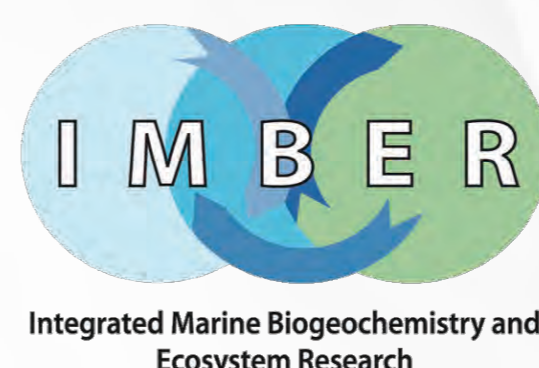


# 7<sup>TH</sup> CHINA • JAPAN • KOREA IMBER SYMPOSIUM



**24 - 26 MARCH 2016**

**JEJU INTERNATIONAL MARINE SCIENCE CENTER  
FOR RESEARCH & EDUCATION**





## Instructions for Participants

### Oral Presentations

In order to ensure a smooth course during oral session, we kindly ask you to consider the following instructions.

- ✓ Please note that all presentations are expected to adhere strictly to the time allocated.
- ✓ The time slot for each presentation is 15 minutes presentation followed by 5 minutes for discussion. Follow any additional instructions given by your session chairpersons.
- ✓ Please bring your presentation file on a USB memory sticks.




### Poster Presentations

- ✓ Each poster board has been allocated a number. The posters must be placed on the panels, following the numbering indicated on the panels.
- ✓ Materials for attaching the posters to the panels will be available at the registration desk.
- ✓ At the end of the poster session, the author(s) **must remove** their poster from the panel. The Organizing Committee will not send/keep any posters that have left at the conference venue.

### Shuttle Bus Information

FREE shuttle bus will be operated twice a day between Hamdeok and Venue.

#### ● Operating Schedule

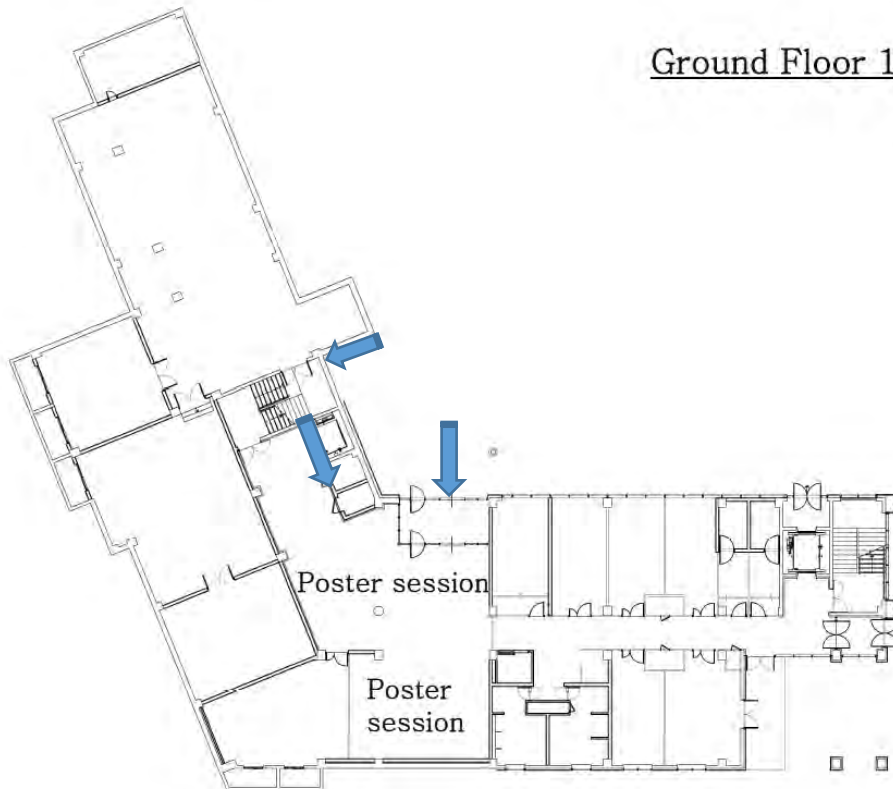
	Hamdeok Ramada Hotel 	Golden Tulip Hamdeok Hotel 	 Venue
24 March	9:10am	9:20am	7:40pm
25 March	8:10am	8:20am	5:10pm
26 March	8:10am	8:20am	2:10pm

# Venue information

Level 1



Ground Floor 1



# Detailed Program

## Day 1(March 24)

### Opening, Session 1, Session 2, Reception

---

#### Opening

10:00-10:10 **Kwang-Soon Park (Vice president of KIOST)**

Welcome address

10:10-10:20 Photo, Announcement

10:20-10:40 **Yi Xu**

Updates on IMBER/FUTURE OCEAN

10:40-11:00 **Yi Xu**

Overview of Chinese IMBER-related activities

11:00-11:20 **Masao Ishii**

Overview of Japanese IMBER-related activities

11:20-11:40 **Se-Jong Ju**

Overview of Korean IMBER-related activities

#### **S1. Recent inter-annual/decadal trends in circulation and ecosystem dynamics**

(Chair: Masao Ishii, Kitack Lee)

11:40-12:00 **Eun Young Kwon**

Northwest Pacific Synchronous Changes in Temperature, Salinity, O<sub>2</sub> and PO<sub>4</sub> driven by a Wind-Driven Gyre Shift

12:00-12:20 **Shouye Yang**

Geochemical indication of Kuroshio Current intrusion to the East China Sea shelf and Okinawa Trough since the LGM

12:20-14:00 **Lunch**

14:00-14:20 **Chan Joo Jang**

Variability of sea surface salinity and chlorophyll in the Yellow and East China Sea: ENSO effects

14:20-14:40 **Sang-Chol Yoon**

Long-term variations in water masses of northern East China Sea

14:40-15:00 **Sinjaee Yoo**

A further suggestion on the mechanism of the 88-91 regime shift in Northwestern Pacific marginal seas

- 15:00-15:20 **Lijun He**  
Population dynamics of fishes linked to climatic cycles in the northwestern Pacific Ocean
- 15:20-15:40 **Minkyung Bang**  
Changes in ecological characteristics and catch production of walleye pollock *Gadus chalcogrammus*
- 15:40-16:00 **Sukgeun Jung**  
Asynchronous responses of fish assemblages to climate-driven ocean regime shifts between the upper and deep layer in the Ulleung Basin of the East Sea from 1986 to 2010
- 16:00-16:20 **Coffee break**

**S2. Anthropogenic impacts (eutrophication, atmospheric deposition, overfishing, increased CO<sub>2</sub>, etc.) on biogeochemical cycles and ecosystem dynamics.**

(Chair: Shouye Yang, Chan Joo Jang)

- 16:20-16:40 **KITACK LEE**  
Human impacts on nutrient dynamics in the marginal seas of the western North Pacific Ocean
- 16:40-17:00 **NAMIL WON**  
Anthropogenic impacts on coastal ecosystems induced by land-based water resources management effort: lessons from case studies in Korea
- 17:00-17:20 **Kwangseok Kim**  
An effect of Changjiang discharge on mid-term variability of chlorophyll-a concentration in the Northeast Asia
- 17:20-19:30 **Reception**

**Day 2(March 25)**

**Session 2, Session 3, Poster Session**

(Chair: Joji Ishizaka, Se-Jong Ju)

- 09:00-09:20 **Min ji LEE**  
Seasonal distribution of phytoplankton assemblages and nutrient- enriched bioassays as indicators of nutrient limitation of phytoplankton growth in Gwangyang Bay, Korea
- 09:20-09:40 **Hyunduck Jeon**  
Improvement of photochemical extraction system for radiocarbon study of dissolved organic carbon in the central Pacific Ocean
- 09:40-10:00 **Kyung-su Kim**  
The combined effects of elevated CO<sub>2</sub> and temperature on the physiological condition of the olive flounder larvae *Paralichthys olivaceus*

10:00-10:20 **Coffee break**

### **S3. Impact of Kuroshio Current on biogeochemical cycles and ecosystem of the marginal seas in the Northwest Pacific**

(Chair: Hiroaki Saito, Wonho Yih)

10:20-10:40 **Tae Keun Rho**

Enhanced summer particulate organic carbon flux by SCM-TEP coupling

10:40-11:00 **Minkyung Kim**

Biogeochemical properties of sinking particles in the southwestern part of the East Sea (Japan Sea)

11:00-11:20 **Zhaowei Wang**

The on-shelf and off-shelf transport of dissolved manganese between the Kuroshio Current and the East China Sea

11:20-11:40 **Chun Ok Jo**

A new estimate of ocean export production ratio based on mixed layer depth and satellite chlorophyll a observations

11:40-12:00 **Chang-Keun Kang**

Seasonal variability of pelagic food web in the Ulleung Basin of the East/Japan Sea

12:00-12:20 **Hwahyun Lee**

Buoyancy and vertical distribution of Pacific mackerel eggs and larvae and its climate change implication for the temporal variability of recruitment

12:20-14:00 **Lunch**

14:00-14:20 **Sukgeun Jung**

Climate-change driven range shifts of chub mackerel (*Scomber japonicus*) projected by bio-physical coupling individual based model in the western North Pacific

14:20-14:40 **Jang-Geun Choi**

Behavior of biological disturbance on the Yellow Sea using Lagrangian particle Tracking method

14:40-15:00 **Coffee break**

15:00-17:00 **Poster Session**

### **Day 3 (March 26)**

#### **Session 4, Closing, Jeju Local Tour**

---

### **S4. Abnormal ecosystem phenomena**

(Chair: Suam Kim, Sukgeun Jung)

- 09:00-09:20 **Wonho Yih**  
Recent Researches on the epiphytic marine dinoflagellate genus *Ostreopsis* in Korean Seas
- 09:20-09:40 **Joo-Eun Yoon**  
Spatio-temporal Interannual Variability of Spring Asian Dust Events and their Influence on Ocean Productivity in the Western North Pacific Ocean
- 09:40-10:00 **Joji Ishizaka**  
Internannual variability of phytoplankton communities in the middle of East China Sea during summer: Influence of excess nitrate?
- 10:00-10:20 **Masao Ishii**  
Decadal trends of the anthropogenic CO<sub>2</sub> increase and remineralization in the North Pacific Subtropical Mode Water at the 137°E section
- 10:20-10:40 **Hiroaki Saito**  
Kuroshio Paradox: Why Fisheries Production is High in Oligotrophic Kuroshio Water?
- 10:40-11:00 **Coffee break**
- 11:00-12:10 **Summary & Discussion**
- 12:10-12:20 **Closing**
- 12:20-14:00 **Lunch**
- 14:00-17:00 **Jeju Local Tour**

## Poster Presentations

### **S1. Recent inter-annual/decadal trends in circulation and ecosystem dynamics**

- S1-P1      **EunAe Lee**  
Seasonal variability of temperature, salinity, and geostrophic currents obtained from CTD and satellite observations around South Korea
- S1-P2      **Chan Joo Jang**  
North Pacific upper-ocean biases and changes in CMIP5 models

### **S2. Anthropogenic impacts (eutrophication, atmospheric deposition, overfishing, increased CO<sub>2</sub>, etc.) on biogeochemical cycles and ecosystem dynamics.**

- S2-P1      **Sun Kyeong Choi**  
Seasonal dynamics in nutrients and trace metals budgets of *Zostera marina* in an anthropogenic impacted lagoon
- S2-P2      **Naohiro Kosugi**  
Autumn CO<sub>2</sub> chemistry in the Japan Sea and contribution of Changjiang diluted water
- S2-P3      **Sujin Song**  
Decomposition of dissolved organic matter in salt water by ozone treatment
- S2-P4      **Shan Zhang**  
Ecological provinces of spring phytoplankton in the Yellow Sea: species composition
- S2-P5      **NAMIL WON**  
Multiple approaches to detect environmental impacts of coastal sand mining on ecosystem structures
- S2-P6      **Wuchang Zhang**  
Tintinnid Ecology in Yellow Sea and Bohai Sea, China

### **S3. Impact of Kuroshio Current on biogeochemical cycles and ecosystem of the marginal seas in the Northwest Pacific**

- S3-P1      **Kyung Hwan Lee**  
Comparison of biological characteristics of Pacific cod (*Gadus macrocephalus*) between the East and the Yellow Sea, Korea



- S3-P2 **Hyunjin Yoon**  
Short-term variation of zooplankton community in the southwestern East Sea coupling with physical processes
- S3-P3 **Taehee Lee**  
Particulate organic carbon cycle at the surface water and sediment in the Ulleung Basin, East/Japan Sea
- S3-P4 **Young Baek Son**  
Reduced satellite-driven chlorophyll-a concentration and its related process in the East China Sea during summer 1998-2014
- S3-P5 **Yeseul Kim**  
Testing hypotheses on the outbreak mechanisms of *Cochlodinium polykrikoides* blooms using long time series data set

#### **S4. Abnormal ecosystem phenomena**

- S4-P1 **Kyung Woo Park**  
*Cochlodinium polykrikoides* blooms in Korean coastal waters in 2012-2014
- S4-P2 **Shanshan Pan**  
Modeling impacts of typhoons on the upper-ocean ecosystem in the northern South China Sea
- S4-P3 **Junying Zhu**  
The interannual variation of the Yellow Sea Cold Water Mass and the influencing mechanism
- S4-P4 **Hyoun-Woo Kang**  
Preliminary results on the nutrients budget simulated in a marine system model in the East China Sea
- S4-P5 **Sangil Kim**  
Population dynamics and community recovery patterns of kelp *Ecklonia cava* depending on disturbance timing and locations in Jeju Island, Korea

## Northwest Pacific Synchronous Changes in Temperature, Salinity, O<sub>2</sub> and PO<sub>4</sub> Driven by a Wind-Driven Gyre Shift

Kwon, E.Y., Kim, Y.H., Park, Y.-G., Park, Y.-H., Dunne, J., Sarmiento, J.L.

*Seoul National University, Korea*

### Abstract

The North Pacific gyre boundaries are characterized by stark contrasts in physical and biogeochemical properties. Therefore, meridional movement of gyre boundaries can exert a large influence on not only marine ecosystems but also on climate. Using historical datasets and a high-resolution climate model, here we report an evidence of synchronous variations in temperature, salinity, PO<sub>4</sub>, and O<sub>2</sub> within the Northwest Pacific gyre boundaries, primarily driven by a wind-driven subtropical gyre shift. Observationally constrained simulations suggest that from the 1950s to the 2000s winds have induced a southward shift in the subtropical gyre by approximately one degree. The shift alone can explain nearly 70% of subsurface temperature and salinity changes zonally averaged in the Northwest Pacific. The shift also explains enrichments in O<sub>2</sub> and depletion in PO<sub>4</sub> within the southern subtropical thermocline and opposing trends within the subarctic-subtropical gyre boundary. The close tie between the wind-driven shifts in gyre boundaries and the tracer distributions is further supported using a high resolution GFDL's climate model, showing that the latitudes of zero Sverdrup streamline are highly correlated with the physical and biogeochemical properties averaged within the Northwest Pacific gyre boundaries with lags of zero to three years.

## **Geochemical indication of Kuroshio Current intrusion to the East China Sea shelf and Okinawa Trough since the LGM**

**Yang S. Y.**, Dou Y. G., Lian E. G., Wu H., Yang C. F., Li C.

*Tongji University, State Key Laboratory of Marine Geology, China*

### **Abstract**

The Kuroshio Current (KC) has an overwhelming influence on the heat exchange, salt and nutrients balance, and sedimentation on the East China Sea shelf and Okinawa Trough (OT). Despite the numerous research attempts, the spatial and temporal variability of KC during the late Quaternary and its impacts on marine environment remain to be clarified more. In particular, the shift of KC pathway since the Last Glacial Maximum (LGM) and the intrusion of its subsurface water onto the inner shelf await more investigations. In this study, we present geochemical evidence including rare earth elements and Nd isotope in the labile fractions of marine sediments and reconstruct the pathway and evolution of deep-water environment in the OT since the LGM. In addition, we combine H-O stable isotopes with satellite sea surface temperature and hydrographic data, aiming to reveal the intrusion of Kuroshio subsurface water onto the inner shelf. Our data suggest that the Kuroshio-branched water northeast of Taiwan can intrude into the inner shelf near Zhe-Min Coast, manifesting by a pronounced boundary at 50 m isobath around 28 °N, and thereby feeds the TWC intrusion into the Changjiang Estuary. During the LGM, the pathway of KC might have shifted outside the OT but strengthened with the onset of Holocene, accompanied by an oxic depositional environment responding to the enhanced deep-water ventilation with the advection of the North Pacific Intermediate Water and/or South China Sea Intermediate Water into the trough. The intrusion and strengthening of KC in the early Holocene enhanced the water stratification and induced a gradual development of the suboxic depositional condition. The KC intrusion complicates the hydrological process in the shelf and OT, and its impact on marine environment deserves more research attention.



## Variability of sea surface salinity and chlorophyll in the Yellow and East China Sea: ENSO effects

Chan Joo Jang<sup>1\*</sup> and Taewook Park<sup>2</sup>

<sup>1\*</sup>*Korea Institute of Ocean Science & Technology, 787 Haean-ro, Sangrok-gu, Ansan  
15627, Republic of Korea*

<sup>2</sup>*RDI Ocean Circulation and Climate Dynamics GEOMAR Helmholtz Centre for  
Ocean Research Kiel, Kiel, Germany*

*\*Corresponding e-mail: cjang@kordi.re.kr*

### Abstract

El Niño–Southern Oscillation (ENSO) has known to affect inter-annual variability in both physical and biological aspects in relation in the Yellow and East China Seas (YECS). In this study, we examine the inter-annual variability of summer sea surface salinity (SSS) and chlorophyll (CHL) in the YECS and its relation with ENSO, using a global ocean general circulation model (OGCM) with a regional focus on the YECS. A cyclostationary EOF (CSEOF) shows that Changjiang River discharge (CRD) contributes to the dominant inter-annual variability of the SSS in the YECS. The variability of the CRD is linked to ENSO through changes in precipitation over the Changjiang River. When El Niño events occur in winter, precipitation over the Changjiang River increases in the rainy season of the following year through enhanced southwesterly moisture flux from the South China Sea into southern China. The increased CRD in El Niño years also appears to increase CHL-a concentration by supplying more nutrients into the YECS, suggesting that the ENSO is likely to affect biological production in the YECS by changing CRD. Our finding suggests that ENSO may contribute to the inter-annual variability of both physical and biological processes in the YECS by modulating CRD through precipitation changes over the Changjiang River.

## Long-term variations in water masses of northern East China Sea

Yoon SC., Youn SH., Hwang JD

*National Institute of Fisheries Science, Korea*

### Abstract

This study was conducted to investigate the oceanographic characteristics of the northern East China Sea through the identification of long-term variations of environment factor in water masses from 1995 to 2014. The main water masses composing the northern East China Sea were classified as Changjiang diluted water (CDW), Taiwan current warm water (TCWW), the Yellow Sea cold water (YSCW), and Kuroshio source water (KW) by water temperature and salinity. The Relative volume of YSCW has increased in the northern East China Sea. However, the relative volume of CDW and TCWW that forms on the surface and sub-surface layers have weakened for 20 years. Particularly the relative volume of KW formed in the intermediate layer has decreased. The concentrations of nitrate were higher in YSCW water masses; this result suggested that the main source of the nitrate was the YSCW in the northern East China Sea. Due to the relatively low value ( $< 0.1 \mu\text{M}$ ) of phosphate in the CDW and TCWW, the concentrations of phosphate have shown a decreasing tendency and depleted at the surface layer since 2009. The concentrations of chlorophyll-a have increased during the study period. These results could be explained by the increase of water temperature, the supply of nutrients from YSCW, and light transmission resulted from the construction of Three Gorges Dam.

**A further suggestion on the mechanism of the 88-91 regime shifts in Northwestern Pacific marginal seas****Sinjae Yoo** and Emanuele Di Lorenzo*KIOST, Korea***Abstract**

In a previous study, we put forward a hypothesis of several factors, anthropogenic and climate change-related, worked together to induce the jump in the lower trophic level around 1988-1991 in the East China Sea, East Sea, and Yellow Sea. The chlorophyll-a time series showed that a statistically significant shift occurred in 1988-1990, which is consistent with shifts in a number of climatic, oceanographic, and biological variables with a slight time lag before and after the chlorophyll-a shift. We also proposed that the effects of physicochemical factors might have been amplified by an increase in the volume transport of Tsushima Warm Current around 1988. Here, we applied a double-integration model to the time series of atmospheric pressure which showed a significant correlation ( $r=0.8$ ,  $p<0.05$ ) with zooplankton time series for 1960-2005. Therefore, it strongly supports the hypothesis on the linkage from atmospheric forcing, and ocean transport, to zooplankton.



## Population dynamics of fishes linked to climatic cycles in the northwestern Pacific Ocean

Lijun He, Jing Zhang

*State Key Laboratory of Estuarine and Coastal Research, East China Normal University, Shanghai, 200062, China*

### Abstract

Climatic cycles were believed to have influenced the population abundance of terrestrial and marine species. As two different ecoregions, the South China Sea and the East China Sea were expected to have different influence on the changes in population size of marine organisms. In this study, the population dynamics of several species of fishes living in different habitats (continental shelf cutlassfishes, *Trichiurus japonicus* and *T. hainanensis*; intertidal zone mudskipper, *Periophthalmus modestus*) from the South China Sea and the East China Sea were compared. For the coastal species in shallow seas, the difference in present population size of *T. japonicus* is closely related to the difference in primary production between the South China Sea and the East China Sea. The East China Sea population of *T. japonicus* experienced glacial bottleneck and postglacial demographic growth related to the Yangtze River Delta's development and Summer Monsoon history. Compared to those in the East China Sea, the population of *T. japonicus* and *T. nanhaiensis* in the South China Sea showed consistent glacial growth in size and postglacial bottleneck, which is synchronous to the Winter Monsoon and palaeo-productivity history in the northern slope of the South China Sea. Contrary to the regional population dynamic pattern observed in *Trichiurus spp.*, the present population size of *P. modestus* in the South China Sea is higher than that in the East China Sea, which is related to the difference in precipitation and terrestrial primary production between the coastal East China Sea and the South China Sea. *P. modestus* showed an evolutionary response of population growth to intensive Summer Monsoon in the late Pleistocene. In summary, the climatic changes influenced marine species' demographic history in different regions.

## Changes in ecological characteristics and catch production of walleye pollock *Gadus chalcogrammus*

Bang Minkyong<sup>1</sup>, Kang Sukyung<sup>2</sup>, Kim Suam<sup>3</sup>, Jang Chan Joo<sup>1</sup>, Shon Myong Ho<sup>2</sup>

<sup>1</sup>*Korea Institute of Ocean Science & Technology, Korea*

<sup>2</sup>*National Institute of Fisheries Science, Korea*

<sup>3</sup>*Pukyong National University, Korea*

### Abstract

Walleye pollock (*Gadus chalcogrammus*, hereafter pollock) was one of the most dominant species in Korean waters, but its stock has rapidly decreased since the late 1980s and collapsed completely in the early 21st century. In this study, we investigated how the decrease in biomass related to growth and maturity of pollock using biological data including length, weight, and gonad weight of pollock collected for 31 years from 1973 to 2003 in the fishing area in Korean waters. A frequency histogram of pollock length indicated that the size was smaller before the late 1980s, when the biomass was larger, while the size became larger after late 1980s when the biomass was smaller.

In addition, zooplankton biomass was inversely related with the biomass changes in the late 1980s: zooplankton biomass was smaller when the pollock biomass was larger, vice versa. These relationships suggest that feeding competition may contribute to the size change of pollock. In relation to the pollock biomass changes, we will also present physical environmental changes including stratification and the wind.

## **Asynchronous responses of fish assemblages to climate-driven ocean regime shifts between the upper and deep layer in the Ulleung Basin of the East Sea from 1986 to 2010**

**Sukgeun Jung**

*Jeju National University, Korea*

### **Abstract**

Past studies suggested that a basin-wide regime shift occurred in 1988-1989, impacting the marine ecosystem including fish assemblages in the western North Pacific. However, detailed mechanisms involved in this phenomenon are still yet unclear. In the Ulleung basin of the East Sea, filefish, anchovy and sardine dominated the commercial fish catches in 1986-1992, but thereafter common squid comprised >60% of the total catch in 1993-2010. To illuminate the mechanisms causing this dramatic shift in dominant fisheries species, I related changes in depth-specific oceanographic conditions from 0-500 m to interannual changes in the fish assemblage structure from 1986 to 2010. In upper layer depths of 50-100 m, water temperature suddenly increased in 1987-1989. Consequently, warm-water epipelagic species (anchovy, chub mackerel, and common squid) became dominant, while sardine, a relatively cold-water epipelagic species, nearly disappeared. An annual index of the volume transport by the Korea Strait Bottom Cold Water, originating from the deep water of the Ulleung Basin, displayed a sudden intensification in 1992-1993. This shift was accompanied by decreased water temperature and increased water density in the deep water and replacement of dominant benthopelagic species from filefish, warm-water species, to herring and cod, cold-water species. The results suggest that climate-driven oceanic changes and the subsequent ecological impacts can occur asynchronously, often with time lags of several years, between the upper and the deep layer, and between epipelagic and deep-water fish assemblages.



## **Human impacts on nutrient dynamics in the marginal seas of the western North Pacific Ocean**

**Lee, Kitack**

*Pohang University of Science and Technology (POSTECH), Korea*

### **Abstract**

The relative abundance of nitrate (N) over phosphorus (P) has increased significantly over the period since 1980 in the marginal seas bordering the northwestern Pacific Ocean, located downstream of the populated and industrialized Asian continent. The rate of increase of excess N relative to phosphate (P) was highest in the vicinity of the source continent, with rates decreasing eastward across the basins, consistent with the magnitude and distribution of atmospheric nitrogen deposition. This increase in the N content of the upper ocean may enhance primary production in these N limited regions, potentially leading to a long-term change in these regions from being N-limited to P-limited. Our results suggest that the input of airborne pollutant nitrogen has been a major driver of the temporal dynamics of seawater N content relative to P in the North Pacific upper ocean over the past half century. Our findings may have broader implications. Indeed, the observed trends may be extrapolated to the coastal seas of the North American Atlantic Ocean and the North, Baltic, and Mediterranean Seas, which have received ever-increasing amounts of airborne N deposition and river-borne N, comparable to those absorbed by coastal and marginal seas of the northwestern Pacific Ocean.

**Anthropogenic impacts on coastal ecosystems induced by land-based water resources management effort: lessons from case studies in Korea****Won NI, Kim YS***K-water Institute, Korea Water Resources Corporation, Korea***Abstract**

Water resources managements have become more important and essential to overcome global water crisis and security issues. Land-based water resources managements can disturb the balance of water budget in the downstream watershed. Subsequently, incoming freshwater will be changed in terms of both water quality and quantity, giving various impacts on coastal environments. Freshwater inputs to coastal ecosystems have been recognized as one of the important key stressors. Coastal ecosystems have become more important as a buffer or transition part in river-to-offshore ecological connectivity. However, there are limited concerns dealing this subject with the view of interdisciplinary cooperation or approach. Korea is one of the nations suffering from water scarcity. Recently, many management efforts have been performed to satisfy water resource needs. This paper summarizes major issues and conflicts induced by water resources management efforts such as dam construction and river management. In Korea, many rivers and streams running into the ocean have been subject to high anthropogenic stressors such as river mouth dike construction and water city development. The land-to-ocean connectivity was affected by water management operations, giving controversies on ecosystem impacts by changed freshwater inputs. The damaged water connectivity could give adverse effects on ecological connectivity and also coastal ecosystem by changing incoming organic materials and forest-originated nutrients. Several case studies implied that there are few direct and urgent impacts on the marine ecosystem. However, relatively long-term impacts are possible and any intensification or mitigation of expected impacts need to be also regarded together. Among oceanographic conditions, abnormal phenomena such as cold bottom water and coastal upwelling as well as ocean warming and sea level rise should be closely considered to interpret land-originated anthropogenic stressors. This paper indicates that multi-scale and disciplinary approaches are desirable to better understand coastal impacts by water resources management operations.

---

**An effect of Changjiang discharge on mid-term variability of chlorophyll-a concentration in the Northeast Asia**

**Kim K.-S.**, Park Y.-J., Racault M.-F., and Moon I.-J.

*Korea Institute of Ocean Science & Technology, Korea*

**Abstract**

The effect of Changjiang discharge on the variability of phytoplankton biomass over the Northeast Asian Sea was investigated using satellite-based chlorophyll-a concentration (Chl-a). The difference in Chl-a anomalies between high and low Changjiang discharge of the years were estimated and then normalized to the standard deviation (DS ratio). An area of strong positive DS ratio of Chl-a was observed first in front of Changjiang estuary in July, which then spreads to the East China Sea in August, extends to Korea Strait in September and finally reached to the Southwestern East/Japan Sea in October. The DS ratio analysis is also used to investigate the influence of other local environmental processes on the changes in phytoplankton biomass in the East/Japan Sea. Our results suggested that the effect of summer Changjiang discharge on Chl-a was maintained in the East/Japan Sea with a time delay of 2-3 months.

## Seasonal distribution of phytoplankton assemblages and nutrient-enriched bioassays as indicators of nutrient limitation of phytoplankton growth in Gwangyang Bay, Korea

LEE M. J., BAEK S. H., KIM D., KIM Y. O.

*KIOST, Korea*

### Abstract

To assess the effect of nutrient limitation on phytoplankton growth, and its influence on seasonal variation in phytoplankton community structure, we investigated abiotic and biotic factors in surface and bottom waters at 20 stations in inner and offshore areas of Gwangyang Bay, Korea. Algal bioassay experiments were also conducted using surface water, to assess the effects of nutrient addition on the phytoplankton assemblages. The fate of major nutrients in the bay was strongly dependent on the discharge of freshwater from the Seomjin River. River flow during the rainy season provides a high nitrogen (N) influx, pushing the system toward stoichiometric phosphorus (P) limitation. However, at some times during the rainy season, there was insufficient N to maintain phytoplankton growth because it was rapidly consumed through nutrient uptake by phytoplankton under stratified environmental conditions. Diatoms made a relatively large contribution to total phytoplankton biomass. The dominant diatoms, particularly in winter and summer, were *Skeletonema marinoi-dohrnii* complex and *Skeletonema tropicum*, respectively, while *Eucampia zodiacus* and the cryptophyte *Cryptomonas* spp. dominated in spring and autumn, respectively, comprising more than 75% of the community at most stations. In the bioassay experiments, the phytoplankton biomass increased by 30 - 600% in the +N (added nitrogen) and +NP (added nitrogen and phosphorus) treatments relative to the control and the +P (added phosphorus) treatments, indicating that phytoplankton growth can respond rapidly to pulsed nitrate loading events. Based on the algal bioassay and the field survey, the abrupt input of high nutrient levels following rainfall stimulated the growth of diatom assemblages including the *Skeletonema* genus. Our results demonstrate that the growth of centric diatoms was enhanced by inputs of N and Si, and that the concentrations of these nutrients may be among the most important factors controlling phytoplankton growth in Gwangyang Bay.



## **Improvement of photochemical extraction system for radiocarbon study of dissolved organic carbon in the central Pacific Ocean**

**Jeon, H.D.**, Otosaka, S., Yamashita, Y., Ogawa, H.

*Atmosphere and Ocean Research Institute, the University of Tokyo, Japan*

### **Abstract**

Understanding the processes that control DOC production, consumption, and biological fluxes is essential to grasp its role in the ocean carbon cycle and to predict how the ocean will react to climate change. Radiocarbon content of DOC (DO14C) can provide useful information on the sources and ages of various DOC reservoirs because of its distinct radiocarbon signature. Fewer measurements have been performed due to the very small concentrations and analytical difficulties with the choice of method in order to extract the DOC from the aqueous sample. Samples have to be treated with a specific preparation system composed of the custom quartz reactor, dedicated vacuum line and UV lamp, and because of this they have only been handled by limited facilities installed in the WHOI. On the other hand, a similar system was introduced to the JAEA, but it still needs to be reformed because both these system utilizes high-pressure UV lamp that demands high electric power installation. We are improving the system that will be able to convert marine DOC into carbon dioxide more efficiently and simpler using a low-pressure UV lamp and a small volume of sample. In this respect samples collected along a transect from the central South Pacific Ocean to the Chukchi Sea are expected to have some oceanographic meanings. We aim to verify the performance of new miniaturized equipment by securing the enough recovery over a short period of time as well as to present the first set of full-depth profiles where DO14C were not reported until now. And besides, we desire to closely investigate the character of distribution and how they are affected by biotic and abiotic factors. We present here not only how the system is progressing but also what radiocarbon study in the central Pacific Ocean means for better understanding of oceanic carbon cycle.

**The combined effects of elevated CO<sub>2</sub> and temperature on the physiological condition of the olive flounder larvae *Paralichthys olivaceus***

**Kim KS, Shim JH, Kim S**

*Pukyong National University, Korea*

**Abstract**

Little is known about how marine fishes respond to the reduced pH condition caused by the increased CO<sub>2</sub> in the atmosphere. We investigated the effects of CO<sub>2</sub> concentration and temperature on the growth of olive flounder (*Paralichthys olivaceus*) larvae. Newly hatched larvae were reared in three different concentrations of CO<sub>2</sub> (479.7, 838.0 and 1422.7  $\mu\text{atm p CO}_2$ ) and two different temperature (18 and 22°C) water tanks for four weeks until metamorphosis. Experiment was repeated three times in June to September 2013. During rearing experiment, larvae were sampled once a week, these samples were used to calculate of the Growth rate. After 4 weeks, all live larvae were sampled and measured length and weight. The length and weight of flounder larvae were significantly increased with increasing CO<sub>2</sub> concentration ( $P < 0.05$ ). In addition, to check skeleton malformation, we used skeleton 2-color dyeing method and bone density was examined for differences using scanning electronic microscope (SEM). Also, we researched the hatching rate among the different conditions in order to check the effects of changing environment on the hatching rate. A result of the experiment, growth was increased with increasing CO<sub>2</sub> concentration in the rearing water. However, the skeleton was influenced the negative effect by high CO<sub>2</sub> concentration in the rearing water.

**Enhanced summer particulate organic carbon flux by SCM-TEP coupling**

**Tae Keun Rho**<sup>1</sup>, Dong-Jin Kang<sup>1</sup>, Jeomshik Hwang<sup>2</sup>, Kyung-Ryul Kim<sup>3</sup>, Tae Keun Rho<sup>4</sup>, Tongsup Lee<sup>4</sup>

<sup>1</sup>*Ocean Observation and Information Section, Korea Institute of Ocean Science and Technology, Ansan 426-744, Korea.*

<sup>2</sup>*School of Earth and Environmental Sciences/Research Institute of Oceanography, Seoul National University, Seoul 151-742, Korea.*

<sup>3</sup>*Gwangju Institute of Science and Technology, Gwangju 500-712, Korea.*

<sup>4</sup>*Department of Oceanography/Marine Research Institute, Pusan National University, Busan 609-735, Korea.*

**Abstract**

Understanding the response of the oceanic biological carbon pump to global warming is a key task in reducing the scientific uncertainty associated with climate projections. In this study, we investigated the ubiquitous and prolonged development of subsurface chlorophyll maximum (SCM) during the stratified season (from April to late October) in the southwestern part of the East Sea, western North Pacific. SCM was strongly coupled with elevated transparent exopolymer particle (TEP) concentrations in the surface euphotic layer. We propose that the coupling of SCM and TEP production in the surface euphotic layer has a strong potential to enhance POC export from the surface euphotic layer to the deep interior of the ocean during the stratified season. The proposed SCM-TEP coupling represents a possible mechanism for the high POC sinking flux that may lead to high organic carbon contents of surface sediments observed in the region. The extrapolation of our results implies that this coupling process will enhance CO<sub>2</sub> absorption and potentially mitigate global warming in the future warm and high CO<sub>2</sub> conditions.

**Keywords:** Particulate organic carbon (POC) flux, Subsurface chlorophyll maximum (SCM), Transparent exopolymer particle (TEP), East Sea, Biological carbon pump

**Biogeochemical properties of sinking particles in the southwestern part of the East Sea (Japan Sea)**

**Kim, M.**, Hwang, J., Rho, T.K., Lee, T.S., Kang, D.J., Chang, K.I., Noh, S., Joo, H.T., Kwak, J.H., Kang, C.K., Kim, K.R.

*Seoul National University, Korea*

**Abstract**

The southwestern part of the East Sea (Japan Sea)-known as the Ulleung Basin has been considered as the most productive region in the East Sea. A few studies have put forward hypotheses for cause(s) of the high primary productivity, including intensive upwelling along the Korean coast and considerable subsurface production over the summer. We collected sinking particle samples from March 2011 for a year at 1000 m and 2000 m nominal depths in the Ulleung Basin to further examine this issue. POC flux in summer in the Ulleung Basin was considerable compared to other major basins, for which sinking POC data are available from previous studies at different times. We will discuss the sinking POC flux data in association with primary productivity in surface waters and contribution of re-suspended sediment and/or aeolian input based on particle composition and radiocarbon content of sinking POC.

## **The on-shelf and off-shelf transport of dissolved manganese between the Kuroshio Current and the East China Sea**

**Wang Z. W., Ren J. L., Xuan J. L., Zhang J**

*Ocean University of China, China*

### **Abstract**

The Kuroshio Current (KW) carries a considerable amount of water into the East China Sea (ECS) shelf in subsurface induced by a topographic change. Thus, the exchange between the KW and the ECS shelf is crucial to understand the geochemical cycle of trace elements. Observations for dissolved manganese (DMn) were respectively undertaken during different seasons in 2011 and 2013 in the ECS. Emphasis was given to the section of dispersal from the Changjiang Estuary to the Ryukyu Islands (PN section) and along the shelf break of the ECS from the northeast of Taiwan to the PN section (KWL section).

The concentration of DMn in PN section ranged from 1.1 to 30.0 nM and decreased across the ECS with distance from the coast. The Changjiang Diluted Water (CDW), characterized by low salinity (< 32) and higher DMn (> 10 nM), can extend to 230 km away from the Changjiang river mouth. The Kuroshio Subsurface Water (KSSW), characterized by high salinity (> 34) and lower DMn (< 2 nM), intrudes onto the ECS shelf region in the subsurface (50–300 m). Seasonal variations showed that the intrusion of KW was significantly higher in autumn than in spring and summer. Vertical profiles of DMn in KWL section decreased with depth and reflected a typical scavenge-type profile. The concentrations of DMn in the surface ranged from 2.1 to 5.6 nM but remained at relatively low concentrations in the KSSW (1.7–2.3 nM). Enrichment of DMn in the upper layer (< 50 m) associated with northeastward flow of the KW along the shelf break suggested the occurrence of export from the ECS shelf to the KW. The results can provide useful information for understanding the trace metal transport between the KW and the ECS shelf.



## **A new estimate of ocean export production ratio based on mixed layer depth and satellite chlorophyll a observations**

**Chun Ok Jo<sup>1</sup>**, Mi-Kyung Park<sup>1</sup>, Shanlan Li<sup>1</sup>, Haeyoung Lee<sup>2</sup>, and Sunyoung Park<sup>1,3\*</sup>

<sup>1</sup>*Oceanic and Atmospheric Research Center, Kyungpook Institute of Oceanography,  
Kyungpook National University, Daegu 41566, Republic of Korea*

<sup>2</sup>*Korea Meteorological Administration, Seoul 07062, Republic of Korea*

<sup>3\*</sup>*Department of Oceanography, Kyungpook National University, Daegu 41566,  
Republic of Korea*

*\*Corresponding author: Tel: +82-53-950-5393; Email: sparky@knu.ac.kr*

### **Abstract**

We introduced a new simple methodology to determine basin-wide marine export production ratios by combining monthly varying mixed layer depths (MLD) derived from observed temperature depth profiles and hypothetical critical depths estimated based on satellite time series of chlorophyll a (chl a) concentrations. The MLD-chl a-based approach yielded monthly export ratios reflecting the seasonal variability of net community production in correlation with the MLD variations. Regional averages of export ratio in the spring for the southern part of the East/Japan Sea (36-39°N, 130-134°E), North Pacific Ocean (42-45°N, 151-155°E), and North Atlantic Ocean (57-60°N, 17-21°W) are  $0.44 \pm 0.22$ ,  $0.42 \pm 0.16$ , and  $0.73 \pm 0.29$ , respectively, which compare favorably with prior field data. This suggests that the approach enables estimation of export production ratios with high spatial and temporal resolutions, complementing the methods that rely on extrapolation of limited field measurements to larger space and time scales.

**Buoyancy and vertical distribution of Pacific mackerel eggs and larvae and its climate change implication for the temporal variability of recruitment**

Lee HH, Kang S, Jung K, Kim S, Jung, S

*Pukyong National University, Republic of Korea*

**Abstract**

Vertical distribution of fish eggs and larvae is a crucial component for determining advection and recruitment variability. Little has been reported on the vertical location of Pacific mackerel *Scomber japonicus* eggs and larvae in Korean waters. Therefore, we measured the specific gravity of eggs and larvae using artificially fertilized eggs and then simulated its vertical distribution to understand the distribution patterns in the spawning area around Jeju Island, Korea. All eggs from broodfish (May-June 2014 and 2015) were spawned, in rearing tank, and the specific gravity of fertilized eggs and larvae was measured by density-gradient column (Martin In. Co. LTD). The egg specific gravity during the early stage ranged from 1.203-1.0211 g/cm<sup>3</sup>. In general, the fertilized egg showed a gradual decline in specified gravity until full development of the main organs, with a sudden increase just before hatching. However, the specific gravity of larvae tended to increase with a diel pattern from 4 to 16 days after hatching. Due to the different salinity in spawning area, the vertical location of eggs and larvae should be different inter-annually, which determines the various levels of advection as well as recruitment success.

**Climate-change driven range shifts of chub mackerel (*Scomber japonicus*) projected by bio-physical coupling individual based model in the western North Pacific**

Jung S., Pang I-C, Lee J-h, Lee K, Lee HH, Kim K-S, Kim S

*Jeju National University, Korea*

**Abstract**

We evaluated and projected the effects of warming ocean on the range shift of biomass of chub mackerel (*Scomber japonicas*) covering from the larval to the adult stages up to age 3 years by developing and applying individual-based models (IBM) based on a regional ocean circulation model and the IPCC AR5 climate change scenarios. Our IBM tentatively suggested that the YOY mackerel in the Korea Strait are mostly transported from the East China Sea where they were hatched. From laboratory experiments, we observed a diurnal cycle in the buoyancy of larval mackerel, which determines their vertical position in the water column. We assumed that juvenile and adult mackerels actively swim to the habitats of the optimal temperatures, which we estimated based on spatially-explicit catch and depth-specific water temperature data from 1986 to 2010. Despite the greater uncertainty, the preliminary results of our IBM projected that, by the 2050s, the strengthened Tsushima warm current in the Korea Strait and the East Sea, driven by global warming, will shift the YOY mackerel biomass distribution north to the East Sea, and adult (> age 1 yr) mackerel biomass north, especially in the Yellow Sea. To improve the model performance, international cooperative researches among the regional countries are required, especially for extensive ichthyoplankton surveys in the East China Sea.

## Behavior of biological disturbance on the Yellow Sea using Lagrangian Particle Tracking method

Choi JG, Jo YH, Kim DW, Park JK

*Pusan National University, Republic of Korea*

### Abstract

Many biological disturbances are originated from the East China Sea and transported toward the Yellow Sea by the ocean current. The rhizostome jellyfish, *Nemopilema nomurai* (or *N.nomurai*), are primarily observed in the East China Sea and well known as one of main biological disturbance there. Because this species damages fishery and attacks swimmers, it is necessary to study about its origin and appearance for precaution. Thus, we identified the temporal changes in its distributions and abundances. We have traced their behavior using the Lagrangian Particle Tracking method (hereafter LPT method) based on both geostrophic flow and wind-driven flow fields. The absolute Sea Surface Height (SSH) data obtained from AVISO and wind velocity fields from ECMWF reanalysis data are employed. We used an analytic solution of Ekman theory for the approximated momentum equation. Accordingly, we tracked the migration of *N.nomurai* using LPT method. Our simulation results show that the wind is the most dominant forcing for *N.nomurai*'s migration. Because of the seasonality of wind direction, it moves northeastward from the east coast of China to Korean Peninsula in summer and continues to move westward in winter. These migrations of particles are well coincide with the appearance of *N.nomurai* around off the coast of Korean Peninsula. The LPT method based on remote sensing measurements of altimetry and wind scatterometers can be utilized for monitoring biological disturbances.

## Recent researches on the epiphytic marine dinoflagellate genus *Ostreopsis* in Korean Seas

Yih W, Kim HS, Oh MR, Yoo YD, Rho JR

*Kunsan National University, Korea*

### Abstract

No observations of *Ostreopsis* species were recorded in Korean waters before 2010<sup>[1]</sup>. Recently, the first report on the occurrence of marine epiphytic dinoflagellates from Jeju coastal waters<sup>[2]</sup> was rapidly followed by some 20 research papers on Korean *Ostreopsis*. Surface distribution of *Ostreopsis* spp. in Jeju coastal waters showed the relatively more eurythermal and euryhaline characteristics with its high abundance center at 20.3 °C and 32.0 psu. Vertically, mean concentrations (cells wwt-gr<sup>-1</sup>) of *Ostreopsis* was highest in June at surface when the epiphytic dinoflagellates on all the macro-algal substrates from 5 water depths (surface, 5m, 10m, 15m, and 20m) at a station off an islet, Moon-seom, near Jeju Island were counted. By contrasts, four other genera examined (*Amphidinium*, *Coolia*, *Gambierdiscus*, and *Prorocentrum*) simultaneously exhibited subsurface maxima. During last five years occurrence of *Ostreopsis* species in other regions of Korean seas than the Jeju coastal waters has been repeatedly confirmed by a few research groups in Korea. Additionally, a 10-year-long program for the monitoring of marine harmful protists was launched in 2013. *Ostreopsis* species are then being reported to occur at even higher latitudes of Korean seas, which include stations off Kosung, Pohang, Hoopo<sup>[3]</sup>, and up to Dokdo, East Sea (Sea of Japan) Korea<sup>[4]</sup>. Recent occurrence of the ‘originally (sub)tropical’ *Ostreopsis* species in Korean seas might imply that they are extending habitats northward in parallel with the regionally accelerated climate changes.

[1] L. Rhodes. 2011. *Toxicon* 57: 400–407

[2] HS Kim, W Yih, JH Kim, G Myung, HJ Jeong. 2011. *Ocean Sci. J.* 46:205-209.

[3] SH Baek. 2012. *Korean J. Environ. Biol.* 30: 355-361.

[4] J. Lee, MR. Kim, M. Chang. 2013. *IPC10. Program & abstract Book*, p.115.



## **Spatio-temporal Inter-annual Variability of Spring Asian Dust Events and their Influence on Ocean Productivity in the Western North Pacific Ocean**

**Yoon J.-E.**, Kim I.-N., Macdonald A.M., Kim T.-W., Kim H.-C., Park K.-T., Yang E.-J.

*Incheon national University, Korea*

### **Abstract**

Generally, the supply of macro- and/or micro-nutrients (i.e., nitrogen and iron) to the Western North Pacific Ocean (WNPO) via Asian dust during springtime is believed to temporarily relieve the nutrient limitations that are thought to be responsible for suppressing ocean productivity. However, because spring Asian dust events are episodic and mostly correspond to the times of typical spring blooming we have little information about (1) the spatial and temporal patterns of spring Asian dust or (2) its impact on ocean production in the WNPO. Here, we present the results which address (1) and (2) using satellite data (chlorophyll-a and aerosol index) and information on mixed layer/critical depths during the periods 1998–2001 and 2005–2014 (the gap due to satellite calibration issues). Spring Asian dust events were recognized by aerosol index values greater than  $1.7(\pm 0.7)$ . Aerosol indices were derived from Korea Meteorological Administration reports on the Asian dust during the study period. Based on the spatial distribution of aerosol indices, we found three spatial patterns from the source region (i.e. the Gobi desert) to the WNPO: dust moving predominantly over the Siberian continent ( $>50^{\circ}\text{N}$ ; April 2008); dust passing across the northern East/Japan Sea ( $40^{\circ}\text{N}$ – $50^{\circ}\text{N}$ ; April 1998); and dust moving over the entire East/Japan Sea ( $35^{\circ}\text{N}$ – $55^{\circ}\text{N}$ ; April 2001). These patterns were significantly correlated with the variation of westerly wind directions. The Asian dust events (April 1998, 2000, 2001, 2008) drove a three-fold increase in chlorophyll-a concentrations and spring bloom duration compared with non-dust years. We suggest that spring Asian dust event, though episodic, play a significant role in stimulating ocean productivity in the WNPO. Recently (since ~2001), a decreasing trend in the frequency of spring Asian dust events suggests that attention should be paid to how ocean productivity in the WNPO will respond to the change.

**Interannual variability of phytoplankton communities in the middle of East China Sea during summer: Influence of excess nitrate?**

Xu Q., Sukigara C., Watanabe Y., Matsuno T., Yoo S., **Ishizaka J.**

*Nagoya University, Japan*

**Abstract**

Phytoplankton community structures were examined by HPLC in the middle of East China Sea during summer of 2010, 2011, 2012, and 2014. Cryptophytes, prymnesiophytes were abundant in 2010 and 2011, whereas diatoms were dominated in 2009 and 2013. Influence of Changjiang Diluted Water (CDW) was strong and excess nitrate was high in 2010 and 2011, whereas CDW was weak and nitrate was low in 2009 and 2013. It is expected that phytoplankton community in the summer East China Sea was controlled by the abundance of phosphate influenced related to the CDW and upwelling.

## **Decadal trends of the anthropogenic CO<sub>2</sub> increase and remineralization in the North Pacific Subtropical Mode Water at the 137°E section**

Ishii, M., Sasano, D., Kosugi, N., Toyama, K., Enyo, K., Takatani, Y., Nakano, T.

*Meteorological Research Institute, JMA*

### **Abstract**

On the basis of the data of repeat measurements of biogeochemical variables including dissolved inorganic carbon (DIC) in the 137°E section since 1994, we report the trend of DIC change in the density layer of  $25.5\sigma\theta$  in the North Pacific Subtropical Mode Water (STMW).

The salinity-normalized preformed DIC ( $\text{pref\_sDIC} = (\text{DIC} - 117/170 \cdot \text{AOU}) \cdot 35/S$ ) in the STMW has been increasing at a mean rate of  $+1.2 \pm 0.1 \mu\text{mol/kg/yr}$  over the last two decades, indicating that the anthropogenic CO<sub>2</sub> has been accumulating significantly in this water mass. This trend of  $\text{pref\_sDIC}$  increase is tightly consistent with the trend of salinity-normalized DIC (sDIC) on the surface of the STMW formation region to the south of Kuroshio Extension (KE) in winter. This consistency demonstrates the role of STMW formation and advection in transporting the anthropogenic CO<sub>2</sub> from the ocean surface into the interior.

The difference between the sDIC and  $\text{pref\_sDIC}$  in the STMW at 137°E, ranging between 20 to 40  $\mu\text{mol/kg}$  and indicating the remineralization of organic matter during the course of STMW advection, shows decadal variability with larger differences at around the years 2000 and 2010. This decadal variability is considered to be ascribed to the variability in the formation and advection of the STMW being associated with the stability of the KE path. The results suggest that variability in the formation and advection of STMW also influences the upward transport of nutrient and thereby the new production in the subsurface of the Kuroshio-recirculation region in the subtropics of the western North Pacific.

## **Kuroshio Paradox: Why Fisheries Production is High in Oligotrophic Kuroshio Water?**

**Saito. H.**

*The University of Tokyo, Japan*

### **Abstract**

Kuroshio is a warm western boundary current of the North Pacific flowing along the continental shelf of Taiwan and the Japanese archipelago. The meaning of “Kuroshio” in Japanese is “black current” which is from dark blue water color (i.e., low phytoplankton biomass) different from greenish (i.e., high phytoplankton biomass) coastal water. In spite of the low phytoplankton biomass, various fishes and squids use the Kuroshio ecosystem as spawning and nursery grounds. These Kuroshio species contribute to 58% of fisheries landing in Japanese water. I named this inconsistency of high fisheries production in oligotrophic water as Kuroshio paradox. To resolve the Kuroshio paradox, an interdisciplinary research project “The Study of Kuroshio Ecosystem Dynamics for Sustainable Fisheries” (SKED) was launched in 2011. SKED scientists found several physical mechanisms of nutrient supply into the euphotic zone. The dominance of nanophytoplankton, such as haptophytes and green algae, and the low fraction of *Prochlorococcus* indicated the Kuroshio ecosystem is rather mesotrophic than oligotrophic. It is suggested, therefore, phytoplankton production is rapidly transferred to higher trophic levels. Mesozooplankton composition indicated the phytoplankton production is passing through not only grazing food chain (i.e., diatom-calanoïd copepod-fish) but also “tunicate-poecilostomatoid food chain”. I will present the unique ecosystem structure in the Kuroshio ecosystem to support high fisheries production in low chlorophyll region.

**Seasonal variability of temperature, salinity, and geostrophic currents obtained from CTD and satellite observations around South Korea****Eun Ae Lee, Sung Yong Kim***KAIST, Korea***Abstract**

The annual variability of temperature, salinity and geostrophic circulation around South Korea (East/Japan Sea, southern coast, and the Yellow Sea) is studied by analyzing conductivity-temperature-depth (CTD) profiles for recent 10 years (2001 to 2010). In the estimates of seasonal amplitudes using harmonic analysis, we examine their accuracy by evaluating how well the seasonal fit reconstructs the known pure seasonal signals with noise. Over the shelf (within 70km of the coast) in the East Sea, the seasonal amplitudes, means, and root-mean-squares of subsurface temperature and salinity are smaller than those offshore about 20-50%, which may be due to southward North Korea cold currents along the shelf nearly all year. Conversely, in the Yellow Sea, the seasonal amplitudes of subsurface temperature onshore waters (within 40 km) become larger than offshore about 40% as a result of enhanced onshore tidal mixing.

## North Pacific upper-ocean biases and changes in CMIP5 models

\***Chan Joo Jang**, Cheol-Ho Kim, and Minwoo Kim

*Korea Institute of Ocean Science & Technology, 787 Haean-ro, Sangrok-gu, Ansan  
15627, Republic of Korea*

\**Corresponding e-mail: cjang@kordi.re.kr*

### Abstract

IPCC (Intergovernmental Panel on Climate Change) have recently released its fifth assessment report (AR5) which provides up-to-date scientific knowledge and socio-economic aspects of climate change, largely based on observational data and CMIP5 (Coupled Model Intercomparison Project Phase 5) global models. This study aims to evaluate the performance of global climate models (CMIP5 models) by comparing their historical run simulation with observed climatology, and to analyze their future climate change projection, focusing on North Pacific upper ocean changes that are associated with ecosystem responses to global warming. Statistical analyses including Taylor diagram show that CMIP5 models have improved spatial patterns of PDO (Pacific Decadal Oscillation) compared with those of CMIP3 models, mainly through better teleconnection representation between the tropics and mid-latitudes. Furthermore, the improvement is not only by decrease in number of models with poor performance, but also by better simulation of PDO spatial patterns. Sea surface temperature bias (model – observation) shows a robust cold bias, which appears to be related to wind stress bias. Mixed layer depth displays a deep bias in the Kuroshio Extension region and a shallow bias in the Oyashio region- a chronic problem in ocean circulation models. Sea surface temperature and mixed layer depth in the North Pacific Ocean, therefore, still appear to have significant biases, thus contributing to simulation biases in ecosystem including chlorophyll concentration. CMIP5 models project that upper ocean processes including mixed layer depth tend to change considerably in the North Pacific, as projected by CMIP3 models. Possible causes of such changes and inter-model spreads in future projection will be also presented.

## Seasonal dynamics in nutrients and trace metals budgets of *Zostera marina* in an anthropogenic impacted lagoon

Sun Kyeong Choi, Sang Rul Park

*Jeju national university, Korea*

### Abstract

We examined nutrients and trace metals budgets, and the growth dynamics of *Zostera marina* in an anthropogenically impacted lagoon (Tongbatarl, Jeju Island, Korea) from February 2013 to February 2015. Eelgrass coverage of approximately 23,262 m<sup>2</sup> was observed in this lagoon. Morphological characteristics, total biomass and productivity of *Z. marina* exhibited distinct seasonal variations. The values of all parameters were similar to those reported globally from other *Z. marina* meadows. Therefore, the existing *Z. marina* beds in Tongbatarl lagoon in Jeju Island were relatively healthy status. The carbon, nitrogen and phosphorus of above- and below-ground tissues showed significant seasonal variations. The calculated average annual C, N and P budgets in all the *Z. marina* meadows of this lagoon were  $1.4 \times 10^4$  kg C y<sup>-1</sup>,  $1.2 \times 10^3$  kg N y<sup>-1</sup> and  $1.0 \times 10^2$  kg P y<sup>-1</sup>, respectively. Additionally, calculated annual Cu, Mn and Zn budgets into the above-ground tissue were 843.7, 1123.7 and 1390.0 g y<sup>-1</sup> in all the *Z. marina* meadows of this lagoon. This indicates that *Z. marina* plays an important role as nutrients and trace elements sink in the study area.

## Autumn CO<sub>2</sub> chemistry in the Japan Sea and contribution of Changjiang diluted water

Kosugi N., Sasano D., Ishii M., Enyo K. and Saito S.

*Meteorological Research Institute, Japan*

### Abstract

We present the results of comprehensive observations of surface water CO<sub>2</sub> chemistry in the autumn Japan Sea (from September to November) from 2010 to 2014. The partial pressure of CO<sub>2</sub> (pCO<sub>2</sub>) in surface water in the autumn Japan Sea (312–329 μatm) is lower by 10–30 μatm than that in the same latitudinal band in the western North Pacific adjacent to Japan. Lower pCO<sub>2</sub> in the Japan Sea is primarily attributable to the large seasonal decrease in pCO<sub>2</sub> owing to strong cooling in autumn. This feature is prominent in the northern Japan Sea where the difference in temperature between surface and subsurface is large in summer. On the other hands, lower pCO<sub>2</sub> in relatively warm and fresh water in the southern Japan Sea is not only attributable to the thermodynamic effect of temperature but also the lower dissolved inorganic carbon to total alkalinity (DIC/TA) ratio. The DIC/TA ratio in this region is as low as 0.87 and lower than in other waters in the Japan Sea (≈0.90) due to the riverine alkalinity input from Changjiang River and the biological consumption of DIC in the East China Sea in early summer. They also elevate the saturation state of calcium carbonate minerals, e.g., that of aragonite ( $\Omega_{\text{arag}} > 3.2$ ), and mitigates anthropogenic ocean acidification at least in this season. These biogeochemical contributions of CDW in the Japan Sea last until November, although the inflow of CDW to the Japan Sea almost ceases by the end of September. The long duration of high saturation state of calcium carbonate will be beneficial for calcareous marine organisms



## **Decomposition of dissolved organic matter in salt water by ozone treatment**

**Sujin Song**, JongWoo Park, Weol Ae Lim, Yangsang Suh, Jea Sam Yang

*NIFS, Busan, Korea*

### **Abstract**

In order to treat hypertrophic salt water, I tested the effect of ozone oxidation method, on the removal rate of dissolved organic materials and inorganic nutrients. In my experimental system 3.12 - 3.50 mg O<sub>3</sub> /ℓ was evolved when 5 mg O<sub>2</sub> /ℓ was supplied under the system option of 55% conversion. After 60 minutes experiment, 23% and 17% of decomposition rates of glucose were found from 0 and 30 salinity, respectively. Under the same condition, 93% and 39% of decomposition rate of glycine were found from 0 and 30 salinity, respectively. Lower salinity condition such as 0 provided higher decomposition rate of glucose and glycine. During the periods of ozone supply, the concentration of phosphate in the phosphate-only condition has kept constant, while the concentration of phosphate in condition including dissolved iron and phosphate has decreased rapidly at the early stage of the experiment. This result indicates that the dissolved phosphate was removed from water by co-precipitation with iron oxide. Experiments with air, oxygen, and ozone gas injection to hypoxia water condition showed that the ozone condition sustained longest duration time with more than 5 mg O<sub>2</sub> /ℓ in water. Based on this experiment, I found the ozone treatment be one of the efficient methods to sustain optimum dissolved oxygen concentration in coastal water

## Ecological provinces of spring phytoplankton in the Yellow Sea: species composition

Zhang S, Sun J

*Institute of Oceanology, Chinese Academy of Sciences, China*

### Abstract

The ecological provinces of phytoplankton derived from species composition and its temperature and salinity were carried out in the Yellow Sea (YS) (31.20°~39.23° N, 120.99°~125.16°E) from 28th April to 18th May in 2014. 173 samples were obtained from 40 stations, and 185 taxa in 81 genera of 7 phyla of phytoplankton were identified and quantified by Utermöhl method. The phytoplankton cell abundance in the surface water layer was concentrated in the West Korean Peninsula, the Southern Liaodong Peninsula, and the West Northern Korea Bay. Phytoplankton in these areas was mainly composed of diatoms and cyanophyta. The first 10 dominant species in the YS were analyzed by multidimensional scaling (MDS) and cluster analysis. By analyzing the water temperature and salinity data combined with station depth, the YS were divided into 5 provinces. Considering the section distribution, the region with a peak value of phytoplankton abundance concentrated in the surface layer of both coastal stations and YWC. Overall, the spring phytoplankton community structure, in some unique areas, such as the Southern Liaodong Peninsula - West Northern Korea Bay, Northern Shandong - Chengshan Corner Area, the West Korean Peninsula and Subei Coastal Zone was quite heterogeneous. Canonical correspondence analysis (CCA) was applied to explore the relationship between phytoplankton species and environmental factors using MVSP. The biplot diagram showed the relationship between dominant species and environmental factors. The main environmental factors affected the distribution of the phytoplankton in the Yellow Sea in spring was nitrate, then temperature and salinity.

## **Multiple approaches to detect environmental impacts of coastal sand mining on ecosystem structures**

**Won NI, Kim YS**

*K-water Institute, Korea Water Resources Corporation, Korea*

### **Abstract**

The anthropogenic activities in the offshore marine environment have been increasing and often gave wide and long adverse effects on marine ecosystems. These impacts can be induced via various ecological pathways and be detected from the whole marine ecosystem and/or its ecological components. Marine biological production is likely to largely rely on ecosystem conditions and there are increasing concerns of multiple stressors affecting the coastal resilience. Those stressors could induce cascade effects on marine ecosystems through trophic linkages. The linkage between offshore and coastal ecosystems is also important to understand environmental impacts of offshore anthropogenic events on marine environments. Coastal sand mining is one of relatively long and remarkable anthropogenic activities in Korean coastal waters. Mining activities produce relatively fine large suspended sediments in surface waters following on-board screening process of raised bottom sand. These mining processes are likely to affect ecosystem structures through direct disturbances on microbial community and benthic community. The fish community around mining area has been concerned about changed ecological structures via trophic linkages. This study was performed to detect any ecological impacts of sand mining activities in southern coastal waters of Korea. Both microorganism and macroorganism communities were examined using NGS technology and stable isotope analyses, respectively. The composition and diversity of microorganisms were described. Novel gene families with representatives only within such metagenomics datasets represented a large proportion of the ocean metagenome. The presence of so many new gene families from these uncultured and highly diverse microbial populations implies possible impacts by sand mining. Trophic linkages from POM to larges fishes were described and fish assemblages were compared between coastal and offshore sites in terms of fish compositions and trophic structures. This study highlights that multiple approaches to analyze ecological traits are necessary and efficient to detect environmental impacts of marine anthropogenic activities.

## Tintinnid Ecology in Yellow Sea and Bohai Sea, China

Zhang W., Chen X., Zhang S.

*Institute of Oceanology, Chinese Academy of Sciences, China*

### Abstract

Tintinnid is an important component of microzooplankton. With lorica as taxonomic character, simple life history and rapid response to environmental change, tintinnid is a good example of plankton community research. Tintinnid community in the sea is resulted from the convergence and mixing of different biogeographical types (neritic, warm-water, cosmopolitan and boreal genera). We studied the vertical distribution of tintinnids communities in the Yellow Sea and the Bohai Sea, China, during the summer cruise in August, 2015. Neritic and cosmopolitan genera were dominant in summer in the Yellow Sea. We studied the influences of water mass on tintinnid communities in the western Yellow Sea. The Yellow Sea Warm Current (YSWC) was strong in summer, and brought some warm-water species to the northern part, which resulted in a mixing of warm-water, cosmopolitan and neritic genera. Another characteristic of tintinnids vertical distribution was that one cool water tintinnid species (*Ptychocylis obtusa*) belonging to boreal genera occurred in the sub-surface (10-50 m) of northern Yellow Sea where the Yellow Sea Cold Bottom Water (YSCBW) occurred in summer. The Bohai Sea had higher species richness than in the Yellow Sea. Cosmopolitan and neritic genera were also dominant in the Bohai Sea. Some species, e.g. *Tintinnopsis corniger*, *T. lohmanni*, and *T. tocantinensis*, was only found in Bohai Sea. No warm-water species were found in Bohai Sea.

Our finding that the cold water species *Ptychocylis obtuse* was present in the Yellow Sea in summer suggested that it was an indigenous species in the Yellow Sea. The Yellow Sea Cold Bottom Water was its refuge to over-summer. Further researches about the vertical distributions of tintinnids and the influences of environmental factors, such as water masses in different seasons in Yellow and Bohai Sea need to be conducted.

**Comparison of biological characteristics of Pacific cod (*Gadus macrocephalus*) between the East and the Yellow Sea, Korea****Kyunghwan Lee, Sukgeun Jung***Jeju National University, Korea***Abstract**

I compared the biological characteristics of Pacific cod (*Gadus macrocephalus*) between the East and the Yellow Sea in Korea. A total of 261, 322 cod samples were collected in the East Sea from January to December 2003, January to February 2007 and 682 samples in the Yellow Sea from January to December 2007. Significant regional differences between the East and the Yellow Sea cod were detected in 1) relationship of total length and body weight 2) von Bertalanffy growth equation and 3) median maturity length. The probability of spawning by adult cod was estimated by logistic regression equation and median maturity length (L<sub>50</sub>). The East Sea cod showed a higher growth rate than the Yellow Sea cod and female cod showed a higher growth rate than male cod. The Yellow Sea cod (male: 2.3 years, female: 2.6 years) were estimated to mature earlier than the East Sea cod (male: 3.9 years, female: 4 years) for the both sexes. I hypothesized that these differences in growth and maturation of cod are attributed to the regional differences in the marine environment between the East and the Yellow Sea. Further comparative studies on marine ecosystems of the two seas will validate this hypothesis.

## Short-term variation of zooplankton community in the southwestern East Sea coupling with physical processes

Yoon HJ, Seo JH, Yoo CM, Ju SJ

*KIOST, Korea*

### Abstract

Community structure and abundance of zooplankton were investigated in the southwestern East Sea in November and December 2015. Zooplankton samples were collected by vertical tow (NORPAC net with 200  $\mu\text{m}$  mesh size) from 200  $\mu\text{m}$  to the surface. Temperature ranged from 13.2° C to 14.3° C (November) and 7.7° C to 11.3° C (December) in the study area with no vertical change in temperature from surface to 200m. Salinity ranged from 32.7  $\pm$  0.3 psu (surface) to 34.1  $\pm$  0.2 psu (200m) in November and 33.5  $\pm$  0.8 psu (surface) to 34.0  $\pm$  0.1 psu (200m) in December. Zooplankton abundance ranged from 396 ind./m<sup>3</sup> to 565 ind./m<sup>3</sup> (average biomass = 19.69  $\pm$  6.98 dry mg/m<sup>3</sup>) in November and 114 ind./m<sup>3</sup> to 147 ind./m<sup>3</sup> (average biomass = 9.14  $\pm$  4.43 dry mg/m<sup>3</sup>) in December, respectively. Zooplankton community was dominated by copepods which comprised 80% (November) and 77% (December) of total zooplankton abundance. The next dominant groups were appendicularians (9%), other crustaceans (4%) and chaetognaths (3%) in November, and copepodite (14%) and appendicularians (3%) in December. The average abundance of zooplankton in November was 3.6 times higher than that of December. There were differences in zooplankton composition (except for copepods) in November and December. These differences could be associated with the physical characteristic of water masses which affects zooplankton community and abundance.

## Particulate organic carbon cycle at the surface water and sediment in the Ulleung Basin, East/Japan Sea

Lee T, Yoo SJ, Son YB

*KIOST, S. Korea*

### Abstract

This study investigated organic carbon fluxes in Ulleung Basin surface water and sediments, East/Japan Sea based on a  $^{234}\text{Th}$  analysis and geochemical analyses. At depths greater than 2,000 m, Ulleung Basin sediments have high organic carbon contents (over 2.0%). Apparent sedimentation rates (ASR) calculated from excess  $^{210}\text{Pb}$  activity distribution, varied from 0.036 to 0.047  $\text{cm year}^{-1}$ . The mass accumulation rates (MAR) calculated from porosity, grain density (GD) and ASR, ranged from 131 to 184  $\text{g m}^{-2} \text{year}^{-1}$ . These results were in agreement with sediment trap results obtained at a water depth of 2100 m. Input fluxes of organic carbon (IF) varied from 7.89 to 11.08  $\text{gC m}^{-2} \text{year}^{-1}$  at the basin sediments, with an average of 9.56  $\text{gC m}^{-2} \text{year}^{-1}$ . Below a sediment depth of 15cm, burial fluxes of organic carbon (BF) ranged from 2.02 to 3.10  $\text{gC m}^{-2} \text{year}^{-1}$ . Within the basin sediments, regenerated fluxes of organic carbon (RF) estimated with oxygen consumption rate, varied from 6.22 to 6.59  $\text{gC m}^{-2} \text{year}^{-1}$ . However, the regenerated fluxes of organic carbon (RF) calculated by subtracting burial flux from input flux, varied from 5.87 to 7.98  $\text{gC m}^{-2} \text{year}^{-1}$ . Respectively, the proportions of the input flux, regenerated flux, and burial flux to the primary production (154.7  $\text{gC m}^{-2} \text{year}^{-1}$ ) in the Ulleung Basin were about 6.2%, 4.5%, and 1.7%. These proportions were extraordinarily higher than the average of world open ocean. Based on these results, the Ulleung Basin might play an integral role in the deposition and removal of organic carbon.

## **Reduced satellite-driven chlorophyll-a concentration and its related process in the East China Sea during summer 1998-2014**

**Son Y.B.**, Lee T., Yoo S.

*KIOST, Korea*

### **Abstract**

The purpose of this study is to investigate climatological variations from the temporal and spatial surface satellite-driven chlorophyll concentration and to understand their related environmental changes that affect the distribution of chlorophyll in the East China Sea (ECS) during 1998-2014, especially summer season (June ~ August). 17-year monthly mean values of surface satellite-driven chlorophyll-a concentration (SeaWiFS and MODIS), nutrients and recorded Changjiang River discharge data were used to determine reduced summer biological activity.

A linear trend analysis of chlorophyll data reveals that, during recent 17 years, the summer chlorophyll-a concentration showed decreased trend. To determine more detailed spatial and temporal variations, we used empirical orthogonal function (EOF) analysis. The first mode is temporally correlated with the area influenced by the Changjiang River discharge and spatially correlated with north-west and south-east patterns. The regional trend between chlorophyll and river discharge determined by K mean analysis showed that reduced summer chlorophyll-a concentrations were correlated with reduced summer Changjiang River discharge in the south of Jeju, Korea. Since the Changjiang River is a major source of nutrients in the ECS, the decreased summer chlorophyll seemed to be related to the change in nutrients in the coastal area before and after impoundment of Three Gorges Dam (TGD), China. Although it is difficult to understand the influence of TGD on the coastal and shelf ecosystem in the ECS, reduced summer chlorophyll might be associated with nutrient limitation (P- and N-limitation) before and after impoundment of TGD.



## Testing hypotheses on the outbreak mechanisms of *Cochlodinium polykrikoides* blooms using long time series data set

Yeseul Kim<sup>1,2\*</sup>, Sinjae Yoo<sup>1,2</sup>, Young Baek Son<sup>1</sup> and Soonmi Lee<sup>1</sup>

<sup>1</sup>*Korea Institute of Ocean Science and Technology, Jeju, R Korea*

<sup>2</sup>*Ocean Science and Technology School, Busan, R Korea*

\**Corresponding e-mail: yeese0408@kiost.ac.kr*

### Abstract

Harmful *Cochlodinium polykrikoides* blooms have continuously occurred and caused large damage to the fishing industry since 1995 in the southern coastal waters of Korea. Earlier studies hypothesized that the environmental factors associated with outbreaks of *C. polykrikoides* blooms include water mass stratification, internal and external nutrients supply, solar irradiance and/or wind. These studies, however, have limitations in that analysis focused only on specific incidences so that require more rigorous verification. In the present study, a comparative analysis using meteorologic and oceanographic survey data (2000-2014) was conducted to see if the hypotheses could consistently explain bloom outbreaks at different locations. The analysis indicated that none of the proposed factors explained *C. polykrikoides* bloom outbreaks for the whole study period, and that critical factors differed by region and period. For example, precipitation showed a significant correlation with the outbreak duration in Yeosu for the period 1996-2003 but not for the whole period (1996-2014). Likewise, wind (direction and speed) and front formation explained incidences in only certain areas and in some years. These analyses suggest that the actual outbreak mechanisms are complicated and consist of multiple pathways that can alternate depending on the balance of many factors working in sequence rather than simultaneously.

***Cochlodinium polykrikoides* blooms in Korean coastal waters in 2012~2014****K.W., Park, Y.S., Suh, S.H., Youn, S.J., Song, C.H., Moon and J.M., Shim***National Institute of Fisheries Science, Korea***Abstract**

This study is carried out to understand the characteristics of *Cochlodinium polykrikoides* blooms in the Southern coastal water of Korea from 2012 to 2014. The frequency of *C.polykrikoides* blooms in Korea is generally one or two times a year, however, *C.polykrikoides* blooms occurred three times and showed small a relatively scale from July to October in 2012. These intermittent blooms might be influenced by the typhoon formed three times during the same period. In 2013, the bloom of *C.polykrikoides* occurred in earliest timing since 1995 and caused large economic damage (\$20 millionaire). It is considered that relatively long hours of sunshine and of affected the mass occurred of *C.polykrikoides*. In addition, relatively high water temperature(>24° C) and continuous Southerly wind lasting more than 20 days led to the influx and accumulator of *C.polykrikoides* cells in the coastal waters. In 2014 *C.polykrikoides* blooms occurred in a wide area covering southern and eastern coastal waters of Korea, and lasted more than 75 days in both waters. HABs in 2014 appeared in mixed way of red tide with other harmful algal such as *Karenia mikimotoi* and *Alexandrium* spp. The large-scale bloom was interpreted to be the influence of raising water temperature, long hours of sunshine and relatively high salinity in 2014. Though the occurrence mechanism is unclear, these results suggested that the mass occurrence and disappearance of *C. polykrikoides* blooms were basically determined by the meteorological factors such as rainfall, sunshine duration, wind and typhoon, and interspecific competition.

## Modeling impacts of typhoons on the upper-ocean ecosystem in the northern South China Sea

Pan SS., Shi J., Gao HW., Guo XY., Yao XH.

*Ocean University of China, China*

### Abstract

The impacts of typhoons on the upper-ocean ecosystem in the northern South China Sea were investigated using a 1-D physical-biological coupled model. The contributions of physical and biological processes to chlorophyll-a enhancement in the surface and subsurface layers induced by typhoon Damrey in 2005 were estimated using the model results. The initial rapid increase of chlorophyll-a concentration (Chl-a) in the surface layer and decrease in the subsurface layer when the typhoon arrived were caused mainly by vertical mixing, whereas the subsequent gradual increases in both the surface and subsurface layers were due mainly to net growth. Besides, the different responses to typhoons with different intensities and translation speeds were examined by comparing the results forced by the typhoon Parpiroon and Chanchu in 2006. Typhoon Parpiroon (Category 1), with the average translation speed of 5.8 m/s, resulted in cooling in the water above 50 m with the maximum temperature decrease at surface by 2.0° C, and warming in the deep layer from 50 m to 130 m. The maximum increase of Chl-a at the surface was 0.18 mg m<sup>-3</sup>. The integrated primary production (IPP) yielded by typhoon Parpiroon was 2.3×10<sup>3</sup> mg C m<sup>-3</sup>, accounting for 3% of the annual IPP. However, super typhoon Chanchu (Category 4), with the average translation speed of 4.4 m/s, resulted in cooling above 55 m with the maximum decrease at surface by 5.0° C, and warming from 55 m to 150 m. The maximum increase of Chl-a at the surface was 0.90 mg m<sup>-3</sup>. The IPP yielded by typhoon Chanchu reached up to 12.8×10<sup>3</sup> mg C m<sup>-3</sup>, accounting for 18% of the annual IPP. The effects of typhoons on ocean ecosystem mainly depend on the intensity and translation speed of typhoons, and water conditions before typhoon passage (e.g. stratification).

## **The interannual variation of the Yellow Sea Cold Water Mass and the influencing mechanism**

**Zhu JY.**, Shi J., Gao HW., Guo XY.

*Ocean University of China, China*

### **Abstract**

The interannual variation of the Yellow Sea Cold Water Mass (YSCWM) was examined using the observations from 1978 to 1998, and the influencing factors were analyzed using a 3-D hydrodynamic model. The average temperature of the YSCWM ranges from 6.83° C to 7.71° C at the layer of 50 m depth. The prominent negative correlation was found between the average temperature and the area of the YSCWM. The intensity of the YSCWM was divided according to characteristics of the YSCWM. The YSCWM was strong in 1984, while was comparably weak in 1995. The influencing factors were quantitatively analyzed using the model results under the different forcing of 1984 and 1995. The sea-air heat flux was the dominant factor determining the intensity of the YSCWM, while the surface winds and the initial conditions had less effect. The sea-air heat flux in winter could contribute ~60% to the difference of the average temperature with YSCWM between 1984 and 1995. Moreover, it was the surface heat flux in the previous winter, not that in spring and summer, which determined the intensity of the YSCWM.

**Keywords:** the Yellow Sea Cold Water Mass, interannual variation, numerical model, sea-air heat flux

## **Preliminary results on the nutrients budget simulated in a marine system model in the East China Sea**

**Hyoun-Woo Kang**<sup>\*</sup>, Ok Hee Seo, Jae Kwi So, and Chan Joo Jang

*Korea Institute of Ocean Science and Technology*

*\*Corresponding e-mail: hwkang@kiost.ac.kr*

### **Abstract**

East China Sea (ECS) is one of the most complex marginal seas and it is influenced by oceanic current, the Kuroshio, from the south and the freshwater flux of Changjiang River from the west. Tide is also a crucial factor of the physical characteristics of ECS. The ECS is connected to the Yellow Sea to the north and to the East Sea (Sea of Japan). The nutrients fluxes through these borders or interfaces affect the nutrients budget in the ECS and the biological pump should play an important role on the redistribution of the nutrients inside the ECS and the strength of the outfluxes in conjunction with horizontal advection. In this study, we have analysed a simulation result of the ECS using a marine system model coupling the POLCOMS (Proudman Oceanographic Laboratory Coastal Ocean Modelling System) and ERSEM (European Regional Seas Ecosystem Model). The model includes all the physical forcing mentioned above and three kinds of nutrients, nitrate, phosphate and silicate. Four (three) kinds of phytoplankton (zooplankton) functional group based on their size fraction as well as microbial loop are those key elements of biological pump in the marine ecosystem in this coupled model.

Monthly climatology of nutrients derived from the interannual simulation of twenty years shows the seasonal variation of the nutrients in the ECS is highly affected by the influx from the Kuroshio and Changjiang River. It is worthwhile to note that the exchange with the Yellow Sea is not so crucial for the nutrients budget of the ECS. Outflux to the East Sea through the Korea Strait is also seasonally variable and affected from the Changjiang river discharge as well especially in summer. Since the simulation of this complex system is not easy, emphasizes are on the possibility of the model results interpretation to understand the nutrients distribution in the ECS rather than the correctness of the simulation. As a starting point of the nutrient budget analysis from the marine system model, annual and monthly budget of nutrients as well as variations in conjunction with depth and horizontal distribution have suggested and discussed.

## Population dynamics and community recovery patterns of kelp *Ecklonia cava* depending on disturbance timing and locations in Jeju Island, Korea

Sangil Kim, Sang Rul Park

*Estuarine and Coastal Ecology Laboratory, Department of Marine Life Sciences, Jeju National University, Republic of Korea*

### Abstract

Marine benthic ecosystems in Jeju Island are under increasing threat from global climate change and local-scale stressors such as typhoons and human impacts. These disturbances are predicted to lead to a decrease of kelp forests distribution in Jeju Island. Although the coasts of Jeju Island are characterized by kelp *Ecklonia cava* forests, few studies have been conducted on population dynamics and the responses of *E. cava* to large-scale disturbances. We investigated population dynamics of *E. cava* and constructed the population projection models. Additionally, we experimentally investigated the reposes of *E. cava* communities to disturbances of different intensities and timings. *E. cava* exhibited very low recruitment during spring-summer. However, high recruitment was observed in April 2015 when canopy cover was very low due to low density. This indicates that recruitment of *E. cava* was controlled by both seasonal effects and physical factors such as canopy and space. The post-recruitment mortality rates were highest due to their unstable settlement. 32 months after the disturbance, *E. cava* almost recovered to the pre-disturbance population size structure. These results suggest that recovery of kelp population following the large-scale disturbance requires a considerable period of time (at least 32 months). Population projection models showed that this population might eventually decline because of anomalous disturbances. Recovery patterns of *E. cava* community were affected by disturbance timings and locations. Recovery of *E. cava* was faster at autumn-cleared plots than at spring-cleared plots due to the recruitment season of *E. cava*. In spring-cleared plots, local specific colonizers inhibited the recruitment of *E. cava*. In conclusion, our results suggest that anomalous disturbances caused by climatic changes can lead to ecological phase shift of kelp forest.