

Form 3

Annual Report

LaMer, Ehime University

Date (24 , 2 , 2017)

To Director of LaMer

Principle Investigator:

Affiliation Ocean University of China

Position Associate professor

Name in print Jie Shi

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

1. Project / Meeting title

Interannual variations of spring phytoplankton bloom in the central Southern Yellow Sea in response to the atmospheric forcing

2. Members of project / meeting

Name	Affiliation	Position	Contribution part
Jie Shi	Ocean University of China	Associate professor	Providing the main scientific idea and writing the paper
Yi Liu	South China Sea Institute of Oceanology	Graduate student	Satellite data processing
Xinyu Guo	Ehime University, Faculty member of LaMer	Professor	Beneficial discussion and helping response to the comments from reviewers
Huiwang Gao	Ocean University of China	Professor	Beneficial discussion

Xinyan Mao	Ocean University of China	Lecturer	Beneficial discussion
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3. Contents (please write in separate sheet, A4-size, within 5 pages including figures and tables. Itemize “Title, members’ names and affiliations, aim, procedure, result, publication/conference presentation, perspectives in future”).

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Title

Interannual variations of spring phytoplankton bloom in the central Southern Yellow Sea in response to the atmospheric forcing

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
Yi Liu	South China Sea Institute of Oceanology	Graduate student	liuyi315@mails.ucas.ac.cn
Xinyan Mao	Ocean University of China	Lecturer	maoxinyan@ouc.edu.cn
Xinyu Guo	Faculty member of LaMer	Professor	guoxinyu@sci.ehime-u.ac.jp
Huiwang Gao	Ocean University of China, OUC	Professor	hwgao@ouc.edu.cn

Aim

Under the help of Prof. Xinyu Guo, we carried out a study on the interannual variation of phytoplankton bloom in the central Southern Yellow Sea using the satellite data and submitted a paper to *Continental Shelf Research*. Based on the previous work, we did some new research on the ecosystem dynamics in the regional seas of China.

Procedure

1. The principal investigator (Jie Shi) made an oral presentation to the researchers in Center for Marine Environmental Studies (CMES), Ehime University. The title of the presentation is "Contributions of physical and biogeochemical processes to phytoplankton biomass enhancement in the surface and subsurface layers during

Typhoon Damrey”.

2. The principal investigator (Jie Shi) carried out a deep discussion on the interannual variations of the main primary production processes in the Yellow Sea of China and the influencing factors with Prof. Guo. These are the spring phytoplankton bloom and the summer subsurface chlorophyll maximum.

3. The principal investigator (Jie Shi) and Prof. Guo wrote a proposal on the nutrients cycle and budget in the Yellow Sea of China. A discussion has been made to confirm the main study contents.

Results

The interannual variations of the start timing, magnitude and duration of the spring phytoplankton bloom (SPB) in the central southern Yellow Sea (SYS) (Fig. 1) were studied using the satellite-derived surface chlorophyll-a concentrations (Chl-a) from 2000 to 2014 (Fig. 2). The correlations between the characteristics of SPB and the generation rate of turbulent kinetic energy (TKE_{RT}) supplied from the atmosphere to the ocean were examined. The start timing of SPB was delayed in years with high TKE_{RT} supplied to the ocean before SPB (Fig. 3). The TKE_{RT} during SPB had no relationship with the magnitude of SPB, but had positive correlation with the duration (Fig. 4). A 1-D physical-biological model was used to examine the influencing mechanisms of the TKE_{RT} on the characteristics of SPB quantitatively. The wind speeds and related TKE_{RT} before the start of SPB were stronger in 2010 than in 2008. Comparison of the model results forced by winds in the two years suggested that the enhanced physical dilution of phytoplankton caused by the stronger TKE_{RT} in 2010 induced a later start timing of SPB. When increasing the winds during SPB period, more phytoplankton was taken

downward from the surface layer by the enhanced vertical mixing. Meanwhile, more nutrients were pumped upward to the surface layer and supported more net growth of phytoplankton. These two contrary processes led to the independence of the magnitude of SPB on the TKE_{RT} during the SPB period. However, larger TKE_{RT} along with stronger wind resulted in a longer duration of SPB because of more nutrients supply by stronger vertical mixing.

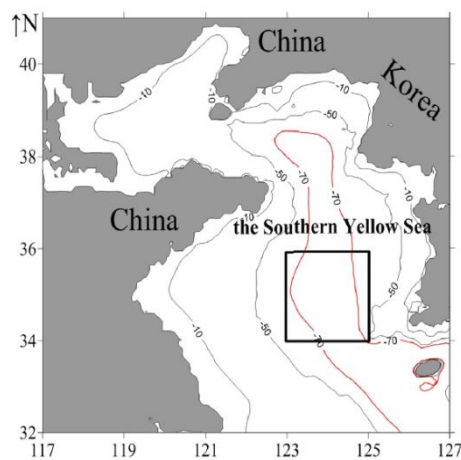


Fig.1 Bathymetric and geographic map of the YS

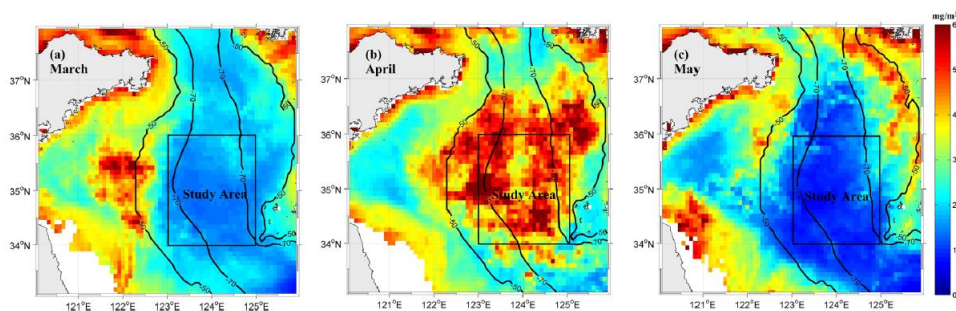


Fig.2 Spatial distribution of monthly mean surface Chl-*a* in the SYS calculated from all the satellite data in the same month from 2000 to 2014. The colors represent the surface Chl-*a*. The solid lines are the isobaths of 50 m and 70 m. The square is the study area.

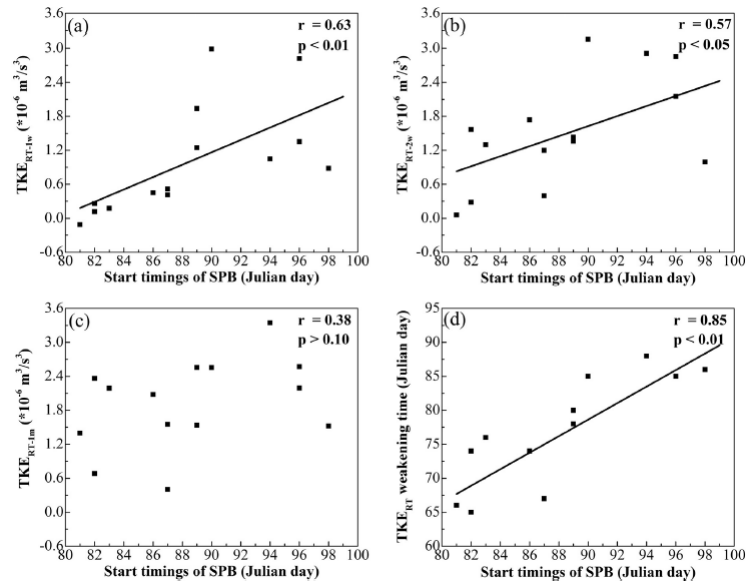


Fig.3 Correlations between TKE_{RT-1w} (a), TKE_{RT-2w} (b), TKE_{RT-1m} (c), the weakening time of TKE_{RT} (d) and the start timing of SPB.

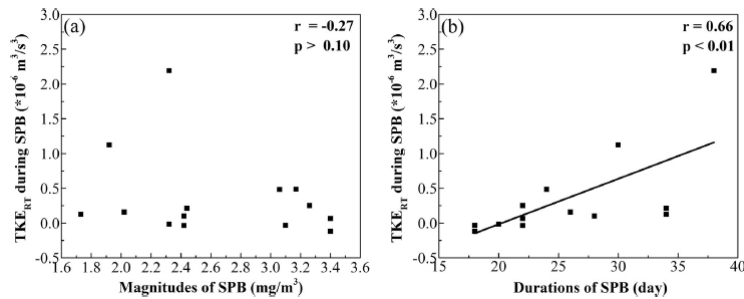


Fig.4 Correlations between magnitudes (a), durations of SPB (b) and TKE_{RT} during SPB.

Publication/conference presentation

Publication:

Jie Shi, Yi Liu, Xinyan Mao, Xinyu Guo, Huiwang Gao, 2017. Interannual variation of spring phytoplankton bloom and response to turbulent energy generated by atmospheric forcing in the central Southern Yellow Sea of China:

Satellite observations and numerical model study. *Continental Shelf Research*, inpress.

Shanshan Pan, **Jie Shi**, Huiwang Gao, **Xinyu Guo**, Xiaohong Yao, Xiang Gong, 2017. Contributions of physical and biogeochemical processes to phytoplankton biomass enhancement in the surface and subsurface layers during the passage of Typhoon Damrey. *Journal of Geophysical Research: Biogeosciences*, 122, doi: 10.1002/2016JG003331.

Oral presentation:

Title: Contributions of physical and biogeochemical processes to phytoplankton biomass enhancement in the surface and subsurface layers during Typhoon Damrey

Lecturer: Jie Shi.

Time: February 7, 2017.

Location: Ehime University.

Perspectives in future

The interannual variations of the Yellow Sea Cold Water Mass (YSCWM) will be examined using the observations and model results. The ecological effects of the YSCWM will also be studied, such as the transport of nutrients, the promotion of primary production and so on. Besides, we will estimate the dynamic variation of the nutrient budget in the Yellow Sea and investigate the influencing factors.