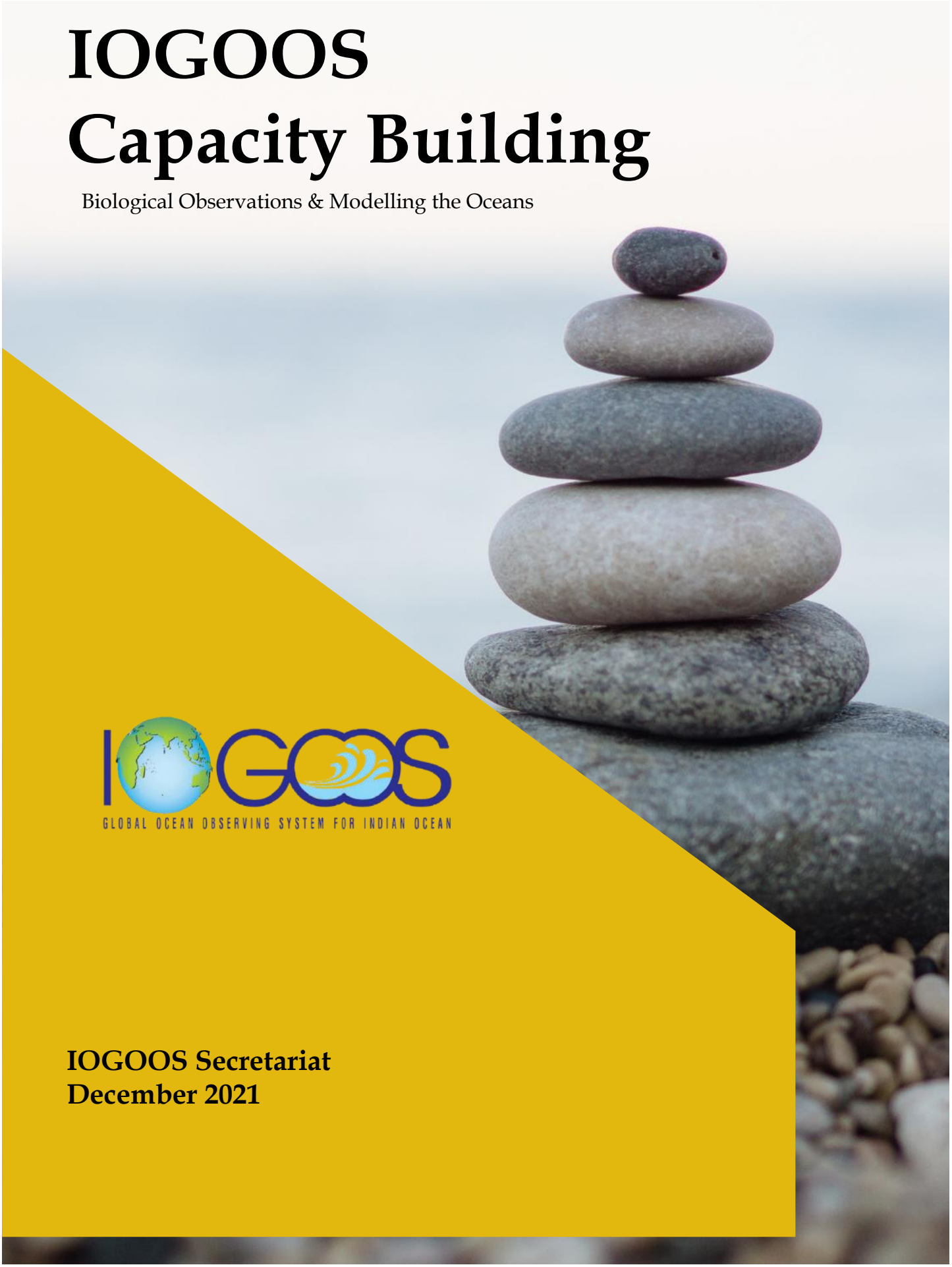
IOGOOS
Capacity Building

Biological Observations & Modelling the Oceans



GLOBAL OCEAN OBSERVING SYSTEM FOR INDIAN OCEAN

IOGOOS Secretariat
December 2021

Background

IOGOOS, during its recent 16th annual meeting emphasized the need for enhancing the capabilities of the region in the field of observations, modeling and operational services through in-presence/online training sessions depending upon the situation of the present COVID-19 pandemic conditions. Accordingly, it is proposed to focus on the following aspects (i) Reviving the Modeling for Ocean Forecasting and Process Studies (MOFPS) through training the researchers in the IO Region and conduct a workshop to identify the significant ocean parameters required and their forecasting requirements including model set up and operational forecast services, (ii) to build capacity in enhancing the biological observations in the region through eDNA, etc. and (iii) contribute to the UN Ocean Decade activities that are of common interest in the region and to address the UN Decade challenges.

Meeting the objectives of the first two aspects are taken on priority and it is proposed to conduct a training programme on "Biological Observations in the Indian Ocean (From Microbes to Megafauna)" and a training cum brainstorming session on "Modeling for Ocean Forecasting and Process Studies (MOFPS)" with each of the training sessions for 05 days.

The training Programme on "Biological Observations in the Indian Ocean (From Microbes to Megafauna)" was conducted through online platform during November 8 - 12, 2021 in partnership with Department of Forestry, Fisheries and the Environment (DFFE), South Africa, Sustained Indian Ocean Biogeochemistry and Ecosystem Research (SIBER), Centre For Marine & Coastal Studies, UniversitiSains Malaysia, Malaysia and Indian National Centre for Ocean Information Services (INCOIS), India with the financial support from International Training Centre for Operational Oceanography (ITCOocean) / Indian National Centre for Ocean Information Services (INCOIS) and Intergovernmental Oceanographic Commission (IOC) of UNESCO.

The second training programme cum brainstorming session on "Modeling for Ocean Forecasting and Process Studies (MOFPS)" was conducted through a hybrid-platform during December 6 -10, 2021 in partnership with International Training Centre for Operational Oceanography (ITCOocean) and Indian National Centre for Ocean Information Services (INCOIS) and with financial support from Intergovernmental Oceanographic Commission (IOC) of UNESCO and International Training Centre for Operational Oceanography (ITCOocean).

Biological Observations in the Indian Ocean (From Microbes to Megafauna)

Overview

The ocean plays an extremely important role in regulating the global ecosystem as well as providing an invaluable source of economic, social, and cultural wealth. It is predicted that the ocean will face numerous challenges especially in the next decade where climate change and ocean acidification will bring extreme impacts to the biological aspects of the sea. Maritime countries around the Indian Ocean rim rely heavily on the health of the ocean to continue driving development and to provide food security for the region. Hence, observation and monitoring of changes in the biological components of the Indian Ocean are becoming essential in order for us to safeguard and ensure the sustainability of the diverse flora and fauna in the ocean.

Currently, efforts in documenting and monitoring various flora and fauna of the Indian Ocean are being undertaken by various parties and institutions with no coordinated or centralized data collection methods. This training aspires to expose researchers of different countries and institutions to adopt standard methodology and data collection protocols for biological monitoring to enable comparisons and integrated data analysis across the region.

This training is also organized in line with the aspirations of UN Ocean Decade to foster joint research and strengthen international cooperation in support of ocean conservation and sustainable development. Implementation of routine and standardized biological observations in the Indian Ocean will also support one of the key challenges of the Decade, to expand the Global Ocean Observing System. This will contribute towards desired outcomes including a healthy and resilient ocean, a predicted ocean and a transparent ocean (www.oceandecade.org).

The training content focussed primarily on biological essential ocean variables (EOVs) for functional groups, in particular microbes, phytoplankton, zooplankton and benthic invertebrates, but will also briefly cover fish, turtles and marine mammals, as well as habitat states such as hard corals, mangroves and seagrasses.

Aims and Objectives

The main aims and objectives of the training is to enhance the capacity of the participants towards conducting sustained biological observations in the Indian Ocean through adaptation of best practices and practical, affordable as well as state of the art methods.

Training Delivery

The training was attended by 70 students encompassing masters' students, research scholars and young researchers from 22 countries mainly covering the Indian Ocean RIM (List of registered participants is attached as **Annexure 1**) and faculty drawn from 11

countries are the experts from international and national research institutions working in the field of Biological Oceanography, Fisheries, etc. and are from the following reputed institutes:

Coastal Oceans Research and Development in the Indian Ocean (CORDIO), East Africa
Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australia
Department of Forestry, Fisheries and the Environment (DFFE), South Africa
Indian National Centre for Ocean Information Services (INCOIS), India
Marine Megafauna Foundation (MMF)
National Centre for Polar and Ocean Research (NCPOR), India
National Ocean and Atmosphere Association (NOAA), USA
Nelson Mandela University (NMU), South Africa
Oceanographic Research Institute (ORI), South Africa
University of Cape Town (UCT), South Africa
Universidade Eduardo Mondlane (UEM), Mozambique
University of KwaZulu-Natal (UKZN), South Africa
University Malaya (UM), Malaysia
University of Oxford, United Kingdom
Universite de la Reunion, France
University of Queensland (UQ), Australia
University of South Florida, USF, USA
Universiti Sains Malaysia (USM), Malaysia
University of Western Australia (UWA), Australia.

The detailed agenda of the training sessions is provided at **Annexure 2.** The course content broadly covers the topics on Microbes, Phytoplankton Biomass and Biodiversity, Remote Sensing Applications, Zooplankton Biomass & Biodiversity, Molecular Analysis / Genomics (Biodiversity), Benthic invertebrate sampling / Biodiversity Assessment, Habitat categories (coral reefs, seagrass beds, mangroves, etc.), Fish Turtles, Marine Megafauna, etc.

The relevant training materials were consolidated and provided to all the participants at https://indiannational-my.sharepoint.com/:f:/g/personal/iogoos_incois_gov_in/EsV0JtoiSxxDqcX0X-zd-eUBfkg1i79rL8FQIoLxjos87g?e=kKNyna with the password to access "BioObs@iogoos" for their future reference as well as for their research utilization and the recordings of all 5 -day sessions were also made available at https://incois.gov.in/ITCOocean/boi0921.jsp

Learning Outcomes

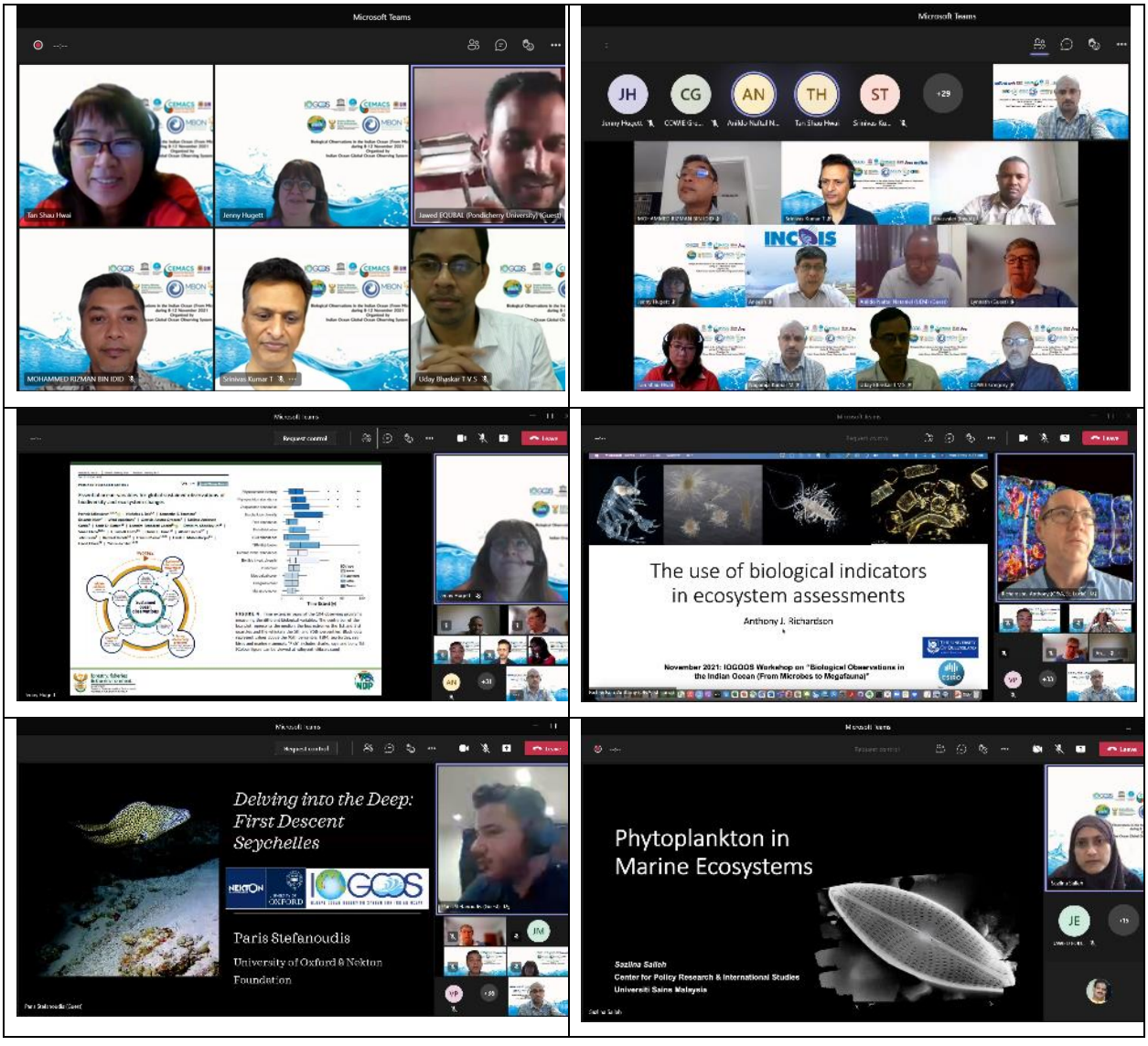
The trainees were benefited with

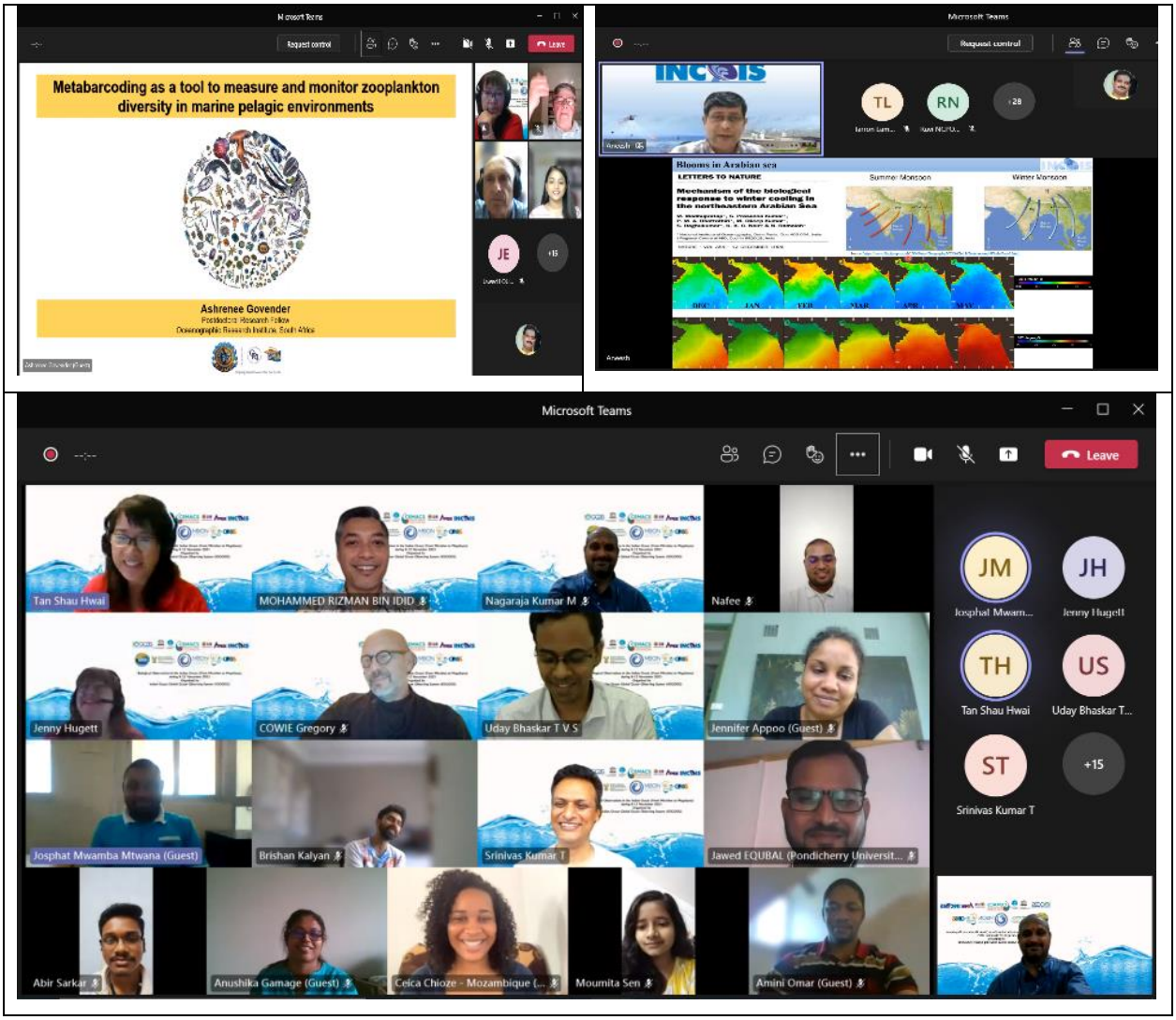
- Access to standardized methodologies for biological EOVs.
- Enhanced regional networking, collaboration and mentorship opportunities.
- Regional ambassadors for biological observations.

- Identification of further training needs for the region.

Financials

ITCOOcean/INCOIS took care of the meeting computational and local logistics costs and provided manpower towards coordination of the meeting, facilitating the sessions, fund management, etc. Though the training sessions were planned as a hybrid, no in-presence participation of the trainees took place due to continuation of the travel restrictions due to the ongoing COVID-19 pandemic situation.





Recommendations

Many of the maritime countries around the Indian Ocean rely heavily on the health of the ocean and also the people depend on the biodiversity. A number of marine ecosystems in various countries are unstudied or under-studied and the existing data on these ecosystems is insufficient. Biodiversity is often the missing link in marine observations. Much of the literature and past training programs have focused on chemical and physical aspects, hence the decision for this program to include biodiversity aspects with a focus on biological observations and the associated essential ocean variables.

The training session was successful with excellent focused talks from several faculty members from all over the world. The following are the some of the recommendations from the training sessions and from participants' feedback:

Take-home messages from the keynote talk by Prof Anthony Richardson on 'The use of biological indicators in ecosystem assessments':

1. **Focus our efforts on EOVs and the need for global assessments** - our national and regional efforts are important and are needed to feed into global assessment

reports. Time-series datasets are critical for mapping marine biodiversity, thus monitoring EOVs over time is essential.

2. **EOVs are a good starting point but 'biomass and diversity' may not explain everything that is happening within an ecosystem**. For example, a bulk biomass indicator is interesting but misses if there are different responses by different species or taxa (some may be increasing while others are decreasing).
3. **We need to develop ecological indicators that are fit-for-purpose and regionally meaningful**, such as focusing on important organisms in your region (e.g. *Noctiluca*, *Trichodesmium*), or important local physical features (e.g. an organism that may indicate current strength, or upwelling, or a particular water mass) – it is useful to read the literature to see what indicators other people have used in their region.
4. **Be careful when interpreting EOVs / Indicators – especially Decline vs Change**. For example, a decline in mangroves, coral cover, or turtles may be bad, but a decline in plankton or microbes may not necessarily be bad, but may indicate a regime shift, or good management leading to reduced eutrophication (and thus les chlorophyll) so again, local or regional context is critical.
5. **Approaches for data synthesis are available**. Some examples are (i) Lifeform analysis (e.g. plankton functional groups, such as dinoflagellates:diatoms), (ii) Community Temperature Index, e.g. to compare short-term recent datasets with historical data, (iii) Statistical models, e.g. to adjust for different sampling methods such as net mesh size, (iv) Online tools, e.g. r packages being developed by CSIRO/IMOS.

Please refer to Dr Richardson's talk on Day 1 for more information on these points.

General recommendations and reflections from participants' feedback:

6. The participants recommended a future **face-to-face meeting with practical hands-on training** in the field / laboratory about the collection and analysis of biological observations.
7. The participants are encouraged to **build collaborations** in their own field going forward, to draw on the knowledge gained during the workshop. Many found the technological applications and focus on sampling methodologies for the different topics very useful and relevant for their own areas of research. Access to the **contact details** for both the younger researchers and the trainers in the different fields will assist in this regard.
8. Suggestion to include a component on **social sciences and humanities** in a future training course, especially related to coastal communities, and ocean economics (multidisciplinary approach).
9. Dr Frank Muller-Karger (Keynote 3) has encouraged all those interested to join the **Marine Biodiversity Networking Fridays**: https://www.aircentre.org/netfridays-marine-biodiversity-01/ to engage with the **Marine Life 2030** community. This is an open network which aims to transform observation and forecasting of marine life for the benefit of all people. Please also visit https://marinelife2030.org/

10. The participants are encouraged to **connect via the early career networks**, e.g. the IIOE-2 Early Career Scientist Network https://iioe-2.incois.gov.in/ecsn/index.html and the WIO Early Career Scientists Network https://www.facebook.com/Western-Indian-Ocean-Young-and-Early-Career-Scientists-Network-1763292820637227

SIBER-related feedback:

11. Dr Greg Cowie (SIBER Co-Chair) emphasized the value of **cross-disciplinary collaboration**, such as using the physical and biogeochemical data from the sensors currently in the Indian Ocean (e.g. Argo and BioArgo floats) to underpin understanding of, and provide environmental context for, the biological components in the Indian Ocean.
12. Greg presented "**CoLaB: Developing a Coastal Lab in a Box**", being developed by Greg Cowie, Tommy Bornman & Juliet Hermes, which aims to provide an affordable and portable package of instruments and methods for coastal oceanographic studies. There will be a "live" workshop on this alongside a planned **CLIVAR Indian Ocean Regional Panel SW Indian Ocean coastal observing meeting (hybrid) in Mozambique and Kuwait in mid-2022**, and the participants are recommended to look out for this training opportunity. If interested feel free to email Greg: Dr.Greg.Cowie@ed.ac.uk

Final recommendations from Dr T. Srinivasa Kumar (Chair: IOGOOS)

13. Don't worry about resources – if you are keen and passionate to conduct this kind of work, we will find a way. **Connect** with the other participants and trainers, and consider submitting joint proposals. We hope to see you at the **International Indian Ocean Science Conference in March 2022**: https://iiosc2020.incois.gov.in/
14. IOGOOS is part of a great network of Indian Ocean researchers, including the SIBER and CLIVAR IORP groups, but it is an informal and friendly network. If your institution is not already a member of IOGOOS, please canvas your Directors to **join IOGOOS –** there is no membership fee, and we would love to have more institutes involved. https://incois.gov.in/iogoos/members.jsp
15. Please look out for **future training opportunities** run by the International Training Centre for Operational Oceanography (ITCOocean): https://incois.gov.in/ITCOocean/Forthcoming_Courses.jsp

16. **THANK YOU AND STAY CONNECTED!**.

Modeling for Ocean Forecasting and Process Studies (MOFPS) and Brainstorming Session

Overview

The dependence of humans on the surrounding oceans has a long history. People depend on oceans for transportation, food, medicine, and many other natural resources. Also, the weather and climate of most parts of the world are determined by the oceans, which cover about 2/3 of the earth's surface. Changing climate imposes threats on the coastal regions due to sea level rise, increase in natural hazards and weather patterns. Hence, understanding the oceans around us and predicting the state of ocean in the timescales from a few hours to a few hundreds of years has become essential for the safety of those who are involved in maritime operations as well as the cost-effectiveness of such operations and the well-being of humankind through our preparedness. Establishment of observational networks and deployment of satellites have increased the availability of important data required to monitor the oceans. Based on these observations, oceanographers have enhanced knowledge of the ocean processes and developed mathematical models to represent their state and circulation. These models are used to (i) represent and forecast the state of the ocean (ii) to study different oceanographic processes.

Aims and Objectives

The course has two components (i). enhancing the capacity of the trainees from Indian Ocean towards ocean forecasting and (ii) brainstorming session to identify the significant ocean parameters required and their forecasting requirements including model set up and operational forecast services.

The training component mainly focused towards introducing the basic concepts of physical and dynamic oceanography and numerical modeling of the ocean general circulation, waves, tides, etc to participants. The lectures were planned in the context of operational applications of ocean modeling. Major topics covered in the course are (i) Fundamentals of Physical Oceanography and Ocean Circulation in the context of Indian Ocean, (ii) Elements of Ocean Circulation Modeling, (iii) Numerical modeling of waves, tides, Tsunami and storm surge, and (iv) Basics of operational ocean forecast systems. The training course is followed by a brainstorming session.

Training Delivery

The training was attended by 78 students comprising of students, researchers, officials and nominees from met-ocean departments from 24 countries mainly covering the Indian Ocean RIM (List of registered participants is attached as **Annexure 3**) and faculty drawn from national research institutions working in the field of ocean state forecasting, ocean modelling, etc. from the following institutions.

Bureau of Meteorology (BOM), Australia
Cochin University of Science and Technology (CUSAT), India

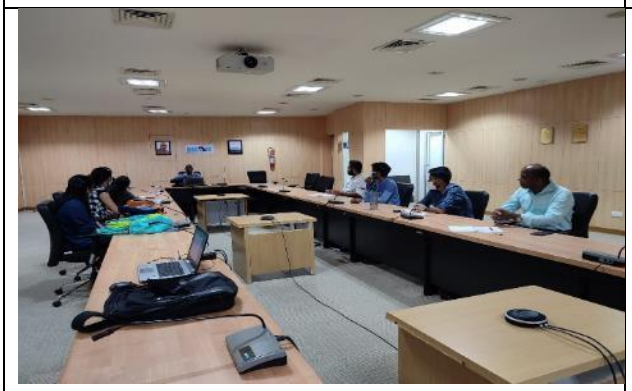
Indian Institute of Technology, Kharagpur, (IIT-K), India
Indian Institute of Tropical Meteorology (IITM), India
Indian National Centre for Ocean Information Services (INCOIS), India

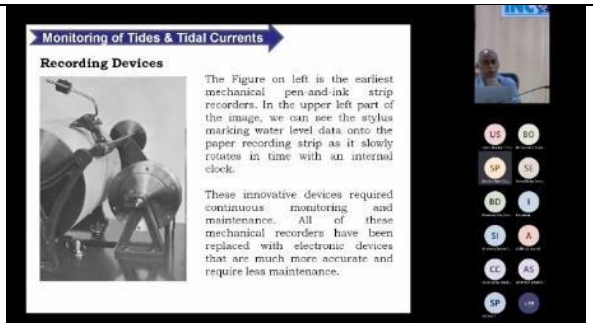
The detailed agenda of the training sessions is provided at **Annexure 4.** The relevant training materials were suggested to all the participants for their future reference as well as for their research utilization and the recordings of all 5 -day sessions were also made available at https://incois.gov.in/ITCOocean/mops0921.jsp

Learning Outcomes

The trainees acquired the

- Knowledge on Ocean circulation models.
- Knowledge on various circulation in Indian Ocean, Waves, tides, Tsunamis etc.
- Elements of operational forecasting.
- Value added products generation using operational forecasts
- Knowledge on the data to be used for ocean modelling, assimilation, etc.





Brainstorming Session

The main objective of the IOGOOS Project on "Modelling for Ocean Forecasting and Process Studies (MOFPS)" is the development of ocean prediction systems (operational implementation, modeling and data assimilation), generating ocean forecasts, generating boundary conditions for finer scale nested models in regions of interest, facilitating marine management and conservation of biodiversity and understanding and adaptation to marine and coastal hazards through ocean forecasting and related ocean modeling.

The MOFPS workshop in 2012 brought out the need to run various models for use of the IOGOOS/MOFPS project members and the capacity building necessity that further emphasized to develop a comprehensive MOFPS capacity building project plan. To meet this need of the region, the present training session on MOFPS has been organized. However, there is still a need to understand what the ocean forecasting needs from the region are, what capacities are available, etc. In order to understand these needs and to identify the essential ocean parameters required for forecasting and the operational needs of the IOGOOS member institutes/ countries from Indian Ocean region, a brainstorming session was held on the last day of the training program. In addition to the trainees, officials from various met-ocean agencies from the countries around IO region were invited as the panelists. Member countries from Regional Integrated Multi-Hazard Early Warning System for Africa and Asia (RIMES) were also invited to join the panel session. The existing Ocean forecasting systems from Australia (by Bureau of Meteorology) and India (from Indian National Centre for Ocean Information Services) were presented to all the participants so as to have an idea of the existing systems in the region. The detailed agenda of the brainstorming session is attached as **Annexure 5.**

In order to identify the ocean parameters required, to know the existing capacities in ocean forecasting from the region, to know the requirement of ocean forecasting, IOGOOS has designed a brief survey form and circulated to all the participants. About 59 participants have responded with their inputs and the results of the survey **(Annexure 6)** were summarized during the brainstorming session and focused discussions were held on the following four aspects.

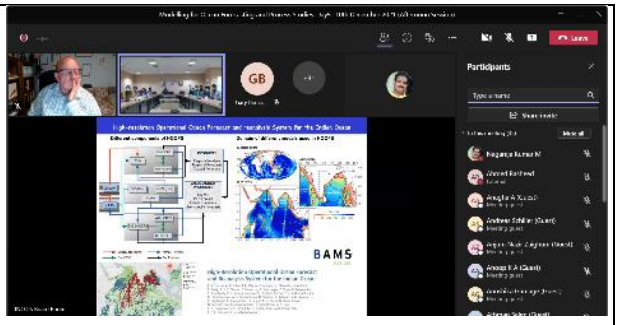
1. What is the availability of operational forecasting products/services for your region?
2. What are the gaps that you feel exist?
3. What are the requirements and purpose of such operational forecasting products/services?
4. What are the resources (computational/human) available? etc.

Panelists from Bangladesh, Comoros, Maldives, and Saudi Arabia participated and presented their responses on the above four discussion points (shown in table below). The recording of the detailed discussions had during the brainstorming session is available at https://indiannational-my.sharepoint.com/:v:/g/personal/iogoos_incois_gov_in/Ee2l0peOcCBBu21vumCIQXABoLp0IoAczQOwI2Phe44xmA?e=nPEF7J.

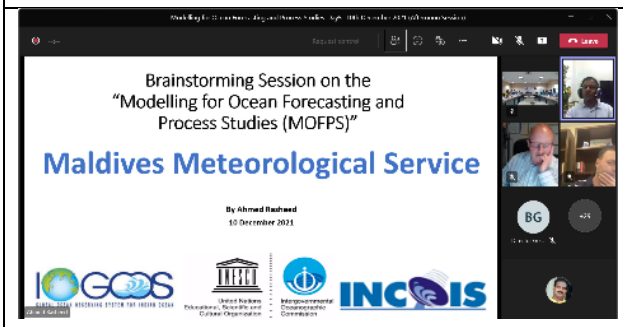
	Bangladesh	Comoros	Maldives	Saudi Arabia
Availability of Operational Forecasting products/ services	• Weather forecasting by Bangladesh Meteorological Department • Flood Forecasting and Warning system by Bangladesh Water Development Board	• Access to forecasting products from South Africa Weather Service (SAWS) • Access to INCOIS forecasting for sea surface parameters • RIMES products	• Dedicated website from INCOIS for Maldives • Access to some of the Products from BOM, Australia • MMS (Local) model products	• Developing operational forecasting system (modeling, monitoring, forecasting and design tools to predict) at KAUST for Red Sea • Oil spill simulations for red sea • Operational Arabian Gulf and Red Sea Forecasting Systems
Existing Gaps	• Lack of skilled manpower, technical knowledge and monitoring system	• Availability of the bathymetric data (nearshore) • High resolution of the wave forecast models • Inability of users/provider to access/send information	• Huge data gaps and training on accessibility and visualization of the data sets •	• The challenges being faced are about continuity of the workforce in the university system. Mostly depend on the students and graduates and need to restart the work as and when new incumbents join. • Downscaling of the atmospheric forcing is a major issue due to limitation of computational resources.
Future Requirements of	• Food Security • Monitoring of (i) marine pollution, (ii)	• High resolution ocean forecasting products/services	• Access to high resolution model data set and training on post	• Downscaled Atmospheric forcing for hybrid

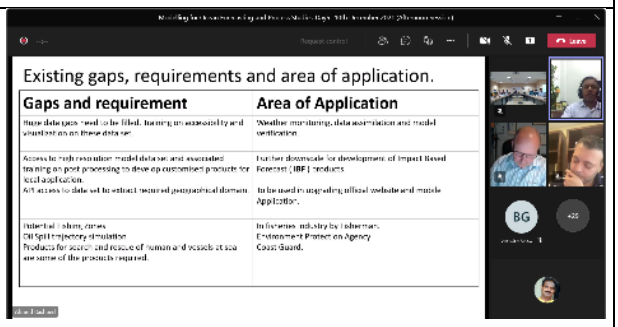
forecasting products / services	marine environment & ecosystem, (iii) shoreline change and (iv) Coral ecosystem • BORI plans to operational forecasting systems for (i) species specific advisories for Tuna, (ii) Monitoring HABs, and (iii) Coral Bleaching Alert System (CBAS)	and their customization • Observations at each fishing ports of the island states • Access to other products such as SARAT, Oil spill propagation model, PFZ, etc.	processing to develop customized products for local applications • More products/ services such as Potential Fishing Zones, Oil spill trajectory simulation, search and rescue products	ensemble assimilation system. • Needed to have a network of observational systems for improving the assimilation system
Resources (Computational / Human) availability	• Currently 12 scientists working in various fields • BORI has high performance Computing for operational forecasting system	• Young team of engineers trained in general disciplines but no specialized expertise • No computational resources but an opportunity exists in climate change, maritime transport and blue economy projects for acquisition	• Need to upgrade PC system to HPC system or switch to cloud computing platform • Access to regional HPC system to host and run local NWP Models • Focused training on NWP Modelling, staff attachment and familiarization to working environment of regional NWP Centres • Training on discovery and operational interpretation and	

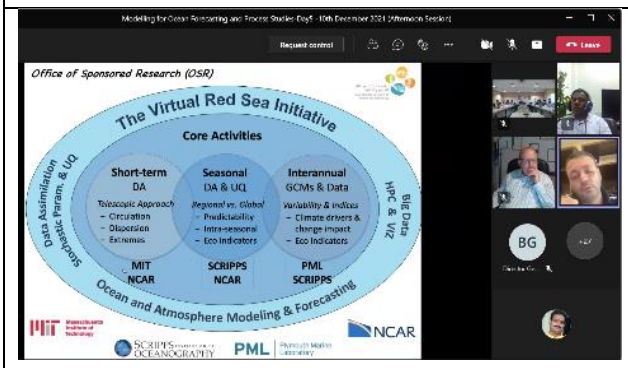
			utilization of available products for daily weather forecasting	

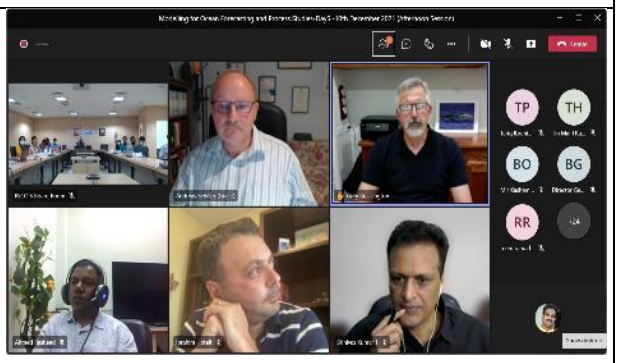



Modelling for Ocean Forecasting and Process Studies
Sayed Mahmood Belal Haider
Director General


Brainstorming Session on the
"Modelling for Ocean Forecasting and
Process Studies (MOFPS)"
Maldives Meteorological Service
By Ahmed Rasheed
10 December 2021
IOGOOS
INCOIS


Existing gaps, requirements and area of application.
Gaps and requirement
Area of Application


Office of Sponsored Research (OSR)
The Virtual Red Sea Initiative
Core Activities
Short-term
DA
Seasonal
DA & UQ
Interannual
GCMs & Data
MIT
NCAR
SCRIPPS
NCAR
PML
SCRIPPS
Ocean and Atmosphere Modeling & Forecasting
NCAR
PML



Recommendations

1. To further specify the gaps and needs of Indian Ocean rim countries in operational oceanography, IOGOOS should design and circulate a detailed survey form to collect the requirements of the member institutes / other countries in the region, in consultation with the IOGOOS Officers, Chair and panelists of the brainstorming session
2. The MOFPS project should be continued with the active stakeholders and newly interested stakeholders from the region
3. IOGOOS should communicate to all IOGOOS Members and regional bodies from IO such as IORA, RIMES, etc. and seek their interest in the MOFPS project as well as the detailed survey.
4. IOGOOS with the technical support of BOM and INCOIS should formulate the necessary capacity building initiatives based on the results of the detailed survey.
5. The requirements in terms of parameters to model, product/services requirement and capacity building were identified by the participants and are detailed as below.
    a. Need for services such as Potential Fishing Zone (PFZ) Advisories, Marine Pollution related services such as Harmful Algal Blooms, Coral Bleaching alert services, Coastal Hazards (swell and wave surge, tidal, cyclones, storm surge, etc.)
    b. Need to address the technical gaps, data gaps, high resolution model setup for the user specific regions, API access to products/services and data, access to regional computing resources by member institutes/ countries.
    c. Need for both short-term and long-term training on modelling, model products interpretation and utilization, data accessibility and visualization, training on meteorology & oceanography, data assimilation, coupled atmosphere and ocean models, etc.

i. Initially a short-term training course in a hybrid mode may be planned followed by a long-term training at a particular center based on the requirements and interests.

6. Explore the cloud computing and data services, especially for island nations and for those countries with limited computational resources
7. Continue and/or establish online community forum to put ideas to collaborate can be made available as part of ITCOOcean

Financials

ITCOOcean/INCOIS took care of the meeting computational and local logistics costs and provided manpower towards coordination of the meeting, facilitating the sessions, funds management, facilitation of local participants, etc. The training sessions were planned as a hybrid, and few faculty members and few national participants have participated in the meeting physically and the following are the details of the participants sponsored under IOC/UNESCO Sponsorship. INCOIS, under the sponsorship of IOC/UNESCO funds, has booked and paid all the charges towards hotel accommodation and a reduced per-diem was reimbursed to the faculty. In addition to the hotel accommodation to the participants present at INCOIS, INCOIS has facilitated entire food (including dinner) to the participants and hence no per-diem is provided (as per the guidelines followed by ITCOOcean/INCOIS). Remaining participants continued to participate in the meeting through online mode.

As per the UN Exchange rate (effective from 01 December 2021 onwards) given at https://treasury.un.org/operationalrates/OperationalRates.php, 1 US$ = 75.09 INR and the same is used while calculating the currency exchanges. While converting the INR to USD, any value higher than 0.5 is rounded up and any value lower than 0.5 are rounded down. The details of the expenditure made towards the air/train fare, hotel and per-diem is provided in the below tables (both in INR and USD). The complete details of the financial receipts and payments are provided at **Annexure 7.**

Acknowledgements

IOGOOS would like to place on record its appreciation to IOC-UNESCO and ITCOOcean/INCOIS for providing the necessary financial and logistics support for organizing these training programmes. It is also acknowledged herewith for the great support extended by Dr. Mika Odido, Head of IOC's Sub Commission for Africa & the Adjacent Island States (IOCAFRICA) and Shri Nageswara Rao, Sr. Accounts Officer, INCOIS and their office in facilitating the administrative processes. IOGOOS would like specially thank Dr. Jenny Huggett, Officer, IOGOOS and Specialist Scientist & Head: Biological Oceanography, Oceans and Coasts of Department of Forestry, Fisheries and the Environment, South Africa, Prof. Dato'Dr. Aileen Tan Shau Hwai, Centre for Marine and Coastal Studies (CEMACS), Universiti Sains Malaysia, Dr. Andreas Schiller, Honorary Fellow, CSIRO, Australia, and the faculty members of both the training programmes for their support in successful conduct of the training programmes as well as the brainstorming session. IOGOOS Also thanks all the Panelists of the brainstorming session of MOFPS for their valuable suggestions to take forward the MOFPS project. We

also thank all the members of IOGOOS and members of RIMES and RIMES Team for their participation in these events. IOGOOS thanks all the participants / trainees to join the training sessions.

Annexure 1

List of participants for the training program on "Biological Observations in the Indian Ocean (From Microbes to Megafauna)"

SL.No	NAME	NATIONALITY	GENDER
1	ABU HENA MUHAMMAD YOUSUF	AUSTRALIA	MALE
2	MOHAMMAD ASHRAF ULLAH ADNAN	BANGLADESH	MALE
3	HAFEZ AHMAD	BANGLADESH	MALE
4	MD.MAHEDEE HASAN(TALUKDAR)	BANGLADESH	MALE
5	KASHAFAD BIN HAFIZ (NAFEE)	BANGLADESH	MALE
6	JOHN VORSTER	CANADA	MALE
7	SUBHADEEP CHOWDHURY	FRANCE	MALE
8	CAMILLE DARDALHON	FRANCE	FEMALE
9	JENNIFER APPOO	FRANCE	FEMALE
10	VYCTORIA MARILLAC FERNANDES DA COSTA CARVALHO	FRANCE	FEMALE
11	ELENA PFEFFER	FRANCE	FEMALE
12	SORY DIAKITE	GUINÉE	MALE
13	SUDIP DAS	INDIA	MALE
14	AVADOOTHA SHIVAKRISHNA	INDIA	MALE
15	JAWED EQUBAL	INDIA	MALE
16	SIRATUN MONTAHA S. SHAIKH	INDIA	FEMALE
17	BRIJ KISHORE	INDIA	MALE
18	DR. BUDHARATNA BHAWARE	INDIA	MALE
19	PRARONA DEY	INDIA	FEMALE
20	SONAMONI KOLEY	INDIA	FEMALE
21	BAPAN MONDAL	INDIA	MALE
22	NASIN AKTAR	INDIA	MALE
23	AKASH HALDAR	INDIA	MALE
24	AMRIT KAMILA	INDIA	MALE
25	SOUMYA KANTI PANDA	INDIA	MALE
26	ABIR SARKAR	INDIA	MALE
27	PRITHVIRAJ BHADURY	INDIA	MALE
28	SOUVIK KUILA	INDIA	MALE
29	MOUMITA SEN	INDIA	FEMALE
30	SANTANU SAHOO	INDIA	MALE
31	ASHMITA BRAHMACHARY	INDIA	FEMALE
32	DENNIS	INDIA	MALE
33	VINMOY MONDAL	INDIA	MALE
34	NILESH PRADHAN	INDIA	MALE
35	JAYITA MAITY	INDIA	FEMALE
36	NANDAN DAS	INDIA	MALE
37	RISKY AYU KRISTANTI	INDONESIA	FEMALE
38	CHRISTINE AKINYI ONYANGO	KENYA	FEMALE
39	HAFIDH ISHMAIL OTIENO	KENYA	MALE
40	JANET MWANGATA	KENYA	FEMALE
41	GEOFFREY ODHIAMBO	KENYA	MALE
42	JOSPHAT MWAMBA MTWANA	KENYA	MALE
43	FAIZA AL-YAMANI	KUWAIT	FEMALE
44	CLAIRE-CÉCILE JUHASZ (CLAIRE)	LA RÉUNION	FEMALE
45	MBELOMANANA ANASVALER	MADAGASCAR	MALE

SL.No	NAME	NATIONALITY	GENDER
46	RITESH SOOBHUG	MAURITIUS	MALE
47	FRANCISCO ZIVANE	MOZAMBIQUE	MALE
48	ANILDO NAFTAL NATNIEL	MOZAMBIQUE	MALE
49	BLESSING EBI OGONODI	NIGERIA	FEMALE
50	RONY TALUKDAR	NORWAY	MALE
51	MD AFSAR AHMED SUMON	SAUDI ARABIA	MALE
52	HAMET DIAW DIADHIOU	SENEGAL	MALE
53	SADAK MOHAMED ALI	SOOMALIA	MALE
54	MAPULA SALOME MAKWELA	SOUTH AFRICA	FEMALE
55	NWABISA MALONGWENI	SOUTH AFRICA	FEMALE
56	CEIÇA ALFREDO CHIOZE	SOUTH AFRICA	FEMALE
57	PHUMLILE COTIYANE-PONDO	SOUTH AFRICA	MALE
58	BRISHAN KALYAN	SOUTH AFRICA	MALE
59	ZAAHID KHAN	SOUTH AFRICA	MALE
60	DIANDRA NAIDOO	SOUTH AFRICA	FEMALE
61	ROBYN PAYNE	SOUTH AFRICA	FEMALE
62	KHUTSO RAMALEPE	SOUTH AFRICA	FEMALE
63	ANTHEA CHLOE PILLAY	SOUTH AFRICA	FEMALE
64	RUPPEGODA GAMAGE ANUSHIKA IROSHANIE	SRI LANKA	FEMALE
65	THILAKARATHNA ARACHCHIGE PESHALA RANMINI	SRI LANKA	FEMALE
66	SULEMANI MASOUD MOHAMED[7]	TANZANIA	MALE
67	AMINI OMAR JUMA	TANZANIA	MALE
68	RAMADHAN MTABIKA SELEMAN	TANZANIA	MALE
69	ZAHOR MWALIM KHALFAN	TANZANIA	MALE
70	CHARLES NYANGA	ZAMBIA	FEMALE

Annexure 2

Agenda of the Training program on "Biological Observations in the Indian Ocean (From Microbes to Megafauna)"

ESSO	**International Training Centre for Operational Oceanography (ITCOocean) ESSO-INCOIS, Hyderabad, India**	INCOIS

Biological Observations in the Indian Ocean (From Microbes to Megafauna) during 8-12 November 2021
Organized by
Indian Ocean Global Ocean Observing System (IOGOOS)

Venue: ITCOocean, Indian National Centre for Ocean Information Services (INCOIS), Hyderabad, India.

1.0 IOGOOS Workshop on Biological Observations in the Indian Ocean

- **Draft Programme**

Table 1 outlines the tentative programme for the workshop.

Table 1. Draft Programme

Time	Activities	Speaker
DAY 1: Monday 8 November Microsoft teams meeting link: Click here to join the meeting		
OPENING AND INTRODUCTION [Chair: Dr PN Vinaychandran]		
Time zone: IST	**Setting the scene & welcome**	
11:00– 11:30 (30 minutes)	Welcoming remarks	**Dr T. Srinivasa Kumar (Director, INCOIS & Chair, IOGOOS)**
	Opening remarks by Partner Institutes: ● SIBER ● CEMACS	**Dr. Greg Cowie (Co-Chair, SIBER)** **Prof. Aileen (USM)**
	Introduction: Biological observations in the context of Climate Change and the UN Decade of Ocean Science - the EOV approach ● Brief on the workshop objectives, and expected outcomes	**Dr. Jenny, Huggett (DFFE, SIBER & IOGOOS Officer)**
11:30 – 12:00 (30 mins)	**Participants brief self-introduction** **Virtual Group photo**	**All Participants**

12:00 – 12:30 (30 mins)	**Keynote 1: The use of biological indicators in ecosystem assessments**	**Prof Anthony Richardson (UQ & CSIRO)**
12:30 -13:00 (30 mins)	**Keynote 2: Delving into the Deep: First Descent - Seychelles**	**Dr Paris Stefanoudis (University of Oxford & Nekton Oxford Deep Ocean Research Institute)**
13:00 – 14:00 (1 hour)	**Lunch**	
MICROBES [Chair: Dr Lynnath Beckley]		
14.00 – 14:30 (30 mins)	**The Ocean Microbiome: The Ocean's invisible Engine**	**Dr Emma Rocke (UCT)**
14:30 – 15:15 (45 mins)	**Modern imaging and OMICS techniques used to describe and quantify marine microbial communities**	**Dr Emma Rocke (UCT)**
15:15 – 16:00 (45 mins)	**Biodiversity measurement (sequencing)**	**Dr Eric Raes (Minderoo Foundation)**
DAY 2: Tuesday 9 November Microsoft teams meeting link: Click here to join the meeting		
PHYTOPLANKTON FUNDAMENTALS [Chair: Dr Tarron Lamont]		
11:00 - 11:30 (30 mins)	**Introduction:** • **Role of phytoplankton in marine ecosystem** • **EOV overview: Phytoplankton biomass & diversity**	**Dr Sazlina Salleh (USM)**
11:30 – 12:15 (45 mins)	**Using data from BGC-Argo floats in fisheries and fisheries management**	**Dr Cara Wilson (NOAA)**
12:15 – 13:00 (45 mins)	**Biomass, pigment, NPP**	**Dr. Anisah Lee Abdullah (USM)**
13:00 – 14:00 (1 hour)	**Lunch**	
PHYTOPLANKTON & ECOSYSTEM [Chair: Dr Tarron Lamont]		
14:00 -14:40 (40 mins)	**A taxonomic approach in harmful algal blooms (HABs) and other aspects of ecosystem dynamics**	**Dr. Ravidas Naik (NCPOR, India)**
114:40-15:20 (40 mins)	**Remote Sensing of HABs with special emphasis on *Noctiluca***	**Dr. Aneesh Lotliker (INCOIS, India)**
15:20 – 16:00 (40 mins)	**Remote Sensing of Fronts & Fisheries**	**Dr. Sourav Maity (INCOIS, India)**
DAY 3: Wednesday 10 November Microsoft teams meeting link: Click here to join the meeting		
ZOOPLANKTON [Chair: Dr Lynnath Beckley]		

11:00-11:30 (30 mins)	**Introduction:** ● **Role of zooplankton in marine ecosystem** ● **EOV overview: Zooplankton biomass and diversity**	**Mr Julian Uribe-Palermo (CSIRO)**
11:30 – 12:15 (45 mins)	**Standard methods for sampling & analysis (Net sampling, microscope, CPR)**	**Ms Claire Davies (CSIRO)**
12:15 – 13:00 (45 mins)	**Advanced methods for sampling & analysis (Optical imaging, acoustics etc)**	**Dr Margaux Noyon (NMU)**
13:00 – 14:00 (1 hour)	**Lunch**	
MOLECULAR ANALYSIS AND BIODIVERSITY [Chair: Dr Johan Groeneveld]		
14:00 – 14:45 (45 mins)	**Metabarcoding as a tool to measure and monitor zooplankton diversity in marine pelagic environments**	**Dr Ashrenee Govender (ORI)**
14:45 – 15:30 (45 mins)	**Challenges and Prospect of eDNA Barcoding in the Tropics**	**Dr. Mohammed Rizman-Idid (UM)**
15:30 – 16:00 Hrs (30 mins)	**Keynote 3: Marine Life 2030**	**Dr. Frank Muller - Karger (USF)**
DAY 4: Thursday 11 November Microsoft teams meeting link: Click here to join the meeting		
BENTHIC INVERTEBRATE SAMPLING & BIODIVERSITY ASSESSMENT [Chair: Prof Aileen Tan Shau Hwai]		
11:00 – 11:30 (30 mins)	**Introduction** ● Long term monitoring of benthic invertebrate biodiversity ● Using benthic invertebrate as proxy for monitoring coastal areas	**Dr Abe Woo Sau Pinn (USM)**
11:30 – 12:00 (30 mins)	**Specimen collection, treatment and cataloguing system** ● Specimen collection strategies for benthic organisms ● Specimen treatment for identification and taxonomic collection ● Cataloguing and keeping records of marine invertebrates	**Dr. Naoto Jimi (USM & NU)**
12:00 – 13:00 (60 mins)	**Benthic Imaging** ● An introduction to benthic camera systems ● Marine imagery data acquisition and annotation – focus on transect surveys using SCUBA	**Dr Charles von der Meden (UKZN)** **Dr Paris Stefanoudis (University of Oxford & Nekton Oxford Deep Ocean Research Institute)**
13:00 – 14:00 (1 hour)	**Lunch**	

HABITAT TYPES [Chair: Dr Greg Cowie]		
14:00 – 14:40 (40 mins)	**Hard coral cover and composition (will mention macroalgae)**	**Dr David Obura & Mr Mishal Gudka (CORDIO East Africa)**
14:40 – 15:20 (40 mins)	**Mangrove cover and composition**	**Dr Salomao Bandeira (UEM) & Dr Sharyn Hickey (UWA)**
15:20 – 16:00 (40 mins)	**Seagrass cover and composition**	**Dr Miguel s (UP & C-GRASS)**
DAY 5: Friday 12 November Microsoft teams meeting link: Click here to join the meeting		
FISH, SHARKS & RAYS; BIRDS, TURTLES & MAMMALS [Chair: Dr Aneesh Lotliker]		
11:00 – 11:40 (40 mins)	**Fish abundance & distribution: Surveys, BRUVS, Acoustics (active & passive), Telemetry (Satellite and Acoustic)**	**Dr. Nimit Kumar (INCOIS, India)**
11:40 – 12:00 (20 mins)	**Shark and ray abundance & distribution: Marine Megafauna**	**Dr Chris Rohner (MMF)**
12:00 – 13:00 (1 hour)	**Sea turtle research and monitoring in South Africa** **Methods for investigating distribution and abundance of seabirds in the Indian Ocean** **Tools and approaches to monitoring marine mammals in the Indian Ocean**	**Dr Diane le Gouvelo (NMU),** **Prof Matthieu Le Corre (Univ Réunion)** **Dr Gill Braulik (Univ St Andrews)**
13:00 – 14:00 (1 hour)	**Lunch**	
CLOSING [Chair: Prof Aileen Tan Shau Hwai]		
14:00 – 15:00 (1 hour)	**Reflection of participants**	**Prof Aileen Tan Shau Hwai (USM) + all**
15:00 – 15:30 (30 mins)	**Closing Remarks**	**IOGOOS / SIBER / Invited experts / Session Chairs**

2.0 Guidelines for content

- GOOS EOV approach
- Ocean best practices / standard operating procedures & where to access them
- cover both basic methods as well as state of the art
- provide links to useful networks/contacts/references/resources etc
- examples of existing monitoring programmes following this approach
- The talks can be pre-recorded, although we would prefer live to permit some time for interaction and Q&A at the end

- We recognise there is insufficient time to do the topic justice but hopefully you can still provide a good overview of your topics and direct the participants to where to access more detailed guidelines, and if you have established a regional network for such activities.

3.0 Institutes and affiliations:

CEMACS: Centre for Marine and Coastal Studies, Universiti Sains Malaysia, Malaysia
CORDIO: Coastal Oceans Research and Development in the Indian Ocean, East Africa
CSIRO: Commonwealth Scientific and Industrial Research Organisation (Australia)
DFFE: Department of Forestry, Fisheries and the Environment (South Africa)
INCOIS: Indian National Centre for Ocean Information Services (India)
IOGOOS: Global Ocean Observing System in the Indian Ocean
Minderoo Foundation (Australia)
MMF: Marine Megafauna Foundation
NCPOR: National Centre for Polar and Ocean Research (India)
NOAA: National Ocean and Atmosphere Association (USA)
NMU: Nelson Mandela University (South Africa)
NU: Nagoya university (Japan)
ORI: Oceanographic Research Institute (South Africa)
SIBER: Sustained Indian Ocean Biogeochemistry and Ecosystem Research
UCT: University of Cape Town (South Africa)
UEM: Universidade Eduardo Mondlane (Mozambique)
UKZN: University of KwaZulu-Natal (South Africa)
UM: University of Malaya (Malaysia)
Université de la Reunion (France)
University of Oxford (United Kingdom)
University of St Andrews (United Kingdom)
UP: University of Philippines
UQ: University of Queensland (Australia)
USF: University of South Florida (USA)
USM: Universiti Sains Malaysia (Malaysia)
UWA: University of Western Australia

Annexure 3

List of participants for the training cum Brainstorming session on "Modeling for Ocean Forecasting and Process Studies (MOFPS)"

SL. NO	FULL NAME (WITH SURNAME)	NAIONALITY	GENDER
1.	PHAM HAI AN	VIETNAM	MALE
2.	MANARE CAROLINE SEJENG	SOUTH AFRICAN	FEMALE
3.	SAGERO PHILIP OBAIGWA	KENYAN	MALE
4.	HAFEZ AHMAD	BANGLADESHI	MALE
5.	EDIANG OKUKU ARCHIBONG	NIGERIA	MALE
6.	CARA-PAIGE GREEN	SOUTH AFRICAN	FEMALE
7.	SHAILEE PATEL	INDIAN	FEMALE
8.	CHARLES NYANGA	ZAMBIAN	MALE
9.	MATTHEW CARR	SOUTH AFRICAN	MALE
10.	PHILILE MVULA	SOUTH AFRICAN	FEMALE
11.	BAFANA GWEBA	SOUTH AFRICAN	MALE
12.	ADDEY	NIGERIAN	MALE
13.	SUDIP DAS	INDIAN	MALE
14.	THILAKARATHNA ARACHCHIGE PESHALA RANMINI	SRI LANKAN	FEMALE
15.	HAFIDH ISHMAIL OTIENO	KENYAN	MALE
16.	HUMBERTO CHAPATA CARVALHO	MOZAMBICAN	MALE
17.	GIOVANNA BIRKETT	SOUTH AFRICAN	FEMALE
18.	ELHAM MAHMOUD ALI	EGYPTIAN	FEMALE
19.	CHALERMRAT SANGMANEE	THAI	MALE
20.	SALAH ALRABEEI	YEMEN	MALE
21.	MOHAMED SALEM HUSSIEN	EGYPTIAN	MALE
22.	RUPPEGODA GAMAGE ANUSHIKA IROSHANIE	SRI LANKAN	FEMALE
23.	GALAHITIYAWE WALAWWE MAHESHI MADUWANTHI KUMARI DHEERASINGHE	SRI LANKAN	FEMALE
24.	TANAYA DAS	INDIAN	FEMALE
25.	MAHESH R	INDIAN	MALE
26.	ATHMAN SALIM HUSSEIN	KENYA	MALE
27.	MS. ANAGHA A	INDIAN	FEMALE
28.	MANARE CAROLINE SEJENG	SOUTH AFRICAN	FEMALE
29.	DHRUBAJYOTI SAMANTA	INDIAN	MALE
30.	AKSHATA ASHOK SARVANKAR	INDIAN	FEMALE
31.	VASUPALLI DHANA RAJU	INDIA	MALE
32.	MORE RUTUJA SANJAY	INDIAN	FEMALE
33.	CAROLINA CAMARGO	BRAZILIAN	FEMALE
34.	SHAILEE JAITRAK PATEL	INDIAN	FEMALE
35.	JOHN VORSTER	KENYA	MALE
36.	RITESH SOOBHUG	MAURITIAN	MALE
37.	SRINIVASARAO KARRI	INDIAN	MALE
38.	ANUP N	INDIAN	MALE
39.	ABHISHEK V A	INDIA	MALE
40.	AMIT KUMAR JENA	INDIAN	MALE
41.	SAMIRAN MANDAL	INDIAN	MALE
42.	SANDIP GIRI	INDIAN	MALE
43.	RAJIVE KRISHNAN R	INDIAN	MALE
44.	ANISHA LG	INDIAN	FEMALE

SL. NO	FULL NAME (WITH SURNAME)	NAIONALITY	GENDER
45.	URMILA P	INDIAN	FEMALE
46.	SAFIN IP	INDIAN	MALE
47.	ANUSREE A	INDIAN	FEMALE
48.	PARVATHY M	INDIAN	FEMALE
49.	FATHIMA H	INDIAN	FEMALE
50.	WELIGAMAGE INDIKA	SRI LANKAN	MALE
51.	ADMED RASHEED	MALDIVIAN	MALE
52.	K ARULNATHAN	SRI LANKAN	MALE
53.	SWATHY AR	INDIAN	FEMALE
54.	BISWARUP DAS	INDIAN	MALE
55.	SIKHA AHLAWAT	INDIAN	FEMALE
56.	CDR PAWAN PARMAR	INDIAN	MALE
57.	MR. VINCENT AMELIE	SEYCHELLES	MALE
58.	DR. NIRIVOLOLONA RAHOLIJAO	MADAGASCAR	MALE
59.	MR. FAWAZ DILMAHOMED	MAURITIUS	MALE
60.	MR. RITESH RUGHOONUNDUN	MAURITIUS	MALE
61.	MR. ANJUM NAZIR ZAIGHUM	PAKISTAN	MALE
62.	MR. TARIQ IBRAHIM	PAKISTAN	MALE
63.	MR. EGBERT QUATRE	SEYCHELLES	MALE
64.	MR. HEZRON ANDANGO	SEYCHELLES	MALE
65.	MR. MOHAMMED ALBOORY	YEMEN	MALE
66.	MR. ADEL HEBAH	YEMEN	MALE
67.	MR. A.R. SUBBIAH	THAILAND	MALE
68.	DR. K.J. RAMESH	THAILAND	MALE
69.	MR. RAMRAJ NARASIMHAN	THAILAND	MALE
70.	MR. CLINT LAGANG	THAILAND	MALE
71.	MR. SUBHAJIT GHOSH	THAILAND	MALE
72.	MS. J ELAINE LAYUG NAPARAT	THAILAND	FEMALE
73.	DR. MAY KHIN CHAW	MYANMARI	MALE
74.	DR. TIN MAR HTAY	MYANMARI	MALE
75.	MS. SANDAR WAI	MYANMARI	FEMALE
76.	DR. SHWE YEE NEW	MYANMARI	MALE
77.	MR. MD. SHAHEENUL ISLAM	BANGLADESHI	MALE
78.	DR. YIN MYO MIN HTWE	MYANMARI	MALE

Annexure 4

Modelling for Ocean Forecasting and Process Studies

6-10 December 2021

Organized by Indian Ocean Global Ocean Observing System (IOGOOS) &

Hosted by International Training Centre for Operational Oceanography (ITCOocean), INCOIS

Inaugural session : 6-12-2021 from 1030 Hrs to 1100 Hrs

Time (IST)	6-12-2021 (Monday)	7-12-2021 (Tuesday)	8-12-2021 (Wednesday)	9-12-2021 (Thursday)	10-12-2021 (Friday)
1100-1200	Ocean Waves - basics, characteristics in deep & shallow waters, wave spectrum, model generation & classes (PKB)	Storm surges - tropical cyclones, characteristics of storm surges, coastal inundation (PKB)	Mixed Layer Processes - surface temperature and salinity, air-sea heat fluxes, evaporation, precipitation, Arabian Sea, Bay of Bengal (VVJ)	Estuaries- river discharge and tides, mixing and stratification, estuarine circulation, modelling estuarine processes (VVJ)	Elements of Operational Ocean Forecast Systems and their applications (PAF)
1200-1300	Introduction to ocean circulation (CGN)	Numerical modeling of ocean waves & operational use; Modeling Tides and Water level elevation (PKB)	Equatorial waves, IOD and ENSO (PAF)	Heterogeneous data for ocean modeling studies. (UB)	Basic concepts of data assimilation (AP)
1300-1400 (Lunch Break)					
1400-1430	Arabian Sea Primary Production and Nutrient & Carbon Cycling (VVA)	Nutrient Limitations of Arabian Sea Primary and Secondary production and evolutions of subsurface chlorophyll maxima (VVA)	Oxygen limitations and denitrification of the Arabian Sea (VVA)	Monitoring and Forecasting the Biogeochemical State of the Indian Ocean (KC)	Transition from EnOI to EnKF based Data Assimilation (GB)
1430-1500					Brainstorming Session (1430-1645 hrs IST)
1500-1600	Ocean Tides - equilibrium & dynamical theories, tidal constituents, monitoring of tides & tidal currents, tide producing forces (PKB)	Tsunami generation models, propagation, & flooding characteristics; Numerical models for storm surge prediction (PKB)	Mixed Layer Processes - entrainment, detrainment, advection, shortwave penetration (VVJ)	Basics of ocean circulation models (PAF)	
1600-1700	Tsunamis - causes & generation, travel time, measurement techniques, coastal vulnerability (PKB)	North Indian Ocean currents (CGN)	Introduction to Marine Ecosystem Modeling (KC)	Modelling the ocean mixed layer (PAF)	

Faculty Members:					
CG	Dr. C. Gnanaseelan, IITM	VVA	Dr. Vinu Valsala, IITM	VVJ	Dr. V. Vijith, CUSAT
PB	Prof. Prasad Kumar Bhaskaran, IITK	KC	Dr. Kunal Chakraborty, INCOIS	AP	Dr. Arya Paul, INCOIS
GB	Dr. Gary Brassington, BOM	PAF	Dr. Francis P. A., INCOIS	UB	Dr. Udaya Bhaskar, INCOIS

Affiliations:

BOM: Bureau of Meteorology

CUSAT: Cochin University of Science & Technology

IITK: Indian Institute of Technology Kharagpur

INCOIS: Indian National Centre for Ocean Information Services

Annexure 5

Brainstorming Session on the "Modelling for Ocean Forecasting and Process Studies (MOFPS)"
December 10, 2021 @ 1430 Hrs

Agenda

Meeting link:
https://teams.microsoft.com/dl/launcher/launcher.html?url=%2F_%23%2Fl%2Fmeetup-join%2F19%3Ameeting_NGU2YzQ4NDQtMzM4YS00NjEyLWFkZjctOWE3YzMyM2UxYmVl%40thread.v2%2F0%3Fcontext%3D%257b%2522Tid%2522%253a%25227e17d518-ccec-443b-afd6-3312ce5c6a1d%2522%252c%2522Oid%2522%253a%2522c40021a2-3327-4500-a2f6-25c378ebc367%2522%257d%26anon%3Dtrue&type=meetup-join&deeplinkId=12ad34f4-d720-4d71-aec0-e176fb5011dc&directDl=true&msLaunch=true&enableMobilePage=true&suppressPrompt=true

Time (in IST)	Agenda Item
1430 – 1435 Hrs	Welcome Address by Dr. T. Srinivasa Kumar, Chair, IOGOOS & Director, INCOIS and Introduction on MOFPS
1435 – 1440 Hrs	Opening remarks by Dr. Andreas Schiller, Honorary Fellow, CSIRO, Australia
1440 – 1455 Hrs	OceanMAPS - Global ocean forecasting in Australia by Dr Gary B Brassington, BOM, Australia
1455 – 1510 Hrs	INDian Ocean FOrecasting System (INDOFOS) by Dr. Francis A Pavanathara, INCOIS, India
1510 – 1525 Hrs	The Ocean Forecasting Systems – Regional Requirements and Resources – Consolidation of Survey Results – Dr. Francis A Pavanthara, INCOIS, India
1525 – 1555 Hrs (5 minutes for each panel member)	Panellist from Bangladesh – Dr. Sayeed Mahmood Belal Haider, BORI Panellist from Comoros, Dr. Saifou-Dine, ANACM Panellist from Maldives – Dr. Ahmed Rasheed, MMS Panellist from Saudi Arabia – Prof. Ibrahim Hoteit, KAUST Panellist from Seychelles - Dr. Vincent Amelie, SMA Panellist from Sri Lanka – Dr. K. Arulnathan, NARA
1555 – 1635 Hrs	Forum open for discussions with all panel members and participants/trainees
1635 – 1645 Hrs	Summarisation of the Regional Requirements (Parameters to be modelled, Capacity Development requirements, Products/Services requirements, etc.)
1645 – 1655 Hrs	Concluding remarks by Dr. Andreas Schiller and Dr. T. Srinivasa Kumar
1655 – 1700 Hrs	Vote of Thanks by Dr. TVS Udaya Bhaskar, Coordinator & Head, ITCOOcean

Focus of Panel Discussions:

1. What is the availability of operational forecasting products/services for your region?
2. What are the gaps that you feel exist?
3. What are the requirements and purpose of such operational forecasting products/services?
4. What are the resources (computational/human) available? etc.

Abbreviations:

ANACM	National Agency for Civil Aviation and Meteorology
BOM	Bureau of Meteorology
BORI	Bangladesh Oceanographic Research Institute
CSIRO	Commonwealth Scientific and Industrial Research Organization
IOGOOS	Indian Ocean Global Ocean Observing System
INCOIS	Indian National Centre for Ocean Information Services
ITCOOcean	International Training Centre for Operational Oceanography
KAUST	King Abdullah University of Science and Technology
MMS	Maldives Meteorological Service
NARA	National Aquatic Resources Research and Development Agency
SMA	Seychelles Meteorological Authority

Annexure 6

Summary of results of the Survey conducted on "Ocean Forecasting Products / Services"

1. **Do your Organization/country use any operational ocean forecast Services (Yes:34, No: 25)**

2. **Whether the ocean forecasting products/services are generated within the country/Organization (Yes:16, No:18)**

3. **Are your organization/country interested in making use of ocean forecast services (Yes:23, No:2)**

4. **Are your organization /country interested in setting up your own ocean modelling/forecasting System (Yes:33, No: 8)**

5. **Do you have sufficient computational resources (Yes:12, No:21)**

6. **Do you have sufficient trained Manpower (Yes:06, No:27)**

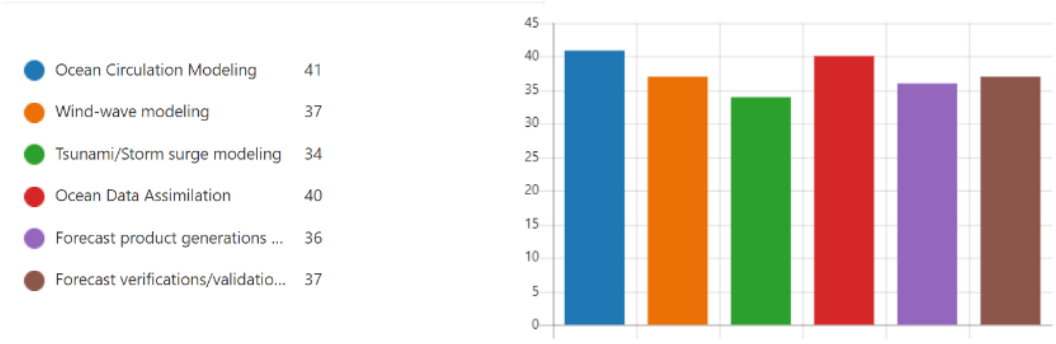
7. **Do you have access to ocean observation data (Yes:13, No: 20)**

8. **Do you carry out process specific observational campaigns (Yes:13, No: 20)**

9. **Do you have access to real-time ocean observation equipment / data for forecast verifications (Yes: 7, No:26)**

10. **Do your organization/country is interested to have training on ocean forecast system (Yes:46, No: 3)**

11. **If yes, in which area do you require training**



12. **Do you have sufficient institutional funding to take training programme**