Summary Proceedings of the IOGOOS Workshop & Fifth Annual Meeting (IOGOOS V)

And

Second High Level Review of Indian Ocean Panel (IOP)

Phuket, Thailand

November 30 – December 03, 2007

Contents

1. Introduction:

The IOGOOS Workshop and Fifth Annual Meeting (IOGOOS-V) and Second High-Level Review Meeting of the Indian Ocean Panel (IOP) was hosted by the Phuket Marine Biological Centre (Department of Marine and Coastal Resources (DMCR), Thailand) at Hotel Metropole, Phuket during November 30 – December 03, 2007. This Meeting was organized jointly by the IOGOOS Secretariat, UNESCO IOC Perth Regional Programme Office and Phuket Marine Biological Centre. Thirty nine participants from thirteen IOGOOS member nation countries and IOC participated in the deliberations of IOGOOS-V and IOP High-Level Review Meeting. The list of Participants is attached as **Annexure 1.**

2. Opening Ceremony

Dr Nisakorn Kositrana, DG, DCMR, welcomed participants to the meeting and delivered the inaugural address. Dr Shailesh Nayak, Dr Neville Smith, Dr Alfonse Dubi, Dr Mitrasen Bhikajee, Dr Somkiat Khokiattiwong, and Dr Nick D'Adamo gave the opening remarks. Mr T. Srinivasa Kumar, Secretary IOGOOS, proposed the vote of thanks. The opening remarks by Mr Nick D'Adamo and Dr Alfonse Dubi are attached as **Annexure 3** and **Annexure 4**.

3. Plenary Talks:

The Plenary Talks had four invited presentations related to the work of IOGOOS, as summarized below.

3.1 Indian Ocean Tsunami Warning System and linkages with IOGOOS. – By, Dr Shailesh Nayak, India.

Dr Shailesh Nayak presented the overview of the Indian Ocean Tsunami Warning System. A brief technical note was presented on the generation of tsunami waves and their characteristics. He highlighted the two key tsunamigenic zones of the Indian Ocean and a number of historical earthquake events that have occurred in Java, Sumatra, Andaman , Nicobar (Bay of Bengal) Makran coast (Arabian Sea) regions. He presented the Terms of Reference of the Indian Ocean Tsunami Warning System (IOTWS) and described the IOTWSs' functional framework. He also presented the generic imperatives of a tsunami warning system and associated warnings associated with a tsunami event. He briefly mentioned the progress made with respect to the Indian

Tsunami Early Warning System that is one of the components of the IOTWS. The components of the Indian Early Warning System (including data centre facilities, seismic, tide gauge, Bottom Pressure Recorders (BPR's), modelling, communications, etc.) were also explained in detail. He explained the sequence of operations that are involved between the occurrence of an earthquake event and issue of a tsunami bulletin (including warning, alert, watch and advisory components). He showed the proven experience and performance of the Indian Early Warning System for the September 12, 2007 earthquake event.

3.2 Recent Marine Science Developments in the eastern Indian Ocean relevant to IOGOOS – By Dr Nick D'Adamo, UNESCO IOC Perth Office

Dr Nick D'Adamo presented an overview of recent marine science developments in the eastern Indian Ocean, as relevant to IOGOOS and focusing on the status of the UNESCO IOC Perth Office, the Western Australian marine environment and associated marine science developments emanating out of recent Western Australian and Australian national ocean observing and related ocean science programs and initiatives. He presented a contextual bio-geography of Western Australia's marine environment, highlighting major environmental forcings (eg bathymetry, geomorphology, habitats, cyclones, major wind regimes, variations of SST, circulation patterns etc) and national and State marine protected area (MPA) programs and associated bio-physical and socio-economic research and monitoring frameworks etc. He described the best practice model that has been adopted for management of Western Australia's MPA system. Further, key features of Western Australia's recent marine science programs and projects were presented in more detail. Finally, an overview was presented of a cost:benefit analysis that Dr D'Adamo undertook as part of the recent UNESCO IOC Perth Office review. That analysis was relevant to IOGOOS in showing the very high leverage associated with both the IOGOOS alliance and its associated projects, showing for example that the Indian Ocean Panel of GOOS/CLIVAR now provides marine scientific value to the Indian Ocean's IOGOOS constituents orders of magnitude greater than the resources assigned to maintain the Panel.

The potential for the UNESCO IOC Perth Office's MoU to be renewed (between its sponsors: UNESCO IOC; Australian Bureau of Meteorology; and

Western Australian State Government) beyond its current tenure to July 2008 was outlined. This was provided in the context of the UNESCO IOC Perth Office's aspirations and commitment to continue to support IOGOOS and its associated initiatives (current and future) and projects, to the best of its capacities and as proportionately relevant to the level of sponsorship and to the objectives of its three sponsors. In this context, Dr D'Adamo outlined the recent formal review of the Office conducted by its three sponsors in Perth on 15 November 2008 and reported that indications were that the Office was likely to receive a positive assessment with favorable prospects for a renewal of the MoU.

3.3 The recently established Australian Integrated Marine Observing System (IMOS) and relevance to IOGOOS member nations – By Dr Gary Meyers, Australia.

Dr Gary Meyers, Director of IMOS, presented an overview of the recenely established Australian *Integrated Marine Observing System* (IMOS). IMOS will receive $AUS55 million over 5 years (2007-2012) through the Australian Government's National Collaborative Research Infrastructure Strategy (NCRIS). Dr Meyers provided the Australian geomorphological and environmental context for IMOS. He explained the IMOS strategic goals, principles and the role of IMOS's 11 *national facilities* as curators, providers and managers of specific types of IMOS research infrastructure around Australia, highlighting the positioning of observing infrastructure within four specific regional nodes in eastern, southern and western Australia He also explained IMOS's open ocean component (eg Argo, Ships of Opportunity), remote sensing, acoustic observations (including fish and marine mammal tracking), coastal radars, gliders, long-term moorings, benthic imaging (AUVs) the centralized data management facility in Tasmania, and the other general shelf scale components of IMOS. The role of IMOS in improving the understanding and predictability of boundary currents around Australia was highlighted.. The services provided by IMOS in respect to Australia's socio-economic and ecological requirements, the associated IMOS data management policy (akin to the GOOS principles of open, timely sharing of data), integration with and contributions to national and international ocean observing and ocean

science programmes, and the manner in which IMOS is envisaged to be sustained in the future as a national bio-physcial ocean observationing system, were described. The planned strategic review of IMOS infrastructure in 2009 was also discussed. Detail on IMOS is available at www.imos.org.au.

3.4 Capacity Building Initiatives relevant to IOGOOS – By Dr Ehrlich Desa, IOC-UNESCO

Dr Ehrlich Desa briefed the meeting on the IOC's Capacity Building (CB) programmes, with context to the IOGOOS region, including information on technical and managerial leadership programmes, modeling training etc. Dr Desa explained the projects involved in the IOCs' CB portfolio and the need to promote and drive capacity development for the various regions within and adjacent to IOGOOS (viz. WESTPAC, IOCINDIO, IOCWIO). He also detailed the implementation aspects of the IOC's CB in the context of IOGOOS. He also provided a briefing on networking of centers of resources in the field of Remote Sensing, data assimilation and modeling. He introduced the concept of proposal-writing workshops, as needed for increasing the flow of funds to the national CB projects. He advised on the forthcoming "The First Advanced Leadership Workshop for director of IOGOOS related institutes" to be conducted at INCOIS, India and requested all too lock these dates in their diaries for potential participation. He also summarized the IOC's various training programmes being conducted as part of its CB activities.

3.5 Presentation on "Oceansat-2 Mission and Its applications" – By Mr. M. Venkata Rao

Mr M. Venkata Rao described the beginning of the Indian Space Programme, status of the Indian Remote Sensing Satellites and Indian Imaging Capabilities. He presented an overview of the Oceansat – 1 mission and its applications. He explained in detail the benefits obtained by the fishing community through the use of potential fishing zone (PFZ) advisories that are being generated using IRS P4 OCM images. He also listed other major applications of the OCM. He described the major applications of the Scatterometer and then presented an overview of the Oceansat-2 Mission. Oceansat-2 will have three pay loads i.e. Ocean Colour Monitor (OCM), pencil beam Scatterometer and Radio

Occultation Sounder for Atmospheric studies (ROSA). He described the objectives of the Oceansat-2 mission., and explained the orbital characteristics and sensors specifications along with the communication aspects. He also listed the products to be generated from these sensors. He also put forward the areas in which international participation is invited.

4 IOGOOS Projects (Progress and New Proposals)

IOGOOS has a number of existing 'projects' within its portfolio (as detailed in the IOOGOS web site), and these projects have been accepted by members as being of relevance to IOGOOS at either a local level (for a specific member nation) or as generically relevant in respect to transferability of the projects outcomes and outputs to some or all member nations. As IOGOOS projects, they receive endorsement through IOGOOS and financial and in kind support through IOGOOS's sponsors and/or through member nations directly. As is custom for IOGOOS meetings, project directors for the various projects were asked to provide updates on their projects. At this year's meeting, four new projects were proposed. Brief summaries on the progress of existing projects and overviews of new projects are given below.

4.1 Project Reports of existing Projects

4.1.1 Update on the "Indian Ocean Panel of GOOS/CLIVAR" – By Dr Gary Meyers

Dr Gary Meyers provided an overview of the history of the IOP and associated Indian Ocean Observing System (IndOOS),which is a multi-platform long-term sustained observation system. He summarized the present status of surface moorings, ARGO floats, multi-parameter deep moorings (including ADCPs) and the surface drifting buoy network, along with the status of the XBT observation lines in the Indian Ocean. He reported on the observing system simulation experiment and future plans for IndOOS. The status of process studies being undertaken through the IOP was also given. Further, a description of seasonal predictability through the IOP-AAMP project was presented. In conclusion, he stated that the IOP is at a point now where there is a need

to introduce a focus on research programmes as a complement to the observational programme.

4.1.2 Update on the project on "Multi-scale monitoring and mapping of Keystone Coastal Ecosystems through remote sensing and participatory in-situ operations" – By Dr Greg Wagner

Dr Greg Wagner gave a presentation on the proposed coastal IOGOOS pilot project on Monitoring Keystone Ecosystems for improved management of the coastal zone and its resources / biodiversity. He explained the importance of monitoring keystone coastal ecosystems, development of the project, and the potential linkages that the project had with other projects/institutes. He summarized the outcomes of the pre-project planning workshop conducted at Phuket during 17-19th February 2006 in which the methodologies, work plan and timeframe, overall project implementation and country implementation plans have been discussed. The overview of the project was then presented along with development objectives, systems objectives and specific goals. The monitoring techniques to be used by the community were also described. He listed the parameters to be measured by remote sensing and by in-situ methods. He also emphasized the need to link the project with other IOGOOS projects. He listed the countries that are or could be involved in the project and also explained the coordination and implementation plan of the project. At the end of the presentation he briefed delegates on the unique/special characteristics of the project.

4.1.3 No Update was provided on the project on "Coastal Shoreline Changes"

4.2 New Project Proposals

4.2.1 Project proposal on "Bluelink and its Relevance to IOGOOS Member Nations" – By Dr David Griffin

Dr David Griffin described Blueliink as Australia's new short-term, high resoulution (10km) ocean forecasting system that predicts ocean currents, temperature, salinity and sea level, 7 days ahead, twice a week. He also presented the relevance of Bluelink to IOGOOS nations.

Bluelink is one of several ocean prediction and reanalysis projects under the auspices of the international GODAE program. Dr Griffin described a range of Bluelink products that are available and encouraged IOGOOS members to begin using them for regional applications. The products include:

- CSIRO Atlas of Regional Seas - a new high quality climatology of Indian Ocean thermal, salinity and nutrient-structure.
- Maps of sea level, currents and SST derived by direct analysis of satellite data.
- Ocean model re-analyses based on model-data assimilation giving the three dimensional velocity, thermal and salinity structure for the period 1991 through to the present. High resolution is limited to the oceans in the Australian region and does not yet cover all of the Indian Ocean.
- Regional Ocean-Atmosphere Model designed to be nested in the Bluelink products to downscale oceanic structure to 2 km over the continental shelf and near coasts.

4.2.2 Project proposal on "Indian Ocean real time Chlorophyll-a mapping project & its application to Marine Fisheries" – By Mr T. Srinivasa Kumar

Mr T. Srinivasa Kumar proposed a new project involving real-time chlorophyll-a mapping and associatged operational applications. The presentation was initiated with an emphasis on the importance of chlorophyll-a mapping through remote sensing techniques. Mr Kumar discussed oceanic phytoplankton biomass distributions adn in the context of the IOGOOS regikon, the associated need to study spatio-temporal variations and associated primary productivity estimates. He also explained the impact of these variations on fish stocks, patterns and distributions. He advised on the use of such studies in terms of understanding general coastal processes, mapping of phytoplankton blooms, estimating the impacts of cyclones etc. He also summarized one of the operational applications of characterising chlorophyll-a

distributions, namely as input to. Potential Fishing Zone Advisories. He emphasized the use of RS techniques (including ch-a distributions) in short-term fishery forecasts and for identifying potential zones of fish aggregations. He explained the benefits of such information tofishermen in terms of reducing fish search times, operations efficiencies, improved catches and associated profitabilities.

He detailed the system set up at INCOIS for real-time satellite data acquisition, processing and dissemination. He also explained the data processing chain involved in generation of the daily, weekly, monthly and seasonal composite images of chlorophyll-a, SST, TSM and Kd 490. He also listed the plans for in-situ measurements for validation of satellite data products. He described the linkage with the Chlorogin Network. Finally, he outlined an IOGOOS work plan and the work done so far by the IOGOOS Secretariat in real-time mapping of chlorophyll-a. He also listed the associated issues that need to be discussed in the Working Groups.of this meeting and pointed to potential further potential action items.

5 IOGOOS Annual Meeting

Dr Shailesh Nayak, Chairman, IOGOOS, in his opening remarks, welcomed members to the meeting. Dr Alfonse Dubi expressed appreciation at the work of the the IOGOOS Secretariat during the intercessional period. Dr Mitrasen Bhikhajee also complimented the efforts of IOGOOS.

IOGOOS congratulated Maldives and Thailand on becoming new members of IOGOOS. Mr Ali Shareef, Maldives outlined the problems faced by that country in respect to climate change, sea level rise, stress on coral reefs and fish mortality. Dr Somkiat has given stress on the study of the Coral Reefs and Fish Mortality. Dr Kamal Tennakoon, NARA, advised that NARA and its coastal conservation department, Sri Lanka, is working towards reviving the IOGOOS coastal erosion project. Dr Dubi suggested that the title of coastal erosion project be modified to the Shoreline Change Project, to better reflect its current motivation.

Discussions ensued on the progress of the IOP, IOGOOS coastal pilot projects, and general IOGOOS remote sensing and capacity building activities. It was noted that

the IOP and remote sensing components have progressed very well. It was noted that considerable effort is obviously required through the respective PIs in respect to reviving the coastal pilot projects (ie on keystone ecosystems and shoreline changes, respectively) in order to achieve tangible progress. It was further noted that the IOGOOS Strategic Plan requires review and updating in view of IOGOOS project developments over the past six years. In this vein, it was also noted that greater emphasis is now required in a number high priority areas, including multi-hazards warning systems, data management and capacity building. It was also decided that the above issues would be discussed in working group meetings over the following days of the meeting and concrete plans addressing the related issues would be drawn up.

5.1 Secretariat Report of Activities since October 2006:

Mr Srinivasa Kumar, Secretary, IOGOOS presented an overview of the activities of the Secretariat. The detailed report is attached as an **Annexure 5**. The meeting appreciated the efforts of the IOGOOS Secretariat and thanked INCOIS for its continued strong support for the Secretariat.

5.2 Accounts and Financial Summary:

The secretariat submitted an audited financial statement of the IOGOOS Accounts to the Annual Meeting and it was endorsed.

5.3 Dates and Venue of the next Annual Meeting:

The meeting has discussed on the venue of the next annual meeting. Offers have been received from Iran, Australia and India for hosting the next annual meeting. The IOGOOS Secretariat was requested to interact with the potential hosts to finalise the venue and the dates of the next Annual Meeting.

The Annual Meeting ended with the vote of thanks by Chair

6 Break out Sessions of the IOGOOS Working Groups and Action Plans:

Dr Shailesh Nayak, Chairman, IOGOOS provided the Chair's remarks on the working groups. He suggested that while the focus will be on regional issues, it will also be important to try and align the working group discussions to national problems of the member states, to the extent possible. Dr Nayak encouraged all

delegates to engage in the discussions and for the working groups to focus on achievable outcomes.

Four Working groups were formed:

- Group 1 – Review and Update of the IOGOOS Strategic Plan.
- Group 2 – Ocean Data and Information Management and Capacity Building.
- Group 3 – Bluelink and its applications to IOGOOS Member States.
- Group 4 – Remote Sensing and Chlorophyll-a Mapping Project.

6.1 Group 1 - Review and Update of the IOGOOS Strategic Plan – Chaired by Dr Neville Smith

This Working group was chaired by Dr Neville Smith. The working group reviewed the current Strategic Plan (2001) of IOGOOS. Section 3.3 of Strategic was renamed Applications and Operational Services in recognition of IOGOOSs' focus on these aspects. The group included a new Section 3.7 addressing publications of the outcomes and outputs of meetings, workshops, studies, etc. and added another section in 3.8. Coastal Systems and Services dealing with coastal inundation, coastal hazards, coastal zone management, ecosystems and shoreline changes. Section 3.8 also addresses the development of the IOTWS through fostering and promoting collaboration on sea level observation systems and other ocean observing networks.

The Strategic Plan was also expanded to include the strategic priorities for 2007-2010 that were developed at the IOGOOS IV Annual Meeting (Section 9 of IOGOOS IV report). These priorities relate to: i) observing systems; ii) applications and operational services; iii) data and information management; iv); capacity building and training; v) support for coastal research and observations; and vi) integration and collaboration between IOGOOS and other relevant GOOS regional forums, Indian Ocean Panel of GOOS/CLIVAR and SIBER (a bio-geochemical science group currently being developed by a yet to be formalised international group of bio-geochemical marine scientists).

The Strategic Plan also lists the IOGOOS program of work and guidance on the formation of work programs within IOGOOS. The Strategic Plan focusses particularly on existing projects that are underpinned by commonality of interest

amongst Indian Ocean rim and island nations countries and on potential new projects that are seen to be highly relevant to IOGOOS (following):

- regional projections of climate change;
- the extended provision of remote sensing products and involvement in satellite missions, which might include ensuring appropriate remote sensing capacity building activities are built into IOGOOS pilot projects, calls for proposals which utilize products from ocean colour sensors, invitation to develop payload instruments for future small satellite missions, etc.
- digital elevation projects (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.
- contribution to and facilitation of the tsunami and other hazards warning working groups, particualry those being driven through the IOTWS.

The revised draft Strategic Plan is attached as **Annexure 6.**

Recommendation/Action

The IOGOOS Secretariat will edit the plan, circulate the draft to IOGOOS Officers, and then finalise the plan accordinagly before circulating it to members prior to the next annual IOGOOS meeting.

6.2 Group 2 – Ocean Data and Information Management and Capacity Building – Chaired by Dr Alfonse Dubi

The group discussed this topic in two parts (i) ocean data and information management and (ii) capacity building, as relevant to IOGOOS member countries. It was noted that the Strategic Plan dated back to 2001, and that since that time a number of new scientific initiatives and programs relevant to these topics have been developed including: the advent of the IOC's Capacity Building Section; GEOOS; IndOOS; Blueliink; the RAMA mooring design and implementation (of the IOP) and ChloroGIN.,

Recommendation/Action

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.

In respect to capacity building, the group suggested that the current strategy be reformulated to more closely align with the programs and protocols of the IOC Capacity Building Section. It was suggested that capacity building be addressed more towards the needs of institutions within the region rather than focusing overly on individual training. This is to ensure sustainability of capacity building within the IOGOOS framework. It was also suggested that bi-lateral and multi-lateral initiatives to facilitate and drive capacity building be encouraged.

6.3 Group 3 - Bluelink and its applications to IOGOOS Member States – Chaired by Dr Somkiat Khokiattiwong

The session was chaired by **Dr Somkiat Khokiattiwong,** Dr David Griffins introduced Bluelink and provided an overview on its history, the modeling framework behind Bluelink and outlined the capabilities of the models used in Bluelink and explained how Buelink is used in an operational sense, including its current public interface via the www.bom.gov.au website. The working group believed it would be timely to now form a IOGOOS Bluelink Working Group to summarise, in the context of potential applications of Bluelink in the region, existing data sources, encourage easy access to these data sets and to feed user needs back to information providers . Bluelink isa 10km scale eddy resolving model and the group emphasized the need to develop proposals for projects that involved dosnscaling from the large (ie 10km) scale to finer scales (~1km) as relevant to addressing marine and coastal environmental and socio-economic issues relevant to Members States.

Recommendation/Action

The formation of a Working Group to progress the development of what was envisaged to potentially be a IOGOOS Bluelink User's Group . It was recommendedthat the Working Group begin with Dr Mitrasen Bhikhajee as

Chairman and Drs M. Ravichandran, David Griffins, Somkiat Khokiattiwong, as members. The working group would facilitate a link between Blueliink technical specialists (from Australia) and the prospective stakeholders and users in the Indian Ocean. This Working group will examine the details and functionalities leading up to the next IOGOOS meeting and develop a scope for an associated work plan.

6.4 Group 4 – Remote Sensing and Chlorophyll-a Mapping Project**. Chaired by Dr Mitrasen Bhikhajee**

The group noted the earlier presentations on progress of IOGOOS projects relating to multi-scale monitoring and mapping of keystone coastal ccosystems through remote sensing and participatory in-situ operations (Dr Greg Wagner), shoreline change (Dr Kamal Tennakkoon) and Indian Ocean real time chlorophyll-a mapping (Mr T. Srinivasa Kumar).

The progress of the IOGOOS Secretariat on the chlorophyll-a mapping project was duly noted and appreciated. The group discussed the merits of amalgamating these three to enable thamtic similarities to be developed and to mor evenly apply resources in order to assist various facets of the three projects that were obviously difficult to progress due to a lack of resources After detailed discussions, the group developed the following recommendations.

Recommendation/Action

The group recommended that the three individual projects 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 three sub-projects as component, each with a designated leader, as detailed below:.

- Multi-scale monitoring and mapping of keystone coastal ecosystems through remote sensing and participatory in-situ operations (Leader: Dr Greg Wagner);
- Shoreline changes (Leader: Dr Kamal Tennakkoon); and
- Indian Ocean real time chlorophyll-a mapping (Leader: Mr T. Srinivasa Kumar).

Guiding scope for the recommended Indian Ocean Core Remote Sensing Project

The working group members had sufficient technical expertise in these disciplines and subject areas that it was able to offer further detailed guidance on the development and scope of the proposal, as follows.

It suggested that the project be underpinned by the use of the remotely sensed information. This arrangement would ensure a more global and synoptic view of the goegraphical sites covered and would also facilitate relatively rapid conveyance of the results and products that flow from the project (through the use of existing remote sensing dissemination networks). Dr Kumar generously indicated that the project could be based at INCOIS, India, through his coordination and, in so doing, provide an important and convenient link back to IOGOOS through his capacity as Secretary of IOGOOS.

The persons that would be responsible for the three respective sub-projects (Dr. Wagner, Dr. Tennakkon, Mr. Kumar), would maintain ownership of their respective areas but would also be responsible for liaising with Dr Kumar, for example, in respect to providing exact coordinates of their own selected field sites at whicdh ground truth data would be collected for the remote sensing images that INCOIS, through Dr Kumar, areto acquire andprocess. Dr Kumar indicated that through INCOIS, all of the project's information would be placed on a GIS platform, to make analysis and ongoing access/usage relatively efficient.

The long term objective of this project would be to develop an adequate understanding (for management and sustainability imperatives) of bio-physical changes in keystone ecosystems and of physical perturbations in shorelines at selected high priority sites according to priorities assigned by contributing member nations. The more immediate objective would be to provide chlorophyll-a data maps to concerned countries in the Indian Ocean. Presently, such chlorophyll-a data sets, along with complementary SST, TSM and Kd 490 products above 5° N are made available by the IOGOOS Secretariat through the INCOIS website. This project would expand the region of coverage of mapping to regions containing countries further south ,should they require them.

The short-term objective (leading up to the next IOGOOS meeting) would be the preliminary distribution of keystone ecosystem health indicator data, shoreline configurations and real-time chlorophyll-a, SST, Kd490 and TSM maps for the countries wishing to participate in the project.

Capacity Building under the framework of this project would be an essential objective, and IOC, UNESCO, would be approached to facilitate and/or support that aspiration. Countries that would express an interest in the project and believe there would be benefit from the information provided would be encouraged to participate in capacity building initiatives especially for the interpretation of time series information of chlorophyll-a distribution.

In the context of this proposal, the group appreciated the offer from the Indian Space Research Organization (ISRO) to provide a dedicated ocean observing sensor for the Indian Ocean region and noted the call for proposals for Oceansat-2 data utilization.

Also in the context of this proposal, the group noted the proposal submitted to the meeting by Dr Wagner on the behalf of Dr David Obura titled: Case study – developing capacity for prediction and response to coral bleaching event. Accordingly, the group recommended that Dr David Obura be requested to provide a detailed project proposal to the IOGOOS Secretariat for circulation and endorsement of IOGOOS members at the next annual meeting.

The working group went so far as to prepare a suggested chronological work flow for the sub-projects, as follows.

Multi-scale monitoring and mapping of keystone coastal ecosystems through remote sensing and participatory in-situ operations

Timeframe	**Actions**	**Responsible**
Dec 07 – Jan 08	Selection of and correspondence with National remote sensing (RS) coordinators to obtain coordinates of selected sites requiring high resolution RS data	Dr. Greg, Mr. Kumar
Feb – April	Production of report on selected sites	Dr. Greg, Mr. Kumar,

08	in Tanzania based on RS and in-situ data (to be used as a example of the potential of what could be done)	Tanzania RS coordinator
Feb –April 07	Planning and preparation of training materials (all components)	Dr. Shailesh, Dr. Kumar, Dr. Greg, Dr. David Obura, Dr Suvaluk
April 08	Coordinators Meeting (Hyderabad-4 days) • Finalize proposal • Write letters to potential donors • Prepare different versions of the proposal according to formats required by the donors	Dr. Greg, Dr. Shailesh, Mr. Kumar, Project Coordinators
April 08	International RS Training (3-4 days) (1 from each of the 8-9 countries) – Hyderabad	Dr. Shailesh, Mr. Kumar
May 08 - onwards	Submit the proposal to various potential donors	IOGOOS Secretariat, Dr. Greg
May/June 08	Implement Phase 0: pilot test the training of all components (Coral Reef, Mangrove, Sea Grass and Remote Sensing) in Dar es Salaam and conduct monitoring in Dar es Salaam in Tanzania and Gulf of Mannar in India.	All Project Coordinators, Dr. Kumar
August 08	Report written for Phase 0	
September 08 – February 09	Solicit funds for the project and integrate the various funding sources, both internationally and nationally	

	within some countries, and coordinate the various players so that everyone knows who's funding what and who's doing what. This may require another sort of meeting, besides email correspondence.	
March 09	Launch main project with an International Training of Trainers event for all components in Dar es Salaam	
April – August 09	Run a session for National Training of Trainers and Monitoring within each participating country	

Shoreline Changes: Dr. Kamal Tennakkoon, the new coordinator of this project was requested to prepare a workplan in the inter-sessional period in consultation with the participating members

Indian Ocean real time chlorophyll-a mapping

Time frame	Actions	Responsible
T (Project Initiation)	Initiation of the Indian Ocean real time chlorophyll-a mapping sub-project	Mr. Kumar
T + 1 Month	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	Mr. Kumar
T + 3 Months	Develop the methods for the project and circulate to members	Mr. Kumar

T + 6 Months	Devlop a plan for in-situ measurements and then provide web based access to results that flow fromteh project..	Mr. Kumar

7 High-Level Review Meeting for the Indian Ocean Panel (IOP) of GOOS/CLIVAR

The Second High-Level Review Meeting for the Indian Ocean Panel (IOP) of GOOS/CLIVAR was held on the third day of the overall IOGOOS meeting, December 03, 2007. Dr Shailesh Nayak, Chairman, IOGOOS welcomed High-Level Review Meeting participants and congratulated the IOP through the IOP members present for the progress made. He also referred to the Terms of Reference for the High-Level Review Panel. Opening Remarks were given by High level Review Panel members in Drs P.S. Goel, Chet Koblinsky, Kiyoshi Suyehiro and Neville Smith. Following this opening phase, presentations were made by IOP members on various aspects of the IOP by invited speakers, upon which the Panel's assessment would be based. This session was chaired by Dr P.S.Goel and Dr Neville Smith was the Rapporteur.

A brief summary of the presentations is given below, followed by the summary of the discussions the then took place in plenery and ending with the detailed recommendations made by the Panel.

7.1 Brief history and overview of IOP – By Dr Gary Meyers

Gary Meyers presented a brief history of the IOP and a complementary overview of the IOP's 'Indian Ocean Observing System' (IndOOS). The presentation highlighted the status of IndOOS's components, including surface moorings, ARGO floats, ADCPs , surface drifting buoys and XBT observation lines. The observing system's simulation experiment was also described. The presentation concluded with an overview of the next phase of work in implementing IndOOS .

7.2 The Science drivers for IndOOS – By Dr Yukio Masumoto

Yukio Masumoto presented an overview of scientific topics relevant to IndOOS. The seasonal variability of surface circulation in Indian Ocean was

discussed followed by the inter-seasonal variability. The high resolution current variabilities at 0^0 N and 90^0 E were described along with an overview of the Indian Ocean Dipole (IOD) and recent IOD events. Aspects of the impacts of this circulation on global climate were also discussed. The presentation concluded with an overview of decadal change of Ekman transport in Indian Ocean .

7.3 Progress of RAMA implementation – By Dr Mike McPhaden

Mike McPhaden presented on the status of the Research Moored Array for African – Asian – Australian Monsoon Analysis and Prediction (RAMA), including progress in respect to establishment of RAMA moorings and anticipated progress in the coming year. Dr McPhaden outlined RAMA's role as a component of IndOOS, the scientific rationale behind the RAMA network design and provided detail on the parameters to be monitored and the spatial coverage that will characterize the RAMA network. Finally, Dr McPhaden presented a proposal to IOGOOS outlignthe resources needed for the future implementation and maintenance of the array.

7.4 India's Ocean observation programme – By Dr M. Ravichandran

M. Ravichandran presented the current status and future plans for India's national ocean observation system. The presentation began with an overview of India's planned observing networks, followed by information on current in-situ infrastructure deployments. The status of India's observational progam components for the Indian Ocean was presented, including ARGO floats, moored buoys, drifting buoys, equatorial current meter moorings and ADCP moorings. The status and long-term plans for monitoring of upper ocean thermocline fields using XCTDs were also presented. Further, a brief overview of Bay of Bengal Observatory program was presented. The framework, current operability and associated dissemination of data from India's various observational platforms along with associated database management plans, were presented.

7.5 China's Indian Ocean observation programme – By Dr Weidong Yu

Dr Weidong Yu presented China's role and contribution to IndOOS. The talk began with the review of China's Indo-Pacific Warm Pool observation pilot

project, highlighting China's first ARGO float deployment and associated data Dr Yu's presentation concluded with a description on China's plans for future contributions to RAMA

7.6 Results of the SIBER Science Planning meeting in Goa – By Dr Raleigh Hood

Dr Raleigh Hood provided a progress report on the state of development for a proposed international scientific alliance for bio-geochemical research in the Indian Ocean (SIBER: *Sustained Indian Ocean Biogeochemical and Ecological Research*). The results of SIBER's two formative meetings to date were outlined (respectively, October 2006 and November 28-30, 2007, both in Goa, India). Dr Hood provided an overview of SIBER's history along with summaries of the key deliberations and outcomes of the Goa 2007 SIBER workshop, which focused on developing SIBER's prospective key objectives and an associated a framework for the subsequent development of a science plan for SIBER, as a precursor to formally establishing a science alliance. The six broad objectives agreed to at the Goa SIBER 2007 meeting were presented as follows:

- Boundary current dynamics, interactions and impacts on biogeochemistry and ecology;
- Equatorial circulation and Indonesian through flow impacts on biogeochemistry and ecology;
- Controls and fate of primary production in the Indian Ocean including marginal seas;
- Biogeochemical differences between the Arabian Sea and Bay of Bengal;
- Global change and anthropogenic impacts - current and future, and feedback on humans, considering the different scales of manifestation of the two; and
- Role of higher trophic levels in ecological processes and biogeochemical cycles.

Dr Hood explained that SIBER would be structured to be generically akin to the IOP. Dr Hood commended the SIBER concept to IOGOOS, detailed the prospective formal links that would be sought by SIBER with IMBER (in terms of providing instutional endorsement, sponsorship and direction). In that vein, Dr Hood proposed to the IOGOOS meeting that SIBER would welcome IOGOOS joining IMBER's potential institutional leadership of SIBER, in the

same way that GOOS and CLIVAR act for the IOP. Dr Hood ended by outlining the SIBER community's aspirations to integrate with IOP, both in terms of infrastructure use and in terms of scientific collaboration and integration.

7.7 Seasonal predictions in the Indian Ocean – By Dr Jing-Jia Luo

Dr Jing-Jia Luo presented on the application of numerical models in the prediction of wind and SST in the Indian Ocean. Dr Luo's key points were: that ENSO now can be predicted out to 1-year lead and even up to 2-years ahead in some cases and that with improved predictability of certain IO ENSO signals prediction could be further improved; that normal Indian Ocean Dipole (IOD) events can be predicted with, at best, 2 season's lead time; that extreme IOD events (and their climate impacts) can be predicted with, at best, a 1 year lead time;.and that in respect to longer term predictability, the IOD does not appear to be controlled by ENSO.

7.8 Improving Economic Development using Climate Information – By Dr Casey Brown

Dr Casey Brown presented on the importance of using climate information for economic development. The presentation was initiated with the determinants of economic growth. A case study relating GDP and annual rainfall of Ethiopia was presented. The effects of climatic variability were also discussed. Further, information and decision support systems were described. A sustainable ground water management scheme in India was also presented as a case study.

7.9 Socio-economic impacts and benefits – By Dr Gary Meyers

Dr Gary Meyers discussed the socio-economic impacts and benefits of marine resources. The talk was initiated with the social issues pertaining to marine resources. This was followed by notes on the impact of natural disasters on economic status of the society. The importance of marine forecasting ,as can be underpinned by operational oceanography was then stated. The value of ocean forecasting to fisheries management was highlighted. Further, the economics of Australia's sustained ocean observation system (through the Australian Integrated Marine Observing System (IMOS)), its benefit and rationale for public funding was then provided. The different sectors that will benefit through

operational oceanography were also addressed. An estimate of the total value, in dollar terms, of IndOOS was presented and Dr Meyers ended by advising the meeting that the Indian Ocean Tuna Commission is to be made aware of the information that IndOOS can provide to support its objectives.

7.10 India-USA MoU for IndOOS Implementation: Salient Aspects related to IOGOOS – By Dr Sidney Thurston

Sidney Thurston presented on the salient aspects of a MoU between NOAA and India on implementing arrangements for ocean observations related to IOGOOS. An overview of the partnership between MoES, India, and NOAA was given..A scientific framework to establish a partnership in climate research and measurement between the MoES, India, and the Climate Programme Office, NOAA, USA was then discussed. The purpose, objectives and the scope of cooperative activities underpinning the MoU were also described, including the contribution to RAMA by the MoES and NOA. The presentation emphasised:

- India's Ministry of Earth Sciences and USA NOAA institutionalizing their Partnership for Earth Observations and Earth Sciences, with agreements to be signed soon
- The initiation of joint implementation under the MoU (with additional activities expected to commence soon); and
- The need to further address shiptime requirements for instrument deployment and maintenance.

Dr Thurston also emphasized that it will be important to demonstrate the societal applications of the activities and results of under the Mou to policy makers in order to help ensure sustainability of the resources assigned under the MoU.

The Panel expressed its appreciation to the IOP for the detailed and informative presentations and noted the obvious progress that has been made through the IOP. After detailed discussions, the Panel formulated its recommendations,, as follows (Section 8).

8 High-Level Review Panel Deliberation on IOP Presentations, Implementation, Progress and Recommendations – Report from Dr Neville Smith, Rapporteur

8.1 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.

8.2 Panel Members

- Dr P S 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 Suyehiro, Executive Director, International Development, JAMSTEC.
- Mark Majodina, Director of International Activities, South African Weather Service (not in attendance).

8.3 Report against Terms of Reference

8.3.1 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; and
    - 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 High Level Review Panel (HLRP) cannot see any major gaps that have not already been identified by the IOP. 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 with respect to 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 IOP. 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 HLRP also believes the IOP should begin to understand this redundancy more directly, particularly between and other elements of the Observing System (OS), with particular attention on quality control.

8.3.2 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 aware 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. For example, ,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 IOP obtaining 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.

8.3.3 The importance of IndOOS for climate research, including SIBER

- As discussed under 8.3.1, the importance of 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 positive 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 for 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 SIBER Science Plan.

8.3.4 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.

8.3.5 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:
        - 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;
        - 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 Sub-Committee would be open. Secretariat support would be provided through the IOGOOS Secretariat and IOC Perth Regional Programme Office;
    - The Sub-Committee would need to be supported by regular scientific reviews of the IndOOS, order 2-3 years;

8.3.6 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 consider measurements of opportunity on vessels working in the region.

9 Closing

9.1.1 Remarks by Dr Chet Koblinsky, Director, Climate Programme, NOAA

Dr Koblinsky expressed his thanks to the host of the meeting, Thailand, and to Dr Goel, Dr Shailesh and all others working on the India-USA IndOOS implementation agreements. He expressed the difficulties associated with distance that confronted countries such as USA in making observations in the Indian Ocean. Dr Kiblinsky noted that understanding the impact of Indian Ocean observations on climate is important for all nations, including eh USA and to that end, referred to the bilateral agreement as a major breakthrough. Dr Koblinsky also emphasized the importance of services that facilitate the establishment of drought management systems. Finally he thanked Dr Goel again in respect to India's engagement in the bilateral agreement and the gathering in general in respect to the IOGOOS-V meeting and associated High Level Review of IOP.

9.1.2 Remarks by Dr P.S. Goel, Secretary, MoES

Dr P.S. Goel emphasized the importance that the Government of India places on the bilateral agreement and acknowledged, with appreciation, the hard work of Dr Thurston in the development of the agreement. Dr Goel noted that the Indian Ocean affects the entire world's met-ocean characteristics, with the Indian Ocean rim countries obviously more directly influenced.. In light of this, acknowledging that the USA has relatively greater fundamental research interests in the Indian Ocean region, Dr Goel expressed his appreciation at the manner in which the USA has engaged in ocean observing initiatives for the Indian Ocean. He advised that India and USA were very close to signing the agreement. He also briefed delegates on the science and organisational aspects of the imminent agreement. While speaking on regional vulnerabilities to met-ocean hazards, Dr Goel mentioned that MoES has made all efforts possible to provide data on cyclones to Bangladesh and also advised that MoES can provide warnings/alerts on Tsunami to neighbouring countries in the Indian Ocean. He advised that bilateral cooperations with neighbouring countries can be developed and implemented in respect to frameworks for the issuance of

warnings to neighbouring countries. Dr Goel offered to host an Indian Ocean Data Centre as part of IOGOOS and advised that all necessary resources would be provided to INCOIS for this purpose, should the IOGOOS community desire the establishment of such a centre.

9.1.3 Remarks by Dr Gary Meyers, Vice-Chair, IOP

Dr Gary Meyers expressed appreciation at the HLRP's positive remarks on the IOP's performance. He advised that a good linkage has been established between IOP and SIBER. He was pleased to confirm that the issue of SIBER representation on the IOP would be addressed at the IOPs' next meeting. He indicated that the IOP would explore means to contribute more broadly to areas such as seismology. DR Meyers advised that research areas such as air-sea fluxes and predictability, as suggested by the HLRP, are on the agenda of the IOP and agreed with the merit of further progressing these objectives. He also explained that boundary arrays will help provide thematic and geographical connections with coastal projects and indicated that the IOP understood and that the impacts of the climate system on humans and their associated natural environments was uppermost in the IOP's thinking. Dr Meyers also mentioned that the IOP understood the need to continue to work towards ensuring its information is used by existing/potential beneficiaries of the research outputs, such as the Indian Ocean Tuna Commission.

9.1.4 Remarks by Dr Nick D'Adamo, Head, IOC-Perth Regional Programme Office and other Participants

Dr Nick D'Adamo noted the importance of this IOGOOS meeting and, in particular, thanked the IOP and HLRP members for their time and effort in respectively presenting and assessing the work of the IOP. Dr Greg Wagner emphasised the importance of IOGOOS coastal projects and highlighted the need to strengthen the sharing of data between IOP and coastal projects. Dr Raliegh Hood advised that he was extremely pleased at the recommendation for IOGOOS to endorse and adopt SIBER as a IOGOOS project. He recommended that the imminent SIBER science plan be reviewed by IOGOOS to ensure that IOGOOS interestw are adequately

covered. He also agreed with the suggestion of adding a bio-geochemical science expert (eg from SIBER) to the IOP. Dr Kamal Tennakoon emphasized the importance of the IOGOOS-V meeting outcomes for island nations.

9.1.5 Remarks by Dr Shailesh Nayak, Chairman, IOGOOS

Dr Shailesh Nayak thanked the HLRP Members for sparing their valuable time and for their suggestions. Dr Nayak advised that IOGOOS will strive to implement the recommendations of the HLRP. He also mentioned that assimilation of remote sensing and in-situ data is important for forecasting of ocean variables. He suggested the formation of a working group to address the technological aspects of ocean observation systems both in-situ and space-based. He emphasized the importance of quality control and integration of the data sets. Dr Shailesh Nayak thanked the host for making all the arrangements required for the successful conduct of the meeting.

Annexure 1

IOGOOS Workshop and Fifth Annual Meeting (IOGOOS-V) and Second High-Level Review Meeting of the Indian Ocean Panel (IOP) November 30 – December 03, 2007 at Phuket, Thailand

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37	Dr Chet Koblinsky, Director, Climate Program, NOAA OAR HQTR Route: R/OGP Tel: 301 427-2334 Fax: 301 427 2222 Email: Chester.j.koblinsky@noaa.gov	USA	IOP HLR Panel Member
38	Dr Raleigh Hood, Professor Horn Point Laboratory University of Maryland Center for Environmental Science P.O. Box 775 Cambridge MD. 21613 Tel: 410 221-8434 Email: rhood@hpl.umces.edu	USA.	IOP HLR Invited Speaker
39	Dr Casey Brown IRI Tel: 845 680 4464 Fax: 845 680 4864 Email: caseyb@iri.columbia.edu	USA.	

Annexure 2

IOGOOS Workshop and Fifth Annual Meeting (IOGOOS-V) and Second High-Level Review Meeting of the Indian Ocean Panel (IOP)

November 30 – December 03, 2007 at Phuket, Thailand

Venue: Metropole Hotel

Provisional Agenda

<table>
<tr><td colspan="2"><u>November 30, 2007 (Friday)</u>
Arrival, Registration</td></tr>
<tr><td>0830 to 0900 Hrs</td><td>Registration</td></tr>
<tr><td>0900 to 1000 Hrs</td><td>Opening Ceremony
Welcome Speech by Ms. Nisakorn Kositratna, DG, DMCR
Opening Remarks by Dr Shailesh Nayak, Chair
Opening Remarks by Dr Neville Smith, Officer
Opening Remarks by Dr Alfonse Dubi, Officer
Opening Remarks by Dr Mitrasen Bhikhajee, Officer
Opening Remarks by Dr Somkiat Khokiattiwong, Officer
Opening Remarks by Dr Nick D'Adamo, Head, IOC-Perth Office
Vote of Thanks by Secretary, IOGOOS</td></tr>
<tr><td>1000 to 1030 Hrs</td><td>High Tea; Press Briefing</td></tr>
<tr><td>1030 to 1300 Hrs</td><td>Plenary Talks
<table>
<tr><th>Proposed Title</th><th>Status Report by</th></tr>
<tr><td>Indian Ocean Tsunami Warning System and linkages with IOGOOS</td><td>Dr Shailesh Nayak</td></tr>
<tr><td>Recent Marine Science Developments in the Eastern Indian Ocean relevant to IOGOOS</td><td>Dr Nick D’Adamo</td></tr>
<tr><td>The recently established Australian Integrated Marine Observing System (IMOS) and relevance to IOGOOS Member Nations</td><td>Dr Gary Meyers</td></tr>
<tr><td>Capacity Building Initiatives relevant to IOGOOS</td><td>Dr Ehrlich Desa</td></tr>
</table></td></tr>
<tr><td>1300 to 1400 Hrs</td><td>Lunch Break</td></tr>
</table>

<table>
<tr><td>1400 to 1600 Hrs</td><td>IOGOOS Projects (Progress & New Proposals)
<table>
<tr><th>Proposed Title</th><th>Presentation by</th></tr>
<tr><td>Indian Ocean Panel</td><td>Dr Gary Meyers</td></tr>
<tr><td>Multi-scale Monitoring And Mapping Of Keystone Coastal Ecosystems Through Remote Sensing And Participatory In Situ Operations</td><td>Dr Greg Wagner</td></tr>
<tr><td>Participatory Data-based Management in the Promotion of Integrated Coastal Resource Management</td><td>Mr Jonathan Shott</td></tr>
<tr><td>Blue-Link and its relevance to IOGOOS Member Nations</td><td>Dr David Griffins</td></tr>
<tr><td>OCEANSAT-2 Mission & Its Applications</td><td>Dr M. Venkata Rao</td></tr>
<tr><td>Indian Ocean Real Time Chlorophyll-a Mapping Project & its Application to Marine Fisheries</td><td>Mr T. Srinivasa Kumar</td></tr>
</table></td></tr>
<tr><td>1600 to 1630 Hrs</td><td>Tea Break</td></tr>
<tr><td>1630 to 1800 Hrs</td><td>IOGOOS Annual Meeting
1. Welcome Remarks by Chairman, IOGOOS
2. Conduct of the Meeting
3. Secretariat Report
4. Accounts and Financial Summary
5. Discussion on IOGOOS Strategic Plan and Next Meeting
6. Welcoming and recognising new Members, if any
7. Any other Item
8. Conclusion</td></tr>
<tr><td>1900 Hrs onwards</td><td>Dinner</td></tr>
<tr><td colspan="2"><u>December 01, 2007 (Saturday)</u></td></tr>
<tr><td>0900 to 1030 Hrs</td><td>Break out session of Working Groups
Group 1 Review & Update of the IOGOOS Strategic Plan
Group 2 Ocean Data & Information Management and Capacity Building</td></tr>
</table>

<table>
<tr><td>1030 to 1100 Hrs</td><td>Tea Break</td></tr>
<tr><td>1100 to 1300 Hrs</td><td>Group 3 Blue-Link and its application to IOGOOS Member States
Group 4 Remote Sensing & Chlorophyll-a Mapping Project</td></tr>
<tr><td>1300 to 1400 Hrs</td><td>Lunch Break</td></tr>
<tr><td>1400 to 1600 Hrs</td><td>Working Group Meetings (Continued)</td></tr>
<tr><td>1600 to 1630 Hrs</td><td>Tea</td></tr>
<tr><td>1630 to 1730 Hrs</td><td>Short Plenary Summaries by Working Groups</td></tr>
<tr><td colspan="2"><u>December 03, 2007 (Monday)</u></td></tr>
<tr><td>0830 to 1030 Hrs</td><td>Implementation Progress and Value of the Indian Ocean Observing System (IndOOS): IOP Presentations.
<table>
<tr><td>Brief History and Overview of IOP</td><td>Gary Meyers</td></tr>
<tr><td>The Science Drivers for IndOOS</td><td>Yukio Masumoto</td></tr>
<tr><td>Progress of RAMA Implementation</td><td>Mike McPhaden</td></tr>
<tr><td>India’s Ocean Observation Programme</td><td>M. Ravichandran</td></tr>
<tr><td>China’s Indian Ocean Region Observation Programme</td><td>Weidong Yu</td></tr>
</table></td></tr>
<tr><td>1030 to 1100 Hrs</td><td>Tea Break</td></tr>
<tr><td>1100 to 1230 Hrs</td><td>IOP Presentations (Continued….)
<table>
<tr><td>Results of the SIBER Science Planning Meeting in Goa</td><td>Raleigh Hood</td></tr>
<tr><td>Seasonal Predictions</td><td>Jing-Jia Luo</td></tr>
<tr><td>Improving Economic Development using Climate Information</td><td>Casey Brown</td></tr>
<tr><td>Socio-economic Impacts and Benefits</td><td>Gary Meyers</td></tr>
</table></td></tr>
<tr><td>1230 to 1300 Hrs</td><td>Announcement of India-USA IndOOS Implementation:
<table>
<tr><td>Brief Presentation on Salient Aspects of MoU & Implementing Arrangement related to IOGOOS</td><td>Dr Sidney Thurston</td></tr>
<tr><td>Remarks</td><td>Dr Chet Koblinsky, Climate Programme Director, NOAA</td></tr>
</table></td></tr>
</table>

	Remarks Socio-economic Impacts and Benefits	Dr P. S. Goel, Secretary, MoES Gary Meyers
1300 to1430 Hrs	**Lunch** (High-Level Panel Deliberates on IOP Presentations, Implementation progress and Future Recommendations, Rapporteur: Dr Neville Smith)	
1430 to 1530 Hrs	High-Level Panel Round Table Discussion: Assessment, Guidance and Future Recommendations to IOP	
1530 to 1545 Hrs	Summary of Panel's Deliberations (Rapporteur: Dr Gary Meyers)	
1545 to 1600 Hrs	Closing Remarks	

Annexure 3

Opening remarks by Dr Nick D'Adamo, Officer in Charge, UNESCO IOC Perth Office (co-sponsor of IOGOOS)

Dr D'Adamo welcomed the IOGOOS Secretariat (hosted by INCOIS, Ministry of Earth Sciences, India), through Dr Shailesh Nayak (IOGOOS Chair) and Dr Srinivasa Kumar (IOGOOS Secretary), and thanked Dr Nayak for his continued support as Chair of IOGOOS and for continuing to champion the vision and objectives of the Alliance and its associated programs and projects. Dr D'Adamo re-iterated the importance of IOGOOS within the UNESCO IOC Perth Office's portfolio of IOC regional alliances and re-affirmed the Perth Office's continued support for IOGOOS. Dr D'Adamo also thanked Dr Kumar for his substantial effort in organising this workshop.

Dr D'Adamo welcomed Dr Nisakorn Kositrana, Director General of the Thailand Department of Marine and Coastal Resources, the institutional host for the workshop, and thanked Dr Kositrana for DMCR's continued support of the IOC's regional alliance network through DMCR's hosting of the IOC WESTPAC and SEAGOOS Secretariats. Dr D'Adamo acknowledged the presence and support of DMCR senior professional and technical staff at the workshop, including Dr Cherdchinda Chotiyaputta, Marine and Coastal Resources Management Specialist, and Dr Woothichai, Policy and Planning. Special thanks went to IOGOOS Officer and Chair of SEAGOOS, Dr Somkiat Khokattiawong (Phuket Marine Biological Centre, DMCR) and his staff, for their local organisational and administrative effort in bringing this workshop to fruition and for their helpful facilitation of arrangements for delegates.

Dr D'Adamo also welcomed to the workshop the many delegates from IOGOOS member nations, invited speakers, IOGOOS Officers, Dr Ehrlich Desa (Head, Capacity Development Section, IOC Secretariat, Paris), attending members of IOP for the Second Indian Ocean Panel (IOP) High Level Review, and particularly acknowledged Dr Sidney Thurston and IOP co-chairs (Drs Meyers and Masumoto) for their efforts in facilitating or coordinating the Review as a special session on day three of the workshop, chaired by Dr Nayak. In that vein, Dr D'Adamo also acknowledged the IOP High Level Review Panel members (Drs Smith, Koblinsky, Goel, Majodina and

Suyehiro) for providing their valuable time and energies for this important component of the workshop.

Dr D'Adamo noted that this fifth IOGOOS workshop promised to be an exciting event, both in terms of the consolidation of existing projects (eg IOP, keystone ecosystem monitoring) but also in terms of developing links with complementary projects of member nations and in terms of the prospective initiatives that are to be discussed in the agenda, such as those that will centre on Bluelink, capacity building, remote sensing, and SIBER. Dr D'Adamo noted the opportunities for thematic and spatial integrations to now strengthen and further evolve through these various projects, existing and proposed, under the stewardship of IOGOOS.

Annexure 4

Opening Remarks by Dr Alfonse Dubi.

Mme Kositrama, DG, DMCR,
Dr Nayak, Chair, IOGOOS
Fellow IOGOOS Officers
Distinguished participants
Ladies and Gentlemen,

It gives me a great pleasure to once again participate in an Annual meeting of the IOGOOS. I wish to take this opportunity to first thank the DG, DMCR and their entire staff for hosting this important meeting. It was a well organised event and Phuket was rightly chosen. I wish to thank the chair person of IOGOOS, Dr Shailesh Nayak, and the entire secretariat at Hyderabad for the excellent preparation of the Agenda and travel arrangements and logistics.

Ladies and Gentlemen:, the importance of Oceanographic Data and Information management, Exchange and Services cannot be over-emphasized any longer. It is obvious that within the Indian ocean rim countries there are a number of observation systems for both space and in-situ data acquisition. It is also known that several modelling applications are available within the IOGOOS Region. It is therefore against this background that I would like to request for an in-depth review of the strategies for intra-regional collaboration in data acquisition, open access to the available data and exchange of the same. We need to take a deliberate step towards elevating skills and knowledge of scientists in those countries with less capacity in numerical modelling and data analysis.

Thank you,

Annexure 5

IOGOOS Secretariat Report (October 2006 – November 2007)

S.No.	Item	Status / Progress
1.	**Manpower** The names and contact details of the persons working at the IOGOOS Secretariat need to be put up on the IOGOOS Website to enable better communication and coordination with the Members	Action Completed
2.	**IOGOOS and ICG/IOTWS** To ensure better coordination between ICG/IOTWS and IOGOOS, it was suggested that the Chairman, IOGOOS report on relevant activities of IOGOOS at the ICG Meetings.	Chairman, IOGOOS is the vice-chair of ICG/IOTWS and has been reporting on the IOGOOS activities.
3.	**IOGOOS Website** The Secretariat was requested to make a Flyer/Brochure on the facilities offered by the IOGOOS Website and publicise the website so that it is more widely used.	A Flyer on IOGOOS has been prepared. An IndOOS Data Portal has been set up at http://www.incois.gov.in/Incois/iogoos/home_indoos.jsp . All the available in situ observation data for IndOOS are listed with the link to data providers. Satellite derived gridded variables are also available through live access server. During the past one year IOGOOS Home page had 1300 Visitiors and IndOOS page had 280 Visitors
4.	**Annual Dues** Membership fee for the last year be waived and that the IOGOOS secretariat should send out invoices for the Membership fee for 2006-07 as soon as the new banking procedure is approved	Invoice for the Annual Membership Fee for the Year 2006-07 was not sent out from the Secretariat awaiting FCRA approval from the Government. FCRA Application has been filed in March 2006. Entire IOGOOS Accounts have been audited by Chartered Accountant and have been submitted to the Government. FCRA Officials visited INCOIS and checked the audited financial

		statements and other IOGOOS reports. Final Approvals are awaited.
5.	**IOP, Coastal Ecosystem, Remote Sensing, Data & Information Management**	Assisting Project Coordinators in pursuing the Work plans
6.	**Chlorophyll-a Project** IOGOOS Secretariat could contact Pogo regarding the project and endorse the utility of such a network and the requirement of remotely sensed chlorophyll-a data sets on a routine basis for meeting the IOGOOS coastal pilot projects.	On a pilot basis, IOGOOS Secretariat initiated providing chlorophyll-a, SST. Kd-490 and TSM products in near-real time at full resolution through INCOIS website (http://www.incois.gov.in/Incois/pfzarchiveimages.html). Presently data is being provided for the North Indian Ocean (upto 5 deg South). Products could be provided for other regions upon request from the project coordinators.
7.	**Coastal Erosion and Prawn Pilot Projects** IOGOOS Secretariat to contact the project coordinators and determine new leaders or termination of the project.	Project Coordinators have been contacted. No response has been received. Prawn Pilot Project may be withdrawn. NARA expressed interest to take up the Coastal Erosion Pilot Project.
8.	**Capacity Building and Training** IOGOOS should pursue activities that facilitate expert/scientist exchange/visits and conduct a survey of facilities, experts, and activities in the region.	Sponsored the Ocean Colour Training Course on "Methods and Application of Ocean Colour Remote Sensing in African Coastal and Regional Seas" held in Mombasa, Kenya during September 24 – October 05, 2007. IOGOOS with support from IOC/Perth Office funded (US$ 3,000) the participation of 2 candidates from South Africa. Facilitated the participation of Scientists from the Indian Ocean region in 8 training programmes organised by ODINCINDIO Assisting in the local organisation of the UNESCO/IOC "First Advanced Leadership Development Workshop from Directors of Marine Institutes from the Central Indian Ocean" to be held at INCOIS during January 20 to February 02, 2007

9.	**Preparation of IOGOOS IV Report**	Finalised and circulated the IOGOOS IV Annual Report
10.	**IOGOOS Meeting on the Sidelines of IOC Assembly**	Facilitated the organisation of the IOGOOS side meeting during the IOC Assembly in Paris during June 19 – 28, 2007.
11.	**Preparations for the IOGOOS V Annual Meeting and Second Meeting of the IOP HLR**	Notification and Invitations for IOGOOS – V were sent out Interactions with Local Host, Participants, IOC-Perth, Funding Arrangements, Logistics, etc Preparation of Agenda, Financial Statements, etc.
12.	**Finance**	INCOIS prepared the Audited Financial Statements of GRAND for the past three years and transferred the balance funds to the GRAND Secretariat. Completed Financial Accounting and Audit for the Period Oct 2006 to Nov 2007. Statement of Account is being submitted for verification and approval.
13.	**Bay of Bengal Cruise**	Facilitated the 15-days cruise in the Bay of Bengal onboard Indian Oceanographic Research Vessel ORV Sagar Kanya. 2 PMEL NOAA Moored Buoys (including Flux Moorings), 24 XBTs, 10 Argo Floats and 10 Drifters have been deployed during this cruise as part of IndOOS.

Annexure 6

Global Ocean Observing System for Indian Ocean

Strategic Plan 2007-2011

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

This should be recast within the context of the IOC CB Strategy. In particular, IOGOOS should work with IOC CB to identify requirements for the region and possible solutions.

- Involve institutions; develop leadership

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

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

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

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

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

f) 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

b) Contribute to international planning and implementation of GOOS,

c) 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

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

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

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

g) 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;

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

i) 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) Esosystems

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

Refer to IOGOOS IV as basis

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:

- 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;
- 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;
- Improving bilateral and multilateral support arrangements; and
- 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 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 Indian Ocean Panel

5.1.2 Remote Sensing

5.1.3 Coastal Ecosystems

5.1.4 Shoreline Changes

5.1.5 Data and Information Management

5.2 Potential new projects

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

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

a. Place keystone ecosystem and chlorophyll-a projects within

- Also shoreline project with GIS, with short term goals
- Initial 5 km x 5 km products for chlorophyll-a; extending domain

b. Ensure appropriate remote sensing CB activities are built into IOGOOS Pilot Projects (chlorophyll-a, keystone ecosystem, shoreline change, coral bleaching, …)

c. Call for proposals for OCS

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

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

(iv) BLUElink

a. … facilitating use …

b. Example applications

c. Working group for extending use, including downscaling

- Experts, IOGOOS, SEAGOOS and IOC Perth Office

d. Ocean analysis and prediction summer school for the Indian Ocean region ~ 2009

(v) Contributions to the Tsunami and Other hazards Warning System (TOWS) Working Group

(vi) Ensure appropriate remote sensing CB activities are built into IOGOOS Pilot Projects (chlorophyll-a, keystone ecosystem, shoreline change, coral bleaching, …)

(vii) Other

Participants of IOGOOS V Annual Meeting

Participants of Second High-Level Review Meeting of IOP