International symposium on coastal ecosystem change in Asia: hypoxia, eutrophication, and nutrient conditions

Nov 14-15, 2019
Ehime University, JAPAN

International symposium on coastal ecosystem change in Asia: hypoxia, eutrophication, and nutrient conditions

Date: November 14-15, 2019

Place: Media Hall, Ehime University, Matsuyama, Japan
(1st floor of Center for Information Technology, Ehime University)

Organizing Committee: Xinyu GUO, Akihiko MORIMOTO, Michinobu KUWAE, Naoki YOSHIE (Center for Marine Environmental Studies, Ehime University)

Purpose:

With increasing of nutrient load into coastal water, some environmental issues have been reported to occur in many bays and shelf seas in Asia. For example, hypoxia water has been observed in the Bohai Sea, East China Sea, Thailand Bay, and Jakarta Bay in recent 10 years. On the other hand, the hypoxia water has been reported in many bays and inland seas in Japan for more than 30 years. The reduction of nutrient load into coastal water in Japan has been continued for many years but the hypoxia water is still observed now. Apparently, the occurrence of hypoxia water is not a simple problem related only to nutrients load into the coastal water. The eutrophication and nutrient condition outside the coastal water should also affect the occurrence of hypoxia water. This symposium will provide an opportunity to summarize our understanding on the occurrence of hypoxia water and some related issues in the coastal water in Asia.

Schedule:

November 14

9:00-9:30 Registration

9:30-9:45 Opening remark (Prof. Shinsuke TANABE, Director of Center for Marine Environmental Studies, Ehime University, Japan)

Chair of Session: Akihiko MORIMOTO

9:45-10:15

Chen-Tung Arthur CHEN (National Sun Yat-sen University, Taiwan): Kuroshio and Hypoxia in the East and South China Seas

10:15-10:45
Di TIAN (Second Institute of Oceanography, China): Impact of dissolved oxygen and nutrients from Kuroshio on the hypoxia off the Changjiang Estuary

10:45-11:15
Feng ZHOU (Second Institute of Oceanography, China): The connection and disconnection of phytoplankton production and subsurface hypoxia: hints from the physically complex dynamic system off the Changjiang Estuary

11:15-11:45
Xinyu GUO (Ehime University, Japan): A method for tracing nutrients from different origins in a low-trophic ecosystem model and evaluating their contribution to primary production in a shelf sea

11:45-12:00 Group photo

12:00-14:00 Lunch and poster session

Chair of Session: Feng ZHOU

14:00-14:30
Xiaohui LIU (Second Institute of Oceanography, China): On the vorticity balance of the on-shelf Kuroshio intrusion northeast of Taiwan

14:30-15:00
Ting-Hsuan HUANG (National Sun Yat-sen University, Taiwan): The Taiwan Strait resembles a quasi-cul-de-sac in late NE monsoon season

15:00-15:30
Goh ONITSUKA (National Research Institute of Fisheries and Environment of Inland Sea, Japan Fisheries Research and Education Agency, Japan): Harmful algal blooms in western Japan

15:30-15:45 Coffee Break

Chair of Session: Yuichi HAYAMI

15:45-16:15
Anukul BURANAPRATHEPRAT (Burapha University, Thailand): Material transport from the river mouths to the Upper Gulf of Thailand under variations in river discharge

16:15-16:45
Akihiko MORIMOTO (Ehime University, Japan): Hypoxia in the Upper Gulf of Thailand –Hydrographic observation and modeling-

16:45-17:15
Jianping GAN (Hong Kong University of Science and Technology, Hong Kong): On Ocean Circulation, Ecosystem and Hypoxia along the coastal transition zone off Hong Kong (OCEAN_HK)

18:00 Reception

November 15

Chair of Session: Muhammad ILYAS

9:00- 9:30
Ario DAMAR (Bogor Agricultural University, Indonesia): The eutrophication states and nutrient-phytoplankton dynamics of eutrophied tropical embayment of Jakarta Bay, Indonesia: temporal dynamics from 2001 to 2017

9:30- 10:00
Suhendar I SACHOEMAR (Agency for the Assessment and Application of Technology, Indonesia): The environmental study to understand the hypoxia behavior in Jakarta Bay

10:00- 10:30
Endro SOEYANTO (Agency for the Assessment and Application of Technology, Indonesia): Behavior and residence time of river waters in Jakarta Bay

10:30-10:45　Coffee Break

Chair of Session: Naoki YOSHIE

10:45-11:15
Haruo ANDO (Tokyo Metropolitan Research Institute for Environmental Protection, Japan): Long-term change in the state of water pollution in Tokyo Bay: Tokyo Bay, trend analysis, COD, nutrients and hypoxia

11:15-11:45
Satoshi AKIYAMA (Research Institute of Environmental, Agriculture and Fisheries, Osaka Prefecture, Japan): Tempo-spatial variations of hypoxia water and nutrient conditions, and emerging problems in Osaka Bay, Japan

11:45-12:15
Chiho SUKIGARA(Tokyo University of Marine Science and Technology): Oxygen consumption rate in the Mikawa Bay using an optical oxygen sensor

12:15-14:00　Lunch and poster session

Chair of Session: Goh ONITSUKA

14:00-14:30
Yuichi HAYAMI (Saga University, Japan): Hypoxic water mass in Ariake Sea, Japan - mechanisms of multi-time scale variations-

14:30-15:00
Tetsuo YANAGI (Kyushu University, Japan): Disappearance of hypoxia in Dokai Bay, Japan

15:00-15:30
Toshiyuki TAKAO (Waterfront Vitalization and Environment Research Foundation, Japan): Enhancing water exchange and suppressing the effects of anoxic water in an inner bay by placement of water flow pipes through tsunami protection breakwaters

15:30-15:45　Coffee Break

Chair of Session: Xinyu GUO

15:45-16:15
Michinobu KUWAE (Ehime University, Japan): Decadal and centennial variability in fish abundance in the Seto Inland Sea during the last 2900 years

16:15-16:45
Naoki YOSHIE (Ehime University, Japan): Long-term variation of nutrient concentration in the Western Seto Inland Sea

16:45-17:15
Moriaki YASUHARA (The University of Hong Kong, Hong Kong): Human-induced marine ecological degradation: historical ecology and the Anthropocene

17:15-17:30 Closing remark (Tetsuo YANAGI, Kyushu University, Japan)

Poster Session

P-01 Naho MIYAZAKI (Tokyo University of Marine Science and Technology, Japan): A challenge on measuring photosynthetic oxygen evolution by optical sensors in the Tokyo Bay, off Haneda

P-02 Xiaokun DING(Ocean University of China, China): The river discharge can change the peak and its occurrence time of the Chlorophyll-a in a semi-enclosed sea

P-03 Hao JIANG(Tianjin University of Science and Technology, China): Annual Cycles and Budgets of Nutrients in the Yellow Sea: a model study

P-04 Jun-Yong ZHENG(Ocean University of China, China): Estimate of environmental capacity of dissolved inorganic nitrogen in the Xiangshan Bay

P-05 Qian LENG(Ocean University of China, China): Study on the Response Mechanism of Primary Production in the East China Sea to the Change of Nutrient Inputs from the Yangtze River

P-06 Aobo WANG(Ocean University of China, China): A simulation of the seasonal variation of decabromodiphenyl ether in a bay adjacent to the Yellow Sea

P-07 Xiaolu WANG (East China Normal University, China): Organic Carbon Distribution and Budget in the Changjiang Diluted Plume based on Chemical analysis and Numerical Model

P-08 Jiliang XUAN(Second Institute of Oceanography, China): The role of submesoscale advections on vertical heat and nutrient transports in the Southern East China Sea

P-09 Xiaojie YU (Ocean University of China, China): Upstream propagation of a bottom-advected plume and its influencing factors

P-10 Yongjiu XU (Zhejiang Ocean University, China): Effects of climate change and human activities on the dynamics of fisheries community and succession of dominant species in Zhoushan archipelago Seas

November 16: Field observation

References

Center for Information Technology, Ehime University
Address: 3 Bunkyo-cho, Matsuyama 790-8577, Japan
Website: http://www.ehime-u.ac.jp

Location & Campus (English)
https://www.ehime-u.ac.jp/en_page/access/johoku-campus/
Location & Campus (Japan)
https://www.ehime-u.ac.jp/overview/access/johoku/

The poster presentation will be held in the space beside the Media Hall. The size of poster should be smaller than 110 cm (width) x 160 cm (length).

About Matsuyama

http://www.city.matsuyama.ehime.jp/lang/en/ (English)

http://www.city.matsuyama.ehime.jp/lang/ch/ (Chinese)

http://www.city.matsuyama.ehime.jp (Japanese)

Title: Kuroshio and Hypoxia in the East and South China Seas

Hon Kit Lui and Chen-Tung Arthur Chen*

Department of Oceanography, National Sun Yat-sen Univ., Kaohsiung, Taiwan
(ctchen@mail.nsysu.edu.tw)

Abstract:

Hypoxia off the Changjiang River mouth has grown into world's largest in size during the past two decades. The Pearl River mouth has also started to develop hypoxia in the past two decades. Decomposition of terrestrial organic material and oceanic phytoplankton supported by the riverine nutrients are the major causes of hypoxia. Here we will show that the hypoxic condition off Hong Kong is diminished when the Kuroshio intrusion to the South China Sea intensifies, perhaps due to the enhanced supply of oxygen by the upper Kuroshio Tropical Water. The hypoxic condition off the Changjiang River mouth also seems to be affected by the Kuroshio intrusion to the East China Sea.

Title: Impact of dissolved oxygen and nutrients from Kuroshio on the hypoxia off the Changjiang Estuary

Di Tian[1], Feng Zhou[1,2], Daji Huang[1,2]

1. State Key Laboratory of Satellite Ocean Environment Dynamics, Second Institute of Oceanography, Ministry of Natural Resources, Hangzhou, China
2. Ocean College, Zhejiang University, Zhoushan, China

Abstract:

The Changjiang Estuary (CJE), the coastal water of East China Sea, is suffering from frequent and series hypoxia in spring and summer. The cause for large variability of hypoxia off the CJE has not been well understood, partly due to various nutrient sources (adjacent river and the Kuroshio) and complex physical-biological processes involved. What extent the oceanic sources of dissolved oxygen (DO) from the Kuroshio and the Taiwan Strait could affect the hypoxia off the CJE is also unclear.

The Regional Ocean Modeling Systems (ROMS) coupled with Carbon, Silicate and Nitrogen Ecosystem (CoSiNE) is used to investigate the impact of dissolved oxygen and different nutrients from Kuroshio and Taiwan Strait on the hypoxia in the East China Sea (ESC). The sensitivity analyses suggest that dissolved oxygen (DO) concentration in the CJE is affected by both DO water and nutrients supply to the ECS shelf by the Kuroshio intrusion. The effect of the Kuroshio intrusion on DO in the ECS is even larger than Kuroshio intrusion on the nutrients. The sensitivity analyses also suggest the hypoxia extent in Changjiang Estuary is more sensitive to the change in the phosphate concentration than other nutrients in the Kuroshio.

Title: The connection and disconnection of phytoplankton production and subsurface hypoxia: hints from the physically complex dynamic system off the Changjiang Estuary

Feng Zhou[1], **Fei Chai**[1, 2], **Daji Huang**[1], **Huijie Xue**[2], **Mark Wells**[2], **Chenggang Liu**[1], **Jilan Su**[1]

1. State Key Laboratory of Satellite Ocean Environment Dynamics, Second Institute of Oceanography, Ministry of Natural Resources, Hangzhou, China

2. School of Marine Science, University of Maine, United States of America

Abstract:

The global increase in near-shore hypoxia over the past decades has resulted from excess anthropogenic nutrient loading of surface waters relative to the residence time of subsurface waters. The spatial relationship between surface phytoplankton production and subsurface hypoxic zones often is readily explained by considering the oceanographic conditions associated with basin size, shape, or bathymetry, but that is not the case where nutrient-enriched estuarine waters merge into complex coastal circulation systems. We investigated the physical and biogeochemical processes that create high-biomass phytoplankton blooms and hypoxia off the Changjiang (Yangtze) Estuary in the East China Sea (ECS). Extensive in situ datasets were linked with a coupled Regional Ocean Modelling Systems (ROMS) and Carbon, Silicate and Nitrogen Ecosystem (CoSiNE) model to explain the connect and disconnect of phytoplankton production and hypoxia. Diatoms were the major contributor of carbon export, and even though phytoplankton concentrations generally were three times greater above the hypoxic zones, high-biomass distributions during the summer-fall period did not closely align with that of the hypoxic zones. A major cause for this decoupling was the non-uniform offshore advection and detachment of segments of water underlying the Changjiang river plume, which carried organic-rich subsurface water northeast of the river mouth. The remineralization of this dissolved organic matter during transit created offshore patches of hypoxia spatially and temporally independent of the nearshore high biomass phytoplankton blooms. The absence of high phytoplankton biomass offshore, and the 1-8 weeks time lag between the inshore diatom production and offshore hypoxia, made it otherwise difficult to mechanistically explain the in situ observations. The findings here highlight the value of developing integrated physical and biogeochemical models to aid in forecasting the dynamics of coastal hypoxia, under both contemporary and future coastal ocean conditions.

Title: A method for tracing nutrients from different origins in a low-trophic ecosystem model and evaluating their contribution to primary production in a shelf sea

Jing Zhang[1], Xinyu Guo[2], Liang Zhao[1]

1. College of Marine and Environmental Sciences, Tianjin University of Science and Technology, Tianjin, China
2. Center for Marine Environmental Studies, Ehime University, Matsuyama, Japan

Abstract:

Nutrients (dissolved inorganic nitrogen (DIN) and dissolved inorganic phosphorus (DIP)) in the East China Sea (ECS) have four external sources, namely the Kuroshio, Taiwan Strait, rivers, and the atmosphere. In order to evaluate the contribution of each source of nutrients to the nutrient inventory and primary production over the ECS shelf, a tracking technique was applied to all the state variables in a low-trophic ecosystem model. Each source of nutrients has strong seasonal variations in the spatial distribution that depends closely on circulation, mixing, and stratification. The primary production supported by each source of nutrient is under the control of a combination of nutrients, temperature, and light. As a mean state over the entire ECS shelf, the Kuroshio contributes 72% of DIN input and 84% of DIP input, 57% of DIN inventory and 78% of DIP inventory, 50% DIN-based primary production and 61% DIP-based primary production and therefore is the dominant one among four sources. However, the contributions of four external nutrients have strong spatial dependence: the riverine nutrients and the atmospheric DIN dominate the inner shelf (0-50 m), the nutrients from the Taiwan Strait dominate the southern part of the middle shelf (50-100 m), and the nutrients from the Kuroshio dominate the outer shelf (100-200 m). The production efficiencies of the nutrients from the Kuroshio are low, while those from the atmosphere and Taiwan Strait are high. The riverine DIN is inefficient but DIP is efficient. The nutrient limitation, light and water temperature at the location of the nutrients determine the production efficiency of each specific sources.

Title :On the vorticity balance of the on-shelf Kuroshio intrusion northeast of Taiwan

Xiaohui Liu[1]

1. State Key Laboratory of Satellite Ocean Environment Dynamics, Second Institute of Oceanography, Ministry of Natural Resources, China

Abstract:

Two expressions of the vertical-averaged vorticity balance during the Kuroshio on-shelf intrusion northeast of Taiwan were discussed by using a regional high-resolution numerical model. The vorticity balance formed by depth-averaged momentum equations shows that, although the advection of geostrophic potential vorticity is mainly balanced by the joint effect of baroclinicity and relief (JEBAR), the ageostrophic terms contributed mostly by the advection of relative potential vorticity is the key dynamic mechanism changing the potential vorticity. The vorticity balance formed by depth-integrating momentum equations suggests the variation of vertical-integrating geostrophic potential vorticity is consequence of the curl of advection caused by the Kuroshio mainstream. The vertical motion near the shelfbreak is also the consequence of the variation of vertical-integrating potential vorticity. The sensitivity test by removing the advection term shows that the Kuroshio on-shelf intrusion is largely decreased due to smaller ageostrophic effects. The vertical motion is also much weaker in the absence of advection.

Title: The Taiwan Strait resembles a quasi-cul-de-sac in the NE monsoon season

Ting-Hsuan Huang, Chen-Tung Arthur Chen*

Department of Oceanography, National Sun Yat-sen University, Kaohsiung, Taiwan

Abstract:

The Taiwan Strait (TS) is the thoroughfare connecting two of the largest marginal seas in the world, namely the East China Sea (ECS) and the South China Sea (SCS). In summer when the SW monsoon prevails the flow is all northward thus transporting the salty, oligotrophic SCS water towards the ECS. In winter when the NE monsoon prevails the fresh, nutrient-rich China Coastal Current (CCC) flows southward. However, 26 ± 26 percent of the CCC turns eastward after entering the TS and then turns back towards the ECS. In the southern TS a mixture of the SCS water and the Kuroshio branch water flows northward initially on the eastern part of the strait. Yet, 46 ± 34 percent of this flow turns towards the west and eventually returns to the SCS resulting in reduced exchange between the ECS and the SCS in winter. Here we compare the northward transport situations during the SW and NE monsoons (SW: May-Oct.; NE: Nov.-Apr.). The northward water transport to the ECS is two times higher during the SW monsoon (2.3±0.7 Sv) than in the NE monsoon (1.2±0.5 Sv). However, the N transport to the ECS is only half during the SW monsoon (1.5±0.6 kmol N s^{-1}) compared to that during the NE monsoon (2.9±1.2 kmol N s^{-1}). Correspondingly, the N/P increases from 6.3±2.5 (the SW monsoon) to 14.4±4.0 (the NE monsoon) which is closer to the Redfield Ratio of 16. The northward transport has a higher N flux and more suitable N/P for biological uptake in the NE monsoon than in the SW monsoon. To conclude, as the ECS water has a N/P ratio higher than the Redfield ratio and vice versa for the SCS water, mixing of the waters from these two seas results in a N/P ratio chose to the Redfield ratio, and is more suitable for phytoplankton to grow.

Title: Harmful algal blooms in western Japan

Goh Onitsuka[1]

1. National Research Institute of Fisheries and Environment of Inland Sea, Japan Fisheries Research and Education Agency, Hatsukaichi, Hiroshima, Japan

Abstract:

Harmful algal blooms (HABs) have occurred mainly in the Seto Inland Sea and around Kyushu area located in western Japan. In the Seto Inland Sea, during the period of high economic growth from the 1960s to the 1970s, the rapid increase in HABs due to industrialization and urbanization became social problem. In particular, the bloom of raphidophyte genus *Chattonella* caused the catastrophic mass mortality of 14 million cultured yellowtail with a value of about 7.1 billion JPY in 1972. The number of bloom occurrences decreased in the 1970s to the 1980s possibly due to the contribution of the reduction of the loads of nitrogen and phosphorus. However, since the 1990s, there have been around 100 bloom events per year, and HABs with fishery damage have still occurred. From the 1970s to the 1980s, *Chattonella* blooms accounted for most of the fishery damage in the Seto Inland Sea, but since the 1990s, large-scale blooms of this species have decreased. In contrasts, harmful blooms of dinoflagellate *Karenia mikimotoi* have occurred almost every year in western Japan, and frequently caused fishery damage in recent years. Comparing the biological characteristics of *Chattonella* spp. and *K. mikimotoi*, these species have different physiological responses to the environmental conditions. For instance, it has been reported that *K. mikimotoi* can survive longer in a low nutrient condition. The differences in responses to environments may have led to the change in HAB species.

Title: Material transport from the river mouths to the upper Gulf of Thailand

Anukul Buranapratheprat[1], Arvut Munhapon[1,2], Siraporn Tong-u-dom[1] and Akihiko Morimoto[3]

1. Department of Aquatic Science, Faculty of Science, Burapha University, Thailand
2. Institute of Marine Science, Burapha University
3. Center for Marine Environmental Studies, Ehime University, Matsuyama, Japan

Abstract:

Eutrophication-related problems in coastal areas have long been occurring in the world including the upper Gulf of Thailand. Organic materials and nutrients from natural and anthropogenic sources transported through rivers are the major course of red tide and hypoxia in water column. Seasonal variations in wind, circulation and river discharge are able modify the problems to be complex in both spatial and temporal scales. In the upper Gulf of Thailand, severe red tide usually occurs in the northeastern corner of the area during the southwest monsoon. We all know that large river discharge and eastward circulation developed along the northern coast trigger eutrophication during this time. The major sources of nutrients are from four rivers including the Maeklong River, the Thachin River, the Chaopraya River and the Bangpakong River, located from the west to the east, but the influences of each river in the area are still unknown. We apply a circulation model coupled with passive tracer experiments to investigate the influence of each river in this area. It was found that most river water transported into the area came mainly from the Chaopraya River for 33 – 40 percent, followed by those from the Maeklong River and the Bangpakong River in almost the same portions for about 25 – 30 percent. The results help us understand the roles of wind, circulation and river discharge on eutrophic condition in this area through nutrient transport.

Title: Hypoxia in the Upper Gulf of Thailand –Hydrographic observation and modeling-

Akihiko Morimoto[1], Yoshishisa Mino[2,] Anukul Buranapratheprat[3], Atsushi Kaneda[4], Siraporn Tong-U-Dom[3], and Xinyu Guo[1]

[1]Center for Marine Environmental Studies, Ehime University, Japan
[2]Institute for Space-Earth Environmental Research, Nagoya University, Japan
[3]Department of Aquatic Science, Faculty of Science, Burapha University, Thailand
[4]Facultiy of Marine Science and Technology, Fukui Prefectural University, Japan

Abstract: The Upper Gulf of Thailand (UGoT) faces to capital city of Thailand, Bangkok. Width and length of the UGoT are approximately 100 km and the UGoT is very shallow bay with maximum water depth of 30 m. Five rivers, Bangpakong, Chaopraya, Thachin, Maeklong, and Phet Chaburi supply fresh water and materials such as nutrients, organic matters into the UGoT. Although the UGoT is high productivity coastal sea with high fish production, recently marine environment in UGoT becomes worse due to large input of organic and inorganic matters from above five rivers. In the present study, we conducted hydrographic observation for 1 year to understand seasonal variation in bottom DO distribution. Hypoxia appeared in river mouth of Chaopraya in August. The hypoxia occupied in half of total area of UGoT in September and DO concentration was less than 1 mg/l west of river mouth of Chaopraya; anoxic condition there. Anoxia and hypoxia occurred in the northwestern part of the UGoT in November, and there was no hypoxia from December to April. Again hypoxia appeared in June between river mouths of Chaopraya and Bangpakong. Hypoxia appeared in the northeastern part of the UGoT in early rainy season and moved to westward with seasons. We also developed a coupled physical-ecosystem model to understand spatial and temporal variation in hypoxia in the UGoT. We examined generation mechanism of hypoxia in the UGoT and influence of river discharge change to the magnitude of hypoxia.

Keywords: Hypoxia, Upper Gulf of Thailand, Lower Trophic ecosystem model

Title: On Ocean Circulation, Ecosystem and Hypoxia along the coastal transition zone off Hong Kong (OCEAN_HK)

Jianping Gan
Department of Ocean Science, Hong Kong University of Science and Technology, Hong Kong

Abstract:

The coastal waters around Hong Kong are affected by persistent and increasing eutrophication. This deteriorating situation may increase the frequency of HABs, expand the area of hypoxic zones and lead to other ecosystem disruptions and worse of all, offset the environmental improvements achieved through the costly Harbour Area Treatment Scheme over the last decade. Eutrophication/hypoxia in Hong Kong waters is primarily caused by the ecosystem's responses to the increasing nutrient discharge from the Pearl River and local sewage effluent. Highly variable oceanic currents transport the nutrients in the interactive river-estuary-shelf (RES) waters around Hong Kong, which undergo complex coupled physical-biogeochemical processes and modulate eutrophication/hypoxia. To date, these key processes have not been investigated in a comprehensive manner in the RES waters, and they remain largely unresolved in similar ecosystems elsewhere in the world. Understanding the full spectrum of coupled physical and biogeochemical processes in eutrophication is crucial to predicting and mitigating the impacts of eutrophication, and it remains a huge scientific challenge regionally and globally. The grand OCEAN_HK project (https://ocean.ust.hk/) aims to determine sources and sinks of nutrients, their biogeochemical controls, ecosystem dynamics, and physical controls on the eutrophication/hypoxia in the RES waters. By conducting an interdisciplinary study, we investigate the coupled physical-biological-chemical processes in this interactive RES system, and diagnose the eutrophication/hypoxia in the study region. We conducted interdisciplinary mapping and time-series measurements, and based on them, developed a novel coupled physical-biogeochemical modelling system. This presentation summarized the research findings in chemical-biological-physical aspects on the eutrophication and hypoxia studies in the coastal transition off HK waters.

Title: The eutrophication states and nutrient-phytoplankton dynamics of eutrophied tropical embayment of Jakarta Bay, Indonesia: temporal dynamics from 2001 to 2017

Ario Damar[1,2], Achmad Fahrudin[1,2], Karl-J. Hesse[3], Franciscus Colijn[4] and Yonvitner[2]

[1]Center for Coastal and Marine Resources Studies – Bogor Agricultural University, Indonesia
[2]Department of MSP, FPIK, Bogor Agricultural University, Indonesia
[3]Forschungs-und Technologie Zentrum – Westkueste – University of Kiel, Germany
[4]Institute for Coastal Research, Centre for Material and Coastal Research, Helmholtz-Zentrum Geestacht, Max-Planck-Strasse 1, 21502 Geestacht, Germany

Abstract: Eutrophication states of the most eutrophied tropical embayment in Indonesian waters was studied over the period of 2001-2017 in Jakarta Bay. There was a clear gradient of dissolved inorganic nutrient concentration, showing very high values in the river mouths and steeply decrease down the bay. This is followed by a steep gradient of Chl-a concentration, showing high phytoplankton biomass in the river mouths (29.2 µg Chl-a l-1) and then decrease 2 folds in the near coastal waters (14.8 µg Chl-a l-1) for then decreased 4 folds in the middle (6.3 µg Chl-a l-1) and finally 14 folds in the outer part of the bay (2.1 µg Chl-a l-1). There is no significant change in nutrient concentration (except nitrogen), phytoplankton biomass and thus eutrophication level during the last 16 years period (between 2001 to 2017), showing relatively stable but high nutrient pollution level in Jakarta Bay. Eutrophication level analysis resulted high level of eutrophication in the bay. Hyper-eutrophic level is always pronounced along the near-shore part of the bay, for then decreases to eutrophic level in the middle of the bay and mesotrophic class in the outer part of the bay. Algae bloom and hypoxia becomes a regular phenomenon which leads to mass mortality of fish in this bay.

Keywords: eutrophication, nutrient, phytoplankton, chlorophyll-a, estuarine

Title: The environmental study to understand the hypoxia behavior in Jakarta Bay

Suhendar I Sachoemar[1], Yuichi Hayami[2], Akihiko Morimoto[3], Agus Sudaryanto[1], M. Saleh Nugrahadi[4], Endro Soeyanto[1], M.Ilyas[1] and Ratu Siti Aliah[1]

1. Agency for the Assessment and Application of Technology (BPPT), Jakarta Indonesia.
2. Saga University, Japan. Institute of Lowland and Marine Research, Saga University. Saga, Japan
3. Center for Marine Environmental Studies, Ehime University. Matsuyama, Japan .
4. Coordinating Ministry for Marine Affair. Jakarta. Indonesia.

Abstract:

Jakarta Bay is a semi enclosed estuary located in the northern coastal area of Jakarta which is surrounded by 13 rivers from 3 provinces (Province Jakarta, West Java and Banten) which empties into the Jakarta Bay. As a consequence, Jakarta Bay has become a place for the emergence of various pollutants carried by 13 rivers from the three provinces in the form of household organic waste and industrial waste. Often the occurrence of mass deaths in fish in Jakarta Bay is thought to be due to the accumulation of the anthropogenic and industrial waste in the coastal areas of Jakarta Bay which can form dead zones in the form of hypoxia in the bottom layers with low DO concentrations. Until now, the actual cause of the frequent occurrence of mass death in fish in the Jakarta Bay is unknown, whether due to the direct pollution or upwelling from hypoxia. To find out and understand the problem, a study of hypoxia in Jakarta Bay is needed.

Title: Behavior and residence time of river waters in Jakarta Bay

Akihiko Morimoto[1], Endro Soeyanto[2]

[1]Center for Marine Environmental Studies, Ehime University, Japan
[2]Agency for Assessment and Application Technology (BPPT), Indonesia

Abstract: The present study using a 3D–numerical modelling technique to predict an overview of temperature, salinity, current velocity distribution in Jakarta Bay, Indonesia in the period year 2016. Furthermore, this ocean model applies to overview the seasonal variation of these parameters and behavior of water age in the bay. Seasonally, the surface current fields in Jakarta Bay controlled the behavior and residence time of river waters in Jakarta Bay. Dominant flows of the river mouths that flow to the bay are from eastern side of the Jakarta Bay. Citarum river gives only highest of contribution rate and shortest age water in transition rainy to dry season (May 2016).

Keywords: Jakarta Bay, 3D numerical modeling, seasonal variation, residence time of river water

Title: Long-term change in the state of water pollution in Tokyo Bay: Tokyo Bay, trend analysis, COD, nutrients and hypoxia

Haruo Ando[1], Nobuhisa Kashiwagi[2], Yuuichi Ishii[1], Hideaki Maki[3]

1. Tokyo Metropolitan Research Institute for Environmental Protection, Tokyo, Japan
2. The Institute of Statistical Mathematics, Tokyo, Japan
3. National Institute for Environmental Studies, Ibaraki, Japan

Abstract:

Tokyo Bay is one of the major coastal seas in Japan. About 31 million people live in the drainage basin accounting for 24% of the total population in Japan. The basin includes the Tokyo metropolitan area, which is the political and economic center of Japan.

During the period of high economic growth that began in the 1950s, the water quality of Tokyo Bay deteriorated rapidly. As a countermeasure to address this problem, in 1979 the Total Pollutant Load Control System was introduced to reduce the total amount of COD flowing into Tokyo Bay. In 2001 the system was expanded to include total nitrogen and total phosphorus as causative substances for eutrophication. Consequently the amount of those pollutants produced in the drainage basin was estimated to be greatly reduced.

We have studied the long-term trend of water quality in Tokyo Bay to evaluate the effects of water pollution prevention measures. In Tokyo Bay, water quality has been measured by the relevant local governments every month at scores of monitoring points for administrative purposes since 1970s. We used a seasonal adjustment method to analyze these data and estimated the trend of water quality.

The result shows that overall the water quality of Tokyo Bay has been improving, but the degree of improvement is different depending on the sea areas. In the eastern side of the bay, the nutrient concentration has decreased considerably. However, in the western side especially around Tokyo, even today the level of nutrient concentration is still high enough for an outbreak of red tide. Because major inflowing rivers and most large-scale sewage treatment plants are located around this area. As a consequence, hypoxia and anoxia frequently occur in the bottom water during the warm season in this area.

Title: Tempo-spatial variations of hypoxia water and nutrient conditions, and emerging problems in Osaka Bay, Japan

Satoshi Akiyama[1], Masaki Nakajima[2]

1. Marine Fisheries Research Center, Research Institute of Environment, Agriculture and Fisheries, Osaka Prefecture, Misaki, Osaka, Japan
2. Research Institute of Environment, Agriculture and Fisheries, Osaka Prefecture, Habikino, Osaka, Japan

Abstract:

Osaka Bay is located in eastern Seto Inland Sea, Japan, and more than 17 million people lives in the catchment area. Over the past 60 years, the bay has undergone various artificial and natural changes, such as coastal reclamation, water pollution and eutrophication accelerated with industrial development and population growth, and the following total pollutant load control and global/regional warming.

In this presentation, we demonstrate transition of occurrence of hypoxia water mass and nutrient conditions in Osaka Bay, using results of water quality monitoring since 1972. From 1970s to 1990s, the area of hypoxia water mass had been reduced in summer, and then has continued approximately constantly. Dissolved nutrient concentration reached peaks from 1970s to 1980s, and have steadily decreased since then. DIN/DIP ratio was temporarily increased in 1980s, with sharp decrease in DIP, and began to show downward trends in 1990s. And, since 2000s, the number of monitoring station where DIN/DIP ratio is falling below the Redfield ratio is increasing.

Like this, in Osaka Bay, trophic and dissolved oxygen conditions have drastically changed. And, in recent years, shortages and uneven distribution of nutrients have been new problems. Since they should have been associated with lower biological productivity and less fish catch, marine environmental conservation considering the bioproductivity would be required for the future.

Title: Oxygen consumption rate in the Mikawa Bay using an optical oxygen sensor

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2. Institute for Space-Earth Environmental Research, Nagoya University, Nagoya, Japan
3. Tokai Marinos Tech, Tokoname, Japan
4. Graduate School of Science and Engineering, Ehime, University, Matsuyama, Japan

Abstract:

Oxygen consumption rate (OCR) of bottom waters at 4 stations from the inner part to the mouth of the Mikawa Bay during May to August 2014 was estimated from dark bottle incubations using an optical oxygen sensor (FirestingO_2, Pyroscience). An error of oxygen measurement by this sensor (±3.26 μmol kg^{-1}) was sufficiently low to evaluate the OCR in the Mikawa Bay. Larger OCR was found in the inner most point than others all the time, with the maximum of 38.3 μmol kg^{-1} d^{-1} in August 24th. Among six observations, low-oxygen water masses (<20 % of oxygen saturation) appeared at the bottom water from the inner to the middle part of the bay in June 24th, July 31st, and August 24th when larger density differences were found in which atmospheric O_2 exchange was inhibited. Severe hypoxia would be formed and maintained by a large OCR and a strong and stable stratification.

Title: Hypoxic water mass in Ariake Sea, Japan -mechanisms of multi-time scale variations-

Yuichi Hayami[1]

1. Faculty of Agriculture, Saga University, Saga, Japan

Abstract:

Ariake Sea is a semi-enclosed coastal water located in Kyushu island, southwestern Japan. The Chikugo River which is the biggest river in Kyushu flows into the inner part of this bay. Recently, serious hypoxia occurred every summer and generated massive kill of bivalves in this bay. The formation of hypoxia was triggered by the enhancement of stratification of water column. The freshet of river was the most important factor which enhanced stratification. The other factor which enhanced stratification was the intrusion of high density water from offshore during neap tide. Therefore, there is a spring-neap cycle variation in hypoxia. The interannual variation of hypoxia was generated by the river discharge. When the river discharge was large, the hypoxia became serious and continued longer. More longer time scale, the variation of hypoxia in Ariake Sea was generated by the organic matter production in the bay and 18.6-year lunar nodal variation. When the M2 tidal range became smaller due to the lunar nodal variation, stratification became stronger and hypoxia became more serious. We estimated the potential for hypoxia removing the effects of the variation in stratification. The potential of hypoxia increased from 1972s to early 90s. The Chemical Oxygen Demand which is an index of organic matter concentration increased in the same period. There was a high negative correlation between the potential of hypoxia and COD. The results of the box model analysis indicated that the COD increase was generated by the internal production. In this period, the bivalve population in the bay largely decreased. Therefore, the decrease of the predation by bivalves enhanced the production of phytoplankton in the bay. Except for them, the construction of the Isahaya Sea dike enhanced the hypoxia.

Title: Disappearance of Hypoxia in Dokai Bay, Japan

Tetsuo Yanagi[1]

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Abstract:

Dokai Bay suffered from severe hypoxia during 1960-2000 but it disappeared in 2010 as shown in Fig.1. This is mainly due to the strict application of the total pollution load reduction law from land. TP load was decreased by about 80 % and TN load by about 60 % from 1998 to 2010.

Other trials such as dredging, bio-remediation, citizen participation and so on are introduced in this presentation.

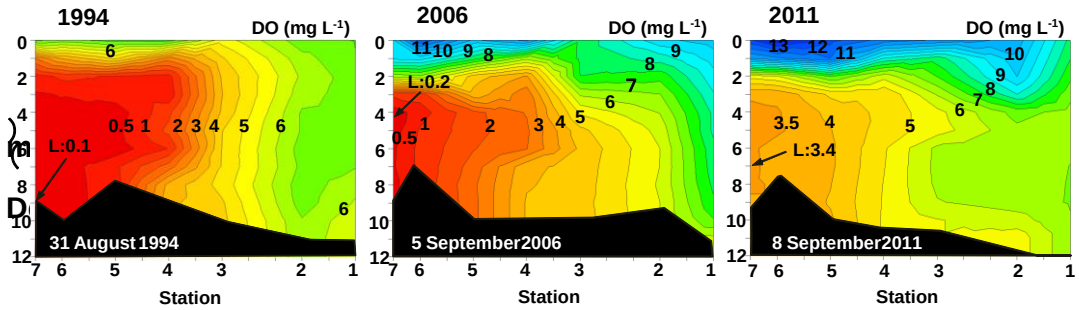

Fig.1 Year-to-year variation in Hypoxia in Dpkai Bay

Title: Enhancing water exchange and suppressing the effects of anoxic water in an inner bay by placement of water flow pipes through tsunami protection breakwaters

Keyword: tsunami protection breakwater, environmental operation, anoxic water, water exchange, Ofunato Bay

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Abstract:

Before the unexpected massive tsunami generated by the 2011 Tohoku Earthquake in March 2011, large-scale anoxic water masses were formed in the middle to lower layers in Ofunato bay from summer to autumn every year. The tsunami protection breakwaters including their mounds at the mouth of the bay were almost collapsed by the tsunami disaster. Post-disaster field measurement data showed that the dissolved oxygen concentration in the bay was kept high even in summer and autumn seasons. The field observation and numerical analysis revealed that the major reason for the decline in the anoxia formation was attributed to enhanced intrusions of low temperature, high dissolved oxygen water mass into the lower part of the bay, which was associated with elevation of the internal density interface off the coast of Ofunato bay. As a result, effective water exchange at the bottom of the bay was promoted to reduce anoxia development.

Therefore, eighteen water flow pipes (diameter 3.5 m) were installed in lower part of the mounds (water depth 31 m) for the reconstruction of tsunami protection breakwaters. Observation data of dissolved oxygen concentration after the construction of the mounds showed higher values than that before the tsunami. At the same time, observation data of the current in those pipes showed an oscillation with semi-diurnal cycle when the depth of the internal density interface was higher than those pipes, and a constant outflow when the depth of the interface was lower than the pipes. The constant outflow was induced by the density difference between warmer water mass of the outer bay and the lower temperature water mass, which was intruded from outer bay to inner bay during the oscillation period. Numerical modeling analysis revealed that the discharging mechanism of the lower layer water through the pipes effectively suppressed the anoxic formation.

Title: Decadal and centennial oscillation in Japanese sardine abundance during the last 2,900 years

Michinobu Kuwae[1]

1. Center for Marine Environmental Studies, Ehime University

Abstract

How changes in nutrient conditions in the Seto Inland Sea influence fish abundance is recent active research and is important for fishery resource prediction. However, fish abundance does not necessarily respond to the nutrient conditions in the inland sea. There may be some species depending on open ocean environments. Here I address long-term variability in sardine and anchovy abundance using fossil fish scales in Beppu Bay sediments and their responses to open ocean environments and climate variability in the Pacific. On the basis of this information, I address whether these species responded to nutrient conditions, in particular in the western Seto Inland Sea for the past millennia.

For the former topic, I discuss whether Japanese 'sardine regime' comes back in the next decades based on our paleo-fish-productivity data reconstructed from Beppu Bay sediments and published paleoclimate data. We found that sardine population showed centennial-scale variability in association with reconstructed PDO indices, likely responding to open ocean climate variability in the Pacific. If the centennial climate forcing on Japanese sardine recruitments are still dominant, Japanese sardine regime does not necessarily come back in the next decades because of potential entering into the negative phase of the centennial variations in sardine abundance.

For the latter topic, I address responses of these species to nutrient conditions in the western Seto Inland sea for the past millennia to test if these species have been influenced by nutrient environments in the inland sea. We found that there is no evidence supporting this hypothesis, rather showing negative relationship between fish and phyto-/zoo-plankton productivity during several periods. Anchovy and sardine in the Seto Inland Sea might migrate from slope and offshore environments in the Pacific; their abundance might result from temperature or nutrients and recruitments of the populations in these regions.

Title: Long-term variation of nutrient concentration in the Western Seto Inland Sea

Naoki Yoshie[1], Sohei Ogawa[1], and Hidejiro Ohnishi[1]

1. Center for Marine Environmental Studies, Ehime University, Matsuyama, Japan

Abstract:

The nutrient concentration around the Sada-Misaki strait is a representative nutrient concentration in the Western Seto Inland Sea because of the huge horizontal and vertical mixing around the narrow strait with the strong tidal current. We have observed the long-term variation of the nutrient concentration by daily nutrient monitoring from 2004 at cape Sada-Misaki where is located at the tip of the Sada-Misaki peninsula which is the longest thin peninsula in Japan. We investigated seasonal and interannual variations of the nutrient concentration and mechanisms of these variations concerning with nutrient supplies from terrestrial and offshore regions. The seasonal variations of nitrate and phosphate were typical variations with the maximum in the winter and the minimum in the summer, while the variation of silicate had second maximum in the summer due to the high-silicate water discharge from the terrestrial region during the rainy season. The interannual variations of nitrate and phosphate were affected by the bottom intrusion of the offshore water originated from Kuroshio subsurface water in the summer. On the other hand, the variation of silicate was affected by the river discharge in the northern part of Kyushu during the rainy season. There was no clear decreasing trend of the nutrient concentration observed in the Eastern Seto Inland Sea, where the water depth is shallower and the nutrient supply from the terrestrial region is larger than those in the Western Seto Inland Sea. As nitrogen is limiting nutrient of primary productivity in this region, the interannual variation of the productivity in this region might be controlled by the nutrient supply from the Kuroshio subsurface water in the summer.

Title: Human-induced marine ecological degradation: historical ecology and the Anthropocene

Moriaki Yasuhara[1]

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Abstract:

We analyzed published downcore microfossil records from 150 studies and reinterpreted them from an ecological degradation perspective to address the following critical but still imperfectly answered questions related to the Anthropocene: (1) How is the timing of human-induced degradation of marine ecosystems different among regions? (2) What are the dominant causes of human-induced marine ecological degradation? (3) How can we better document natural variability and thereby avoid the problem of shifting baselines of comparison as degradation progresses over time? The results indicated that: (1) ecological degradation in marine systems began significantly earlier in Europe and North America (~1800s) compared with Asia (post-1900) due to earlier industrialization in European and North American countries, (2) ecological degradation accelerated globally in the late 20th century due to post-World War II economic growth, (3) recovery from the degraded state in late 20th century following various restoration efforts and environmental regulations occurred only in limited localities. Although complex in detail, typical signs of ecological degradation were diversity decline, dramatic changes in total abundance, decrease in benthic and/or sensitive species, and increase in planktic, resistant, toxic, and/or introduced species. The predominant cause of degradation detected in these microfossil records was nutrient enrichment and the resulting symptoms of eutrophication, including hypoxia. Other causes also played considerable roles in some areas, including severe metal pollution around mining sites, water acidification by acidic wastewater, and salinity changes from construction of causeways, dikes, and channels, deforestation, and land clearance. Microfossils enable reconstruction of the ecological history of the past 10^2–10^3 years or even more, and, in conjunction with statistical modeling approaches using independent proxy records of climate and human-induced environmental changes, future research will enable workers to better address Shifting Baseline Syndrome and separate anthropogenic impacts from background natural variability.

Title: A challenge on measuring photosynthetic oxygen evolution by optical sensors in the Tokyo Bay, off Haneda

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[2]Center for Marine Research and Operations, Tokyo University of Marine Science and Technology, Japan
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[4]Institute for Space-Earth Environmental Research, Nagoya University, Japan
[5]Center for Marine Environmental Studies, Ehime University, Japan

Abstract: The inner part of Tokyo Bay forms shallow and vast estuaries is known as one of the enclosed coastal seas in the world. Coastal estuaries are not only places with high productivity area, but high biodiversity is providing many useful ecosystem services for human. This result preliminary reports that oxygen gross primary productivity (GPP) estimation in Tokyo Bay off Haneda during 2018-19. Primary productivity as three methods were measured by the simulated in situ incubation under different light intensities about for five hours; high precision Winkler titrations (Grasshoff, 1983) and net primary production (NPP) from ^{13}C uptake rates (Hama et al., 1983) with in situ quantification of oxygen generation rate in the same vials using fiber optic oxygen sensors (FireStingO_2, Pyro Science GmbH, Aachen, Germany). This fiber optic O_2 sensors were glued to the interior of the glass vials, and the sensor spots The FireSting oxygen meters excites the indicators with a 620 nm LED and measures the luminescent lifetime of the indicators using the phase modulation method (Holst et al. 1995). Two approaches of oxygen generation as the optical sensor and precise titrations showed good agreement (r^2=0.96, $p<0.01$), suggested that GPP can be monitored using the optical sensor that easy handle with immediate results. The minimum value of GPP was 1.0 μmol O_2 kg^{-1} h^{-1} in December, and the maximum value was 42.6 μmol O_2 kg^{-1} h^{-1} in August by the Winkler method. The maximum GPP under light saturation conditions were ranging between 0.36 and 1.41 μmol O_2 μg Chl. a^{-1} h^{-1} in this study, almost same as four decades ago (0.05-2.5 μmol O_2 μg Chl.a^{-1} h^{-1}, Yamaguchi et al., 1988).

We plan to estimate particulate organic carbon (^{13}C-POC) as NPP and then compare to GPP measurement, to facilitate for simplified productivity measurement methods in future.

Keywords: Primary productivity, Tokyo Bay, Oxygen generation, Carbon uptake.

Title: The river discharge can change the peak and its occurrence time of the Chlorophyll-a in a semi-enclosed sea

Xiaokun Ding[1]

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Abstract:

The peak and its occurrence time of the Chlorophyll-a concentration (Chl-a) are not often fixed in the coastal area, due to the dual influence of human activities and natural factors. For example, the seasonal variation of the Chl-a may show two peaks in spring and autumn or one peak in summer, directly affected by the nutrients supply, convective mixing for phytoplankton, etc. In the Bohai Sea (BHS), which is a typical semi-enclosed sea in the Northwest Pacific, the seasonal pattern of sea surface Chl-a has not been yet unsterdood in recent decades. The paper specifically introduces the change in seasonal pattern of the Chl-a in the BHS, using the previous in-situ data and satellite-derived data. The results show that the seasonal pattern of the Chl-a has gradually changed from two peaks in spring and autumn to high value of the Chl-a in spring and summer in recent decades. The shift year is around 2002. Moreover, the annual range of seasonal variation in the Chl-a increased significantly with a higher value (~2.2 $mg \cdot m^{-3}$) of average after 2002 than before (~0.4 $mg \cdot m^{-3}$). A large amount of nutrients loads in summer due to the Water-Sediment Regulation Scheme (WSRS) play a vital role in the change in seasonal pattern of the Chl-a while other factors have a little influence. The model results show that the WSRS can generally increase the Chl-a and primary productivity over the whole central area by 0.04 mg $Chl\text{-}a \cdot m^{-3}$ and 3.19 mg $C \cdot m^{-2} \cdot d^{-1}$ respectively per 10^8 m^3 fresh water into the sea. The above change maybe also has a drastic effect on the zooplankton and aquaculture by changing the feed supply and water quality. This work helps clarify the seasonal pattern of the Chl-a in a typical semi-enclosed sea and maybe promotes the study on the impact of human activities on the marine ecosystem through showing a new case.

Keywords: Chlorophyll-a; Seasonal pattern; Change; River discharge; Bohai Sea

Title: Annual Cycles and Budgets of Nutrients in the Yellow Sea: a model study

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Abstract:

To study the annual cycles and budgets of both dissolved inorganic nitrogen (DIN) and particulate organic nitrogen (PON) in the Yellow Sea, a three-dimensional coupled biophysical model (ECSECOM) was established. We simulated the DIN and PON cycles in the Yellow Sea, calculated the annual budgets of nitrogen and analyzed the spatial distributions and seasonal variations of each sources and sinks of DIN and PON. The results indicate that (1) The DIN concentration decreases through spring and summer due to the spring blooms and reaches the lowest value in June-August, then increases greatly in autumn. The concentration of PON is low in winter and spring, and increases in summer and autumn following the growth of chlorophyll-a and peaks in September. (2) Regarding the budgets of DIN, primary production and respiration of phytoplankton are the most important sink and source of DIN. The remineralization of the detritus pool compensates 21.5% of the consumption of DIN by the primary production process, while external input of DIN accounts for 18.1%. The external inputs of DIN are dominated by sediment-water interface exchange in mud areas in the central part of the Yellow Sea, the eastern part of the Bohai Strait and the center of the North Yellow Sea. The input of DIN from atmospheric deposition to the Yellow Sea is comprehensive, and the area affected by the bottom interface release and river loading is regional. (3) The major source of PON is mortality release of phytoplankton. The exchange of sediment-seawater interface of PON show a net sedimentation. The transformation rate between DIN and PON is also calculated. There are 76.5% of PON converting to DIN, the most of the rest PON deposit to the sediment. The transformation rate from DIN to PON is 30.0%.

Title: Estimate of environmental capacity of dissolved inorganic nitrogen in the Xiangshan Bay

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2. Ningbo Scientific Research and Design Institute of Environmental Protection, Ningbo 315012, China;
3. College of Environmental Science and Engineering, Ocean University of China, Qingdao 266100, China

Abstract: A three-dimensional water quality model in the Xiangshan Bay was established based on ROMS (Regional Ocean Model System) to simulate the distribution of dissolved inorganic nitrogen (DIN) in the Xiangshan Bay, including 10 land-based discharge sources. In the condition of class I water quality standard, the discharge optimization method was applied to calculate the environmental capacity (EC) of DIN with the minimum DIN discharge concentration (R_{min}) getting larger. The results show that the EC of DIN in the Xiangshan Bay is 167.16~274.17 t/a. The capacity will decrease when R_{min} gets larger, which means more discharge flux of DIN needed to be cut down. According to the reduction priority, the ten discharge sources can be divided into four levels, which mainly depends on the water half-exchange time and annual DIN discharge flux.

Title: Study on the Response Mechanism of Primary Production in the East China Sea to the Change of Nutrient Inputs from the Yangtze River

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Abstract:

Using a three-dimensional coupled biophysical model, we simulated the responses of primary production in the East China Sea (ECS) to long-term changes in nutrient transport from the Yangtze River during 1960–2005. Nutrient transport was affected by combined effect of river discharge and nutrient concentration. Increasing river discharge accompanied with increasing nutrient transport raised nutrient concentration except phosphate in most parts of ECS. Increasing part was quickly consumed through primary production for phosphate is a candidate limiting factor. Increasing river discharge also caused dramatic changes in physical situation in the estuary and further strongly affected the ecological processes. Due to increased use of chemical fertilizer and construction of water conservancy projects, increasing nitrate and phosphate concentrations in the river primarily led to increases in nitrate, phosphate, and primary production in the ECS, whereas decreases in silicate concentration in the river led to lower silicate concentrations in the ECS, indicating that silicate is not a limiting nutrient for photosynthesis. Increasing N/P and N/Si ratios in the Yangtze River could lead to main algae changing from diatom to dinoflagellate. As flooding events and anthropogenic activities will increase in the future, it is significant to find out the response mechanism of primary production in the ECS from nutrient transport from Yangtze River.

Title: A simulation of the seasonal variation of decabromodiphenyl ether in a bay adjacent to the Yellow Sea

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2. Center for Marine Environmental Studies, Ehime University, Matsuyama, Japan
3. Laboratory for Marine Ecology and Environmental Sciences, Qingdao National Laboratory for Marine Science and Technology, Qingdao, China

Abstract:

A three-dimensional transport-ecosystem-POP coupled model is configured to simulate the seasonal variation and budget of decabromodiphenyl ether (BDE-209) in a semi-enclosed bay adjacent to the Yellow Sea. The model includes five types of BDE-209 (gaseous, dissolved, phytoplankton-bound, detritus-bound, and suspended particulate matter (SPM)-bound) and related physical and biogeochemical processes, such as advection and diffusion due to seawater motion, input from rivers, air-sea exchange, decomposition of dissolved BDE-209, uptake and depuration between dissolved and phytoplankton-bound BDE-209, mortality of phytoplankton-bound BDE-209, remineralization and sinking of detritus-bound BDE-209, and sinking of SPM-bound BDE-209. Model results show that the dissolved and particulate BDE-209 in the bay are higher in the nearshore area than in offshore area and are higher in summer than in other seasons; these results are consistent with field data. SPM-bound BDE-209 is dominant among the five types due to its large supplying from rivers. Dissolved BDE-209 concentrations are around 5-fold that of phytoplankton-bound BDE-209, which depends on uptake and depuration rate constants between dissolved and phytoplankton-bound BDE-209 and biomass of phytoplankton. Evaluation of mass balance indicates that the input from rivers is major source of BDE-209, while the exchange with the Yellow Sea is major sink. Sensitivity experiments demonstrate that the input of BDE-209 from rivers plays the most significant role in the seasonal variation of dissolved and particulate BDE-209 concentrations, and the change in water temperature is a secondary factor.

Reference:

Wang, A., Guo, X., Shi, J., Luo, C., Gao, H., 2019. A simulation of the seasonal variation of decabromodiphenyl ether in a bay adjacent to the Yellow Sea. Science of the Total Environment 664, 522–535. https://doi.org/10.1016/j.scitotenv.2019.01.385

Title: Organic Carbon Distribution and Budget in the Changjiang Diluted Plume based on Chemical analysis and Numerical Model

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Abstract:

River plume carries lots of materials to adjacent sea, interacting with local ecological environment and has great influence on carbon cycling. However it is difficult to quantify organic carbon (OC) budget in such dynamic region while there are many studies about descriptive of their distribution and behavior only. In this study, based on a three-dimensional numerical model combined with in situ chemical analysis, we characterized the distribution and budgets of OC along the Changjiang Diluted Water especially the residence time (RT) of water mass and phytoplankton contribution to OC were quantitative estimated. Integrated all physical and chemical parameters, very different two typical groups (estuarine region and coastal region) were identified by the principal component analysis (PCA). In estuarine region, the average RT was 4.9 days while it was 39 days in coastal region, and the longer RT allows phytoplankton blooming during the spread of the Changjiang Diluted Plume in the offshore. We found, in coastal surface layer, about 17.4% (±10.2%) of DOC and 74.8% (±17.4%) of POC was derived from phytoplankton in situ production while it was only 2.9% (±6.6%) of DOC and 12.1% (±9.8%) of POC in estuarine region and about 30.2% contribution of OC was from the Changjiang. This study first quantitatively estimated the influence of Changjiang plume on carbon cycling of the Eeast China Sea and will shed light on the biogeochemistry of terrestrial delivery of OC in the dynamic coast.

Title: The role of submesoscale advections on vertical heat and nutrient transports in the Southern East China Sea

Jiliang Xuan[1], Qicheng Meng[1], Feng Zhou[1], Daji Huang[1]

1. State Key Laboratory of Satellite Ocean Environment Dynamics, Second Institute of Oceanography, Ministry of Natural Resources, Hangzhou, China

Abstract:

Horizontal resolutions of regional ocean models are often not sufficient to resolve submesoscale vertical advection (SVA) in continental shelf seas. In this study, we investigate the role of SVA on vertical heat and nutrient transports through two similar models in the Southern East China Sea with different horizontal resolutions. (1) The SVA increases downward heat transport in early autumn. An internal warming process is significant in both the observations and the high-resolution model (HRM) but is absent in the high-resolution model (LRM). Combined with the observations, we found that the internal warming, which occurred in the barrier layer of the water column in early autumn, is accompanied by submesoscale oscillations of isothermals in the HRM. SVA increases the total vertical advection by up to an order of magnitude in the HRM compared with the LRM and dominates the internal warming process. (2) The SVA increases upward nutrient transport in the whole year, which contributes to the Phytoplankton Production mainly in summer. Weak SVA with great positive contribution to the Phytoplankton Production in summer is mainly due to the strong stratification and intensive Photosynthetically Active Radiation. In such circumstance, SVA provides a significant vertical nutrient supplement pathway particularly on the middle shelf. Intensive Photosynthetically Active Radiation facilitates the phytoplankton growth by making full use of the replenished nutrient.

Title: Upstream propagation of a bottom-advected plume and its influencing factors

Xiaojie Yu[1]

1. College of Environmental Science and Engineering, Ocean University of China, Songling Road, Qingdao, China.

Abstract:

Several summer hydrographic data during sharp variation of river discharge in the Yellow River revealed that the Yellow River plume propagated upstream under low river discharge, in a direction opposite to that of a Kelvin wave, but turned downstream after river discharge increased. A numerical model for the Bohai Sea reproduced the upstream propagation of the Yellow River plume under low river discharge, as well as the alternation to downstream direction under high river discharge. Through numerical experiments, the upstream extension of the Yellow River plume is found to feature significant spring and neap variation. During spring tide, the Yellow River plume is bottom-advected plume and extends upstream, while during neap tide, the plume becomes surface-advected and turns downstream. The mechanism driving the upstream propagation of the bottom-advected plume in spring tide is the Euler tidal residual current in the bottom boundary layer, which flows upstream-ward near the Yellow River mouth. The surface-advected plume in neap tide detaches from the bottom layer and is deflected downstream by the Coriolis force. Further analysis indicates that the vertical structure of the plume determines the propagation direction of the plume. After river discharge increases, the Yellow River plume becomes surface-advected in spring tide and consequently turns downstream. The momentum balance of the plume transforms from advection dominated in low river discharge to Coriolis force dominated in high river discharge. Besides, summer wind has little influence on the upstream extension of the Yellow River plume under low river discharge in spring tide.

Title: Effects of climate change and human activities on the dynamics of fisheries community and succession of dominant species in Zhoushan archipelago Seas

Yongjiu Xu[1]

1. School of Fisheries, Zhejiang Ocean University, China

Abstract:

The effect of climate change, fishing activity, stock enhancement and fisheries management policy on dynamic of fisheries community structure were rarely evaluated in the Zhoushan archipelago areas. According to the fisheries survey between 2015 to 2018, which corresponded to the critical periods of those activities above, we quantified the effect of fishing activity on the dynamic of dominant fish, the effect of fisheries recovery management, and the climate change on the critical stage of fisheries recruitment. The results indicated that the climate change and human activities have significant influence on the dynamics of fisheries community. The comparison to the previous datasets indicated that there is a significantly increasing trend of the abundance of dominant species during recent decades. Human related activities explained more than 50% of the long-term dynamic of fisheries community, rather than the climate change, however, for their seasonal dynamic, climate change played an more important role. The long term influence were more reflected on the size of dominant species, while, the short-term influence were reflected on their abundance. The fisheries management policy benefited the long-term dynamics of fisheries size community, through increasing the size of most dominant species. The climate change in spring strongly affected the subsequent recruitment of dominant species. These results probably reflected different fisheries response strategy, and fisheries management should consider different responses.