Sixth China-Southeast Asian Countries Marine Cooperation Forum

Hosts: Ministry of Natural Resources of China &
Guangxi Provincial Government, People's Republic of China

Local Organisers: First Institute of Oceanography (FIO) &
Fourth Institute of Oceanography (4IO) of the Ministry of Natural Resources, China

16 to 17 November 2018
Beihai, China

Summary Report of the Meeting

Opening Ceremony

The Sixth China-Southeast Asian Countries Marine Cooperation Forum was successfully convened from 16 to 17 November 2018 in Beihai, China. The Forum was hosted by the Ministry of Natural Resources of China (State Oceanic Administration of China) & Guangxi Provincial Government, People's Republic of China. The organizers were the First Institute of Oceanography (FIO) and the Fourth Institute of Oceanography (4IO) of the Ministry of Natural Resources, China.

This year's Forum was chaired by Dr. Fangli Qiao, Secretary-General, First Institute of Oceanography, Ministry of Natural Resources of China. In total, approximately 400 government officials and scientists from China, Bangladesh, Cambodia, Indonesia, Malaysia, Myanmar, Philippines, Thailand, and Timor-Leste participated in the Forum. The List of Participants is listed in Annex 1.

Keeping in line with the objectives of this annual Forum and its past successful results, the objectives of the 6th Forum were to:

- Further strengthen the communication of marine science and technology among the Southeast Asian countries and China; and
- Establish an international platform for the Southeast Asian countries and China for future cooperation.

The Forum again provided a platform for participants to exchange ideas and develop collaborative efforts in marine science research, ocean technology, conservation, and governance.

The Forum was opened by Her Excellency, Ms. Zhichan Yan, Vice-Governor, Guangxi Autonomous Region. Ms. Yan mentioned the history of Beihai's coastal development as the starting point of the maritime silk road, and Guangxi Province's international cooperation with various Asian countries in the area of marine development and investment. Particularly with Southeast Asian countries, Guangxi recognizes the importance of international collaboration towards a common agenda to sustainably develop each other's economy, communication, and marine protection. It is important to protect the important resources in a complementary manner with regional economic development. Therefore, Guangxi gives attention to these aspects of cooperation with Southeast Asia. She wished the Forum every success to discuss these issues and find innovative ways forward.

His Excellency, Dr. SAUT Yea, Under Secretary of State, Ministry of Environment in Cambodia, gave an opening speech speaking about the importance to protect coastal and marine resources. As countries face transboundary issues, it is necessary to engage with all stakeholders and countries to exchange data and information. In this way, we can find solutions to address issues of common concern. Mr. Saut wished the Forum success in its endeavours for scientific exchange and to formulate cooperative actions in marine management.

Dr. Zhanhai Zhang, Director-General of Department of Marine Strategic Planning and Economy, Ministry of Natural Resources of China. Dr. Zhang welcomed all participants to the meeting. He mentioned that multi-lateral dialogues have taken place and continue to do so to find the best ways to progress collaborative efforts in marine management. He noted that since the first

Forum held in Indonesia, there has been increasing participation in the Forum, evidence that stakeholders recognize the importance of the marine environment. Mr. Zhang encouraged that the protection of the marine environment, research, technological development, and other use and management of the maritime realm should be carried out in a sustainable and cooperative manner. He wished the Forum success in further exploring these issues, and driving the process forward.

Session 1 – Keynote Speeches

In Session 1, six keynote speeches were given by:

- Mr. Somkiat Khokiattiwong, Department of Marine and Coastal Resources, Thailand
- Mr. Andreas Patria, Head of Program Division, Coordinating Ministry of Maritime Affairs, Republic of Indonesia
- Mr. MEAS Rithy, Deputy Director, Department of Marine and Coastal Zone Conservation, Ministry of Environment, Cambodia
- Ms. Nurul Adni Nik Hassan, Ministry of Energy, Science, Technology, Environment and Climate Change, Malaysia
- Mr. Zaw Moe, Director, Environmental Conservation Department, Ministry of Natural Resources and Environmental Conservation, Myanmar
- Mr. Wenxi Zhu, Head, WESTPAC Secretariat
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The speakers spoke about scientific cooperation, marine debris, status of marine biodiversity, and the UN Decade of Ocean Science.

Mr. Khokiattiwong spoke about the joint research between China and SE Asia. He highlighted some Thailand-China marine cooperative projects, including ocean forecasting system (OFS), monsoon monitoring, marine endangered species research (MESR), and ecological management. The OFS project is being improved with high resolution data and looks toward future application of the data. The ecological management project will help to designate MPAs in Thailand towards ecological management networks. The MESR project focuses on capacity building, monitoring, and establishment of a database. Researched species include Bryde's whale, dugongs, Irrawaddy dolphins, humpback dolphins, and sea turtles.

Mr. Patria shared Indonesia's experience in combatting marine debris. Waste management varies across the country, and thus, formal and informal sectors should jointly address this problem. The Indonesian Government has a target to reduce plastic waste by 70% by 2025. A National Action Plan has been devised consisting of five strategies including research, enforcement, behavioural change, and reduction of waste leak from land and sea sources. Additional financial support to implement the Action Plan is being sought through private-public partnerships, international organisations, and NGOs. Mr. Patria also introduced recycling of plastics being used for other means such as a plastic-tar road. Mr. Patria closed by recommending that further research is required to support the Action Plan, and that Indonesia is open to collaboration with various parties to address this problem.

Mr. Meas spoke about Cambodia's marine biodiversity status and the future plan for marine park cooperation. Cambodia's coastal area provides opportunity for economic development;

however, such activities face problems including lack of land use area, population increase, overexploitation of resources, coastal erosion, and accentuation of climate change impacts. Mr. Meas informed the Forum about the kinds of protected areas and the framework to protect them. He alerted the Forum that Cambodia is currently collaborating with Ministry of Natural Resources – China for further protected area capacity building and knowledge exchange. This has resulted in a joint observation centre, draft marine spatial planning document, joint survey on endangered species, plankton, sediment and water, and coral monitoring with drones. Mr. Meas closed by affirming the continued collaboration between China and Cambodia.

Ms. Hassan shared Malaysia's government agencies responsible for marine environment management. She started off with the history of the development of the Ministry responsible for marine affairs. As Malaysia's new government is under-going restructuring, the government agencies' structure and function will be finalised at the end of the year. Ms. also showed the commitment of Malaysia to international bodies such as ASEAN, Intergovernmental Oceanographic Commission, and International Collaboration Fund, amongst others.

Mr. Moe talked about Myanmar's economic development that at times brings threats to the environment. Myanmar consists of complex ecosystems, with the marine sector playing an important role in the country's economic development. Mr. Moe shared with the Forum the roles of various government agencies and legislation on conservation. There are many policies governing marine resource use addressing water quality, resource extraction, fisheries stocks, and international cooperation. Myanmar also participates in ASEAN's Working Groups relevant to the marine sector. Mr. Moe affirmed that Myanmar will continue to engage in international cooperative efforts to protect the marine environment.

Mr. Zhu talked about China's relationship with SE Asia on various fronts. He mentioned that SE Asia is a region on the rise and that natural resources need to be properly used. He showed examples from the region of marine pollution and the marine biodiversity hotspots. Mr. Zhu spoke about UNESCO's role to promote education, science, and culture. He shared UNESCO IOC/WESTPAC's priorities in ocean science issues, and the UN Decade of Ocean Science (2021-2030) where the approach will be inclusive and transformative. Mr. Zhu emphasised the need for science-driven outcomes, and introduced the preparation modality for the UN Decade. He stated that UNESCO looks forward to finalising and implementing the Action Plan to kick off the Decade.

Parallel Sessions

Presentations were given under the Forum's three parallel sessions:

1. Session 2: Ocean Observation, Forecasting and Services, Chaired by Dr. Weidong YU and Dr. Somkiat Khokiattiwong.
2. Session 3: Marine Biodiversity and Ecosystem Health, Chaired by Dr. Chengjun SUN and Dr. Saifullah A Jaaman.
3. Special Session: Investment and Financing in Marine and Fishery Industry, Chaired by Dr. Hesheng JIANG.

The agenda is attached as Annex 2, and the abstracts of the presentations are attached as Annex 3.

Parallel sessions allowed an opportunity for participants to discuss the oceanic value chain from observation discovery, numerical prediction to social services, marine biodiversity monitoring and research, marine microplastics, coral-algal symbiosis, benthic HABs, and MPA establishment. There was also an opportunity for participants to share information and ideas for transboundary development of the marine industry.

The main discussion points from each session are summarized below.

Session 2 - Ocean Observation, Forecasting and Services

In this session, participants shared their research on ocean observation and forecasting. Altogether, 12 talks addressed the oceanic value chain from observation discovery, numerical prediction to social services.

Seven talks were dedicated to the new progress on the knowledge gained from observation, including topics such as water mass, internal wave, upwelling, upper ocean stratification, deep ocean discovery and sediment records, most of which are conducted through the bilateral and/or multilateral cooperation. Southeast Asia suffers from a lack of ocean observation data which is the key reason holding back scientific progress in this region. All talks demonstrated the value of cooperation, partly driven by this Forum series.

There were three presentations on forecasting study, including topics on ocean forecasting system, typhoon, and hypoxia. The session discussion reflected the wide regional concern on the ocean forecasting system (OFS) and service, not only the physical processes but also the biogeochemical ones. Such OFS is a useful tool to bring research to services such as helping to increase predictability.

There was also a presentation on CLIVAR, an international science programme focusing on climate variability, and one presentation on ocean renewable energy.

Based on the presentations and discussions, some recommendations were proposed, considering the high level of regional concern and priority. Please refer to the "Recommendations and Proposals for Further work" section below.

Session 3 - Marine Biodiversity and Ecosystem Health

This session provided an opportunity for participants to share their research and future ideas on various aspects of marine biodiversity research and management. Talks were given on the following topics:

- Monitoring and observation of marine mega-fauna (dolphins, dugongs, sea turtles)
- Conservation of giant clams, Cardiidae and Tridacna spp.
- Marine macro and microplastics
- Coral-algal symbiosis
- Benthic HABs
- MPA establishment and management

Mega-fauna

Monitoring and observation of marine mega-fauna is increasingly being done via unmanned methods. Aerial surveys are still used, but unmanned auto-vessels such as drones and bioacoustics are less invasive and becoming more economical. Bioaccoustics can help measure the clicks of Irrawaddy dolphin, seagrass feeding by dugongs, selective feeding by dolphins, habitat mapping, and organism behaviour. Other methods used are radio telemetry and photogrammetry that can help with species population survey. The different methods should be integrated for more robust data interpretation and use.

In the absence of actual observations, proxies can be used to measure dugong health, analysing seagrass boundary, density, biomass, % cover, and species diversity. Feeding trails in seagrass beds can also help determine dugong presence.

High echolocation clicks of the Irrawaddy dolphin in the Bay of Brunei suggests they were searching for prey in a small area. Shallow waters are more challenging to detect clicks compared to open ocean; however, this method can determine the range, seasonality, and abundance of dolphins. Dolphins are found feeding in human fishing area. A photo ID survey of dolphins in the Malaysia side of Brunei Bay determined 41 individuals identified from 2013 to 2015. Biopsy sampling is another method to estimate the dolphin population.

Giant clams

Giant clams are important contributors to corals as food, shelter, and reef builders. In recent years, human exploitation in using the shells for jewellery has increased. The clams are also suffering from bleaching and poaching as a delicacy. Specific to Perhentian Island, giant clam populations can still replenish, thus can be used as larvae source for other areas and restocking. Future actions should focus on genetic diversity assessment across Malaysia, genetic connectivity across different areas, and symbiont-host relationship in the context of climate change.

Marine plastics

There remains insufficient scientific data on marine plastics, especially microplastics. It is necessary to investigate the occurrence, fate and impacts of plastics. Cosmetics are a source of microplastics, and ingestion by marine organisms including by *Acropora* coral has been experimented on. Microplastics are appearing in food such as in water and salt.

Lab research has shown the possibility of microbes attaching to plastics in the marine environment. In particular, biofilms could enhance microorganism attachment to plastic. Plastics can also provide a new environment for microbes and possibly HABs, and also be a transporter of alien species. The effects of climate change on input, distribution, and impacts of plastic require further examination.

Strategies to address marine debris and microplastics could include citizen science programme, collaborative cruises, analyses, community empowerment, and interdisciplinary research. There is also a need for standardised investigation methods for microplastic, improved research quality control, impacts on invertebrates, and international cooperation.

Coral-algal symbiosis

With increased sea water temperatures, coral bleaching is more frequent, and the symbiotic relationship between coral and algae are affected. However, corals may be able to adapt their algal symbiotic partners to adapt to climate impacts. Symbiosis at different latitudes affect the functional diversity in symbiotic relationships, as do environmental factors. Phylogenetic relationships can be used assess environmental adaptation.

Benthic HABs

Ciguatera fish poisoning (CFP) occurrence has increased throughout the region. This is a transboundary issue as frozen contaminated fish exported to other countries can cause CFP to consumers. BHAB species occur across varied micro-habitats. Higher cell abundances were observed in reefs with high turf algal cover and coral rubbles. Microhabitat heterogeneity is a key factor governing the benthic harmful dinoflagellate assemblage. International collaboration on this front is in process.

MPA establishment and management

The example of Thailand's MPA establishment revealed that there are various categories of designation including non-hunting areas, fish refugias, marine parks, amongst others. A new tool is now in place for MPA establishment and management. This clarifies the definition of conservation of resources and habitats, criteria for designating MPAs outside conservation areas (existing protected areas), and controls the types of activities allowed in MPAs. It is important to ensure that the process is inclusive with stakeholder participation, conflict resolution, enforcement and compliance.

For the topics listed above, a synergised method for international collaborative studies is highly encouraged. It was also suggested that stronger links between physical and biological aspects of the marine environment should be made through cross-cutting studies.

Special Session - Investment and Financing in Marine and Fishery Industry

This special session shared information and ideas for developing the marine industry. Over 200 representatives from government bodies, experts, scholars, entrepreneurs from China and Southeast Asian countries attended the forum to discuss matters of cooperation. The session consisted of an Agreement/contract Signing Ceremony, special reports on investment and financing policies of China and Southeast Asian countries, and introduction and promotion of key projects. The signing ceremony was held for 18 projects with a planned cumulative investment of 9.55 billion Yuan, including Sandun offshore marine ranch in Qinzhou Bay, Sri Lankan *Adenophora* germplasm resources protection, and industrial development. Presentation and discussion topics included investment and financing policy, marine and fishery resources environmental protection, and the promotion of key investment cooperation projects in the marine and fishery industries. With the support of the Ministry of Natural Resources of China and the People's Government of Guangxi Zhuang Autonomous Region, this session achieved a resounding success with fruitful results, thanks to the concerted efforts of the Guangxi Oceanic Administration Bureau and the Beihai Municipal People's Government.

Recommendations and Proposals for Further work

The following recommendations were agreed by the Forum:

- Promote the integrated internal wave, mixing and water mass transformation study in Andaman Sea, including satellite, in situ, and modeling work.
- Promote the coordinated upwelling study in South China Sea.
- Encourage the deep ocean exploration in Indonesian Seas and Indian Ocean.

- Enhance the comprehensive ocean forecasting system and operational system study, including tide and biogeochemical modelling.

- Encourage more active engagement of young scientists in international programmes like CLIVAR and IOC/WESTPAC, and to increase capacity building.

- Foster the value chain from science to service, targeting supporting sustainable development.

- Consider that different methods to monitor marine megafauna should be integrated for more robust data interpretation and use.

- Promote conservation of giant clams focuses on genetic diversity assessment, genetic connectivity across different areas, and symbiont-host relationship in the context of climate change.

- Suggested that strategies to address marine debris and microplastics could include citizen science programme, collaborative cruises, analyses, community empowerment, and interdisciplinary research. There is also a need for standardised investigation methods for microplastic, improved research quality control, impacts on invertebrates, and international cooperation.

- Promote collaborative studies on endangered species studies, benthic HABs and marine plastics. Furthermore, promote a synergised method for international collaborative studies as well as stronger links between physical and biological aspects of the marine environment should be made through cross-cutting studies.

- Encourage that MPA establishment should ensure that the process is inclusive with stakeholder participation, conflict resolution, enforcement and compliance.

Closing Session

At the Closing Session, Mr. Hesheng JIANG, Deputy Director-General, Guangxi Natural Resources Department and Director of Guangxi Oceanic Administration Bureau, thanked all participants for their enthusiasm and frank discussions on marine research, ecosystem health, and regional cooperation in research and investment. He hoped to see increased successful cooperation on these fronts between China and SE Asia. Mr. Jiang wished all participants a safe journey to their home

Participants agreed to continue with the Forum next year. Mr. Qiao informed participants that there were offers to host the Forum next year. Once the host is decided, further details will be shared.

In closing, Mr. Qiao thanked the Beihai Municipality Government and all the volunteers for hosting and organising the event.

Annex 1

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Annex 2

Agenda

November 16 (Friday), 2018		
Time	**Program**	
08:00-09:00	Registration	
09:00-09:40	**Opening Ceremony** (Wuzhou Hall, Second Floor) **Chair:** Dr. Fangli QIAO	
	Welcoming remarks by representative of MNR	
	Opening speech by representative of SEA countries	
	Opening speech by representative of local government	
09:40-10:20	Group photo and coffee break	
10:20-12:20	**Session 1: Keynote Speeches** (Wuzhou Hall, Second Floor)	
	Keynote speech by Dr. Somkiat Khokiattiwongh, DMCR, Thailand	
	Keynote speech by Dr. TB Haeru Rahayu, CMMAR, Indonesia	
	Keynote speech by Mr. Meas Rithy, MOE, Cambodia	
	Keynote speech by Miss. Nurul Adni Nik Hassan, MESTEC, Malaysia	
	Keynote speech by Mr. Zaw Moe, DOF, Myanmar	
	Keynote speech by Mr. Wenxi ZHU, WESTPAC	
12:20-14:00	Lunch break	
13:30-17:30	**Parallel Sessions**	
Session 2: Ocean Observation, forecasting and Services (Yunsong Room, Second Floor) **Co-chairs:** Dr. Weidong YU, Dr. Somkiat Khokiattiwongh		
13:30-13:45	Observations and Modelling of the Physical Oceanography in the Lembeh Strait, North Sulawesi	PAN Aijun, TIO
13:45-14:00	Upwelling, thermal front, and the influence of ENSO variability in the southern South China Sea	Mohd Fadzil Akhir, UMT
14:00-14:15	Presence of ocean processes in the Ocean Forecast System for Southeast Asia Seas	Nuttida Chanthasiri, DMCR
14:15-14:30	On the Physical Properties of Water Mass in Andaman Sea	Chalermrat Sangmanee, PMBC
14:30-14:45	A study of the characteristics of internal waves in the Andaman Sea using satellite remote sensing data	MENG Junmin, FIO
14:45-15:00	Spatiotemporal variation of thermal inversion, upper thermal layer depth and barrier layer thickness in the Bay of Bengal	K M Azam Chowdhury, OUC & University of Dhaka
15:00-15:15	Deep sea research in Indonesia, with special notes on TRIUMPH Program	Augy Syahailatuak, LIPI
15:15-15:45	Coffee break	
15:45-16:00	Parameterizing oceanic SST feedback to typhoon forecast using deep-learning neural network algorithms	Jun Wei, Guangxi University

16:00-16:15	Tropical monsoon climatology modulates the delivery and dispersal of organic carbon over the Upper Gulf of Thailand	WU Bin, FIO
16:15-16:30	Integrated investigations on hypoxia with field surveys, satellite observations and numerical modelling	Feng Zhou, SIO
16:30-16:45	The role of CLIVAR in promoting ocean and climate research around the Southeast Asia	Jose Santos, CLIVAR
16:45-17:00	Combined ocean renewable energy system (CORES) for Malaysia-China research and cooperation on marine renewable energy utilization	Omar bin Yaakob, UTM
17:00-17:30	Discussion	
Session 3: Marine Biodiversity and Ecosystem Health (Jinlan Room & Jinxiu Room, Second Floor) **Co-chairs:** Dr. Chengjun SUN, Dr. Saifullah A Jaaman		
13:30-13:45	Regional Integrated Observation in The Tropical Asia: Targeting Marine Migratory Megafauna	Xuelei Zhang, FIO
13:45-14:00	Unmanned aerial vehicles (UAVs) as a low-cost method for marine megafauna studies	Lu Sun, FIO
14:00-14:15	Aerial images for dugong population and body size estimation	Kongkiat Kittiwattanawong, PMBC
14:15-14:30	Clicks recorded from Irrawaddy dolphins (Orcaella brevirostris) while foraging in the Bay of Brunei, Malaysia	Hairul Masrini Muhamad, XMU
14:30-14:45	More description of the whistles produced by irrawaddy dolphins	Ying Jiang, FIO
14:45-15:00	Occurrence, distribution and population estimation of Irrawaddy dolphins (Orcaella brevirostris) in the Bay of Brunei	Saifullah A. Jaaman, UMT
15:00-15:15	Diversity and conservation of two giant clam species (Cardiidae: Tridacna) in Malaysia	Po Teen Lim, UM
15:15-15:45	Coffee break	
15:45-16:00	Stop Plasticizing Indonesian Watershed!	Agung Dhamar Syakti, Raja Ali Haji Maritime University
16:00-16:15	Monitoring of marine microplastics	Jingxi Li, FIO
16:15-16:30	Plastics-HABs link: Potential roles of marine plastic debris in the dispersal of harmful and invasive species in the marine environment	Deo Florence L. Onda, Marine Science Institute of Philippines
16:30-16:45	Macroplastic and Microplastic pollution in the Marine Environment of Asia	Phaik-Eem Lim, UM
16:45-17:00	Coral-algal symbiosis exhibits high flexibility and adaptive potential to respond to climate change in the South China Sea	Biao Chen, Guangxi University
17:00-17:15	Benthic Harmful Algal Blooms in Malaysia: Research collaborations and scientific productivity	Chui Pin Leaw, UM
17:15-17:30	Challenge of the Department of Marine and Coastal Resources (DMCR), Thailand on the establishment of MPAs in Thailand	Wannakiat, PMBC
17:30-18:00	Discussion	

Special Session: Investment and Financing in Marine and Fishery Industry (Wuzhou Hall, the 2nd Floor) **Host:** Dr. Jiang Hesheng		
14:00-14:30	Agreement/contract-Signing Ceremony	
14:30-14:45	Remarks by a leading official of Beihai Municipal Government	
14:45-15:05	Opportunities and Prospects for Cooperation in Marine Industry between Guangxi and Southeast Asian Countries against the Backdrop of the Belt and Road Initiative	Wang Xiaohui, NMDIS
15:05-15:25	Introduction to the Investment Policy in the Marine and Fishery Industry of Cambodia	Chen Licheng, Cambodian Business Liaison Office in Nanning
15:25-15:45	Development Thinking on the Fishery Industry	Cui He, China Aquatic Products Processing and Marketing Alliance
15:45-16:00	Introduction to Guangxi Investment Promotion Policy	Lu Wanqing, Investment Promotion Bureau of Guangxi
16:00-16:20	Investment and Financing in Marine Industry	Tian Guangfeng, Tongji University
16:20-16:35	Tea Break	
16:35-16:55	Application of Beidou Satellite in the Era of Marine Economy	He Shanbao, China Academy of Space Technology
16:55-17: 05	Introduction to the Integrated Fishery Park Project in Timor-Leste	Ma Yixin, China Guangxi Yixin Fishery Development Co., Ltd.
17:05-17:15	The Innovation-Oriented Technology and Industrialization of Maine Biology	Gu Yongbiao, Beihai High-tech Innovation Park Incubator
17:15-17:25	Introduction to Pelagic Fishery Park Project in Mauritania	Zhang Yingcong, Guangxi Xiangheshun Pelagic Fishery Co., Ltd.
17:25-17:35	The "Unforgettable" Fish (high-end rare fish in fresh waters) Project Promotion	Tang Zhanyang, Guangxi Academy of Fishery Sciences
17:35-18:00	Free negotiation for intended cooperation projects	
18:30-20:30	**Reception hosted by MNR & Guangxi Government** (Siji Hall (Four Season Hall), Ground Floor)	
November 17 (Saturday), 2018		
Time	**Program**	
09:00-10:30	**Session Reports** (Wuzhou Hall, Second Floor)	

	Chair: Dr. QIAO Fangli
	Report by Session 2
	Report by Session 3
	Report by Special Session
10:30-11:00	Coffee break
11:00-12:00	**Closing session** (Wuzhou Hall, Second Floor)
12:00-14:00	Lunch break
14:00-18:00	**Visit local institutions**

Note: The side meeting of Ocean Forecasting System was organized by FIO on Nov 18, 2018

Annex 3

Presentation Abstracts

Session 2

1. Observations and Modelling of the Physical Oceanography in the Lembeh Strait, North Sulawesi

Ai-Jun Pan[1], Wei-Bo Wang[1], Jun-Peng Zhang[1], Muh Hasanudin[2], Edi Kusmanto[2], Deny Sutisna[2], Xi-Wu Zhou[1], Kai Li[1] and Ming-Zhang Zeng[1]
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The two field observations are conducted in the Lembeh Strait in September 2015 and 2016 respectively. Evidences indicated that sea water around the Lembeh Strait is consisted of North Pacific Tropical Water (NPTW), North Pacific Intermediate Water (NPIW), North Pacific Tropical Intermediate Water (NPTIW, only observed in the south) and Antarctic Intermediate Water (AAIW), and there exists some south-north differences in terms of water mass property: In southern Lembeh Strait, sea water with homogeneous thermohaline property is detected at 200-260m where it is between NPTW and NPIW, and is identified to stem from south Pacific Ocean. The distribution of Mixing Layer Pressure (MLP) illustrated the existence of an onshore surface current in northern Lembeh Strait, which delivers amounts of sea water to the coast, and there exists a southward current along Lembeh Strait. It is indicated the shoaling of thermocline and the deepening of NPIW are only observed at northern Lembeh Strait in 2015, and induced by positive wind stress curl covering northern Lembeh Strait. In addition, at 272m, the daily variation of temperature in northern Lembeh Strait contains 10-32 days and 32-64 days oscillate and happens in-phase and out-of-phase variation with corresponding salinity, which is result from the internal variation of water mass stemmed from north Pacific Ocean instead of wind stress curl. Furthermore, ROMS model is employed to investigate the seasonal evolution features of water transport in the Lembeh Strait. In general, the direction of water flow in the strait is oriented northward with a maximum volume of about $4x10^{-3}$ Sv in August. Interestingly, the volume transport will decrease to nearly zero from November to January. Water transport is mainly controlled by seasonally changed monsoon forcing. The source of water bypass the Lembeh Strait in different seasons is diagnosed and testified by tracer-release experiments. It suggests most water through the narrow channel are emanated from southern off the Strait, not only the surface water, but also the deep water brought by the upwelling and the internal tides.

2. Upwelling, thermal front, and the influence of ENSO variability in the southern South China Sea

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Abstract: This study was conducted based on data collected from numerous scientific cruise, numerical modelling and extensive satellite data that cover the region of southern south China Sea (SSCS). South China Sea upwelling system presents some unique features; 1) It is a seasonal coastal upwelling driven by south-westerly monsoon wind, 2) The upwelling water process affected by the circulation in the Gulf of Thailand and form a thermal front, 3) The whole upwelling system is influence by inter-annual variability that strongly dominated by El-Nino Southern Oscillation (ENSO). The cross-section plot at the upwelling area revealed the presence of upwelling water from offshore at the subsurface layer (10-15m) and also the presence of warmer water at surface layer (5m) from the Gulf of Thailand at the nearshore area. Normally, the upwelling water that moves northward will be deflected towards the Vietnam region and merged with the Vietnam coastal current instead of continuing into the Gulf of Thailand. The model-derived data and numbers of observations from the study area proved this thermal front zone is responsible in containing the dynamics connections between the colder upwelling water from the east coast Peninsular Malaysia and the warmer water from the Gulf of Thailand. On the other hand, study of ENSO effect on the region shows significant change of SST distribution during the El-Niño years which weaken the coastal upwelling event along the ECPM. The wavelet transformation analysis showed the highest temperature fluctuation was in 2009-2010 which indicated the strongest El-Niño throughout the time period. It is suggested that the El-Nino is favourable for the stratification in water column thus it is weakening the upwelling and thermal frontal zone formation in ECPM waters. The understanding thus far have shown interconnectivity of different dynamics in the region where ocean data and information are previously lacking.

3. Presence of ocean processes in the Ocean Forecast System for Southeast Asia Seas

Nuttida Chanthasiri[1], Somkiat Khokiattiwong[2], Chalermrat Sangmanee[3], Fangli Qiao[4]

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The first version of Ocean Forecast System (OFS) has been operating and providing ocean forecasts for Southeast Asia Seas since 2015 under cooperation and support from First Institute of Oceanography (FIO), China. In a meantime, several joint cruises were conducted in the Andaman Sea and the Gulf of Thailand including buoys observation for evaluation of the OFS system performance. Aims of this presentation would like to demonstrate the capability of OFS system by comparing the forecast with observation. Data from hydrographic survey and observations from buoys and Acoustic Doppler Current Profiler (ADCP) were compared with simulation. Results show that OFS is able to simulate wave height, temperature as well as mixed layer depth, and currents in the Andaman Sea and the results are well agreement to observations. Nevertheless, the system can be useful for the construction of initial condition to local domain model. The OFS system currently develop the higher resolution to improvement by coupling with tidal and wave in order to enhance and improve its capability in simulating of complexity processes.

4. On the Physical Properties of Water Mass in Andaman Sea

Chalermrat Sangmanee and Somkiat Khokiattiwong

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Abstract: Since the recovery of subsurface mooring in early 2017, half-year hydrographic observations were collected for the deep region in Andaman Sea (8.66°N, 96°E) under the projects Monsoon Onset Monitoring and its Social Ecosystem Impact (MOMSEI) and Ocean Forecasting and marine disasters mitigation System for Southeast Asia seas (OFS). Salinity and temperature data were collected at three depth levels (~300m, ~1400m, and ~1900m) by SBE 37, a high-accuracy conductivity and temperature. This brief paragraph is to preview some analysis on this dataset. Displayed in T-S diagram, the data reveals that, at this location, there are likely two distinct water masses separated at density around 1026-1027 kg/m^3. This is regardless of upper layer water (<100m depth). Wide scattering in temperature data around 300m is possibly due to mixing between upper and lower water layers. Compared between two seasons (August and December), there is no indication implying change in water property at the observing depths. This is a preliminary result based on the data obtained under the projects. Further analysis is still needed for insight understanding of the characteristics of water mass in this area.

5. A study of internal waves in the Andaman Sea by using remote sensing data

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Internal waves are common features in deep sea and coastal ocean. Andaman Sea is a marginal sea in the northeastern Indian Ocean.It has a stable stratification because of the monsoon rainfall, surface runoff and the special bottom topography, the internal waves occur frequently in the Andaman Sea. We employing a large number of remote sensing images to study the characteristics of internal waves in the Andaman Sea, including spatial-temporal distribution of internal waves, sources of internal waves, propagation velocity and amplitude estimation. Results of the spatial and temporal distribution, generation sources and propagation characteristics of internal waves are presented. The statistical analysis shows that internal waves can be observed almost in the entire area of the Andaman Sea. More internal waves are observed in the northern, central and southern regions of the Andaman Sea. A significant amount of internal waves between 7°N and 9°N in the East Indian Ocean are also observed. Internal waves can be observed through all the year in the Andaman Sea, while most of internal waves are observed between February and April. The double peak distribution for the occurrence frequency of internal waves is found. The generation sources of internal waves are explored based on the propagation characteristics of internal waves. The results indicate that six sources are located between Andaman Islands and Nicobar Islands, and one is located in the northern Andaman Sea. The amplitude of the internal wave general between 20m-80m, wavelength in 6km-15km, and propagation speed is greater than 2 m/s.

6. Spatiotemporal variation of thermal inversion, upper thermal layer depth and barrier layer thickness in the Bay of Bengal

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The upper layer is sensitive for concluding the hydrodynamics, circulation, biogeochemistry, hydrography and also the sound transmission of an ocean. The Oceanography of the Bay of Bengal (BoB) as a whole, and particularly the information on the construction and the variation of thermal inversion (TI), upper thermal layer depth (UTLD) and barrier layer thickness (BLT) are inadequate owing to the deficiency of sufficient in-situ oceanographic data. The availability of Argo temperature and salinity data has provided an opportunity to address those issues in this study for the duration of 2009-2013 in the BoB. A threshold of minimum 0.1°C is considered as TI in this study. A new category of thermal inversion is observed mainly during summer season when high wind mixing could enhance the mixed layer containing a less intense TI, just above the base of the mixed layer. So a new numerical approach was needed for calculating MLD and UTLD such a second category of TI (SCTI) in this research. The new formulae also could conquer the overestimation compare to the previous general definitions. First category of thermal inversion (FCTI) occurs maximum during winter season due to net surface cooling along the northern bay resulting thick BL but SCTI exists maximum during summer season due to high wind stress along southern bay resulting thin BL. Cool apparent temperature induced FCTI, negative wind stress curl and down welling water mass lead to enhance UTLD as well as BLT and vice-versa. Besides high, low saline water current and weak wind stress lead to enhance BLT and vice-versa. More detail analysis even model study will need to reveal clearly the actual contribution responsible for such variation in the upper layer and its implication in the BOB.

7. Deep-sea Research in Indonesia, with Special Notes on 'Triumph' Program

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Marine research in Indonesia had already taken before the independent in August 1945. During the 17th - 19th centuries, at least 33 marine expeditions had conducted in Indonesian waters, and they initiated from several countries, such as France, British, Dutch, Austria, Germany and US (Nontji, 2009). Some of these expeditions were well recognized in marine science world wide, such as as Rumphius (1627-1702), Bleeker (1819-1878), Challenger (1872-1876), Siboga (1899-1900), and Snellius I (1921-1930). Since then, we understood that marine science has developed in Indonesia.

After 1945, some more marine expeditions had done in Indonesian waters either by Indonesian or foreign scientist(s) (Nontji, 2009). Some of them also provided more data and information related to marine resources, such as Galathea (1950-1952), Baruna I (1964), Baruna II (1976), Rumphius I (1973), Rumphius II (1975), Alpha Helix I (1975), Rumphius III (1977), Alpha Helix II (1979), Rumphius IV (1980), Coridon (1981), and Snellius II (1984-1985). Moreover, in the 1990's, we observed the giant current as called as "Indonesia Through Flow" from the Pacific Ocean to the Indian Ocean. Most of the study were taken in eastern Indonesia waters. We also discovered the seamount "Baruna Komba" in south Banda Sea in 2003. All findings from the previous marine expeditions or observation or studies could enhance our knowledge on marine resources and environment.

In term of deep-sea research in Indonesia, so far we have collaborative work with Aquamarine Fukushima (Japan) for observing coelacanth or living fossil fish in several locations in Indonesia. Since 2005, and we found remarkably a few habitats of coelacanth in Indonesian waters, such as in North Sulawesi and Papua. Collaborative work has been also developed with National University of Singapore, and south Java deep-sea expedition was taken in March 2018 more focused on deep-sea biodiversity. Moreover, the collaborative research with the First Institute of Oceanography (China) and University of Maryland (US) called 'TRIUMPH' (The Transport of Indonesia Sea, Upwelling and Mixing Physics) was established in November 2017, and we did our first cruise in Indian Ocean (south of Java) in October 2018. The cruise succeed to release and deploy several buoy moorings.

The main objective of doing marine research in Indonesian waters is to provide data and information on marine resources and ecosystems, and then they could be utilised to manage the marine resources with determining several strategies in term of sustainable use of its resources.

8. Parameterizing oceanic SST feedback to typhoon forecast using deep-learning neural network algorithms

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Two algorithms based on machine-learning neural networks are proposed—the shallow learning (S-L) and deep learning (D-L) algorithms—that can potentially be used in atmosphere-only typhoon forecast models to provide flow-dependent typhoon-induced sea surface temperature cooling (SSTC) for improving typhoon predictions. The major challenge of existing SSTC algorithms in forecast models is how to accurately predict SSTC induced by an upcoming typhoon, which requires information not only from historical data, but more importantly also from the target typhoon itself. The S-L algorithm composes of a single layer of neurons with mixed atmospheric and oceanic factors. Such a structure is found to be unable to represent correctly the physical typhoon-ocean interaction. It tends to produce an unstable SSTC distribution, for which any perturbations may lead to changes in both SSTC pattern and strength. The D-L algorithm extends the neural network to a 4 × 5 neuron matrix with atmospheric and oceanic factors being separated in different layers of neurons, so that the machine learning can determine the roles of atmospheric and oceanic factors in shaping the SSTC. Therefore, it produces a stable crescent-shaped SSTC distribution, with its large-scale pattern determined mainly by atmospheric factors (e.g. winds) and small-scale features by oceanic factors (e.g. eddies). Sensitivity experiments reveal that the D-L algorithms improve maximum wind intensity errors by 60% ~ 70% for 4 case study simulations, compared to the atmosphere-only model runs.

9. Tropical monsoon climatology modulates the delivery and dispersal of organic carbon over the Upper Gulf of Thailand

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The seasonal reversal of monsoon climatology modulates precipitation, fluvial discharge, coastal currents and a variety of biogeochemical processes. In the present study, we evaluate the role of tropical monsoon influences pertaining to fluvial discharge, sediment load, coastal current and water stratification on organic carbon dynamics in the upper Gulf of Thailand (UGOT), SE Asia during four sampling campaigns. This study demonstrates the export of organic carbon associated with sediment load increases with the intensification of physical erosion in the river basins when there are heavy rains brought by monsoonal winds. Terrigenous organic matter prevails in the river sections while marine-derived organic matter dominates in the non-river sections as indicated by C/N ratio. The temporal variations of organic carbon in the study region display significant seasonality, with relatively higher organic carbon in the southwest monsoonal winds and non-seasonal heavy precipitation periods. Further, small rivers, such as Bang Pakong River, export disproportionally high organic carbon into the UGoT. We also find the year round water stratification across the region functions as the barrier in retaining organic carbon in the upper gulf from entering into the lower Gulf of Thailand. High sedimentation rate further favors the organic carbon burial in the study area. Therefore, the tropical monsoon climatology is an important driver to govern the organic carbon in the UGoT, which is highly underscored because regional climate is closely associated with the global warming.

10. Integrated investigations on hypoxia with field surveys, satellite observations and numerical modeling

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One of the largest hypoxic zones in the world coastal water has been observed off the Changjiang Estuary in the recent decade. Compared to the widely-known knowledge on how the hypoxia generated, its multi-scale variability is not well understood yet. A comprehensive data sets consisting of buoy, large-scale field surveys and satellite observations were used to analyze the spatial-temporal variability of hypoxia. A coupled physical-biogeochemical model was applied to diagnose the hypoxia event in 2006, when seasonal hypoxia was captured by four cruise surveys. The model performance was comprehensively assessed by comparing a suite of quantitative metrics, procedures and spatiotemporal patterns between the simulated results and observed data. Event-scale reduction of hypoxia occurred during the weakening of stratification in mid-July and mid-September, which was associated with strong stirring due to tropical storms or strong northerly winds. Change in wind direction shifted the location of hypoxia by altering the spread of Changjiang Diluted Water. Increase in river discharge led to an expansion of hypoxic water under the summer monsoon. Sensitivity experiments suggested that the hypoxia extent was affected by the change in nutrient concentration of the Changjiang as well as that in the Kuroshio. Sensitivity experiments also suggested the importance of sediment oxygen consumption to the size of the hypoxic zone. A warning system based on buoy monitoring and numerical simulations was established to alarm the hypoxia event.

11. The role of CLIVAR in promoting Ocean and Climate Research around Southeast Asia

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The World Climate Research Programme (WCRP) coordinates international climate research to develop, share and apply the climate knowledge that contributes to societal well-being. WCRP addresses aspects of climate science that are too large and too complex to be tackled by a single nation or scientific discipline. Through international science coordination and successful partnerships, WCRP aims to lead the way in determining the interactions between human activities and the Earth system. WCRP research provides the climate science underpinning the United Nations Framework Convention on Climate Change, the Agenda for Sustainable Development (including SDG 14) and the Sendai Framework for Disaster Risk Reduction. WCRP also engages with other in ocean related activities such as the UN Ocean Decade and the Arctic Council's Protection of the Arctic Marine Environment Working Group.

WCRP is currently organized as a network of core and co-sponsored projects, working groups, modelling activities and cross-cutting initiatives (see wcrp-climate.org). All WCRP International Project Offices, including CLIVAR (Climate and Ocean: Variability, Predictability and Change), will play a paramount role in refining and implementing WCRP's upcoming strategy, including their own strategic contributions to the programme.
In 2017, CLIVAR produced its second-generation Science Plan, built on the important legacy of CLIVAR since its inception in 1992. The plan redirects the CLIVAR goals and priorities for the coming decade after consultation with scientists and stakeholders throughout the climate community. CLIVAR's mission is to understand the dynamics, the interaction, and the predictability of the climate system with emphasis on ocean-atmosphere interactions.

The CLIVAR organizational structure is comprised of four global panels (Ocean Model Development Panel, the Global Synthesis and Observations Panel, the Climate Dynamics Panel, and the joint CLIVAR-GEWEX Monsoons Panel), and five regional ocean basin Panels (Atlantic, Pacific, Indian Northern, and Southern Ocean). All Panels report to the CLIVAR Scientific Steering Group.

12. Combined ocean renewable energy system (CORES) for Malaysia-China research and cooperation on marine renewable energy utilization

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The island communities in Malaysia heavily depend on diesel or combined solar-diesel power plants. High cost of diesel, difficulties of transporting diesel during the monsoon seasons, low and variable solar flux, and the high maintenance cost of solar cells and batteries are perennial issues associated with these conventional energy systems on the islands. Hence, the next solution is to rely on renewable energy from natural green sources as a sustainable alternative to the hydrocarbon power. However, Malaysian coastlines have low wave heights and low current speeds, giving rise to more challenges in optimizing devices for extracting wave and tidal energy sources. This presentation introduces the development of a combined offshore energy harvesting system in Malaysia seas condition, which will be further utilized for the project of MalaysiaChina research and cooperation on marine renewable energy utilization. The main objectives are to develop, construct, and test a prototype demonstrator and test platform of the Combined Ocean Renewable Energy System (CORES) for the Malaysian sea. In order to harvest large power from the ocean, CORES combines wave and current devices on the same shared floating platform. Wave and tidal energy data from the chosen site location, Pulau Tinggi, in the state of Johor, Malaysia was assessed to estimate the output power to be produced. Meanwhile, a comprehensive study was conducted to optimize the CORES concept to verify its reliability, safety, and cost-effectiveness. Numerical simulations on the behaviors of the platform and oscillating water column, point absorber, savonius current turbine and solar devices were carried out at Marine Technology Centre at Universiti Teknologi Malaysia. Finally, a full scale prototype was built and deployed near an island in the South China Sea. The findings in this research are expected to bring significant reference towards further collaboration in between Malaysia and China in the research and cooperation on marine renewable energy utilization.

Session 3

1. Regional Integrated Observation in The Tropical Asia: Targeting Marine Migratory Megafauna

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The marine and coastal areas in the tropical Asia are under dual impacts from the Indian and Pacific Oceans, hosting richest biodiversity in the world that support the social-economics in the region, such as fisheries and eco-tours. Among these, marine migratory megafauna are critical to the marine ecosystem, either as top predators or grazers of seagrasses structuring the habitat. Therefore, conservation of marine migratory megafauna is protection of the whole marine ecosystem. Like other marine megafauna, tropical species such as dolphins, dugongs and sea turtles also migrate between their habitats. Traditionally, the tropical region relies on labor intensive methods to observe the marine migratory megafauna. These methods cannot meet increasing demand for higher efficiency, objectivity and repeatability, which can be empowered with modern science and technologies such as telemetries using bioacoustic sensors, satellites, unmanned aero vehicles (UAV) and boats (USV), molecular bioassays and advanced lab analysis. The marine migratory megafauna are components of the marine ecosystem. Thus, for sound science and toward effective conservation measures, we also need to conduct concert research into the system's productivity, oceanography and coastal anthropogenic activities therein. Efforts are being joined to establish the first regional integrated observation system of marine migratory megafauna in the tropical Asia. In the first phase, the system will focus on coastal cetaceans, dugongs and green turtles, to apply and integrate traditional methods and modern science and technologies such as marine bioacoustics, UAV, USV, molecular biology and advanced analysis. It is expected that such a system will not only empower our ability to observe and collect data for effective conservation of marine migratory megafauna in real time, but greatly increase public awareness by improving visitors' in situ experiences of the charming animals.

2. Unmanned aerial vehicles (UAVs) as a low-cost method for marine megafauna studies

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Observation of marine megafauna species, which are in many cases cryptic and/or widely dispersed, has long been a challenge for researchers and conservation practitioners, due to the high cost and low efficiency of conventional methods. Rapid development of unmanned aerial vehicles (UAVs) in recent years provided low-cost applications in various fields. We tested and used a consumer drone in surveys for dugongs *Dugong dugong*, green sea turtles *Chelonia mydas*, and Irrawaddy dolphins *Orcaella brevirostris* in different environmental settings to identify and explore the potential of this method. Using UAVs with cameras was determined to be a feasible and flexible approach, and a valuable addition to conventional observations in both land and boat based marine megafauna surveys based on our experience duing the fieldwork. Aerial videos and photos from the camera onboard UAV were then examined and behavioral data were extracted by multiple image analysis approaches. These data were appropriate to be used to help generate information of abundance, population composition, and individual/group behaviors of targeted animals. Hence we propose that aerial surveys using UAVs can be a valuable standard method in observation work, and because of its relatively lower cost and flexibility in operation, should facilitate research, conservation and management projects with limited funding of marine megafauna species in Southeast Asian waters.

3. Aerial images for dugong population and body size estimation

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Estimation of dugong population size has been a challenge task. The shy behavior made dugongs difficult to spot with a traditional boat-based survey. The most effective method to estimate the number of dugongs is an aerial survey with a small fixed wings aircraft. However, the use of such a method is somehow risky and highly cost. The recent development of commercial drones and autopilot applications allow researchers to obtain the aerial images with ease. In this study we employed fixed wings and multi-rotors drones. The images were stitched and geo-referenced into aerial maps. The map data is then further analyzed with GIS software to count the number of dugongs and measuring of the body size. The results demonstrated that the dugongs can be visualized and the body size can be measured. In the study, we succeeded to obtain 10 sq.km. Map coverages with the dugong population count of 156 individuals. The normal distribution of size frequency of this dugong population can be interpreted as a healthy population.

4. Clicks recorded from Irrawaddy dolphins (*Orcaella brevirostris*) while foraging in the Bay of Brunei, Malaysia

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Irrawaddy dolphins produce a wide variety of acoustic signal for social and echolocation purposes. Acoustic studies of this species earlier focused on whistles, but very little about clicks. A towed two-channel hydrophone system with a sampling rate of 524kHz was used to record acoustic signal at Bay of Brunei in January 2016. Acoustic parameters such as sound pressure level (SPL), peak frequency, duration, inter-click-interval (ICI) were quantified. Mean SPL was 160.95 dB peak-to-peak re: 1 μPa (SD=10.86). A total of 606 click trains (CT) were further analysed. The CT duration and number of clicks per train was up to 5s (Mean = 1.66 s, SD =1.001) and 254 clicks (Mean = 15.87 clicks, SD=24.96) respectively. Mean peak frequency and center frequency were 63.88 kHz (SD=37.42) and 67.06 kHz (SD=31.24). The ICI was classed into seven categories. Mean ICI was 0.041 s (SD=0.035) and 28.2% were in moderate category. Quantifying the characteristics of Irrawaddy dolphin acoustic signals is an important step in understanding their acoustic repertoire. The knowledge can be essential for future acoustic research of this species.

5. More description of the whistles produced by Irrawaddy dolphins (*Orcaella brevirostris*)

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Exploration of dolphin whistles help understanding their social behaviors. We collected 1038 whistles of Irrawaddy dolphins in the Bay of Brunei, with a high sampling rate and broadband recorder. A more complete quantitative analysis of the whistles including harmonics was first presented for Irrawaddy dolphins. The whistles had a mean whole duration of 0.37 s (S.D. = 0.24 s). The fundamental frequency ranged from 370 Hz to 52340 Hz, while the maximum frequency of whistles extended to about 65 kHz. Results indicated the whistles above 20 kHz had special function in group activities. The whistles showed a relatively simple contour shapes. The percentage of whistles with no inflections accounted for 80.6%, and with constant type accounted for 82.1%. The number of harmonics was high up to 8 (Mean = 0.89, S.D. = 1.35), and 45% of whistles had harmonics. The top two highest percentages of the whistles were constant contours without harmonic and with one harmonic (47.9% vs 19.3%), while the types with much richer harmonics were constant, upsweep and downsweep contours. Whistle frequency contours were extracted and analyzed using probability density. The most probable position of fundamental frequency was around 6000 Hz. The values of the maximum probability density of the fundamental frequency and the following three harmonics frequency were similar to an arithmetic progression. The more complete description of the Irrawaddy dolphin's whistles will provide a baseline for the selection of future acoustic recording equipment. More characteristics of Irrawaddy dolphin whistles have the potential to provide information on presence/absence in sympatric species and their habitat.

6. Occurrence, distribution and population estimation of Irrawaddy dolphins (*Orcaella brevirostris*) in the Bay of Brunei

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Irrawaddy dolphin (*Orcaella brevirostris*) is the most frequently occurred cetacean in large estuaries and bays of Borneo. Its habitats often overlap with areas of intensive use by human activities. The species is common in the Bay of Brunei, which is shared between the East Malaysian States of Sabah, Sarawak, and the Federal Territory of Labuan and Brunei Darussalam. Series of dedicated boat sighting surveys were conducted between April 2013 and October 2018. A total of 160 days were spent to conduct these surveys and covered a total distance of 10,045.20 km in 750.79 hours, with a total daily survey effort of 50,059.57 km.hrs. A total of 145 sightings of Irrawaddy dolphins were recorded with a rate of 0.29 sighting per 100 km.hrs. The highest sighting rate was recorded in Brunei region with 0.40 sighting per 100 km.hrs., followed by Lawas (0.38), Labuan (0.16) and Weston (0.11) regions. The sighting rates were highly significantly greater in Brunei and Lawas regions than Labuan and Weston regions (χ^2 = 0.0005, df = 3, p < 0.01). Sighting rate of Irrawaddy dolphins during pre-Southwest monsoon was 0.37 sighting per 100 km.hrs., followed by the Southwest (0.32), pre-Northeast (0.25) and Northeast (0.23) monsoons, which suggested that sighting was not significantly difference between seasons (χ^2 = 0.85, df = 3, p > 0.05). Group size of Irrawaddy dolphins ranged between 1 to 35 individuals (mean = 6.35 ± 6.03SD). There were 52 (36%) occurrences of calves in groups of Irrawaddy dolphin sighted, ranged between 1 to 4 individuals per group (mean = 0.60 ± 0.77SD). In the Malaysian side, 41 individuals of Irrawaddy dolphins were identified using photo ID match software DARWIN. The super-population size was 47 (95 % CI = 42 - 62) estimated using the mark-recapture open-population POPAN parameterization in Program MARK; the mean school size was 6 (SE = 0.66, range 1-18). All these evidences suggest that the Bay of Brunei is a residing and an important habitat for a significant population of Irrawaddy dolphins. Ecological and behavioural studies on the population in the Bay will be continued by using bioacoustics, UAV, USV, and biopsy sampling techniques. A long-term

conservation management plan is required to protect not only Irrawaddy dolphins but other marine endangered species that inhabit the Bay of Brunei.

7. Diversity and conservation of two giant clam species (Cardiidae: *Tridacna*) in Malaysia

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Giant clam is one of the key reef species contributing to overall reef biodiversity and functionality. Their ecological niche are significant, where they act as caches of calcium carbonate for coral reefs, contribute productivity to overall marine food webs and serve as an excellent holobiont host. Unfortunately, human-mediated threats have accelerated the loss of giant clams across the Indo-Pacific and they are in pressing need of conservation action. This study aimed to evaluate the diversity and distribution of giant clams in the Perhentian Islands Marine Park, and to fill the information gaps of population genetic connectivity between selected *Tridacna* species of Perhentian Islands and other populations in the South China Sea. In our field surveys, two species of *Tridacna* were observed in Perhentian Islands: *T. maxima* and *T. squamosa*. The abundance of *T. maxima* (401 individuals) was higher than *T. squamosa* (195 individuals) across the 13 sites; the highest clam density observed was 17.4 individuals per 100 m^2. For juvenile clams (<5 cm in shell length), *T. maxima* juveniles were more abundant with 67 individuals recorded, but recruits of *T. squamosa* were rare. This observation may clue in the recruitment constraints in *T. squamosa* populations. Evidence of recent recruitment of giant clams in the survey sites was reassuring, as it stands for healthy and replenishing *Tridacna* populations in Perhentian Islands Marine Park. Survey will be carried out to determine the distribution and abundance of giant clams species in other Malaysian coral reefs. Comparison of population status of giant clams in Southeast Asian countries will provide insight into the status of these threatened species in the region.

8. Stop Plasticizing Indonesian Watershed!

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A recent study indicated that Indonesia is one major contributors of plastic wastes to the ocean based on a model linking data on solid waste production, population density and economic status. Marine plastic debris (macro-, meso-, micro- and nano- plastcs) have been causing negative impacts on marine organisms, ecosystems, human health, and even socio-economic development. Indonesia has a national action plan for combating Marine Plastic Debris (2017-2025) under the coordination of the Ministry of Maritime Affairs. While the government focuses on marine debris management, Universities and Research Institute agencies in Indonesia focused on five main research aspects, including beach macro-litter monitoring, microplastics monitoring; co-pollutions occurrence (such as Polycyclic aromatic hydrocarbons-PAHs, polychlorinated biphenyls-PCBs and heavy metals); ingested plastic by fish; and community empowerment program on re-use of plastic litter. Development of the national and international collaboration and networking is necessary to develop collaborative research projects or initiatives for broader networks. Thus, through continuum lectureships integrating the under graduate and graduated students courses and training as well as the involvement of the society in a citizen science program our ultimate goal to increase the public awareness might be achieved that lead to stop plasticizing Indonesian watershed. It is not only a scientific jargon but a real actions to protect our sea and ocean.

Keywords: marine debris, microplastcs, co-pollutions, citizen science, anthropogenic, Indonesia

9. Monitoring of marine microplastics

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Marine microplastics have become one of the research hotspots of international concern. In our research, we had established the pretreatment and detection methods of microplastics in water, organisms and sediments. We also analyzed the distribution characteristics of microplastics in typical sea areas and organisms, an so on. The results showed that the content of microplastics in seawater was quite different by using different sampling methods to collect microplastics. The preliminary research results of microplastics in the Western Pacific showed that there were many kinds of microplastics, such as PET, PE, PS and PP, in the surface seawater of the Western Pacific. Among them, PET was the main type(more than 60%), and the shape of microplastics was mainly fibrous. The size of microplastics concentrated in the range of 0.5-2 mm in seawater. The results of vertical distribution indicated that microplastics existed in different depths of seawater and showed a regular trend of change. The microplastics in both the soft tissue and the digestive tract of bivalves and fish from the markets were also tested. Results showed that the individual detection rate of microplastics was higher in the fish than that in the bivalves, and that the abundance of microplastics measured in items/individual was significantly higher in the fish than that in the bivalves. Fibrous microplastics were the most dominant ones in different organisms. The number of microplastics decreased with microplastic sizes increasing. Microplastics of less than 1 mm coming from different organisms were in the range of 43% to 78%. At present, we have obtained samples of microplastics on a global scale, such as Atlantic, Pacific, Indian, Antarctic and Arctic. All samples are being tested and analyzed. We also have some international cooperation, We look forward to our joint research results could promote the research process of marine microplastics.

10. Plastics-HABs link: Potential roles of marine plastic debris in the dispersal of harmful and invasive species in the marine environment

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Global plastic production has steadily increased in the past decades and is expected to continue with the growing population and consumption worldwide. However, due to their unsustainable use and improper disposal, most plastics end up in the marine environment. Despite the apparent abundance and threat of plastics, their accumulation, biodegradability and ecological implications are little studied. Floating marine plastics in particular provide novel substrates for the attachment of varying microorganisms including biofilm forming, biodegrading, photosynthetic, and heterotrophic species. Some invasive and pathogenic species such as harmful algal bloom (HABs)-forming phytoplankton may also attach in these floating environments. To date, our understanding of the underlying mechanisms driving the attachment and survival of HABs species in plastics remain limited. In this study, we explored the release of DOC and formation of biofilm in some common single use plastics (i.e., polyethylene and polyethylene terephthalate). We then explored how biofilm could facilitate the attachment of some toxic dinoflagellates. Results showed that the attached phytoplankton remained viable, indicating their potential to also survive in floating plastic debris, serving as a dispersal mechanism in nature. The high abundance of plastics in some environment may also enrich for species capable of biodegrading the material, which we investigated by looking for the presence of possible PET-degrading genes. This study provides new insights and challenges in understanding HABs distribution, dispersal and dynamics in the changing ocean landscapes.

11. Macroplastic and Microplastic pollution in the Marine Environment of Asia

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Plastics pollution is a global environmental issue and it has reached an alarming state where the plastic debris has reached all the oceans of the world. This has brought threats to the marine environments which has diverse impacts on the marine biodata, biodiversity as well as ecosystem. The plastics over the time scales will be degraded into microplastics and nanoplastic which will facilitate the uptake by the marine biodata through food-chain. Some biodata may grow on the surface of plastic and being transported to non-native environment which might potentially introduce invasive species. These polymers may contain toxics substances which might pose potential risk to marine biodata as well as health implications. Eight out of the top 10 countries that have most ocean plastics pollution are reported to be from Asian countries. Despite of that, there is not much study with regards on plastic pollutions in our regions with regards on sources, biomass, fate and occurrence or effects on organisms. It is timely for us to have concerted effort in standardizing methods for assessment of the status, effect and comes out with appropriate measurement for mitigation and management of plastic pollution in the ocean. We would like to propose a joint collaboration project among China and Southeast Asian countries on plastic pollution with focus on microplastic.

12. Coral-algal symbiosis exhibits high flexibility and adaptive potential to respond to climate change in the South China Sea

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Coral reefs are continuing to decline worldwide because of the anthropogenic climate change. Whether coral-algal symbiosis has sufficient flexibility and adaptive potential to respond to this situation is critical for the development of future coral ecosystem. Accordingly, the study of the diversity, community composition, and phylogenetic relationship of *Symbiodinium*, as well their environmental impact factors, are essential to evaluate the adaptive potential of coral-algal symbiosis to respond to dramatic marine environmental changes. Therefore, NGS was used to analyze the *Symbiodinium* rRNA internal transcribed spacer 2 (ITS2) marker genes from 88 reef-building coral samples (five genera) in eight coral habitats across ~13° of latitude in the South China Sea (SCS). The results showed that there is a high degree of *Symbiodinium* diversity in the SCS. A total of eight clades (A, B, C, D, F, G, H, and I) and 216 subclades were identified, among which clade C and D were the dominant symbionts. A PERMANOVA analysis suggested that there are significant differences in the *Symbiodinium* community composition in the SCS. The major clades were subclade C1 in high latitude areas, subclades Cspc, C50, and D1 in intermediate latitude areas, and subclade C3u in low latitude areas. Canonical correspondence analysis (CCA) showed that the relative abundance of different symbiont forms is affected by environmental factors. Phylogenetic analysis indicated that the members of clade C which show similar environmental adaptability have closer phylogenetic relationship. Based on these results, we suggest that the high *Symbiodinium* diversity and a variety of combinations of symbionts at different latitude areas will result in functional diversity in symbiosis. Environmental factors, especially temperature, can shape the distinct community composition of symbiont at different latitude areas. Moreover, widespread rare symbionts and low symbiotic specificity enhance the flexibility of coral-algal symbiosis. Phylogenetic relationships can be used to assess the environmental adaptability of symbionts, but these are not stable because they are affected by different evolutionary histories of flora, shared common ancestors and potential recent invasion of symbionts. Consequently, these findings indicate that coral-algal symbiosis in the SCS has a high flexibility and adaptive potential to respond to climate change.

Keywords: *Symbiodinium*$_1$, flexibility$_2$, adaptive potential$_3$, ITS2-rRNA$_4$, next-generation sequencing$_5$, South China Sea$_6$.

13. Benthic Harmful Algal Blooms in Malaysia: Research collaborations and scientific productivity

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Benthic harmful Algal blooms (BHABs) have been one of the focus of HAB research owing to the increased incidence of ciguatera fish poisoning (CFP) in the region. This presentation summarizes the research and collaborations among China-ASEAN, focuses on the experience in Malaysia, our scientific endeavors and the advancement of knowledge are discussed. To determine the occurrence of BHAB species, joint field surveys have been conducted in Malaysia. This collaboration has effectively allows the exploitation of data and led to discovery of several new species and new records. To learn how microhabitats of coral reefs affect the distribution and abundance of BHAB dinoflagellates, field surveys have been undertaken on fringing reefs of Perhentian Islands (Terengganu), an island with no CFP record. Sampling was carried out by an artificial substrate sampling method utilizing fiberglass screens. Five major taxonomic groups of BHAB dinoflagellates were identified (*Ostreopsis*, *Gambierdiscus*, *Prorocentrum*, *Amphidinium*, and *Coolia*), and cells were enumerated. Microhabitats of the studied reef area were characterized simultaneously based on the bottom substrate types. The results showed that *Gambierdiscus* was less abundant than the other genera throughout the study period. The abundance of *Gambierdiscus* reported in this study was at least a magnitude lower than areas with known CFP cases. This implied low CFP risk in the study area. Higher cell abundances were observed in reefs with high turf algal cover and coral rubbles. Microhabitat heterogeneity was identified as a key factor governing the benthic harmful dinoflagellate assemblage. The results will serve as a fundamental basis of consideration in BHAB monitoring strategies in potential CFP prone areas, particularly in ASEAN region.

14. Challenge of the Department of Marine and Coastal Resources (DMCR), Thailand on the establishment of MPAs in Thailand

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Marine Protected Areas (MPAs) in Thailand has composed of various types of MPA as in IUCN categories, namely, Marine National Park, Non-hunting Area, Marine Fisheries Reserved Areas, Environmental Protected Area, etc. Total areas of MPAs in Thailand is 18,136 km2 which is 5.60 percent of total Thai territorial water (323,488 km2). Department of Marine and Coastal Resources (DMCR), Thailand is new agency under Ministry of Natural Resources and Environment (MNRE) which has mandated on the establishment of MPA in Thailand under the new law: *Marine and Coastal Resources Management Promotion Act, B.E. 2558 (2015)*.
The key issue of MPA establishment under DMCR's law is the participation of the stakeholders which need the consultation of the stockholders in all steps from the initial step (site selection) to the designation of the management measures. The establishment of MPA is one of the steps, heading to Blue economy which need at least 3 important issues, namely,1) participation of the stakeholders 2) guidance from the government sector and 3) mobilization of private sector.

Keyword: Marine Protected Areas (MPAS)