

## Report to CLIVAR SSG-19

**Panel or Working Group:** Indian Ocean Panel (IOP)

### **1. Contributions to developing CLIVAR science and fit, where appropriate, to the CLIVAR imperatives**

IOP mainly contributes to CLIVAR imperatives through building the ocean observing capability in the tropical Indian Ocean and stimulating the data and model based studies. It has developed the Implementation Plan for Indian Ocean Observing System (IndOOS) and is coordinating the implementation and maintenance. As of April 2012, 30 of the 46 planned mooring sites are already occupied (65%), with the equipment and/or ship time contributions from the US, Japan, India, China, Indonesia, and France, as well as from regional programs such as ASCLME. Due to insufficient ship time and piracy issue in the northwestern Indian Ocean, the RAMA implementation rate is only gradually increasing in the recent years. Most of the IndOOS data are available through the IndOOS data portal site at [http://www.incois.gov.in/Incois/iogoos/home\\_indoos.jsp](http://www.incois.gov.in/Incois/iogoos/home_indoos.jsp). Specifically, the RAMA buoy data can be downloaded at <http://www.pmel.noaa.gov/tao/rama/>.

An international research project focusing on MJO initiation in the Indian Ocean, named CINDY2011/DYNAMO project, is coordinated by IOP and AAMP, and its intensive observation campaign (IOP) has successfully ended in January 2012. All data is being archived by NCAR/EOL and JAMSTEC and will be released after QCed.

### **2. Briefly list any specific areas of your panel's activities that you think would contribute to the WCRP Grand Challenges as identified by the JSC at its most recent meeting<sup>1</sup>**

#### **a. Provision of skillful future climate information on regional scales (includes decadal and polar predictability)**

IOP is promoting the implementation of the Indian Ocean Observing System (IndOOS), especially its critical component called the Research Moored Array for African-Asian-Australian Monsoon Analysis and Prediction (RAMA). This will dramatically change the data-poor condition in Indian Ocean and will definitely improve the understanding of the monsoon climate system. All these will improve the relative poor model simulation and prediction skill in the monsoon region.

IOP is working closely with AAMP to realize the maximum scientific contribution from observation to prediction.

IOP is working on the review paper on the decadal variability in Indian Ocean, which will also discuss the further research priorities along this direction.

#### **b. Regional sea-level rise**

IndOOS includes the tide gauge component and IOP works to coordinate the sea-

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1. Provision of skillful future climate information on regional scales (includes decadal and polar predictability)
2. Regional sea-level rise
3. Cryosphere response to climate change (including ice sheets, water resources, permafrost and carbon)
4. Improved understanding of the interactions of clouds, aerosols, precipitation, and radiation and their contributions to climate sensitivity
5. Past and future changes in water availability (with connections to water security and hydrological cycle)
6. Science underpinning the prediction and attribution of extreme events

level observation in the rim of Indian Ocean, which helps to better monitor the regional sea level rise. However, efforts are underway to study and document the sea level changes in the Indian Ocean using Altimeter, Argo and GRACE. In addition to the observational efforts, modeling researches have been conducted at several places. IOP encourages such research activities.

**c. Improved understanding of the interactions of clouds, aerosols, precipitation, and radiation and their contributions to climate sensitivity**

IOP observing system include observations for process studies. During 2006/07, IOP coordinated MISMO and CIRENE and later CINDY2011/DYNAMO focusing on MJO initiation in the Indian Ocean.

**d. Science underpinning the prediction and attribution of extreme events**

RAMA array provides in situ real-time data for the cyclones in Bay of Bengal, especially they measured the air-sea condition during the super cyclone Nargis (2008). These data will help the prediction of the super cyclones. Also the data already led to some research papers. The influences of ENSO on tropical cyclone activity in the Bay of Bengal are documented. It is reported that during La Nina conditions, the number of cyclones and the intensity of cyclones (super cyclone) are enhanced in the Bay of Bengal.

Further, IOP is enhancing its research focus on the monsoon anomalies, especially the extreme drought and severe flood.

**3. Key science questions that you anticipate your community would want to tackle in the next 5-10 years within the context of a more ocean-atmosphere orientated CLIVAR (1-3 suggestions)**

- Prediction of Indian Ocean Dipole from coupled climate model
- Ocean-atmospheric dynamics of monsoon system with application in improving the seasonal and intra-seasonal forecast (*the chances of predictability is high on ISO than seasonal*)
- Indian Ocean decadal variability
- The influence of air-sea interactions and climate variability on tropical cyclones
- Inter-basin exchanges (ITF, Agulhas system, ACC)

**4. Cooperation with other WCRP projects, outside bodies (e.g. IGBP) and links to applications**

Although IOP does not have specific items in its Terms of Reference that address cooperation with IMBER, the panel leadership recognized from its start the importance of establishing meaningful interdisciplinary ties and collaborations aimed at understanding how physical processes impact biogeochemical cycles and particularly air-sea CO<sub>2</sub> exchange and carbon export. The panel has supported since the beginning the development of the Sustained Indian Ocean Biogeochemistry and Ecosystem Research (SIBER) program. Several successes have been achieved:

- Plan and Implementation Strategy which emphasizes interdisciplinary research and IOP/SIBER/IMBER mutual leveraging of effort.
- Motivation for an interdisciplinary modeling study of the physical and biological factors that determine the spatial distribution of the oxygen minimum zone in the Arabian Sea.

- Implement bio-geochemical sensors on the existing RAMA flux mooring
- New interdisciplinary collaborations focusing on the biogeochemical impacts of the Indian Ocean Dipole (IOD)
- Several ongoing interdisciplinary studies that are focused on the southern hemisphere boundary currents in both the western and eastern Indian Ocean; many of these projects fit both into SIBER Theme 1 and are also of considerable interest to the IOP

IOP and SIBER is discussing to further enhance the linkage by initializing the joint project on Eastern Indian Ocean Upwelling: Dynamics and Ecosystem.

#### **5. Workshops/meetings held**

- 8th IOP meeting, in association with SIBER SSC-2 and IRF-2 meetings, Chennai, India, 25-29 July 2011.
- ITF workshop, in association with Pacific Panel, Jakarta, Indonesia, 12-13 Mar. 2011.

#### **6. New activities being planned, including timeline**

- The cooperation between CLIVAR and IMBER in the Indian Ocean, via IOP/SIBER, is a model and flagship for future collaborations. The next step is the development of a scientific joint program on dynamics, air-sea interaction and ecosystem of the Eastern Indian Ocean Upwelling, and this will be discussed as a high priority between IOP and SIBER. YR2013-2014 will be the planning phase and pilot study, followed by 3-5 years program research.

#### **7. Workshops / meetings planned**

- 9th IOP meeting, in association with SIBER SSC-3, IOGOOS and IRF-3 meetings, Cape Town, South Africa, 15-20 October 2012

#### **8. Issues for the SSG**

Indian Ocean Panel is a unique one trying to build a sustainable observing system in the data-poor Indian Ocean and to build new science outcomes based on the new observation. This task is far from completion. In that purpose, IOP has some difficulty on the membership rotation. We will rotate the member as the CLIVAR rule requires to our best capacity. However, we would like to hold some members to stay longer to insure the momentum and effectiveness of the panel in implementing and maintaining IndOOS. We hope SSG can understand this situation and give its consolidate support on this membership issue.

## Annex A

### Proforma for CLIVAR Panel and Working Group requests for SSG approval for meetings

Requests should be made through D/ICPO ([Catherine.beswick@noc.ac.uk](mailto:Catherine.beswick@noc.ac.uk)), against the following headings:

**1. Panel or Working Group:**

Indian Ocean Panel

**2. Title of meeting or workshop:**

10<sup>th</sup> Panel Meeting

**3. Proposed venue:**

To be determined

**4. Proposed dates:**

To be determined

**5. Proposed attendees, including likely number:**

Attendees include the Indian Ocean Panel members, ICPO secretaries and invited experts. The likely number is 20.

**6. Rationale, motivation and justification, including: relevance to CLIVAR themes & JSC cross cutting topics and any cross-panel/working group links and interactions involved:**

The IOP-10 will review the implementation progress of IndOOS and the corresponding research activities. Also the meeting will discuss the follow-up actions to the 3<sup>rd</sup> IndOOS Resource Forum that will be held back to back with IOP-9 in Oct. 2012 in South Africa. Furthermore, IOP-10 will discuss the progress of the IOP-SIBER joint initiative on the upwelling system. All these meet the CLIVAR themes.

**7. Specific objectives and key agenda items:**

Specific objectives include the efficient coordination of the IndOOS implementation and related observational activities, and stimulating the application of IndOOS data in the climate research and prediction.

Key agenda items include: (1) review of the IndOOS implementation; (2) science progress based on the IndOOS observations; (3) follow-up actions to the 3<sup>rd</sup> IndOOS Resources Forum; (4) IOP-SIBER collaboration, including the joint initiative on upwelling system; (5) demonstration of the scientific and social values of IndOOS.

**8. Anticipated outcomes (deliverables):**

The 10<sup>th</sup> Indian Ocean Panel meeting report will be delivered.

**9. Format:**

**10. Science Organising Committee (if relevant)**

Two and a half days meeting.

**11. Local Organising Committee (if relevant)**

Nico Caltabiano (ICPO)

**12. Proposed funding sources and anticipated funding requested from WCRP:**

The funding will come from WCRP and IOC Perth Regional Office. The anticipated funding request to WCRP/CLIVAR would be USD10K.