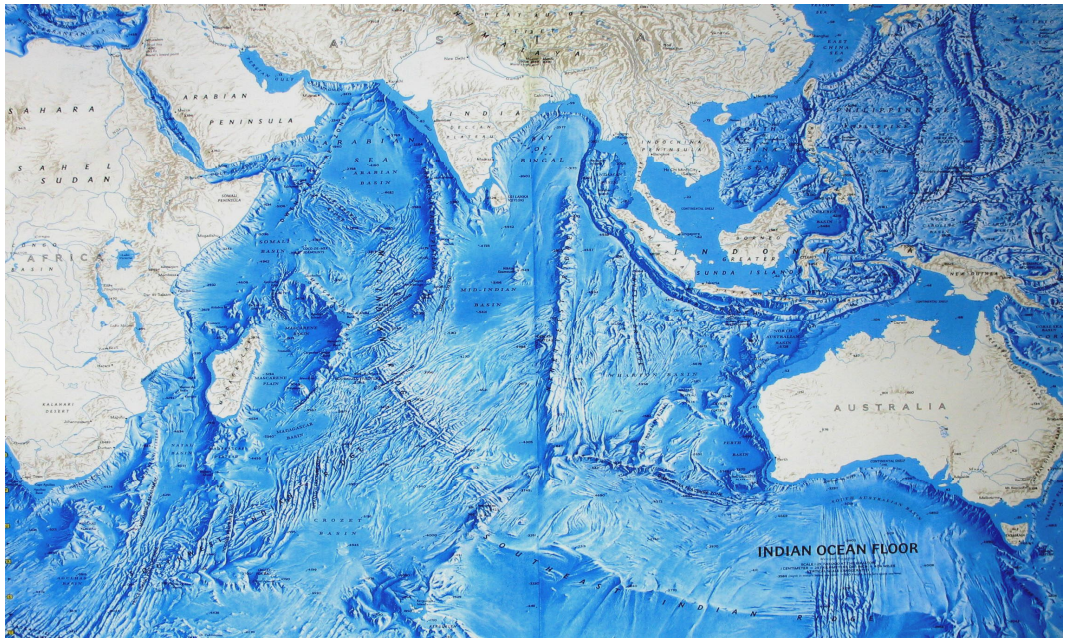
Summary Proceedings of IOGOOS-VI: the Sixth Annual Meeting of the Indian Ocean Global Ocean Observing System

Hyderabad, India

3-5 December 2008



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EXECUTIVE SUMMARY

This year's meeting was held in Hyderabad, India, during the sombre atmosphere that befell the nation as a result of the recent Mumbai terror attacks. Delegates conveyed their condolences to the host Nation, its people and to those affected. Delegates expressed their appreciation at the local host and individuals who underpinned the local planning arrangements and brought the meeting together in such circumstances.

The meeting addressed a full agenda and dealt with an exciting range of existing and proposed initiatives for IOGOOS. The cross-cutting characteristic of these initiatives was again a feature of the IOGOOS framework, in that they aim to provide benefits that apply either directly or generically to all member nations of IOGOOS. One common feature is that they concern issues that transmit across the region, through inter-connecting currents and associated atmospheric phenomena.

The continuing strength of the Indian Ocean Panel (IOP) in progressing ocean observations, analysis and predictions of the dynamics of the Indian Ocean and coupled weather phenomena was a highlight, as was the emergence of concrete plans to establish a bio-geochemical equivalent program called SIBER (*Sustained Indian Ocean Bio-geochemical and Ecological* Research). The development of an Indian Ocean Observing System (IndOOS) Resources Forum, (IRF) to facilitate the allocation and/or alignment of operational resources in support of the IOP's work, was also positively advanced. These three inter-related initiatives will be addressed in an integrated fashion at the forthcoming sixth annual meeting of the IOP, in La Reunion during 3-5 June 2009, with a view to reporting on the outcomes at the next IOGOOS meeting.

There was also good progress made in respect to the development of a number of new and integrated region-wide projects concerning an integrated package of sub-projects focused on monitoring of: bio-physical processes (ie remote sensing and mapping of Chl-a); key coastal ecosystem health indices; and shoreline changes. The approach of developing these individual projects under the umbrella of one integrating theme was accepted and will underpin discussions in a related capacity building workshop to be held in Kota Kinabalu, Sabah, Malaysia, during 10-14 December 2008. The Kota Kinabalu workshop will aim to advance the development of an integrated project proposal containing these elements and follows two related UNESCO/IOC-IOGOOS capacity building workshops held in May and November of 2008 at INCOIS, Hyderabad, India.

The concept of applying ocean forecasting systems that are now emerging for the region gained further currency at the meeting. The meeting advanced a project that was originally proposed at IOGOOS-V, and in which the Australian forecasting system *Bluelink* would be used as a basis to provide direct oceanographic outputs in 3D (ie currents, S and T patterns, sea surface height anomaly) and boundary conditions to enable downscaling for finer scale modelling in localities of specific interest to IOGOOS members. Furthermore, in response to interest by the neighbouring GRA, SEAGOOS, for the ocean forecasting project to be extended to the SEAGOOS region, the IOGOOS membership resolved to invite SEAGOOS to become a partner in this project. The project concept was also addressed in the context of it being the subject of working group discussions to be held in Perth, Western Australia, during 23-24 February 2009,

at a GOOS Scientific Steering Committee (GSSC) workshop to be held as an adjunct to the GSSC-XII meeting of 25-27 February 2009.

Other projects that were addressed at the meeting covered the areas of: ocean data management and capacity building; application and uptake of ocean products; ocean modelling and forecasting, including waves; the AMESD project (African Monitoring of the Environment for Sustainable Development) and related marine/coastal activities in the IOGOOS region; and coral reef mapping and monitoring.

The meeting also received excellent reports on the important partnership that has been established between NOAA and the Indian Ministry of Earth Sciences in respect to operational support of ocean observations in the IOGOOS region, supporting in particular the requirements of the deep ocean mooring network (ie RAMA) of the IOP's IndOOS framework. Additionally, informative and highly relevant technical presentations were received concerning: observing and prediction systems of the west coast of India, the Bay of Bengal and the Arabian Sea; the Indian Ocean Dipole; synergies between IOGOOS and neighbouring GRAs (WAGOOS, SEAGOOS and PIGOOS); India's advances in data management, and operational wave modelling and forecasting; and updates on satellite technology focusing on Oceansat-II products and associated utilisation.

The IOGOOS Annual General Meeting was held. Dr Neville Smith was warmly acknowledged as a retiring Officer of IOGOOS, and roundly thanked for the substantial and important contributions that he has made to IOGOOS through his professional and energetic work over many years. A replacement for Dr Smith will be sought out of session prior to the next meeting. Dr Shailesh Nayak, Secretary, Indian Ministry of Earth Sciences, will continue as IOGOOS Chair and INCOIS will continue to provide the Secretariat for IOGOOS, with the Secretariat function now split between two Co-Secretaries: Mr Srinivasa Kumar and Mr Nagaraja Kumar of INCOIS. The IOGOOS membership expressed its appreciation and thanks to the Chair, Co-Secretaries and Indian Government for their commitment and ongoing support of IOGOOS. The UNESCO IOC Perth Regional Programme Office was renewed for 5 years by its sponsors during the year, and will continue to support IOGOOS as a key activity of its portfolio.

A set of action items resulted from the meeting and these will be monitored through the Chair and Secretariat.

Iran and Australia offered to host the next meeting. The venue and date of the next meeting will be determined through consultation amongst members, out of session.

ACKNOWLEDGEMENTS

IOGOOS gratefully acknowledges the important support for this meeting from the Government of India, through INCOIS, Hyderabad, as host and co-sponsor, and the UNESCO IOC Perth Regional Programme Office as co-sponsor. IOGOOS also acknowledges and appreciates the support of delegates who gave of their valuable time and resources in attending the meeting to progress the vision and programs of IOGOOS, and that appreciation extends to the delegates' host institutions for supporting IOGOOS through the approval and allocation of their representatives to engage in IOGOOS, its meetings and associated projects.

This report was written by Nick D'Adamo, based on notes recorded by Nick D'Adamo and Raghavendra S Mupparthy as the meeting rapporteurs.

1 INTRODUCTION

The IOGOOS-VI meeting was held at the Kasani GR Hotel in Hyderabad, India, 3-5 December 2008, and hosted by INCOIS of the Government of India and co-sponsored by the UNESCO IOC Perth Regional Programme Office (IOC Perth). Administrative coordination for the meeting was managed principally through the IOGOOS Secretariat, based at INCOIS, with assistance from IOC Perth. The list of participants is given in **Annex 1.**

The meeting agenda, IOGOOS Secretariat Report for the preceding year's activities and the IOGOOS Strategic Plan are given in Annexes 2, 3 and 4, respectively.

A set of background notes to assist with the meeting's discussions and deliberations was produced by the IOGOOS Secretariat for the meeting, and these are reproduced in full in Annex 5 and held at the IOGOOS Secretariat.

This report provides a record of the salient elements, recommendations and action items resulting from the meeting.

Presentations and associated notes delivered by delegates at the meeting are held at the IOGOOS Secretariat.

2 OPENING ADDRESS AND CEREMONY

The Chair, Dr Shailesh Nayak, opened the meeting, thanking Mr Srinivasa Kumar (Secretary), others assisting the IOGOOS Secretariat (from INCOIS) and IOC Perth, for resourcing, arranging and administering the meeting.

Dr Nayak emphasised the need for IOGOOS to continue to evolve with a focus on the management and application of the vast amounts of data now emanating from IOGOOS projects and initiatives, through capacity building and with the objective of building products and the delivery of services thereof.

Dr Nayak noted that the GOOS component involving satellite observations still provided challenges for the region, in terms of the development of an adequate constellation of satellites geared to provide the type of information that is critical to support the IOC's high level objectives for its constituent members, such as relating to climate change, ocean and coastal sustainability etc. The associated challenges of calibration and validation of satellite derived measurements was noted.

Dr Nayak acknowledged with thanks the capacity building initiatives being supported in the region by the UNESCO/IOC Secretariat, with reference to the leadership training workshops recently held in Hyderabad (INCOIS) and to be continued during 10-14 December 2008 in Kota Kinabalu, Malaysia. Dr Nayak urged those involved to focus on identifying appropriate international donors for the projects being developed at these workshops, and then ensuring that the workshops resulted in proposals that meet the criteria of the donors to maximise the possibility of success in achieving funding.

Dr Nayak thanked IOC Perth and its sponsors for the continuing underpinning support and resourcing provided to IOGOOS.

A ceremonial 'lighting of the lamp' then took place to formally open the meeting, led by Dr Nayak.

IOGOOS Officer Dr Mitrasen Bhikajee, noted the steady progress that IOGOOS has made since its inception in 2002, and commended IOGOOS for focusing on developing itself as a useful forum for interaction and networking amongst its members, leading to synergies and collaborations in keeping with the spirit of the IOC's global charter.

Dr D'Adamo, on behalf of IOC Perth as patron of IOGOOS, acknowledged the excellent work of the Secretariat in organising the meeting, and thanked the IOGOOS Chair, IOGOOS Secretary and INCOIS for their support of the alliance. Dr D'Adamo also noted the important support of the members and their host institutions in the role that they collectively play in supporting IOGOOS, through the allocation of personnel time to attend meetings and engage in projects, and through the institutional backing that the host institutions give to IOGOOS's activities and projects.

Dr Nayak then designated Nick D'Adamo and Nugaraja Kumar as rapporteurs for the meeting, and advised that there would be two breakout sessions focusing on (i) ocean observations (based mainly on the Indian Ocean Panel and complementary programs) and (ii) the development of a package of integrated monitoring projects addressing: core remote sensing; Chl-a mapping; keystone ecosystem indicators; shoreline changes; and coral reef health.

IOGOOS Secretary, Srinivasa Kumar, closed the opening session with a vote of thanks to the Chair, Dr Nayak, for his continued support of IOGOOS.

3 PLENARY TALKS

3.1 Elements of a frugal observing and prediction system for the west coast of India

This talk was delivered by Dr Satish Shetye, of the National Institute of Oceanography, Goa, India. The talk examined the use of geographically focused observational networks in areas where the predominant hydrodynamics (in terms of currents) are locally forced and therefore can be studied through a locally based program, eliminating the need to supplement the regime with expensive and more complex deep water measurements. Observed de-tided current patterns off Goa during March-April 2003 were shown to raise the possibility that along the west coast of India (depths less than approximately 50m) a simple system with very few instruments could be invoked to observe the dynamics.

The talk focused on a case study using analyses of data collected off Goa during 2003, where the nearshore dynamics was studied in the context of the broader scale dynamics of the adjoining deep ocean region. Dr Shetye emphasized that the study found along-shore sea level and currents to be correlated suggesting quasi-geostrophy and it was evident that alongshore current was correlated to the along shore wind, suggesting local forcing effects were dominating. However, it was noted that in moving further offshore, the underlying dynamics becomes more complicated

It was concluded that such a system should be able to provide good insights into how the west coast of India behaves in a dynamical sense. The practical importance of this result is in guiding the choice (ie optimizing for cost-effectiveness) of observing instruments needed to capture the essential dynamical characteristics of a nearshore area.

3.2 NOAA-MoES partnership

Dr Sidney Thurston described the exciting new 5-year partnership (2008-2013) that was forged in April 2008 after 3 years of negotiations between NOAA USA and the Ministry of Earth Sciences India. The agreement, in the form of a formal MoU, delivers a new implementing arrangement for Indian Ocean observations, facilitating the RAMA mooring network of the Indian Ocean Panel's IndOOS framework. Dr Thurston outlined the key elements of the arrangement, known in the MoU as the RAMA Implementing Arrangement, as follows:

NOAA agrees to:

- Provide all mooring instrumentation and hardware for the deployment of NOAA subsurface ADCP and surface ATLAS moorings;
- Provide training of MoES personnel in mooring deployment and recovery onboard MoES Research Vessel;
- Provide data processing and quality control;
- Display and disseminate data telemetered in real-time data from surface moorings on a public web site. The data will be made available to INCOIS in near real time;
- Provide delayed-mode data to research partners within 6 months of mooring recovery.

Ministry of Earth Sciences agrees to:

- Provide 75 Days at sea per year on a research vessel equipped to deploy, recover and repair deep ocean (up to 6000 m) surface and subsurface moorings;
- Conduct detailed bathymetric surveys at mooring sites before deployments;
- Provide ship personnel for technical and deck support during mooring operations;
- Provide high quality meteorological (wind speed and direction, air temperature, relative humidity, rainfall, short and long wave radiation, and barometric pressure) and oceanographic (CTD to 1000 m) measurements from the research vessel when near the mooring sites.

MoES and NOAA jointly agree to:

- Support, by the end of the 5-year period, 25 of the 47 moorings in RAMA though the combined contributions of equipment, personnel and ship time;
- Promote the development of the Indian Ocean Observing System with other potential international partners;
- Promote the use of the data for improved weather, ocean, and climate forecasting, with special emphasis on prediction of Asian monsoon rainfall;
- Share results of data analysis and jointly publish papers in the refereed literature;
- Encourage interaction and coordination with other collaborative efforts under the MoES-NOAA Partnership where synergies exist.

3.3 Predicting the IOD and its impacts

Dr Yukio Masumoto, Co-chair of the Indian Ocean Panel (IOP) presented the IOP's findings on the latest understanding of the Indian Ocean Dipole and the Dipole Mode Index. The technical presentation addressed recent consecutive Indian Ocean Dipole (IOD) events (2006, 2007 and 2008, respectively) and IOD experimental forecasts undertaken at JAMSTEC, Japan. Dr Masumoto outlined the role of the IOP's observational program (including RAMA) and associated analytical/modelling efforts in relation to better understanding and predicting the IOD.

In summary, the talk concluded as follows:

- IOD is one of the air-sea coupled climate modes in the tropical Indian Ocean at the inter-annual time-scale, and it influences not only the regional climate but also the global climate systems;
- IOD consecutively appeared over three recent years (2006/07/08), with different conditions in the tropical Pacific Ocean. Negative subsurface temperature anomalies in the eastern equatorial region may be considered as the precondition for the IOD events; and
- The JAMSTEC modeling system, SINTEX-F1 CGCM, successfully predicted the recent IOD events with a lead time of about six months. Off-equatorial Rossby waves in the western Indian Ocean may be an important factor controlling the IOD predictability.

3.4 Ocean observations in the Bay of Bengal and Arabian Sea

This talk was presented by IOP member Dr M Ravichandran of INCOIS Hyderabad. An overview of the observational network and research activities in the Bay of Bengal and Arabian Sea was given, focusing on the tidal network, drifter buoys, XBT lines, moored buoys, Argo,

tsunami buoys, coastal radar systems and relevant satellites. A comprehensive overview was presented of the types of intensive coastal monitoring that are underway and now providing observations along the Indian coast. Detail on the emergence of the Bay of Bengal Observatory, supported by a range of Indian marine research agencies, including significant vessel support, was provided.

The objectives of the Observatory were given as follows.

- To generate high quality data on temperature, salinity, oxygen and currents in the upper ocean by deploying a single deep-sea current meter mooring at 18°N, 89°E in the northern Bay of Bengal.
- To generate high quality data on surface meteorological parameters from a moored buoy in the northern Bay of Bengal.
- To describe the sub-intraseasonal variability in the near-surface fields of temperature, salinity, oxygen and currents in the northern Bay of Bengal.
- To investigate the mixed layer heat budget in the northern Bay of Bengal.

The key science imperatives that will be addressed by the Observatory were given as follows.

- Bay of Bengal circulation, heat and freshwater balance.
- Basin scale waves and wind driven circulation.
- Upper ocean circulation driven by salinity gradients.
- Air-sea interaction on diurnal to seasonal scales.
- Interaction between the upper ocean and organised atmospheric convection - tropical convergence zone, low pressure systems and tropical cyclones.
- Model validation.

3.5 IOC Perth update and potential IOGOOS links with WA, SEA and PI GRAs

Dr Nick D'Adamo reported that the UNESCO IOC Perth Office was 'renewed' through a new 5-year Cooperation Agreement between its three sponsors (UNESCO IOC, Western Australian State Government and Australian Bureau of Meteorology), giving the Office funded tenure to October 2013. This was highlighted in terms of the renewed capacity for IOC Perth to continue its support of IOGOOS. The sponsors acknowledged and valued the role that IOC Perth has for its constituents (including the GRAs) in coordinating and facilitating an improved characterisation, prediction and building of capacity across the IOC's four high level objectives (HLOs), as relevant to all three parties. The IOC's HLOs (specified at the IOC 24th Assembly in 2007) cover:

Natural hazards

- Monitoring, warning systems, education, training.

Climate change

- Observation, monitoring, prediction (modelling).

Marine ecosystem health

- Global state of marine environment reporting;
- Research and monitoring for natural resource management, biodiversity conservation;
- Capacity building in natural resource management.

Management procedures and policies

- Knowledge transfer;
- Capacity building;
- Facilitation of decision making.

Dr D'Adamo pointed out that leading up to the sponsors agreeing to renew the UNESCO IOC Perth Office, their vested interests in the inter-connections across and between ocean basins, both in the oceanographic and coupled climatic senses, made for a compelling case in terms of securing the ongoing support of the three parties. The relevance of the 'cascade of scales' linking larger scale processes (such as for example being examined by the IOP) and the connected smaller scale processes (such as for example being examined by the shelf/nearshore related projects in IOGOOS), was accepted as a key motivation to support programs such as IOC Perth in respect to their potential to deliver benefits to all continental rim and island communities. Another key factor in support of the nature of work undertaken and promoted through the Office and the associated alliances is the role of the projects within their purview to support the extension and application of emerging operational ocean forecasting models, such as Australia's Bluelink, through the provision of assimilation data and improved understanding of the key dynamical processes that need to be simulated.

Dr D'Adamo indicated that IOGOOS has potential strong links with neighbouring GRAs (eg SEAGOOS) through the proposed ocean forecasting project, SIBER and remote sensing based projects which cover overlapping domains of the IOGOOS, SEAGOOS and WAGOOS GRAs. Additionally, WAGOOS's recent analysis of the value of ocean observations to Australian society (based on four benefiting sectors: agriculture; fisheries; iron ore; and oil/gas) may be upgraded to include a greater cross section of benefiting Australian sectors. The notion of perhaps also including other nations (say from IOGOOS) in the analysis was submitted.

The overlapping domain (with IOGOOS) of Australia's IMOS (Integrated Marine Observing System, www.imos.org.au) was outlined, as was the proposed 'white paper' to be written by a group including some IOGOOS members for the Ocean Observations 2009 conference, Venice, 21-15 September 2009. The white paper would focus on regional ocean observing systems around the Indian Ocean with a view to motivating the development of mechanisms to coordinate regional observations around the Indian Ocean basin, and to integrate the Indian Ocean regional ocean observing programs with those addressing inter-ocean connections (south of Africa, southeast of Australia and in the SEA throughflow region). The paper may also propose a set of standards for core observations to be collected in all three regions. IOP members Drs Yukio Masumoto, Wiedong Yu and Gary Meyers are leading this white paper's development.

In the context of IOC Perth's engagement in IOGOOS relevant events, Dr D'Adamo also mentioned: the Office's sponsorship of the IOP5 meeting, Bali, 2008; the census of Marine Life initiative to develop a regional node of CoML out of Sultan Qaboos University, Muscat, Oman; the ongoing development of the SEAGOOS Strategic Plan; the ongoing delivery and upgrading of SEREAD, the oceans/climate curriculum for high/primary schools in the Pacific through PIGOOS; and the outcomes of the recent 4th Forum of the GOOS Regional Alliances (GRA4), Guayaquil Ecuador, 25-27 November 2008, at which agreement to form a GRA Council was reached.

Dr D'Adamo ended by advising that IOC Perth is considering strengthening inter-GRA integration through the potential formation of a reference forum for the southern hemisphere GRAs within its purview (IO, SEA, WA and PI GOOSs), which might for example meet once every 2 years through its key representatives (Chairs/Secretaries).

3.6 Oceansat-II products and utilisation

This talk was presented by Dr R M Dwivedi of the Space Applications Centre, Ahmedabad, India, and covered sensor specifications for Oceansat-II, activities relating to calibration and validation, algorithms for parameter retrieval and outlined the range of applications of the Oceansat-II data. Oceansat-II will have an ocean colour monitor, a scattermometer for wind observations, and a radio occultation sounder for atmospheric studies, and have a 2 day repeat cycle, as per Oceansat-I. The colour monitor will return data on chlorophyll, suspended matter, diffuse attenuation coefficient and aerosol optical depth.

Dr Dwivedi then outlined the calibration and validation plans through in-situ observations, discussed relevant developments in chlorophyll algorithms, diffusion attenuation coefficients, and aerosol optical depth relationships.

In terms of applications, Dr Dwivedi pointed out a range of planned and potential operational and/or scientific applications to include the following.

- Primary productivity, algal blooms, secondary production (zooplankton).
- Enhanced primary productivity under cyclones.
- Formation of cyclones.
- Bio-geochemistry (eg carbon and nitrogen studies of the IO's seas).
- Hydrodynamics (mixed layer physics).
- Fisheries, fish stock assessment and potential fishing zone assessment.
- Fluvial fluxes into the coastal environment.
- Mapping and monitoring of aerosols.
- Prediction of cyclogenesis.
- Improved weather Forecast (Scatt-winds assimilation).
- Ocean State Forecast- Wave, MLD, etc.
- Science: application oriented.
- Monsoon onset (wind reversal, an indicator).
- Alternate Wind Forecast technique.
- Surface Pressure fields.
- Polar ice and climate change-ice, shelf ice, icebergs.
- Land applications including vegetation growth, surface moisture.
- Air-sea interactions, surface stress.
- Oil seepage detection.

4 IOGOOS ANNUAL GENERAL MEETING

The Chairman reported and emphasised the importance at this meeting of progress in: the development of the proposed IndOOS Resources Forum to facilitate the operational needs of the IOP; the elections for Chairman and Secretariat; tacking stock of IOGOOS's financial status; the working groups for this meeting; and the date and venue of the next meeting (IOGOOS-VII).

Dr Nayak commended members on the excellent progress made in IOGOOS since IOGOOS-V, particularly that of the IOP in furthering the implementation of its monitoring network (eg RAMA of IndOOS is almost 50% installed), the continued development of the integrated package of monitoring projects (including: bio-physical processes (ie remote sensing and mapping of Chl-a); key coastal ecosystem health indices; and shoreline changes), and the important progress in capacity building through the leadership training workshops held throughout the year. Dr Nayak encouraged members involved in the leadership training workshops to work towards finalising proposals for submission to appropriate funding agencies.

Dr Nayak indicated that at this meeting the key resolutions to be considered involved the IndOOS Resources Forum and new project proposals.

The Secretary, Mr Srnivasa Kumar, presented the IOGOOS Secretariat Report (Annex 3) for the period December 2007 to November 2008. Mr Kumar tabled the associated statement of finances for the period 1 November 2007 to 30 November 2008, which was accepted and endorsed by members.

Mr Kumar re-iterated the Chairman's comments on the significant progress that had been made in the capacity building area, through the Secretariat's support and coordination of the Advanced Leadership Workshops for Heads of Institutes in the IOCINDIO region: the first and second, respectively during May and November 2008 at INCOIS, Hyderabad, India, and the planned third workshop to be held at Kota Kinabalu, Sabah, Malaysia, during December 2008. These initiatives are jointly resourced with the IOC Secretariat, Paris. These three workshops (10-14 May 2008, 27 October 2008 and 10-14 December 208) are briefly described in the Secretariat Report for this meeting (see Annex 3 of this document).

A brief overview of the proposal to establish the IndOOS Resources Forum (IRF)) was received from the Co-Chair of the IOP, Dr Yukio Masumoto. The IRF evolved as an idea from the 2nd High Level Review of the IOP (held during IOGOOS-V, Phuket 2007). The IRF is proposed as a coordinating mechanism to allow high level representatives of institutions representing stakeholders of the IOP to scope, identify and facilitate the provision of resources to support the operational needs of the IOP, particularly for moorings (eg RAMA). The draft Proposed Terms of Reference for the IRF (as submitted to the meeting by IOP) were discussed. Members sought the support of the IOC Perth Office in respect to helping to resource the IRF. The only aspect therefore for which a change to the draft ToR was sought by members was the final section (5.4), referring to the manner in which the IRF would be resourced, and where the wording would be changed to: "5.4 IOGOOS will seek Secretariat support for the Forum from the UNESCO IOC Perth Regional Programme Office." Dr Masumoto noted this required change. The change would also be conveyed to the IOP through its receipt of the IOGOOS-VI report. With respect to

the actual working function of the IRF, members agreed not to comment at this level of detail, and were comfortable for the IOP to decide on its own modus operandi.

The Chair requested that IOP finalise the Terms of Reference for the IRF to be as submitted to this meeting, but with Section 5.4 of the draft ToR changed to: "5.4 IOGOOS will seek Secretariat support for the Forum from the UNESCO IOC Perth Regional Programme Office."

The Chair requested, through the IOP Co-Chair Dr Masumoto, that IOP have the Business Plan for the IRF ready for consideration by IOGOOS, at the next IOGOOS meeting.

The draft Strategic Plan for 2007-2011 was then discussed (Annex 4). Members variously commented as follows:

- Data management and exchange remains a fundamentally important issue to IOGOOS;
- The extension of IOGOOS's project and program activities, associated information, products and data, for societal benefit remains a key objective;
- Capacity building remains a key plank of IOGOOS, and that energy to continue to exploit bilateral and multi-national opportunities for such remains important;
- Section 3.8 of the draft plan could be expanded by adding some information to elaborate on the headings in (a) to (g), followed by an explanation that this will be further considered once the respective items are developed through specification of project goals;
- In respect to Section 4.4, on-board ship training presents as an important opportunity for oceanographers and this was supported by the Chair;
- It would be useful to develop a list of all IOGOOS related scientific publications in a form that allows interested persons to source them, and the Chair suggested that this could be achieved through electronic links being specified (eg URLs) and that such a notion should be added to the Strategic Plan as Section 3.7 (b).

Members indicated that they would accept the Strategic Plan to be finalised with the above editorial changes to be made out of session by the Secretariat.

Noting the members' discussion on the draft IOGOOS Strategic Plan for 2007-2011, the Chair asked the Secretariat to address member's comments for editorial changes and edit and finalise the draft Strategic Plan accordingly.

The general issue of how to address existing IOGOOS projects that were both working well (ie feasible and achieving their objectives) and not working well (ie either having become 'outdated' and now passed the point of relevance, or having become unfeasible due to financial or human resourcing constraints).

The discussion generally concluded that where possible and relevant, projects experiencing difficulty be incorporated into feasible projects (either existing or proposed) and that where necessary, projects that obviously have minimal chance of success and have for some time shown no progress be addressed at the next IOGOOS meeting with a view to removing them from the IOGOOS project agenda.

The Chair asked the Secretariat to provide a critical review and assessment of all feasible existing and proposed IOGOOS projects as well as unfeasible existing or proposed projects at the next IOGOOS meeting, to facilitate decisions that would need to be made by members on continuance or otherwise of all projects, with a view to then revising and updating the project listing on the IOGOOS website.

The composition of the IOGOOS executive and Secretariat was then discussed.

Mr Srinivasa Kumar explained that the Secretariat workload would continue to increase as IOGOOS evolved and expanded its portfolio. To that end, he recommended and requested that members agree to the creation of Co-Secretary posts, comprising Mr Srinivasa Kumar and Mr Nagaraja Kumar as Co-Secretaries.

Members accepted the proposition. The Chair supported the proposition while also placing on the record the GRA's appreciation at the hard work put into IOGOOS by the current Secretary and the role of INCOIS in continuing to host the Secretariat.

Dr Kamal Tennakoon of Sri Lanka proposed that Dr Nayak continue as Chair. Dr Nayak indicated that he maintained a strong interest in IOGOOS, despite his change in role in the Indian Government having been recently appointed as Secretary to the Ministry of Earth Sciences. Members unanimously agreed that should Dr Nayak wish to continue as Chair his role would be greatly appreciated and accepted. Dr Nayak offered to continue and the forum unanimously seconded the proposition with a vote of deep appreciation to Dr Nayak for his support and energy for IOGOOS, acknowledging that Dr Nayak's portfolio of responsibilities and commitments had significantly increased in his new role as Secretary, MoES.

The Chair tasked the current Secretary Mr Srinivasa Kumar to reflect in the IOGOOS communications media and relevant documentations the change to now having two co-Secretaries for IOGOOS, comprising Mr Srinivasa Kumar and Mr Nagaraja Kumar, of INCOIS, and the renewal of the Chair position with Dr Nayak as Chair.

The issue of the other IOGOOS Officers was then discussed with members noting their deep appreciation at Drs Bhikajee, Khokiattiwong and Dubi for agreeing to continue in their roles. Members also unanimously wished to record their warm appreciation and thanks to Dr Neville Smith for his role as Officer for IOGOOS.

The Chair noted for the record his appreciation and thanks to Dr Smith for his tireless and important contributions to IOGOOS as Officer and indicated that IOGOOS should maintain strong links with Dr Smith in respect to seeking advice and direction for IOGOOS into the future.

Through the Chair, IOGOOS Members decided that the process for Dr Smith's replacement would be undertaken out of session, coordinated by the Secretariat.

The Chair tasked the Secretariat to (i) coordinate a letter of thanks and appreciation (through the Chair) to Dr Smith on his retirement as IOGOOS Officer and (ii) coordinate the process for Dr Smith's replacement out of session, before the next IOGOOS meeting.

The statements of accounts and financial summaries (ie for the domestic and foreign accounts, respectively) were presented by Officer Dr Bhikajee, as prepared by the INCOIS Senior Administrative Officer, for the Secretariat. Members accepted and approved the statements.

The two working groups were then discussed and nominations called for participation in the two respective groups.

The last item to be discussed was the venue and date of the next meeting. Iran and Australia offered to host the meeting. Dr Thurston suggested that IOGOOS consider holding IOGOOS and related project meetings together to promote economies in travel, related expenses and time, as many members are involved in more than one of the respective meetings. For example, IOGOOS, IOP and the IRF could have their meetings synchronized. There was some discussion about the possibility of at least holding the first meeting of the IRF with the next IOGOOS meeting and that perhaps since the IOP High Level Review panel is also due to meet again next year, that three entities could meet in a synchronous manner this time around. This will require consideration out of session.

Dr Abbas Nobakhti renewed Iran's offer to host a meeting of IOGOOS and proposed that the next meeting be held in Tehran. Nick D'Adamo indicated that if required, Perth would be available as a venue and it would hosted by IOC Perth, and that a meeting in Perth would represent (in 2010) the ten year anniversary since the first SOCIO (Sustained Observations of Climate in the Indian Ocean) meeting was held in Perth during 13 to 15 November 2000, and from which the creation of IOGOOS stemmed. The Chair thanked both members for their offers and tasked the Secretariat to coordinate the selection of the venue and date of the next meeting through consultation with members out of session.

The Chair tasked the Secretariat to coordinate the selection of the venue and date of the next meeting (IOGOOS-VII) through consultation with members, out of session, and to try to arrange, if feasible, a combined meeting of (i) IOGOOS-VII, (ii) IOP7, (iii) the first meeting of the IndOOS Resources Forum and (iv) the 3rd IOP High Level Review Panel meeting, noting members' interest in planning for cost-effective attendance at these respective events. To this end, the Secretariat was asked to bear in mind the potential to have the next IOGOOS-VII meeting early in 2010, as a means of perhaps facilitating the holding of the four meetings back-to-back in one locality.

5 VISIT TO INCOIS

Delegates at IOGOOS-VI visited INCOIS, Hyderabad, with the visit and arrangements sponsored by INCOIS.

Members undertook this visit, which provided an enjoyable and interesting insight into the progressive multi-disciplinary activities of INCOIS (www.incois.gov.in) related to IOGOOS. In addition, the visit exposed members to the latest status of the tsunami warning system that India has in place under the IOTWS.

6 IOGOOS PROJECTS (PROGRESS AND NEW PROPOSALS)

6.1 Indian Ocean Panel of GOOS/CLIVAR

6.1.1 General IOP Progress

Co-Chair of IOP, Dr Yukio Masumoto, presented an overview of the IOP. This highlighted the significant progress that has been made in respect to the IOP, through the observational component (eg RAMA of IndOOS is in the order of 50% complete), analyses and modelling.

IOP continues to meet yearly with all members continuing to be actively engaged in IOP activities. IOP held its fifth annual meeting in Bali in May 2008. Dr Masumoto's plenary talk (day 1 of IOGOOS-VI) highlighted some of the significant advances of the IOP in respect to characterisation of the Indian Ocean's dynamics relating to the Indian Ocean Dipole.

The IOP will be the subject of working group discussions at this meeting.

6.1.2 IOP response to the recommendations and findings of the High-Level Review of IndOOS at IOGOOS-V

Dr Masumoto spoke to the IOGOOS-V meeting paper that was prepared and submitted in respect to this item (see Annex 5 of this report). The High-Level Review Panel (HLRP) made 11 recommendations/findings and the IOP's paper (Annex 5) responded to all 11 items. Members were satisfied with the IOP's responses and commended the IOP on the manner in which it has addressed the HLRP's issues.

The key issue of the establishment of the IndOOS Resources Forum (as introduced above in Section 4) is addressed in the proceeding Section.

Another major recommendation of the HLRP related generally to ensuring that the development of SIBER (Sustained Indian Ocean Biogeochemistry and Ecological Research) continue in close liaison with IOP with a view to ensuring synergies between the operational and scientific aspects of both programs, recognising the geographical and thematic overlaps that are inherent in the respective hydrodynamic objectives of IOP and biogeochemical objectives of SIBER. Members were satisfied that the development of SIBER was indeed progressing in keeping with the spirit

of this HLRP recommendation and Dr W Naqvi's presentation (as Co-Chair of SIBER) to follow in the day's proceedings refers.

6.1.3 IndOOS Resources Forum Terms of Reference

This item was discussed in the AGM (Section 4, above). The key result of the discussion was the acceptance by IOGOOS of the concept of a IndOOS Resources Forum, with one recommended change to the draft Terms of Reference that was tabled at this meeting (see Annex 5) a change to item 5.4 of the ToR, to now read:

"IOGOOS will seek Secretariat support for the Forum from the UNESCO IOC Perth Regional Programme Office".

6.2 Indian Ocean core remote sensing project and Chl-a mapping project

Mr S Kumar presented on this project and described how it has developed into one that provides underpinning remote sensing support to Mr Kumar's project titled *Indian Ocean real time chlorophyll-a mapping* and to the *keystone coastal ecosystems* and the *shoreline changes* projects, led by Drs Wagner and Tennakoon, respectively and which are the subject of specific presentations at this meeting (see sections 6.3 and 6.4, below).

Mr Kumar outlined how the respective project leaders (Wagner, Tennakoon and Kumar) believed that the three individual projects should be amalgamated to form one project, using remote sensing as a unifying theme, with the project named as the Indian ***Ocean Core Remote Sensing Project***, and containing the three sub-projects as components. Members agreed with this proposition.

Mr Kumar also outlined that the three component projects (ie including Dr Wagner's and Dr Tennakoon's, below in Sections 6.3 and 6.4, respectively) will form important themes for the forthcoming "UNESCO/IOC bid-writing workshop for IOGOOS and SEAGOOS regions", to be held in Kota Kinabalu, Sabah, Malaysia, during 10-14 December 2008, immediately following the IOGOOS-VI meeting.

Mr Kumar reminded members of the recommendations from the last IOGOOS-V meeting in respect to this project:

- International RS Training (3-4 days) – Hyderabad;
- Identification of sites for the monitoring of coral reef, mangroves and shoreline changes;
- Conduct pilot studies on the test sites to develop operational and capacity building;
- Selection of and correspondence with the national remote sensing (RS) coordinators to obtain coordinates of selected sites requiring high resolution RS data;
- Initiation of the Indian Ocean real time chlorophyll-a mapping sub-project:
    - Collate the requirements of member countries for real time maps of environmental parameters, such as SST, chlorophyll-a, total suspended sediments and Kd_490 products;
    - Develop the methods for the project and circulate to members;

    - Develop a plan for in-situ measurements and then provide web based access to results that flow from the project;
- Submit the proposals to various potential donors.

Mr Kumar then outlined the progress that has been made since IOGOOS-V:

- "First Advanced Leadership Development Workshop for Directors of Marine Institutes from the Central Indian Ocean" held at INCOIS, India during May 10 – 14, 2008;
- "Tsunami Modeling, Inundation Mapping and Remote Sensing" workshop held at INCOIS, India during October 27, 2008 to November 7, 2008;
- Bid-writing workshop for IOGOOS and SEAGOOS regions" scheduled to be held at Kota Kinabalu, Sabah, Malaysia, during December 10 – 14, 2008;
- The base map for the generation of products for requested domains was prepared based on the inputs from interested IOGOOS countries;
- Web based dissemination of near real-time satellite products viz. Chlorophyll-a, SST, kd_490, TSM to all requested countries was initiated on 1 November 2008
- Generated remote sensing case studies for the following areas:
    - Keystone Ecosystems – Tanzania, Malaysia;
    - Shoreline Changes – Sri Lanka, Tanzania, Madagascar and Malaysia;
    - ChloroGIN - Iran, Kenya, Maldives, Oman, Sri Lanka, Tanzania and Thailand;
- In-situ measurements for the Indian region have been initiated as part of a National Project. Plan for in-situ measurements for other participating countries has to be drawn up;
- Three IOGOOS pilot projects will be recast into business-like proposals and presented to the potential donor agencies.

Mr Kumar also highlighted the links between the ocean colour / SST aspects of this project and the Coastal GOOS ChloroGIN Network project (see http://www.ioc-goos.org).

6.3 Keystone coastal ecosystems

This project was described by Dr G Wagner as having the principal objective of improving environmental management for sustaining livelihoods of coastal people through monitoring of keystone marine ecosystems. The key outputs of the project were being developed but were described in draft as:

- Changes in keystone coastal ecosystems (mangroves, coral reefs and seagrass beds), and the causes of those changes, monitored effectively with a regional approach;
- Information, zoning plans, predictions and recommendations disseminated to decision-makers, environmental managers, resource users and NGOs;
- Enhanced environmental awareness of the coastal communities and / or resource users; and
- Improved livelihoods of coastal people.

The essence of the project was described as having a network of member nations engaged in facilitating or actually monitoring health indicators of primary producers in keystone ecosystems,

focusing on coral reefs, mangroves and seagrasses, with a view to providing data to the core remote sensing project (above, S Kumar) in order to calibrate remote sensing images to be acquired at the IO scale (and at high resolution in localities of specific interest to the project) by INCOIS as a contribution to the project. The ultimate aim is to provide local communities with better scientific information from which to underpin management decisions leading to improved management and sustainability of their marine and coastal natural resources.

This project is to be further developed at the forthcoming "UNESCO/IOC bid-writing workshop for IOGOOS and SEAGOOS regions", to be held in Kota Kinabalu, Sabah, Malaysia, during 10-14 December 2008 immediately following the IOGOOS-VI meeting.

6.4 Shoreline changes

Dr Tennakoon outlined this project as one that would focus on long term monitoring of shoreline changes to assess the impact of human activity and regional global climate change impacts.

Dr Tannakoon gave the key elements of the background and rationale to the project as:

- Coastal zones are economic centres and provide a livelihood for thousands of people in the region;
- Increasing population density, poorly based decision-making, and mismanagement of coastal zones are threatening the livelihoods of the coastal communities;
- Shoreline changes, overexploitation, degradation of key habitats, and pollution are key issues identified in the region;
- The systematic approach is required to monitor shoreline changes for better planning and management of coastal zones;
- It is necessary to improve the awareness among the people living in the coastal villages leading to the better understanding of the processes that are responsible for degradation of the coastal environments.

The objectives of the project were given as:

- To collect historical data on coastal geomorphologic changes and its trends;
- To establish baseline data for the selected areas of the participating countries;
- To study the impact of shoreline changes on marine ecosystems and coastal communities;
- To establish GIS based databases and develop coastal vulnerability index maps for disaster management;
- To establish linkage among participating countries for data sharing and exchange of relevant infrastructure and knowledge; and
- To create awareness among the coastal communities and develop capacity building.

This project is to be further developed at the forthcoming "UNESCO/IOC bid-writing workshop for IOGOOS and SEAGOOS regions", to be held in Kota Kinabalu, Sabah, Malaysia, during 10-14 December 2008 immediately following the IOGOOS-VI meeting.

6.5 Ocean data management and capacity building

Dr E Pattabhi Rama Rao, INCOIS, presented on the ocean data management and IOGOOS-related capacity building activities and related potential of the INCOIS Data and Information Management Group that he leads. Dr Pattahbi outlined the INCOIS data management frameworks in the context of the end-to-end philosophy that drives the 'delivery' of INCOIS's data to end users, the technical aspects of the Meta Database, the types of data involved (principally as components of GOOS), the nature of the derived data products including reanalysis for modeling, INCOIS's Satellite Data Acquisition and Processing System and its use of in-situ GOOS data for ground-truthing and eventual product derivation. An overview of the related IOGOOS Data Inventory was also given.

Further details are contained in the Technical Report submitted to the meeting by Dr Pattabhi and this can be found in the meeting documents (Report No. INCOIS-DMG-DM-TR-01-2008; in Annex 5 of this report).

Dr Pattabhi's talk then covered the Data Management Capacity Building aspect of INCOIS's activities for IOGOOS and described its link to the IOC's International Oceanographic Data Exchange (IODE) program and plans for basic, advanced and specialised training courses for the next inter-sessional period.

The basic courses would cover:

- metadata;
- ocean data collection; and
- ocean data products and synthesis thereof.

The advanced courses would cover:

- marine GIS;
- data analysis and synthesis of satellite imagery;
- development of marine and coastal atlases; and
- marine biodiversity data management.

The specialised courses would cover:

- ocean modeling related data management;
- sea level data management and analysis;
- MapServer Application for marine and coastal atlases;
- introduction to the GTS and WIS;
- accessing and using real-time data;
- providing real-time data services;
- website development (static html and dynamic content management systems);
- web-based data services development;
- proposal writing;
- teaching the principles of data management to oceanographers; and
- Ocean Data Portal - data provider installation, setup and maintenance.

A related IODE survey that identified data management requirements of IOGOOS users, leading to the priorities that underpinned the designation of the above training themes, is available at:

http://www.surveymonkey.com/s.aspx?sm=bt3tWXa_2fj_2f6pEvc1lYcaZA_3d_3d.

Finally, Dr Pattabhi outlined plans for future data management activities:

- development of application software for in-situ and remote sensing data management and providing web-based data services;
- networking of Marine Data Centers; and
- implementation of data warehousing and mining concepts.

6.6 IOGOOS ocean products (Bluelink, OSF etc) user group

Dr Nick D'Adamo presented this talk to update on progress since this project was first raised as a potential IOGOOS activity at IOGOOS-V in 2007 (Phuket). The original concept, which still holds, was that in view of Bluelink's imminent geographical expansion to cover the Indian Ocean (and for that matter, the SEAGOOS and PIGOOS regions) as a 10 km eddy resolving 3D ocean forecasting system (using data assimilation), there is now the potential for the IOGOOS community to benefit from the operational products that can be derived from Bluelink, as useful to Indian Ocean continental margin and island communities. Dr D'Adamo recalled Dr David Griffin's presentation from IOGOOS-V in that context and referred to the high level of interest shown by members at that meeting for IOGOOS to develop a 'Bluelink users group'.

Dr D'Adamo described that Bluelink uses the output from a global hydrodynamic model, then assimilates data from GOOS to give finer scale resolution predictions of 3D salinity, temperature, currents and sea level anomaly. Bluelink has the potential to provide IOGOOS communities with forecasts of these parameters up to 7 days in advance (as is currently the case for Australian waters), depending on the amount and quality of data available for Bluelink's assimilation needs and the human and institutional resources allocated to running the forecasting system. Bluelink can also be used to provide boundary conditions to force finer resolution models (<10 km grid) in sub-domains of specific interest. Bluelink can be explored via: (***www.bom.gov.au/bluelink; www.bom.gov.au/oceanography/forecasts***)

Hence, a model such as Bluelink can provide direct insight into the hydrodynamics of a region at 10 km resolution and also contribute to hydrodynamic characterisations at finer resolutions through the provision of boundary conditions and forcings.

The key to the project therefore was emphasised as being the collaborative engagement of interested partners to provide support for Bluelink's expansion and related application to areas outside of its current Australian domain. This support would be required in the form of personnel to engage in running the models, providing data for assimilation and managing the forecasting aspects of the system. The idea from IOGOOS-V was that a collaborative user group be formed comprising IOGOOS members and Bluelink personnel.

Since IOGOOS-V, SEAGOOS has also expressed an interest in joining the proposed project, in view of Bluelink's plans to cover the SEAGOOS region as well as IOGOOS over the coming years, thereby also providing the potential for ocean forecasting in the SEAGOOS region.

In this context, Dr D'Adamo advised members that the forthcoming 12th GOOS Scientific Steering Committee meeting was to be held in Perth during 25-27 February 2009, and that an associated workshop to explore opportunities for the application of emerging ocean forecasting systems for the IOGOOS/SEAGOOS/PIGOOS and Australian regions was going to be held during 23-24 February 2009. The IOGOOS Bluelink user's group project proposal concept would be discussed at the Perth workshop and Dr D'Adamo encouraged IOGOOS members to attend and engage at the workshop in the current context. Furthermore, SEAGOOS was likely to engage at the Perth workshop with a view to promoting the development of the Bluelink user's group as a joint IOGOOS/SEAGOOS initiative. Dr D'Adamo indicated that he would represent IOGOOS's interests in respect to this project at the Perth workshop and that the workshop may result in joint IOGOOS/SEAGOOS interest in progressing this project concept.

Dr D'Adamo advised that he would report to members in the inter-sessional period on any relevant developments.

6.7 Sustained Indian Ocean Biogeochemical and Ecological Research (SIBER)

Dr Wajiv Naqvi, Co_Chair of SIBER, provided an update on SIBER's development. He reminded members that SIBER emerged under the following imperatives:

- The potential opportunity to leverage the IndOOS observational infrastructure and associated vessel support;
- Opportunity to develop a new, parallel program in the IO focused on biogeochemical and ecological research, with the mooring array (and other existing infrastructure) providing the physical observational foundation;
- Opportunity to promote inter-disciplinary, international collaboration and research in the IO;
- It has been some time (over 10 years) since the last major biogeochemical and ecological investigations (ie through JGOFS) had been undertaken in the IO; and
- The scientific interest of studying the biogeochemistry of the IO is one of the last great frontiers for ocean biogeochemical and ecological research.

SIBER has had two formative science planning meetings (both in Goa: 2006 and 2007). The draft SIBER plan was in preparation, following it being scoped as part of the 2007 SIBER meeting that took place in Goa. SIBER's themes were consolidated at that meeting as:

- Boundary current dynamics, interactions and impacts on biogeochemistry and ecology;
- Dynamical variability of the equatorial zone, southern tropics and Indonesian Throughflow and their impacts on ecological processes and biogeochemical cycles;
- Controls and fate of phytoplankton and benthic production in the Indian Ocean;
- Physical, biogeochemical and ecological contrasts between the Arabian Sea and the Bay of Bengal;
- Climate and anthropogenic impacts on the Indian Ocean and its marginal seas; and
- Role of higher trophic levels in ecological processes and biogeochemical cycles.

Dr Naqvi outlined that the SIBER community believe IMBER and IOGOOS to provide logical international programmatic 'homes' for SIBER and that IMBER has accepted, in principle, SIBER as a program, pending its further development.

Dr Naqvi ended by commenting on SIBER's likely progress and future directions, as follows:

- International Steering Committee is being constituted, with a view to meeting once a year.
- Financial support will be needed, with potential sponsors being UNESCO IOC Perth Office, IMBER, national agencies.
- A draft Science Plan has been prepared as a very broad science plan from which different stakeholders (ie such as IOGOOS members) can 'pick and choose' from.
- National programmes need to be developed and associated funding needs to be secured for SIBER's activities.
- An International Scientific Steering Committee for SIBER is to be developed to promote networking and collaboration among various countries including Capacity Building.
- Optimal utilization of existing infrastructure/resources/programmes, collaborative cruises, and establishment and networking of time-series sites is to be given highest and immediate priority in SIBER's initial development.

There was an important discussion motivated by the presentation, with the Chair of IOGOOS encouraging SIBER to approach the Ministry of Earth Sciences concerning Indian support for SIBER through IOGOOS. The likely Governance arrangements for SIBER was also a topic of interest in the discussion, with Dr D'Adamo indicating that IOC Perth as a sponsor of SIBER views development of the Governance to be a key priority, and further suggesting that one current example worth using as a reference is the IOP governance structure. The Chair of IOGOOS supported SIBER exploring the IOP governance model for SIBER. There was also a suggestion from Dr D'Adamo that it would be timely for IOP and SIBER to meet in a workshop forum soon to examine optimal integration between the two programs.

The discussion ended with delegates noting that the meeting's breakout session would address these issues.

6.8 Ocean modelling and forecasting

Dr Balakrishnan Nair of INCOIS India presented on INCOIS's ocean modelling and forecasting activities in the IOGOOS context.

Dr Nair described the range and details of models, associated parameters and validation programs involved in INCOIS's forecasting framework, including winds, bathymetry, swell waves, currents, temperature, salinity and sea level. The status of INCOIS's modelling capacity includes an operational status for wave height and direction.

INCOIS has a well advanced program of regional and coastal wave forecasting in place, including the forecasting and validation of winds and the specific case of cyclone generated waves.

INCOIS is also working with circulation models with a view to adding circulation predictions to its operational suite of tools for the simulation of parameters including temperature, salinity, currents. The climatology of IO salinity, temperature and currents is being determined as a key

aspect of this modelling objective. The incorporation of satellite derived parameters in the above context was also outlined.

The progress that INCOIS is making in respect to consultation with end users, through interaction meetings, awareness raising forums and general liaison with users at 'village' scale was also conveyed, with the result that to date the benefits have reached 25000 people.

Dr Nair ended by listing the elements of action to be pursued between 2008 and 2012:

- procurement and blending of coastal bathymetry;
- incorporating water level in wave models;
- semi-automation of processes;
- input-output validation;
- spatial validation of wave parameters;
- web site upgrading;
- operationalisation of tidal current models;
- efforts for inclusion of currents in open ocean forecasts;
  upgrading the forecast system to disseminate the forecast data on the same day;
- extending coastal forecast activity to the whole of the Indian coast;
- operationalisation of the Global Wave Forecast Model;
- preparation of a Wave Atlas;
- ship routing software;
- user workshops for dissemination coastal forecasts;
- enhancement of delivery chain of OSF (DDB, TV, radio, VIC, direct to Sea)
- wave energy atlas;
- validation of high resolution wind products for coastal sea state forecast improvement and extension of location specific forecasts and now-casts;
- sensitivity studies and validation experiments for oil spill models;
- value added services;
- deployment of wave rider buoys, AWS and wave height meters;
- deployment of sediment traps and biogeochemical studies.

6.9 AMESD project and forthcoming activities for the SWIO region

Dr Mitrasen Bhikajee, IOGOOS Officer and Director of the Mauritius Oceanography Institute, advised members on the recently initiated project African Monitoring of the Environment for Sustainable Development (AMESD), a project coordinated by the African Union and funded (21 million Euros) by the European Union. The project will run from 2008 to 2012 and will involve five regional economic communities and respective themes, of which one is 'marine and coastal management' led by the Mauritius Oceanography Institute in conjunction with the Indian Ocean Commission, as one of the five AMESD 'regional implementation centres'.

AMESD's overall objectives are:

- to improve access by African users to existing earth observation data;
- to establish operational information services in the fields of environmental management;

- to strengthen political and policy development frameworks for ensuring an active participation of African governments in the global environmental surveillance initiatives; and
- to ensure an adequate technical level of AMESD African stakeholders.

EUMATSAT (European Organisation for the Exploitation of Meteorological Satellites) and national meteorological services are key partners in AMESD. In the marine and coastal context, AMESD will therefore significantly enhance monitoring of the oceans, with the SW Indian Ocean a major benefiting region. Indian Ocean countries that will directly benefit include Mauritius, Madagascar, Seychelles, Comores, La Reunion, Kenya, Mozambique and Tanzania. The coastal and marine management themes comprise:

- Support for the management of fishery resources;
- Monitoring and control of fishery resources; and
- Physical oceanography and management of maritime risk.

6.10 Coral reef mapping and monitoring

Dr R M Dwivedi of the Indian Space Applications Centre, outlined the Centre's activities in the area of satellite based coral reef mapping and monitoring in fringing, patch, shallow/deep atoll and barrier reef ecosystems in the Arabian Sea, Bay of Bengal and Maldives of the IOGOOS domain. Dr Dwivedi focused on the application of data from the LISS-4, LISS-3 and AWIFS satellite payloads in respect to the improved capacity that India now has to resolve and discern coral reef features for the purposes of improving mapping of benthic habitat extents, coral reef types and habitat boundaries. This can be summed as an improvement in the capacity for eco-geomorphic mapping.

Interesting examples of application were presented, such as pre-post December 2004 tsunami mapping of loss of reef in the Musal Reef Complex in the Gulf of Mannar.

The benefits of the improved satellite remote sensing capacities cover: long-term detection of change (relevant to climate change questions); general coral reef mapping for inventory purposes; identification of stress and health (eg bleaching, algal cover, seagrass encroachment). Dr Dwivedi outlined how the advances are helping in the development of health warning indices (for ecological and physically based stresses), involving for example SST, bleaching, turbidity, sedimentation, seagrass/algal growth etc. Future plans include:

- Monitoring coral reef (keystone ecosystems) for the indicator signals of multiplicative changes in surrounding ecosystems;
- Coral reef bio-optical studies using hyper-spectral data (already initiated);
- Using the OERPs (already identified) to develop a Coral Reef Early Warning System for Indian reefs that would essentially mark a reef as a 'hotspot' as soon as the stress develops due to temperature rise or any other factor; and
- Monitoring of reef scale processes.

There are obvious links between this presentation and the needs of some other projects discussed at this meeting.

7 BREAKOUT SESSIONS OF WORKING GROUPS

7.1 Working Group 1: Ocean Observations (IOP and complementary programs)

Dr Masumoto led this group. Dr D'Adamo was rapporteur and prepared a record of the discussions, on behalf of the working group. These notes were then reported to members by Dr Masumoto in plenary, at which time IOGOOS members had the opportunity to ask questions on the working group's work.

The following text contains the recorded notes (changed only for editorial consistency) from the working group's discussions (including the working group's recommendations (in **bold**) in respect to selected items that were discussed), along with (in ***italics-bold***) any comments that resulted from the plenary discussion of this working group's presentation.

7.1.1 Ensuring balanced progress in the implementation of IOP IndOOS components

This discussion focused on identifying the needs of the IOP in respect to achieving its ocean observing aspirations, referring to the IOP Implementation Plan. Where issues, problems, or needs were identified and agreed to by the group, tangible actions to address these were suggested.

It was submitted that although the IndOOS RAMA component had seen considerable progress, over and above expectations in nature and speed of implementation, perhaps now is the time to examine the adequacy or otherwise of the other components of IndOOS to facilitate the balanced development of IndOOS.

Recommended Action: That IOP be tasked with undertaking an internal review and prioritization of the needs of the respective ocean observing components of IndOOS, with a view to having the priorities and associated needs for enhancement of those components submitted to the 1st meeting of the proposed IndOOS Resources Forum (likely to be held in conjunction with IOGOOS-VII, sometime towards the end of 2009).

7.1.2 Prioritizing SIBER's ocean observing requirements

This discussion then led to an examination of any early observing initiatives that might be useful to progress in the near future for the SIBER initiative, which was in the process of formation.

Recommended Action: Seek from SIBER an initial prioritization of the bio-geochemical parameters and associated sensors needed to establish SIBER in respect to its own observing framework aspirations, and integrate that list with the results of the similar prioritization recommended for IOP (above). Dr W Naqvi offered to coordinate this with Dr R Hood through and on behalf of SIBER, in consultation with IOP, with a view to tabling the proposed network at the IOP6 meeting for consideration, comment, revision as necessary.

7.1.3 Immediate needs and opportunities for observations for SIBER (Underway PCO_2)

The discussion continued to address SIBER and highlighted the immediate priority of improving the network of measurements of ocean carbon through the Underway PCO_2 system. It was noted that opportunities exist through the XBT related Ships of Opportunity program and through potential berths that may be available on IndOOS related research vessel cruises.

Recommended Action: Dr Wajih Naqvi, NIO, to make a presentation to the Secretary, Ministry of Earth Sciences, requesting the Ministry's institutional support for resources to progress the SIBER objective of improving the network of measurements of ocean carbon through the Underway PCO_2 system.

Comment from plenary: Chair Dr S Nayak (SN) believes both recommendations are acceptable and should be adopted. SN invited any extra comments from the group and none were received.

7.1.4 Data Management for IOGOOS

Issues and possible future actions on the management of data related to IOGOOS were discussed. It was felt important to expand the database beyond the IOP data so as to meet requirements from various levels of data users and user groups in the IOGOOS community. Accordingly, it was felt timely to now survey and respond to the broad requirements for data management amongst the full spectrum of the IOGOOS community.

Recommended Action: Survey the data management requirements of all IOGOOS member nations, through E Pattabhi Rama Rao and M Ravichandran, who offered to undertake this task, noting the plenary comments on this item from IOGOOS-VI.

Comment from plenary: SN supported this proposition but queried as to how exactly it might be achieved, noting past examples of surveys that have failed because it is generally difficult to get people to respond to survey requests due to the many requests of that nature that are generally received by professionals. SN suggested that a notice be sent to all users, describing what is currently available, and asking what categories recipients wish to be added in the IOGOOS data management framework. If no answer is received then this should be taken to imply satisfaction with the current situation. SN added that it might be useful to consider having a data management and exchange workshop at IOGOOS-VII.

7.1.5 IOP and Argo

An examination of the adequacy of the Argo network for IndOOS was undertaken. Although the target number of approximately 450 Argo floats has been reached in general for the Indian Ocean, the spatial balance in the coverage was identified as currently inadequate. In other words, some areas of the Indian Ocean were relatively intensively covered by Argo, and other areas were poorly covered. The main reason for this was the idiosyncrasy of the rapidly moving and diverging waters in the region approximately 10-20^{o}S / 30-40^{o}E. This particular dynamic characteristic works against a balanced spatial coverage in the network. Diverging currents

quickly move Argo floats out of a selected area deemed to be in need of Argo floats. Rapid changes occur in the status of particular deployment areas (ie those representing gaps in the Argo network) in the intervening period between planning and deciding on a particular Argo float deployment at a particular location. Other floats from neighbouring well-covered areas can quickly enter the deployment locality under rapid currents, thereby reducing the need to have a new float in that chosen area. The main problem is thus that when Argo floats rise to the surface to transmit their data to the Argo satellite they remain at the surface for undesirably long periods. The discussion examined possible improvements to the deployment strategies to overcome this problem. One solution was to make better use of numerical model predictions of circulation in the subject deployment areas, as an aid to planning where in the six months between securing resources (floats and vessels) for a new deployment and the deployment date, a model could advise on the best location to navigate to in order to ensure that a deployment was made in an area that was truly likely to represent a 'gap' in coverage. To this end, it was noted that CSIRO Australia had tackled the same problem with the assistance of numerical hydrodynamic modeling, through Dr Andreas Schiller. It was resolved that Dr Schiller's assistance in the IOGOOS matter would be sought, as would that of Dr G Vecchi of IOP. The other potential improvement that was identified was the attractiveness of reducing the amount of time that Argo floats spend at the surface transmitting data, to thereby avoid being advected in relatively fast surface currents; the sooner an Argo float descends to depths (where currents are much weaker) the better, in order to minimize movement away from a particular location. To this end, the group noted that data transfer to the Iridium satellite network is much faster than to the Argo network.

Recommended Action: That IOP be tasked with (i) examining the potential to use numerical ocean models to assist in planning Argo deployments with respect to predicting likely gaps that will emerge at times of new Argo float deployments, with initial assistance ideally being sought from IOP modeler Dr G Vecchi and CSIRO modeler, Dr S Schiller; and (ii) examining the feasibility of using the Iridium satellite system for rapid data transfers whilst Argos are at the surface, thereby allowing the floats to spend minimal times in fast current environs near the surface before descending back to weak current zones at depth. Dr M Ravichandran offered to undertake this task.

7.1.6 Proposed IndOOS Resources Forum (IRF)

The group noted the outcomes of the plenary of IOGOOS-VI (3 Dec 2008) in respect to (i) the re-affirmation by the IOGOOS of the merit of establishing the IRF, (ii) the commitment of IOGOOS to oversee and facilitate the IOP in the development and implementation of the IRF, (iii) the need to act in a timely manner to establish the IRF, cognizant of two major temporal points (the forthcoming IOP6 meeting in early June 2009 in La Reunion and the next IOGOOS-VII meeting sometime in the next 12 months or so to be associated with the third IOP High Level Review Panel meeting).

The group believed that with the 12 month time frame associated with the above imperatives, there was an opportunity for the IRF to be developed through and as an outcome of the IOP6 meeting (June 2009), for out of session submittal to the IOGOOS in time for finalization to allow

the first IRF meeting to be held in conjunction with IOGOOS-VII and the 3rd IOP HLRP meeting.

The group added that it felt it important to include, as appropriate, the needs of SIBER within the ambit of the terms of reference, particular in respect to facilitating efficiencies and synergies in the sustained observing aspects of the respective data needs of SIBER and IOP. To this end, it was felt important that the design of the SIBER observing system be undertaken with due integration with IOP. A joint exercise to progress the development of SIBER's observing system, accordingly re-examine IOP's observing system to promote harmony and integration with SIBER's, and scope out cross-cutting efficiencies and opportunities was recommended.

Recommended Action: That IOP be tasked with developing a Business Plan for the IndOOS Resources Forum as an outcome of the forthcoming IOP6 meeting in La Reunion (early June 2009), with that plan then submitted promptly to IOGOOS (through the Chair) out of session for consideration, endorsement and to assist in planning, desirably, a major IOGOOS-VII meeting (sometime in the period late 2009/early 2010) that would include the first IndOOS Resources Forum meeting and third IOP High Level Review Panel meeting. The Business Plan should be developed with due reference to and inclusion of SIBER, in respect to potential synergies in science pursuits and harmonizing the respective sustained observing system developments across the IOP and SIBER. To that end, it is recommended that SIBER participate in the development of the IRF at IOP6 to assist in developing the IRF Business Plan and also in order to ensure appropriate recommendations for representation of bio-geochemical needs in the IRF.

Comment from plenary: ***SN sought that the current draft IndOOS Resources Forum ToR to be accepted with the change to the last line as per the discussion of day 1 of the meeting (see above, Section 4). This was agreed. SN suggested that we should target the next IOGOOS-VII meeting to have an associated IRF and HLRP panel meeting.***

Comment from plenary: ***Dr Masumoto indicated that SIBER will be invited to join IOP through one permanent membership position. Dr Nayak suggested that the same should apply for IOP (ie an IOP member should be on SIBER). This was supported by members at plenary.***

7.1.7 Modelling

The group re-affirmed that this project, conceived at IOGOOS-V, was still relevant and highly important, particularly in respect to the potential to generate ocean forecasting capacities for the Indian Ocean and modelling applications at sub-regional and local scales. The group agreed that the scope of the project should be of a broader nature, and suggested a title: ***IOGOOS modeling for ocean forecasting and process studies.***

At IOGOOS-V Dr Bhikajee offered to take on the coordination role for this project. On agreement with Dr Bhikajee, the group accepted Dr Ravichandran's offer to take over the role.

A number of points were emphasized as being important to consider in this proposed group, as follows.

- Both forecasting and processes studies need assistance from models.
- It is important to ensure an early activity in the project is that of identifying the key priority user requirements in respect to parameters that models can focus on and also regions/localities requiring model products.
- Ensure bio-geochemical imperatives are scoped in this group.
- Capacity building in the use and applications of models is a high priority.
- Focus on existing opportunities for ocean forecasting applications through models such as Bluelink, in view of Bluelink's plans to cover the entire IO at 10 km resolution soon.
- Invite SEAGOOS and WAGOOS to become members of this group to promote inter-GRA synergies and integration with respect to the objectives of the proposal.
- Invite all interested members to join the group.
- Note that there is to be an ocean modeling and data assimilation conference likely in Hobart in early 2010.

Recommended Action:

- **That Dr Ravichandran be installed as the Project Leader and that he be tasked with coordinating the development of the project proposal for the project titled: *IOGOOS Modeling for Ocean Forecasting and Process Studies*.**
- **That the Chair, IOGOOS, invite IOGOOS members to join the group, through direct contact with Dr Ravichandran.**
- **That the development of the proposal use, as a first step, the opportunity for group members to attend the GSSCXII workshop (Perth 23/24 Feb 2009), where this thematic topic will be addressed with ocean forecasting modelers and existing/potential users, for the IO, SEA, WA and PI GOOS regions.**
- **That after the Perth 2009 workshop, Dr Ravichandran coordinate the development of a project proposal and submit it to IOGOOS out of session for endorsement, where members can input key priorities to the proposal, covering the points noted by the group during the IOGOOS-VI Breakout Session plenary discussions. The project proposal should include as a first activity a project planning workshop to include, group members and Bluelink personnel, aiming for this meeting to be held during mid-2009, requesting assistance to host the workshop through Bluelink and IOC Perth.**

The plenary session ended with a general discussion on a variety of general issues, as follows:

In respect to coastal observations SN referred back to Dr Shetye's talk on simple coastal observational systems and commented that it would be desirable for member nations to work towards this. For example, members could develop a specific package for simple coastal monitoring. Dr Naqvi commented that at the very least, IOGOOS as a community could work towards installing observational infrastructure for long term time series and sustained

observations wherever and whenever possible, using cost effective techniques. Parameters that could be monitored include temperature, salinity, O_2, waves etc. S Kumar commented that Dr Wagner's project will probably have this covered and that it would be worth waiting for the report from Dr Wagner at this plenary.

A general modelling issue arose, where the use of models to inform observation system design and operations and process studies was roundly noted as good idea. However, it was also noted that it would be important to have at least some products now in respect to forecasting. This was noted as important in terms of showing benefits to society from the activities that IOGOOS engages in. It was noted that this generic topic was a highlight of Dr Masumoto's presentation at this meeting.

In respect to SIBER, SN asked Dr Naqvi to elaborate on what SIBER regards as IOGOOS's role and to attempt to articulate for members what exactly is sought from IOGOOS to progress SIBER, including any specific action requests on IOGOOS. Dr Naqvi replied that funds were needed to run the SIBER panel (currently in formation) in the same way that IOP is run. SN replied that this should be seen as a legitimate request in that SIBER has already been endorsed in principle by IOGOOS, in the same way that the IOP was an IOGOOS project. Therefore whilst IOGOOS would encourage members of SIBER to fund themselves it would also also encourage IOC Perth to find some funds and also facilitate resources to be found to assist SIBER. In this same context SN referred to the potential role of the proposed IndOOS Resources Forum.

7.2 Working Group 2: Developing a package of integrated monitoring projects: IO core remote sensing, Chl-a mapping, keystone ecosystem indicators, shoreline changes, coral reefs

Dr Wagner reported on this item, referring to the Working Group's (WG) general strong support for the project, which is to be progressed as an integrated package of sub projects bringing together, under one overall project umbrella, the objectives of the projects described in earlier presentations:

- Indian Ocean core remote sensing project and Chl-a mapping (ref: this report, Section 6.2, S Kumar);
- Keystone coastal ecosystems (ref: this report, Section 6.3, G Wagner);
- Shoreline changes (ref: this report, Section 6.4, K Tennakoon); and
- Coral reef mapping and monitoring (ref: this report, Section 6.10, R M Dwivedi)

Specific features of the project specifications were provided in brief, but were not reported on in detail during this plenary since they were fully covered by the talks of day 2 of this meeting (see Sections 62, 6.3, 6.4 and 6.10, above).

Dr Wagner advised members that it is intended to continue to develop this project, as an integrated package of sub-projects described above, at the forthcoming capacity building (report writing) workshop to be held in Kota Kinabalu, Sabah, Malaysia, 10-14 December 2009. Relevant IOGOOS members will be present at the Kota Kinabalu workshop with the aim of

advancing the writing of a proposal for the project. This is intended as a key step to eventually developing a proposal that can be submitted to international donor agencies for funding. The Kota Kinabalu workshop follows the earlier leadership training workshops held in Hyderabad under UNESCO/IOC and IOGOOS support (as covered in Section 6.2 of this report, above).

Dr Wagner also pointed out that the 'remote sensing' needs of this project are already being supported by INCOIS, through the leadership of S Kumar of the IOGOOS Secretariat, and as embedded in the project described by S Kumar (Section 6.2, above).

Comments from plenary.

- ***Overall, members noted this project to be developing well and worthy of continued endorsement and support through IOGOOS.***
- ***The approach to develop an overall project comprised as a set of sub-projects, making each sub-project manageable in terms of project development, was supported.***
- ***It was felt important that the project leaders ensure that the 'outcomes' of the intended projects be clearly specified to assist potential donors in assessing the merits of the proposal when considering the potential benefits of the projects for society.***
- ***The coral reef aspect of the project was noted to be already in progress (ref: R M Dwivedi's presentation, Section 6.10, above) and an issue raised in plenary was the need for IOGOOS support to continue to momentum of the coral reef work. To that end, the Chair SN invited Dr Dwivedi to submit a short document (proposal) to IOGOOS outlining the requirements in respect to funding. SN undertook to assist as best as possible in terms of identifying potential funds on behalf of IOGOOS through the MoES.***
- ***Members called for the work plan for the project to be ready for the next IOGOOS meeting so that the issue of sourcing funds for the project could be addressed in proper context.***
- ***Members felt it important that in the project proposal, proper identification and reference be made of existing IOGOOS activities that contribute to the overall objectives of the proposed project.***
- ***Members were keen that in the project proposal, the 'true' budget be declared, referring to the importance of ensuring that all in-kind contributions from IOGOOS members and their institutions are accurately reflected. The motivation for this is that often the in-kind components of such projects add up to large amounts and it is worthy to make these explicit to potential cash donors.***
- ***Dr Naqvi commented that the Asia Pacific Network may be relevant in the context of tis proposal.***
- ***Dr Naqvi also pointed out that there may be merit in having a regular 'summer school' type aspect to the project, where, for example, India could underpin the resourcing of such in a capacity building sense. Dr Naqvi offered to try to find support for this proposition if the project leaders wished to follow up on the idea.***
- ***Dr Tennakoon added his support to the summer school idea and indicated that Sri Lanka could be approached to act as a collaborating partner in any summer school proposal.***

Recommended action:

Dr R M Dwivedi to submit a proposal to MoES via the IOGOOS Chair for resources to support the coral reef monitoring, as relevant to the integrated IOGOOS project currently being developed for IO core remote sensing, Chl-a mapping, keystone ecosystem indicators, shoreline changes and coral reefs.

7 Key action items arising out of IOGOOS-VI.

The key action items arising from IOGOOS-VI are listed as follows (with each item headed by responsible party for action)

From the AGM

IOP (THROUGH IOP CO-CHAIRS)
The Chair requested that IOP finalise the Terms of Reference for the IRF to be as submitted to this meeting, but with Section 5.4 of the draft ToR changed to: "5.4 IOGOOS will seek Secretariat support for the Forum from the UNESCO IOC Perth Regional Programme Office."

IOP (THROUGH IOP CO-CHAIRS)
The Chair requested, through the IOP Co-Chair Dr Masumoto, that IOP have the Business Plan for the IRF ready for consideration by IOGOOS, at the next IOGOOS meeting.

IOGOOS SECRETARIAT
Noting the members' discussion on the draft IOGOOS Strategic Plan for 2007-2011, the Chair asked the Secretariat to address member's comments for editorial changes and edit and finalise the draft Strategic Plan accordingly.

IOGOOS SECRETARIAT
The Chair asked the Secretariat to provide a critical review and assessment of all feasible existing and proposed IOGOOS projects as well as unfeasible existing or proposed projects at the next IOGOOS meeting, to facilitate decisions that would need to be made by members on continuance or otherwise of all projects, with a view to then revising and updating the project listing on the IOGOOS website.

IOGOOS CO-SECRETARY S KUMAR
The Chair tasked the current Secretary Mr Srinivasa Kumar to reflect in the IOGOOS communications media and relevant documentations the change to now having two co-Secretaries for IOGOOS, comprising Mr Srinivasa Kumar and Mr Nagaraja Kumar, of INCOIS, and the renewal of the Chair position with Dr Nayak as Chair.

IOGOOS SECRETARIAT
The Chair tasked the Secretariat to (i) coordinate a letter of thanks and appreciation (through the Chair) to Dr Smith on his retirement as IOGOOS Officer and (ii) coordinate the process for Dr Smith's replacement out of session, before the next IOGOOS meeting.

IOGOOS SECRETARIAT

The Chair tasked the Secretariat to coordinate the selection of the venue and date of the next meeting (IOGOOS-VII) through consultation with members, out of session, and to try to arrange, if feasible, a combined meeting of (i) IOGOOS-VII, (ii) IOP7, (iii) the first meeting of the IndOOS Resources Forum and (iv) the 3rd IOP High Level Review Panel meeting, noting members' interest in planning for cost-effective attendance at these respective events. To this end, the Secretariat was asked to bear in mind the potential to have the next IOGOOS-VII meeting early in 2010, as a means of perhaps facilitating the holding of the four meetings back-to-back in one locality.

From the Breakout Sessions and related Working Group and plenary comments.

IOP (THROUGH DR YUKIO MASUMOTO AS CO-CHAIR)
Recommended Action: That IOP be tasked with undertaking an internal review and prioritization of the needs of the respective ocean observing components of IndOOS, with a view to having the priorities and associated needs for enhancement of those components submitted to the 1st meeting of the proposed IndOOS Resources Forum (likely to be held in conjunction with IOGOOS-VII, sometime towards the end of 2009).

SIBER (THROUGH DR W NAQVI AND DR R HOOD)
Recommended Action: Seek from SIBER an initial prioritization of the bio-geochemical parameters and associated sensors needed to establish SIBER in respect to its own observing framework aspirations, and integrate that list with the results of the similar prioritization recommended for IOP (above). Dr W Naqvi offered to coordinate this with Dr R Hood through and on behalf of SIBER, in consultation with IOP, with a view to tabling the proposed network at the IOP6 meeting for consideration, comment, revision as necessary.

SIBER (THROUGH DR W NAQVI)
Recommended Action: Dr Wajih Naqvi, NIO, to make a presentation to the Secretary, Ministry of Earth Sciences, requesting the Ministry's institutional support for resources to progress the SIBER objective of improving the network of measurements of ocean carbon through the Underway PCO_2 system.

DR PATTAHBI RAMA RAO AND DR M RAVICHANDRAN
Recommended Action: Survey the data management requirements of all IOGOOS member nations, through E Pattabhi Rama Rao and M Ravichandran, who offered to undertake this task, noting the plenary comments on this item from IOGOOS-VI.

IOP (THROUGH DR M RAVICHANDRAN)
Recommended Action: That IOP be tasked with (i) examining the potential to use numerical ocean models to assist in planning Argo deployments with respect to predicting likely gaps that will emerge at times of new Argo float deployments, with initial assistance ideally being sought from IOP modeler Dr G Vecchi and CSIRO modeler, Dr S Schiller; and (ii) examining the feasibility of using the Iridium satellite system for rapid data transfers whilst Argos are at the surface, thereby allowing the floats to spend minimal

times in fast current environs near the surface before descending back to weak current zones at depth. Dr M Ravichandran offered to undertake this task.

IOP (THROUGH IOP CO-CHAIRS)

Recommended Action: That IOP be tasked with developing a Business Plan for the IndOOS Resources Forum as an outcome of the forthcoming IOP6 meeting in La Reunion (early June 2009), with that plan then submitted promptly to IOGOOS (through the Chair) out of session for consideration, endorsement and to assist in planning, desirably, a major IOGOOS-VII meeting (sometime in the period late 2009/early 2010) that would include the first IndOOS Resources Forum meeting and third IOP High Level Review Panel meeting. The Business Plan should be developed with due reference to and inclusion of SIBER, in respect to potential synergies in science pursuits and harmonizing the respective sustained observing system developments across the IOP and SIBER. To that end, it is recommended that SIBER participate in the development of the IRF at IOP6 to assist in developing the IRF Business Plan and also in order to ensure appropriate recommendations for representation of bio-geochemical needs in the IRF.

DR M RAVICHANDRAN

Recommended Action:

- **That Dr Ravichandran be installed as the Project Leader and that he be tasked with coordinating the development of the project proposal for the project titled: *IOGOOS Modeling for Ocean Forecasting and Process Studies*.**
- **That the Chair, IOGOOS, invite IOGOOS members to join the group, through direct contact with Dr Ravichandran.**
- **That the development of the proposal use, as a first step, the opportunity for group members to attend the GSSCXII workshop (Perth 23/24 Feb 2009), where this thematic topic will be addressed with ocean forecasting modelers and existing/potential users, for the IO, SEA, WA and PI GOOS regions.**
- **That after the Perth 2009 workshop, Dr Ravichandran coordinate the development of a project proposal and submit it to IOGOOS out of session for endorsement, where members can input key priorities to the proposal, covering the points noted by the group during the IOGOOS-VI Breakout Session plenary discussions. The project proposal should include as a first activity a project planning workshop to include, group members and Bluelink personnel, aiming for this meeting to be held during mid-2009, requesting assistance to host the workshop through Bluelink and IOC Perth.**

DR R M DWIVEDI

Recommended action:

Dr R M Dwivedi to submit a proposal to MoES via the IOGOOS Chair for resources to support the coral reef monitoring, as relevant to the integrated IOGOOS project currently being developed for IO core remote sensing, Chl-a mapping, keystone ecosystem indicators, shoreline changes and coral reefs.

10 CLOSING

Dr D'Adamo thanked the Chair, Secretary and INCOIS staff for their roles in achieving this successful meeting, and also thanked again IOGOOS members and their institutions for their contributions to this meeting. Dr D'Adamo also thanked, on behalf of delegates, the generous hosting of associated social events to this meeting by the Government of India, through INCOIS.

These comments were echoed by Secretary Kumar and Chair Dr Nayak, who again emphasised the need to focus in the inter-sessional period on IOGOOS further energising and realising its full potential for the benefit of its member communities. Dr Nayak also reminded members to address outstanding membership fee invoices, and encouraged IOGOOS to increase its membership to engage a greater range of Indian Ocean communities.

ANNEX 1

List of Participants for the IOGOOS Workshop and Sixth Annual Meeting

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ANNEX 2

IOGOOS Workshop and Sixth Annual Meeting (IOGOOS-VI)

December 03 – 05, 2008 at Hyderabad, India

Venue: Ganga Hall, Kasani GR Hotel, Madhapur

Provisional Agenda

<table>
<tr><td colspan="2"><u>December 03, 2008 (Wednesday)</u>
Arrival, Registration</td></tr>
<tr><td>0900 to 0930 Hrs</td><td>Registration</td></tr>
<tr><td>0930 to 1000 Hrs</td><td>Opening Ceremony
1. Invocation
2. Welcome Speech by Director, INCOIS
3. Lighting of the Lamp
4. Opening Remarks by Dr. Shailesh Nayak, IOGOOS Chair
5. Opening Remarks by Dr. Mitrasen Bhikhajee, IOGOOS Officer
6. Opening Remarks by Dr Nick D'Adamo, Head, IOC-Perth Office
7. Organisation of Meeting, IOGOOS Chair
8. Vote of Thanks by Secretary, IOGOOS</td></tr>
<tr><td>1000 to 1030 Hrs</td><td>High Tea</td></tr>
<tr><td>1030 to 1330 Hrs</td><td>Plenary Talks (25 Minutes each)
<table>
<tr><th>Proposed Title</th><th>Status Report by</th></tr>
<tr><td>Elements of a frugal observing and prediction system for the west coast of India</td><td>Dr. Satish Shetye</td></tr>
<tr><td>NOAA – MoES Partnership</td><td>Dr. Sidney Thurston</td></tr>
<tr><td>Predicting IOD and its Impacts</td><td>Dr. Yukio Masumoto</td></tr>
<tr><td>Ocean Observations in the Bay of Bengal and Arabian Sea</td><td>Dr. Ravichandran</td></tr>
<tr><td>IOC Perth Update and potential IOGOOS links with WA, SEA and PI GRAs</td><td>Dr. Nick D Adamo</td></tr>
<tr><td>Oceansat-II Products and Utilisation</td><td>Dr. RM Dwivedi</td></tr>
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1330 to 1430 Hrs	**Lunch Break**
1430 to 1600 Hrs	**IOGOOS Annual Meeting** 1. Report by Chairman, IOGOOS 2. Presentation of Secretariat Report 3. Discussions on IOGOOS Strategic Plan 4. Discussions on IOGOOS Pilot Projects 5. Election / Nomination / Confirmation of IOGOOS Officer/s 6. Election / Nomination / Confirmation of IOGOOS Secretariat 7. Accounts and Financial Summary 8. Nomination of Working Groups 9. Next Meeting and any other Item 10. Conclusion *Tea will be served in Meeting Room*
1600 to 1900 Hrs	**Visit to INCOIS Facilities**
1900 Hrs onwards	**Dinner hosted by INCOIS – Hotel "Sitara Grand"**

December 04, 2008 (Thursday)

0900 to 1100 Hrs — **IOGOOS Projects (Progress & New Proposals) – 20 Minutes each**

Proposed Title	Presentation by
Indian Ocean Panel	Dr. Yukio Masumoto
Indian Ocean Core Remote Sensing Project & Chl-a Mapping Project	Mr. T. Srinivasa Kumar
Keystone Coastal Ecosystems	Dr. Greg Wagner
Shoreline Changes	Dr. Kamal Tennakkoon
Ocean Data Management & Capacity Building	Mr. E. P. Ramarao
IOGOOS Ocean Products (Bluelink, OSF, etc.) User Group	Dr. Nick D' Adamo

1100 to 1130 Hrs	**Tea Break**	
1130 to 1300 Hrs	**IOGOOS Projects (Progress & New Proposals)… Contd…**	
	Proposed Title	**Presentation by**
	IBER	Dr. SWA Naqvi
	)cean Modelling and Forecasting	Dr. Balakrishnan Nair
	AMESD project and forthcoming ctivities for the SWIO region	Dr. Francois Carnus
	Coral Reef Mapping and Monitoring	Dr. R. M. Dwivedi
1300 to 1400 Hrs	**Lunch Break**	
1400 to 1530 Hrs	**Break out session of Working Groups**	
1530 to 1600 Hrs	Tea Break	
1600 to 1730 Hrs	**Break out session of Working Groups (Continued)**	
1900 Hrs onwards	**Dinner hosted by IOC Perth Office at Hotel "Ginger Court"**	

December 05, 2008 (Friday)	
0900 to 1100 Hrs	**Break out session of Working Groups (Continued)**
1100 to 1130 Hrs	Tea Break
1130 to 1300 Hrs	**Break out session of Working Groups (Continued)**
1300 to 1400 Hrs	**Lunch Break**
1400 to 1530 Hrs	**Short Plenary Summaries by Working Groups and Presentation of Work Plan**
1530 to 1600 Hrs	Tea Break
1600 to1730 Hrs	**Finalization of Work Plan and Closing of the Meeting**

ANNEX 3

IOGOOS Workshop and Sixth Annual Meeting (IOGOOS-VI)
December 03 – 05, 2008 at Hyderabad, India
Agenda Item 2 of the Annual Meeting

IOGOOS Secretariat Report (December 2007 – November 2008)

Sl. No.	Item	Status / Progress
1.	**IOGOOS Annual Meeting**	
1.1	IOGOOS V Report	• Finalised and circulated the IOGOOS V Annual Report. • The Printed copy of the report is distributed to the IOGOOS VI Participants (Provided along with Registration Kit).
1.2	The IOGOOS Secretariat was requested to interact with the potential hosts to finalise the venue and the dates of the next Annual Meeting	• Action Completed
1.3	Conduct of IOGOOS VI	• Circular, Invitations, Agenda, Funding, Local Arrangements for IOGOOS VI. • Funding from IOC Perth Office (USD 14, 000) and INCOIS (USD 10, 000).
2.	**IOGOOS Revised Strategic Plan**	
2.1	The IOGOOS Secretariat was asked to edit the IOGOOS Strategic Plan, circulate the draft to IOGOOS Officers, and then finalise the plan accordingly before circulating it to members prior to the next annual IOGOOS meeting.	• The strategic Plan has been edited and put up for approval of the Annual Meeting (Agenda Item 3). The same is attached as Annexure I to this report
3	**Capacity Building**	
3.1	IOGOOS Secretariat was asked to approach IOC / UNESCO for Capacity Building under the framework of IOGOOS projects	INCOIS/IOGOOS Secretariat worked extensively with IOC/UNESCO for the conduct of the following training programmes, aligning the objectives of the workshops to further IOGOOS pilot

		project: • "First Advanced Leadership Development Workshop from Directors of Marine Institutes from the Central Indian Ocean" held at INCOIS, India during May 10 – 14, 2008. INCOIS co-sponsored USD 10, 000 for this Workshop. Brief attached as Annexure II • "Tsunami Modeling, Inundation Mapping and Remote Sensing" held at INCOIS, India during October 27, 2008 to November 7, 2008. INCOIS co-sponsored USD 10, 000 for this Workshop. Brief attached as Annexure III • "Bid-writing workshop for IOGOOS and SEA-GOOS regions" scheduled to be held at Sabah during December 10 – 14, 2008. Brief attached as Annexure IV
4	**Indian Ocean Core Remote Sensing Project**	
4.1	International RS Training (3-4 days) – Hyderabad	• Action Completed. Training on RS and Modelling held during October 27, 2008 to November 07, 2008
4.2	Coordinators Meeting (Hyderabad 3-4 days) to Finalize proposals	Action Completed • First Project coordinators meeting was held during October 27, 2008 to November 07, 2008 • Second Project coordinators meeting is scheduled during December 06 – 08, 2008 in Hyderabad back to back with IOGOOS VI to work on the Proposals
4.3	Remote Sensing Data Analysis & Generate maps of the preliminary distribution of keystone ecosystems, shoreline configurations and real-time chlorophyll-a, SST, Kd490 and TSM maps for the countries wishing to participate in the project (to be used as a example of the potential of what could be done).	Action Completed. Generated remote sensing case studies for the following areas. • Keystone Ecosystems – Tanzania, Malaysia • Shoreline Changes – Sri Lanka, Tanzania, Madagascar and Malaysia • ChloroGIN - Iran, Kenya, Maldives,

		Oman, Sri Lanka, Tanzania and Thailand.
4.4	Write letters to potential donors and Prepare different versions of the proposals according to formats required by the donors.	• IOGOOS Project Coordinators are participating in the forthcoming Proposal writing Workshop being organized by IOC/UNESCO in Sabah, Malaysia during December 10 – 14, 2008 • Three IOGOOS pilot projects will be recast into business-like proposals and presented to the potential donor agencies.
5	**Initiation of the Indian Ocean real time chlorophyll-a mapping sub-project**	
5.1	Collate the requirements of member countries for real time maps of environmental parameters, such as SST, chlorophyll-a, total suspended sediments and Kd_490 products	• Action Completed.
5.2	Providing chlorophyll-a, SST, TSM and Kd 490 products data sets for extended domain covering Iran, Kenya, Maldives, Oman, Sri Lanka, Tanzania and Thailand.	• INCOIS has already started generating near real-time satellite products viz. Chlorophyll-a, SST, kd_490, TSM to all requested countries.
5.3	Develop the methods for the project and circulate to members	• Document preparation is underway
5.4	Develop a plan for in-situ measurements and then provide web based access to results that flow from the project.	• In-situ measurements for the Indian region have been initiated as part of a National Project. Plan for in-situ measurements for other participating countries has to be drawn up.
6	**Ocean Data and Information Management**	
6.1	The group recommended that the IOGOOS's efforts in respect to ocean data management start to increase its focus on developing inventories of existing metadata and products/information from existing data acquisition systems, both in terms of remote sensing and in-situ.	Action Completed. The following two reports have been compiled that enlists data available for the Indian Ocean from various sources: • Indian Ocean Data Inventory • INCOIS Data Inventory These documents are being circulated for discussion during IOGOOS VI

7	**Governance**	
7.1	IOGOOS Officers	• The secretariat sent out the status paper and requested for nominations for the position of IOGOOS Officer. The status is attached as Annexure – V. Will be discussed as Agenda Item 5 of the Annual Meeting.
7.2	IOGOOS Secretariat	• The secretariat sent out the status paper and requested for submission of proposals for hosting the IOGOOS Secretariat. The status is attached as Annexure – VI. Will be discussed as Agenda Item 6 of the Annual Meeting.
8	**Finance**	
8.1	The IOGOOS Secretariat was asked to expedite the approvals required for receiving foreign currency	• Action Completed. Obtained the Foreign Contribution (Regulation) Act (FCRA), 1976 Approvals. • IOGOOS Secretariat will now send out the invoices to the members for Annual Membership Fee.
8.2	Audit	• Completed Financial Accounting and Audit for the Period December 2007 – November 2008). • Statement of Account is being submitted for verification and approval. The status is attached as Annexure – VII. Will be discussed as Agenda Item 7 of the Annual Meeting

Annexure I of IOGOOS Action Taken Report and ANNEX 4 of IOGOOS VI Report

Agenda Item 3 of Annual Meeting

Draft Strategic Plan put up for adoption by IOGOOS VI

Global Ocean Observing System for Indian Ocean (IOGOOS)

Strategic Plan 2007-2011

1 Mission of IOGOOS

2 Objectives

3 Strategic Approaches

3.1 Enhancement of Ocean Observing System

3.2 Data Management, Data Exchange and Communication

3.3 Applications and operational Services

3.4 Capacity Building

3.5 Research

3.6 Co-operation with other programmes and bodies

3.7 Publications

3.8 Coastal systems and services

4 Strategic Priorities 2007-2010

5 Operational Plan (Programme of Work)

5.1. Project Areas

5.1.1 Currently being pursued

5.1.2 Potential New Projects

1 Mission of IOGOOS

To foster cooperation and concerted actions on ocean observations, ocean science and operational oceanography for the Indian Ocean, to mitigate the impacts of natural disasters and climate change and to inform policy and decision making for protecting life and property and marine habitats and resources.

2 Objectives

The association of marine operational and research agencies and institutions which is IOGOOS recognized the imperative need to take a pro-active role and concerted actions to understand the ocean and coastal regions of the Indian Ocean for making informed decisions that save lives and protect living habitats and resources in the Indian Ocean region,

The broad intent was to contribute, collectively, to the progress of ocean observations, ocean science and operational oceanography, focussing on these imperative needs of the Indian Ocean region,

IOGOOS provides an organizational framework for planning, coordination and effective implementation of appropriate regional and sub-regional ocean and coastal observing systems, associated research and development, and services,

Members of IOGOOS will collaborate and work together for developing programmes for the implementation of GOOS in the Indian Ocean and for promoting activities of common interest for the development of operational oceanography in the Indian Ocean region

The specific objectives are to:

a) Contribute to the enhancement and establishment of the ocean observing system in the region;
b) promote and facilitate efficient and effective management, exchange and utilisation of oceanographic data;
c) promote and facilitate projects in coastal oceanography, in particular in relation to the prediction and mitigation of the impacts of hazards;
d) promote programmes and projects in operational oceanography and ocean services in the region meeting the requirements of end-users;
e) strengthen capacity building for enhancing the capabilities in the region;
f) encourage research in support of the above and the needs of users; and
g) develop synergies with other ocean programmes and regional GOOS bodies and .contribute to international planning and promotion of GOOS.

3 Strategic Approaches

3.1 Enhancement of the Ocean Observing System

a) Identify gaps and deficiencies in the existing/planned in-situ and remote sensing ocean observing system, and develop a programme for realising a well-designed and affordable ocean observation system for the region, adhering to the ‘GOOS principles’

b) Promote the development of low cost and efficient operational instrumentation and observing systems

3.2 Data Management, Data Exchange and Communication

a) Promote the development of low cost and efficient systems for acquisition, management, processing and interpretation of data.

b) Expand and strengthen networking of countries using modern technology including internet for real and near real time exchange of data and products.

c) Promote the development of standardized data procedures, including data quality control, adoption and use of metadata models, and data management more generally.

d) Provide high quality data and time series for a better understanding and improving the Indian Ocean ecosystem,

e) Collaborate with other programme and bodies in the field of data collection and data management, including as appropriate, through the ocean contribution to GEOSS

f) Co-ordinate GOOS data acquisition with existing regional and national data gathering systems under the agreements and conventions relating to pollution monitoring, marine meteorology, navigation and safety at sea,

g) Inventory of available data and products

h) Promote the exchange of coastal sea level data

3.3 Applications and operational Services

a) Identify priorities for operational oceanography and ocean services in the Indian Ocean region, based on evaluation of social and economic benefits,

b) Promote the development of regional and local operational oceanography, taking into account the components of GOOS, for realising services and products of maximum value to the countries of the region

c) Support operational oceanography and services in collaboration with marine-related public and private sector organizations and programmes

3.4 Capacity Building

IOGOOS should work with IOC CB to identify requirements for the region and possible solutions encompassing the following.

a) Involve institutions, develop leadership

b) Identify the training needs of countries in the region and promote organisation of training courses, workshops and seminars

c) Promote the development of common infrastructure, major systems or capital installations required to support operational oceanography in Indian Ocean,

d) Promote and aid capacity building, exchange of know-how, technology and personnel as well as collaboration, within the framework of GOOS;

e) Promote pilot projects and studies in the countries of the region to demonstrate the economic benefits of GOOS

f) Strengthen collaboration with GOOS and JCOMM, including DBCP capacity building panels and IOC TEMA including IOCINWIO and IOCINDIO capacity building programmes.

g) To exploit bilateral and multi-lateral opportunities for CB in the region (e.g., exchange of training for access to facilities)

3.5 Research

a) Promote research and pre-operational research for solving problems relating to operational oceanography in the Indian Ocean,

3.6 Co-operation with other programmes and bodies

a) Contribute to international planning and implementation of GOOS,

b) Assist in developing policies for the furtherance of GOOS and co-ordinate the best regional participation in GOOS, identifying where greatest value is added by collaboration

c) Promote collaboration between existing regional multi-national agencies, programmes, organisations, and initiatives having expertise in oceanography, operational systems, and remote sensing of the ocean,

d) Collaborate, as appropriate, with GOOS-Africa, NEAR-GOOS, SEA-GOOS, WAGOOS and WIOMAP through joint projects and activities,

e) Cooperate, as appropriate, with organisations concerned with the assessment of climate change, global environmental research, and the impacts of climate variability and climate change,

f) Promote collaboration with space agencies and remote sensing scientists and engineers so as to ensure optimum integration of both in situ and remote sensed data in operational oceanography;

g) Promote collaboration between Institutes and agencies in providing aid and assistance to developing countries for operational oceanography, and the necessary capacity building.

h) Provide as appropriate, expertise, consultants, etc., to the GOOS Steering Committee (GSC), IOC WMO UNEP Committee for GOOS (I-GOOS), and to the international sponsoring agencies of GOOS

3.7 Publications

a) To publish findings of meetings, workshops, studies and other documents commissioned by the IOGOOS members and submission of documents to international meetings related to GOOS and collective representation of GOOS to regional and national agencies when requested by members.

3.8 Coastal systems and services

a) Coastal indundation

b) Coastal hazards

c) Coastal Zone Management

d) Ecosystems

e) Shoreline change

f) To contribute to the development of the IOTWS through fostering and promoting collaboration on sea level observations and systems;

g) To promote development of observational networks (pilot and operational) that support monitoring and prediction of ocean-related hazards;

4 Strategic Priorities 2007-2010

4.1 Observing System Activities

a. The ongoing Indian Ocean (Climate) Observing System activities that are being pursued by the Indian Ocean Panel are progressing well and are direct contributions of IOGOOS to the Observing System activities in the Indian Ocean. These activities are to be pursued.

b. IOGOOS role and contributions to the Global Coastal Network (GCN): An audit could be coordinated from IOGOOS that could cover national programmes of the IOGOOS members in coastal monitoring, in-situ and remote sensing activities, data products, modelling and prediction activities, Data and Information Management, etc.

c. IOGOOS role and contributions to the coastal ocean beyond the Global Coastal Network (GCN): The coastal ecosystem pilot project, the Indian Ocean elements of Chloro GIN and the remote sensing activities of IOGOOS have been identified as the IOGOOS contributions to the coastal ocean beyond the GCN. These activities are to be pursued

4.2 Data and Information Management:

a) INCOIS and the IOGOOS Secretariat are involved in the Data Management of the IOP Data. An interface to the data is already provided on the IOGOOS Website. Further, a Comprehensive data and information management plan could be evolved by ensuring wide participation of the data managers from the region.

4.3 Applications and Operational Services:

a) Applications of ocean climate reanalyses and climate change projects through downscaling (coral reefs and fisheries applications)

b) Downscaling ocean analysis and prediction: The long-term objective is to develop an IOGOOS project on coastal modelling

c) ChloroGIN Project

4.4 Capacity Building and training:

a) IOGOOS should work with IOC CB to identify requirements for the region and possible solutions

b) Activities need to align with the projects of IOGOOS

c) IOGOOS should pursue activities that facilitate expert/scientist exchange/visits

4.5 Support Coastal Research/Observing:

IOGOOS has strong programmes in climate, coastal ecosystems as well as remote sensing. IOGOOS could play a potentially strong role in coordinating coastal research/observing.

4.6 Co-operation:

a) Participation of IOGOOS on the GOOS Regional Forum

b) Collaboration between the IOP and SIBER.

5 Operational Plan (Programme of Work)

Regional work programs are a fundamental component of the IOC structure to translate the global programmes and ocean services of the Commission into activities that maximize the benefit for Member States, taking into account the regional-specific perspectives and capability and the priorities indicated by Member States.

IOGOOS is not part of the intergovernmental structure but is recognized as one of the GOOS Regional Alliances and can influence the development of GOOS. The MoU for IOGOOS delivers a measure of autonomy since it is the Members themselves who decide actions and mutual commitment.

However, IOGOOS will only be seen as effective as a GRA if its work and actions truly add value and capacity in line with GOOS objectives and related Member State needs. The creation of a GOOS Regional Council does provide a mechanism for formally linking the

work program of IOGOOS to GOOS itself but, in practical terms, it will be through working to the priorities established in GOOS plans, collaboration in bodies and panels of GOOS, and national coordination via IGOOS and JCOMM.

Regional alliances have a unique role in terms of building partnerships and cooperation at the agency level and it is at this level that IOGOOS is most effective.

Work (action) of IOGOOS takes on many forms:

a) Building scientific knowledge and supporting data for

   - ocean and coastal management,
   - decision making and policy formulation, and
   - as contributions to the broader base of oceanographic data and knowledge;

b) Increasing national and regional capacities in marine sciences and observations through

   - training,
   - development of leadership,
   - networking among scientists and research institutions, and
   - the mobilization of resources;

c) Improving bilateral and multilateral support arrangements; and
d) Enhancing communication and awareness building.

The work program can be organized in a number of different ways including

(a) Sector/field or regional specific projects. They are characterised by (among other things)

   - A project plan, with specified objectives, outcomes and measures of performance;
   - An agreed period for the project; and
   - Identified leaders and participants.

(b) Work that is a direct contribution to a GOOS or related IOC program of action. The definition of this work should include

   - Well defined objectives, which may be ongoing;
   - Designation of rapporteurs and/or leaders responsible for interaction with GOOS;
   - A schedule of work for each inter-sessional period; and
   - A clear identification of the IOGOOS role and responsibility.

The IOC's Work Program falls under two Main Lines of Action (MLA) with Natural Sciences, : MLA 3 "Oceans and Coastal Zones" and MLA 7 "Prevention and mitigation of tsunamis and other marine hazards".

5.1 Project Areas

5.1.1 Currently being pursued

a) Indian Ocean Panel and IndOOS

b) Coastal Ecosystems

c) Shoreline Changes

d) Real-time Chlorophyll Mapping and Applications

e) Indian Ocean Core Remote Sensing Project encompassing the remote sensing component of the IOGOOS pilot projects

f) Data and Information Management

g) Capacity Building

5.1.2 Potential new projects

a) Regional (coastal) projections of climate change (sea level, sea temperature, acidification)

b) Extended provision of remote sensing products and involvement in satellite missions

c) Call for proposals for Ocean Colour Sensors

d) Invitation to develop payload instruments for future small sat missions

e) Digital elevation projects to support inundation studies (storm surges, sea level rise), coastal morphology and shoreline change, tsunami modelling

f) Modelling and Operational Forecasting

- Facilitating use of products generated by programs such as Blue Link, OSF, etc
- Demonstration of applications
- Form a Working group with experts from IOGOOS, SEAGOOS and IOC Perth Office for extending use, including downscaling
- Ocean analysis and prediction summer school for the Indian Ocean region ~ 2009

g) Contributions to the Tsunami and Other hazards Warning System (TOWS)

h) Ensure appropriate remote sensing CB activities are built into IOGOOS Pilot Projects

Annexure II

UNESCO/IOC sponsored "Advanced Leadership Workshop for Heads of Institutes in the IOCINDIO region" held at INCOIS during May 10 – 14, 2008
(Inputs from IOC/UNESCO / INCOIS)

- This workshop was the first for directors of marine-related institutions in the central Indian Ocean region of IOC (IOCINDIO), with a focus on organisations related to the Indian Ocean Global Ocean Observing System (IOGOOS), of which INCOIS is the host institution.

- 25 participants from 10 countries (Bangladesh, India, Malaysia, Maldives, Mauritius, Oman, Seychelles, Sri Lanka, Thailand, and UAE) of the Indian Ocean attended, most of them directors or senior executives in their organisations. Specialisations and expertise of the participants included operational meteorology, physical oceanography, marine hazards, hydrography, biological oceanography and fisheries, remote sensing, modelling and data management.

- The workshop first focussed on presentation of methods and best practices to work and grow directors' performance in leading their organisation. Feedback from participants indicates that this was perceived as a very useful and inspiring experience by most participants.

- The delegates then discussed the priorities in marine issues in their countries and region, their vision for the future of marine sciences in the Indian Ocean, and priorities in growing capacity and regional collaboration.

- Participants had largely converging view on the issues of priority that could broadly be grouped in issues pertaining to marine resources, and those pertaining to marine hazards. The possible focus for an initial limited number of pilot projects to address some of these issues was discussed.

- The next steps in the development of these projects could include a focus on regional collaboration for better multi-hazard warning systems, and coastal ecosystems, with mangroves for continental states and coral reefs for the island states.

- INCOIS hosted this important training and supported by sponsoring **US$ 10,000.**

Annexure III

UNESCO/IOC sponsored Training on "Tsunami Modeling, Inundation Mapping and Remote Sensing" held at INCOIS, India during Oct. 27 to Nov. 7, 2008.
(Inputs from IOC/UNESCO / INCOIS)

- This training programme was initially aimed at improving the skills of the participants to undertake Tsunami Modelling and Inundation Mapping.

- This objective was consistent with the revised strategy of IOGOOS that advocates pursuing projects related to Digital elevation models (data acquisition and modeling) to support coastal vulnerability, risk assessment and development planning studies, based particularly around coastal morphology, shoreline change, storm surge and tsunami inundation modeling.

- In addition, IOGOOS Secretariat worked closely with the Capacity Building Section of IOC to broaden the scope of this workshop to include Remote Sensing components.

- This facilitated IOGOOS to implement important decisions from the IOGOOS V Meeting which was to conduct a remote sensing training programme addressing the remote sensing capacity building needs of the proposed pilot projects viz. (i) Coastal Keystone Ecosystems, (ii) Coastal Shoreline Changes and (iii) Chlorophyll-a Mapping.

- The project coordinators of the IOGOOS Pilot Projects were trained in the Remote Sensing data analysis and at the end of the training, they could generate case studies for their respective priority areas for inclusion in the project proposals.

- 17 Participants from 13 countries (Bangladesh, Comoros, India, Madagascar, Maldives, Malaysia, Mauritius, Mozambique, Myanmar, Seychelles, Sri Lanka, Tanzania and Thailand) participated in this training programme.

- INCOIS hosted this important training and supported by sponsoring **US$ 10,000.**

Annexure IV

Background to the UNESCO/IOC Bid-writing workshop for IOGOOS and SEA-GOOS regions to be held in Sabah, Malaysia during December 10 – 14, 2008
(Inputs from IOC/UNESCO / BMRI, Universiti Sabah Malaysia)

Directors of national research institutes have identified important regional issues in the IOGOOS AND SEAGOOS regions. Their interactions over the last 3 years under a wide variety of IOC inter-governmental platforms have given them the opportunity to better appreciate the areas where collaboration would benefit the regions. As a result they have proposed 4 studies to be implemented in pilot sites: (i) Monitoring Keystone Coastal Ecosystems under threat, (ii) Coastal Shoreline changes, and (iii) Tsunami and other marine hazards. The suggested fourth area of collaboration is remote sensing with emphasis on chlorophyll mapping.

Directors also identified project leaders to draft proposals addressing these issues. The first step was to train the project leaders (PL) in Decision Support tools of modelling, remote sensing, and geographical information systems. PL learnt how to access a variety of data sources and use DS tools to better understand the selected pilot sites. They have incorporated these insights to improve their draft proposals, addressing where possible MDG 7 within the context of climate change. These drafts will be discussed and enriched by the other participants at Sabah under the guidance of a professional consultant who will illustrate how to package proposals in formats suitable for national, regional and international sponsors.

Buy-in from many high-level decision-makers has been obtained – as seen in the active interest and participation of the Minister, Ministry of Science, Technology and Innovation, Malaysia; Ministry of Earth Sciences, India; and Ministry of Fisheries, Sri Lanka. Efforts are on to obtain similar high-level endorsements in the other countries. A scientifically sound proposal targeted to meet MDG 7 that attracts interest from a regional or international sponsoring agency will be an important asset in getting similar commitments for in-kind support from remaining countries.

Now we seek interest from potential sponsors, crucial if the self-drive exhibited by these national institutes is to be extended regionally. Developing countries normally fund national priority projects (especially if these address important social impacts), though regional networking and collaboration is rarely a high priority. In the marine field however, networking is especially important since many issues (erosion, pollution, and destruction of habitats to name a few) are best addressed holistically through cooperative efforts that cross national boundaries. This is the important role potential sponsors are called upon to support in the Sabah workshop.

Further UNESCO support for regional implementation is assured through the Capacity-development program of IOC. The complete IOC-CD program, presently sponsored by the Swedish International Development Collaboration Agency, consists of workshops to strengthen organisations to lead and manage change. These efforts will continue with the many partners that are now increasingly co-sponsoring workshops with IOC, thus raising visibility of their institutes and of the issues at stake.

Annexure - V

Notification for the position of IOGOOS Officer

Agenda Item 5 of the Annual Meeting

IOGOOS Chair and Officers: The following is the status of the Tenure of Chair and Officers of IOGOOS:

Term	**2002 - 2004**	**2004 - 2006**	**2006 - 2008**	**2008 - 2010**
Chair	Dr. K. Radhakrishnan	Dr. K. Radhakrishnan	Dr. Shailesh Nayak	Eligible for Extension for two year term.
Officer	Dr. Johnson Kazungu	Dr. Johnson Kazungu	Dr. Alfonse Dubi	Eligible for Extension for two year term.
Officer	Prof. Anthony Forbes	Prof. Anthony Forbes	Dr. Somkiat Khokiattiwong	Eligible for Extension for two year term.
Officer	Dr. Harry Ganoo	Dr. Mitrasen Bhikajee	Dr. Mitrasen Bhikajee	Eligible for Extension for two year term, with the unanimous agreement of all members, in exceptional cases.
Officer	**Dr. Neville Smith**	**Dr. Neville Smith**	**Dr. Neville Smith**	**To be Elected.**

- Dr. Shailesh Nayak, Dr. Alfonse Dubi, Dr. Somkiat Khokiattiwong and Dr. Mitrasen Bhikajee are willing to continue for one more term.

- Nominations have been invited from interested Members for the position of IOGOOS Officer to replace Dr. Neville Smith.

- No nominations have been received so far.

Annexure - VI

Notification for Hosting the IOGOOS Secretariat

Agenda Item 6 of the Annual Meeting

Term	2002 2008	2009 - 2015
Secretariat	INCOIS, India	Location of Office may be rotated after six years from one Member to another by agreement of Members at an Annual Meeting. INCOIS has expressed willingness to continue.
Secretary	Mr. T. Srinivasa Kumar	

INCOIS has expressed its willingness to continue. If any other member wishes to be considered for hosting the Secretariat for the period 2009-2015, a proposal may be sent to the Secretariat addressing briefly the following points.

Criteria for hosting the IOGOOS Secretariat:

The host agency has to a leading oceanographic research establishment in the Indian Ocean region and is expected to provide and bear the cost of the following facilities to host the IOGOOS Secretariat:

- Nominating a Secretary for provision of administrative (communication and information exchange, travel planning, meetings, staff agenda organization, arrangements for shipping) and technical support (pursue decisions of the annual meetings and coordinate Inter-sessional activities related to IOGOOS Pilot Projects)
- Provision of Office Space for Secretariat Staff
- Provision of Computers and Communication facilities such as Telephone, Fax, and Internet
- Providing accommodation, support services, and/or professional staff
- Hosting and Management of IOGOOS Website
- Collection of Annual Membership fee, maintenance of Bank Account and issue of audited annual financial statements
- Support day-to-day functioning of the Office by following the practices of the host Agency

The proposals for IOGOOS Officer and Secretariat will be tabled for discussion in the IOGOOS Annual Meeting on December 03, 2008.

- Considering the excellent work being done by INCOIS in hosting the IOGOOS Secretariat Dr. Somkiat Khokkiattiwong, Dr. Alfonse Dubi and Dr. Mitrasen Bhikajee have expressed their willingness to continue the Secretariat at INCOIS.
- If for any reason, Members wish to change the Secretariat, Mauritius Oceanography Institute is willing to host.
- No other Member has submitted proposal for hosting the IOGOOS Secretariat so far

Annexure VII

Receipts and Payments for the Period From 09/11/2007 to 30/11/2008

INDIAN OCEAN GLOBAL OCEAN OBSERVING SYSTEM (IOGOOS)
"Ocean Valley" P.B.No. 21, IDA, Jeedimetla, P.O. Hyderabad-500 055
(Domestic Contributions)

Receipts and Payments for the period from 01/11/2007 to 30/11/2008

Receipts	Amount Rs	Payments	Amount Rs
Opening Balance as on 01/11/2007 Andhra Bank Jubilee Hills, Hyderabad	2,69,242		
Subscriptions from Members: Foreign Contributions Domestic Contributions	 --- ---	Expenditure	---
Interest earned	7,908		
		Closing Balance as on 30/11/2008 Andhra Bank, Jubilee Hills, Hyderabad	2,77,150
TOTAL	**2,77,150**	**TOTAL**	**2,77,150**

(T.Srinivasa Kumar)
Secretary, IOGOOS &
Head, ASG, INCOIS

(K.K.V.Chary)
Sr. Admn.Officer, INCOIS &
Head, ESG, INCOIS

Checked and verified

IOP Response to the Recommendations and Findings of the High-Level Review of IndOOS at IOGOOS-V

6 The Terms of Reference for the High Level Review (HLR) and Review Panel Members (HLRP) are given in the Panel's Report in Attachment A. The Recommendations and Findings of the Panel are:

1. The HLRP should welcome the tremendous progress that has been achieved, in terms of the IndOOS, and in terms of leadership for ocean and climate science in the region through the work of the Panel. The engagement of Indian Ocean agencies in the work is to be welcomed and should always be seen as a measure of success.
2. The HLRP does believe increased emphasis and attention should be given to the remote sensing aspects of the IndOOS. It is clear that remotely sensed data has already played a critical role in developing knowledge, but the degree to which it has shaped the thinking surrounding the development of the IndOOS was absent from the presentations.
3. The HRLP welcomes the attention given to socioeconomic issues and the data and information aspects of the system. Both were seen as challenges at the time of the last Review and we welcome the significant response facilitated by the IOP.
4. With respect to redundancies, the HLRP is of the view that there is an appropriate level of redundancy within networks, and between networks. However, the Panel also believes the IOP should begin to understand this redundancy more directly, particularly between and other elements of the OS, with particular attention on quality control.
5. The HLRP recommends strengthening of the links to ocean state estimation science, with perhaps a future meeting of the panel getting perspectives from specialists, including from the satellite community. Particular emphasis should be given to satellite data and developing a qualitative sense of impact of various elements for decadal predictability.
6. The HLRP welcomes the strong links between the development of IndOOS and research, from climate to ocean prediction, and extending into biogeochemical and ecological domains. The IOP should consider appointment of a Rappporteur or Member from SIBER.
7. The HLRP believes we should recommend that IOGOOS immediately consider SIBER as an initiative in its work program, and undertake to bring nations of the Indian Ocean into the program, as part of IndOOS extended. This would be subject to the review of the Science Plan.
8. The HLRP believes there are opportunities for strengthening the sharing of data between IOP activities and coastal projects and would encourage both the IOP and IOGOOS to examine opportunities.
9. The HLRP emphasised the importance of quality control, integration and assembling of data sets and encouraged even greater emphasis in the future.
10. A Sub-Committee for IndOOS Resources:
    - The HLRP takes the view that a "club" like CEOS is the most appropriate model, with the common interest being the ocean observing system of the Indian Ocean (general, but with initial focus on climate).

- The Indian Ocean GOOS provides the broad framework for participation, though we note it is for IO agencies primarily
- The "club" would be a sub-Committee with the specific charge of coordinating the deployment of resources for the IndOOS

11. IOGOOS should consider the convening a technical Working Group, ideally working with the IOP, SIBER and the IOTWS-ICG to examine and exploit the use of IndOOS platforms as "platforms of opportunity" for expanded instrumentation. This WG might also considers measurements of opportunity on vessels working in the region

Recommendation/Finding 1: The HLRP should welcome the tremendous progress that has been achieved, in terms of the IndOOS, and in terms of leadership for ocean and climate science in the region through the work of the Panel. The engagement of Indian Ocean agencies in the work is to be welcomed and should always be seen as a measure of success.

Recognition of progress in establishing the observing system in the Indian Ocean is appreciated. With the initial implementation plan accepted by key agencies, maintaining and enhancing the OS will require a more coordinated approach to resourcing. This is discussed further below at Recommendation/Finding 11. The next big challenge for IOP is to develop a research plan to address a range of issues relevant to Indian Ocean-climate, drawing on the background of a sustained OS. Initial interest at IOP-4 and IOP-5 was in ocean-predictability at time scales from Madden-Julian Oscillation (MJO) to Indian Ocean Dipole (IOD), decadal and longer variation of the Indian Ocean circulation and its connectivity to the Pacific, Southern and Atlantic Oceans, improved estimation of heat, freshwater and momentum fluxes, and in collaboration with SIBER, basin-scale biogeochemical and ecological studies. The discussion will continue at IOP-6. IOP will enhance engagement with Indian Ocean agencies by beginning collaboration with regional and coastal observing activities, as discussed below at Recommendation/Finding 8.

Recommendation/Finding 2: *The HLRP does believe increased emphasis and attention should be given to the remote sensing aspects of the IndOOS. It is clear that remotely sensed data has already played a critical role in developing knowledge, but the degree to which it has shaped the thinking surrounding the development of the IndOOS was absent from the presentations.*

The IndOOS implementation plan states that satellite observations are the backbone and the essential first element of IndOOS. Satellite observations were taken into account in the design of IndOOS through a series of observing system simulation experiments "recruited" by IOP (see: J.Climate **20** 3269, J.Climate **20** 3300, GRL **34** L19601, J.Atm.Oc.Technol. **25**, 794). That said, the design of IndOOS was ultimately the qualitative expert opinion of observational oceanographers. The need to rationalize and possibly modify the design taking satellite observations into account as we gain experience should remain on the IOP agenda. This need will come to the fore as the panel addresses a research plan involving MJO and seasonal prediction studies.

Recommendation/Finding 3: The HRLP welcomes the attention given to socioeconomic issues and the data and information aspects of the system. Both were seen as challenges at the time of the last Review and we welcome the significant response facilitated by the IOP.

IOP will continue to engage socioeconomic issues, particularly with regard to marine climate impacts on a regional scale (see Recommendation/Finding 8). A new initiative to

connect the OS outputs and end-users of the marine climate information in a seamless way has been started in JAMSTEC, focusing on the IOD as the first target, which will enhance the IOP engagement to socio-economic issues. The data and information service will continue to be developed at INCOIS and APDRC. IndOOS & RAMA have also initiated a collaboration with the Agulhas Somali Large Marine Ecosystems (ASCLME) Project which conducts research cruises in the western Indian Ocean to fill gaps in our understanding of ecosystem-level processes which affect sustainable management decisions.

Recommendation/Finding 4: With respect to redundancies, the HLRP is of the view that there is an appropriate level of redundancy within networks, and between networks. However, the Panel also believes the IOP should begin to understand this redundancy more directly, particularly between and other elements of the OS, with particular attention on quality control.

Noted. This is an issue that might be pursued in collaboration with ocean state estimation modelling (see Recommendation/Finding 5).

Recommendation/Finding 5: The HLRP recommends strengthening of the links to ocean state estimation science, with perhaps a future meeting of the panel getting perspectives from specialists, including from the satellite community. Particular emphasis should be given to satellite data and developing a qualitative sense of impact of various elements for decadal predictability.

IOP has been developing a joint project with GSOP to develop indices of Indian Ocean variability to be used as performance indicators for ocean estimation activity. This will involve initial activity working together, which may in time be enhanced, for example, to help IOP asses redundancies in the observational program.

Recommendation/Finding 6: The HLRP welcomes the strong links between the development of IndOOS and research, from climate to ocean prediction, and extending into biogeochemical and ecological domains. The IOP should consider appointment of a Rappporteur or Member from SIBER.

Recommendation/Finding 7: The HLRP believes we should recommend that IOGOOS immediately consider SIBER as an initiative in its work program, and undertake to bring nations of the Indian Ocean into the program, as part of IndOOS extended. This would be subject to the review of the Science Plan.

IOP members have worked with SIBER to produce a paper on the theme of basin-wide physical and biogeochemical variation during the past several months. The Chair of the SIBER science team has been nominated to be a member of IOP. The physical and biogeochemical aspects of climate science will be taken into account as IOP and SIBER develop the next phase of their research plans.

Recommendation/Finding 8: The HLRP believes there are opportunities for strengthening the sharing of data between IOP activities and coastal projects and would encourage both the IOP and IOGOOS to examine opportunities.

IOP has proposed writing a whitepaper for OceanObs09 with leaders of several regional and coastal observing activities around the Indian Ocean, including:

- Agulhas and Somali Current Large Marine Ecosystems (ASCLME)
- Agulhas Current Time-series (ACT) (proposed)
- Mozambique Channel Long-term Ocean Climate Observations (LOCO)
- Corral Reef Degradation in the Indian Ocean (CORDIO)

- Indian Mooring Program (Arabian Sea and Bay of Bengal)
- Indonesian GOOS (InaGOOS)
- Australian Integrated Marine Observing System (IMOS)

We intend this will lead to more collaborative activity

Recommendation/Finding 9: The HLRP emphasised the importance of quality control, integration and assembling of data sets and encouraged even greater emphasis in the future.

Noted. This is a critically important activity that requires substantial resources. Some resources are available through INCOIS (Hyderabad) and APDRC (Honolulu). Collaboration and possibly external, high level expertise is needed to develop a plan to provide access to research quality Indian Ocean data in a framework that permits integrated applications of the various streams of data.

Recommendation/Finding 10: A Sub-Committee for IndOOS Resources

Terms of Reference for the IndOOS Resources Forum (IRF) will be tabled by the Co-Chair of IOP at IOGOOS-VI.

Recommendation/Finding 11: IOGOOS should consider the convening a technical Working Group, ideally working with the IOP, SIBER and the IOTWS-ICG to examine and exploit the use of IndOOS platforms as "platforms of opportunity" for expanded instrumentation. This WG might also considers measurements of opportunity on vessels working in the region.

Noted. Deployment of SIBER instruments on some IndOOS platforms is already under discussion. The Working Group could be a useful, and should have a small membership, possibly only one representative from each group. The feasibility of this will be discussed at IOP-6.

Appendix A

High-Level Panel for the IndOOS

7 Terms of Reference

(1) Assessment of implementation progress: gaps, redundancies, opportunities
(2) The use of IndOOS data for ocean state estimation and socio-economic applications
(3) The importance of IndOOS for climate research, including SIBER
(4) Providing for free, open and timely exchange of data
(5) The merits of establishing a Resource Board to coordinate implementation requirements and resources for IndOOS
(6) Identify near Term Priorities

8 Panel Members

- Dr PS Goel, Secretary Ministry of Earth Sciences, India
- Dr Chet Koblinsky, Director Climate Program, NOAA
- Dr Neville Smith, Deputy Director (Research and Systems), Bureau of Meteorology, Australia [Rapporteur]
- Dr Kiyoshi Suchiro, Executive Director, International Development, JAMSTEC
- Mark Majodina, Director of International Activities, South African Weather Service (not in attendance)

9 Report against Terms of Reference

1. Assessment of implementation progress: gaps, redundancies, opportunities

- The progress since 2002, and since the last review is unambiguously positive. We see:
  - The target Argo and drifter deployments have been reached
  - RAMA is now 1/3 complete
  - There are a number of recent enhancements from India, Australia, and others that provide significant supplementation in a number of areas, particularly for the boundary regions.
  - The increased participation is also to be applauded: e.g., > 10 participants in Argo (incl. Deployment assistance); ~ 6 nations contributing to moorings
  - The IOP itself has been a positive force for participation in IndOOS
- Articulation of the benefits are in early stages, but some indications of benefits for prediction, and significant advances in terms of knowledge are evident.
- Within the remit of the IOP, the HLRP cannot see any major gaps that have not already been identified by the Panel. The emergence of boundary monitoring as a strength among the activities fills a gap that was evident in early planning. Western Indian Ocean sampling is less than desired, particularly wrt boundary regions.
- There was a significant gap in the presentations around remote sensing, particularly with respect to an integrated approach to observing the Indian Ocean. It was difficult for the HLRP to see how consideration of the existing and planned satellite missions has impacted thinking on the in situ array design.

- It would have been nice to see greater emphasis on sea surface fields, even SST, since this remains a critical element in prediction on daily to intraseasonal time scales
- The HLRP noted a seeming decrease in importance attached to surface fluxes emerging from the FAR. This might encourage a re-examination of the role of surface observation platforms for the region.

- There is redundancy, but it would seem that which exists now has scientific benefits in excess of any budget advantages that might accrue from lessening this redundancy. The HLRP suggests that the intersections of, say RAMA and Argo be studied more closely, in terms of the strength it adds, and opportunities for bridging temporal and spatial gaps.
- Conclusions:

Recommendation/Finding 1. The HLRP should welcome the tremendous progress that has been achieved, in terms of the IndOOS, and in terms of leadership for ocean and climate science in the region through the work of the Panel. The engagement of Indian Ocean agencies in the work is to be welcomed and should always be seen as a measure of success.

Recommendation/Finding 2. The HLRP does believe increased emphasis and attention should be given to the remote sensing aspects of the IndOOS. It is clear that remotely sensed data has already played a critical role in developing knowledge, but the degree to which it has shaped the thinking surrounding the development of the IndOOS was absent from the presentations.

Recommendation/Finding 3. The HRLP welcomes the attention given to socioeconomic issues and the data and information aspects of the system. Both were seen as challenges at the time of the last Review and we welcome the significant response facilitated by the IOP.

Recommendation/Finding 4. With respect to redundancies, the HLRP is of the view that there is an appropriate level of redundancy within networks, and between networks. However, the Panel also believes the IOP should begin to understand this redundancy more directly, particularly between and other elements of the OS, with particular attention on quality control.

2. The use of IndOOS data for ocean state estimation and socio-economic applications

- The socio-economic presentations were interesting and instructive. It is clear that the socio-economic development of the Indian Ocean region is sensitive to climate variability and climate change. We have seen a number of ways climate information can be used to both mitigate the negative impacts for vulnerable sectors, and to improve efficiency and productivity where the sensitivity provides opportunities.
- It is less clear there can be a direct line drawn from the OS to socio-economic impacts, but this is a challenge that is not unique to IndOOS. It suffices at this time to be well informed about the potential benefits and to be aware that unique attribution of effect is rare.
- There was less emphasis on ocean state estimation within the presentations. Indeed, this aspect might be seen as a weakness were it not for the fact that the HLRP is ware the climate and ocean state estimation efforts are well linked to the IOP.
- In other regions, particularly in the North Atlantic there have been a number of studies that tease out the relevance of elements of the OS to particular phenomena and

mechanisms. Such studies for the Indian Ocean would be beneficial, particularly with a view toward decadal prediction. E.g., are there adequate deep observations?

Recommendation/Finding 5. The HLRP recommends strengthening of the links to ocean state estimation science, with perhaps a future meeting of the panel getting perspectives from specialists, including from the satellite community. Particular emphasis should be given to satellite data and developing a qualitative sense of impact of various elements for decadal predictability.

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3. The importance of IndOOS for climate research, including SIBER

- As discussed under 1, the importance of the IndOOS for research is unambiguous. There remains a belief that the Indian Ocean has climate modes that operate independent of other climate modes.
- The emergence of decadal variability as a more prominent aspect of research does in our view add greater weight to relevant data than before. Understanding the level of predictability will be important for the future.
- The emergence of process studies for boundary currents and air-sea processes and intraseseasonal variability is a +ve aspect.
- The emergence of SIBER is to be welcomed. The use of data for management and associated research should only be strengthened by this emerging partnership.
- SIBER is an outstanding opportunity for the future. The scientific rationale is strong with both socio-economic and knowledge benefits evident.
    - The strength of the IMBER endorsement provides great confidence for the potential involvement of IOGOOS. Irrespective of the latter, there are clear benefits fr the work of the IOP.

Recommendation/Finding 6. The HLRP welcomes the strong links between the development of IndOOS and research, from climate to ocean prediction, and extending into biogeochemical and ecological domains. The IOP should consider appointment of a Rappporteur or Member from SIBER.

Recommendation/Finding 7. The HLRP believes we should recommend that IOGOOS immediately consider SIBER as an initiative in its work program, and undertake to bring nations of the Indian Ocean into the program, as part of IndOOS extended. This would be subject to the review of the Science Plan.

4. Providing for free, open and timely exchange of data

- The HLRP welcomed the presentations on data and data exchange. It agrees that exchange of data is critical for advancing climate and related research.

Recommendation/Finding 8. The HLRP believes there are opportunities for strengthening the sharing of data between IOP activities and coastal projects and would encourage both the IOP and IOGOOS to examine opportunities.

Recommendation/Finding 9. The HLRP emphasised the importance of quality control, integration and assembling of data sets and encouraged even greater emphasis in the future.

5. The merits of establishing a Resource Board to coordinate implementation requirements and resources for IndOOS

Recommendation/Finding 10. A Sub-Committee for IndGOOS Resources.

- The rapid development of IndOOS is based on scientific understanding and this is mandatory. IndOOS development thereafter is inextricably linked to the investment and broad multi-national institutional support. Bilateral agreements are valuable but not sufficient to guarantee successful and efficient coordination implementation.
- The HLRP takes the view that a "club" like CEOS is the most appropriate model, with the common interest being the ocean observing system of the Indian Ocean (general, but with initial focus on climate).
- The Indian Ocean GOOS provides the broad framework for participation, though we note it is for IO agencies primarily
- The "club" would be a sub-Committee with the specific charge of coordinating the deployment of resources for the IndOOS.
    - The sub-Committee for IndOOS Resources would …
        - To consider the resource requirements for the implementation of IndOOS and develop forward estimates of the committed, in principle commitments and highest priority unmet needs;
        - To the extent possible, harmonise and coordinate the deployment of resources dedicated to the program;
        - To report on the deployed resources to the Heads of the Institutions, through IOGOOS.
    - Scientific guidance is provided by the IOP initially, but we may anticipate an expanded remit over time.
    - The Committee would be open. Secretariat support would be provided through the IOGOOS and IOC Perth Regional Office Secretariats;
    - The Sub-Committee would need to be supported by regular scientific reviews of the IndOOS, order 2-3 years;

6. Identify (other) near Term Priorities

Recommendation/Finding 11. IOGOOS should consider the convening a technical Working Group, ideally working with the IOP, SIBER and the IOTWS-ICG to examine and exploit the use of IndOOS platforms as "platforms of opportunity" for expanded instrumentation. This WG might also considers measurements of opportunity on vessels working in the region.

IndOOS Resource Forum
Terms of Reference
11 October 2008

1. Establishment

The IndOOS Resource Forum (IRF) will be established by resolution of IOGOOS, incorporating the institutions that are currently committing resources to the IndOOS.

2. Composition

The membership of the IRF will be invited by the Chair of IOGOOS and comprised of representatives of institutions allocating or facilitating resources to accomplish the overall goals of IndOOS, and the Chair of the CLIVAR/GOOS Indian Ocean Panel as an Observer.

The initial members will be representatives of MoES, JAMSTEC, NOAA, SOA, BPPT, BoM (Australia), South Africa(TBA) and France(TBA). The forum will review membership at each meeting and invite additional members as required.

3. Functions

The main function of the IRF is to provide a multi-institutional Forum for the coordination of resources for implementation of the IndOOS, including the following:

3.1 To review the requirements for the implementation of IndOOS;
3.2 To facilitate and coordinate resources that may be applied to the system, especially ship time for the Research Moored Array for African-Asian-Australian Monsoon Analysis and Prediction (RAMA);
3.3 To encourage scientific and technological initiatives, in the participating countries, to meet the objectives of IndOOS;
3.4 To report on its activities to the Heads of the institutions providing resources.

4. Scientific and Technical Advisory Bodies

In discharging its tasks, the IRF should be guided by the scientific objectives and research strategy formulated by the Indian Ocean Panel, which is regarded as the main scientific body to advise the IRF.

5. Organization of Sessions

5.1 The IRF will hold sessions at dates and places to be decided at the previous session. The secretariat (see below) will be responsible for arranging meetings and will send invitations to attend to:

- All IRF members;
- Experts invited as Observers by the Chair of the IRF, including firstly the Chair(s) of the Indian Ocean Panel, as necessary for the deliberations in that specific session of the IRF.

5.2 At the close of every other session, the IRF will elect from its members a Chair who will serve in that capacity for the next two sessions. An individual shall serve no more than two consecutive terms as Chair.

5.3 Sessions will be conducted in English and reports published in that language.

5.4 Secretariat support for the Forum will be provided by the UNESCO IOC Perth Regional Program Office.

Dear Kumar, Please ensure that this is correctly addressed to Dr Shailesh Nayak. I don't know if INCOIS is still the right address.

Dear Shailesh,

Congratulations on your new role as Secretary of MoES.

We're writing to follow-up the discussion of resources for IndOOS that took place at the High Level Review as part of IOGOOS-V in Phuket.

Recognizing the need for ongoing activity to promote resourcing of ocean observing, the CLIVAR/GOOS Indian Ocean Panel recommends formation of an IndOOS Resource Forum (IRF). Draft Terms of Reference for the Forum are attached. Yukio Masumoto, Co-chair of IOP, will table the document at IOGOOS-VI for discussion at a break-out session.

IOP is of the opinion that we need such a Forum to build a sense of common purpose among the nations trying to develop IndOOS in general and RAMA in particular. Specifically, the main purpose of the IndOOS Resource Forum would be to provide an international framework for the coordination of resource commitments to the observing system. For RAMA in particular, there are several bilateral agreements that have helped to jump start implementation of the array. However, these are not sufficient
to guarantee success in the long term. There needs to be a mechanism that ensures all participating organizations are aware of how their resource commitments mesh with those of other organizations for the common good. This will help avoid duplication of effort and ensure limited resources like ship time are deployed in themost efficient manner possible.

The Forum will be guided by scientific advice from the IOP. However, it is not intended that the IOP (or any other organization or individual) will dictate to the Forum, or that the Forum or its members will be required to make binding commitments. We simply need a mechanism for the regular flow of information about resources among the countries investing in the program. This gives each organization and each country the opportunity to optimize their contributions in view of the totality of all national contributions.

The Forum members should ideally be made up of program managers or their designees, rather than heads of agencies. Forum members will not set IndOOS policy for their organizations. Rather, they will report to the Forum their nation's policies and contributions, then work with other Forum members to ensure the overall transnational objectives of the observing system are achieved.

On behalf of IOP members, we hope you will agree to discussion of the draft TOR at IOGOOS-VI. We think it will be helpful if we can discuss the TOR with you before the meeting, so please comment if you see a need for revision before the document is tabled.

On a related matter we will send, an IOP response to recommendations of the Phuket HLR early next week, which might serve as initial input to the proposed Forum.

Best regards,

Gary Meyers and Yukio Masumoto
Co-chairs Indian Ocean Panel

IOGOOS VI Annual Meeting Inaugural Welcome Address by In-Charge, Director, INCOIS

Inaugural Address by Chairman, IOGOOS