High-level Meeting to review the Indian Ocean Panel implementation plan for sustained observations

Bali, Indonesia August 9 – 12, 2005

Mr. William Erb welcomed participants to the high-level meeting. Dr. Radhakrishnan chaired the Meeting and gave his opening remarks. The CLIVAR/GOOS Indian Ocean Panel (IOP, Chair Gary Meyers) is a group of experts in ocean-climate science and observing systems, formed in response to a recommendation from the first meeting of IOGOOS (Mauritius, 2002). The Panel has met face to face twice (Pune, India, 2004; Hobart, Australia, 2005), but works primarily between sessions by email and internet. The Panel's plan for IOGOOS is reported on the web site of the International CLIVAR Project Office at http://www.clivar.org/organization/indian/IOOS/obs.html . The Panel has published a Report entitled, "The Role of the Indian Ocean in the Climate System—an implementation plan for sustained observations." The final draft of the Report was presented to the high level participants for review and comment. The Report is in two parts: Part 1 is a review of what is known about the Indian Ocean's role in climate variation and the research issues that can be resolved with better data, as well as the potential uses of data by operational oceanography. Part 2 presents technical details of the implementation for each of the commonly used types of instrumentation.

The following four presentations based on the IOP Report were made in the plenary session.

Weather and Intra seasonal Variability-Predictability and managing impacts:

This topic was presented by Dr. Gary Meyers on behalf of Dr. Peter Webster. The presentation covered model-simulation of Madden-Julien Oscillation (MJO) and Monsoon Intraseasonal Oscillation (MISO) as well as data-based diagnostic studies of MJO and MISO. The focus was on the processes in the ocean associated with these phenomena. A statistical scheme to predict rainfall due to MJO and ISO was compared to results from a coupled model. The conclusion indicated that planned observations are required for the accurate simulation of such events, and as an initial condition to improve their prediction. In particular, the continuous measurements from an array of moorings is needed to capture the fast time-scale of MJO and MISO.

Role of the Ocean in Climate Variability & Change

Prof. Friedrich Schott presented this topic. He presented the relation between large scale (>1000 km) patterns of SST and rainfall to demonstrate the Indian Ocean impacts on the atmosphere. The focus was on subsurface ocean thermal structure and currents associated with the

SST patterns, implying predictability associated with the oceanic memory and propagation of remote forcing. He showed the high correlation between SST and rainfall in Africa and Indonesia associated with the Indian Ocean Dipole (IOD). The thermocline ridge in the southwestern Indian Ocean and related mixed layer structure, are associated with the probability of cyclones forming in the region. He also identified the role of Ekman transports and circulation patterns for the southwest (summer) monsoon and for the winter monsoon. Accurate simulation of seasonal-to-interannual cycles in the ocean by coupled models is required before we can hope to use climate models for prediction of climate variability and change. The Indian Ocean observing system is needed to identify the ocean-processes and initialize prediction models.

Operational Oceanography:

This topic was presented by Dr. Neville Smith. He elaborated on the need for sustained and systematic observing systems in the Indian Ocean in order to make operational ocean nowcasts, hindcasts and predictions. The products of operational oceanography will be used in a wide range of marine activities, including fisheries, transport, off shore industries (e.g. oil and gas) and tourism. Accurate, high-resolution winds, oceanic data, flux measurements, coastal topographies and other data are required to enable operational oceanography. He listed the critical issues for operational oceanography such as sustainability of satellite measurements (Scatterometer, Microwave SST, Altimeter and Ocean Colour) and rapid easily accessible dissemination of observational data, as well as operational products. He elaborated on the need for Global High Resolution SST and stressed that IOGOOS should put in efforts to have such a product for the Indian Ocean.

As an example of the products of operational oceanography that are available now, he summarized the Australian BLUELink Project. http://www.marine.csiro.au/bluelink/exproducts/index.htm. The applications include coastal predictions and marine ecosystems, short-range ocean prediction, seasonal-to-interannual prediction, Reanalysis and Research. He concluded that operational ocean prediction has a future in its own right and a sustained ocean observing system is required to realize the potential benefits of operational oceanography.

The Integrated Observing System

Dr. Gary Meyers presented an overview of the design for an Indian Ocean Observing System. It is integrated in the sense (a) that it makes use of all the available types of instrumentation that can be deployed in the ocean for long periods of time, (b) it provides data for a wide range of parameters relevant to the physical and biological state of the ocean and (c) it observes all the relevant time-scales of variability from intraseasonal to multi-decadal. The high level objective of the observing system is to

observe, describe, understand, model and predict: seasonal monsoon variation with related intraseasonal variability; the interactions among monsoon—El Nino Southern Oscillation—Indian Ocean Dipole; and the multidecadal warming trends and natural variation.

Moorings: An array of moorings to measure ocean temperature, salinity, currents, weather variables and other parameters is required to measure the basin-scale variations associated with the above objective, in particular the fast variability associated with MJO and MISO. The first design of the array was based on observational studies and the experience of researchers. Modelling studies were conducted to confirm that the sites for the moorings were adequate and to identify gaps. Three types of moorings will be deployed: TAO and mini-triton to measure the upper ocean temperature, salinity and surface weather; upward looking ADCP's along the equator where geostrophy does not hold and flux reference sites where additional weather data will be collected to estimate surface heat and fresh water fluxes for calibration of satellite estimates. The moored buoy array will provide all data in real-time using Argos. During October to November 2004, PMEL-NOAA and NIO deployed 5 moorings in the central equatorial Indian Ocean in the locations of the design. JAMSTEC has maintained three moorings at locations in the eastern Indian Ocean since 2000. The Indian Ocean Moored Buoy Data Assembly Centre (DAC) has been set up that is modelled after TAO/TRITON and PIRATA. PMEL & JAMSTEC are initial contributors with PMEL hosting the site now with a possibility of having a mirror site outside US at INCOIS.

Argo Floats: The full implementation of the Argo Program in the Indian Ocean is essential to achieve the goals of understanding and prediction at all time scales, particularly interannual to multidecadal scales. Possible strategies for alternative Argo sampling have been discussed and it was decided to follow the standard 10 day sampling since it would give maximum life time for the float. The areas of weak sampling as well as areas of divergence need to be covered well. INCOIS is going to proactively announce opportunities to deploy floats getting the details of research cruises planned in the Indian Ocean. About 120 deployments are required per annum to maintain the Argo array.

XBT: The panel identified the lines to be covered and prioritized them following a set of considerations. The high priority lines recommended for more frequent sampling include- IX 01, 08, 09N/1X-10E, IX-12, IX15/IX21, IX22, PX-02 and IX-14. The coverage in the WIO is poor and hence a workshop is being arranged in October at NIO to improve this.

Drifters: The panel feels that 5degx5deg sampling needs to be maintained. Needs full implementation and reseeding of northern areas.

Data management – Progress and shortfall: CSIRO and APDRC have compiled and carefully edited all the available subsurface temperature data for the Indian Ocean collected during the 20th century. Though data from various instruments at various centres are available, what is missing is a one-stop shop for research. INCOIS and APDRC have the capability to do this. IOP recommended that they together prepare a joint plan for Indian Ocean data management and dissemination, optimizing the great capability available in these agencies. Capacity building in all the nations around the Indian Ocean rim needs to be addressed through ODINCINDIO.

The major issues that have to be resolved to fully establish the mooring array include: Ship time (180 days per year), Fishing Vandalism, Operational Funding, International Coordination, System Integration (e.g. commonalities with multi-hazard warning system), Data management. In the mean time, incremental steps to develop the Indian Ocean observing system will be made through national and bilateral arrangements coordinated through the Indian Ocean Panel.

Comments/Presentation by High-level Participants

Dr. Neville Smith – Australia

Dr. Neville Smith read out the following statement on behalf of the Director of Bureau of Meteorology.

"On behalf of the Director of the Bureau of Meteorology, I would like to thank the organizers of this Meeting for the opportunity to comment on the Implementation Plan and its importance to our work.

First we extend our thanks and congratulations to the Indian Ocean Panel and to Gary Meyers in particular, for the fine work and tremendous effort that has gone into getting the plan to this point. The scientific basis is strong and the engagement of Indian Ocean scientists in the process is to be commended. In a general sense, Australia attaches great importance to the Indian Ocean region for Global and regional weather prediction; Tropical cyclone and other extreme weather prediction; Studies and prediction of intraseasonal variability such as the MJO; Emerging operational ocean analysis and prediction systems; Seasonal to interannual climate prediction; and Monitoring and understanding climate change.

For the Bureau of Meteorology, we can confirm our intent to at least sustain and, as resources permit, enhance our ocean observing activity in the region. The Indian Ocean region remains a top priority. This includes a surface drifter program through the DBCP; Surface met observations through VOS; Upper ocean measurements through XBTs/SOOP; Upper ocean measurements from Argo profilers; SST observations; Sea level

measurements (tsunami, climate) through the NTC; and Various products that will complement the observing system including surface wind analyses and TC predictions.

With CSIRO, the RAN and AIMS and others, we continue to advocate a substantial enhancement of the observing system. The so-called Australian Integrated Ocean Observing System is being developed as a high-level initiative within Australia. The strategic approach has been endorsed and we are planning to establish a secretariat over the coming months, probably in the National Oceans Office. The Indian Ocean region is a major focus of this plan and it will be strongly guided by the IOP Panel. We would like to emulate the success of our hosts and obtain substantial government commitment to this plan, possibly under the framework of GEOSS.

In conclusion we warmly welcome the publication of the IOP and generally support its recommendations. Specifically we support the underpinning research rationale and scientific basis; the mooring array design and initiatives to establish cooperation with the IOTWS; full Argo coverage, enhancements and changes to SOOP, and IX1 in particular; and the surface drifter network.

I would like to note in addition an upcoming major atmosphere-ocean experiment, the Tropical Warm Pool International Cloud Experiment (TWP-ICE). This experiment will be centered on Darwin and involve extensive atmospheric and air-sea observations with the aim of developing understanding of the evolution of clouds and convection in the tropical warm pool region. These processes are very important to intraseasonal variability. The experiment proper will run over Jan-Feb 2006 and involve around six aircraft as well as the R/V Southern Surveyor and contributions from many international scientists.

Again, I would like to thank the meeting for the opportunity to comment and I look forward to contributing to the IOP plans implementation"

Dr. Guifei Jing – China;

Dr. Jing presented the efforts from China contributing to GOOS and IOGOOS. He elaborated on the activities of the Chinese Ocean Observing System (COOS), which is a multi-platform monitoring system using satellites, aircraft and in-situ monitoring.

Dr. Francois Gerard – France;

He congratulated Dr. Gary Meyers and felt that the design is scientifically sound and comprehensive. He listed the activities that France conducts in

the Indian Ocean such as the Regional specialized centre for cyclones at La Réunion and the newly established Tsunami warning centre. France also has research vessels operating in the Indian Ocean, able to host people from the region on their research ship. The RV "Marion Dufresne" is presently operating west of Sumatra for a post tsunami cruise, and Indian Ocean will be part of the programme of the French research fleet in 2006. France has agreed to contribute to the IOTWS and has developed plans to contribute to tidal observation networks in the Western Indian Ocean and to upgrade the warning dissemination capabilities in the region. France is willing to continue to contribute to the IBPIO action group for surface drifters; to the Argo Programme and to XBT lines. France also has the capability to contribute to ocean monitoring and forecasting thru the MERCATOR project, which will be presented later

Furthermore, Dr. Gérard elaborated that the design presented by Dr. Gary Meyers for Indian Ocean Observations is good and cannot be disputed. One of the concerns is the way that the network will be implemented and sustained. It also has to cater to operational activities since just science objectives will not be sufficient to sustain funding. He noted that the GEOSS framework can provide new approaches for securing long term funding.

He concluded, noting that in this part of the ocean 60% of the world population is living and that most members are developing countries. Therefore, as I-GOOS Chair the suggestion is that we should focus on operational oceanography that is user-driven, to mobilize governments, scientists and citizens. This is the challenge for IOGOOS and GOOS as a whole.

Dr. Radhakrishnan – India;

Dr. Radhakrishnan made a presentation on the Indian plan for observing systems in the Indian Ocean, elaborating on the Indian plans for ocean observation, information and advisory services. He also mentioned the satellites planned for launch for coastal and ocean studies. Dr. Mahesh Zingde of NIO commented on the insitu observations being implemented by NIO viz. XBT, Drifting buoys and current meter moorings. Dr. S. Kathiroli, Director, NIO, presented on the Indian programme on moored data buoys, tide gauges, Argo floats and research vessels.

Dr. Sugiarta Wirasantosa – Indonesia;

Dr. Wiarsantosa thanked IOGOOS and the Panel for making an excellent effort. The presentations clearly brought out the importance of integrated ocean observations and international collaboration. Indonesia is contributing to the INSTANT project and working on areas related to environmental monitoring, climate studies, etc. Indonesia also welcomes

the use of its facilities such as SEACORM for benefiting the Indian Ocean observations

Dr. Jan Sopaheluwakan, Indonesia;

Indonesia is participating and also contributing its research vessels and scientists for programmes like INSTANT, CoML as well as several marine and coastal resources management projects. Fish stock assessment, modelling on coastal transport, conservation of islands, remote-sensing stations, are some areas where Indonesia can contribute to IOGOOS. Fishing vandalism is an area, which Indonesia is willing to tackle as part of the tsunami warning project. In short, Indonesia has two agendas- Indonesia wishes to intensify their observational lines, and making Indonesia a hub for data dealing with data archival, rescue, and exchange.

Japan: Dr. Yoshifumi Kuroda

He thanked the IOGOOS Secretariat and BPPT for making the necessary arrangements on the behalf of TRITON project and JAMSTEC. Also he thanked Dr. Gary Meyers for making this excellent plan which provides a guidance how the IO observation systems to be implemented. JAMSTEC is developing a small size TRITON buoy that could be maintained by small vessels, and continue to contribute the IO mooring array for climate studies. The continuous vandalism is a major obstacle for the mooring array and it cannot be solved without commitment by IOGOOS member countries to reach and educate fishing fleets. JAMSTEC is also making a research cruise named MISMO focusing on air-sea interaction during MJO in 2006 by R/V Mirai that will contribute to the Indian Ocean climate studies.

Mr. Harry Ganoo – Mauritius;

Mauritius is a small country but is fully committed to cooperate with the world community. Mauritius has hosted the IOTWS Meeting and will host the forthcoming WIOMSA Meeting. They are members of IOCINDIO and have a national GOOS community.

Considering the importance of ocean on climate, Mauritius is committed to contributing to the moorings programme in the Indian Ocean. Two tide gauges are operational and they are also willing to deploy Argo floats. Mauritius has expertise and would be willing to collaborate with the IOP and IOGOOS initiatives. IOGOOS should form a network of experts working on climate variability. He commented that progress in the IOGOOS projects has not been as rapid as required and that the IOGOOS officers could be given the responsibility of individual projects based on their expertise.

Dr. Kamal Tennakkoon – Sri Lanka;

Sri Lanka wishes to support the plan. The plan would be submitted to their steering committee and necessary endorsement would be obtained and communicated.

Sri Lanka is interested in activities related to upwelling and current systems. They are operating a tide gauge and are ready to share their data. Sri Lanka welcomes deployments of Argo floats in its EEZ. Their vessel can be used to deploy instruments in the region.

Dr. Chester Koblinsky – USA;

Dr. Koblinsky made a presentation on NOAA's contributions to GEOSS with a focus on the Indian Ocean. Plans of observations in the Indian Ocean need to be pointed towards the overall GEOSS programme. Ocean objectives of NOAA include observing: long term trends in sea level changes; ocean carbon sources and sinks; oceans storage and global transport of heat and fresh water; ocean – atmosphere exchange of heat and fresh water.

He wholeheartedly supported the design and encouraged implementing the plan; however, the implementation needs to be prioritized. Some challenges in implementing observing systems include (a) ship time requirement (b) international coordination.

Partnerships are needed to implement and sustain the Indian Ocean moored buoy array. The US is ready to support capacity building activities. IOGOOS could identify the areas requiring capacity building. Data from satellites also need to be used. IOGOOS needs to articulate their operational and scientific needs for satellites so that satellite systems can be sustained. He suggested IOP to consider adding a statement about the potential role of the Indian Ocean in the global climate context (teleconnections).

Conclusions

Dr. Radhakrishnan, chair of the session concluded that the plan has the broad endorsement of all the participants and the suggestions made by the participants have to be taken onboard by the IOP and IOGOOS. He suggested that a formal communication could be sent by the IOGOOS Secretariat to the IOP sponsors, i.e. IOC-Perth and CLIVAR thanking them for their support and congratulating the excellent progress made by IOP in developing this plan.