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25-26 July 2011, Chennai, India

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IOP-8 MEETING
25-26 July 2011, Chennai, India

Action Items

ACTION: Engage with the Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System in order to facilitate resources and data sharing (co-chairs)

ACTION: Discuss at IOP-9 issues related about drifters in the Indian Ocean (co-chairs)

ACTION: Request IRF to discuss the possibility of multi-institutional ship-time coordination in the eastern Indian Ocean (co-chairs)

ACTION: Define the research and explore the possibility of replacing moorings with Argo floats and gliders. Request IRF to support it (IOP members)

ACTION: Make statement to NOAA on the impact that reducing the XBT network in the IO would have on climate research in the region (co-chairs)

ACTION: Request IRF to formulate a strong statement and examine potential high-level solutions to deal with piracy issues in the Western Indian Ocean (co-chairs)

ACTION: Discuss the issue of Decadal Variability in the Indian Ocean at the next panel meeting (co-chairs)

ACTION: Endorse the proposal of Chapman Conference on the Agulhas System (co-chairs)

ACTION: Organise, jointly with the SIBER SSC and IRF, the IOP-9 meeting in September 2012 in South Africa, in conjunction with the Chapman Conference proposed by the SCOR Agulhas System WG (co-chairs, ICPO)

ACTION: Develop a review paper on decadal variability in the Indian Ocean (W. Han to lead with help from J. Vialard, T. Lee, G. Vecchi)

ACTION: Update IOP webpages (ICPO)

ACTION: Recommend to CLIVAR SSG that M. Ravichandran replaces Yukio Masumoto as IOP co-chair (co-chairs, ICPO)

1. Indian Ocean Panel overview and Terms of Reference

The CLIVAR/GOOS Indian Ocean Panel provides scientific and technical oversight for implementation of the sustained ocean observing system for the Indian Ocean and coordinates research on the role of the Indian Ocean on the climate system.

1. Provide scientific and technical oversight for a sustained ocean observing system for the Indian Ocean and Indonesian Throughflow in order to provide ocean observations needed for climate variability research, and to underpin operational ocean applications and services relevant to the region, particularly with regard to ocean-state estimation and climate prediction.

2. Develop, coordinate, and implement a plan for a sustained ocean observing system for the Indian Ocean, to: (a) meet the common requirement of CLIVAR research themes and regional initiatives, particularly those identified by AAMP and VACS and the CLIVAR modelling panels; (b) satisfy the common requirements of GOOS and its modules; and (c) coordinate implementation activities in collaboration with relevant regional and global bodies and IOGOOS and JCOMM in particular.

3. Liaise with relevant research panels of CLIVAR and implementation panels of GOOS and JCOMM and provide a focal point for coordination of ocean observing networks in the region.

4. Report to the CLIVAR SSG through its AAMP and to GOOS through the IOC Perth Office.

2. IOP-8 setting and charge to the meeting

Yukio Masumoto, IOP co-chair, welcomed all panel members and invitees. Apologies were sent by Weidong Yu, Ming Feng. IOP-8 will be held in conjunction with the 2nd SIBER-SSG meeting on 27-28 July and the 2nd IndOOS Resource Forum (IRF) on 29 July. We will have a joint session with SIBER on 27 July afternoon, and there is a mini symposium on "Challenging scientific issues that are being addressed by IndOOS" during the morning of 29 July, as a part of IRF. IOP members are invited to participate in these discussions. Welcome words have also been said by representatives of the panel's sponsor, CLIVAR (Nico Caltabiano, ICPO, UK) and GOOS (Nick D'Adamo, UNESCO IOC Perth Office). M. Ravichandran and Dr. S.S.C. Shenoi local host and INCOIS representative, also welcome all participants. Meeting attendees reviewed action items from the 7th Indian Ocean Panel meeting (IOP-7) and 18th Session of the CLIVAR Scientific Steering Group (SSG-18).

3. IndOOS session

S.S.C. Shenoi presented India's activities in providing Ocean Information Services. INCOIS was established in 1999 with the purpose of applying the advances in Ocean Science and Technology, Space Technology and Information & Communication Technology for the benefit of Society. Its main mission is to "Provide the Ocean Information and Advisory Services to Society, Industry, Government Agencies and Scientific Community through Sustained Ocean Observations and Constant improvements through Systematic and Focussed Research"

Suryachandra A. Rao spoke about India's Monsoon Mission. All models have serious biases in simulating all aspects of monsoon such as diurnal, intreaseasonal and interannual variability, and the seasonal mean. These biases reflect in poor prediction skill of both monsoon weather (short-

medium range) and climate (seasonal). Over the past 20 years, although India has made some notable contribution in observational programs, we have made no tangible contribution in model development/improvement and it is necessary a large investment so that changes can be seen in this aspect. The main objective for a India to develop a Monsoon Mission is to improve forecasts in the country for weather (short and medium range), climate (seasonal and interannual scales) and climate change (decadal prediction) scenarios.

T. Srinivasa Kumar, Scientist In-charge of the Indian Tsunami Early Warning Centre at INCOIS, Hyderabad, and Vice Chair of the Intergovernmental Coordination Group for Indian Ocean Tsunami Warning and Mitigation System presented the latest developments of the Indian Tsunami Early Warning System. He explained the processes developed for detection, warning and dissemination in case of occurrence of a tsunami. He also showed the educational material for tsunami awareness that has been prepared and is distributed at capacity building workshops. The key priorities of these workshops is to educate the public (especially in near-source vulnerable coastal areas) on responding to earthquakes & tsunami warnings, provide support to coastal administrators, disaster management officials and public on SOPs, use of tsunami inundation maps. There is also a component to include disaster awareness and response related topics in primary, secondary and high school curriculum.
Several links with IOP and IRF may exist. Data Sharing is one of them since observing sea-level rise is an essential requirement for the climate observing system. Also, real-time sea-level stations are needed to facilitate the maintenance of continuous sea-level records and to validate satellite altimetry data in operational ocean models. Other link that can be strengthened is observing platforms and ship time optimisation. Logistics for implementation of Climate monitoring system and tsunami warning system can potentially including shared ship time, protection from vandalism, coordinated development of instrumentation packages, fail–safe communication system and a long-term commitment to maintain the sites. These issues will all be discussed during IRF-2.

ACTION: Engage with the Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System in order to facilitate resources and data sharing (co-chairs)

ACTION: Discuss at IOP-9 issues related about drifters in the Indian Ocean (co-chairs)

Tim Moltmann updated the panel with the latest activities of Australia's Integrated Marine Observing System (IMOS). The programme is a national enterprise, with collaboration from several Australian institutions, driven by science planning, focused in nodes of activities and delivered by Institutions operating ten National Facilities, making all data discoverable and accessible for free. One of the activities that IMOS has been developing is the monitoring of Indonesian Throughflow (ITF) and northwest shelves of Australia, with Timor Passage and Ombai Strait recently occupied with moorings.

ACTION: Request IRF to discuss the possibility of multi-institutional ship-time coordination in the eastern Indian Ocean (co-chairs)

M. Ravichandran presented the current status of Argo floats in Indian Ocean. He mentioned that there are 718 floats are active in the total Indian Ocean and about 474 floats in the north of 40S.

About 75 floats were deployed during last one year, out of which 18 floats with iridium communications. Due to Piracy issues, not many floats were deployed in the Arabian Sea. Pressure offset correction in real-time data has been done for more than 90% of the floats and more 90 % of the floats were done with delayed mode QC. About 11 floats were deployed with oxygen sensors in the Indian Ocean. He mentioned that though the required number of active floats meets the Argo design criteria of one float in 3x3 deg box in the Indian Ocean, there are some gaps where there is no floats exists, especially in the Arabian Sea. He also mentioned that Argo float information is available in Google earth and data download site for the Indian Ocean from INCOIS website and for the global ocean from Coriolis data center or US GOADE website. He also presented Argo data system challenges (ongoing and future) and core issues faced by Argo community.

ACTION: Define the research and explore the possibility of replacing moorings with Argo floats and gliders. Request IRF to support it (IOP members)

He has also presented the status of IndOOS portal. This portal is built on distributed network of data archives and provides both direct binary accesses to data via OpeNDAP and ftp protocols. It has web based browsing, live access server (LAS) and data discovery. The primary data consists of all in-situ systems and secondary data set consists of products and satellite data. The new Live Access Server set up at INCOIS has Indian Ocean Argo Gridded data sets and GODAS ocean analysis. In-situ data archives are maintained by the individual groups in IndOOS at their institutes. However, satellite data (wind, SSHA, SST and chlorophyll) are available in LAS for the Indian Ocean region. He has shown the different in-situ system's data available from IndOOS portal and the organizations involved in maintaining the same.

Gary Meyers provided an overview of the XBT network in the Indian Ocean. The sampling during 2010 is described in the following table:

Line	Number of Transects	Number of Profiles
IX01	37/(50)	**752**
IX12	14/(18)	**834**
IX14	1/(4)	**7**
IX15	3/(4)	**433**
IX21	3/(4)	**311**
IX22	7/(18)	**66**
PX02	20/(18)	**217**

IX08 is an important line but has proven to be logistically very difficult and was not sampled in 2010. The number of transects recommended by IOP in the IndOOS Implementation Plan is given in parenthesis. Sampling in 2010 is close to recommended levels; however more resources are required to complete the network.

Apparently some XBT operators may have to reduce sampling in the future due to a lack of resources. IOP critically reviewed the Indian Ocean XBT network at IOP-2, identified the phenomenological targets for each line and prioritized the lines according to the relevance of features to climate variability and change. IOP also prepared a list of publications in refereed journals that used Indian Ocean data for the period 1990 to 2008. There were 72 publications during this period demonstrating the scientific value of the Indian Ocean XBT network. IOP can if requested revisit the review and update the publication list.

IOP recommends: Before any reduction in XBT sampling, a careful study is required to determine if other methods of observing subsurface temperature can document important phenomenological features as well as XBT sampling. For example, for both HDX and FRX lines, can the interannual variation of major currents and associated ridges and troughs be monitored with equal accuracy?

ACTION: Make statement to NOAA on the impact that reducing the XBT network in the IO would have on climate research in the region (co-chairs)

Raleigh Hood, chair of the Sustained Indian Ocean Biogeochemistry and Ecosystem Research (SIBER) Scientific Steering Committee presented a brief update on the observational capabilities of SIBER, a international research initiative sponsored jointly by the Integrated Marine Biogeochemistry and Ecosystem Research (IMBER) project and the Indian Ocean Global Ocean Observing System (IOGOOS). The long-term goal of SIBER is to understand the role of the Indian Ocean in global biogeochemical cycles and the interaction between these cycles and marine ecosystem dynamics. Several on-going interdisciplinary research activities have been instigated by SIBER and the IOP or have benefited from the programmatic framework that this linkage provides. An interdisciplinary modeling study of the physical and biological factors that determine the spatial distribution of the oxygen minimum zone in the Arabian Sea is a good example of those. At present, SIBER and IOP efforts are focused on finding the resources needed to deploy biogeochemical sensors on IndOOS/RAMA moorings (see SIBER SPIS, Appendix IV, available at http://www.imber.info/siber.html). The overarching objectives of this effort are to provide data for: 1) Defining biogeochemical variability in key regions of the Indian Ocean and for understanding the physical, biological and chemical processes that govern it; 2) Developing and validating models of ocean-atmosphere-biosphere interactions; and 3) Assessing the impacts of climate change on oceanic primary productivity and air-sea CO2 exchange.

4. Science talks Session

Weiqing Han gave a talk on the causes for interannual, seasonal and intraseasonal variability of the Southern Indian Ocean (SIO) sea level and thermocline depth, which are investigated by quantifying the effects of local forcing over the IO and remote forcing from the Pacific via the Indonesian Throughflow (ITF). On interannual timescales, sea level and thermocline variability in the thermocline ridge region is associated with the westward propagating Rossby waves, and is largely driven by wind forcing acting upon the IO. Remote forcing from the Pacific via the ITF makes a secondary contribution in the thermocline ridge region. Further south (65^oE-75^oE; 13^oS-17^oS), however, the Pacific forcing plays a much larger role. Consistent with previous studies, semiannual variations of the thermocline dominate the annual cycle between 50^oE-75^oE, 5^oS-10^oS, and they are primarily forced by the semiannual component of local Ekman pumping velocity (w_e). In the region of the ridge between 60^oE-80^oE, 8^oS-12^oS, however, annual cycle dominates thermocline variability, and it is caused by both local w_e and Rossby waves generated by the w_e from the east IO, with the remote forcing from the Pacific somewhat weakening its amplitudes. On intraseasonal timescales, strong sea level variability is found in the southeastern IO between 10°S-15°S. Our model results suggest that the variability primarily arises from oceanic internal instability. In the ridge region, sea level variability is relatively weak, and it results from IO wind forcing. While the Pacific forcing primarily determines the interannual variability of the ITF volume transport, seasonal variability of the ITF is controlled by a

combination of Pacific and IO forcing, whereas forcing over the IO is the major cause for the ITF's intraseasonal variability with the Pacific also having significant contributions.

Weiqing Han also presented, on behalf of Toshi Shinoda, findings from a study on the seasonal variation of Indonesian Throughflow (ITF) transport. The transport is investigated using ocean general circulation model experiments with the HYbrid Coordinate Ocean Model (HYCOM). Twenty eight years (1981-2008) of 1/3° Indo-Pacific basin HYCOM simulations and three years (2004-2006) from a 1/12° global HYCOM simulation are analyzed. Both models are able to simulate the seasonal variation of upper ocean currents and the total transport through Makassar Strait measured by INSTANT moorings reasonably well. The annual cycle of upper ocean currents is then calculated from the Indo-Pacific HYCOM simulation. The reduction of southward currents at Makassar Strait during April-May and October-November is evident, which is consistent with the INSTANT observations. Analysis of the upper ocean currents suggests that the reduction in ITF transport during April-May and October-November results from the wind variation in the tropical Indian Ocean through the generation of a Wyrtki jet and the propagation of coastal Kelvin waves, while the subsequent recovery during January-March originates from upper ocean variability associated with annual Rossby waves in the Pacific that are enhanced by western Pacific winds. These processes are also found in the global HYCOM simulation during the period of INSTANT observations. The model experiments forced with annual mean climatological wind stress in the Pacific and 3-day mean wind stress in the Indian Ocean shows the reduction of southward currents at Makassar Strait during October-November but no subsequent recovery during January-March, confirming the relative importance of wind variations in the Pacific and Indian Oceans for the ITF transport in each season.

Agus Supangat gave an overview of the Adaptation and Science Policy Study in Indonesia, which aims to support the government to mainstream climate change into Indonesia's medium – term development plan. It does so by surveying the efforts that have been made in the areas of science and policy development. Under the leadership of the DNPI (National Council on Climate Change), used a rapid assessment methodology to evaluate existing policy documents, studies and data.

The study reviewed 23 reports and assessed them against the indicators formulated by the IPCC AR4 (2007) and AR5 (2010) reports. We use a gap analysis – that is describing the indicators proposed by the IPCC reports to monitor climate change impacts and then assessing whether the Indonesian scientific and policy community has already analysed those indicators. In terms of key policy recommendations, more advanced studies are needed in the near future to solidify the scientific basis to measure the impacts of climate change. Further research will have to rely on a combination of observations, data analysis, modelling and projections to fulfill the needs of climate change adaptation basis, and to elaborate the natural characteristics of Indonesia (especially : ENSO – IOD and ITF).

M Ravichandran presented the observed variability of barrier layer thickness in the South Central Bay of Bengal during 2006-2009. He reported that Barrier Layer thickness (BLT) exhibits large intraseasonal, seasonal and year-to-year variability in the bay using RAMA moored buoys data. He concluded that large variability of BLT, especially during winter, cannot be explained by variations in MLD alone, but is mainly the result of vertical movements in ILD. The prominence of westward propagating intraseasonal Rossby waves, which are driven remotely by intraseasonal zonal winds along the equator alternately deepen and shoal the ILD, leading to a thickening and thinning of the BL on intraseasonal time scales.

5. INDOOS Resources Forum (IRF) Session

Gary Meyers reported on the Actions that resulted from the first meeting of the IndOOS Resource Forum (IRF) and the Agenda for the second meeting. The complete list of actions and the agenda are in the appendix of this report.

The most important results of intercessional activity were:
Establishing a website for the IRF at the IOC Perth Regional Program Office (http://iocperth.org/IOCPerth/) under the page for IOGOOS. Several documents were loaded on the IRF page including a paper on the current status of IndOOS and a paper summarizing the contributions by the main agencies supporting IndOOS. The original IRF Business Plan and Terms of Reference are also available on the page.
A summary of all the cruises and ship time that have supported RAMA since 2000 was compiled by Mike McPhaden's team and is available at
http://www.pmel.noaa.gov/tao/rama/cruises.html.
IOC Perth initiated a project entitled: "Modelling for Ocean Forecasting & Process Studies", which will provide useful marine products to developing nations. This project was brought to the attention of officers in the Global Environment Facility with a view toward making that agency aware of the societal benefits derived from IndOOS.
The International Project Office for SIBER was established at INCOIS, Hyderabad, India and staffed with a secretary/coordinator.

IRF-2 began with a mini-symposium on challenging scientific issues that are being addressed by IndOOS. Presentations were presented by M. McPhaden, M. Ravichandran and T. Rixen. In addition to operational items, the critical items on the agenda for discussion were:
Immediate needs of IOP and SIBER to continue physical and biological development of IndOOS
Steps toward providing ship time for RAMA with sufficient lead time to ensure smooth operations
The impact of piracy on development of IndOOS and what key international bodies need to be aware of the impact
The need for periodic, high level external reviews of IndOOS

ACTION: Request IRF to formulate a strong statement and examine potential high-level solutions to deal with piracy issues in the Western Indian Ocean (co-chairs)

The group discussed at length some issues that should be taken to IRF. Regarding ship time, several cruises have been arranged every year to maintain and enhance the RAMA array. Some of them are arranged based on bilateral cooperation and some are national/institutional projects. Such situation may not be ideal in terms of efficiency of buoy operations. For example, we had 9 cruises (PMEL/INCOIS, JAMSTEC, NIO, PMEL/BPPT, FIO/AMFR/BPPT, PMEL/ASCLME) in 2011 for RAMA (30 buoys), which gives 3.3 buoys/cruise. This number is much smaller than that for TAO/TRITON (8 buoys/cruise) and requires a large effort of coordination. This efficiency gets worse in the eastern Indian Ocean, especially along a section at 90°E and some locations nearby.

One way forward is for a cruise schedule to be agreed for the next several years for the eastern IO region, in which three or more institutions will in turn make one annual cruise for a large portion of the region, it will optimize cruise time and provide a longer term horizon for allocation of ships. Each institution/country with the resources for long cruises would have to provide a vessel perhaps only once every three-five years, which matches the lead time for cruise proposals in many countries. Sites not reached by the long cruise could be serviced by smaller ships of more limited capacity and duration, such as Indonesia's Baruna Jaya. However, at present, most of the

cruises are conducted under bilateral MOUs between various partners or under national/institutional projects. Coordination under a multi-institutional framework is highly required. IOP will request IRF to discuss the possibility of multi-institutional ship-time coordination in the eastern Indian Ocean.
Piracy in the western Indian Ocean is becoming more serious, and it is impossible to arrange cruises in the northwestern region. This is having a very negative effect on climate research and the world's ability to address the impacts of climate variability and climate change. Discussions on the piracy issue are needed among high-level representatives from many world-leading institutions/agencies.

6. New Research Directions Session

Panel members discussed the new science directions that the Indian Ocean Panel should take. There is a strong motivation for a focus on the influence of air-sea interactions on tropical cyclones. The panel has already contributed to this discussion and made the case for additional RAMA pressure measurements. However, is it necessary to have more oceanic measurements for cyclone intensity forecast purposes? There is certainly scope for cross-panel activity about the influence of air-sea interactions on tropical cyclones, the influence of climate variability on tropical cyclones and the oceanic control on tropical cyclones

Another proposal is to setup experiment to study upper ocean process/mixing in the Bay of Bengal 2014-2015. This region is also of importance to SIBER. It would be necessary microstructure measurements to understand some of these upper ocean processes.

The main issue for the panel regarding its future research directions is if the focus will be on regional approaches, e.g. Bay of Bengal, which is quite unique, or rather focusing on a particular timescale. Decadal variability in the Indian Ocean is a possible topic for the panel: What are the mechanisms that control decadal variability in the IO? For this, the use of ocean synthesis products and atmospheric reanalysis need to be taken into account. Also, an intercomparison of model data with dynamo would be an important activity since the models are not so consistent.

The panel has agreed to discuss these issues in more details at the next meeting, taking into account any changes considered for CLIVAR and WCRP.

ACTION: Discuss the issue of Decadal Variability in the Indian Ocean at the next panel meeting (co-chairs)

7. Regional studies Session

Kunio Yoneyama gave an update on the CINDY2011/DYNAMO project. A field experiment CINDY2011 (Cooperative Indian Ocean experiment on intraseasonal variability in the Year 2011) and DYNAMO (Dynamics of the Madden-Julian Oscillation) will start from the coming October 1, 2011 till January 2012 as an intensive observation period. Many researchers from thirteen countries/territories are involved in this campaign to collect in-situ atmospheric and oceanic observations to advance our knowledge of initiation process of MJO-convections as well as to improve our skill of MJO simulation and prediction. During the four month IOP, we will form a quadrilateral array with two islands (Gan, Maldives, and Diego Garcia) and two ship sites (EQ and 8S, 80E with four ships from Japan, USA, India, and Indonesia). While an integrated sounding system will be deployed at Diego Garcia, a super site will be established at Gan Island.

Various (S/C/X/Ka/W-bands) radars, sounding systems, as well as surface meteorological sensors will be deployed. During November to December, two aircrafts observations are planned to be taken place to measure boundary layer structure and meso-scale convective cloud systems by US DYNAMO (NOAA P-3 base at Diego Garcia) and French (Falcon-20 at Gan) research groups. As for the measurement of oceanic conditions, in addition to observations from the ships such as CTD casting with water sampling, surface and sub-surface moorings will be deployed along the 78.5E line in conjunction with RAMA buoys along the 80.5E line. Recently, by considering the seasonal poleward propagation, we decided to form a northern sounding array by enhancing soundings at Male, Maldives and Colombo, Sri Lanka for the first two months, which is defined as a special observation period. To monitor upwind conditions, enhanced atmospheric sounding will be performed at Nairobi, Kenya and Seychelles. At the several land-based sites, observations will continue until the end of March 2012 as an extended observation period to incorporate with US DOE project called AMIE (Atmospheric Radiation Measurement program MJO Investigation Experiment), which will be carried out at Manus Island, Papua New Guinea. AMIE project also contribute to form the quadrilateral array in the central Indian Ocean by providing AMF2 (ARM Mobile Facility-2) on Gan Island as AMIE-Gan project. During the campaign, numerical research groups as well as several operation centers will perform various numerical studies, including forecast, hindcast, and reanalysis. Forecast data will be used for both decision making of flight operation plan and inter-comparison of MJO-prediction. Those data (figures) will be uploaded at the CINDY/DYNAMO web pages. As for the hindcast, 15 global models, 3 regional models, and 5 small-domain models are expected to conduct the calculation. In addition, special reanalysis data sets will be produced by several agencies. Currently, several forecast research groups are conducting"dry runs" and communicating with observational researchers for mutual benefit.

Jerome Vialard updated the panel on plans for a French contribution to Cindy/Dynamo. Megha-Tropiques (http://megha-tropiques.ipsl.polytechnique.fr) is an Indo-French mission developed by Indian Space Research Organisation (ISRO) and Centre National d'Etudes Spatiales (CNES) with launch scheduled for Fall 2012. The scientific objectives are to better understand the energy budget in the Tropics, the life cycle of Mesoscale Convective Complexes, in addition to monitoring and data assimilation for better prediction of extreme events.

David Vousden also gave an update on the status of the ASCLME (Agulhas and Somali Current Large Marine Ecosystems) Project in the Western Indian Ocean and relations to other basin-scale observing systems. ASCLME is addressing all oceanographic aspects: coastal artisanal and subsistence fisheries, coastal livelihoods, community engagement into the LME management process, as well as identifying management and governance mechanisms.

The following areas highlight the main achievements of the ASCLME project so far:
21 cruises around the WIO which have added to our understanding of the LMEs and their role in global and regional climate variation and change
National Marine Ecosystem Diagnostic Analyses completed for every participating country (including CB&T Plans, coastal livelihood assessments, socioeconomic)
Nearshore and coastal monitoring programmes developed and adopted for each country to contribute to LME management. Monitoring equipment supplied.
Training of over 70 scientists on both offshore and nearshore ecosystem assessment
National and regional Policy & Governance assessments completed
Regional Cost-Benefit of the Ecosystem Approach nearing completion
Creation of over 10 major signed Agreements (MOUs) with various agencies and bodies for sustainable, long-term monitoring and management of the LMEs
Active demonstrations in each country of the DLIST approach and community engagement in the LME management process

Gary Meyers discussed the Australian IMOS interest in two RAMA sites:
a proposed new site in the Timor Sea focused on the measurement of surface fluxes in relation to Madden Julian Oscillation, and
the RAMA site at 25°S off Western Australia for observation of subduction into the shallow subtropical-tropical overturning cells.

Australia already operates the Southern Ocean Flux Station (SOFS) as part of the Integrated Marine Observing System (IMOS). The new stations would provide in situ flux measurements in the tropical, subtropical and subantarctic zones to validate flux-estimates based on satellite data and re-analysis products. Capability for mooring work in Australia has increased substantially in recent years due to development of the Tsunami Warning System by the Bureau of Meteorology and an extensive array of moorings around the continent by IMOS and CSIRO Marine and Atmospheric Research.

a) Proposed Timor Sea Flux Station (TSFS) at 14°S, 115°

Australian interest in TSFS is motivated by the impact that MJO and air-sea interaction in the Timor Sea have on rainfall in southern Australia. The principal investigator for TSFS is Eric Schulz from the Bureau of Meteorology. A formal proposal to add this site to RAMA was reviewed by IOP and external referees before IOP-8. The referees praised the scientific merit of the proposal and requested more information on the budget and logistics. Dr Schulz submitted a reply to referees' comments before IOP-8. The most important comment by referees was a suggestion to move the mooring site further east to bring it closer to the location of maximum SST variability at intraseasonal time scales. TSFS is already provisionally in the IMOS implementation plan and has been rated highly for the next stage, beginning after June 2013. TSFS is located close to Tsunami Warning buoys operated by the Bureau of Meteorology, which may provide some economies of scale in maintaining TSFS.

Jerome Vialard gave an excellent presentation on the Madden Julian Oscillation in the Timor Sea. He documented the location and magnitude of large scale SST variability with time scales of 30-110 days as well as the eastward movement of MJO through the region.

Following the review of the TSFS proposal, IOP recommends that Australia go ahead with a 2-3 year pilot study to demonstrate that the site can in fact be maintained through resource sharing partnerships, that the moorings are survivable (i.e. not regularly damaged by vandals) at the target location, that they produce good data, and that the data are being distributed and used for RAMA relevant scientific analyses. After 2-3 yrs, IOP will review a proposal to make TSFS a permanent expansion of RAMA to be implemented with co-investments by PMEL and Australia following the "formula" discussed at IOP-7, where PMEL will cover all equipment, refurbishments, data processing and dissemination, and Australia provides ship-time, storage space, and mooring cruise technicians (to be trained during the pilot phase).

b) RAMA site at 25°S

The Principal Investigators for this site are Nathan Bindoff and Helen Phillips from the University of Tasmania. Ming Feng (an IOP member) and biologists from Universities in Western Australia are also interested in the mooring. The original RAMA observing array earmarked a site at 25°S, 97°E for a flux reference site. The scientific rationale is to support research on subduction in this region as it relates to the so called Cross Equatorial and Tropical-Subtropical shallow overturning Cells. These features of Indian Ocean circulation are critical

components of the basin-scale surface layer heat budget and appear in climate models to affect SST in the upwelling branches on decadal and longer time scales.

This site has not yet been occupied due to the lack of ship support for servicing. Bindoff and Phillips have applied for ship-time from the Marine National Facility for 2012. This may provide an opportunity for early occupation of the site. Sustained monitoring will require bringing this activity into the IMOS implementation plan for the post-2013 period.

IOP encourages the PI's to progress the planning for this site and as soon as possible to submit a case to IOP to update the science behind the 25°S site, including biogeochemical and biological issues. The case should also reconsider the feasibility of long-term sustained logistical support.

R. Venkatesan presented the current setup of Indian moorings in Bay of Bengal and Arabian Sea. Several moorings have been deployed since 1997, which will support studies on the warm and cool events, freshening by river discharges and barrier layer formation, and validation of satellite data and model outputs.

Nick D'Adamo presented, on behalf of Will de Ruijter, some topical science planning for the Southwest Indian Ocean region and Greater Agulhas System. The Greater Agulhas System is a key component of the regional and global ocean circulation and climate and the targeted observations in the Greater Agulhas System should become an integral component of IndOOS and GOOS.

The following key components for a sustained observing system are recommended as an add-on to IndOOS:

An air-sea flux buoy in the Agulhas System, positioned within the region of maximum negative surface fluxes. These represent some of the largest surface fluxes anywhere in the world.

Long-term monitoring of the water masses and transports of the Agulhas Current. A plan to monitor mass transports via a ground-truthed satellite proxy is underway (Beal, Agulhas Current Time-series), but important heat content and water mass changes remain unobserved. A strategic plan for a multi-country long-term array is vital.

Reference mooring(s) in the Mozambique Channel to continue the existing 10-year LOCO time series. By maintaining a reference mooring and utilizing sea surface height data, this time series can continue and provide information on interannual and decadal variability in the western IO and its connection to the ITF.

Nick also reported about the Chapman Conference proposed by the SCOR 136 (Climatic Importance of the Greater Agulhas System) Working Group on the "Agulhas System and its role in changing ocean circulation, climate and marine ecosystems". The proposal is to organize the conference in South Africa to optimize the conditions to entrain talented new scientists into this research field, in particular from the region, therefore adding an opportunistic capacity building theme. Discussion sessions will focus on continuation or development of joint regional and global future interdisciplinary programs and identify future directions in modeling and (sustained) observations.

ACTION: Endorse the proposal of Chapman Conference on the Agulhas System (co-chairs)

ACTION: Organise, jointly with the SIBER SSC and IRF, the IOP-9 meeting in September 2012 in South Africa, in conjunction with the Chapman Conference proposed by the SCOR Agulhas System WG (co-chairs, ICPO)

Sydney Thurston reported on some NOAA bilateral activities in the region. NOAA is funding a PhD student from Indonesia, looking at ITF and effects on fisheries. Also, NOAA has been working collaboratively with the Somalian government and there are discussions about coastal environment and climate/ocean in the region.

Mahmood R. Akbarpour gave a presentation on oceanographic research and observations in Iran. The Iranian National Institute for Oceanography is a research and educational institute affiliated to the Ministry of Science, Research and Technology of I.R.Iran which was established in collaboration with UNESCO in 1992. INIO has increased its capacity for research in the area, with establishment of an oceanographic database and participation in many marine environmental projects.

Dwi Susanto presented a science overview of the Indonesian Throughflow. The ITF varies from tidal to interannual signals, and thee volume transport towards Indian Ocean is 15 Sv. Makassar Strait carries most of the Throughflow (12.7 Sv). The intraseasonal signals associated with Kelvin waves from the Indian Ocean and Rossby waves from the Pacific Ocean have not been fully resolved. On a larger scale, both ENSO and IOD affect the ITF however, detailed analysis is still needed in order to identify the magnitude of the impact. Even though the annual mean of South China Sea Throughflow is small, the seasonal variability is important and may control the thermocline intensified flow in the Makassar Strait.

Following this presentation, Weiqing Han led a discussion on the development of an Indian Ocean decadal variability review paper. There has been a lot of activity in terms of decadal variability in the region, with different models. Data collection takes time so a full analysis of the model data is not straightforward. The results of the 20C reanalysis is starting to be analysed but some problems have already been identified. Also, comparison of several reanalysis products in terms of decadal variability in the Indian and Pacific Oceans are being done.

ACTION: Develop a review paper on decadal variability in the Indian Ocean (W. Han to lead with help from J. Vialard, T. Lee, G. Vecchi)

Yukio Masumoto presented the discussion that the CLIVAR SSG had o approving the Indonesian Throughflow Task Team. The main objectives of the ITF-TT is to (i) Review the current understanding and uncertainty in ITF and Indonesian Sea variability and their influence on climate variations; (ii) Facilitate collaboration between existing and planned observational and modeling studies to minimize the gaps in the research and maximize the scientific outcome, and (iii) Develop strategy to monitor ITF for long term. Members of the Task Team have been identified and the kick-off meeting will happen in Indonesia in March 2012.

8. Panel business

The Panel felt the need that IOP webpages need to be updated very soon. Due to change of staffing at the ICPO, this has not been done.

ACTION: Update IOP webpages (ICPO)

For membership, Yukio Masumoto is stepping down from his role as co-chair. The panel thanked Yukio for all his invaluable work as co-chair, and will recommend M. Ravichandran to replace him.

ACTION: Recommend to CLIVAR SSG that M. Ravichandran replaces Yukio Masumoto as IOP co-chair (co-chairs, ICPO)

9. Meeting Participants:

IOP members: Weiqing Han, Raleigh Hood, Tony Lee, Charles Magori, Yukio Masumoto, Gary Meyers, M. Ravichandran, Debasis Sengupta, Agus Supangat, Jerome Vialard
(Apology for absence: Will de Ruijter, Mike McPhaden, Toshiaki Shinoda, Gabe Vecchi, Weidong Yu, Ming Feng)
Invited experts: Mahmood Akbarpour Janat , Sidney Thurston, David Vousden, Kunio Yoneyama, Ken Ando, Tim Moltmann, V.S.N. Murty, R. Venkatesan, Tommy Bornman
ICPO staff: Nico Caltabiano
IOC Perth Office: Nick D'Adamo