

Form 3

Annual Report

LaMer, Ehime University

Date (26 , 2 , 2018)

To Director of LaMer

Principle Investigator:

Affiliation Ocean University of China, OUC

Position Graduate student

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

1. Project / Meeting title

A Study on the Air-Sea Exchange of POPs and Their Transportation in Jiaozhou Bay, Qingdao, China.

2. Members of project / meeting

Name	Affiliation	Position	Contribution part
PI Aobo Wang	Ocean University of China, OUC	Graduate student	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
LaMer Faculty member in charge Xinyu Guo	Ehime University	Professor	Beneficial discussion

Title

A Study on the Air-Sea Exchange of POPs and Their Transportation in Jiaozhou Bay, Qingdao, China.

Members' names and affiliations

Name	Institution and Department	Employment	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 simulation of physical and biochemical processes of persistent organic pollutants (POPs) in Jiaozhou Bay, from which we can find spatial distribution and seasonal variation of POPs. Meanwhile, this project aims to discuss responsible mechanisms which control the spatial distribution and seasonal variation of POPs.

Procedure

The principal investigator (PI) has first made an oral presentation "A numerical study on the seasonal variation and responsible mechanisms of persistent organic pollutants in Jiaozhou Bay" and showed the recent studies including:

1. Decabromodiphenyl ether (PBDE209), a kind of POPs, was referred to as study object and velocity, temperature, salinity and chlorophyll simulation results was tested with observation data.
2. The spatial distribution and seasonal variation were investigated using a 3-D model.
3. Responsible mechanisms which control the spatial distribution and seasonal variation of PBDE209 were discussed.
4. The mass balances of physical and biochemical processes were calculated.

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

1. Establish a model including hydrodynamic module, ecological module, suspended particular matter (SPM) module and POPs module and use this model to simulate physical and biochemical processes of POPs in the East China Sea.
2. Generalize the POPs model to a new model which can be used to simulate new-type contaminants such as antibiotics.

Results

Test of velocity, temperature, salinity and chlorophyll simulation results indicates that the simulation of physical and ecological processes in Jiaozhou Bay is true (figure1). The maximum flow velocity appears in maximum flood tide time and it is 1.1 meter per second, which is agreed with the observation data. The highest temperature is around 28 degree centigrade and appears in August, while the lowest temperature is around 1 degree centigrade and appears in February. As for the seasonal variation of salinity, it is low during wet season (July, August, September) as the result of increased fresh water discharge from rivers. Chlorophyll concentration is higher during summer as the result of increased fresh water discharge from rivers, which carry lots of nutrients.

Concentration of PBDE209 is higher in inner of Jiaozhou Bay than out of the bay, which is caused by lots of pollutants input from rivers and hydrodynamic transport condition of the bay. Vertical distribution of dissolved PBDE209 is homogeneous and appears weak stratification during summer, because the depth of water in Jiaozhou Bay is shallow so it can be stir well by wind and tide. As for seasonal variation, concentration of dissolved PBDE209 is higher during summer than the other seasons as the result of increased fresh water flux from rivers, which carry lots of pollutants, while concentration of particular PBDE209 is also higher during summer than the other seasons, which is not only caused by higher concentration of dissolved PBDE209 in summer but also caused by higher concentration of chlorophyll in summer.

Physical and biochemical processes of PBDE209 are enhanced in summer and full, while subdued in spring and winter, which is caused by not only more pollutants input form rivers but also more biomass. Air-sea exchange and rivers discharge are two sources for PBDE209, while rivers discharge are dominating. Decomposition of dissolved PBDE209, sinking of particular PBDE209 to bottom, evaporating to air and advection to open seas are fates for PBDE209, while advection to open seas is dominating. Besides, PBDE209 fluxes of uptake by phytoplankton, phytoplankton mortality and detritus decomposition processes are at the same magnitude.

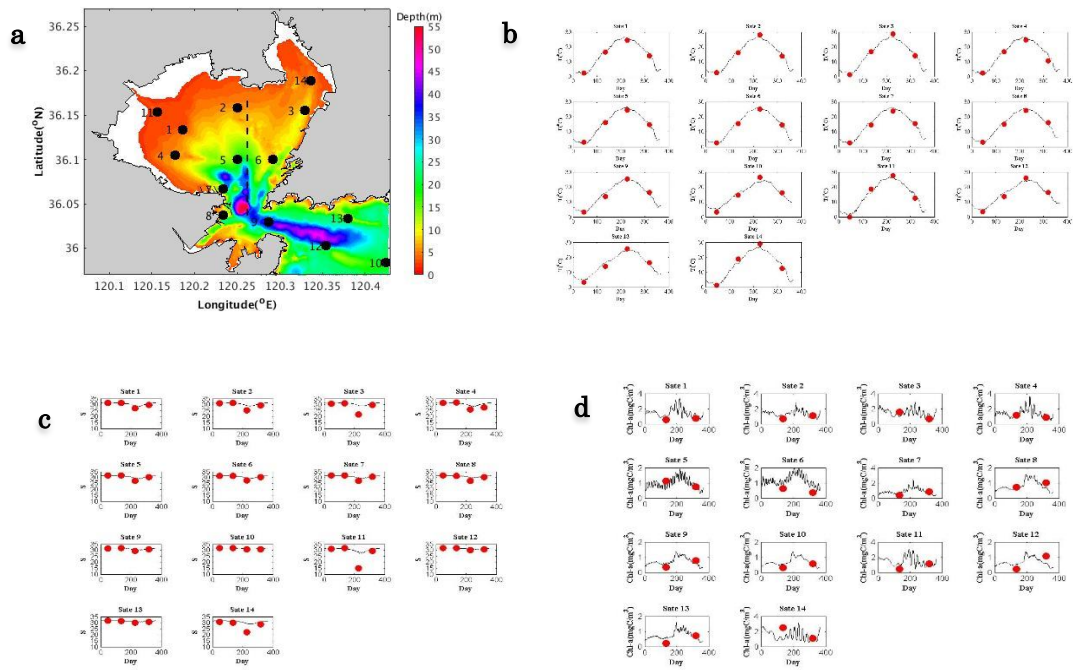


Figure. 1. Topography of the study area and observation stations(a) and test of temperature(b), salinity(c) and chlorophyll(d) in Jiaozhou Bay

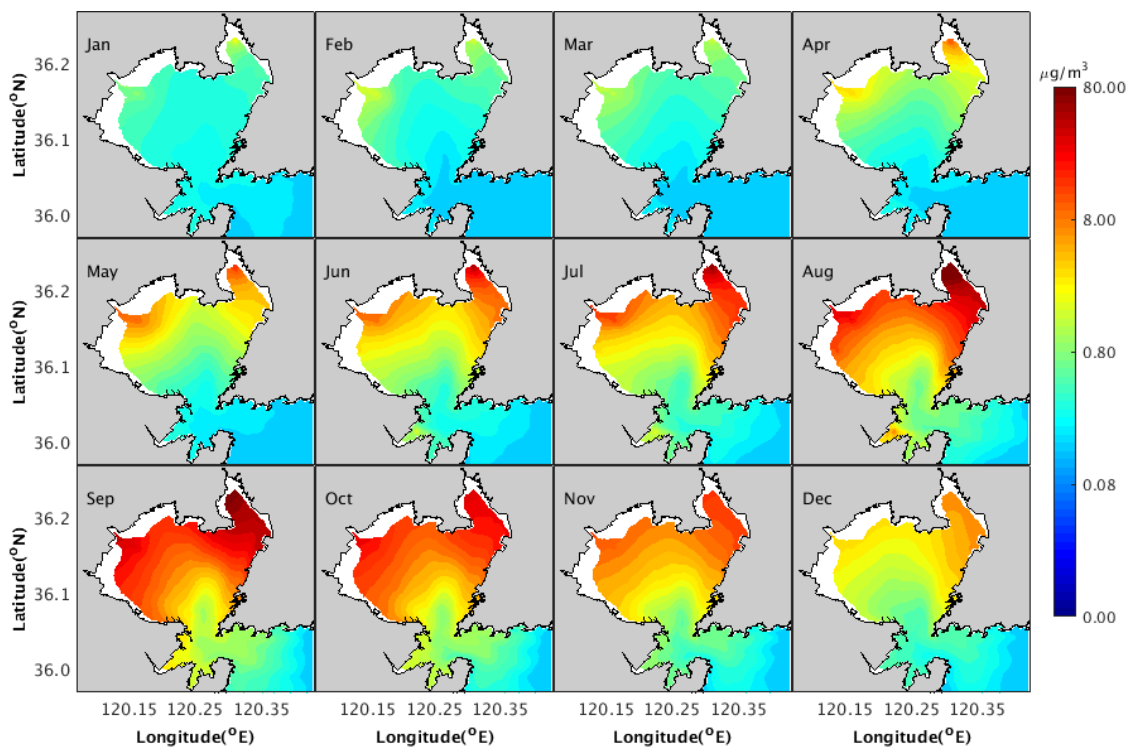


Figure. 2. Horizontal distribution of dissolved PBDE209 concentration

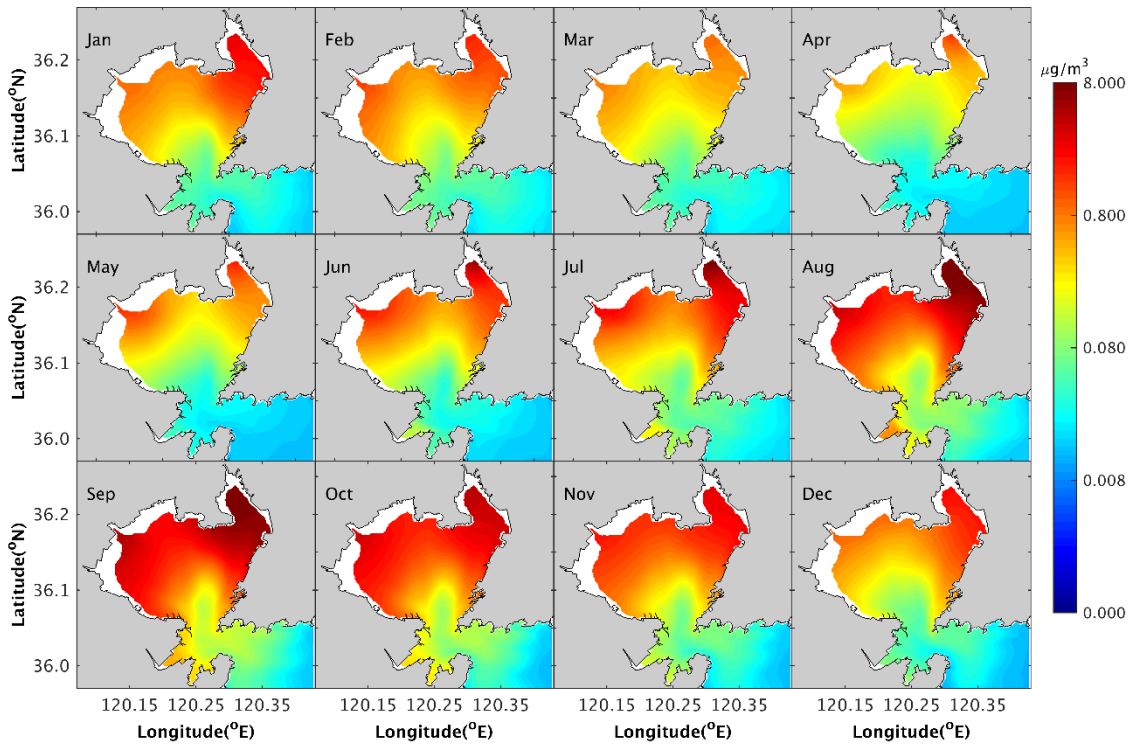


Figure. 3. Horizontal distribution of particulate PBDE209 concentration

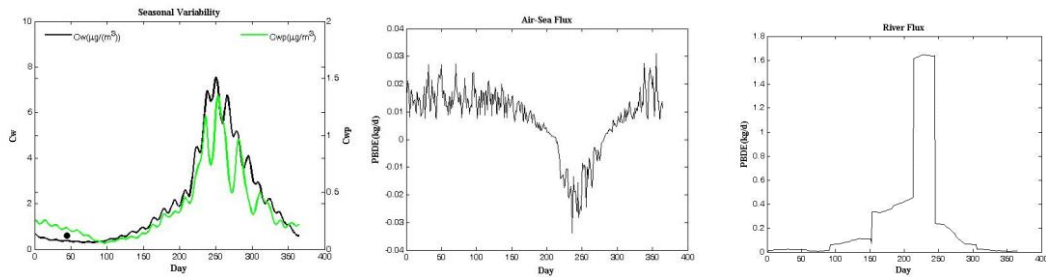


Figure. 4. Seasonal variation of PBDE209 concentration, surface flux of PBDE209 and river discharge of PBDE209

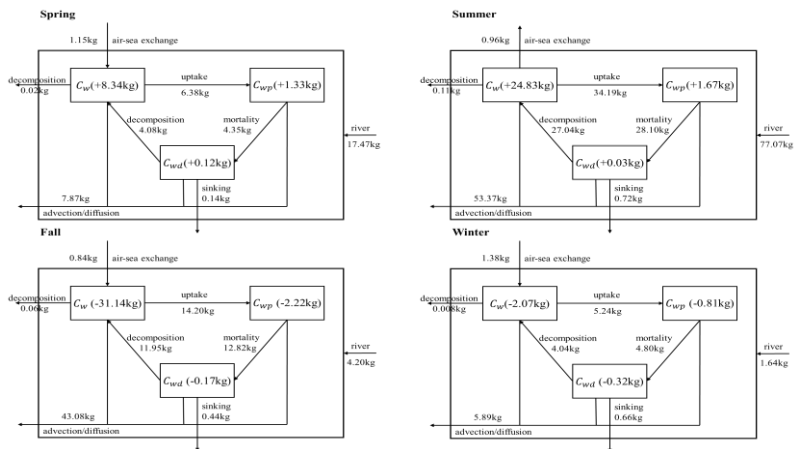


Figure. 5. Mass balances of PBDE209 in Jiaozhou Bay

References:

- Cetin B, Odabasi M. Measurement of Henry's law constants of seven polybrominated diphenyl ether (PBDE) congeners as a function of temperature [J]. *Atmospheric Environment*, 2005, 39(29):5273-5280.
- Jordi Dachs †, † S J E ., ‡ J E B, et al. Coupling of Phytoplankton Uptake and Air–Water Exchange of Persistent Organic Pollutants[J]. *Environmental Science & Technology*, 1999, 33(20):3653-3660.
- Ju T, Wei G, Tao J, et al. Polybrominated diphenyl ethers in dissolved and suspended phases of seawater and in surface sediment from Jiaozhou Bay, North China[J]. *Science of the Total Environment*, 2016, 557-558:571.
- Ono J, Takahashi D, Guo X, et al. A numerical study on the seasonal variability of polychlorinated biphenyls from the atmosphere in the East China Sea[J]. *Chemosphere*, 2012, 89(4):389-97.

Publication/conference presentation

Conference:

The Surface Ocean Lower Atmosphere Study (SOLAS) Symposium in Qingdao, China during 2016.11.26-2016.11.28.

The 11th cross-strait marine science symposium in Taian, China during 2017.8.21-2017.8.25.

The 5rd OUC-UEA Symposium in Qingdao, China during 2017.9.12-2017.9.13.

Oral presentation:

Title: A numerical study on the seasonal variation and responsible mechanisms of persistent organic pollutants in Jiaozhou Bay

Lecturer: Aobo Wang.

Time: January 9, 2018.

Location: Ehime University.

Perspectives in future

Sea water temperature, wind, concentration of chlorophyll, rivers discharge all can affect seasonal variation of PBDE209 in Jiaozhou Bay. We will investigate responsible mechanisms on the seasonal variation of PBDE209 by designing numerical experiments. Furthermore, we will generalize the POPs model to a new model which can be used to simulate new-type contaminants such as antibiotics and apply the new model in other sea areas.