

## Progress Report of Working Group for developing the Integrated Investigation in Indo-Pacific Convergent Center -Marine Ecosystem and Biodiversity (I<sup>3</sup>PCC-MEB)

### 1. Introduction and justification

The Indo-Pacific Convergent Center (IPCC, Figure 1) in this proposal refers to the region of 90°E -150°E, 30°N - 30°S. It covers the tropical Pacific Ocean west of the Mariana Trench, and the tropical Indian Ocean east of the Ninety East Ridge, with the Indonesian seas in between, connecting the tropical Pacific and Indian Oceans.

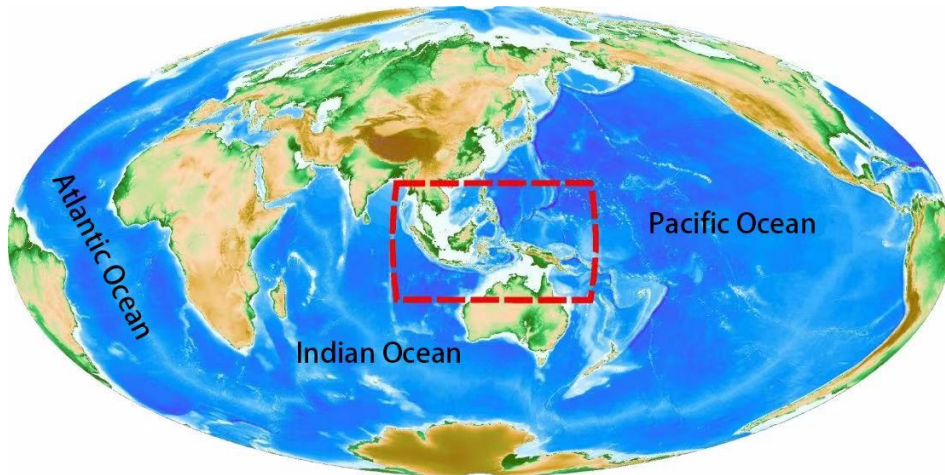


Figure 1: Illustration of the Indo-Pacific Convergent Center (IPCC)

The IPCC is located in the center of the Indo-Pacific warm pool (Figure 2). With the warmest temperature over the global oceans, it provides the primary heat that drives the tropical ocean-atmosphere coupled system. So far, the understanding of the processes and dynamics of the mass and energy exchanges between the western Pacific and the Indian Oceans through the Indonesian seas has been primitive. Little is known about the vertical exchange and water mass mixings inside the Indonesian seas and the surrounding oceans. The study of the atmospheric bridge and the oceanic channel processes in IPCC is still in its embryonic stage.

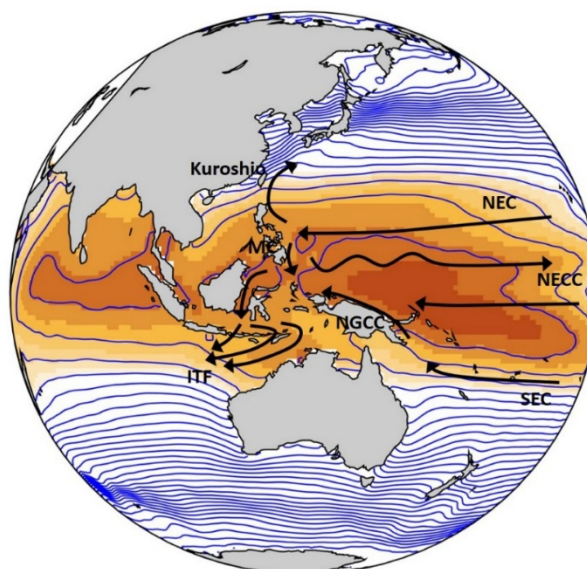


Figure 2. Illustration of the warm pool in IPCC area

There are many plate subduction zones in IPCC, which is the region of the most active and intensive recycling and energy exchange (Figure 3). The Mariana, the Neotethys, and the

## Restricted distribution

Philippine Sea subduction systems in IPCC have been a hot subject of study internationally, with special foci on the initiation of plate subduction, recycling, and earthquakes. The interactions of different plates also lead to the formation of complex submarine hydrothermal systems, which allow for the studies of vulnerable deep-sea ecosystems.

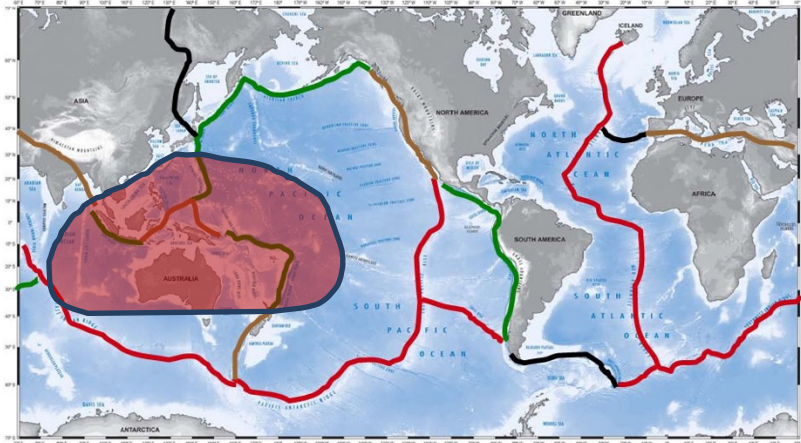


Figure 3. Illustration of the plate subduction zones in IPCC area

The “Coral Triangle” in IPCC is recognized as the global center of marine biodiversity and has bred the highest marine biodiversity in the world oceans by hosting 76% (605) of the world's coral species, 37% (2,228) of the world's coral reef fish species, nearly 75% of the world's mangrove species, over 45% of sea grass species, and at least 22 species of marine mammals. An astounding level of biodiversity is concentrated in less than 1% of the world ocean's surface area. At the crossroad of the Pacific and Indian Oceans, IPCC is deeply influenced by many oceanic and atmospheric systems, such as the warm pool, the tropical ocean circulation, the western boundary currents, and the Asian-Australian monsoon. The formation and evolution of marine biodiversity are strongly associated with tectonic processes, paleo-ocean environment, climate changes, and life processes. Many scientific issues associated with the biodiversity center, however, have not yet been explored, including species and geographic distribution patterns, origin and evolution of marine organisms, diffusion regularity and driving factors, and molecular basis of adaptive novelties. This will support an evaluation of the ecological role of some important habitats as “stepping stones” which has important implications for the distribution of animals as well as their resilience and possible recovery if damaged by human activities (such as commercial fishing or seabed mining).

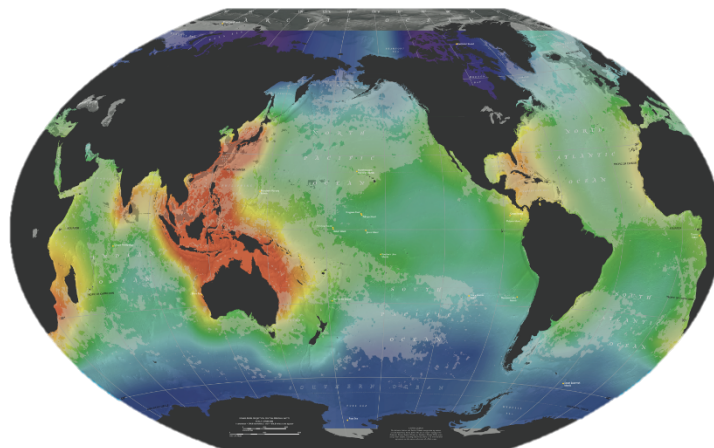


Figure 4. Illustration of the marine biodiversity center in IPCC area.

The significant interactions between different spheres, including the lithosphere, hydrosphere, biosphere, and atmosphere, led to significant impacts on sustainable development of countries in the IPCC region. The sustainable development of the countries depends heavily on a clean, healthy, safe, and productive ocean. IPCC has been identified as a hotspot in ocean studies for a long time and included in many international research projects, such as Future Earth, Integrated Marine Biosphere Research project (IMBeR), Marine Geological and Biological Habitat Mapping (GeoHAB), and Northwestern Pacific Ocean Circulation and Climate Experiment (NPOCE). Studies in the IPCC region, however, are still scarce due to the lack of observations. The current global or regional models are incapable of simulating the oceanic multi-scale variability, the marine biological evolutionary patterns, and their responses to climate changes. International cooperation among countries surrounding IPCC is urgently needed to fulfill the multidimensional need. To develop an international programme focusing on I<sup>3</sup>PCC-MEB, therefore, is a necessary task in face of the UN Decade of Ocean Science for Sustainable Development.

The I<sup>3</sup>PCC-MEB WG we proposed will contribute to the Ocean Decade Challenge 2: Understand the effects of multiple stressors on ocean ecosystems, and develop solutions to monitor, protect, manage and restore ecosystems and their biodiversity under changing environmental, social and climate conditions.

The I<sup>3</sup>PCC-MEB WG aims to identify the priority issues about the marine ecosystem and biodiversity research in the IPCC area and integrate the shared interests of countries in this region for further collaboration. The outcomes of this WG will contribute to most of the expected Ocean Decade outcomes, including Outcome 2 “A healthy and resilient ocean where marine ecosystems are understood, protected, restored and managed”; Outcome 4 “A predicted ocean where society understands and can respond to changing ocean conditions”; Outcome 5 “A safe ocean where life and livelihoods are protected from ocean-related hazards”; Outcome 6 “An accessible ocean with open and equitable access to data, information and technology and innovation”, and Outcome 7 “An inspiring and engaging ocean where society understands and values the ocean in relation to human wellbeing and sustainable development”.

## **2. Timeframe and objectives**

### **2.1 Timeframe**

This WG started from April 2021 and the initial planned timeframe of this Working Group was designed to be 2 years. The WG aims to identify the priority issues on marine ecosystem and biodiversity research in the IPCC area from multi-circle and multi-disciplinary perspectives, for instance, species and geographic distribution patterns of coral and coral fish, use of eDNA to identify and predict the evolution of marine biodiversity and ecosystems, transportation of nutrients and its effect on primary productivity, etc. And thus formulate an interdisciplinary program to advance the knowledge of, and research capacity for Marine Biodiversity in the Indo-Pacific Convergent Center.

### **2.2 Objectives:**

- Identify the priority issues on marine ecosystem and biodiversity research in the IPCC area from multi-circle and multi-disciplinary perspectives, which could address A Healthy and Resilient Ocean.

- Integrate the shared interests of countries in this region for further collaboration and capacity development.
- Improve understandings on formation mechanism, current status, and trend of evolution of the biodiversity center in the IPCC and their socio-economic impacts.
- Promote the involvement of early-career scientists in cooperative studies on I3PCC-MEB WG.

### **3. Major activities, outputs & outcomes over the last intersessional period (May 2021-April 2023)**

#### 3.1 Major activities:

Jan 2020 – Dec 2020:

- Identified the objectives of the I<sup>3</sup>PCC-MEB initiative and designed the framework.
- Organized several workshops within IOCAS to develop the I<sup>3</sup>PCC-MEB initiative.
- Participated in the Ocean Decade virtual series “Co-designing the Ocean Science we need for the Western Pacific and adjacent areas” which was hosted by IOC WESTPAC, to better integrate the I<sup>3</sup>PCC-MEB initiative with the Ocean Decade.

Feb 2021:

- Developed the I<sup>3</sup>PCC-MEB proposal and submitted the proposal to IOC WESTPAC.

March 2021:

- Coordinated a workshop to discuss the feasibility of the I<sup>3</sup>PCC-MEB proposal with IOC WESTPAC Advisory Group Members.

April 2021:

- Introduced the I<sup>3</sup>PCC-MEB proposal at the 13th Intergovernmental Session of the IOC Sub-Commission for the Western Pacific (WESTPAC-XIII).
- Established the I<sup>3</sup>PCC-MEB Working Group under the support of IOC WESTPAC.

Sep 2021-Oct 2021:

- Organized two Scientific Committee meetings to identify the priority areas and common interests in the Indo-Pacific Convergent Center, to development 7 Sub-Working Groups and to establish the Programme Support Office. (Attendees: Scientific Committee Members)
- Organized two Co-design meetings of the I<sup>3</sup>PCC-MEB WG to promote communication and collaboration in understanding the recent status of Marine Biodiversity and developing solutions in this region. (Attendees: 20 Scientists)
- Proposed a side event – “the Decade Action Incubator 8” at the UN Ocean Decade Regional Kickoff Conference for the Western Pacific and its adjacent areas and invited six experts, two of which were early career young professionals, to introduce the I<sup>3</sup>PCC-MEB WG and recent progress in marine biodiversity conservation in this region from a multidisciplinary perspective.

Nov 2021:

- Coordinated the side event - “Unlock the mysteries and opportunities of marine biodiversity in the Indo-Pacific Convergent Center” (the Decade Action Incubator 8) at the UN Ocean Decade Regional Kickoff Conference for the Western Pacific and its adjacent areas. (Attendees: More than 70 scientists)

Jan 2022:

- Submitted a proposal for conducting a workshop of I<sup>3</sup>PCC-MEB WG at PICES ‘Effects of Climate Change on the World’s Ocean’ meeting which will take place in early 2023.

Feb 2022-Aug 2022:

- Called for leaders of the I<sup>3</sup>PCC-MEB Sub-WGs and engage more interested partners.
- Invited experts who were concerned about Marine Biodiversity and focused on the interdisciplinary study and organized 3 Sub-WG discussion meetings to identify the detailed framework and develop a section of science plan of each Sub-WG.

Sep 2022-Oct 2022:

- Organized the I<sup>3</sup>PCC-MEB WG 2022 Co-design meeting to develop the draft of the Science Plan of the I<sup>3</sup>PCC-MEB Program by integrating the shared interests of the region and promote following WG activities.
- Planned and held the I<sup>3</sup>PCC-MEB Side Event at the 4th Open Science Symposium on Western Pacific Ocean Circulation and Climate organized by NPOCE, to promote the collaboration of the I<sup>3</sup>PCC-MEB Working Group and discuss potential pilot projects.

Nov 2022-Jan 2023:

- Organized several workshops to narrow down the research topics and endeavored to develop a feasible Science Action Plan and an effective mechanism to involve more partners.
- Drafted and improved the Science Action Plan.

### 3.2 Outputs:

- More than 70 attendees from various ocean stakeholder communities, including early career ocean professionals, attended the Side Event “Unlock the mysteries and opportunities of marine biodiversity in the Indo-Pacific Convergent Center”. During the discussion, many attendees showed high interest in the I<sup>3</sup>PCC-MEB initiative and the willingness to engage in the Co-design process of the I<sup>3</sup>PCC-MEB programme.
- A list of priority issues identified in future collaboration on marine ecosystem and biodiversity in the IPCC area.
- Enlarged partnership to further develop the I<sup>3</sup>PCC-MEB Program
- Improved awareness of early career ocean professionals to bridge the gaps between the scientific community, the general public, and policymakers.

### 4.A summary of key achievements since its establishment

- (1) Successfully organized the Side Event “Unlock the mysteries and opportunities of marine biodiversity in the Indo-Pacific Convergent Center” at the UN Ocean Decade Regional Kickoff Conference for the Western Pacific and its adjacent areas, which broadly advertised the I<sup>3</sup>PCC-MEB initiative and attracted more potential partners.
- (2) Identified a list of priority issues during several rounds of discussion and co-design process, which also well integrated the interests of different countries in this region.
- (3) Improved awareness of the idea of the I<sup>3</sup>PCC-MEB initiative among early career ocean professionals.
- (4) Enlarged partnership to further develop the I<sup>3</sup>PCC-MEB Programme.
- (5) Developed the I<sup>3</sup>PCC-MEB Science Action Plan and several pilot projects.

### 5. Self-assessment on implementation against objectives

- The Working Group has well implemented the programme according to the set objectives and delivered the expected outputs.

- During the implementation process, the COVID-19 pandemic indeed was a huge challenge to develop regional collaboration of the I<sup>3</sup>PCC-MEB initiative, but we still moved forward as planned.

#### **6. Problems encountered and recommended actions**

The innovative and unique point of this programme is to integrate a Multi-Spheric approach and considers the interaction trans-spheres, especially the interaction among anthropogenic, ecological and environmental factors. Therefore, many research topics should be covered to make sure the efficiency and integrity, which also makes the research scale too large and not easy to understand. The solution to figure this out is to narrow down the research focus and effectively identify the core priority areas, and to develop a few pilot projects which could best transfer the spirit of the programme and engage more interested partners, including scientific community, NGOs, industry, and decision-makers.

#### **7. Objectives to be achieved, if applicable, over the next intersessional period (May 2023- April 2025)**

- Integrate the shared interests of countries in this region for further collaboration and capacity development.
- Improve the observation systems and modelling capabilities in the IPCC area through implementation of joint cruises, long-term observations, interdisciplinary research, and coupling of multi-disciplinary models.
- Improve understandings on formation mechanism, status quo, and trend of evolution of the biodiversity center in the IPCC and their socio-economic impacts.
- Construct a comprehensive data and sample sharing platform to advance the sharing of knowledge, data products, and best practices.
- Involve more early-career scientists to contribute to I<sup>3</sup>PCC-MEB programme, through cooperative studies, joint cruises, and training courses, etc.

#### **8. Planned activities for May 2023- April 2025**

- Organize several Co-design meetings and workshops to disseminate the I<sup>3</sup>PCC-MEB Programme and develop pilot projects.
- Organize International conference on Indonesian Throughflow (ITF) 2023 (Organizer: BRIN-RCO and IOCAS).
- Invite more qualified experts from different countries in this region to join the Scientific Committee and cultivate young professionals to be leaders during the implementation process of the I<sup>3</sup>PCC-MEB Programme.
- Promote the communication and collaboration within the I<sup>3</sup>PCC-MEB framework.
- A better understanding of the status of the Marine Biodiversity in the IPCC from a multi-spheric perspective.
- Carry out a series of technical training for students, policymakers, and private sectors.

[provide, in tabular form, the action items that should be included in the work plan and budget]

| Program |                                      |  |   |   | Funding Required  |   | Remark |
|---------|--------------------------------------|--|---|---|---|---|--------|
|         | Activities                           | Objectives   | Expected outputs/outcomes   | Date and place                                | IOC   | Other sources (i.e., from national or international)  |        |
|         | 1. Workshops, seminars, and meetings | Communicate and discuss the research and findings on formation mechanism and status of marine biodiversity in the IPCC and their socio-economic impacts. | Better understandings on the mechanism and trend of evolution of the biodiversity center in the IPCC. | China, Indonesia, Malaysia, Bangkok, Japan... | Financial support for a few participants to join the workshops. | - Chinese Academy of Sciences (CAS)<br>- other available funding opportunities will be welcomed |        |
|         | 2. 3-4 Training courses              | - Deep sea ecosystem.<br>- Ocean observation.  | More young professionals could benefit from the training and grow to be leaders.                      | China, Indonesia, Malaysia, Bangkok, Japan... | Coordination and training resources.                            | To be confirmed.  |        |
|         |                                      |  |   |   |   |   |        |