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SUMMARY REPORT OF THE FIRST MEETING OF THE ADVISORY GROUP FOR THE IOC OCEAN SCIENCES SECTION (OSS)

Paris, 9–10 November 2005

Summary. The Advisory Group for the IOC Ocean Sciences Section was formed as a result of discussions at the 22nd Assembly and follow-up discussions at the 23rd Assembly of the IOC. The Advisory Group is regarded as an on-going mechanism for providing advice on ocean science activities and specifically to develop advice for the Head of the Ocean Sciences Section on the Ocean Science Program of the IOC.

Executive Summary

The Advisory Group for the IOC Ocean Sciences Section was formed as a result of discussions at the 22nd Assembly and follow-up discussions at the 23rd Assembly of the IOC. The Advisory Group is regarded as an on-going mechanism for providing advice on ocean science activities and specifically to develop advice for the Head of the Ocean Sciences Section on the Ocean Science Program of the IOC.

The Advisory Group expressed general satisfaction with the existing elements of the Ocean Sciences Program and Ocean Sciences Section and noted the overwhelming constraint provided by resources for IOC activities.

The Advisory Group advised that a more explicit statement of objectives and strategy for the Program was needed, with particular attention on relevance and integration. The fundamental role of ocean observations, for research and operational ocean systems and services, and the overall cross-cutting relevance of such activities should be more prominent in the Ocean Sciences Program strategy. A restatement of the functions of the Ocean Sciences Section in a form that provides guiding principles for adoption of work and responsibility within the Program should be developed.

The Advisory Group noted the general weakness of the internal and external communication activities and the urgent need to improve communication channels to Member States. While this is not a responsibility of the Section alone, it was an area IOC as a whole needs to pay attention to.

Notwithstanding relatively recent restructuring, the Advisory Group concluded that the structure of the Program should be modified so that it clearly showed both the leading strategic objectives and more explicitly reflected the relevance to the mandate of IOC and needs of the Member States.

With respect to existing themes, the Advisory Group recommends

- Revitalisation and strengthening of the engagement and involvement in the World Climate Research Program;
- Greater priority to the integration and inter-relationship of presently distinct elements;
- Assigning high priority to the integration of the science program with other IOC Programs, particularly ocean observations and data and information management; and
- Providing more attention to presenting work in its policy context, emphasising the uses and utility within a common framework.

The Advisory Group recommends the incorporation of several new aspects and/or raising the priority of existing actions, including:

- The impacts of climate variability and climate change in the marine environment and on its living resources and ecosystems (lead with Oceans and Climate Sub-Program);
- Explicit recognition of coastal research as a primary element (Sub-Program), including (the overlapping) climate impacts introduced above, direct anthropogenic influences, integrated coastal management, natural marine hazards and coastal prediction;
- Early introduction of marine assessment as a primary element (sub-program), with emphasis on the science that will underpin the Global Marine Assessment and its assessment of assessments;
- Introduction of an underpinning, cross-cutting element in marine modelling, recognizing the need for IOC to exercise its mandate and responsibility in new technology and its unique position which allows it to facilitate interaction and coordination among many existing activities;

The Advisory Group emphasises the need for effective cooperation and integration among the new and existing themes, recognizing the inevitable overlaps, but also the strengths that arise from successful joint development and interoperability among the sub-programs and themes.

1. Introduction

Umit Unluata opened the meeting on behalf of the Executive Secretary and passed on the apologies of Patricio Bernal for not being able to join the discussions.

At the invitation of the Chair of IOC, and as the Vice-Chair with the lead on science matters, Dr Smith was asked to Chair this session of the Advisory Group. Dr Smith introduced the Agenda (Attachment A) and the participants (Attachment B) and provided a brief introduction to the purpose of the Advisory Group. He noted that the Advisory Group was formed as a result of discussions at the 22nd Assembly and follow-up discussions at the 23rd Assembly.

The Advisory Group is regarded as an on-going mechanism for providing advice on ocean science activities and specifically to develop advice for the Head of the OSS on the Ocean Science Program of the IOC. The remit extends to advice on both present and future activities and includes the activities of the Secretariat in support of the Program. Through the Chair, it will be possible to take this advice to the Officers of IOC and, as appropriate, through to the Executive Council.

The purpose of this meeting is to:

1. To develop advice on existing activities, including appropriateness and effectiveness within the mandate[1] and resources of the IOC;
2. To identify strengths and weaknesses of the Program;
3. To develop advice on the effectiveness of the OSS in support of the Program;
4. To examine linkages, collaboration and cooperation with other Programs and provide advice on the effectiveness of such links; and
5. To develop advice on future directions of the Program, including objectives for the next biennium.

The Advisory Group was referred to background documents prepared by the Secretariat including:

- IOC Ocean Sciences Section: Overview and expected results, 2005 (IOC/INF-1206)
- "Look Deeper" (published by IOC, 2005)

[1] The IOC is mandated as the UN focal point for marine scientific research and responds to the needs of its Member States, the UN General Assembly and relevant UN Agreements.

- Brief reports on specific activities (Attachment C)
- IOC Annual Report 2004
- Documents at *http://ioc.unesco.org/iocweb/activities/ocean_sciences/*

2. The IOC Ocean Science Programme – Mandate and Structure

The Director of the OSS provided an introduction to the Programme referring to the documents listed above.

Several themes emerged from the subsequent discussion.

Relevance

Member States, especially developing Member States, have on occasion expressed frustration with the science Agenda of the IOC arguing that it lacked relevance to their particular needs; they are generally much more interested in coastal areas and, although the Integrated Coastal Area Management (ICAM) initiative does focus in this area, they need the supporting science. While the Group generally recognized the success of Program initiatives, they also suggested the Program needed to respond more explicitly to these scientific needs in coastal regions, including the impacts of climate variability and climate change. There are opportunities for responding to these needs and the OSS can play a key role.

More generally, there is continual pressure to re-examine and establish the relevance of programs, including the Ocean Sciences Program. The priorities implied by present activities do owe a lot to history and circumstance and perhaps do not adequately reflect the fundamental interests and needs of Member States, such as in the coastal regions as mentioned above. Just as the IOC through its Global Ocean Observing System has used the Open Ocean (Climate) and Coastal Ocean as unifying and integrating frameworks, the Group concluded that we should use these themes more explicitly as the over-arching and complementing frameworks for ocean science.

Such an approach would need to balance this need against sector specific needs and to the extent possible seek consistency with the way Member States see and implement their own ocean science programs – this helps in recognition and acceptance.

The Advisory Group also stressed the importance of relevance to policy and decision-making and thought the Program structure should give more emphasis to this aspect.

Strategic Directions/Objectives

The Group noted that while the mandate of the OSS to catalyse, coordinate, and communicate marine scientific research was clear, the directions and objectives of Program were not. A statement of the objectives of the Program would be beneficial in communicating to the Member States the purposes of the Program and provide guidance for the inclusion of new initiatives. The thematic program areas (see IOC/INF-1206) do

provide a sense of the content of the Program but are more in the form of headings for collections of activities rather than goals. The Group thought it would be beneficial if the "reasons for being" were more explicit, perhaps to the point of adoption by the Member States.

Functions (of the Section)

The OSS supports the Program (i) through the establishment and implementation of working groups or panels to address specific issues of marine scientific research; (ii) sponsorship of global research programs; (iii) provision of secretariat support, as requested, for UN interagency activities; and (iv) communications, publications, and outreach. These activities are used to catalyse research to focus on relevant issues, to coordinate scientific efforts, and to communicate results to stakeholders in the Program.

While the Advisory Group did not have an issue with the scope of activities or their purpose, they did see a need for the establishment of principles and/or guidelines that could be used more directly for testing the value of Section activities. This is especially important in a climate of reduced resources. The priority will largely be determined by the relevance and the level of the "value-added" (benefit) relative to resource commitments (the cost).

Coordination function

The primary way the Program adds value is through coordination of activities, at both the regional and global level. The Section does not of itself provide capacity but can, through efficient coordination, assist in developing capacity and functionality over and above that of national and/or regional contributions.

The *measure of success* is the degree to which the coordinated activity delivers additional relevant scientific value (incremental benefit) that would not otherwise be derived from the uncoordinated set of activities. It is not the total number of publications but the additional science arising specifically from the coordinated activity. It is often true that coordination simply delivers needed critical mass, without which the science can stagnate.

Networking (catalysing) function

This is closely related to coordination but focuses on the development and concentration of scientific effort in areas of specific concern to the IOC. Creating opportunities for networking among scientists with specific issues as the theme enhances the scientific effort over and above that which would derive normally.

The *measures of value* relate the number of scientists (total scientific effort) and the investment attracted to the area by way of networking. Clearly there must be purpose to the networking – simply creating a forum for scientists to exchange views is not sufficient; the networking must be contributing incrementally to the goals of the Program and be relevant to the mandate.

In several cases, this networking (and coordination) is delegated to and manifests as sponsorship of a defined research program, such as the World Climate Research Program (WCRP) or the Global Ecology and Oceanography of Harmful Algal Blooms (GEOHAB) initiative. The provision of sponsorship, however, does not by itself ensure effective value for the IOC; there remains an onus to engage and guide to ensure benefits accrue to the stakeholders within the Ocean Sciences Program.

Observatory function – monitoring trends

It is important that the Section, and the stakeholders in the Program, do have access to information that allows them to follow implementation and to access key metrics. The former often comes in the form of web pages on the program and details of the initiatives and groups, highlighting progress. The latter might take on the form of an information centre, maintaining data on, for example, indicators, trends or hot spots of interest, or data that can be used to measure the impact of the Program (e.g., special volumes; scientific papers; reports).

Capacity building

Capacity building in the present context is the development, fostering and support of infrastructure, resources and relationships for ocean science by and for the benefit of Member States.

The IOC Principles and Strategy for Capacity Building emphasise that such interventions should be structured to have enduring long-term impacts, addressing both the "know-why" and the "know-how". Implicit in those Principles is an understanding that the IOC Capacity Building Program will target the full range of capacities, including research and operations, and that the Program will be integrated with other Programs of the IOC, including the Ocean Sciences Program.

There is a responsibility to promote and develop scientific capacity – this is a primary role of the IOC – and the relevance of scientific initiatives will in part derive from the degree to which they are seen as relevant to Member States, particularly developing nations. Initiatives of the Ocean Science Program will be implemented consistent with the adopted Principles and Strategies, including the use of a common framework for testing effectiveness.

Dissemination of good practice *(standards)*

The IOC is the natural "keeper" of relevant standards for marine science. In part, such standards are promulgated through capacity building activities and through the establishment of collaborative networks through which standards sometimes emerge. Certainly, without such networks it is difficult to reach consensus on standards.

Integrative Framework

One of the fundamental principles of the approach should be that the Ocean Sciences Program is integrating rather than selective and dispersed. One way of assisting toward this goal is to have more focus on the ultimate purpose and utility of an activity, e.g. for

indicators, and thereby seek a framework that allows individual activities to be seen and implemented within a broader, more directly relevant framework

An example provide by the Advisory Group was the link between GEOHAB work, nutrient dynamics and integrated coastal management, all of which were seemingly presented as independent activities.

Another example is provided by modelling and, in particular, modelling within an interdisciplinary framework that allows coupling of processes and links from core modelling functionality (e.g., a predictive ocean model) to an application (e.g., guidance for fisheries management).

The integration needs to be planned and systematic, not *ad hoc* and the Advisory Group felt this was not so at present.

Communication

Communications, publications and outreach were identified as core activities of the OSS. It was noted that the Program did not receive the attention and review by Member States that was perhaps warranted, in part because of time constraints and pressures at the Executive Council and at the Assembly.

The Advisory Group concluded that both the internal and external communication strategy and its implementation needed strengthening.

There is a problem with the way this Main Line of Action gets communicated to Member States, to present progress (the 22nd Assembly drew attention to this issue) and to obtain review. There are less issues arising from the implementation of the Science Program requiring decision and direction from the Assembly, so there is a tendency to relegate it in the agenda. The establishment of the Advisory Group in part addresses the review issue though it is not a substitute for review and comment at the intergovernmental level.

The Advisory Group agreed to work with the OSS on an improved strategy. The communication to Member States should focus on decisions setting the directions of the program, identifying high level successes, and seeking endorsement of the overall strategic objectives and goals. From time to time, endorsement of specific initiatives will be required (as with Census of Marine Life in 2005).

Scientific lectures at the Executive Council or General Assembly can be a useful adjunct but are not a substitute for the above decision process. Though in the first instance the strategy should be to communicate the value of the programme, it is ultimately about ensuring informed decisions on the Program. We should not present science for its sake, but in the context of its relevance.

There needs to be a more professional communication strategy overall for the Program, including communication with scientists external to the intergovernmental process. However this requires resources. In resourcing future activities, such factors should be taken into account.

3. Briefs on selected Activities

The Secretariat provided presentations and briefing on selected activities of the Section (see Attachment C as well as IOC/INF-1206).

Some specific issues and general concerns were identified by the Advisory Group.

Oceans and Climate

The theme/sub-program is important and there is clear recognition within the Member States of the importance of climate and climate change. The Advisory Group recognized the strengths and relevance of the carbon and CO_2 initiatives, including the high level of coordination provided. However, the Advisory Group felt there was a need to better articulate the overall goals within the theme, including the science underpinning and supporting the ocean observing system for climate, through OOPC and through the WCRP initiatives.

WCRP

The objectives and outputs and outcomes of the IOC co-sponsorship of the WCRP need further elaboration and articulation. There needs to be a process for informing the Joint Scientific Committee for the WCRP of climate issues arising within the marine science domain of IOC and of informing IOC of significant climate developments relevant to IOC interests. The Advisory Group strongly believes that the IOC needs to engage more directly in the development of strategy and plans of the WCRP and be more active in communicating the results and outcomes of the WCRP to the Member States, for the benefit of related areas of the Science Program and for reinforcing the relevance of such activities to decision making and policy formation.

It was recognized that there are multiple lines of communication from the WCRP to nations, including through the National Meteorological and Hydrological Services of WMO and the International Council for Science (ICSU) but IOC has a key role in establishing the relevance to the marine sector and bring marine science issues to the attention of the JSC.

In examining the structure of the sub-program, the Advisory Group concluded there should be, in addition, a more explicit role coordinating climate related issues for marine science, including impacts on ecosystems and coastal systems (see Section 9 below on the identification and characterization of possible new/revised areas).

Science for Ocean Ecosystems and Marine Environmental Protection

Harmful Algal Blooms

A major activity is the Harmful Algal Bloom Program which, uniquely for the Ocean Sciences Program, is governed by an Intergovernmental Panel (for Harmful Algal Blooms; IPHAB). By all accounts, these arrangements seem to be working well and are delivering effective value (see Attachment C, paper 3 for a summary).

The Group did raise some issues concerning integration within the overall program which could be addressed through better articulation of the objectives and goals of the Program and Sub-Programs. Nevertheless, it enjoys strong support from both developed and developing member states, impacting, as it does, most coastal states as an increasing problem with clear economic and human health consequences.

GEOHAB is the research program component, while IPHAB effectively develops the capacity building program. At present IPHAB focuses only on taxonomy and toxins, while GEOHAB also covers areas related to oceanography, nutrient dynamics and ecology. The Group felt that IOC needed to also introduce/involve the (developing) Member States in such areas, either through IPHAB or some other process.

It was noted that the Program is now experiencing severe budgetary pressures, in part because of the specialist nature of the work and the lack of a broader supportive framework. Developing linkages between the HAB work and, for example, climate and nutrient dynamics related research initiatives would serve to improve the profile and context for the program as well as perhaps open new avenues of support.

Coral Reef Research

The GEF/World Bank Coral Reef Targeted Research and Capacity Building Project represents a significant area of work. The IOC acts as one of the Executing Agencies and contributes to the coordination and other aspects through the Bleaching Targeted Research Group (see Attachment C, paper 4).

Again, the Advisory Group supported the work as clearly relevant to the economies of many states, but raised some concerns about the degree to which this work was integrated within an overall program of work, for example related to climate research (acidification) and/or nutrient export into the coastal zone. The deficiencies noted under Agenda item 2 contribute to this perception. The Advisory Group suggested the strategic framework for the Ocean Sciences Program must explicitly address integration and inter-related activities.

The Advisory Group also drew attention to the important issue of deep cold-water corals that while less susceptible to sedimentation and fishing issues, might be highly susceptible to increased acidity.

Global Nutrient Export from Watersheds

Attachment C (paper 5) gives a summary of this activity.

The Advisory Group were particularly interested in why such seemingly relevant work was not picked up under the Land Ocean Interface Coastal Zone (LOICZ) or perhaps IMBER – Integrated Marine Biogeochemistry and Ecosystem Research – and why there was not more evidence of the integration of this work with other initiatives and sub-programs. One view was that LOICZ declined or failed to seize an opportunity – the support by GEF would suggest there is significant relevance, and the publications support

the scientific integrity of the work. The other was that not sufficient effort was given to encouraging its adoption within the IGBP research program.

Though the project is within a larger GEF project, it is the integration within the IOC Ocean Sciences Program that most concerned the Group. Though the GEF probably appreciates the role of IOC as an Executive Agency, and the standing of IOC as a relevant body is enhanced, those factors alone do not justify its existence within the Program. The Group did not doubt that such justification could be made – it is clearly highly relevant to GEOHAB, Coral Reef and ICAM research, and addresses anthropogenic influences on the marine environment. The adoption of projects in isolation tends to leave the impression of an ad hoc collection of projects rather than one of a systematic program of science support.

Other Research

Other research coordinated within this theme includes the development of quantitative marine indicators (for assessment and monitoring ocean health) and environmental indices for management, and various other work related to assessments (nutrient exports from watersheds, ecosystem modelling, and a training-through-research program on geosphere-biosphere coupling (see IOC/INF-1206 for some further details).

The general reaction from the Advisory Group centred on the degree to which these activities are implemented and integrated within a broader, planned Program, c.f. an *ad hoc* collection of activities. Indicators and indices, for example, would seem to be potentially an integrating theme for this work.

There was also a short discussion on the regional implementation of the science program, through subsidiary bodies and regional committees of the IOC. It would seem in some cases this works well, and the regions have led in the development of relevant initiatives, while in others there has been a degree of disconnect. It would seem regional initiatives are treated on a case-by-case basis, often driven by external funding rather than the strategic directions of the Ocean Science Program. The fact that such bodies are working with the Ocean Sciences Program and the Capacity Building Program (as well as Services) creates another complicating dimension.

Science for Integrated Coastal Area Management (ICAM)

Though ICAM is the major driver for this science theme/sub-program (see Attachment C, paper 7), there are a collection of other activities that contribute to the outputs (see IOC/INF-1206).

Much of the discussion focused on the development of indicators (metrics) for integrated coastal management, concerned with governance arrangements, ecosystem health and socio-economic factors[2]. Much of the concern surrounded the science supporting the

[2] The Group was provided copies of a primer on "Sustaining coastal societies and ecosystems: Is coastal management effective" and a related "Handbook for Measuring the Progress and Outcomes of Integrated Coastal and Ocean Management" (IOC Manuals and Guides, #46).

definition and quantification of the indicators and the degree to which this was integrated within the overall Program. For managers there has to be a rationalization process, to digest the information, with strong coordination between the field scientist and the policy side, which is the part the coastal management community is struggling with. In this instance, we have heard interesting things about HABs, coral reefs and CO_2, and on the other hand on coastal indicators, but there isn't a structured way to translate from one to the other. We need a strategy to move from the science to the policy-makers/managers.

The discussion reinforced the points made previously (see Item 2) concerning the development of coastal research in a broader framework, though this needs to be done in full recognition of the many existing players in coastal research.

The Secretariat noted the work that led to the publication of two volumes of *The Sea* which addressed interdisciplinary aspects of coastal ocean science. Such initiatives do bring the work of the IOC to the attention of scientists generally.

Within this theme there is also a focus on climate change adaptation in coastal zones and shoreline change management, supported as a contribution to the NEPAD Environment Action Plan. There has also been direct involvement in the ODIN-Africa Project.

4. Involvement/sponsorship of research programs

There was a wide-ranging discussion of the IOC's sponsorship of the WCRP (see discussion recorded within Item 3). The Advisory Group concluded the Ocean Sciences Program must seek greater engagement on the strategy and implementation of the WCRP, and must be pro-active in establishing the relevance and application of this work for marine science generally (see also the conclusions under Item 9, concerning climate impacts in the marine environment).

The Chair briefly discussed the recent adoption, through a Resolution of the 23rd Assembly of the IOC, of the Census of Marine Life as an element of the Ocean Sciences Program. Relative to the objectives of the Advisory Group, this resolution creates an opportunity for the Ocean Sciences Program to take advantage of the expertise gathered for the Census. However, at this time, the coordination and integration of the Census into the mainstream thrusts of the Ocean Sciences Program remains to be done.

The International Geosphere – Biosphere Program (IGBP) was raised in the discussions on several occasions (GLOBEC, IMBER and LOICZ are three marine research initiatives within IGBP, while SOLAS is co-sponsored by WCRP).

The Scientific Committee for Oceanic Research (SCOR), a component of ICSU like IGBP, is a prominent collaborator of the IOC and has taken the lead, or shared the lead, in many initiatives.

It was emphasised that Research Programs have been an effective method for the IOC to discharge its mission. The recent World Ocean Circulation Experiment was perhaps the one mostly closely identified with the IOC, although GLOBEC and JGOFS were equally

visible as IOC entities within their own international communities. At the level of Member States, however, it is often difficult to see their needs and requirements being addressed since they are subsumed into the broader, more complicated structures of the research Programs.

5. IOC Secretariat, Intergovernmental Context and Subsidiary Bodies

The publication "Look Deeper" was distributed to the Advisory Group and used as the basis for an introduction to the IOC and its Secretariat.

A copy of the 2004 Annual Report was also made available to provide members of the Advisory Group as an indication of the scope and resource base of the IOC. The "We have a Problem" document (IOC-XXIII/2, Annex 8) was also made available.

Much of the discussion centred on resources and the "business model" for operation of the IOC and its Ocean Sciences Program[3] and, in particular, the resources available to the Ocean Sciences Program.

The gearing of IOC-to-external funding is a prominent characteristic. For example, in one case the Advisory Board that the IOC investment in the project amounted to $20K of regular budget in a Program/Project of greater than $1M. The Advisory Group questioned what this meant in terms of the "business model" for IOC science? Do we "buy" influence much greater than the relative amount of this contribution? Or does the $20K represent a sponsorship (donation) without any level of influence or control? Is the contribution nominal, in order to allow the project to use the facilities and endorsement of the IOC? If the amount were withdrawn, would the activity collapse / cease to exist? Is the *control* and *ownership* in such circumstances illusionary?

The Advisory Group was not in a position to fully analyse neither this investment model, nor the investment arrangements for other projects where the apparent gearing was less one-sided. There was also no way to determine the relative value-added benefit for IOC. However, it was clear that such issues do need to be addressed if the Program is to have a robust existence. Heavy reliance on external funds will be the future norm and the Program must develop a better understanding of the full costs and benefits derived from each element of its Program, and develop a model that efficiently and effectively deploys total resources for the benefit of the Program.

A question also arose as to whether the situation owes something to the lack of distinction between projects and Programs, both in terms of strategy and in terms of funding arrangements. The Advisory Group was of the view that the Ocean Sciences Section should distinguish involvement in short-term projects from longer-term Programs.

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[3] Though the IOC is concerned with public goods and not the generation of commercial gains, it is probably useful to think in terms of "business models" whereby the outputs and outcomes (products) are linked to the methods and process (production), both of which must be related to investment (regular budget, special account, extra-budgetary). Such issues will be the focus of inter-sessional discussions of the IOC.

The Advisory Group committed to providing more specific advice at a future time.

6. Draft Advice on Present Program

The Advisory Group discussed its preliminary findings and outlined the likely form of its advice on the strengths and weaknesses of present set of activities and guidance on the future of existing program elements.

Detail is included under the relevant items above.

A recurring issue that fell somewhat beyond the purview of the Advisory Group related to data management.

Large-scale science programs have an important legacy in creating data but invariably data management is poorly addressed. One responsibility for IOC is to stress the importance of a modern data management system that is interoperable, within and among the relevant disciplines of marine science. Interoperability is critical. Within IOC and its IODE there is a large effort to set up data and metadata standards, and WMO is working in this area as well. There are also several initiatives at the regional (e.g., Europe) and national (e.g., USA, Australia) levels addressing these issues. It was noted that SCOR and IGBP have been working on an enduring data management system for carbon measurements.

The Advisory Group agreed that data and information management perspectives should be consider as an integral aspects of the strategy, even if in practical terms the functionality was coordinated in other parts of the IOC.

With regard to strategy and coherence, the Advisory Group noted that the IOC programs don't have to be coherent in and of themselves, but they do have to take an overall role. The IOC can influence and guide programs they sponsor or hold influence with in order to achieve a coherent whole.

Part II: Developing Advice on Future of Ocean Sciences in IOC for OSS

7. Drivers from existing activities of IOC

Most of these items were picked up in the general discussion associated with earlier items and/or introduced with the background documents.

Attachment C (paper 6) provided specific detail on the status of the Global Marine Assessment, including the initial Assessment of Assessments phase.

The Advisory Group noted the several intersections with other Sections/Programs and the need for good management and coordination among the lines of action of IOC.

The Earth Systems Science Partnership of WCRP, IGBP and the International Human Dimensions Program, was identified as an opportunity.

The Advisory Group noted that there were several cross-cutting activities, such as modelling and observations, and that these should perhaps be represented in the structure more explicitly. They did not express a view on whether, say, experimental (process study) observations should be under GOOS or within the science program.

There is a broader issue of context and the role and modalities of IOC engagement in marine science activities led from other UN Agencies, regional bodies and non-governmental entities.

8. Ocean science issues shaping the future

Members of the Advisory Group were invited to introduce/present perspectives that they might expect to shape future directions of the IOC Ocean Sciences Program.

Dr Biliana Cicin-Sain introduced the Global Forum which is supported through GEF funds with IOC as an executing agency; the emphasis is on developing countries, Small Island Developing States (SIDS) and economies in transition. www.globaloceans.org contains further information, including on the third Conference on Oceans, Coasts, and Islands.

The presentation stimulated a discussion on the links between science and policy and opportunities provided by the forum to communicate the utility and outcomes of marine science. The Global Forum supports intergovernmental fora such as the Informal Consultative Process. The Global Forum is able to bring governmental and non-governmental mechanisms together, globally, and gives a link between science and policy.

The challenge is to try to operationalize the science advice in a way that it can be used in decision-making. Have some examples of moving in that direction (fisheries) but other sectors are missing this. Using the IPCC model is one effective way to link the science to support decision-making – the assessment presents science in an integrated fashion that informs policy decisions.

On a more general perspective, she noted the IOC is an ocean commission with a broad mission. It is science based, but not a research organisation or academic organisation, so the central issue is that IOC should bring science-based ocean issues to the world. IOC should be networking the networks, and produce synthesized information to present to the world, like a broad IPCC.

Su Jilan highlighted the (governmental) similarities between IOC and WMO and FAO but noted the severe funding constraints. IOC is active collaborating with WMO and SCOR on several fronts but we have to pay special attention to the needs of member states and involve the member states (governments and scientists). He noted that SCOR was focused on the "blue" ocean and climate but has now shifted emphasis to include the

coastal ocean components as well. The WMO partnership is fine, but we have exercised a very weak voice and as a result are a weak stakeholder in these programs. The Ocean Sciences Program needs a more coherent and stronger coastal ocean program, not in place of the global (open) ocean science, but to complement and overall strengthen the relevance of IOC science. Weaknesses include the links with FAO and UNEP. Jilan suggested links with UNEP might develop through the GMA and perhaps the LME and regime shifts might create better links with FAO. ICAM and coastal ocean issues generally touch on policy issues and what countries need.

John Church stressed that the science program must be put back on the agenda of the Assembly and its value communicated to the Member States. He noted that WCRP is attempting to become much more integrated through COPES, with focus on practical applications of use to society. An example is the sea level rise workshop in Paris next year. WCRP and partners (IGBP, IHDP, Diversitas) formed the Earth System Science Partnership (ESSP) with foci on carbon, food, water and health. He believed the IOC as one of the 3 sponsors of WCRP must become more involved and more demanding. His third comment regarding strengthening of the observing programs, including data exchange and data archaeology issues. The emerging issue of marine impacts of climate change is important. Elements have been picked up in the OSS, but not all – sea level, pH issues, coral bleaching, habitats and species ranges.

Andrew Rosenberg noted that GMA can be used as an organizing principle for the Program's work and made the following observations concerning elements that IOC to contribute to the effort :

1. Ability to assess status and trends in a comprehensive way for coastal and ocean systems;

2. Climate impacts in the marine environment – consideration of the major drivers needing immediate attention (natural and anthropogenic) with regard to changing ocean systems;

3. Observing systems. IOC should take the perspective that we need to create systems as tools for policy makers as well as researchers, This is a difficult task – we could have an observing system that monitors well, but whose results are not immediately relevant to policy. Another concern is that we could end up with an extensive set of data on natural features of the ocean but poor data on the human drivers, e.g. very good data on biological characteristics but little useable information on fishing impacts because of poor monitoring and statistics. We need to link to human activities.

4. "White water to blue water impacts" is an area that needs to come forward in IOC program. Freshwater influences in the marine environment are important and the impacts are large.

More generally, the OSS agenda should turn from a series of projects into a program.

Mike Reeve noted that there have been enormous efforts over the years to link research programs – difficult to do. IGBP programs coming out of JGOFS, GLOBEC, etc beginning to mix and match (for example with IMBER). IOC needs to continue to focus on basic science and issues of individual coastal regions. One suggestion he supported was to bring IGBP-WCRP together to talk about drivers and impacts – IOC could do this. New programs are being formulated; easy for individual scientists to deal with their interest, but to pull them together to focus on a new strategy (for example: climate impacts rather than individual science issues) is more difficult. Reeve noted extensive work in the geophysical area (e.g., the International Ocean Drilling Program) but reasoned these were areas that IOC could leave to others. On the other hand, carbon is one of the central science issues and IOC has been providing a lead for decades. Reeve also drew attention to the International Polar Year and some opportunities for IOC involvement. The ageing of the research fleet is a critical issue for NSF and the US – we are struggling to see how to keep infrastructure up to do research and observations but while it is probably a global issue, he was not sure that IOC could or should take a lead.

Wolfgang Fennel focussed his comment on modelling. IOC should encourage cross-cutting activities and interdisciplinary approaches to address ecosystem issues and to increase predictive abilities. Modelling should enhance the ability to integrate IPCC scenarios into ecosystems. Biogeochemical models mainly see the upper part of the food web, but lower part of food web only in terms of mortality, while fish stock models see the lower part of the food in terms of prescribed zooplankton biomass. After the great success of coupling physical and biogeochemical/ecosystem models, we could encourage attempts to bridge the gap between fisheries models and biogeochemical models. He noted again the opportunity for IOC with SCOR to take on the issue of data management. Modelling requires data, but models can help to optimize observations. IOC could catalyze courses on modeling to help with education in modeling and data management.

Neville Smith referred to ocean prediction systems and the likely legacy from the Global Ocean Data Assimilation Experiment, which is entering its consolidation and operational phase. The first issue is that we need to have in place coordination of the science that underpins the core ocean prediction systems and this will disappear with GODAE unless action is taken. Working Groups on Numerical Experimentation (WGNE, mainly weather) and Coupled Modelling (WGCM, coupled modelling, climate change scenarios) play leading roles in their respective areas. Though there are ocean modelling groups for climate issues, there is not group with the charge to foster and coordinate the development of ocean models and applications beyond climate time scales. He noted that it is these models that are starting to be used for constraining coastal prediction systems, ecosystem models and fisheries management/prediction systems, aside from their inherent utility in open ocean prediction.

The Chair also invited members of the OSS to provide their perspectives. Resources, from their perspective, provide a hefty constraint on innovation and taking on new tasks and they reminded the Advisory Group of this over-arching issue. However, they also emphasised that as a Section, they wanted their work to be relevant to Member States and to the science community, and if that meant changing strategy and rearranging priorities, then that could be taken on. The emphasis on coastal research, on climate impacts in the

marine environment, on GMA and on modelling gelled with their own perceptions. The Section recognized the over-arching need for relevance but noted that Member States were free recommend any number of things, which by definition are then relevant, but without considering the resource implications in detail. The reducing regular budget simply exacerbates this situation.

9. Identification and characterization of possible new/revised areas

From the far reaching discussion of the previous Agenda Item, the Advisory Group identified a number of strategies/scientific areas that they believed should be given priority in the Ocean Sciences Program. In all cases they clearly fall within the mandate of the IOC and there is evidence of both direct and indirect support by Member States for the activities.

There is certainly some issue with overlap with existing research activities and Programs and in all cases a more careful analysis of the need and likely outcome is required before seeking endorsement and commitment.

In each case the Advisory Group considered the rationale, the vision (the big outcome), the scope, and some specific actions and implementation tasks, including where possible some guidance on the timeline. In all cases it is their judgement that the initiative is highly relevant and feasible and worthy of scientific attention. In one case (water issues) it was ultimately decided that there was insufficient justification for a specific focus but that the issue should be revisited within the strategy.

A. Climate impacts in the oceans

Rationale

- Identified several areas where climate variability and climate change impacts are issues for the open ocean and coastal marine environment;
- Presently both WCRP and IGBP have roles, one providing advice on the climate aspects, the other providing a collection of efforts related to impacts (e.g., ecosystems in GLOBEC; biogeochemistry in IMBER);
- This is a theme that is prominent in the Coastal GOOS Implementation Plan and so, by implication, is a key issue for the IOC science;
- Need for a more strategic approach where marine impact issues can be seen in the whole.

Vision relative to IOC areas of competence

- To provide a focal point for networking and coordination of research on marine impacts from climate, climate variability and climate change.

Scope

- The Earth Systems Science Partnership provides a convenient framework, within the specific area of climate impacts in the marine environment.
- Would integrate a range of issues that are already being considered by IOC and/or sponsored science programs, such as sea level rise, coral bleaching, calcification, acidity, changes in ecosystems, etc.
- Should consider the issue of downscaling into the coastal environment.
- Should include ecosystem impacts and regime shifts.
- Should include links from climate to natural marine hazards.

What specific actions could/should be taken

- Develop a paper (brief) that would stimulate discussion at the joint JSC/IGBP meeting in Pune – 6/7 March;
- It would analyse current efforts, within WCRP and IGBP, and within IOC Programs, including OSS and GOOS;
- The upcoming Global Forum could be used to test the policy relevance of the intended science focus.
- Could suggest a session at the upcoming ESS Symposium.
- Turn brief paper into a strategic plan, as appropriate.

How should it be implemented

- Short discussion paper then, if there is support, develop a strategic plan for adoption as part of the IOC Ocean Sciences Program.
- In many instances, implementation would be through existing initiatives and Programs.

Consideration of schedule, feasibility, impact, investment/effectiveness

- Jan 06 – introduced into Global Forum discussion.
- Mar 06 – discussed at joint WCRP/IGBP session.
- Dec 06 – first draft of plan.

B. Integrated Coastal Research

Rationale

- IOC is in a unique position to lead and coordinate coastal ocean science.

- The Member States have provided a strong signal that they would like such research to be more prominent.
- There is a good foundation for extension through existing ICAM and related initiatives.
- Many opportunities for synergy with existing open ocean and physical ocean initiatives.
- Underpinning and contributing to coastal ocean observing system.
- Provides a suitable integrating framework for currently disparate activities.

Vision relative to IOC areas of competence

- To provide a focal point for networking and coordinating all aspects of coastal ocean research.

Scope

- Integrated coastal management (note that ICAM involves several sectors, not just coastal research).
- Coastal ocean prediction and predictability.
- Science supporting and underpinning the development and evolution of the coastal ocean observing system (cuts across Sections).
- Would include relevant capacity building activities.
- There will be overlaps with other OSS activities and with both sponsored and non-sponsored research programs.

What specific actions could/should be taken

- Using the Carbon Project as a model, begin to identify unifying scientific objectives that both capture the strengths of existing work and provide a future framework for integrated approaches to coastal science.
- Make objectives *policy relevant*: let the needs of coastal management, climate and environmental change, etc. drive the objectives (use Global Forum to test).
- Could use nutrient inputs into the coastal zone as a unifying theme, involving HAB, ICAM, corals, etc.
- Will need to develop an integrated strategic approach to coastal research, ultimately for endorsement by the Member States.

How should it be implemented

- Not inventing a *Programme* to replace LOICZ, IMBER, C-GOOS, etc. but developing a strategy and process to deliver an integrated science program to member states.
- Provide a scientific focus within the remit of IOC to provide stronger coordination and coherence to coastal research work: represent this first as a strategy document, as part of larger Ocean Sciences Program.
- Initially, working through existing scientific programs, supplemented as appropriate by initiatives/projects run by IOC.
- The strategy would emphasise the links to ocean/climate; to GOOS; to DM; to CB
- Should seek Member State comments and endorsement at an appropriate time.

Consideration of schedule, feasibility, impact, investment/effectiveness

- Initial part is developing a strategy, as an element of a renovated Ocean Science Program: wait response from Officers (Jan 06) before committing to any work.
- Draft coastal research framework paper 06/07, with initial airing at 2007 Assembly.
- Seeking comments from SCOR during 2006.

C. Marine Environmental Modelling

Rationale

- Modelling is vital to advancing (impacting) most aspects of marine science, from climate and climate change through to ecosystems and prediction of hazards.
- Timely to bridge gap between biogeochemical modeling and fisheries modeling.
- The Global Ocean Data Assimilation Experiment has led the development of operational predictions systems and related applications – requires ongoing stewardship (presently under OOPC).
- Modelling provides essential infrastructure for developing applications in a multi-disciplinary environment.
- Modelling is focus of many different research initiatives in WCRP and IGBP. Gaps exist at the interface.

- There is role for promoting convergence, consistency and regularised framework for the development and application of models.

Vision

- The primary forum for the coordination of marine modeling and its application.

Scope

- Modelling for open ocean prediction
- Coastal ocean modelling
- Supporting ocean data assimilation and prediction
- Ecosystems modeling – interdisciplinary focus
- Characterisation and prediction of marine hazards.
- Coupling (air-ocean; intra-ocean) would be a focus.
- Re-analysis activities would be a major component.
- Caution: Must take account of the many other sector specific modeling for a to ensure convergence, consistency and a regularised framework for the development and application of models.

Specific Actions

- Develop a description of the activities that would be coordinated and led through such a group (scoping exercise).
- Develop ToR for a scientific group.
- Must be sure it is performing a useful and value-adding networking and coordination role
  ⇒ Must be certain it is not duplicating efforts elsewhere
- The work program should include capacity building modeling (summer schools, specialist training, etc.), implemented as part of the IOC CB program
- There should be strong links to and involvement with data management
- Envisaged as THE Working Group for marine modeling
- IOC as the primary sponsor

Implementation and possible timetable

- Canvas objectives and scope with likely stakeholders 2005/6

- Could build on a renovated and reformed GODAE group -2006/07 timeframe
- Target 2006 EC for testing the idea
- Target 2007 Assembly for formal endorsement
- May need to test SCOR interest; also possible links to World Weather Research Program and WCRP of WMO.

D. Global Marine Assessment

Rationale

- Principally, the relevant science for the Global Marine Assessment, viz.
  - ⇒ Ecosystem base for assessment
  - ⇒ Integrated global syntheses of the status and trends of marine ecosystems, including socio-economic aspects. Science underpinning.
  - ⇒ Access to information on the status and trends of marine ecosystems on diverse geographic scales.
- Informing policy makers, ocean users, the public, and the scientific community with reliable and objective information.
- Development scientifically sound and robust indicators.

Scope

- Marine ecosystems and the physical and chemical environment, biota, and socio-economic aspects;
- Address the state of marine ecosystems, causes of change, regime shifts;
- Coastal and estuarine waters through to ocean basins;
- Taking account of terrestrial and atmospheric influences.
- Scientific findings on the state of and trends in the marine environment and its living resources and ecosystems;
- Address gaps, nationally, regionally and globally in existing knowledge;
- Foster the development of supporting observation, monitoring and data management systems;
- Promote national, regional, and global capacity building efforts to improve scientific information for ocean management.

The Advisory Group was reluctant to be any more specific at this stage but was of the firm view that the GMA and the initial phase of Assessment of Assessments should be the basis for a substantial component of the Ocean Sciences Program.

E. Freshwater/Runoff and the Marine Environment

The Advisory Group recognized the socio-economic importance of freshwater and that at least some of the science within the domain of IOC is relevant (e.g., climate change and sea level rise impacting freshwater resources in the Pacific Islands; the oceans role in climate variability and change that impacts precipitation and freshwater resources). Moreover, it is clear that the link between runoff and coastal ecosystems is impacting policy on allowed river-flows: water mandated as run-off is not available for domestic consumption or industrial/commercial use. Nutrients, sediments and other loads carried across the land-ocean interface also impact coastal systems, including coral reefs, so there is an imperative to improve understanding of the role of freshwater and associated fluxes into the coastal zone, including groundwater.

However, the Advisory Group ultimately took the view that such issues were best integrated into a coastal research program and specifically within the area of anthropogenic and related influence on the marine environment. As with climate change, there is a priority to understand the natural system as well as the changes that might be attributed to anthropogenic causes. The Advisory Group concluded such science had high policy relevance and that the existing works on nutrient export would be an important contribution (notwithstanding some reservations concerning the extent to which IOC rather than other science programs was left with the lead). The work on groundwater discharge is also interesting but not necessarily at the highest priority and again are best integrated into a coastal research program.

10. Draft Report

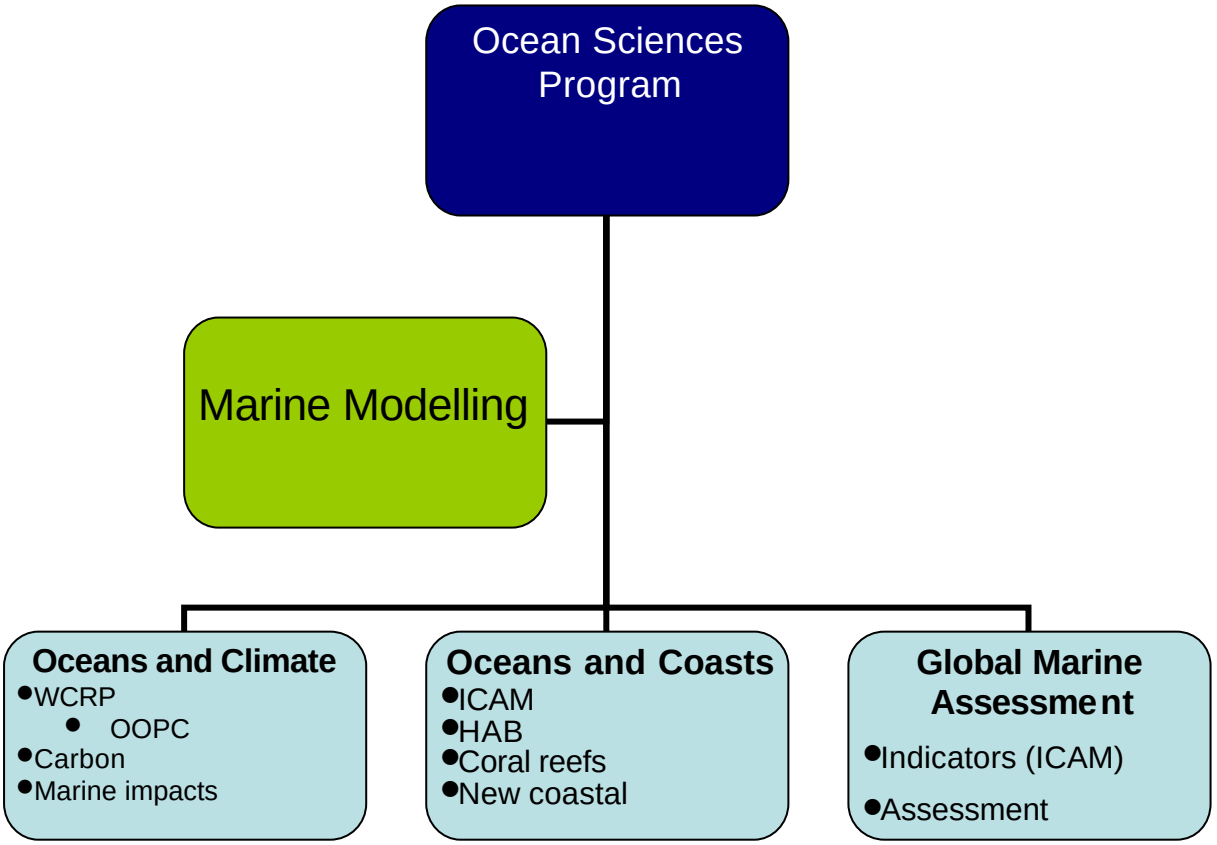
The Chair led a discussion of the main conclusions of the Advisory Group which included:

- The general satisfaction with the existing elements of the Ocean Sciences Program and Ocean Sciences Section;
- The overwhelming constraint provided by resources for IOC;
- The need for a more explicit statement of objectives and strategy for the Program, with particular attention on relevance and integration;
- The general weakness of the internal and external communication activities and the urgent need to improve communication channels to Member States;
- The fundamental role of ocean observations, for research and operational ocean systems and services, and that this cross-cutting area should be more prominent in the Ocean Sciences Program strategy;
- A restatement of the functions of the Ocean Sciences Section in a form that providing guiding principles for adoption of work and responsibility within the Program;

- Notwithstanding relatively recent restructuring, a recommendation to structure the Program so that it clearly showed both the leading strategic objectives and the relevance to the mandate of IOC and needs of the Member States (see Figure 1);

- With respect to existing themes,
  - ⇒ Revitalise and strengthen the engagement and involvement in the WCRP;
  - ⇒ Give greater priority to the integration and inter-relationship of presently distinct elements;
  - ⇒ Give high priority to the integration of the science program with other IOC Programs, particularly ocean observations and data and information management;
  - ⇒ Give more attention to presenting work in its policy context, emphasising the uses and utility within a common framework.
- A recommendation to incorporate several new aspects (or raise the priority of existing actions), including:

  - ⇒ Impacts of climate variability and climate change in the marine environment and on its living resources and ecosystems (lead with Oceans and Climate Sub-Program);
  - ⇒ Explicit recognition of coastal research as a primary element (Sub-Program), including (the overlapping) climate impacts introduced above, direct anthropogenic influences, integrated coastal management, natural marine hazards and coastal prediction;
  - ⇒ Early introduction of marine assessment as a primary element (sub-program), with emphasis on the science that will underpin the GMA;
  - ⇒ Introduction of an underpinning, cross-cutting element in marine modelling, recognizing the need for IOC to exercise its mandate and responsibility in new technology and its unique position which allows it to facility interaction and coordination among the many existing activities;
  - ⇒ High priority to integration among the new and existing themes, recognizing the inevitable overlaps, but also the strengths that arise from successful joint development and interoperability among the sub-programs and themes.



Close

Dr Smith thanked the members of the Advisory group for their constructive input and the staff from IOC who had assisted in the preparation for and conduct of the meeting.

The meeting was closed at 1730

Attachment A: DRAFT AGENDA

ADVISORY GROUP FOR IOC OCEAN SCIENCE SECTION (OSS)

FIRST MEETING

Paris, 9-10 November, 2005

9 November

0915

Opening of the meeting by Patrico Bernal

Part I: Developing Advice on Existing Activities

Part I A: Background

Documentation: *IOC Ocean Science Section: Overview and expected results*

http://ioc.unesco.org/iocweb/activities/ocean_sciences/

0930-1015

1. Introduction [Chair]
   - Purpose of the Advisory Group
   - Purpose of meeting
2. Background on IOC Ocean Science Programme- Mandate and Structure [Umit]
   - Linkages with other IOC lines of work [Umit]

1015 -1300

3. Briefs on selected Activities (1/2 Hour each):
   - Brief on Ocean Observing Panel for Climate (OOPC) and International Ocean Carbon Coordination Programme (IOCCP) [Maria, Albert] & Discussion
   - Brief on Harmful Algal Blooms programme [Henrik] & Discussion
   - Brief on Programmes on Coral Reefs & nutrients from water sheds [Umit] & Discussion
   - Brief on Socio Economic Indicators Programme[Julian] & Discussion
   - Discussion

Part I B: Collaboration, linkages and role of the Secretariat

4. Involvement/sponsorship of research programs

- WCRP [Chair]
- Census of Marine Life [Chair]
- IGBP- GLOBEC, LOICZ, SCOR [Umit]
- LME, [Umit]
- Discussion

5. IOC Secretariat, Intergovernmental Context and Subsidiary Bodies

[Chair, Umit]

6. Draft Advice on Present Program

- Identify strengths and weaknesses of present set of activities
- Develop advice and guidance on future of existing program
- Consolidation of conclusions from Part I including gaps

Part II: Developing Advice on Future of Ocean Sciences in IOC for OSS

7. Drivers from existing activities of IOC [Chair, Umit]

- UN.Oceans
- Global Marine Assessment
  - Assessment of assessments
- Global Ocean Observing System
- Tsunami and other natural hazards
- International Polar Year

10 November

0900-1030

8. Ocean science issues shaping the future

- Advisory Group invited to introduce/present items: top 2 or 3 issues
- Discuss relevance or not of IOC/OSS

1100

9. Identification and characterization of possible new/revised areas

- From item 8, begin to prioritize and characterize role
  - Short descriptive title

- Vision relative to IOC areas of competence
- Scope
- What specific actions could/should be taken
- How should it be implemented
- Consideration of schedule, feasibility, impact, investment/effectiveness

1430-1530

- Consolidation of Conclusions from 7-9

1530

10. Draft Report

- Consideration of messages and conclusions for report to OSS
- Strategic issues for IOC

1730 Close

Attachment B: Participants

Advisory Group Members

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Ocean Sciences Section and other IOC Staff

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Dr Maria Hood
Dr Albert Fischer
Dr Henrik Enevoldsen
Dr Stephano Belfiore
Dr Roger Dargaville
Dr Christian Wild
Dr Ehrlich Desa (part)
Dr Keith Alverson (part)

Attachment C: Briefs on Specific Activities of the Section

1. International Ocean Carbon Coordination Project (IOCCP)

Scientific Background

Of the fossil-fuel CO_2 emitted globally since the beginning of the industrial revolution, only about half has remained in the atmosphere. The other half has been taken up (48%) by the ocean, a global commons[4]. Without the ocean sink, atmospheric CO_2 would be much higher and its climate impacts more severe. But will the ocean continue to take up almost half of the CO_2 emitted to the atmosphere, even in a warmer climate with changed ocean mixing patterns? Perhaps a more pressing question is how these higher levels of ocean CO_2 may affect ocean ecosystems. Today, there is growing concern that this natural service provided by the oceans may come at a steep ecological cost - the acidification of the oceans. The study of the Earth's carbon cycle and climate is no longer strictly an academic exercise, but is instead one that demands political consideration and cooperation at an international level.

History of Programs at the IOC

The IOC has played a leading role in international coordination of ocean carbon observations since its inception in 1960, under the chairmanship of Roger Revelle. The IOC is called on directly by the UNCED/Agenda 21 and WSSD conventions, and indirectly by the UNFCCC, to carry out analyses, assessments and systematic observations of the role of the oceans as a carbon sink. The International Ocean Carbon Coordination Project (IOCCP) is a new ocean carbon program that has grown out of over two decades of continuous ocean carbon programs at the IOC.

Implementation

The IOCCP compiles information about ocean carbon observations being carried out in national, regional, and global research programs to create a global cooperative network of ocean carbon observations and research. These maps, tables, and other program information are published in an on-line directory with weekly updates. The IOCCP also brings together the community to analyze this information and to ensure that:

- the coverage from this combined network is sufficient to meet research needs for basin and global scale issues (and where it is inadequate, to identify and prioritize needs.)
- the data from individual activities are comparable (through development and use of reference materials, qc/qa procedures, standard practices, etc.)
- the data management practices of each program are compatible and coordinated, and that there are mechanisms in place to facilitate data sharing and data synthesis activities between programs.

The IOCCP works closely with the Ocean Observations Panel for Climate and JCOMM to integrate this information into the plans of the Global Observing Systems for Climate in support of the UNFCCC, GEOSS, and other international strategies on a regular basis.

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[4] Sabine et al., Science, 305, July 2004.

Highlights (2003-2005)

Three international workshops for coordination of ocean carbon measurements on ships of opportunity and repeat hydrographic sections. (have included ~120 scientists from 18 countries);

International agreements on data formats for underway pCO_2 measurements and data integration practices;

Initiation and implementation of a project to create a historical dataset of surface pCO_2 data using the newly-developed data format (joint with the Carbon Dioxide Information and Analysis Center (CDIAC) and the EU CarboOceans project);

Development of a Guide of Best Practices for Oceanic CO2 Measurement and Data Reporting (joint with PICES);

2 international stakeholders' meetings with representatives of national, regional, and global research programs to foster collaboration and coordination.

Development and maintenance of the Ocean Carbon Directory and quarterly email based newsletters to over 150 scientists.

1 International Science Symposium (joint with SCOR), "The Ocean in a High CO_2 World" to focus attention on the issues of ocean acidification and the science of purposeful sequestration of CO2 in the ocean (~120 participants). Publication of a special-issue of the *Journal of Geophysical Research-Oceans* from the symposium. Media coverage mentioning the IOC in a number of newspapers, including the New York Times and the Financial Times. Recognition by the Royal Society London of the important role the IOC should continue to play in reviewing this issue.

Finance and Budget

Staff: 1 Temporary P4 Staff post (funded by NSF, $115,000 total costs for post); 1 post-doctoral fellow on a P3 Consultant Contract (funded by NSF, $45,000 total costs for post)

Regular Program Budget: 2004-2005 biennium ~ $30,000 / year. 2006 budget estimate ~ $12,500 / year.

Extra-budgetary Funds 2004-2005:

- National Science Foundation grant to SCOR for IOCCP activities ~ $75,000;
- Japanese Ministry of the Environment / National Institute for Environmental Research / JAMSTEC ~$100,000 for IOCCP activities (e.g., hosting IOCCP workshops).
- US National Science Foundation and the Norwegian Research Council ~$30,000 each in support of the Ocean in a High CO2 World Symposium.

2. Scientific advice for a global ocean observing system for climate

The Ocean Observations Panel for Climate (OOPC)

The three sponsors of the OOPC are the Global Climate Observing System (GCOS), the Global Ocean Observing System (GOOS), and the World Climate Research Programme (WCRP). The Panel also has a close relationship to the Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM), in particular with its Observations Programme Area.

The Terms of Reference of the OOPC charge it with: (1) developing recommendations for a sustained global ocean observing system in support of the needs of its sponsors, including plans for phased implementation; (2) helping to develop a process for ongoing evaluation and evolution of the system and recommendations; and (3) supporting global ocean observing activities by involved parties, via liaison and advocacy for the agreed observing plans.

This observing system is designed to produce data and information products to serve: (1) climate assessment, including that for the needs of the UN Framework Convention on Climate Change (UNFCCC), (2) as a baseline for the climate research community, for climate monitoring, and upon which specialized observations of specific processes can be built, (3) for seasonal to interannual climate predictions by operational centers and research groups, and climate forecasting on longer time scales, and (4) additionally as the basis for global operational oceanography.

The foundation for the work of the OOPC was provided by the Ocean Observing System Development Panel (OOSDP) Report of 1995. An international conference[5] was held in October 1999 to reach ocean research and operational community consensus on the Next Steps forward for the global ocean observing system, which were endorsed by the sponsors of OOPC. In April 2003 the *Second Report on the Adequacy of the Global Observing Systems for Climate in Support of the UNFCCC*[6] was accepted by the Conference of the Parties (COP) of the UNFCCC, and an implementation plan was requested. OOPC and other ocean community scientists contributed the ocean domain section of this implementation plan[7], which was reviewed and in December 2004, recommended for implementation by COP-10 in Buenos Aires. The OOPC and its Secretariat also contributed to an April 2005 report to the UNFCCC on *Progress with the initial ocean climate observing system.*

The plan calls for the phased implementation of a composite surface ocean observing system including satellite observations, a composite subsurface ocean observing system, data and analysis systems in support of the observations, and continued research. Research is needed to enhance the efficiency and effectiveness of observing efforts, and to develop capabilities for important ocean variables that cannot currently be observed globally. This need for enhanced capability is particularly acute for remote and extreme environmental locations, for improved understanding of the ocean ecosystems, for improving the estimates of uncertainty of climate and ocean products, and for research in understanding the mechanisms of climate change.

In October 2005, the recommended *in situ* system was about 54% complete, as compared to about 40% complete at the beginning of 2003.

The Panel and its Secretariat work through sponsorship and contributions to international and regional coordination workshops and reports, and agreements on analysis and data management. It is also working

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[5] International Conference on the Ocean Observing System for Climate (OceanObs), St Raphaël, France, 18-22 October 1999.

[6] Global Climate Observing System report GCOS-82 (WMO/TD No. 1143), available from http://www.wmo.ch/web/gcos/gcoshome.html

[7] *Implementation Plan for the Global Observing System for Climate in Support of the United Nations Framework Convention on Climate Change,* GCOS report GCOS-92, available from http://www.wmo.ch/web/gcos/gcoshome.html

towards advocacy for the ocean observing system through the estimation of uncertainties in climate indices and fields of interest.

Finance and Budget

- Staff: 1 temporary P4 staff post (Appointment of Limited Duration, funded by NOAA, $115k total costs for post)
- Regular Programme budget: 2004-2005 biennium ~$47.5k / year. 2006 budget estimate ~ $40k / year.

The panel is chaired by Ed Harrison, based at NOAA/PMEL, Seattle, USA.

3. Harmful Algal Bloom Programme

Scientific Background

About 100 species of microalgae are known to cause problems to public health, aquaculture, aquatic living resources, drinking water, or tourism, either through their production of potent biotoxins or by their mass occurrence. Based on recurrent international need assessments, it is well documented that one basic element in national capacity to monitor and develop harmful algae mitigation plans is to be able to identify the causative organisms and to test seafood products for toxicity. One of the major research challenges is to improve our ability to forecast harmful algal events. The development of models requires detailed knowledge of the specific systems (hydrography, species, physiology, ecology, etc) characteristic for a given harmful algal event.

History and organisation of the Programme

The IOC initiated the programme in collaboration with FAO in 1991. SCOR assisted with programme plan formulation. An IOC Intergovernmental Panel on Harmful Algal Blooms (IPHAB) serves as the governing body for the Programme as well as a well established international forum for coordinating and linking HAB activities developed and implemented by a wider range of GOs and NGOs. The science programme on the global ecology and oceanography of harmful algal blooms, GEOHAB, was initiated in 1999 jointly with SCOR. The HAB Programme has a decentralized Programme Office located at University of Copenhagen, Denmark, hosted jointly by four Danish institutions; IOC Science and Communication Centre on Harmful Algae. A subsidiary centre focused on assisting Latin America and North Africa is located at the Spanish Institute of Oceanography, Vigo, Spain.

Implementation

The IPHAB develop and implement activities according the objectives given in the HAB Programme Plan. The activities thus encompass capacity building, a research programme, networks, a newsletter, publications, working groups, data bases etc. The Programme has joint activities with SCOR, ICES, PICES, IMO, WHO and ISSHA. A detailed overview of ongoing activities and partnerships is given in document IPHAB-VII/Inf.2 (see http://ioc.unesco.org/hab/IPHABVII.htm)

Highlights (2003-2005)

- Three international training workshops on species identification and toxicity testing;
- Four regional training workshops on species identification and monitoring systems;
- Publication of 'Manual on Harmful Marine Microalgae' in the UNESCO series 'Monographs on oceanographic methodology';

- Publication of a guide to the design of monitoring and management systems for harmful algae (with APEC)
- Three Open Science Meetings within GEOHAB (with SCOR);
- Development of an international data base on harmful algal events (with ICES and PICES)
- Establishment of science networks on HAB in North Africa, strengthening of similar networks in the Caribbean and South America
- Publication of 'Harmful Algae News' printed and on-line newsletters to over 2000 subscribers.

Finance and Budget

Staff: 1 P4 Staff post (1991-2005 funded by Denmark, Danida); At the IOC Centres: 1 Associate Professor in Copenhagen on half time (funded by Danida), 1 coordinator and one administrative assistant in Vigo (funded by the Spanish Institute of Oceanography and Ministry of Foreign Affairs)

Regular Program Budget: 2004-2005 biennium 41,000 USD +65.000 USD / year. 2006-2007 expected budget ~ $30,000 / year.

Extra-budgetary Funds contributed to the IOC Trust Fund 2004-2005:

- Denmark: 297.000 USD
- Spain: 73.000 USD
- USA: 63.000 USD
- Japan: 34.000 USD for WESTPAC/HAB
- Additional funds are provided via the HAB Centres in Cph and Vigo.

Extra-budgetary Funds 2006-2007 expected:

- Denmark: 180.000 USD
- Spain: 73.000 USD
- Japan: 34.000 USD

4. IOC/UNESCO- GEF/World Bank

Bleaching Targeted Research Group (BTRG) Summary about progress in 2005 and planning for 2006

Scientific background

Coral reefs are characterized by an enormous productivity and biodiversity. They also play a key role for the coastal populations that depend on food and resources for daily livelihoods. Despite their global significance, coral reefs are in decline worldwide. The Global Status of Coral Reefs 2004 Report lists two thirds of the world's coral reefs as under severe threat from the cumulative impacts of economic development and associated impacts of climate change. In this context, massive coral bleaching events, occurring as a response to environmental stress (in particular high water temperatures) and often subsequent resulting in the degradation of large affected reef areas, play an important role, because the frequency of these events increases. Calls for protection and more sustainable use of coral reef ecosystems have been included in several major global initiatives, in particular the Convention on Biological Diversity (1995) and the World Summit on Sustainable Development (2002). Thus, there is an urgent need to a) address main knowledge and technology gaps, b) promote scientific learning and capacity building and c) link scientific knowledge to management and policy in order to enhance the sustainability of the global coral reef ecosystems.

History of programme at IOC

Ocean Sciences Section at IOC-UNESCO initiated a Working Group on Coral Bleaching in April of 2001. The group's initial efforts included the development of indicators specifically for coral bleaching. Subsequently, it expanded its mandate to examine specific physiological mechanisms for coral bleaching as well as the local ecological factors that cause bleaching and its after-effects, and differences between direct human stresses and those related to climate change. The working group has prioritized hypotheses at various levels of interaction related to stress tolerance and the basis for vulnerability and resilience of corals reefs to bleaching. OSS also supported a major workshop with over 40 experts at Heron Island in 2002.

In 2004, the IOC Working Group on Coral Bleaching, coordinated by Ocean Sciences Section (OSS) at IOC and chaired by Prof. Ove Hoegh-Guldberg from University of Queensland, was re-named to Bleaching Targeted Research Group (BTRG) and incorporated as an integral member into the GEF Coral Reef Targeted Research & Capacity Building for Management Project (CRTR).

Implementation

The CRTR, whose executing agencies University of Queensland and IOC are, became operational in **late April 2005** and has begun a series of activities aimed at doing the science and training required for understanding the global challenges faced by coral reefs across the planet. This project is a high priority global initiative that will accelerate and refine a global response to understanding the science underlying these environmental temperature crises and how we manage them on coral reefs. It is bringing together over 80 of the world's leading scientists within six working groups. These working groups will focus on four international Centers of Excellence based at four leading international research institutes: University of Dar Es Salaam, Tanzania; Universidad Nacional Autónoma de México; University of the Philippines; University of Queensland, Australia.

The BTRG, which is coordinated by OSS, has a budget of USD $1.6 million for the next five years. This will cover a range of activities in the four focal regions, each of these having both research and capacity building objectives. A range of interconnected projects are planned by the 12 members of the Bleaching group over the next 5 years. These projects address a number of ecological to molecular issues.

The first regional workshop took place in **May-June 2005** at the Mexican Centre of Excellence in Puerto Morelos with contribution of OSS. Over 60 leading experts and graduate students participated in discussions, research presentations and experimental work aiming to resolve key aspects of the coral bleaching problem. Topics to be discussed were the significance of bacterial versus environmental bleaching, the truth or otherwise of the Adaptive Bleaching Hypothesis, new techniques for monitoring physiological change in coral populations, genomic approaches to understanding stress and the efficiency of remote sensing in reef management.

In **July/August 2005**, OSS, as a capacity building initiative, supported a 3-week specialized training workshop on "Stress biology of coral reefs" for five Indonesian students from Demarang University at University of Queensland's (UQ) Centre for Marine Studies (CMS). This is supposed to facilitate a strong linkage between both universities.

Another BTRG workshop with contribution of OSS will take place at the Australian Center of Excellence, Heron Island, in **November/December 2005**. This workshop will focus on scientific exchange and a series of collaborative scientific studies covering ecological consequences of coral bleaching as well as coral bleaching caused by microbial organisms.

For **April 2006**, the BTRG was asked to organize a session on "Thermal biology of coral reefs" at the SEB conference in Cambridge. Another major collaborative initiative between OSS and the BTRG, an international science symposium with the title "Coral Reefs in Crisis – Science and Solutions" is planned in

Paris for late 2006/early 2007. Major goals of this symposium will be to exchange previous main findings, to address key questions from the BTRG to the other CRTR groups, and to establish a link between science and management solutions.

Finance and budget

Staff: 1 postdoctoral fellow on a P4 Consultant Contract (Partly funded by NOAA; $ 49,884 total costs for post

Regular Program Budget: 2004-2005 biennium $20,000 / year; 2006 budget estimate ca. 20,000 / year

5. IOC Workgroup: Global Nutrient Export from Watersheds (Global NEWS)

Human activities related to food and energy production have greatly increased the amount of nutrients entering the coastal environment from land-based sources. This has resulted in considerable ecosystem degradation with negative economic consequences. The UNESCO-IOC workgroup, Global Nutrient Export from Watersheds (Global NEWS), was formed in the spring of 2002 as an international effort to understand the relationship between human activity in watersheds and coastal nutrient enrichment through the development of predictive global models (http://marine.rutgers.edu/globalnews). The workgroup consists of 21 scientists, including students and post-doctoral associates, from 7 countries; Sybil Seitzinger (Rutgers University and NOAA, USA) chairs the Global NEWS workgroup. Global NEWS has developed the first, spatially explicit, multi-element (N, P and C), multi-form, GIS-based global nutrient export models. This model system relates nutrient transport by rivers to coastal systems as a function of land-use, N and P inputs, and hydrology in watersheds globally. These models are currently being used to examine the relative magnitude of land-based nutrient sources to coastal systems and, therefore, the causes of coastal eutrophication. Additional model runs to explore past and potential future river nutrient transport are planned. An important next step would be additional model development to link nutrient transport by rivers (predicted from Global NEWS models) to coastal ecosystem effects.

A special section of the scientific journal *Global Biogeochemical Cycles* (December 2005 issue) will be devoted to the Global NEWS models and activities (listed below). Numerous other papers have been/will be published.

Through World Bank/GEF funding of USD 370,000 administered through IOC, the Global NEWS workgroup will also hold a series of nutrient export model training workshops in 2006 to train several people from Central America, South America, Eastern Europe, Africa and Asia in the use and application of Global NEWS nutrient export models for their particular Large Marine Ecosystem (LME) region. Outcomes of those workshops will also include information on the relative magnitude of land-based N sources to their LME, and a summary for local policy makers of nutrient sources (current and projected future) and their potential effects in their LME region. We envision this initial training workshop as the first of many that IOC Global NEWS could conduct to support capacity building in developing countries and countries with economies in transition through the transfer of advanced methods, practices and tools for coastal nutrient management.

To date IOC regular programme, NSF and UNEP have provided support of USD 55,000 per annum to to the Group's activities.

***Global Biogeochemical Cycles* (December 2005 issue) Papers**

Sources and delivery of carbon, nitrogen, and phosphorus to the coastal zone: an overview of Global NEWS models and their application. By S. P. Seitzinger, J. A. Harrison, E. Dumont, A. H. W. Beusen, and A. F. Bouwman

Global distribution and sources of dissolved inorganic nitrogen export to the coastal zone: Results from a spatially explicit, global model. By E. Dumont, J. A. Harrison, C. Kroeze, E. J. Bakker, and S. P. Seitzinger

Dissolved inorganic phosphorus export to the coastal zone: Results from a spatially explicit global model. By J. A. Harrison, S. Seitzinger, N. Caraco, A. F. Bouwman, A. H. W. Beusen, and C. Vörösmarty

Global patterns and sources of dissolved organic matter export to the coastal zone: Results from a spatially explicit, global model. By J. A. Harrison, N. F. Caraco, and S. P. Seitzinger

Estimation of global river transport of sediments and associated particulate C, N and P. By A. H. W. Beusen, A. L. M. Dekkers, A. F. Bouwman, W. Ludwig, and J. A. Harrison

A comparison of global spatial distributions of nitrogen inputs for nonpoint sources and effects on river nitrogen export. By G. Van Drecht, A. F. Bouwman, E. W. Boyer, P. Green, and S. Siebert

Modelling nutrient (N, P, Si) budgets in the Seine watershed: application of the Riverstrahler model using data from local to global scale resolution. By A. Sferratore, A., G. Billen, J. Garnier, S. Théry

Coastal ocean and carbonate ecosystems in a high CO_2 world. By A.J., Andersson, F.T. Mackenzie, and A. Lerman.

Lithological composition of Earth's continental surfaces derived from a new digital map emphasizing riverine material transfer. By H. H. Dürr, M. Meybeck, and S. H. Dürr

Global coastal segmentation and its river catchment contributors: a new look at land-ocean linkage and at regional seas filter. By M. Meybeck, H. H. Dürr, and C. J. Vörösmarty

6. A Brief on the Regular Process of Global Assessment of the State of the Marine Environment

In 2001, the Governing Council (GC) of the UN Environment Programme (UNEP) adopted decision GC/21/13 on the "Global assessment of the state of the marine environment," whereby the GC requested UNEP to explore the feasibility of establishing a regular process for the assessment of the state of the marine environment. The conclusions of two meetings held respectively in Reykjavik, Iceland; (12-14 September 2001) and in Bremen, Germany (18-20 March 2002,) consider possible modalities the Global Marine Assessment (GMA) process which should be established on existing assessments activities, in order to facilitate the provision of scientific and socio-economic information for policy makers.

The World Summit on Sustainable Development (26 August-4 September 2002, Johannesburg, South Africa) negotiated and adopted two main documents: the Johannesburg Plan of Implementation (JPOI) and the Johannesburg Declaration on Sustainable Development. Paragraph 36(b) of JPOI requested for the establishment "by 2004 of a regular process under the UN for global reporting and assessment of the state

of the marine environment, including socio-economic aspects, both current and foreseeable, building on existing regional assessments."

On 12 December 2002, the 57th session of the UNGA adopted resolution 57/141 on "Oceans and the Law of the Sea." In response to paragraph 36(b) of the JPOI, the General Assembly requested the Secretary-General to prepare proposals on modalities for the GMA, drawing on the work of UNEP pursuant to decision GC/21/13.

The resolution XXII-2 was adopted at the 22nd Session of the IOC Assembly (24 June- 2 July 2003) requesting appropriate contributions of IOC and its programmes to the Process, including feasibility of taking a leading role.

In response to UNGA resolution 57/141, the Secretary-General prepared a report containing proposals on modalities for a regular process for the GMA (A/58/423).

Following the first GMA International Workshop that took place in conjunction with UNICPOLOS-5 (7-11 June 2004, New York), it was recommended that the General Assembly invite the Secretary-General to establish a task force to oversee the next stage of preparatory work for the GMA.

At its 59th session, UNGA adopted resolution 59/24 on "Oceans and the Law of the Sea," which requested the Secretary-General to convene the second International Workshop on the regular process for global reporting and assessment of the state of the marine environment, including socio-economic aspects, from 13 to 15 June 2005, to continue considering issues relating to the establishment of the process, including its scope and a task force to initiate the start-up phase, of the Assessment of Assessments.

During the Second International Workshop, the need to initiate an Assessment of Assessments as called for in UNGA resolution 59/24 was reiterated. The aim of this Assessment of Assessments would be to assemble information on and to make a constructive appraisal of marine including coastal assessments, and establish how these assessments have been communicated to policy makers.

The work on the Assessment of Assessments is expected to be carried out with IOC and UNEP acting as the lead agencies.

7. Integrated Coastal Area Management Programme

Scope of the Programme

The IOC ICAM Programme, established in 1997 by the 19th session of the IOC Assembly and operational since 1998, aims to assist IOC Member States in their efforts to build marine scientific and technological capabilities in the field of ICAM, and to ensure that scientific requirements are integrated into national and regional ICAM programmes and plans.

Main Activities and Expected Results

The activities of the IOC ICAM Programme fall currently under to main lines: (a) development of guidelines and tools for enhancing the effectiveness of ICAM programmes and plans and (b) support to ICAM initiatives at the regional level. More specifically, expected results of the ICAM Programme include:

- Development of manuals, procedures, inventories, guidelines, which provide guidance to coastal scientists and managers and enable them to effectively contribute to ICAM.

- Development of guidelines on aggregated environmental, socio-economic and governance performance indicators for ICAM, including evaluation indicators of ICAM programmes and projects.
- Dissemination of a major global synthesis of how coupled physical-biological-chemical-sedimentary-ecosystem dynamical processes work in the coastal oceans, to improve the scientific basis for the management of coastal seas;
- Increased expertise and regional assessment for the characterization of watershed/coastal zones interactions (including coastline change, groundwater exchange in the coastal zone, including nutrient transport, and the transport of both bed and suspended sediments).
- Development of Regional Pilot project studies on interdisciplinary coastal processes (GEF Project – African Process, Latin America, Caspian Sea, Mediterranean).
- Further development of Global Web Service on ICAM acting as Clearing House Mechanism for global, regional, national information on ICAM.

Main Accomplishments

The IOC-NOAA-DFO Project on the use of Indicators for Integrated Coastal Area Management is ongoing following the international workshop held in Ottawa in 2003. A *Reference Guide on the Use of Indicators for ICAM* (IOC Manual 42) was published in 2003 by IOC, and provides a survey of practices for assessing coastal management programmes. A Special Issue on Indicators was published in the *Ocean and Coastal Management* Journal (Elsevier) in 2003. A *Handbook for Measuring the Progress and Outcome of ICAM* has been produced and is currently been applied in six countries. In this context, the testing of indicators will incorporate results from the coastal modules of the Global Ocean Observing System (GOOS) and the Global Terrestrial Observing System (GTOS).

The joint IOC/IHP/IAEA Project on Submarine Groundwater Discharge (SGD) in the Coastal Zone is continuing its intercalibration work and field experimentations. So far 4 international experiments have taken place in various geological environment, in Sicily, Australia, USA, Brazil and the fifth one will take place in Mauritius in March 2005. A Guide on SGD was published by IOC/IHP in 2004. More than 20 scientific papers on the IOC/IHP/IAEA Project have been published in various journals including *Continental Shelf Research Journal*, *Biogeosciences*, *EOS*, *Biogeochemistry*, *Hydrological Processes*, *Journal of the Total Environment*, *Journal of Environmental Radioactivity*.

As a follow up to PACSICOM and the African Process, IOC has led the development of a project proposal on climate change adaptation in coastal zones and shoreline change management through ICAM in West Africa. In 2003, this project was endorsed by the NEPAD Partnership Conference on Environment as a direct contribution to the NEPAD Environment Action Plan. The project has been accepted to pipeline entry as a PDF-B project and will be funded up to 1 Million US$ (GEF-$750k, co-financing-$250K). IOC will be the executing agency of this project, which has started in 2005.

In a drive to improve the delivery of useful ocean data products and services for he coastal management community at the national and regional level, ICAM has taken a major part in the development of the ODINAFRICA-III project, which was approved by the Government of Flanders in 2003. As Workpackage 4 of ODINAFRICA, ICAM is organising national consultations in the participating countries to identify stakeholder needs, as well as the development of targeted products, including training for Coastal GIS, development of State of the Coast reports, vulnerability mapping activities, etc.

As part of its regional strategy, the ICAM Programme is also engaged in Building an operational and representative network of National Focal Points (ICAM-LAC Initiative) as well as in the development of a new GEF project for the Caspian Sea.

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