PICES-2011; Recent advances in monitoring and understanding of Asian marginal seas, Khabarovsk, Russia , Oct. 14, 2011

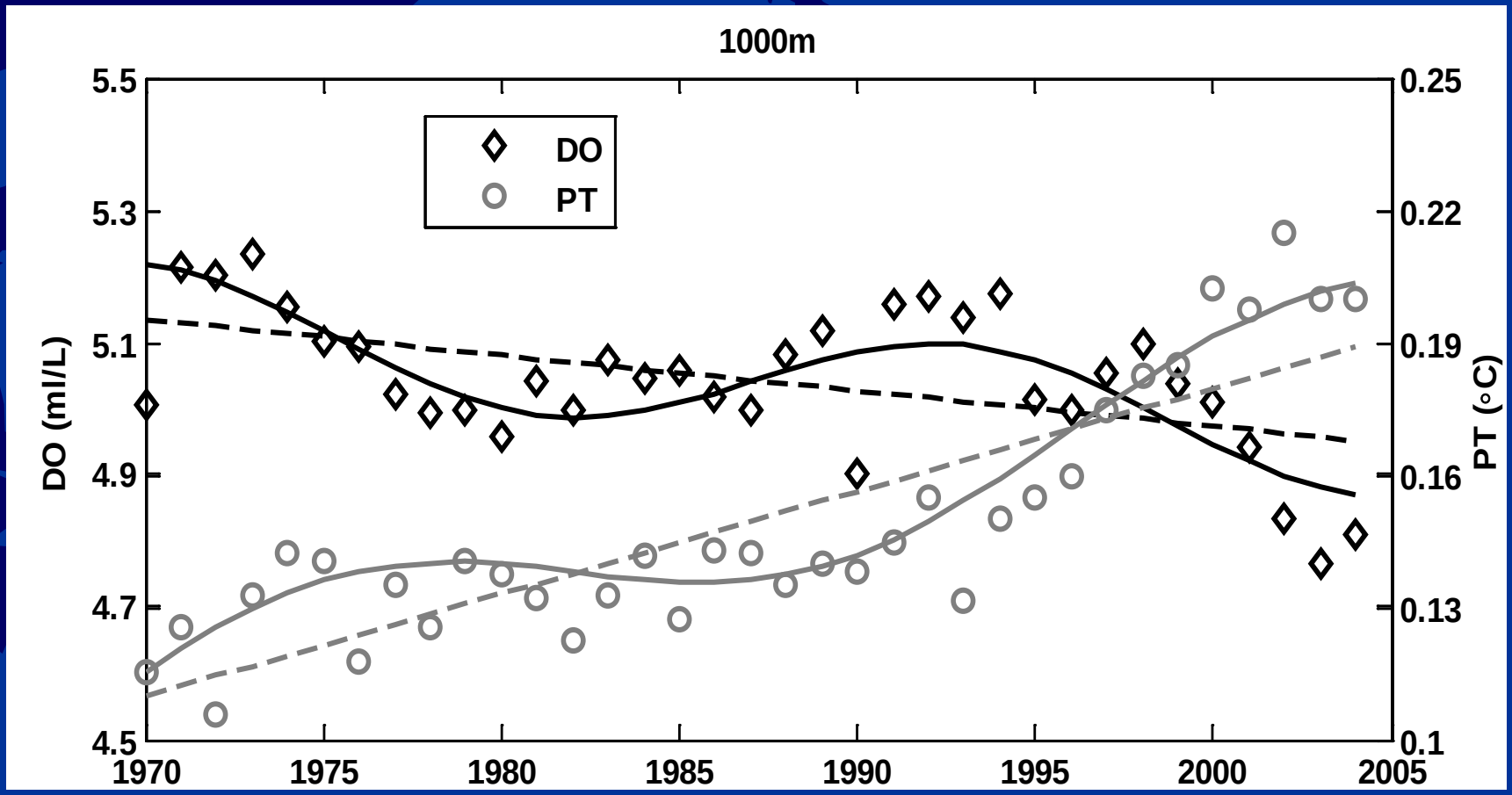
The East Asian Marginal Seas System: Connectivity between the Japan Sea and the East China Sea

Tomoharu Senjyu (RIAM, Kyushu Univ.)

The linkage system among the East Asian marginal seas including atmosphere over the seas.

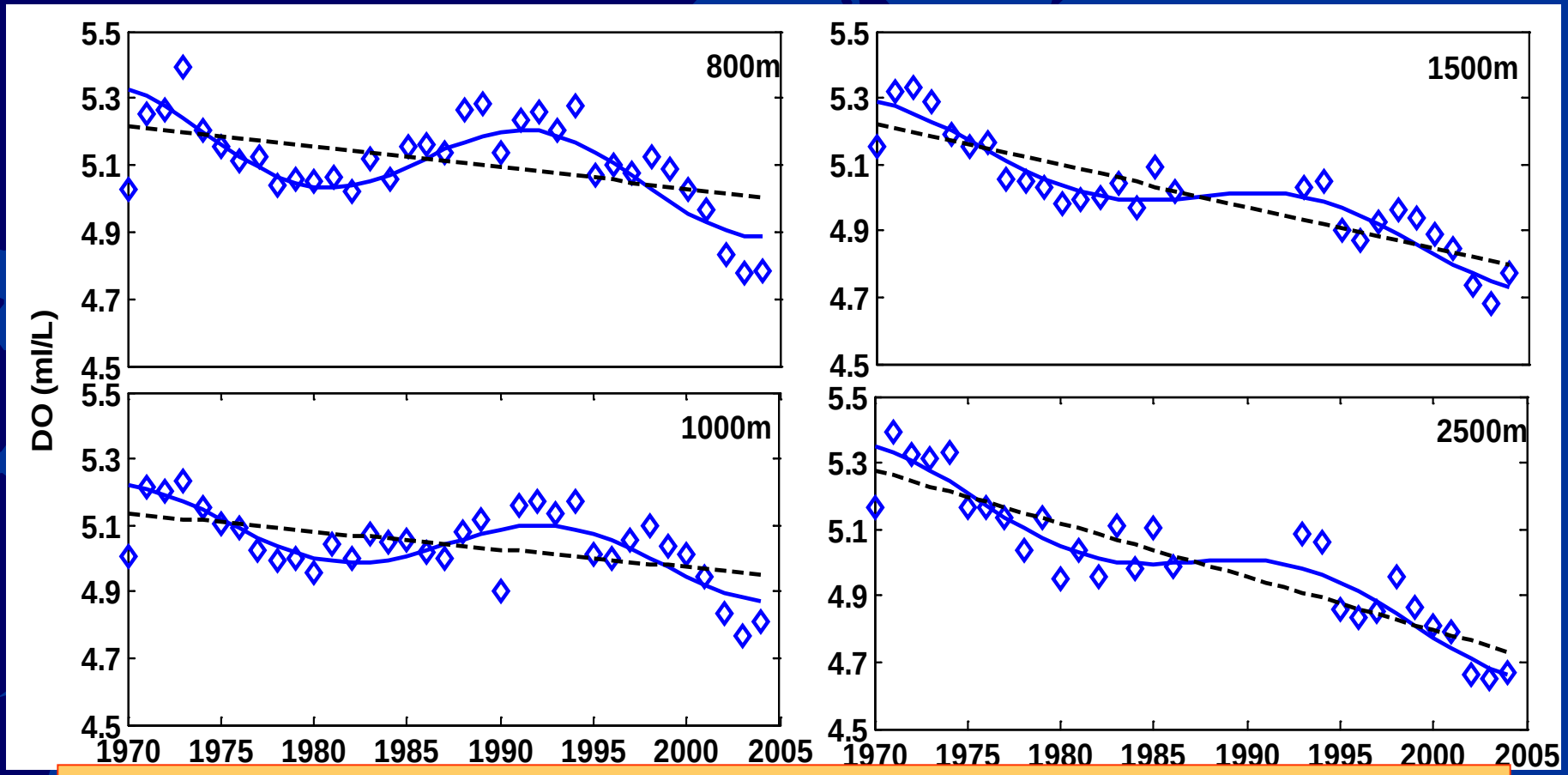
1. Interdecadal variation in the Japan Sea Proper Water
2. Interannual salinity variations in the Tsushima Strait

Interdecadal variation of DO and PT in the Yamato Basin



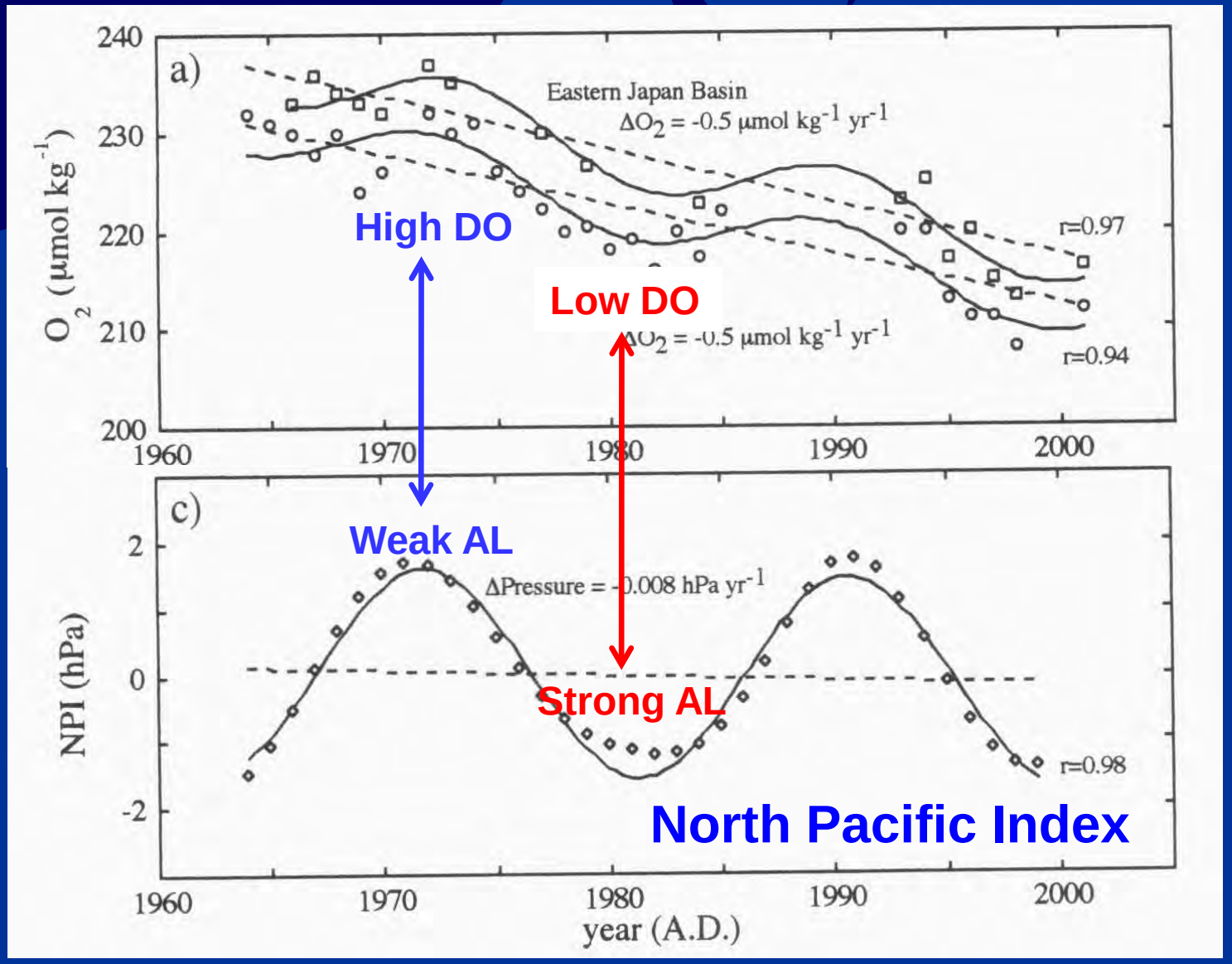
Cui and Senjyu (2010)

Time series of DO at some depths



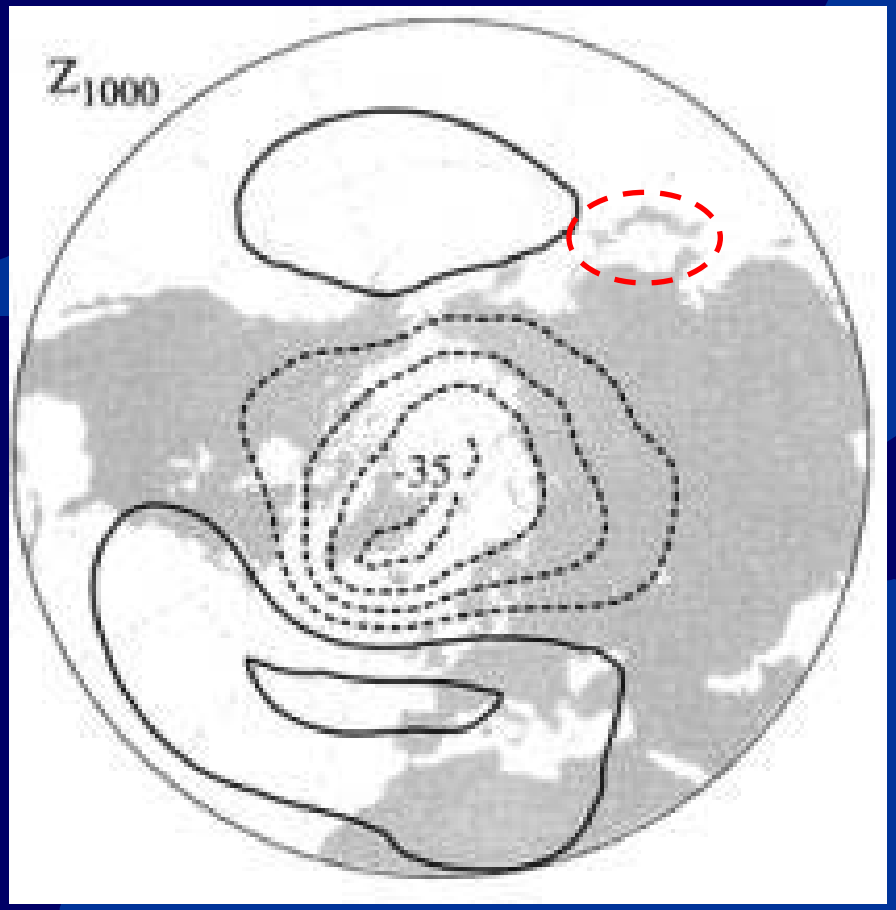
An interdecadal variation with a period and phase is recognizable throughout the 800-2500 m range

Time series of DO in the JSPW and NPI



Watanabe et al. (2003)

Arctic Oscillation



Anomaly of 1000 hPa surface associated with the Arctic oscillation

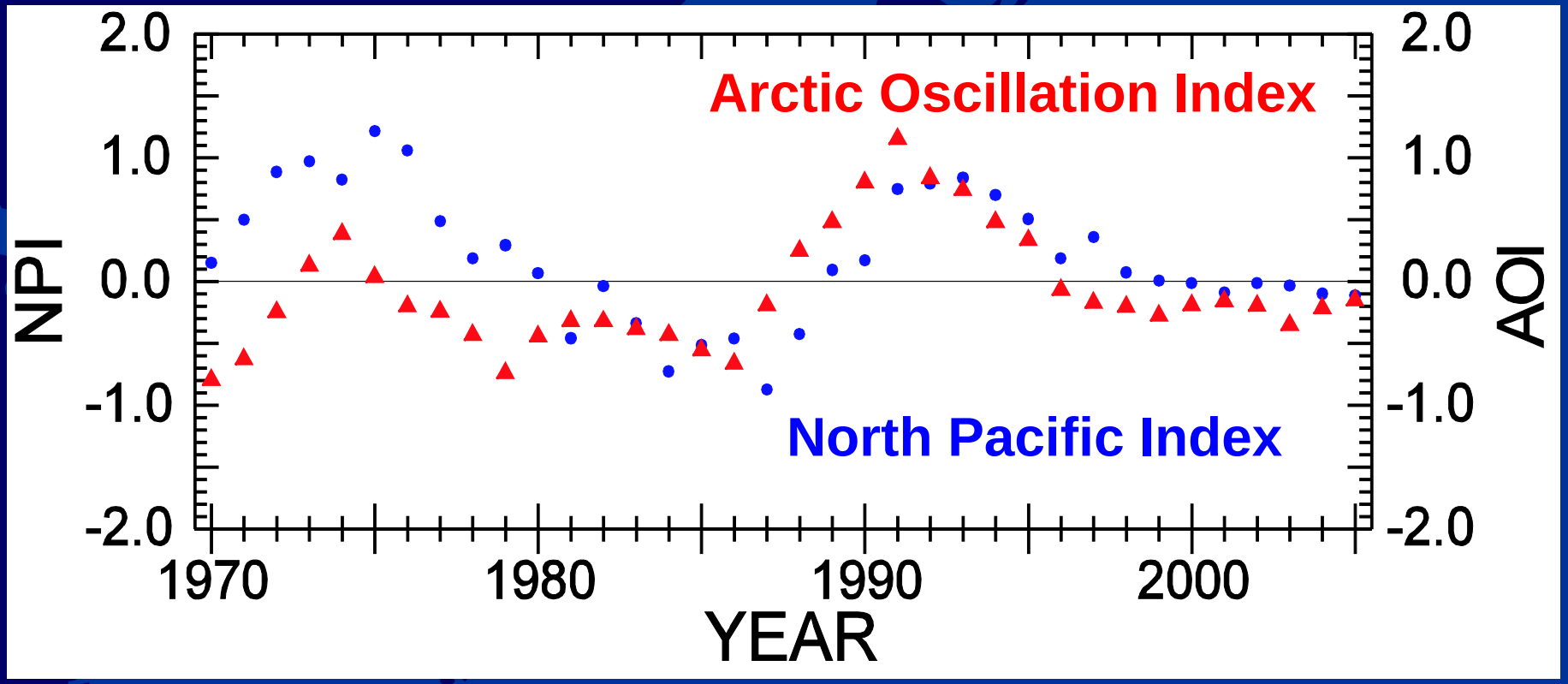
Thompson and Wallace (2000)

Climatic oscillation pattern with opposite polarity between the North pole and mid-latitude areas.

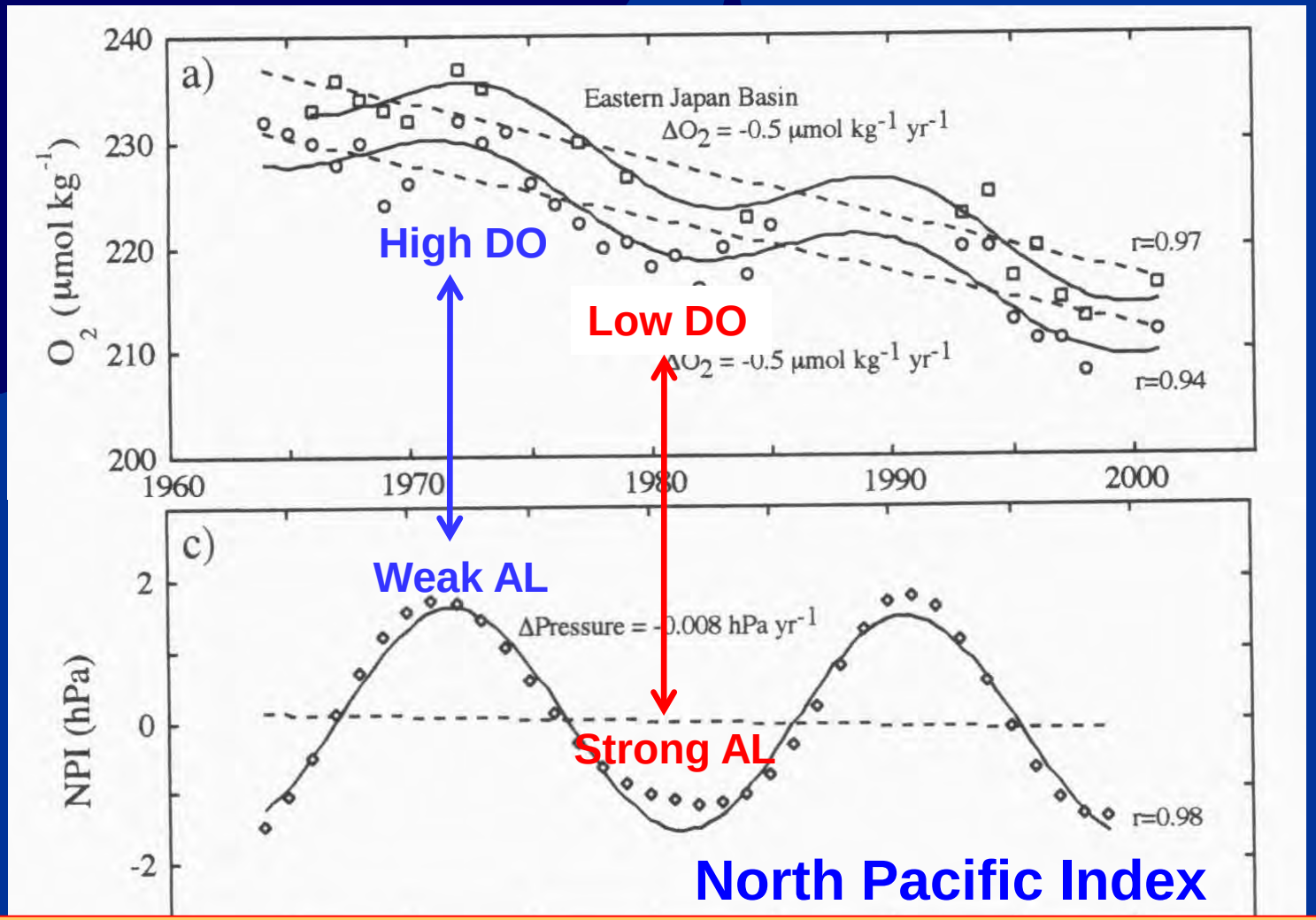
Positive anomaly in the Aleutian Low and negative in the Siberian High.

East-west atmospheric pressure gradient over the JS becomes large in the period of negative AOI, and vice versa.

Time series of NPI and AOI



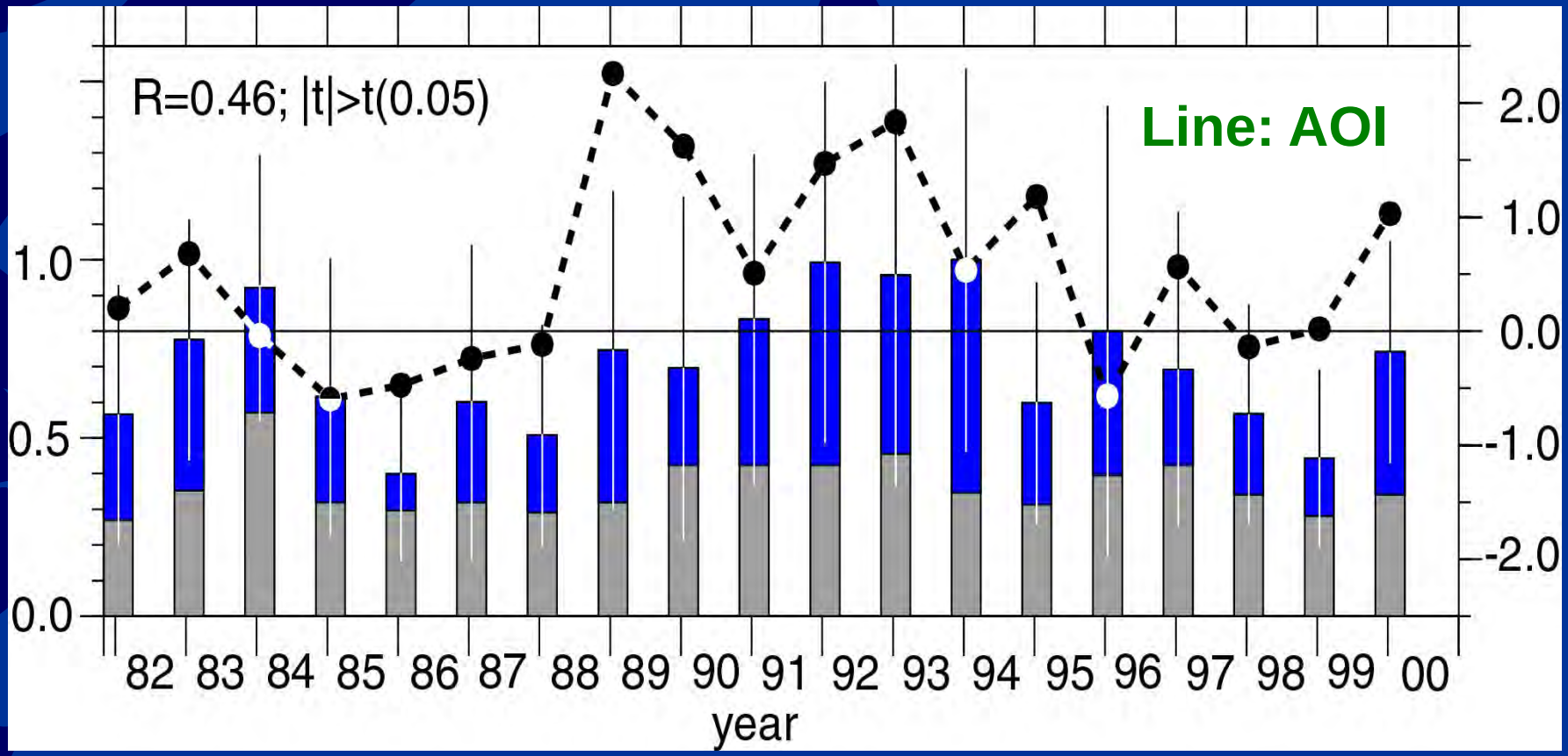
The periods of negative NPI or AOI correspond to the strong winter monsoon over the Japan Sea.



JSPW is formed
in the winter with weak monsoon
rather than winter with strong monsoon?

Variation of cold-air outbreak and AOI

Bar: wavelet spectrum of winter wind speed for the 5-15 day period band over the Yamato Basin



Isobe and Beardsley (2007)

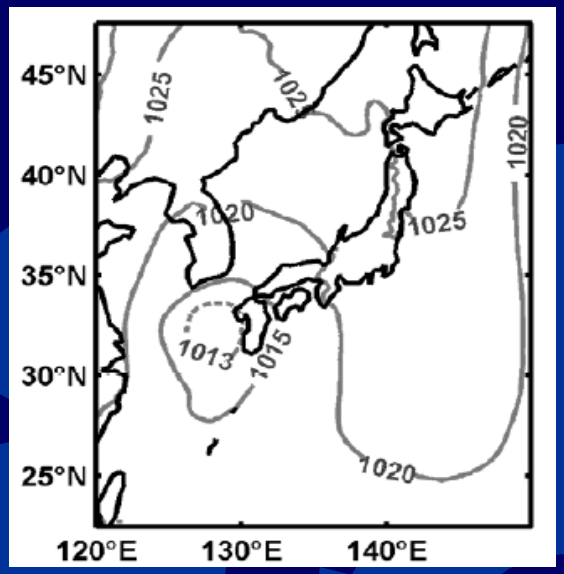
2003

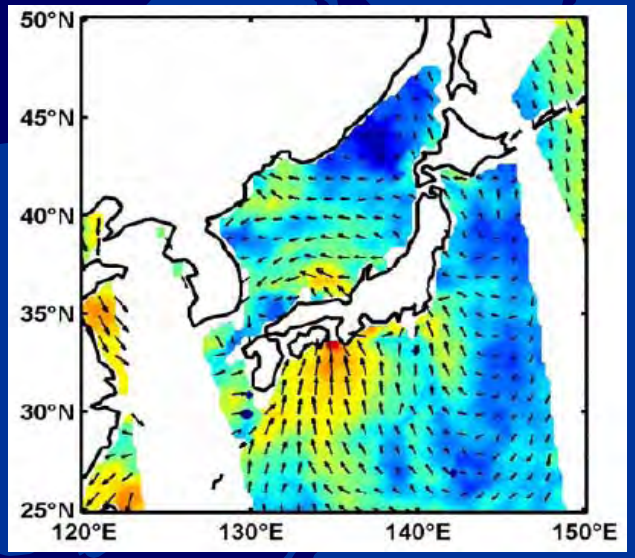
pressure

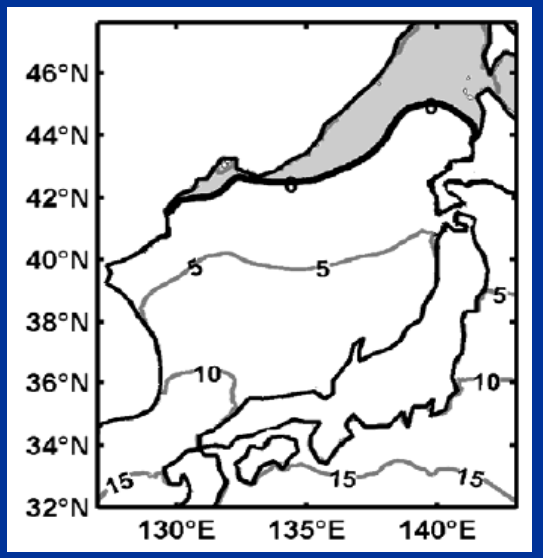
wind

A.-temp.

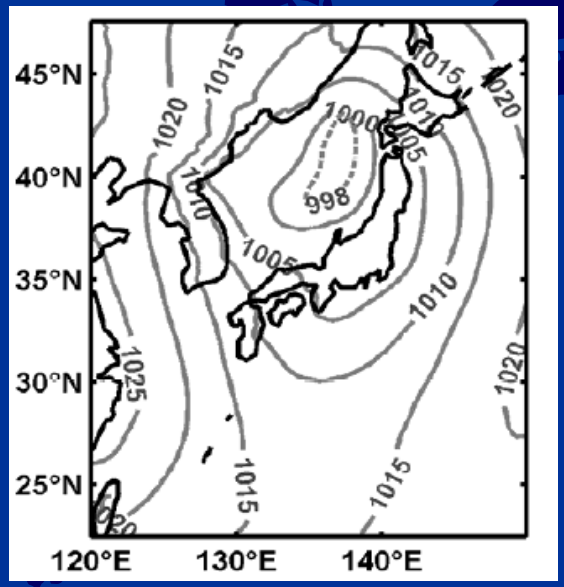
1/26

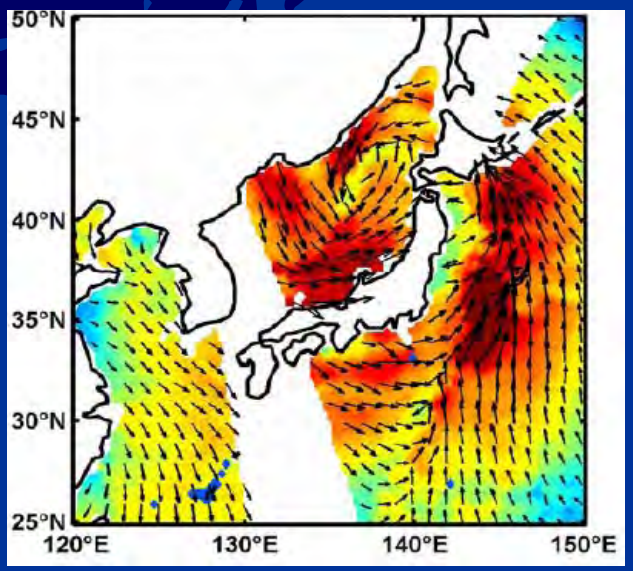


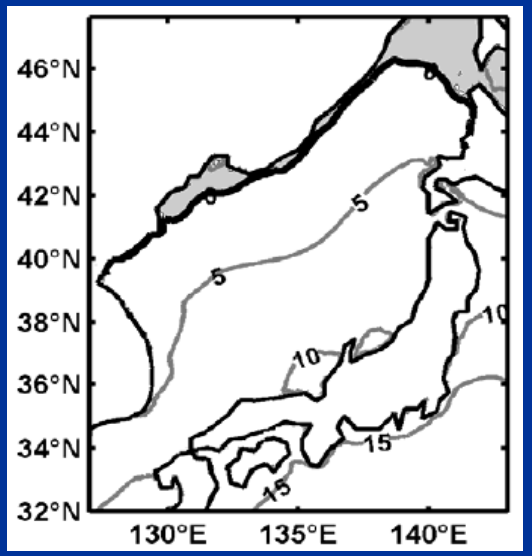




1/27







Cui and Senjyu (2010)

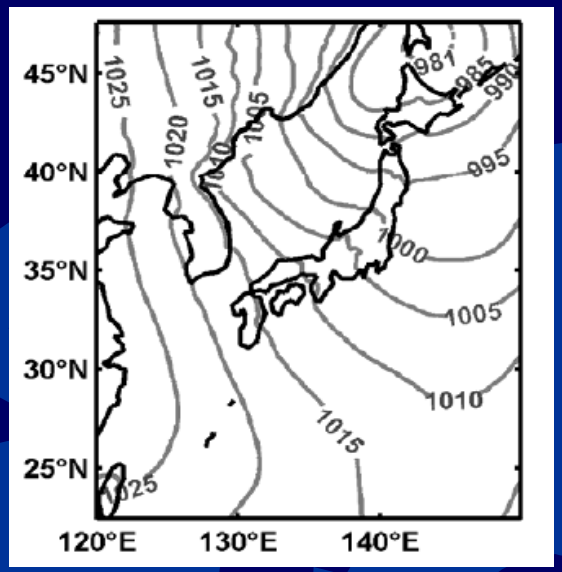
2003年

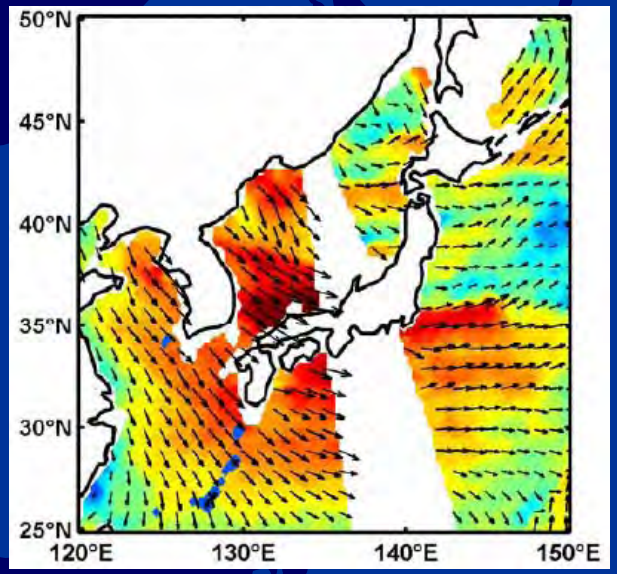
pressure

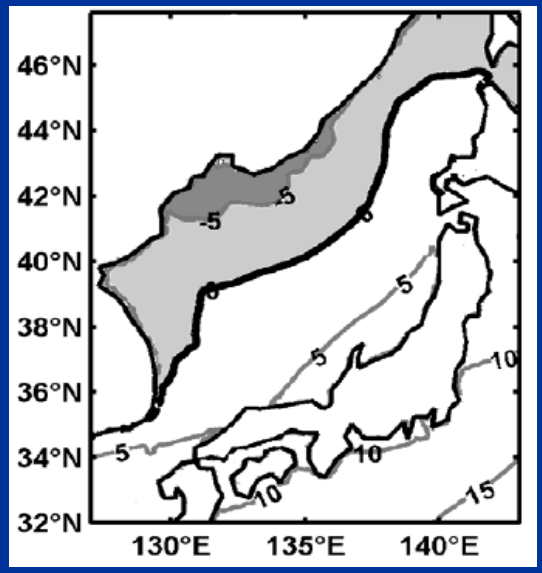
wind

A.-temp.

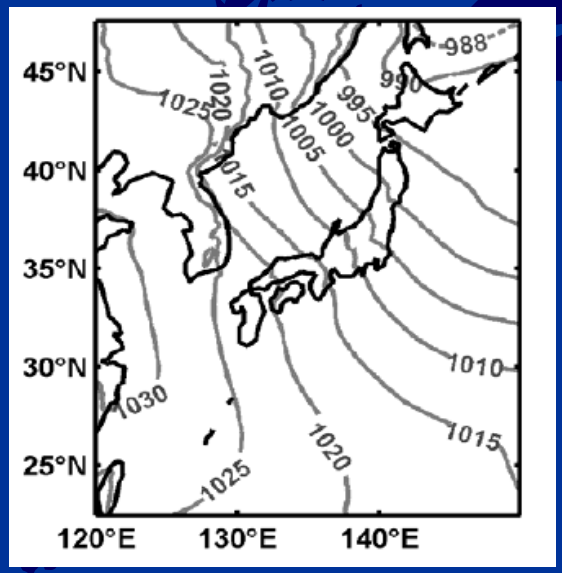
1/28

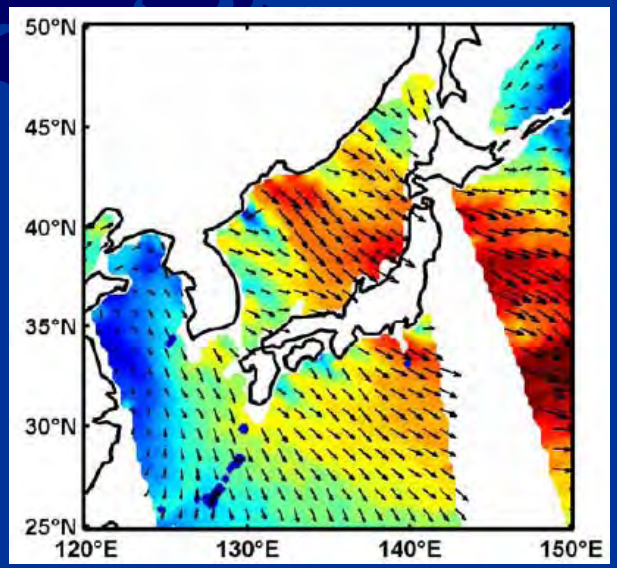


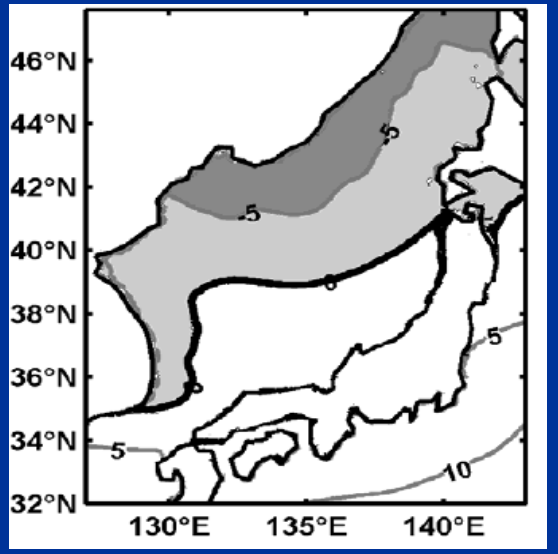




1/29

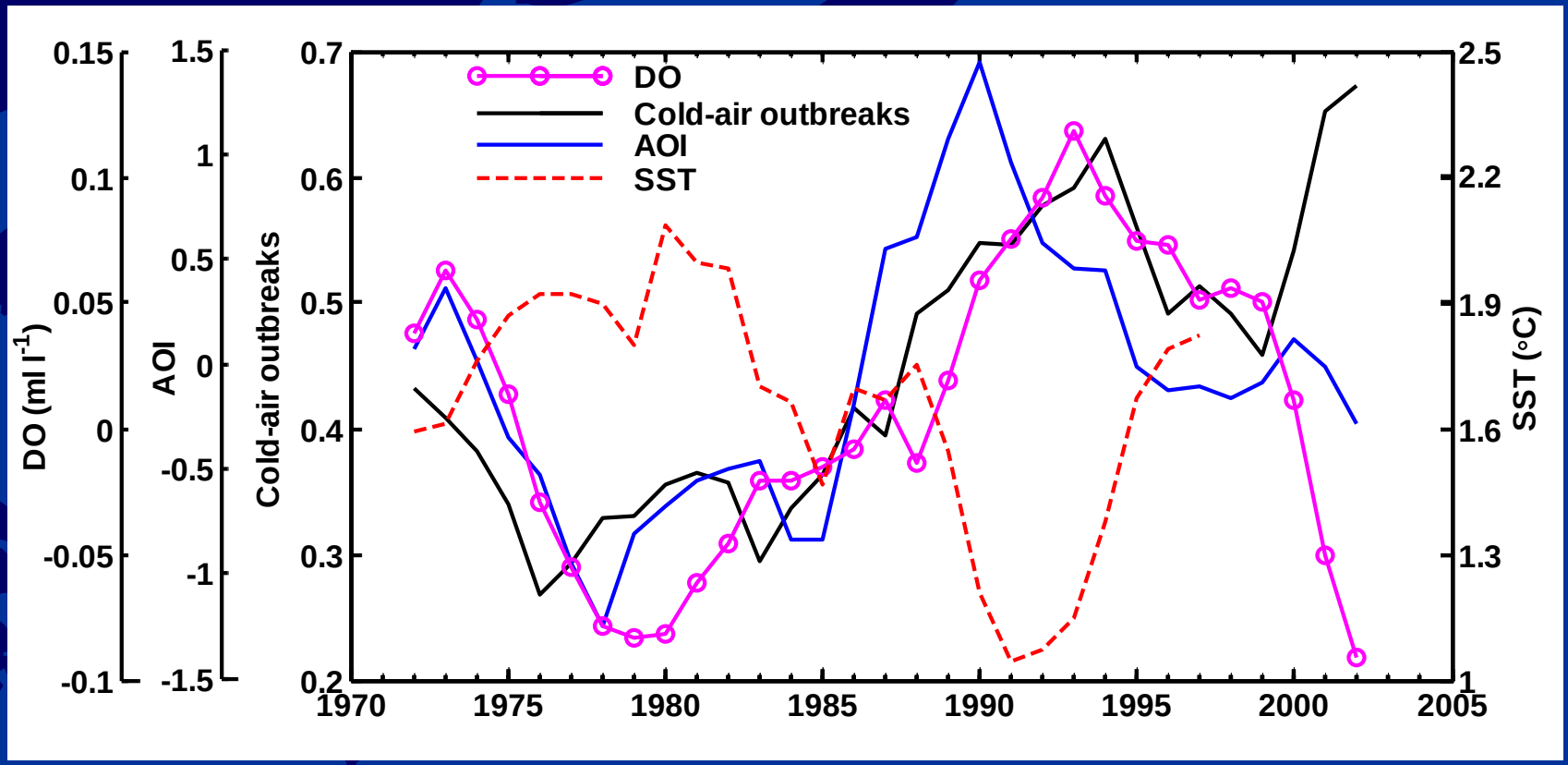






Cui and Senjyu (2010)

5-yr running means of DO, cold-air outbreak, AOI, and SST south off Vladivostok

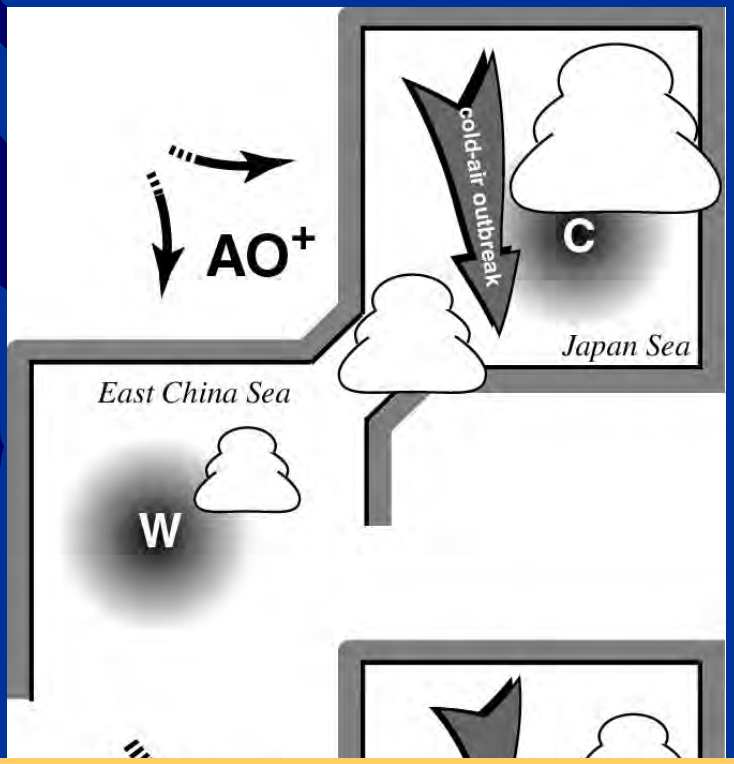


The formation of JSPW is modulated by AO!

In the year of positive AOI, the East Asian winter monsoon is weak

The SST over the East China Sea is relatively warm, and atmospheric disturbances easily develop on the ECS.

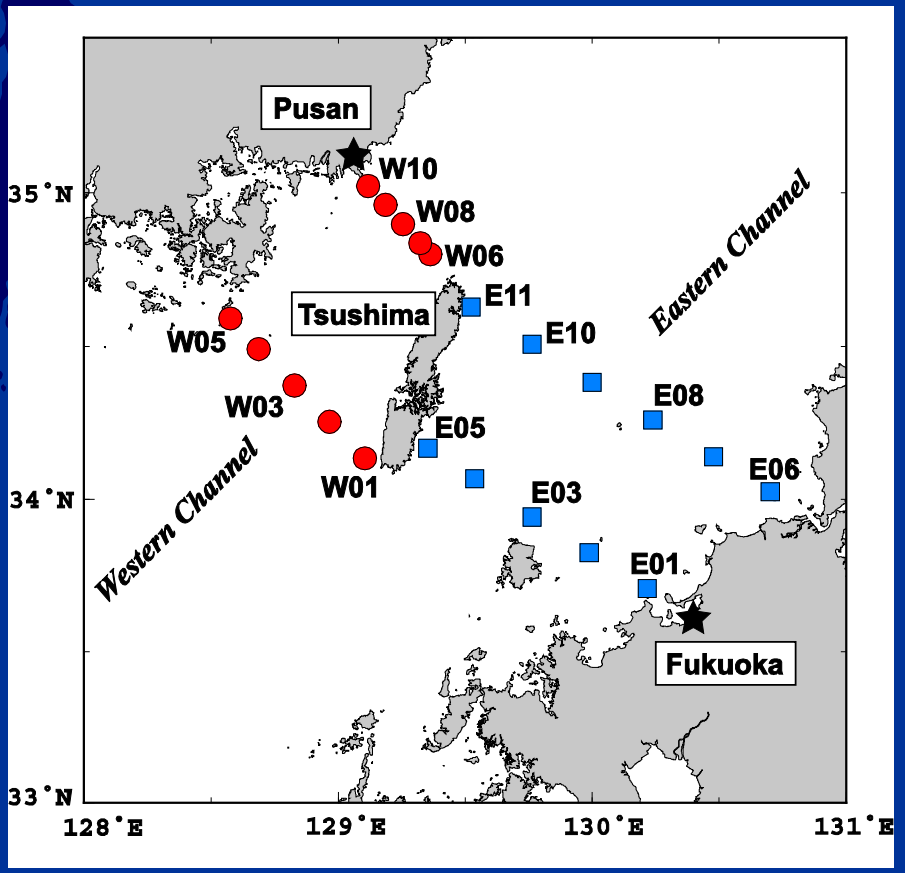
Since the atmospheric



The formation of the JSPW is linked with the SST in the East China Sea through the atmosphere over the seas, in the larger framework of the Arctic Oscillation.

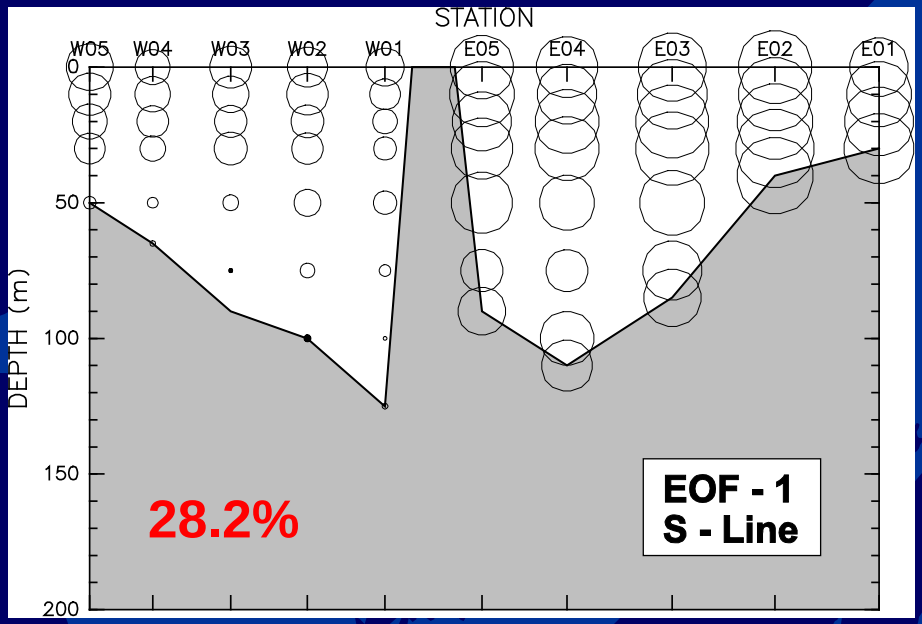
Interannual salinity variations in the Tsushima Strait

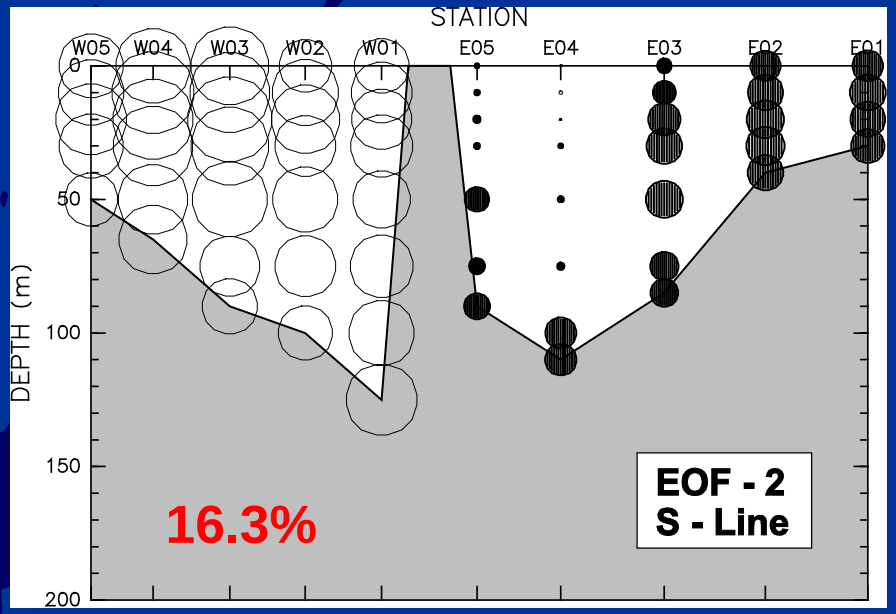
- The Tsushima Strait consists of the eastern and western channels.
- Interannual salinity variations in the channels are different from each other !?

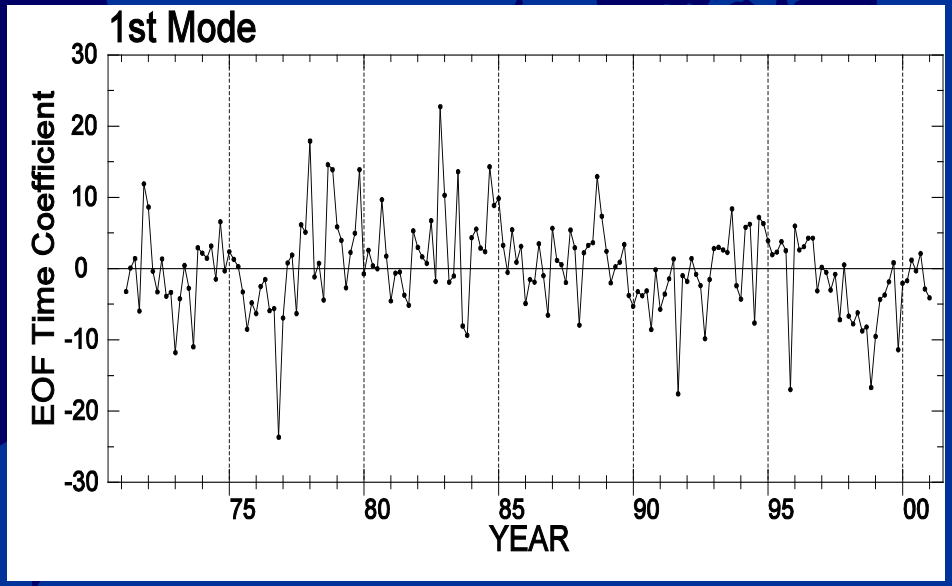


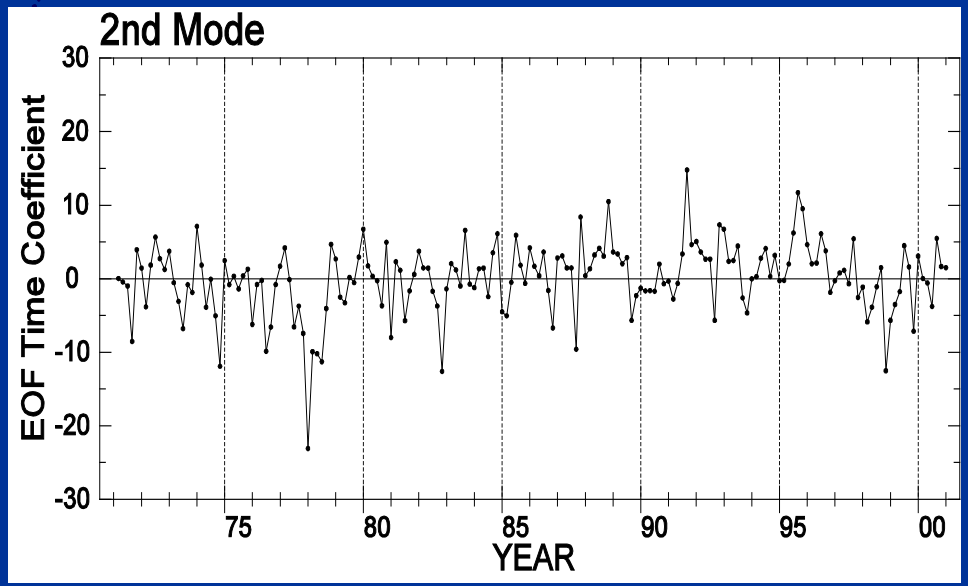
Senjyu et al. (2006)

1st and 2nd EOF modes for the salinity variation

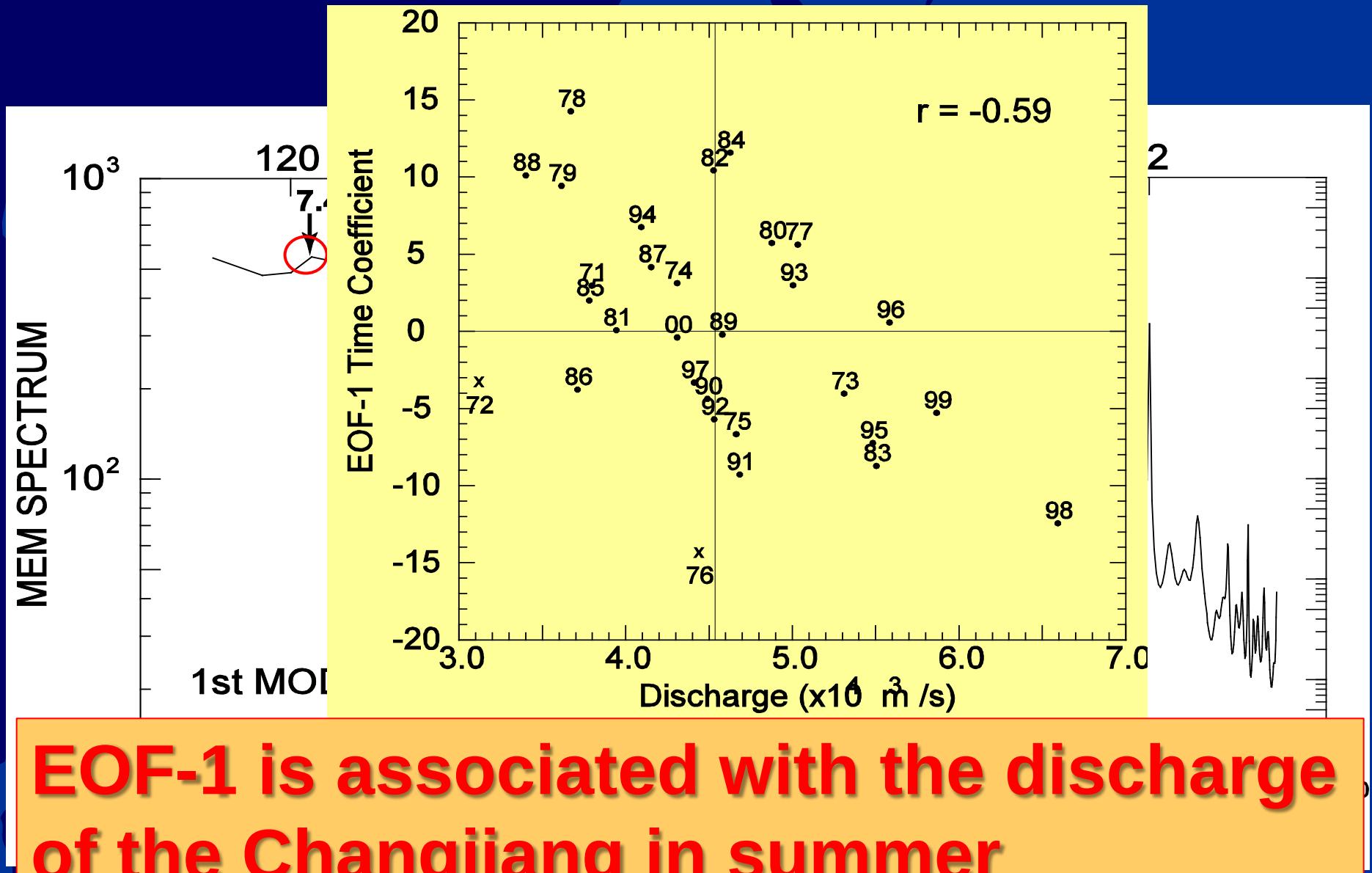




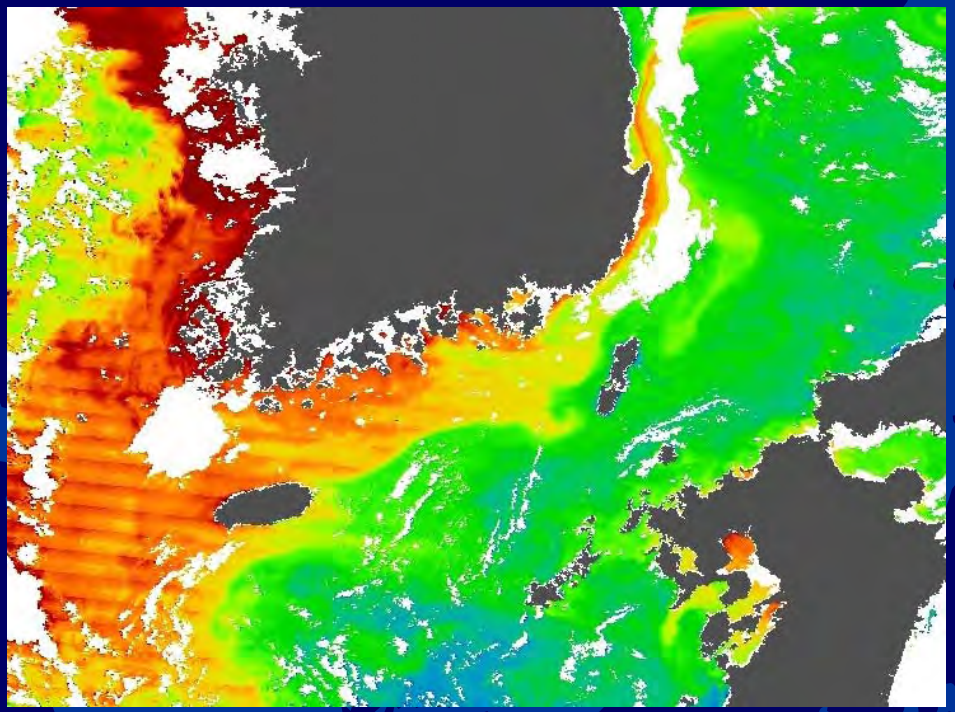




Spectrum of EOF-1 and Changjiang discharge



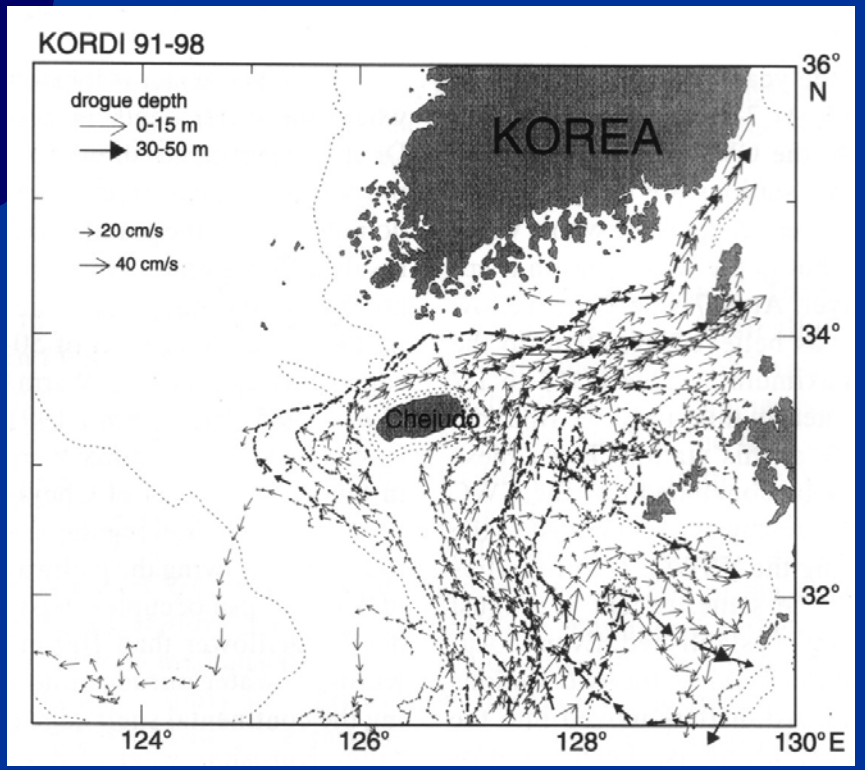
EOF-1 is associated with the discharge of the Changjiang in summer



MODIS Chl-a image

Aug. 15, 2006

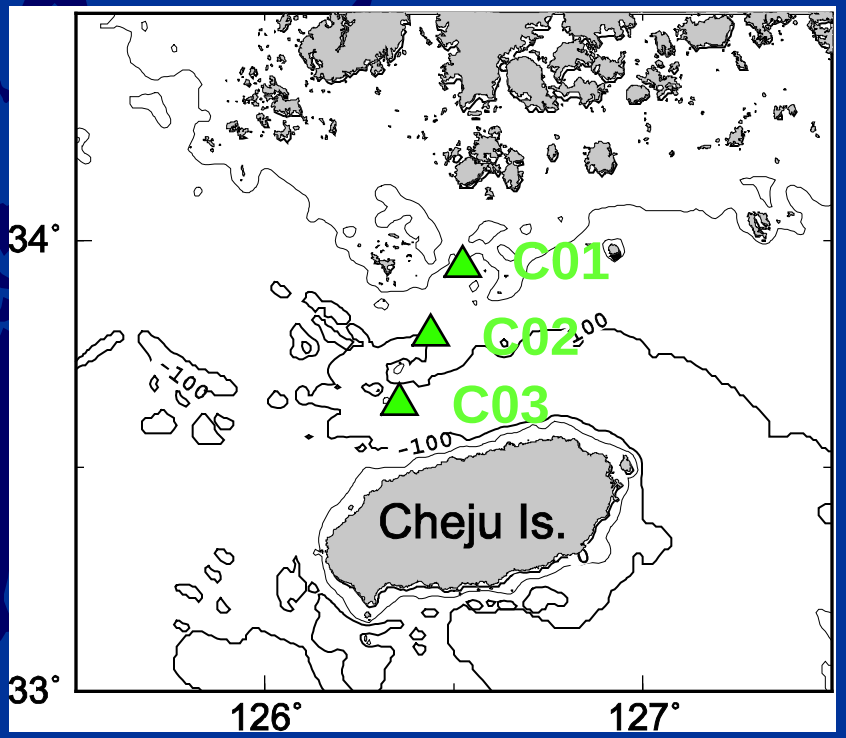
(HP of JAXA/EORC)



Salinity variation in the western channel is associated with that in the Jeju Strait?

Lie et al. (2000)

- The datasets of temperature and salinity anomalies were prepared by subtracting the climatological monthly means for each data point from the original data.

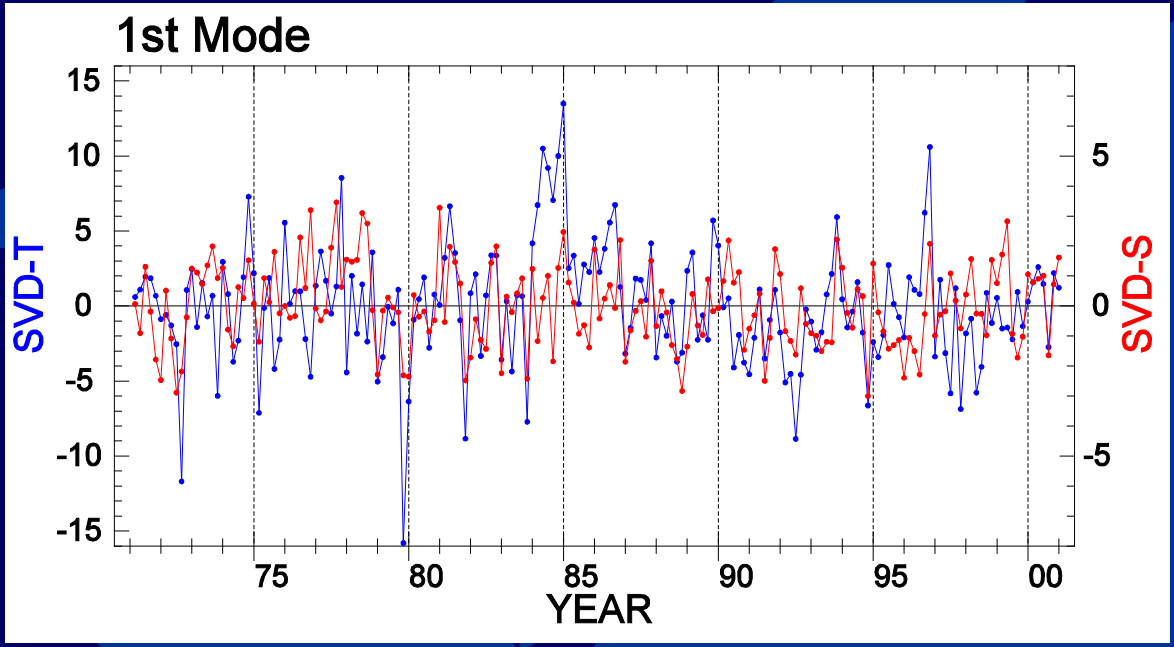


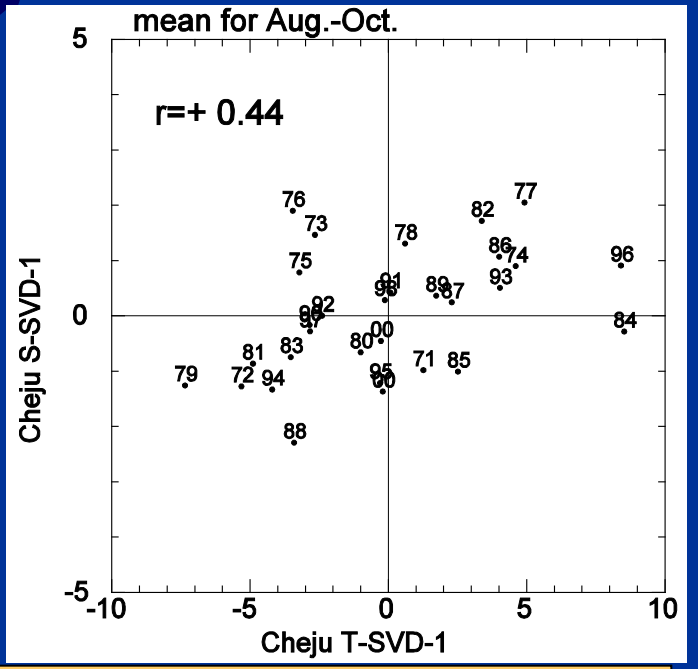
To the T and S anomaly datasets, we applied

1. EOF Analysis
   --- To detect of dominant modes of variation
2. SVD Analysis
   --- To detect of co-variability in T and S fields

Time coefficient of SVD-1 (SCF=0.778)

blue: T, red: S

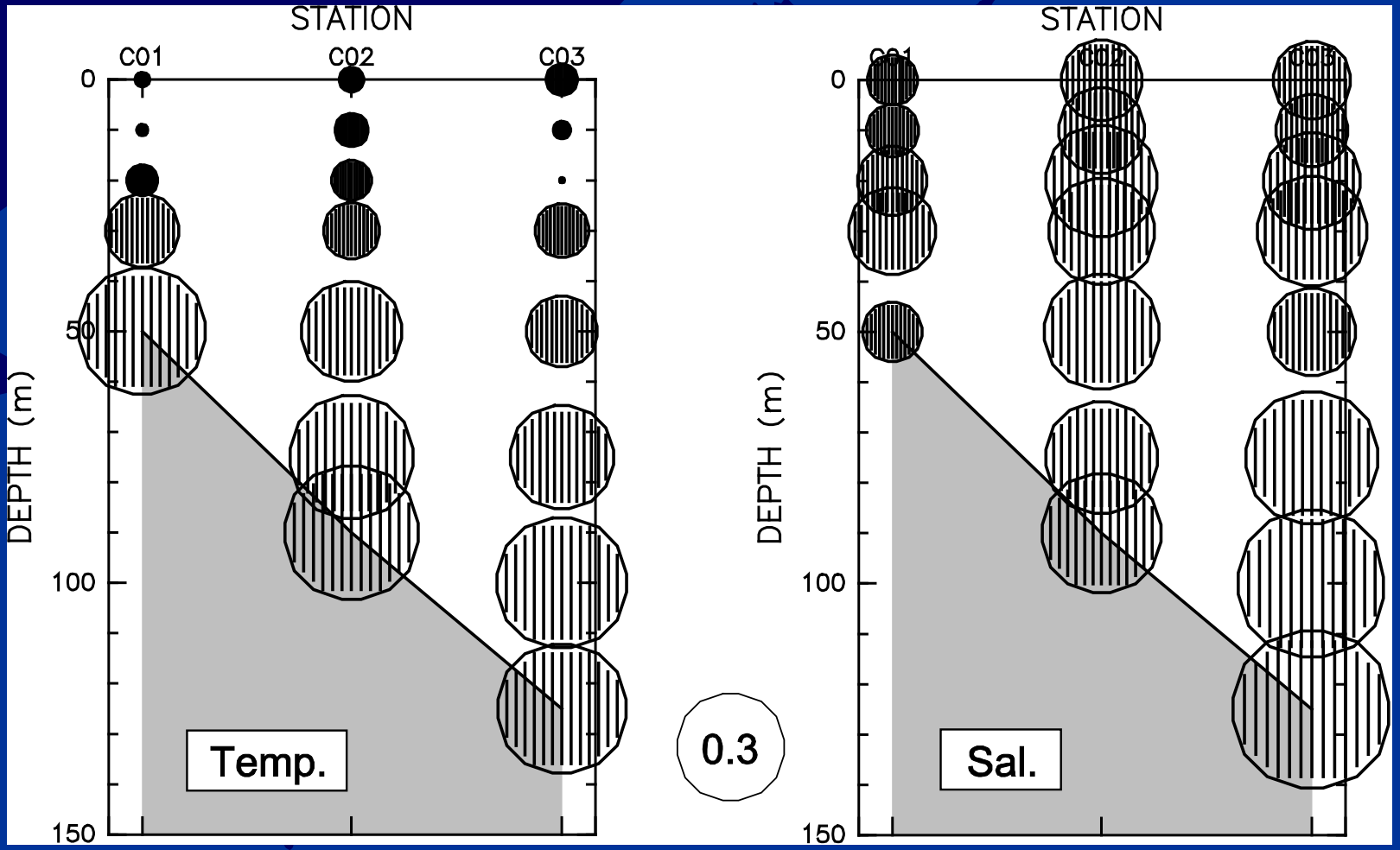




Significant co-variability between T and S fields in summer

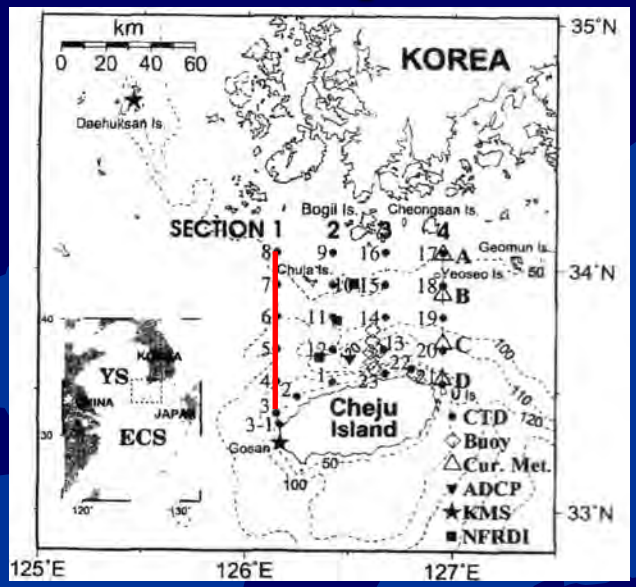
Corresponding to EOF leading modes in T and S → dominant mode

Heterogeneous correlation map for SVD-1



When the bottom temperature decreases, salinity in the strait tends to be decreases.

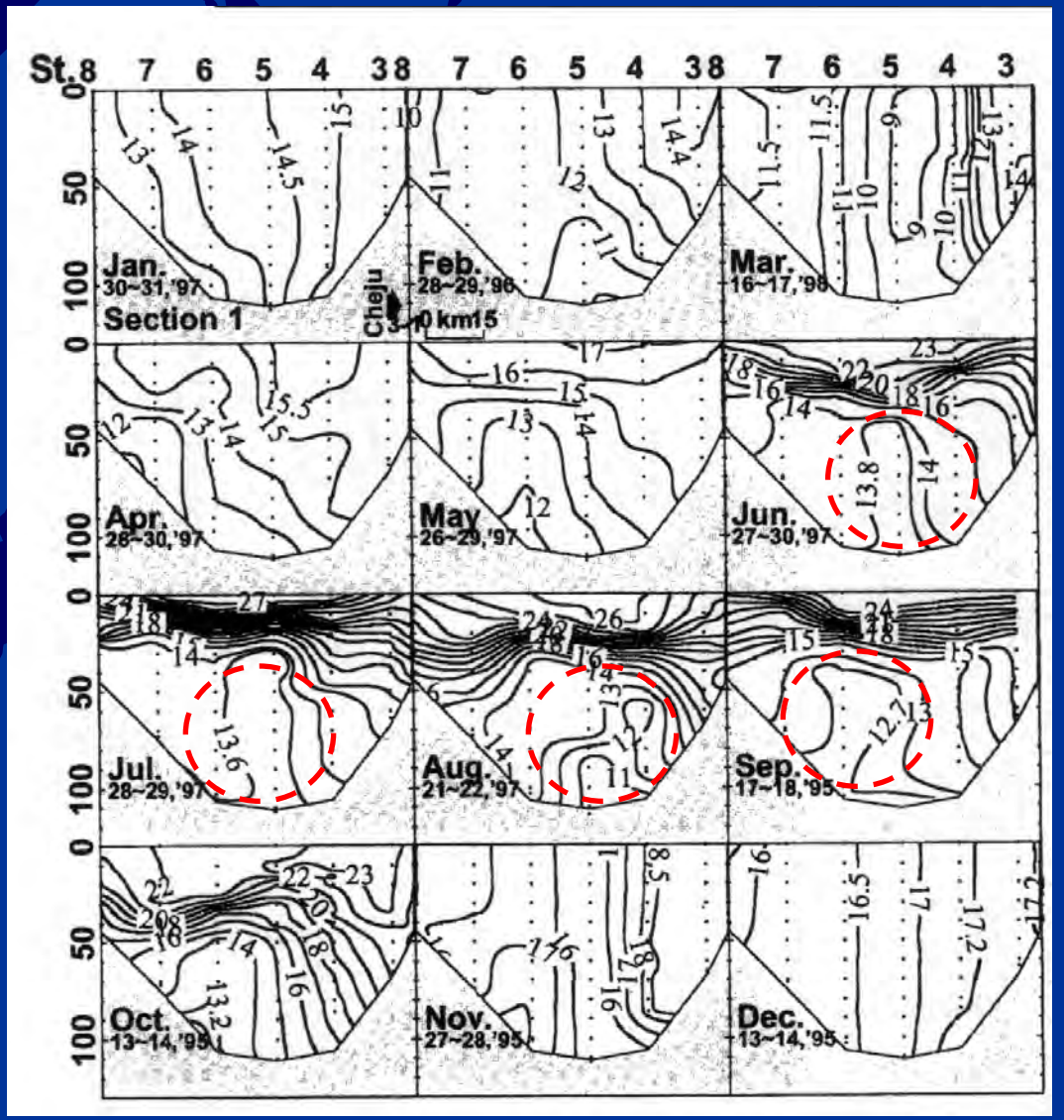
Temperature in the Jeju Strait



Intrusion of cold bottom water in summer

→ intensification of stratification and baroclinicity

→ increase of eastward baroclinic transport



Pang et al. (2003)

Possible scenario···

- Intrusion of cold bottom water into the Jeju Strait in summer

↓

- Increase of baroclinicity and intensification of eastward baroclinic flow in the strait

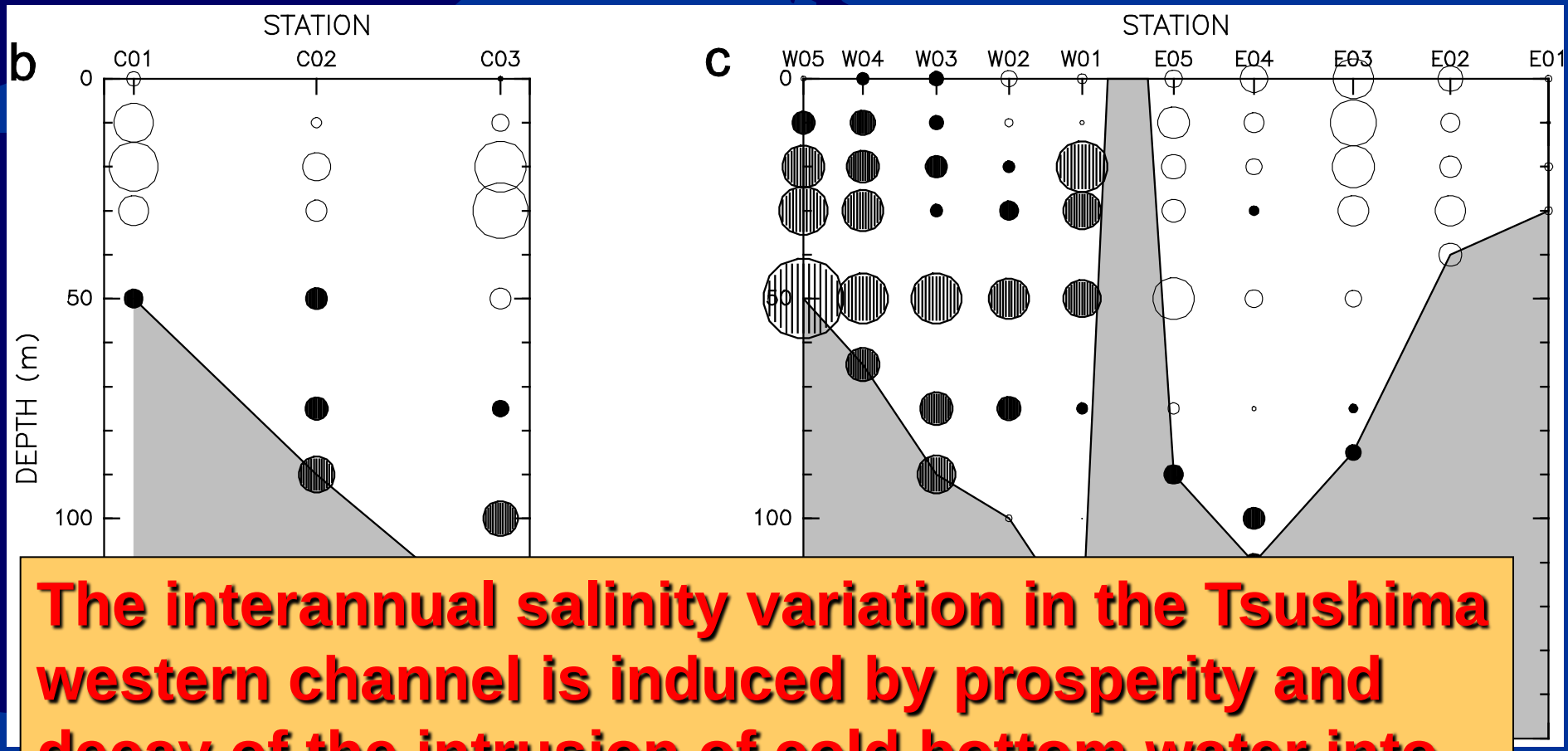
↓

- CDW west of the Jeju Island is drawn in the strait and decrease of salinity in the strait

↓

- Decreasing of salinity in the Tsushima western channel

Heterogeneous correlation map for SVD-2 between temperature in the Jeju Strait and salinity in the Tsushima Strait



The interannual salinity variation in the Tsushima western channel is induced by prosperity and decay of the intrusion of cold bottom water into the Jeju Strait in summer.

The cold bottom water in the Jeju Strait

- The cold bottom water comes from west of the Jeju Strait in summer
  - Yellow Sea cold bottom water
  - Southwestern water of the Jeju Strait
- Connectivity between the Yellow and/or East China Seas and the Japan Sea

Salinity condition in the Japan Sea is controlled by the hydrographic conditions in the Yellow and East China Seas

Conclusion

The East Asian marginal seas including atmosphere over the seas should be interpreted as one system

(The East Asian Marginal Seas System)