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Annual Report

LaMer, Ehime University

Date (1 , 12 , 2016)

To Director of LaMer

Principle Investigator:

Affiliation <u>Ocean University of China, OUC</u>

Position <u>   PHD candidate   </u>

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Include the report on the result of the project/meeting in a separate sheet.

1. Project / Meeting title

Interannual variations of the Yellow Sea Cold Water Mass (YSCWM) and prediction of its temperature using sea surface temperature and air-sea heat flux

2. Members of project / meeting

Name	Affiliation	Position	Contribution part
PI Junying Zhu	Ocean University of China, OUC	PHD candidate	Data processing; Paper writing
Members Jie Shi	Ocean University of China, OUC	Associate Professor	Beneficial discussion
Huiwang Gao	Ocean University of China, OUC	Professor	Beneficial discussion
Xinyu Guo	Ehime University	Professor	Beneficial discussion

Title

Interannual variations of the Yellow Sea Cold Water Mass (YSCWM) and prediction of its temperature using sea surface temperature and air-sea heat flux

Members' names and affiliations

Name	Institution and Department	Employment position	E-mail
Jie Shi	Ocean University of China, OUC	Associate Professor	shijie@ouc.edu.cn
Huiwang Gao	Ocean University of China, OUC	Professor	hwgao@ouc.edu.cn
Xinyu Guo	Faculty member of LaMer	Professor	guoxinyu@sci.ehime-u.ac.jp

Aim

This project aims to carry out cooperative research with Prof. Guo Xinyu of Ehime University on interannual variations of the Yellow Sea Cold Water Mass and prediction of its temperature, solving the existing questions and completing the preliminary modification of the first draft.

Procedure

The principal investigator (PI) has first made an oral presentation "Interannual variations of the Yellow Sea Cold Water Mass (YSCWM) and prediction of its temperature using sea surface temperature and air-sea heat flux" and showed the recent studies including:

1. The interannual variations of the YSCWM and the relationship between its water temperature and area were examined based on observations from 1978 to 1998.

2. The dominant factors influencing the intensity of the YSCWM were investigated and

the contribution rates of those factors were quantified using a 3-D model.

3. The prediction of water temperature of the YSCWM using SST and air-sea heat flux in previous winter.

4. The relationship between interannual variations of the YSCWM and the Arctic Oscillation.

We will carry out further research with Prof. Guo Xinyu on the following subjects:

1. The ecological effects caused by interannual variations of the YSCWM.

2. The nutrients cycle in the Yellow Sea and annual variations of some primary ecological process, estimating the nutrients budget.

Results

Using the observation data of the YSCWM from 1978 to 1998 (Fig. 1), the interannual variations of the YSCWM was identified and the intensity of the YSCWM was defined. Two key questions were addressed using the simulation and several numerical experiments. The first one was to find dominant factors influencing the intensity of the YSCWM and quantify the contribution of those factors to intensity of the YSCWM. The second one was to predict the interannual variations of water temperature of the YSCWM using those factors and explore the relationship between the interannual variations of the YSCWM and the Arctic Oscillation..

Though the observation (Fig. 2), the negative correlation between the area and the average temperature of the YSCWM in summer was examined, and a cold period (1984-1988) and a relative warm period (1989-1995) were distinguished. The results of sensitivity experiments in Table 1 suggested that the SST and air-sea heat flux in previous winter were the dominant factor to variations of the YSCWM. And the

interannual variations of the YSCWM could be reproduced by changing the two factors. Therefore, we tried to reconstruct the water temperature of the YSCWM in summer using the sea surface temperature and air-sea heat flux in previous winter from NCEP, and the prediction showed reliability to some extent compared with other studies (Fig. 3).
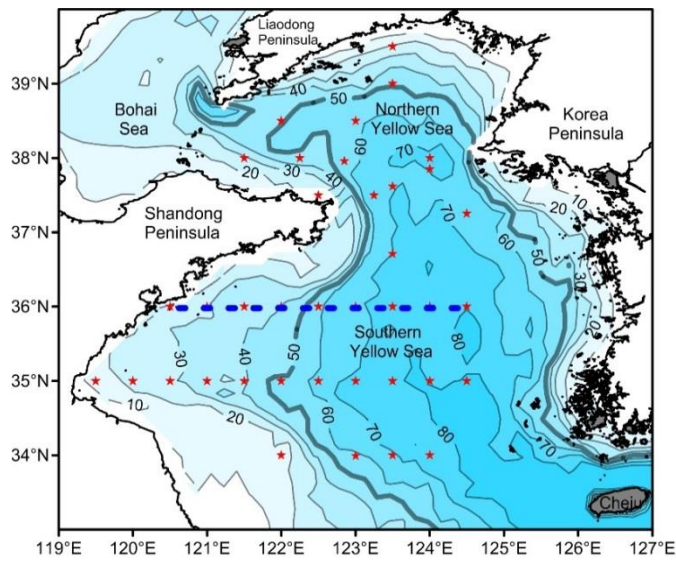

Fig. 1. Topography of the study area and observation stations. The bold line indicates 50 m isobaths, the blue dash line indicates the transection of 36°N, and observation stations are denoted by the red stars.
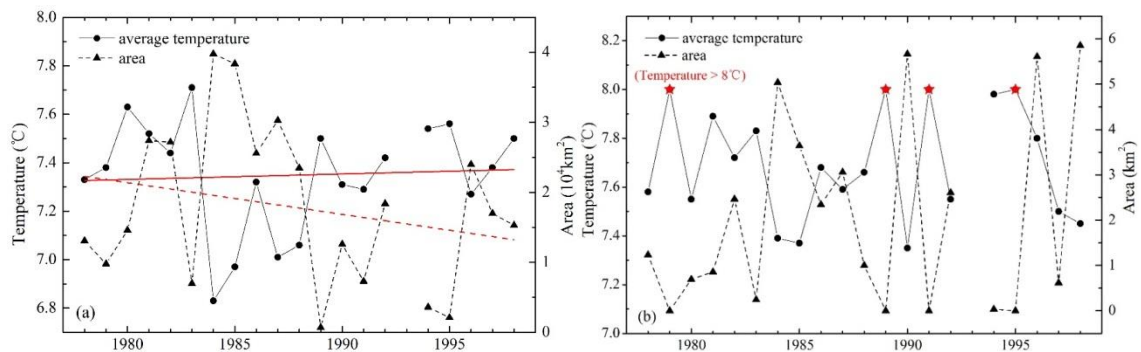

Fig. 2. Time series of average water temperature and area of the YSCWM in target region: (a) at the depth of 50 m; (b) along the transection of 36°N. The years when the YSCWM is not observed are donated by red stars.

Table 1. The contribution rate of local forcing to the difference of average water temperature and area of the YSCWM between strong (1984) and weak (1995) year.

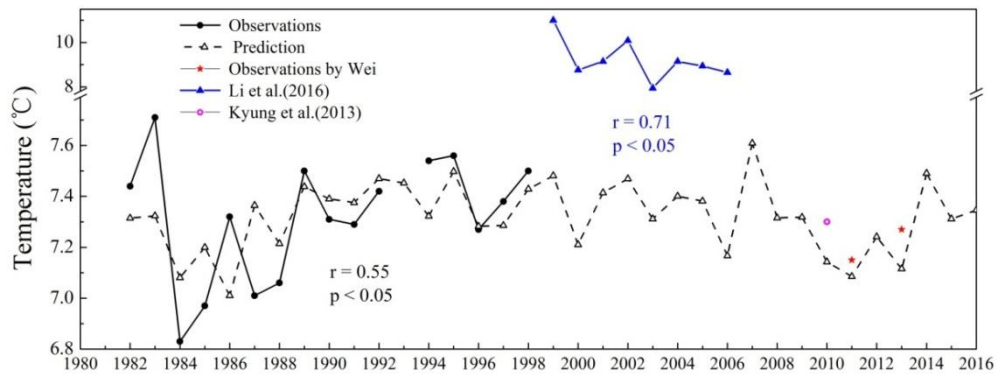| Experiment	Temperature		Area	
	50 m depth	transection of 36°N	50 m depth	transection of 36°N
W	-6.20%	-4.70%	-13.30%	-26.60%
Q_{NCEP}	20.50%	10.80%	27.10%	30.70%
SST_{NCEP}	58.10%	38.00%	68.90%	81.30%
AS	80.00%	48.90%	73.60%	90.90%
Spring-AS	18.70%	12.50%	31.60%	28.20%
Summer-AS	0.50%	-0.40%	0.20%	2.10%
Autumn-AS	3.20%	2.70%	7.50%	7.10%
Winter-AS	64.20%	40.50%	57.80%	75.90%

Fig. 3. Observed and reconstructed average water temperature of the YSCWM in target region. The blue line represents the average water temperature below 30 m in the transection of 36°N in western part of the YS (Li et al., 2016).

References:

1. Oh K H, Lee S, Song K M, et al. The temporal and spatial variability of the Yellow Sea Cold Water Mass in the southeastern Yellow Sea, 2009–2011[J]. Acta Oceanologica Sinica, 2013, 32(9): 1-10.

2. Li A, Yu F, Si G, et al. Long-term temperature variation of the Southern Yellow Sea Cold Water Mass from 1976 to 2006[J]. Chinese Journal of Oceanology and Limnology, 1-13.

Publication/conference presentation

Conference:

The 7th China-Japan-Korea IMBER Symposium in Jeju International Marine Research and Education Center, 2016.3.24 - 2016.3.26,

Poster: The interannual variations of the Yellow Sea Cold Water Mass (YSCWM) and the influencing mechanism.

Oral presentation:

Title: Interannual variations of the Yellow Sea Cold Water Mass (YSCWM) and prediction of its temperature using sea surface temperature and air-sea heat flux

Lecturer: Junying Zhu.

Time: November 15, 2016.

Location: Ehime University.

Perspectives in future

We will investigate the ecological effects caused by interannual variations of the YSCWM and estimate the nutrients budget in the Yellow Sea, which will deepen our understanding on the nutrients cycle in the Yellow Sea. We are planning to publish our joint research on an international journals.