Decadal changes in temperature and salinity In Korean waters

Pukyong National University in Korea
National Fisheries Research and Development Institution

Yeojin Jung, Jong Hee Lee,
Jae Bong Lee and Chang Ik Zhang

Introduction

- physical environment ⟺ ecosystems

⇒ regime : evident in physical and biological variables

Physical symptoms	Biological symptoms
- oceanic circulation - temperature, salinity - mixed layer depth & themocline	- distribution - spawning - productivity (abundance of phytoplankton & zooplankton)

- For the sustainable management of fisheries

Identification of Regime shifts by specific species

Needed a systematic biological observation

- **Papers about regime shift in Korean waters**

  - 'Climatic regime shifts and their impacts on marine ecosystem and fisheries resources in Korean waters by Zhang et al. (2000)
  - 'A comparison of three marine ecosystems surrounding the Korean peninsula: Responses to climate change by Rebstock et al. (2004)
  - 'Variability in scale growth rates of chum salmon *(Oncorhynchus keta*) in relation to climate changes in the late 1980s' by Seo(2006)

- **Decadal oceanic changes in whole Korean waters have not been studied yet**

Purpose of study

requires study on the mechanisms of interaction between physical and biological system

PURPOSE

- **To suggest the basic information for these studies**
- **To identify the degree and time of the decadal changes by spatially and temporally in Korean waters**

Data

Ocean physical indicators

SOI, PDO, wind, water temperature, salinity

This study

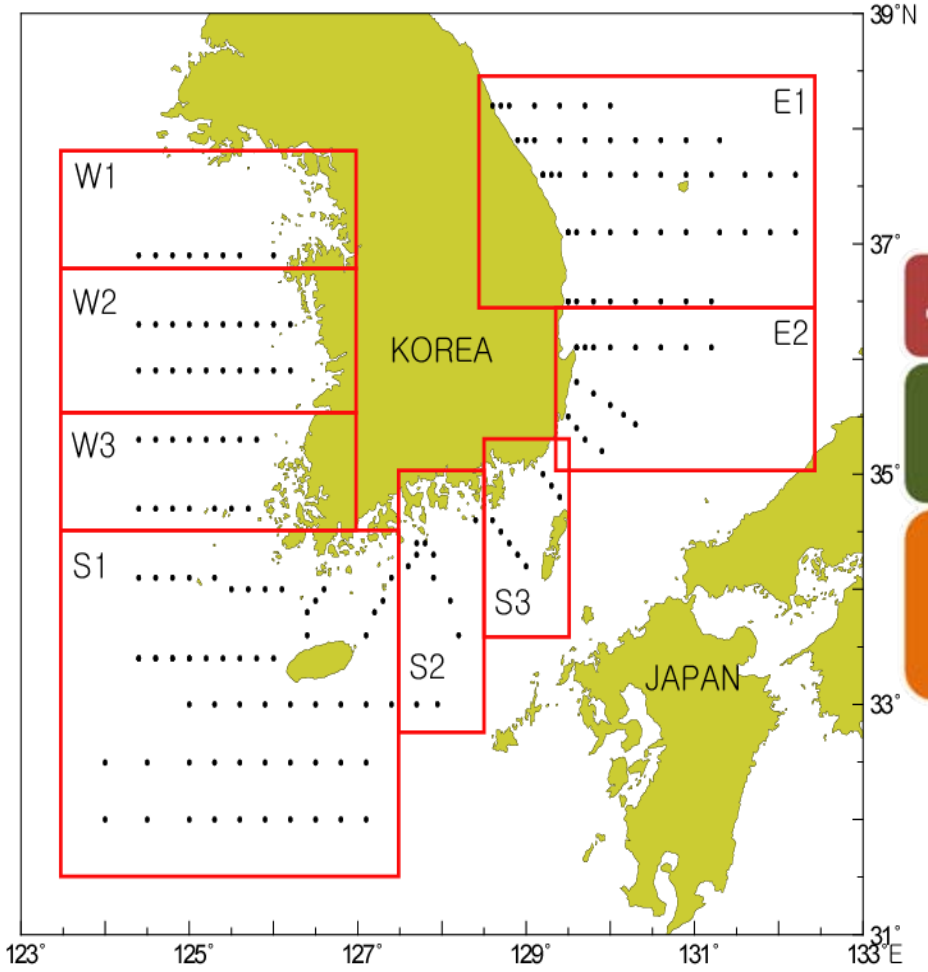
using water temperature, salinity data

RSI, SOM

Temperature, salinity data

- Serial oceanographic data from National Fisheries Research and Development Institute (NFRDI)
- Bymonthly mean seawater temperature and salinity
- Depth : at 0m, 50m
- Period : 1962-2007

- Map of study area



Japan/East Sea	• E1, E2
Yellow Sea	• W1, W2, W3
Northern East China Sea	• S1, S2, S3

Methods

Temporal characteristics

- **RSI (Regime Shift Index) –** by Rodionov (2004)
  1. calculated for 8 areas
  2. seawater temperature, salinity

$$RSI_{i,j} = \sum_{i=j}^{j+m} \frac{x_i^*}{l\sigma_l} \quad , m = 0,1,\ldots,l-1$$

i, j : year
l : The minimum length of the regimes
σ : Standard deviation

$$x_i^* = x_i - \overline{x'_{R2}}$$

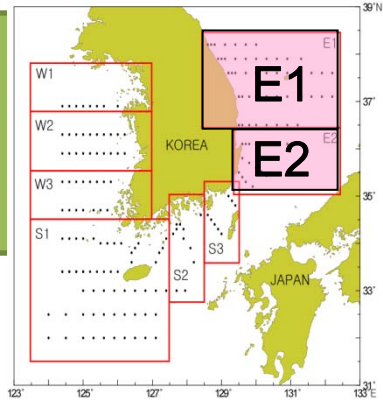
Methods

Spatial characteristics

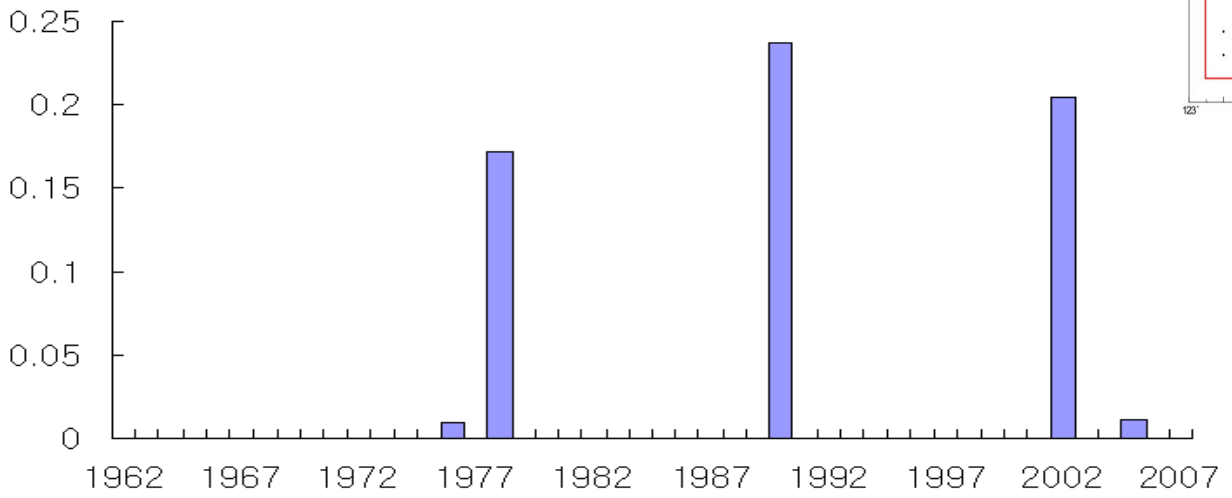
- SOM (Self Organizing Map) – by Kohonen (1995)
  1. calculated by 163 fixed stations
  2. seawater temperature, salinity

Results

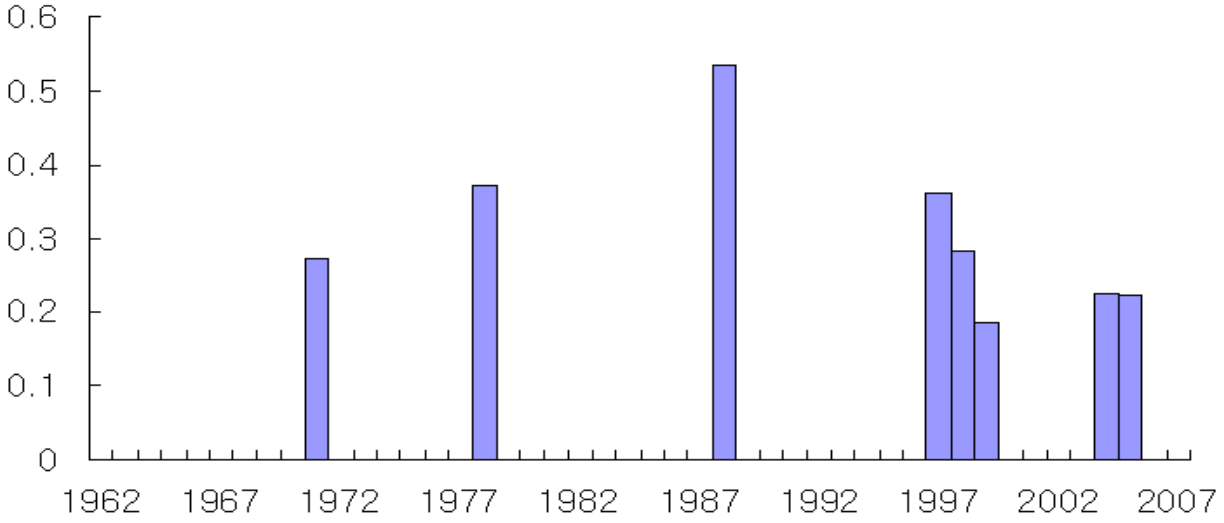
RSI (p=0.1, cut off lengh=10, Huber parameter=1)
- 1. by sea areas



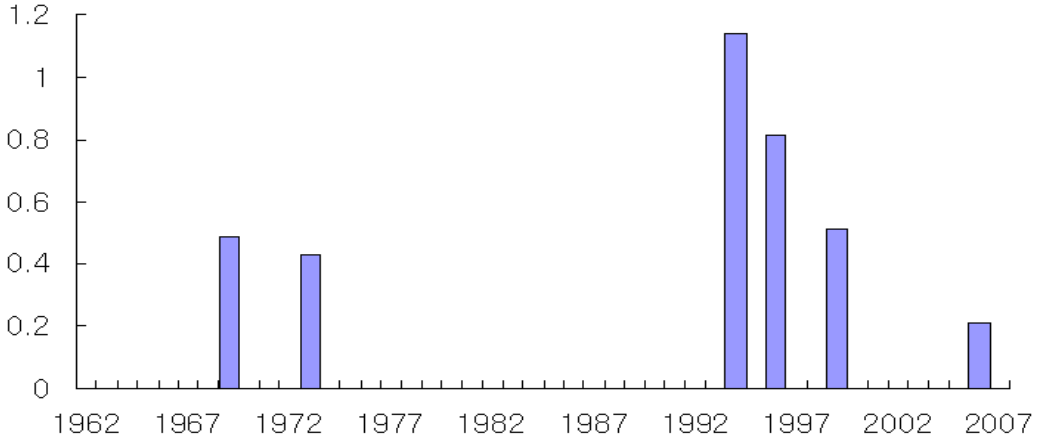
E1

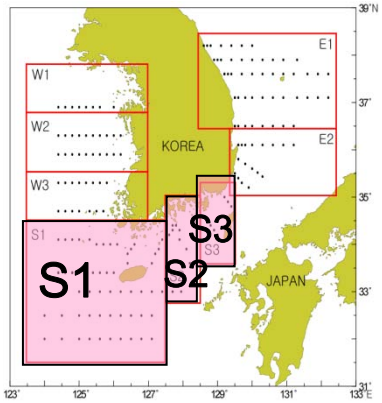


E2

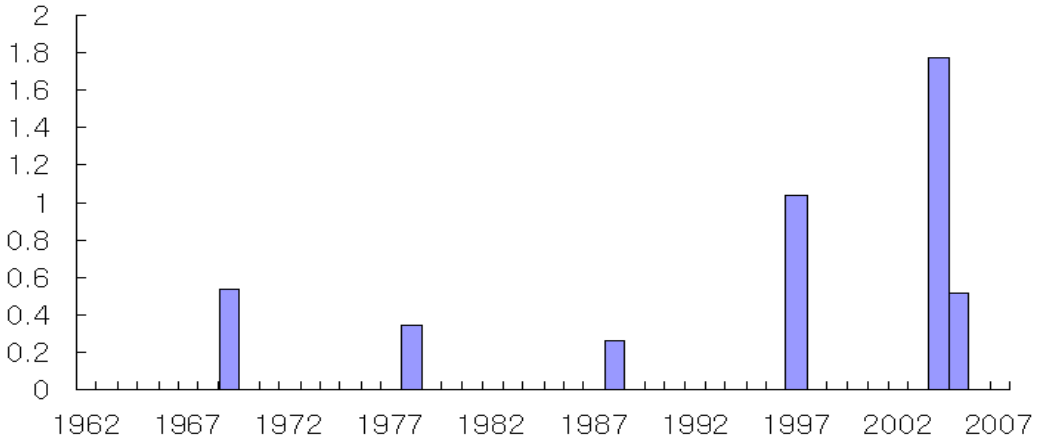


S1

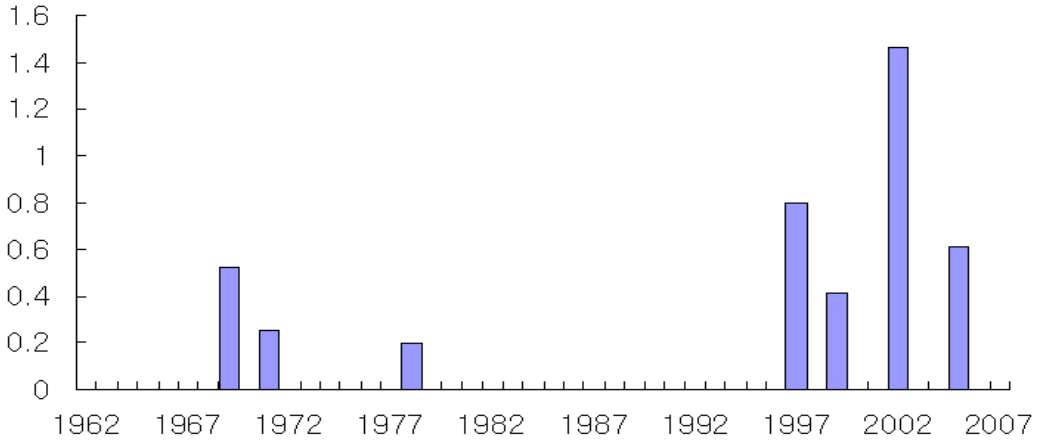

1.2
1
0.8
0.6
0.4
0.2
0
1962
1967
1972
1977
1982
1987
1992
1997
2002
2007


W1
W2
W3
E1
E2
KOREA
JAPAN
S1
S2
S3
39°N
37°
35°
33°
31°
123°
125°
127°
129°
131°
133°E

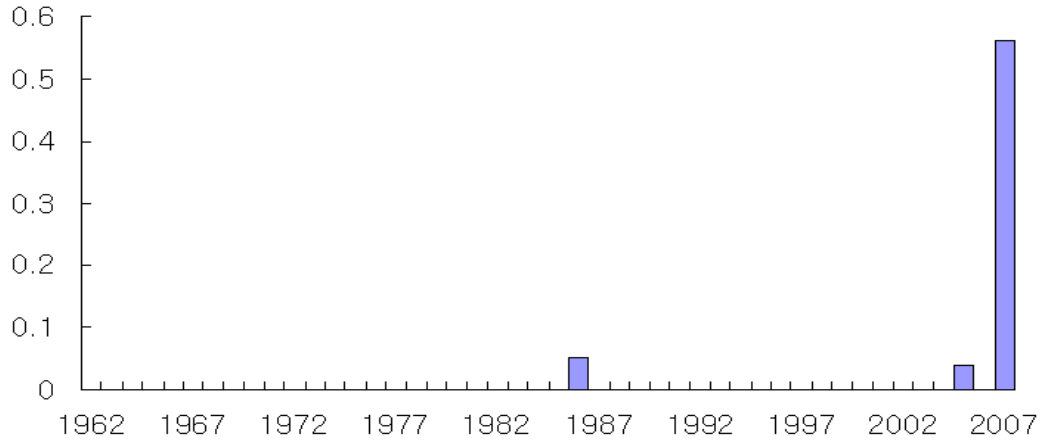
S2

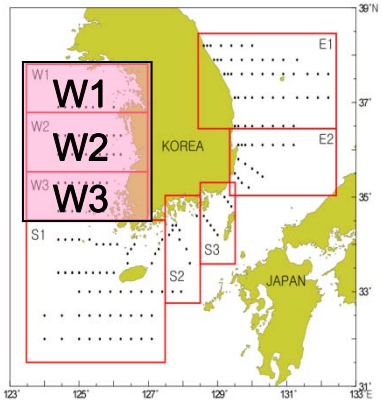

2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1962
1967
1972
1977
1982
1987
1992
1997
2002
2007

S3

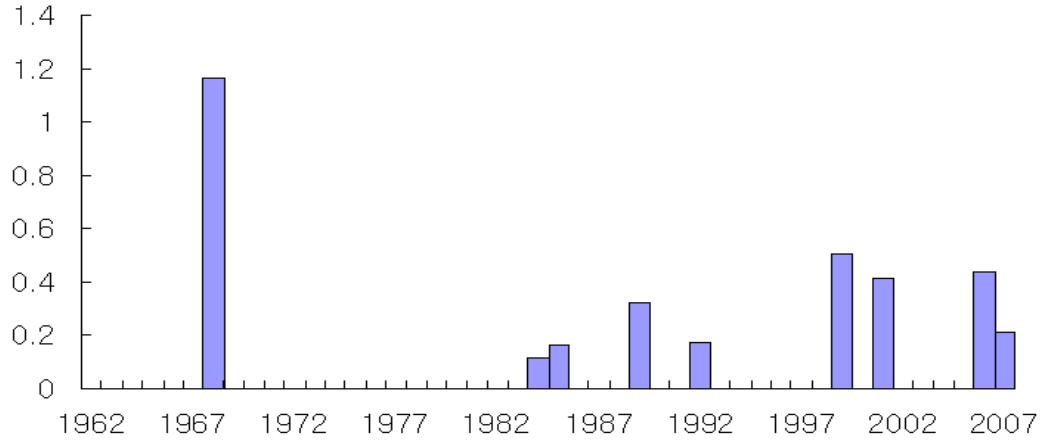

1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1962
1967
1972
1977
1982
1987
1992
1997
2002
2007

W1

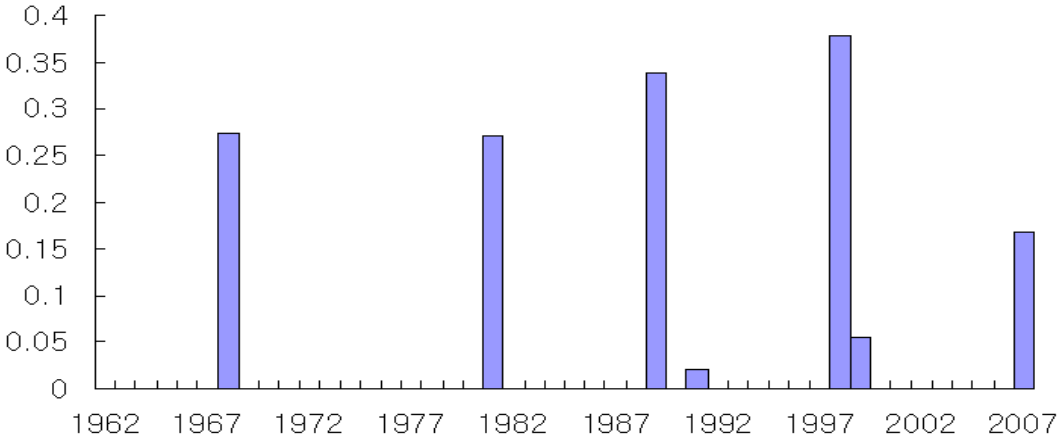

0.6
0.5
0.4
0.3
0.2
0.1
0
1962
1967
1972
1977
1982
1987
1992
1997
2002
2007


W1
W2
W3
KOREA
JAPAN
E1
E2
S1
S2
S3

W2

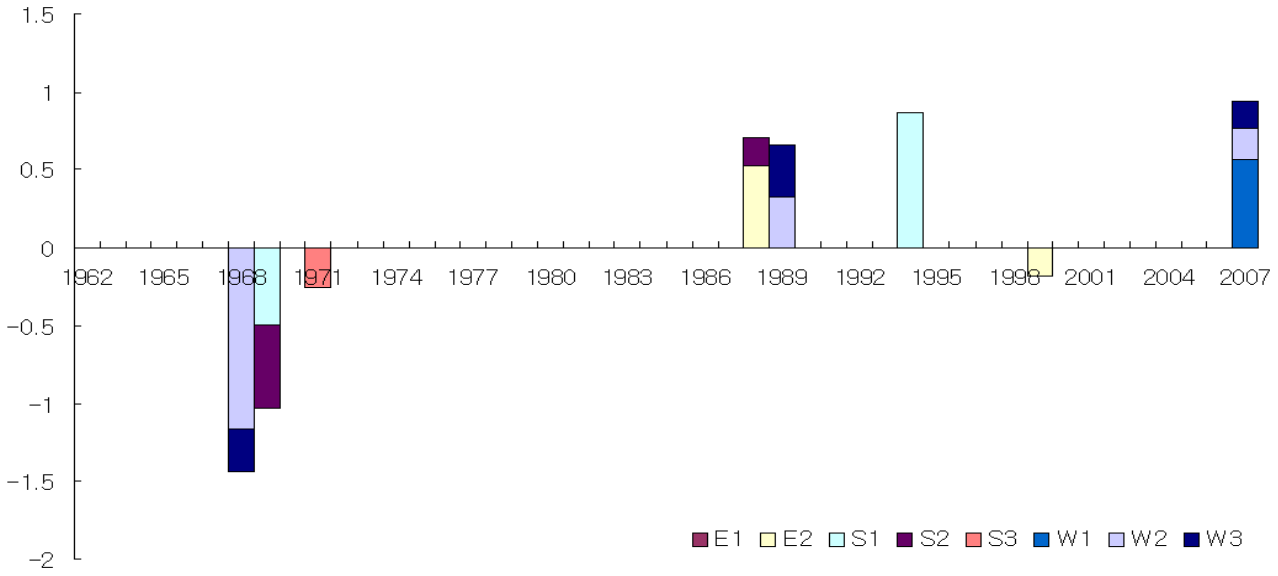

1.4
1.2
1
0.8
0.6
0.4
0.2
0
1962
1967
1972
1977
1982
1987
1992
1997
2002
2007

W3

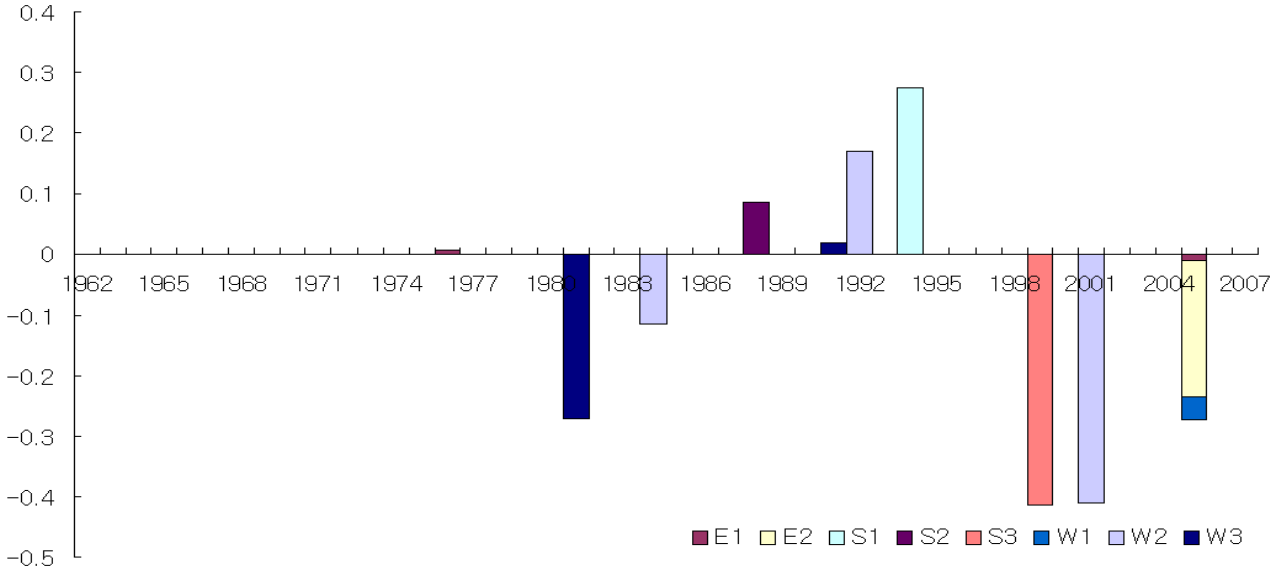

0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
1962
1967
1972
1977
1982
1987
1992
1997
2002
2007

- 2. seawater temperature and salinity by depth

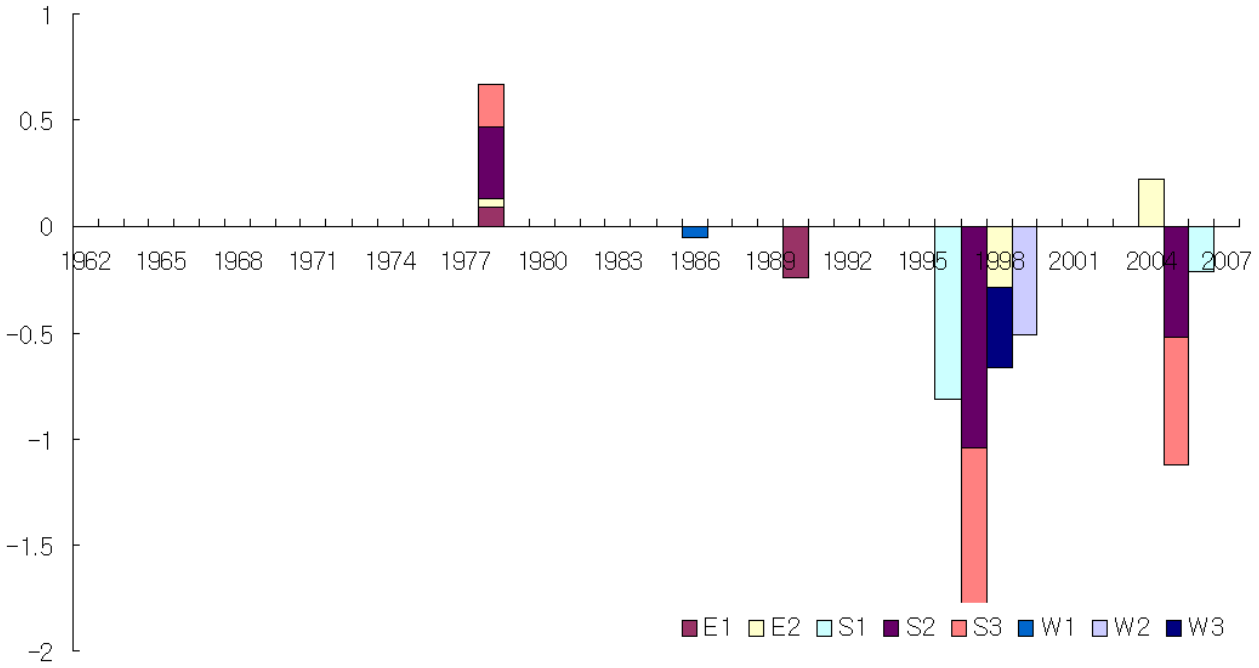
Temperature at 0m



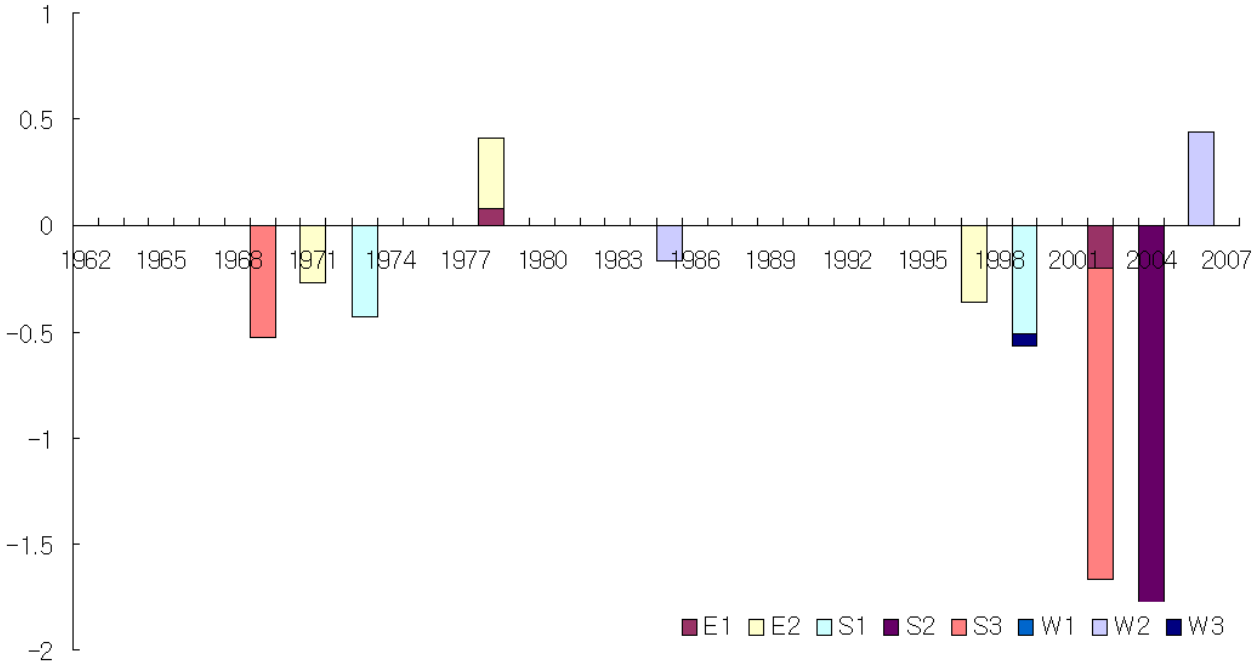
Temperature at 50m



Salinity at 0m

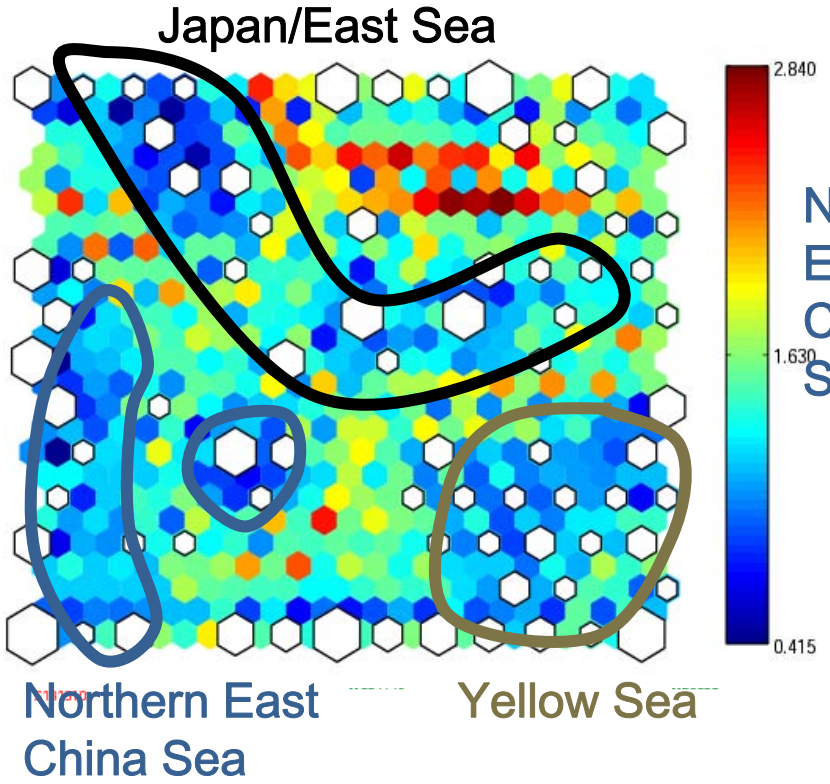


Salinity at 50m

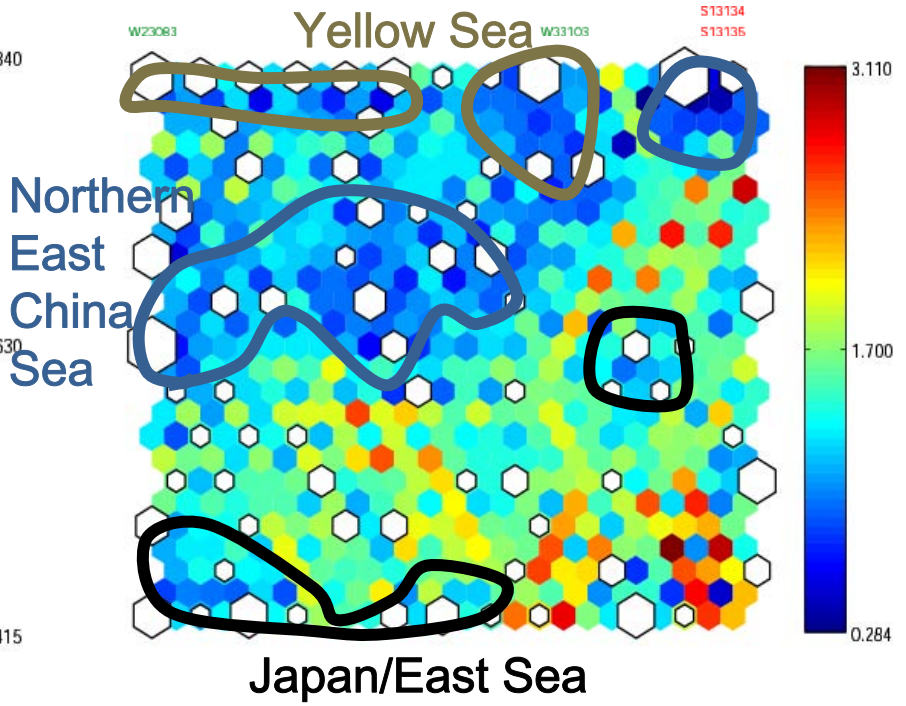


SOM
- by stations

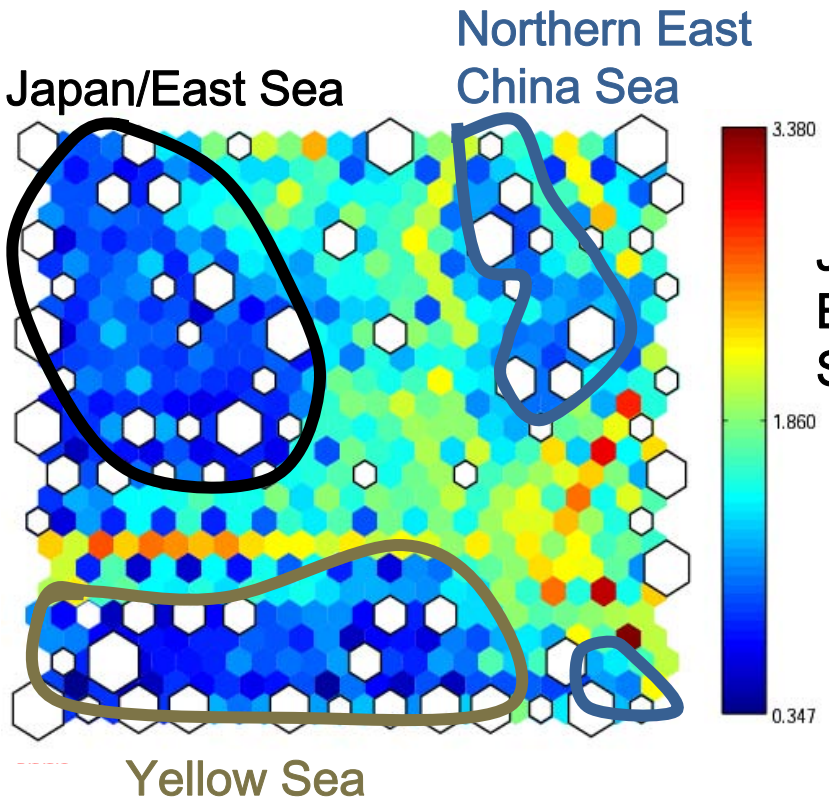
Temperature at 0m



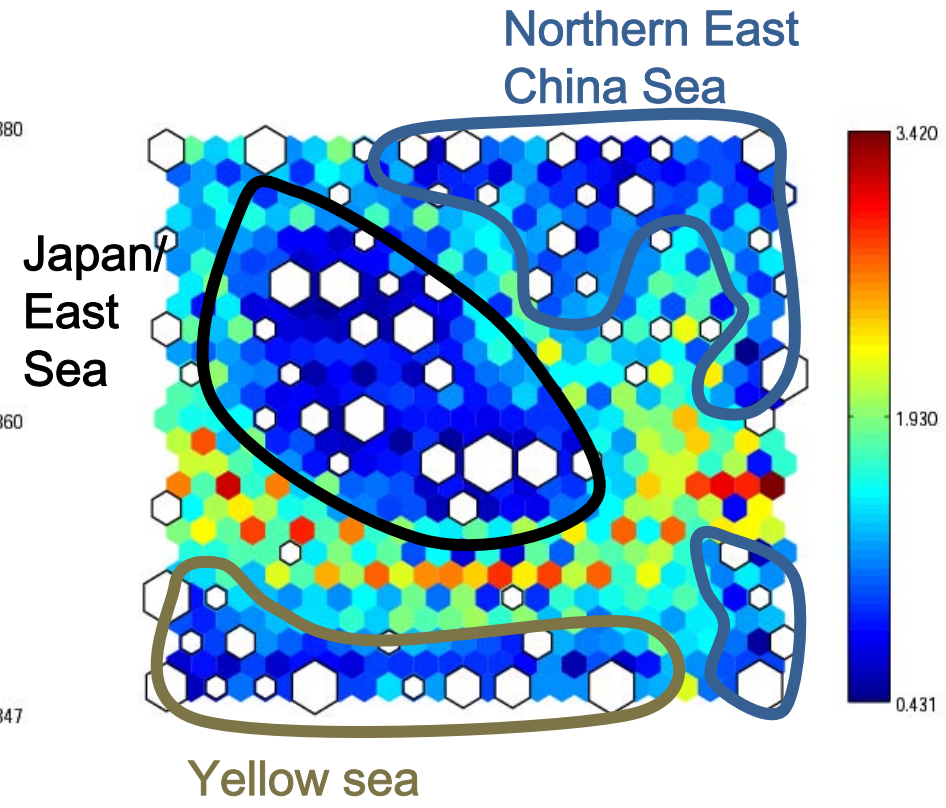
Temperature at 50m



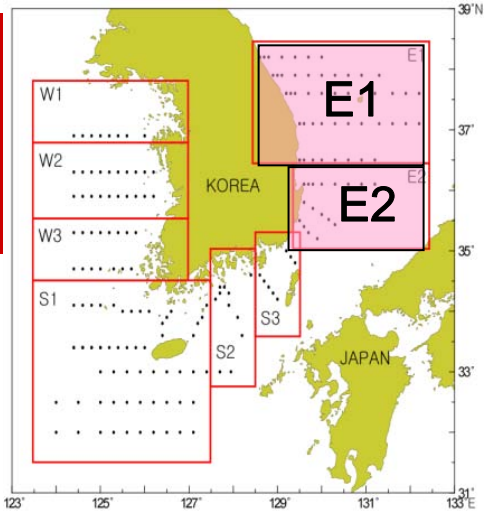
Salinity at 0m



Salinity at 50m



Discussion



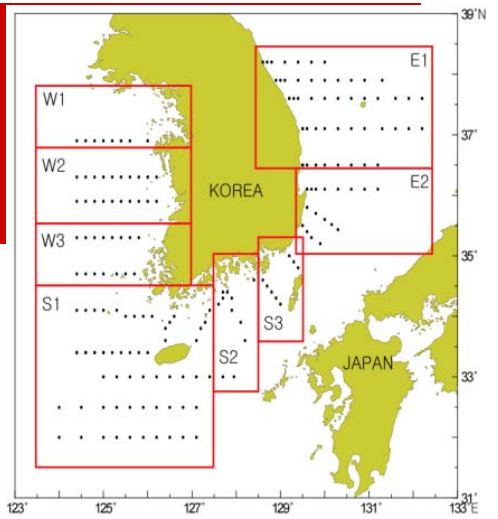
Temporal characteristics

RSI (Regime Shift Index)

supports a theory that there was a regime shift in Japan/East Sea around 1977
(Climate regime shifts and their impacts on marine ecosystem and fisheries resources in Korean waters by Zhang et al. 2000)

- 2006-2007 : detected RSI in the whole Korean waters but <u>not significant</u>
- temperature : Regime shift did not appear at 0, 50m in 1997
- salinity : Regime shift appear around 1977 & 1998
  In 1989 - salinity decreased at 0m but did not show any changes at 50m

Discussion



Spatial characteristics

SOM (Self Organizing Map)

- Seawater temperature

0 m : dramatic temperature differences between Yellow Sea and Japan/East Sea,

the elongate distribution of similar seawater temperature

50 m : large fluctuations in Japan/East Sea

- Salinity

0 m : water mass with similar salinity in Japan/East &Northern East China Sea

50m : small fluctuations in Yellow Sea

Conclusion

- Salinity anomalies well fit together with North Pacific regime shift periods.

- Temperatures fluctuated largely even though they are not in regime periods.

- Water masses that have relatively small fluctuations in salinity rather than temperature in Japan/East, Yellow and Northern East China Seas


Thank you