

# CLIVAR REPORT

Climate and Ocean: Variability, Predictability, and Change



## Meeting Report

### **Report on the 15<sup>th</sup> Session of the CLIVAR/IOC-GOOS Indian Ocean Region Panel (IORP)**

14-15 March 2019, Port Elizabeth, South Africa

September 2019

CLIVAR Report No. 05/2019

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## List of Actions

**Action 1:** *IMOS will make their XBT lines/SOOP lines available (included) into IndOOS (Indi Hodgson-Johnston).*

**Action 02:** *Add recommendation to establish a CPR line in the Indian Ocean as part of IndOOS-2.*

**Action 03:** *Make recommendation for a pilot project towards sustained measurement of air-sea fluxes in the eastern subtropical gyre in Tier 3. - DONE*

**Action 04:** *To consider the possibility to include process studies in the 'Synthesis' Chapter.*

**Action 05:** *To forward the actionable recommendations from IndOOS Decadal Review to IRF members (through IRF chair, Sid Thurston).*

**Action 06:** *Nick HM will help contact the leader of the IMOS team to push the BGC Argo deployment in the Indian Ocean with the societal impact.*

**Action 07:** *To solicit comments from review board and chapter lead authors on the Executive Summary, Introduction and Synthesis chapters. (Lisa, Jerome, Roxy and Jing).*

**Action 08:** *To coordinate with ICPO in Qingdao and ICMPO for the report layout and publication (Jing and Roxy).*

**Action 09:** *To seek the endorsement from the donors organisations (IORP).*

**Action 10:** *To disseminate the IndOOS-2 recommendations to national institutions and funding agencies - in particular to increase participation and resources.*

**Action 11:** *To take the IndOOS Decadal Review outcomes to observation group meetings, with digestible messages to a range of audience. Jing will map out the relevant meetings.*

**Action 12:** *To put together 2-3 slides (for 2-min presentation) or 6 or more slides (for 10-min presentation) on IndOOS Review outcomes (Lisa & Roxy). This information should be included in the report, e.g. the stats in a picture in the report/synthesis.*

**Action 13:** *To submit a poster based on the white paper to OceanObs'19 (led by Juliet & Yukio).*

**Action 14:** *To further publish the outcomes of the IndOOS Review on scientific journals.*

**Action 15:** *To prepare a report card like JCOMMOPS' (Nick H-M, Lisa and Juliet).*

**Action 16:** *To re-design and update IndOOS Review webpage on CLIVAR website (Jing & Roxy).*

**Action 17:** *To put the 136 actionable recommendations in a spreadsheet, and track over time for the status of accomplishment. This should be a standing agenda item and can be linked to the IndOOS webpage.*

**Action 18:** *Data accessibility should be included as a statement in the synthesis (Roxy and Lisa).*

**Action 19:** *To further investigate how physical and biogeochemical interact in coastal areas in the CLIVAR new Science Plan (Jing).*

**Action 20:** *Lisa and Jerry will talk to Raleigh to explore how to continue the interaction between physical and biogeochemical scientists in the Indian Ocean through joint effort of IORP and SIBER.*

**Action 21:** *To add 'change' in addition to 'climate variability' in the IORP Terms of Reference #1 (Roxy and Lisa to include this in the IORP 2018-2019 Annual Report to SSG).*

**Action 22:** *Jing will set up a google drive and Roxy will follow up with panel members to find 2-3 papers focusing on the impact of oceans on society.*

**Action 23:** *Lisa will introduce the Lin Liu to Elaine McDonagh from Go-SHIP and to discuss the possibility to incorporate Global Air-Sea Interaction: Indo-Pacific Ocean Environment Variation and Air-sea Interaction (GASI, 2017-2020) into GO-SHIP.*

**Action 24:** *The paper of 'Monsoon-Indian Ocean Interactions', jointly proposed by IORP and Monsoon Panel will be dropped as there is no progress in the past three years.*

**Action 25:** *Lisan Yu will take the lead to coordinate a special issue on CLIVAR Exchanges for the IndOOS Review in collaboration with Jing and ICPO, by sending an email to all chapter lead authors of the IndOOS Review Report, to request them to submit articles based on their respective chapters.*

**Action 26:** *Roxy and Lisa will follow up with IORP members to identify the candidates for vacant membership positions.*

**Action 27:** *To invite PRP and ARP to the IIOSC 2020 in Goa, India (Lisa and Roxy).*

**Action 28:** *Jing will consult IORP panel members for the time availability at least 2-weeks before the telecon. Talking points need to be available before the meeting (Jing with Lisa and Roxy).*

The [15<sup>th</sup> Session of CLIVAR/IOC-GOOS Indian Ocean Region Panel](#) took place in Port Elizabeth, South Africa, on 14-15 March 2019, in conjunction with other Indian Ocean Science meetings, including the 3rd Meeting of the second International Indian Ocean Expedition (IIOE-2) Steering Committee, the 9<sup>th</sup> IndOOS Resource Forum, the 15<sup>th</sup> Indian Ocean Global Observing System (IO-GOOS) and the 9<sup>th</sup> meeting of Sustained Indian Ocean Biogeochemistry and Ecosystem Research (SIBER).

The process, summary and outcomes from the IndOOS (Indian Ocean Observation System) Decadal Review has been communicated during the IndOOS review session on March 14, followed by a discussion on implementation and resources for IndOOS, with IO-GOOS, IRF and SIBER. Participants volunteered themselves to different working groups to communicate the outcomes of IndOOS Decadal Review with stakeholders in the Indian Ocean rim countries, other international programmes and projects as well as to the broader scientific communities.

A joint session between IORP and SIBER (Sustained Indian Ocean Biogeochemistry and Ecosystem Research) was organised in the morning of 15 March, covering featured scientific talks from both groups, on how the Indian Ocean observation could be applied in understanding the key physical and biogeochemical processes in the Indian ocean. Since the overarching scientific and functional objectives of IORP and SIBER are converging, they agreed to work synergistically in the near future.

In the afternoon of the second day, IORP had its panel business meeting, focusing on how to better align the panel's priorities with the newly proposed WCRP Strategic Plan and CLIVAR new Science Plan, as well as the strategy for increasing the interactions among panel members between the annual meetings. Membership issue has also been discussed during the IORP panel business meeting.

## 1. IndOOS Review Session

### 1.1 Process, Summary, and Outcomes from the IndOOS Decadal Review

Lisa Beal and Roxy Matthew Koll, co-chairs of IORP, presented the process, summary and outcomes from the IndOOS decadal review.

Roxy began his presentation by looking back the origin of IndOOS in 2006, and mentioned that since then, the societal and scientific priorities and measurement technologies have evolved, and practicalities of implementation have been learned. Those are the motivations to conduct the IndOOS Decadal Review. The Review is aiming to make actionable recommendations for priority observing system components going forward, including pilot studies with new technologies and to provide justification for these recommendations.

Since the review launched at the 1<sup>st</sup> Workshop in Perth Australia (31 Jan – 2 Feb, 2017), there were three workshops and two completed rounds of draft chapters being organised. An independent Review Board consisting of six members representing CLIVAR, IMBeR, OOPC, IOGOOS and IOC Perth Project Office has been established and provided comments to draft of the review report. The structure of the IndOOS Decadal Review Report is:

- a. **Executive Summary** presents the proposed evolution of the IndOOS based on the core findings of the decadal review and concludes with the prioritized list of Actionable Recommendations.
- b. In the 25 chapters that follow we:

- **Chapters 1 – 8:** Review the current status of the IndOOS, component by component, including past successes and failures;
  - **Chapters 9 – 11:** Assess the demands that operational products and forecasts place on the IndOOS;
  - **Chapters 12—25:** Articulate the oceanic and climatic phenomena that the observing system must capture.
- c. Each chapter identifies a set of **Essential Ocean Variables** (EOVs) and a list of **Actionable Recommendations** that address the most important gaps and needs.
- d. Finally, in the **Synthesis** these chapters are summarized and the process of consolidating and prioritizing the Actionable Recommendations is described.

**Core findings** of the IndOOS Decadal review were introduced by Lisa, which include:

- IndOOS coverage of the **Arabian Sea and western equatorial Indian Ocean** needs to be rapidly completed.
- Enhanced vertical and temporal resolution of upper-ocean measurements are needed at RAMA moorings in upwelling regions and in the salinity-stratified Bay of Bengal to capture MJO and MISO development.
- Need to establish boundary flux arrays in the Agulhas and Leeuwin Currents, enhance Indonesian Throughflow (ITF) monitoring, and increase observations of the deep ocean below 2000 m to capture circulation, heat content, and sea level change.
- Need an increase in biogeochemical measurements throughout the basin, initially targeted to regions of high variability and change, such as the Arabian Sea, Bay of Bengal, and eastern equatorial Indian Ocean.
- Continuous, overlapping satellite measurements are central to the IndOOS.
- There is a necessity for increased engagement and partnerships among Indian Ocean rim countries.
- There is urgent need for advancements in data assemblage and coupled data assimilation techniques

Lisa also introduced in details about the **summary of recommendations for each IndOOS Component**, as well as the **prioritisation of the 136 actionable recommendations** derived from the reports, which are sliced into three tiers:

- a. **Tier 1 (High priority):** Maintain and consolidate essential capacities, while better considering practicalities;
- b. **Tier 2 (Desirable):** Extend IndOOS capacities to better address scientific and operational drivers.
- c. **Tier 3 (Low priority):** Pilot projects to investigate efficacy, sustainability, and potential for integration into the IndOOS.

## 1.2 Discussion on Implementation of IndOOS

### 1.2.1 Feedback to the actionable recommendations

#### a. XBT & Ships of Opportunity Program (SOOP)

- The key is to get as many measurements and as frequently as possible. SOOP with smaller sensors should be much easier (Peter);
- For SOOP, it is hard to calibrate and the lines change (Lisa).

- The Argo Programme has been successful to supersede the SOOP and XBT lines. In particular, the Argo floats do a better job on salinity and SOOP has fewer lines comparing to original (Lisa and Mike);
- We might include XBT lines across BoB (IX14) and AS (IX08) conducted by India, which are committed until 2022. However, the data from these are not shared in a manner consistent with the IndOOS/GOOS/FOO framework.
- IMOS has XBT lines/SOOP lines that aren't reflected in the IndOOS Review report, and should be.

**Action 01: IMOS will make their XBT lines/SOOP lines available (included) into IndOOS (Indi Hodgson-Johnston).**

**b. Biogeochemical Observations:**

- Continuous Plankton Recorder (CPR) survey has been going for over 70 years in Atlantic and this expertise is moving to Indian ocean. Advocate to use CPR as towed bodies for BGC sensors (Peter);
- CPR does some phytoplankton but more zooplankton. However, underwater video towed recorders may improve on this moving forward (Nick H-M);
- Institutions in India (NIO and fisheries institute) started to talk with scientists in UK (Plymouth University) and Australia (Australian Antarctic Society and IMOS) about establishing a repeat CPR line in the Indian Ocean (Nick H-M).

**Action 02: Add recommendation to establish a CPR line in the Indian Ocean as part of IndOOS-2.**

**c. RAMA**

- The impact on Leeuwin Current product by removing three RAMA Buoys in the Southeast Indian Ocean (Nick D'Adamo).
- The RAMA sites to be removed because they are either difficult to access and maintain or subjected to vandalism. XBT lines combining with Argo floats may solve the problem (Lisa and Mike). Recommendations on XBT IX01 line to encourage higher density profiling on ITF and close to Leeuwin current.
- The reduction of RAMA buoys in subduction zone will cause us to miss the potential mode of water formation, which cannot be substituted by Argo floats in the subtropical gyres. Suggest to keep those sites even though there are difficult logistics. (Lisan Yu)
- It could be potential to put this in Tier 3 as a pilot project towards sustained measurement of air-sea fluxes in the subtropical gyre (Lisa to work with Lisan, Helen, Mike).

**Action 03: Make recommendation for a pilot project towards sustained measurement of air-sea fluxes in the eastern subtropical gyre in Tier 3.**

**d. Southern Ocean exchange issues**

- IIOE-2 may help with coordinating the opportunistic observation from Ships (Nick D'Adamo);
- Cooperation with Southern Ocean Observing System (SOOS)

## 1.2.2 Future Actions to Facilitate the Implementation of the IndOOS Decadal Review Recommendations

Discussion on the Implementation of the IndOOS Review recommendations were carried on during both the IndOOS Review workshop and IORP/SIBER joint session. As IORP and SIBER are consisting of scientists who can only provide scientific guidance to the IndOOS, there is an urgent need to bring the actionable recommendations from IndOOS Decadal Review in front of the people, e.g. through IOGOOS and IRF. A list of actions has been identified jointly by the participants.

### a. Process studies in eastern equatorial region of the Indian Ocean

Though the IndOOS is focusing on the sustained observations and pilot studies of new technologies or new ideas, there is a synergy between the process studies (e.g. moorings deployed by Dongxiao's team in the eastern equatorial region of the Indian Ocean and similar exercise by Republic of Korea). The data from process studies are always in a delayed mode. However, on the other aspect, cruises for the process studies can be partnered with IndOOS and should be recognised as well.

**Action 04:** *To consider the possibility to include the process studies in the 'Synthesis' Chapter.*

### b. To reactivate the IndOOS Resource Forum (IRF)

The IRF is expected to mobilise resources to sustain the Tier 1 recommendations of the IndOOS Decadal Review. Both IORP and SIBER played an active role behind through identifying candidates for IRF national representatives since the meeting in last year (2018). It is still in the process for Nick and Satheesh to bring new IRF members onboard.

**Action 05:** *To forward the actionable recommendations from IndOOS Decadal Review to IRF members (through IRF chair, Sid Thurston).*

### c. To finance more biogeochemical (BGC) measurements

According to Raleigh, there are strategies for more BGC sensors for RAMA as well as BGC Argo floats to be deployed in the Indian Ocean, but yet no ideas out of the box. According to BGC Argo Steering Committee, 200 BGC Argo is needed in the Indian Ocean. However, as the BGC Argo is not yet funded at the needed scale, collaboration with GO-SHIP and IIOE-2 for BGC Argo deployment is necessary. On the US site, a big proposal led by Lynne Talley has just been submitted to fund BGC Argo. The IMOS in the Australia is now funding BGC Argos (2 million Aus. Dollars) headed by Pete Strutton, with up to 100 BGC Argo floats deployed in the whole programme (not just in the Indian Ocean). India has deployed 32 BGC Argo floats in the Indian Ocean currently, and plans to add 15 BGC Argo floats each year to be deployed in the open ocean. Also, BGC sensor has been added to a buoy in the Arabic sea and to be incorporated into RAMA database. The French (Herve Claustre) also showed interest in deploying BGC Argos in the Indian Ocean.

**Action 06:** *Nick H-M will help contact the leader of the IMOS team to push the BGC Argo deployment in the Indian Ocean with the societal impact.*

### d. Detailed plan for IndOOS Implementation Strategy

#### IndOOS Review Report Publication and Dissemination

There was a discussion on which organisation(s) should be enlisted the ownership to publish the IndOOS Decadal Review Report. CLIVAR and IOC-GOOS will be the joint publishers of the



report. The International CLIVAR Project Office (ICPO) will provide support on report layout and publication. A doi number is necessary for the IndOOS Review Report, probably through IODE or ICPO. 100 to 200 hard copies are needed to be distributed at various meetings. Proactive actions should be taken by all to seek every possible opportunity to disseminate the recommendations from the Review. The advocacy strategy from TPOS 2020 can be learnt. A great weight will be assigned if the Report could be endorsed by donors and other international organisations and programmes related to ocean observations.

**Action 07:** *To solicit comments from review board and chapter lead authors on the Executive Summary, Introduction and Synthesis chapters. (Lisa, Jerome, Roxy and Jing)*

**Action 08:** *To coordinate with ICPO in Qingdao and ICMPO for the report layout and publication (Jing and Roxy);*

**Action 09:** *To seek the endorsement from the donors organisations (IORP):*

- NOAA (Sidney);
- IMBeR (Greg and Raleigh);
- OOPC (Lisa, Katy Hill);
- WCRP (Jing);
- IOGOOS (Raja);
- IOC-UNESCO: through the IOC Assembly and country focal points (Nick D'Adamo);
- IUGG (Lisa)

**Action 10:** *To disseminate the IndOOS-2 recommendations to national government institutions and funding agencies:*

- Australia: To contact the facility leaders directly at IMOS (e.g. Pete Strutton) and push IO with the societal impacts (Nick HM);
- Japan: To translate the Executive Summary into Japanese (Yukio)

**Action 11:** *To take the IndOOS Decadal Review outcomes to observation group meetings, with digestible messages to a range of audience. Jing will map out the relevant meetings.*

- Go-Ship (Elaine);
- JCOMM OCG (Juliet) and Tide Gauge and XBT through JCOMM OCG;
- Argo (send to Wijfells and Herve Claustre);
- GDP (Sidney);
- NOAA Global Ocean in June (Sidney and Mike McPhaden);
- IOGOOS (Sateesh);
- IMOS Planning Meeting (Lynnath);
- Workshop on Atmospheric Convection and Air-Sea Interactions of the Tropical Oceans (Dongxiao Wang & Weiqing Han);
- IMBeR SSC (Greg);
- Ocean Carbon OCB (Raleigh and Jerry);
- Fisheries (Australia groups: Lynnath; IO Tuna Commission: Francis);
- The Western Indian Ocean Marine Science Association (WIOMSA) – Francis and Juliet;
- Indian Ocean Rim Academic Group (IORAG) – Juliet

**Action 12:** *To put together 2-3 slides (for 2-min presentation) or 6 or more slides (for 10-min presentation) on IndOOS Review outcomes (Lisa & Roxy). This information should be included in the report, e.g. the stats in a picture in the report/synthesis*

**Action 13:** *To submit a poster based on the white paper to OceanObs'19 (led by Juliet & Yukio)*

**Action 14: To further publish the outcomes of the IndOOS Review on scientific journals:**

- Frontiers in Marine Science (already has an OceanObs'19 white paper published led by Juliet and Yukio);
- High-ranking journals, such as Nature and Sustainable Observations, BAMS (7500 Words, need to write a proposal, IF=8) or AGU Earth & Space Science (led by Lisa, Jerome and Roxy)
- EOS: to write a review of the meeting and revised IndOOS schematic (Raleigh & Jing)
- Annual Review of Marine Science;
- Link with IPCC report (Roxy);
- Journals on social science: e.g. Economists (Nick H-M and Nick D'Adamo);
- CLIVAR Exchanges (Lisan Yu and Jing)/OCB or IMBeR Newsletter (Raleigh & Jerry);

**Action 15: To prepare a report card like JCOMMOPS' (Nick H-M, Lisa and Juliet)**

**Action 16: To re-design and update IndOOS Review webpage on CLIVAR website (Jing & Roxy)**

**Action 17: To put the 136 actionable recommendations in a spreadsheet, and track over time for the status of accomplishment. This should be a standing agenda item and can be linked to the IndOOS webpage.**

**Data assemblage**

Advancement in data assemblage could be viewed as adding value to the whole Indian Ocean Observing system, e.g. data assimilation highly relies on data assemblage. RAMA and Argo are good examples for assembling data but still yet to be perfect.

**Action 18: Data accessibility should be included as a statement in the synthesis (Roxy and Lisa).**

## **2. CLIVAR-SIBER Joint Session**

Six science presentations (3 SIBER, 3 IORP @ 15 minutes each) have been made during the CLIVAR-SIBER joint session in the morning of 15 March 2019.

- The shallow overturning circulation in the Indian Ocean depicted using CTD and Argo float observations (Motoki Nagura, IORP)
- A reflection on how ocean observations of biogeochemistry and ecology can help deliver on sustainable ocean development in the Indian Ocean region (Nick Hardman-Mountford, IORP)
- Temperature changes in the Indian Ocean (Elaine McDonagh, IORP)
- BoBBLE: Bay of Bengal Boundary Layer Experiment (P. N. Vinayachandran, SIBER)
- A brief overview of recent and ongoing zooplankton research and monitoring in the SWIO (Jennifer Huggett, SIBER)
- Physics to fish with some whales on the side! 110° E repeat line (Lynnath Beckley, SIBER)

## **3. IORP Panel Business Session**

### **3.1 WCRP Strategic Plan and CLIVAR Science Plan and Implementation Strategy**

As required by co-chairs, Jing Li, Staff Scientist from International CLIVAR Project Office (ICPO), briefly introduced the new WCRP Strategic Plan and CLIVAR Science Plan and Implementation Strategy at the beginning of the IORP panel business session.

In reflection to the changing scientific and societal requirements, there is a need to take a holistic view of the earth system and strengthen our capacity in seamless prediction at various time and special scales. An independent **review** instigated by the three sponsors of WCRP (WMO, IOC-UNESCO and ISC) took place from February to October 2017, in order to ascertain the effectiveness of WCRP in delivering its mandate, how well it works in partnership with other organizations, and to advise on the future structure, governance and resourcing of the programme. According to the Review, *'WCRP is at a critical point in its history, and that significant changes are required in its governance, structure and delivery for it to fulfil its mission in the context of 21<sup>st</sup> Century challenges. The core, underpinning climate science which WCRP delivers is needed more than ever, as society seeks solutions to climate change, to resilience to disasters, and to sustainable development for the planet.'* A new WCRP Strategic Plan (2019-2028) has been developed with the following highlights:

- ✓ To balance the fundamental research and application driven researches. WCRP should advocate the importance of fundamental science in the future.
- ✓ WCRP is focusing on the physical science rather than the societal impacts and stakeholder involvement. However, WCRP found itself to be more and more important as a bridge for science to society.
- ✓ Rather than compromising its researches, WCRP plans to add more elements on building capacity, engagement with more stakeholders.

Four scientific objectives and the critical infrastructures required to build the capacity needed to execute globally coordinated climate science was brought in the new WCRP Strategic Plan. The Implementation Plan for WCRP is under preparation.

Meanwhile, a new Science Plan of CLIVAR has also been published in 2018, with three scientific priorities identified:

- ✓ **Mechanisms** of climate variability and change that require further investigation with the ultimate goal of better constraining the fluxes of energy and carbon in the climate system;
- ✓ Ocean **processes** that modulate climate variability and change for which open questions remain;
- ✓ Climate **predictability** challenges that exist over a broad range of space and time scales.

Discussion was carried out in particular on how to improve understanding of regional climate phenomena and prediction, as well as to enhance the physical and biogeochemical interaction. One of the core findings from the IndOOS Review is the need to expand the Indian Ocean Observing System into coastal region. The biogeochemistry observation in the east Java upwelling region was also highlighted in the Tier 3 recommendations. However, there was a hesitation in IIOE-2 in terms of getting too close to the coast due to it is more challenging. There are other coastal processes need to be further studies, besides the boundary currents which have already been studied over ten years.

**Action 19: To further investigate how physical and biogeochemical interact in coastal areas in the CLIVAR new Science Plan (Jing).**

As there are new IORP members attending the meeting, Jing also introduced the Terms of References for IORP. Lisa mentioned that in the past two years, the focus of the panel was TOR#1 (observations), but the panel used to focus more on TOR#3 (review and research). IORP has a good tradition to interaction with biogeochemical groups through the close cooperation with SIBER. With the Jerry Wiggert serving as a joint member for both IORP and SIBER in the past

five years, in addition to the new members of Nick Hardman-Mountford and TaeKeun Rho (Korea), the panel worked well to this new direction. In addition, there was also a discussion on whether to maintain the IORP and SIBER as separate panels, or we could advocate that the two panels work together and moving forward, given the situation that SIBER will experience severer shrinking financial support in the coming years. There are pros and cons of this new modality of cooperation. It was suggested to change the panel as **CLIVAR/IMBeR/IOC-GOOS Indian Ocean Region Panel** to keep the involvement and support from IMBeR. IORP would welcome the idea for SIBER to join IORP and the support from IMBeR, since it would benefit both panels. One practical issue is the membership rotation.

**Action 20:** Lisa and Jerry will talk to Raleigh to explore how to continue the interaction between physical and biogeochemical scientists in the Indian Ocean through joint effort of IORP and SIBER;

### **3.2 Reflection on action items from IORP-14**

Some of the action items (listed here) have not been completed in the past year. It was suggested to have periodic track between sessions for the action items.

**Action 21:** To add 'change' in addition to 'climate variability' in the IORP Terms of Reference #1 (Roxy and Lisa to include this in the IORP 2018-2019 Annual Report to SSG);

**Action 22:** Jing will set up a google drive and Roxy will follow up with panel members to find 2-3 papers focusing on the impact of oceans on society;

**Action 23:** Lisa will introduce the Lin Liu to Elaine McDonagh from Go-SHIP and to discuss the possibility to incorporate Global Air-Sea Interaction: Indo-Pacific Ocean Environment Variation and Air-sea Interaction (GASI, 2017-2020) into GO-SHIP;

**Action 24:** The paper of 'Monsoon-Indian Ocean Interactions', jointly proposed by IORP and Monsoon Panel will be dropped as there is no progress in the past three years;

**Action 25:** Lisan Yu will take the lead to coordinate a special issue on CLIVAR Exchanges for the IndOOS Review in collaboration with Jing and ICPO, by sending an email to all chapter lead authors of the IndOOS Review Report, to request them to submit articles based on their respective chapters.

### **3.3 Membership**

There are four members whose terms will be ended by the end of 2019: Lisa Beal (Co-chair, USA), Agus Atmadipoera (Indonesia), Jerry Wiggert (USA) and Dongxiao Wang (China). IORP members are encourage to nominate appropriate candidates for each vacancy.

**Action 26:** Roxy and Lisa will follow up with IORP members to identify the candidates for vacant membership positions.

### **3.4 Other business**

In reflection to the SSG's feedback towards the panel to strengthen the cooperation with other CLIVAR panels and research Foci, Lisa proposed the idea to invite CLIVAR Pacific Region Panel

and Atlantic Region Panel, who are carrying on similar review as IndOOS in their respective basin to meet during the 2020 International Indian Ocean Science Symposium, which is to be organised in March 2020 at Goa, Indian. Also, IORP panel co-chairs could interact with the co-chairs from other panels at OceanObs'19 (September 2019) or other occasions.

**Action 27:** *To invite PRP and ARP to the IIOSC 2020 in Goa, India (Lisa and Roxy).*

In order to strengthen the involvement of panel members between sessions, Jing introduced the practices from other CLIVAR panels, which include:

1. To create **task groups** within the panel:

e.g. NORP: <http://www.clivar.org/clivar-panels/northern>

2. To designate **national representatives** (aside from panel members) and to prepare annual national report,

e.g. SORP: <http://www.clivar.org/clivar-panels/southern/national-representatives>

3. To organise **telecon** more frequently (e.g. bi-monthly or quarterly?)

4. **Google scholar special page** for the panel:

e.g. OMDP: <https://scholar.google.com/citations?hl=en&user=AGbQMyoAAAAJ>

5. **Online community:**

e.g. Monsoon Panel: <http://www.clivar.org/clivar-panels/monsoons/contact-network>

Participants welcome the ideas to establish thematic working groups within the panel, as well as to have quarterly telecon between sessions.

**Action 28:** *Jing will consult IORP panel members for the time availability at least 2-weeks before the telecon. Talking points need to be available before the meeting (Jing with Lisa and Roxy).*

The meeting adjourned at 15:45, GMT+2.



Group photo of IORP-15 (Juliet Hermes is missing in the photo)

## Appendix 1: Agenda

IndOOS Review (Mar. 14, 2019)	
<b>Session 1: Presentations of Process, Summary, and Outcomes from the IndOOS Decadal Review</b> (Chaired by Lisa Beal, Roxy Mathew Koll and Jing Li)	
1.1 What is the IndOOS Decadal Review?	Lisa Beal & Jing Li
1.2 Scientific and Societal Motivations for IndOOS and the IndOOS Review process	Roxy Mathew Koll
1.3 The outcomes of the IndOOS Decadal Review: Actionable Recommendations for a future, fit-for-purpose observing system	Lisa Beal
<b>Session 2: Discussion about Implementation and Resources for IndOOS, with IO-GOOS and IRF: Break-out groups around e.g. Actionable Recommendations or Observing platforms</b> (Chairs: Lisa Beal, Roxy Mathew Koll)	
Ideas for break-out groups on Implementation: <ol style="list-style-type: none"> <li>(1) Progressing IndOOS as a partnership among Indian Ocean rim countries: How do we promote and improve participation of rim countries, resource sharing, capacity building, and international partnerships?</li> <li>(2) Expanding IndOOS into the coastal zone (boundary currents and upwelling): EEZ challenges and other logistics, sustainability</li> <li>(3) Observing system components: e.g. RAMA, BGC-Argo, subtropical boundary current arrays</li> </ol>	
<b>Lunch</b>	
<b>Session 3: Discussion of Implementation and Resources for IndOOS, with IO-GOOS and IRF: Break-out groups, reporting, and wrap-up</b> (Chairs: Lisa Beal & Roxy Mathew Koll)	
IORP/SIBER Joint Meeting (a.m. Mar. 15, 2019)	
<b>Session 4: Science Presentations (3 SIBER, 3 IORP @ 15 minutes each)</b>	
4.1 The shallow overturning circulation in the Indian Ocean depicted using CTD and Argo float observations	Motoki Nagura, IORP
4.2 A reflection on how ocean observations of biogeochemistry and ecology can help deliver on sustainable ocean development in the Indian Ocean region	Nick Hardman-Mountford, IORP
4.3 Heat uptake in the Indian Ocean	Elaine McDonagh, IORP

4.4 BoBBLE: Bay of Bengal Boundary Layer Experiment	P. N. Vinayachandran, SIBER
4.5 An overview of recent and ongoing zooplankton research in the SWIO	Jennifer Huggett, SIBER
4.6 110° E line: Physics to fish with some whales on the side!	Lynnath Beckley, SIBER
<b>Session 5: Discussion of future projects (e.g. review paper, workshops, summer schools etc)</b>	
<b>Lunch</b>	
<b>Session 6: IORP Business Meeting (p.m. Mar. 15, 2019)</b>	
6.1 New WCRP and CLIVAR Science Plans	Jing Li
6.2 Reflection on action items from IORP-14 and SSG recommendations to IORP	Jing Li
6.3 IORP Membership	Lisa & Roxy
6.4 Enhanced communication between sessions	Lisa & Roxy
6.5 CLIVAR Exchanges special issue on IndOOS Review	Lisa & Roxy
6.6 Other business	Lisa & Roxy
<b>Meeting Adjourn</b>	

## Appendix 2: List of Participants

First name	Last Name	Email	Country	Organization	Role
Lisa	Beal	<a href="mailto:lbeal@rsmas.miami.edu">lbeal@rsmas.miami.edu</a>	USA	University of Miami	Co-Chair
Roxy Mathew	Koll	<a href="mailto:roxy@tropmet.res.in">roxy@tropmet.res.in</a>	India	IITM	Co-chair
Weiqing	Han	<a href="mailto:weiqing.han@colorado.edu">weiqing.han@colorado.edu</a>	USA	University of Colorado	Member
Jerry	Wiggert	<a href="mailto:jerry.wiggert@usm.edu">jerry.wiggert@usm.edu</a>	USA	University of Southern Mississippi	Member
Nick	Hardman-Mountford	<a href="mailto:Nick.Hardman-Mountford@csiro.au">Nick.Hardman-Mountford@csiro.au</a>	Australia	CSIRO	Member
Elaine	McDonagh	<a href="mailto:e.mcdonagh@noc.ac.uk">e.mcdonagh@noc.ac.uk</a>	UK	National Oceanography Centre	Member
Lisan	Yu	<a href="mailto:lyu@whoi.edu">lyu@whoi.edu</a>	USA	Department of Physical Oceanography Woods Hole Oceanographic Institution,	Member
Juliet	Hermes	<a href="mailto:juliet@saeon.ac.za">juliet@saeon.ac.za</a>	South Africa	South African Environmental Observation Network	Member
Motoki	Nagura	<a href="mailto:nagura@jamstec.go.jp">nagura@jamstec.go.jp</a>	Japan	JAMSTEC	New Member
TaeKeun	Rho	<a href="mailto:tkrho@kiost.ac.kr">tkrho@kiost.ac.kr</a>	Korea	KIOST	New Member
Michael	McPhaden	<a href="mailto:michael.j.mcphaden@noaa.gov">michael.j.mcphaden@noaa.gov</a>	USA	NOAA, PMEL	Ex-officio
Satheesh	Shenoi	<a href="mailto:Shenoi@incois.gov.in">Shenoi@incois.gov.in</a>	India	INCOIS	Ex-officio
P. N.	Vinayachandran	<a href="mailto:vinay@caos.iisc.ernet.in">vinay@caos.iisc.ernet.in</a>	India	Centre for Atmospheric & Oceanic Sciences (CAOS), Indian Institute of Science (IISc)	SIBER
Jennifer	Huggett	<a href="mailto:jhuggett@environment.gov.za">jhuggett@environment.gov.za</a>	South Africa	Oceans and Coasts Research, Department of Environment Affairs, Cape Town, South Africa	SIBER



<b>First name</b>	<b>Last Name</b>	<b>Email</b>	<b>Country</b>	<b>Orgnization</b>	<b>Role</b>
Lynnath	Beckley	<u><a href="mailto:L.Beckley@murdoch.edu.au">L.Beckley@murdoch.edu.au</a></u>	Australia	Murdoch University	SIBER
Jing	Li	<u><a href="mailto:jing.li@clivar.org">jing.li@clivar.org</a></u>	China	International CLIVAR Project Office (ICPO)	Staff Scientist