

6th China-Japan-Korea IMBER Symposium

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Over the past decade, marine scientists from China, Japan and Korea have worked actively in the research areas of Global Ocean Ecosystem Dynamics (GLOBEC) and Integrated Marine Biogeochemistry and Ecosystem Research (IMBER). Beginning during the GLOBEC era, a series of scientific meetings have been organized every two years. Now organised by IMBER, the China-Japan-Korea (CJK) IMBER Symposium series provides the countries' scientists with the opportunity to collaborate, and share and exchange research achievements and ideas. The goals of the 6th IMBER Symposium were:

- to advance our understanding of marine biogeochemistry and ecosystem dynamics for the sustainable use of ecosystem services
- to understand the response of various marine ecosystems to multi-stressors and drivers, from climate change to anthropogenic forcings.

More than 50 IMBER scientists from the three countries participated in the symposium (Fig. 1). In addition to 30 oral presentations, about 16 posters showing IMBER-related research achievements were displayed during the symposium (Fig. 2).



Figure 1. Group photo of the participants at the 6th China-Japan-Korea (CJK) IMBER Symposium



Figure 2. Discussions at the poster session

Ken Furuya, the Director of the Graduate School of Agricultural and Life Science, Faculty of Agriculture, UT, gave the welcome address and briefly introduced the university. Liuming Hu, Deputy Executive Office of the IMBER Regional Project Office in Shanghai, China, provided an overview of the science themes of IMBER and recent achievements from its working groups and regional programmes. She also mentioned plans for IMBER's future development and some of the upcoming events including the ClimEco4 summer school (August 2014, China) and IMBER Open Science Conference (June 2014, Norway).

The oral presentations were grouped into four topics:

- The impact of climate change on biogeochemical cycles in the marginal seas and adjacent open oceans (Chaired by Hiroshi Ogawa)
- Marine ecosystem responses to anthropogenic activities and natural stressors (Chaired by Se-Jong Ju)
- Modelling the interaction between marine biogeochemistry and food web dynamics (Chaired by Hiroaki Saito)
- Towards the sustainable use of marine resources and services at the interface of marine and human systems (Chaired by Hiroaki Saito)



Hiroshi Ogawa



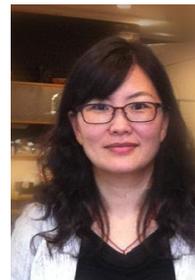
Se-Jong Ju



Hiroaki Saito



Ken Furuya



Liuming Hu

Topic 1: The impact of climate change on biogeochemical cycles in the marginal sea and adjacent open oceans

Presentations given on this topic, included research on nutrients, carbon, organic matter, and trace metal dynamics in coastal area and open oceans. Six of them focused on Kuroshio, the East China Sea and Changjiang River. Most of the presentations provided possible implications of the impact of change in the structure of biogeochemical cycles in the ocean and river systems.

Based on the examination of oceanic nutrient fluxes using a 3D model, Xinyu Guo found that Kuroshio nutrients are transported all the way downstream from its source. A similar result was found when Yutaka Hiroe clarified the 3D structure and seasonal/interannual variability of nutrients and chlorophyll in the Kuroshio region, by analysing historical hydrographic data. Masao Ishii's research demonstrated the progress of ocean acidification in the western North Pacific subtropical and tropical zones, as well as in the interior of the subtropical gyre. Youhei Yamashita investigated Fluorescent DOM (FDOM_H) in the Japan Sea Proper Water (JSPW) and found that

FDOM_H produced *in situ*, and possibly also photo-degraded terrestrial FDOM_H, is accumulating along the JSPW, due to its repeated formation.

The spatial distribution of Labile Dissolved Organic Phosphorus (LDOP) is similar to that of phosphate in both the western North Pacific and East China Sea, suggesting that LDOP is actively hydrolysed under phosphate-depleted conditions and is potentially important as a P source for microorganisms (Fuminori Hashihama). The sources of NO₃ were identified based on the T-S diagram and δ¹⁵N and δ¹⁸O values of NO₃ in the East China Sea. It was found that their contribution to NO₃ dynamics differed, depending on the season and year (Yu Umezawa). ¹³C and ¹⁵N tracer experiments were conducted by Xiuqing Ge. Results showed that the high primary production in summer in Tokyo Bay was mainly controlled by temperature and Photosynthetically available radiation PAR, rather than nutrients. Lignin phenols in dissolved organic matter (DOM) in Otsuchi Bay were measured as a tracer of terrigenous origin, suggesting that terrigenous DOM in the bay water was degraded by photo-oxidation (Chia-Jung Lu). Research from Juan Du suggested that the main source of ²¹⁰Pb and ¹³⁷Cs in the estuary and inner shelf of the Changjiang Estuary was derived from the outer shelf input, and most are stored in sediments. Zhongqiao Li investigated the distribution and source of organic carbon in the Changjiang basin, based on the measurements of glycerol dialkyl tetraethers (GDGTs) and lignin phenols.

Topic 2: Marine ecosystem responses to anthropogenic activities and natural stressors

Presentations on this topic focused on biological responses to anthropogenic activities and natural stressors from Chinese, Japanese, and Korean scientists, working in the Yellow Sea, East China Sea, East Sea/Japan Sea and northern Pacific Ocean. Most of presentations discussed the structural and functional responses and changes in marine ecosystems due to anthropogenic and natural forcings (e.g. ocean warming, high CO₂, hypoxia).

Meixun Zhao reported on the state of East China Sea coastal ecosystems over the past 30 years, based on biomarker records in sediment cores. From onboard experiments on the chain reaction of the microbial loop to the decay process of diatom blooms, Lingfeng Huang concluded that the response of each link in the microbial loop may have tight cascade relations during the decay process of an algal bloom in the East China Sea. Joji Ishizaka discussed the influence of river discharge (fresh water) on phytoplankton absorption properties in coastal regions, and recommended that careful approaches are required when using satellite data to estimate total biomass of phytoplankton in the East China Sea, where the total biomass is significantly influenced by fresh water discharge, particularly in summer.

Based on the responses of spring diatom assemblages to CO₂ availability in Oyashio waters, Koji Suzuki suggested that future ocean acidification could affect the photosynthetic physiology and species composition of diatoms in this region during

spring. Eunho Ko reported on methodological comparisons (^{14}C uptake method vs. fast repetition rate fluorometry) of primary production measurements in Korean waters.

Hongbin Liu explored various aspects of predator-prey interactions in planktonic food webs under different food web structures and environmental conditions. Se-Jong Ju presented his research outcomes on the structural role of *Euphausia pacifica* in the Yellow Sea ecosystem through multiple approaches. Ying Cui reported on the variation in the $\delta^{13}\text{C}$ of specific fatty acids $\delta^{13}\text{C}$ -FA in *Coilia mystus* (anchovy) during migration, and indicated that $\delta^{13}\text{C}$ -FA may provide additional information to better understand the feeding ecology of anchovy. Yasunori Sakurai discussed the negative effect of ocean warming on the survival of Japanese common squid paralarvae that could result in a decrease in the annual catch of the squid in the future. Aida Sartimbul examined the dynamics of omega-3 content in Bali sardines, during two seasons, comparing the diet compositions in water and fish stomachs.

Topic 3: Modelling the interaction between marine biogeochemistry and food web dynamics.

In this topic, various mathematical modelling approaches to understand food-web dynamics and biogeochemical cycles were presented.

Ian Jenkinson presented recent advances in small-scale fluidics related to plankton ecology. He considered the rheological approach to understanding the behaviour of plankton and marine food-web dynamics to be important.

Eiji Masunaga presented the influence of internal waves on the movement of sediments in coastal regions. In addition to high resolution surveys, the movement of suspended matter was reproduced using a mathematical model. They showed the importance of vortex structure generated by the breaking of internal waves, which influenced the resuspension and cross-margin transport of sediments and nutrients.

Yoichi Ishikawa developed a novel physical-biogeochemical coupled model for the stock assessment of neon flying squid (*Ommastrephes bartrami*). They forecast future feeding and spawning grounds under global warming. Hiromichi Igarashi also used the model and developed the forecasting procedure for fishing grounds of neon flying squids. Both studies targeted the optimal use of fisheries resources.

Jun Sun discussed the distribution of coccolithophores in Chinese waters. He showed the major factors controlling the distribution, and estimated the contribution of coccolithophores to the carbon cycle.

Topic 4: Towards the sustainable use of marine resources and services at the interface of marine and human systems.

The studies on this topic aimed to resolve socio-economic issues, especially for the wise use of marine fisheries resources.

Hiroaki Saito introduced the multidisciplinary research project SKED (Study of Kuroshio Ecosystem Dynamics for Sustainable Fisheries). One of the purposes of SKED is to understand the influence of the Kuroshio variation on the nutrient supply and ecosystem dynamics and to resolve the “Kuroshio paradox” (high fisheries productivity in the oligotrophic Kuroshio ecosystem).

Using satellite-derived fishing ground and fine-scale model-derived environmental data, Sei-ichi Saitoh developed a method to predict daily potential fishing zones for the Japanese common squid (*Todarodes pacificus*). The four-day prediction map of the fishing zones has been provided to fishermen every day and has helped to decrease fuel consumption and make their fishing efforts more effective.

Yang Liu investigated the suitability of different areas in Funaka Bay (Japan) and Dalian Bay (China), for aquaculture of the Japanese scallop (*Mizuhopecten yessoensis*), using a GIS-based model and satellite remote sensing. He examined the impact of climate change events, such as AO and ENSO, in each region and identified zones less impacted by climate events that would consequently be more suitable for aquaculture.

Takaomi Kaneko examined the social and economic impacts of the sardine stock collapse in the late 20th century in Japan. He presented four management options relating to fishing vessel regulation and managers, and provided detailed analyses of the advantages and disadvantages of each option, including the impact on the regional economy, food self-sufficiency rate, required government support, etc.

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