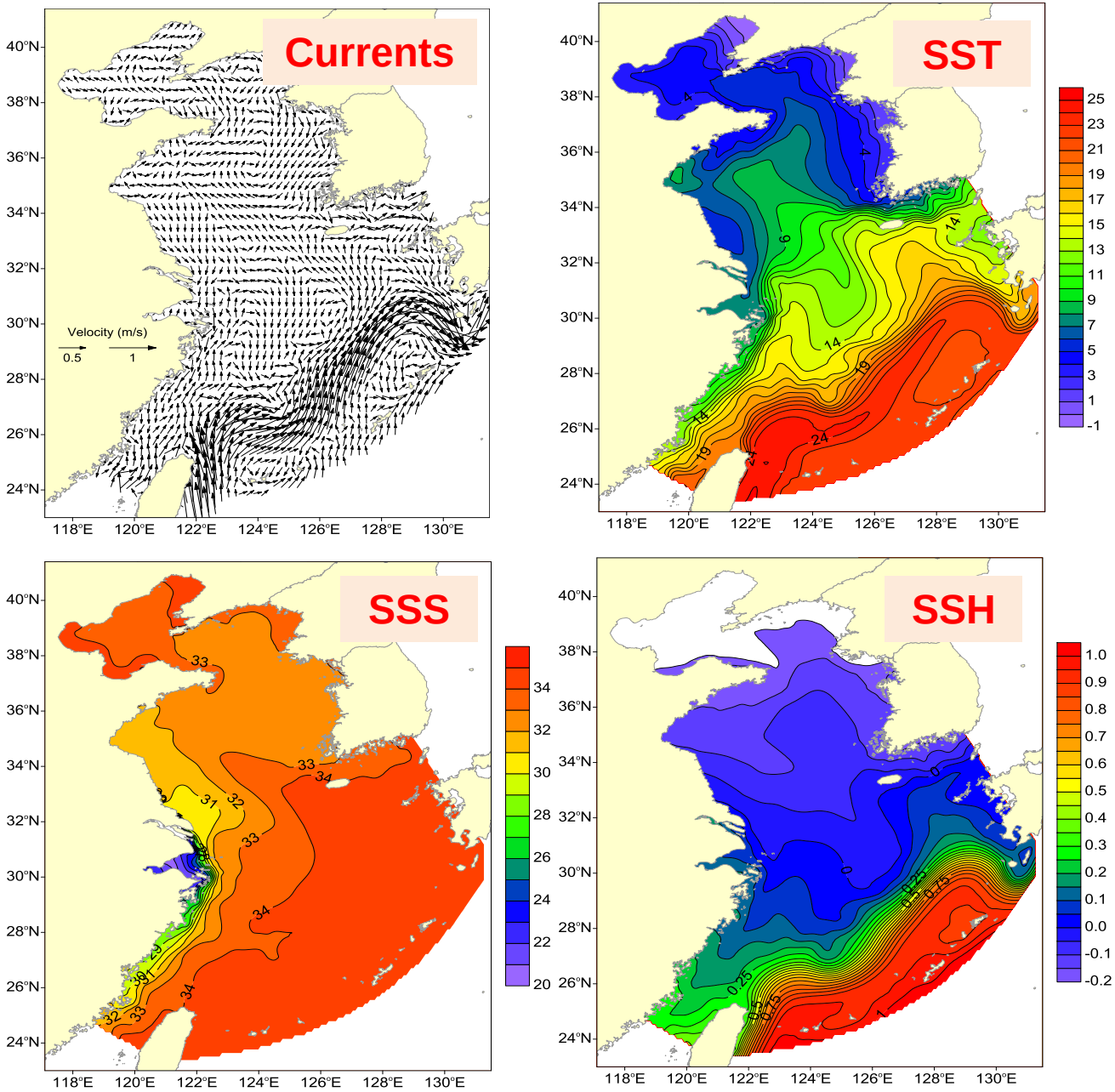
1) **The period of 1971-2000 for Ctl_E is set to represent the climatological mean.**
2) **The two periods for the Bef_E and Aft_E such as 1958-1977 and 1977-2000 are set to represent the variations of wind stress impacts for the periods before and after 1976/77.**
3) **The responses of the currents, SST, SSS and SSH in the ECS to EAM in the two periods of 1958-1977 and 1977-2000 are simulated, respectively.**

Experiment codes	Wind stress (Data from SODA)	Open boundary	Heat and fresh water fluxes
Ctl_E (Climatology)	**Monthly average period of 1971-2000**	Sea temperature, salinity, water level and current data from SODA	Data from COADS05
Aft_E (after EAM jump)	**Monthly average period of 1977-2000**		
Bef_E（before EAM jump）	**Monthly average period of 1958-1976**		



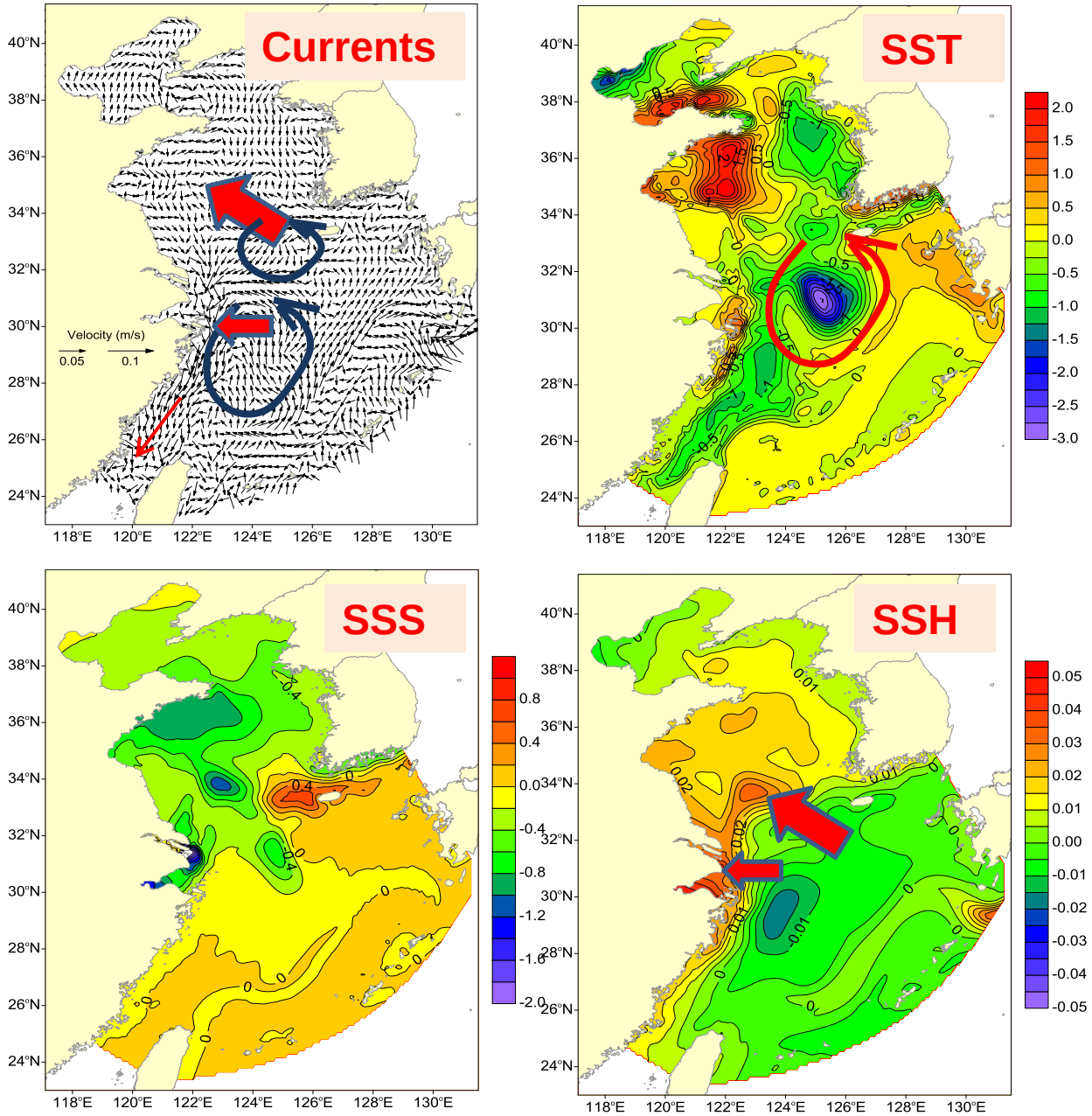
Simulated **summer** mean currents, SST, SSS and SSH in the ECS for the period of 1971-2000 (Ctl-E)

Climatological summer mean marine environment in the ECS



Climatological winter mean marine environment in the ECS

Simulated **winter** mean currents, SST, SSS and SSH in the ECS for the period of 1971-2000 (Ctl-E)

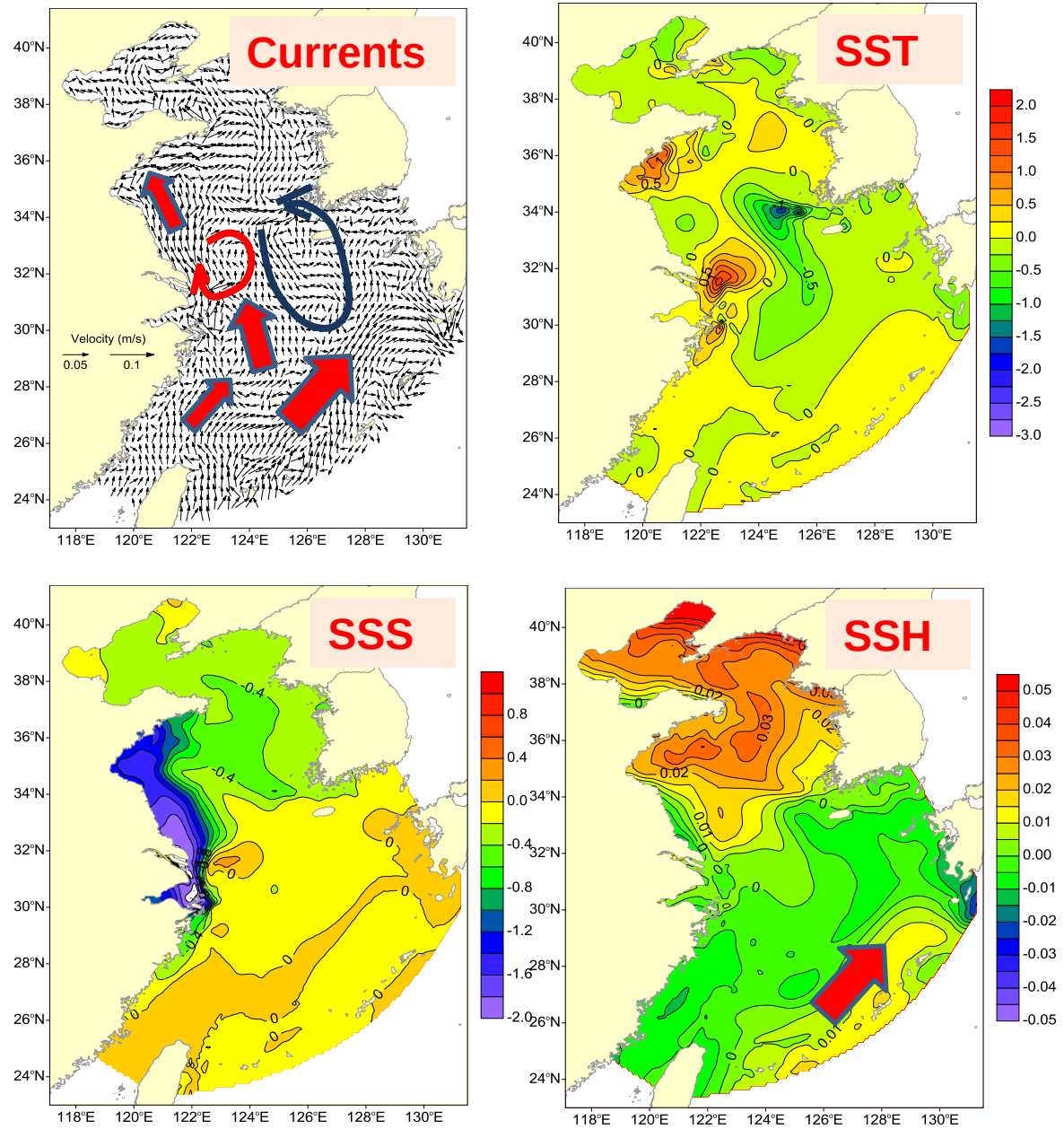


Difference between the simulated summer currents, SST, SSS and SSH anomalies in the ECS for 1977-2000 and those for 1958-2000 (Aft E minus Bef E)

Differences between the periods of 1977-2000 and 1958-1976 in summer = the simulated results for 1977-2000 minus those for 1958-2000:

The summer currents, SST, SSS and SSH anomalies in the YS/ECS.

The results show that while the EASM weakens after 1976/77, **anomalous cyclonic currents** appear in the YS/ECS including the anomalous weakening TWC & CRD, which induce the negative SST, positive SSS and SSH anomalies in the ECS, but negative coastal SSH anomalies in Bohai Sea/YS and along the coast area.



Difference between the winter simulated currents, SST, SSS and SSH anomalies in the ECS for 1977-2000 and those for 1958-2000 (Aft_E minus Bef_E)

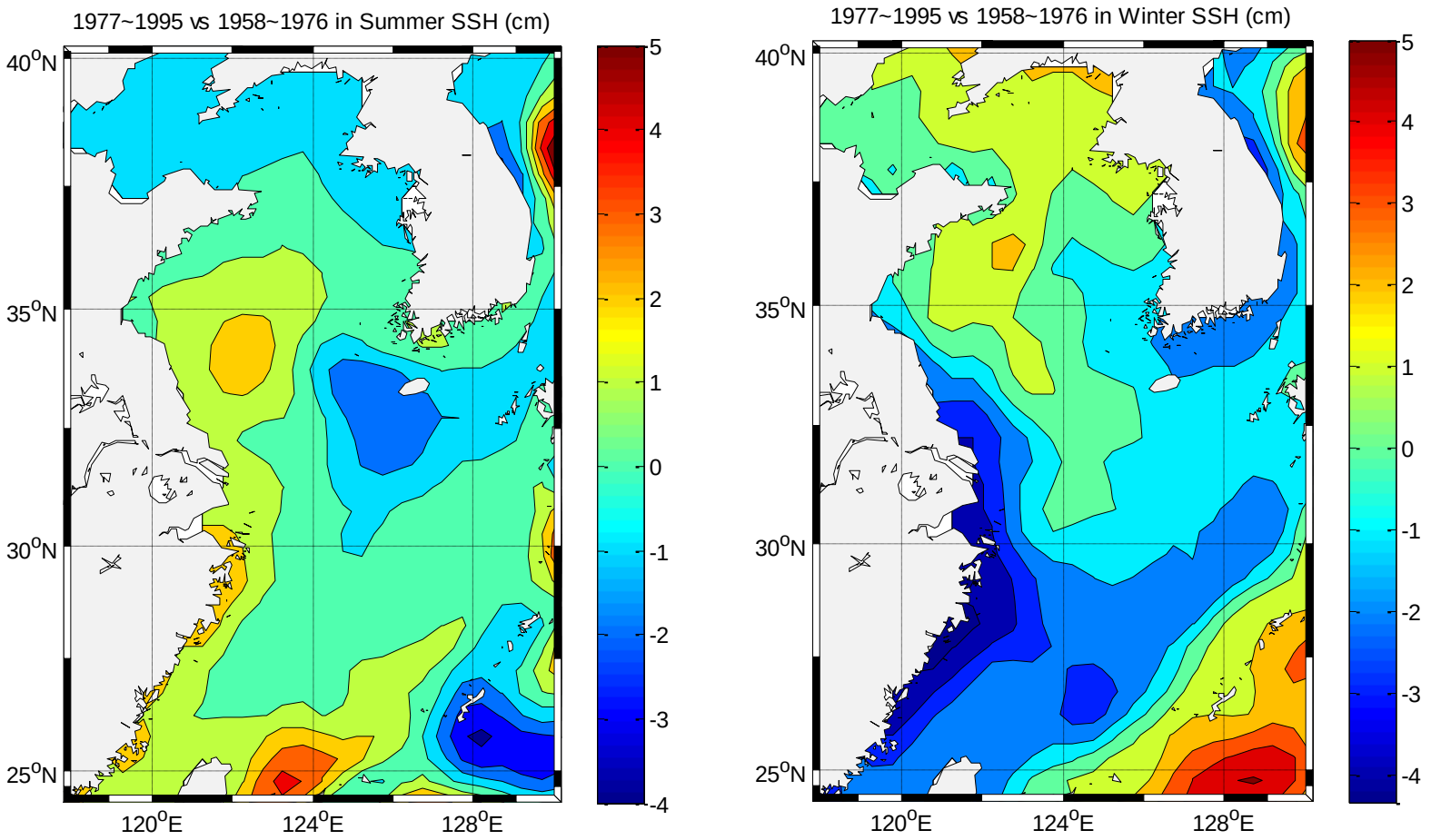
Differences between the periods of 1977-2000 and 1958-1976 in winter *= the simulated results for 1977-2000 minus those for 1958-2000*:

The winter currents, SST, SSS and SSH anomalies in the YS/ECS.

The results show that while the EAWM weakens after 1976/77, **a cyclonic and an *anti*-cyclonic anomalous currents** appear in the YS/ECS including the increasing TWC & KC, which induce a negative and a positive SST anomaly centers, negative SSS and positive SSH anomalies in the YS, but the opposite in the ECS.

Summer

Winter

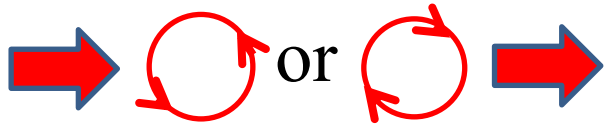


The observed SSH anomalies in the ECS for 1977-1995 minus those for 1958-2000

Left: summer; Right: winter; Data from SODA.

Comparison of the simulated and observed results could identify that the change of EAM would play a great role in the marine environment, e.g., SSH variations.

4. Conclusion

1. Weakening EAM  SST, SSS & SSH.

It would be easy to understand Why and How the change of the EAM could greatly impacts on the ECS marine environment.

2. The variations of SSH do not simply depend on the wind field change, but on the changes of the ocean current patterns forced by wind field.

3. It needs to explore how the strengthening EAM (if so) impacts on the ECS marine environment.

Thank you!