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Intergovernmental
Oceanographic
Commission

2007

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Intergovernmental Oceanographic Commission

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purpose and role

Intergovernmental Oceanographic Commission of UNESCO

The purpose of the Commission is to promote international cooperation and to coordinate programmes in research, services, and capacity-building, in order to learn about the nature and resources of the ocean and coastal areas and to apply that knowledge for the improvement of management, sustainable development, the protection of the marine environment, and the decision-making processes of its Member States.

FROM THE **CHAIRPERSON**

Photo courtesy of ISD/Earth Negotiations Bulletin

For the first time as the Intergovernmental Oceanographic Commission's new Chairman, it is my pleasure to summarize the events during this intersessional period. Although it is now the twenty-first century, how difficult it is still to exchange ideas at a distance, especially when these ideas get coloured with the passion we all share for the ocean sciences.

During this intersessional period, I participated in the First JCOMM Scientific and Technical Symposium on Storm Surges in Seoul, Republic of Korea. I had the opportunity to see the remarkable enthusiasm of this group of oceanographers and meteorologists, as well as the commitment of our partners at the World Meteorological Organization. During the meeting in Seoul, participants agreed on recommendations and actions to be undertaken in relation to research and development on short– and long–term storm surge prediction, the transition from research to operations, storm surge related data management and observations, as well as capacity-building and outreach, including the 'JCOMM Guide to Storm Surge Forecasting' and its effective linkage to ICAM hazard guidelines.

The need for interdisciplinary cooperation and international coordination was stressed and it was further recommended that JCOMM foster a forum for enhanced and rapid exchange of information and ideas on surge modelling among existing and future national efforts. The importance of developing risk assessments and providing related expert recommendations to UNESCO/IOC, the World Meteorological Organization and national agencies was also recognized.

Regarding forecasts, the Seoul meeting highlighted the need to further develop fully coupled basin/coastal/tide/wave/atmosphere models and programmes for continuous improvement, including coupled hydrological, hydraulic and surge models for inundation. The meteorological research community was also addressed concerning the requirement for fully coupled models to improve numerical weather predictions for tropical cyclones, extra-tropical storms and winds in coastal areas.

I then had the great pleasure of visiting the Republic of Korea again to participate in the World Ocean Forum in Busan. There, I verified how important it is for Member States to be fully committed to ocean issues. I hope the attitude and the interest that Korea demonstrates in ocean issues extends to other regions.

As usual, towards the end of 2007, another IOC Officers meeting took place in order to follow up on the most outstanding topics in the organization. At this meeting we decided to modify the way topics are presented and distributed in our plenary meetings with the aim of making them more comprehensible, more related to our adopted main lines of action and easier to supervise. This is a decision we now put forward to you, the Member States, for your consideration.

Special attention was also given during the IOC Officers meeting to the celebration of the fiftieth anniversary of our Commission, approving some initiatives subject of course to the final agreement of this Executive Council, as follows:

- To confirm a Publishing Committee to publish a historical summary of our Commission.
- The presentation before the Executive Council of an outline of conferences and events to be held during 2009 and 2010.

During this period I also participated in the meeting of the Working Group on the Future of the IOC, chaired with pragmatism by Dr Savi Narayanan, our Vice-Chairperson for Group I.

What a great opportunity it was to have participated in this meeting. It was clear that we not only had a problem, we also had different interpretations of it. However, having certain management tools on the meeting table, such as the questionnaire drawn up by Atkins International Ltd., along with the experience of delegates who have been involved with the IOC for many years, and the reports of similar groups previously summoned (e.g. DOSS), the Working Group searched for an acceptable solution for the years to come.

I had never been aware of a majority inclination to leave UNESCO, but thanks to a few of you who expressed that idea, we had additional advocates at the UNESCO meeting, and this in turn resulted in a reinforced budget. This is a clear example that when Member States so desire, they can indeed revert situations.

I was convinced there was a will either to kindle a stronger bond among Member States through a convention on data and information or, more simply, to augment the hierarchy of our current situation as a specialized organization in marine scientific research. However, where this topic is concerned, I now believe discussions should continue. There was, in fact, a questionnaire that supported an initiative to this effect, but clearly during the meeting no agreement was reached as to the reason or the cost/benefit it would demand. In summary, this Working Group has enriched all those who took part in the meeting and enabled us to find an acceptable solution for the coming years.

I also had the opportunity to join a meeting of the Permanent Commission for the South Pacific (CPPS) in Guayaquil, Ecuador and share views with stakeholders of the Southeastern Pacific, followed by the Fourth Meeting of the Upper Southwest and Tropical Atlantic Regional Alliance meeting held in Rio de Janeiro, Brazil (held back to back with the International South Atlantic Buoy Programme biannual meeting).

I am also looking forward to representing the Commission at the fiftieth anniversary symposium of the Scientific Committee on Oceanic Research (SCOR) in October 2008.

I would like to finish here by extending my grief to the people of Myanmar and China who have lost their families, their homes and their livelihoods following recent tragic events there. Only a few years have passed since the terrible tsunami of December 2004, and in the wake of such momentous events there are always questions. How did this happen? What are the implications? What should we do? Such questions, indeed, are further reminders of the importance of early warning systems and the value and significance of increased and more precise forecasting.

Javier A. Valladares
Chair
Intergovernmental Oceanographic Commission
of UNESCO

FROM THE **EXECUTIVE SECRETARY**

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Living under the effects of a changing climate

The year 2007 was marked by the release of the Fourth Assessment Report completed by the Intergovernmental Panel on Climate Change (IPCC). On 29 January, I had the privilege of welcoming to UNESCO Headquarters the participants in the Tenth (and last) Session of Working Group I of the IPCC. This meeting was the culmination of the work of hundreds of scientists based on new and more comprehensive data on past and present changes in the climate system, more sophisticated analysis of that data and significant improvements in the understanding of the processes involved in climate and climate change. At the end of the week, their conclusions addressing the physical science basis of climate change were released to the public in a room packed with more than five hundred journalists.

The following September, UNESCO invited Dr Rajendra Pachauri, Chairman of the IPCC, to address the Executive Board during a one-day thematic debate on 'The Construction of Knowledge Societies and Climate Change'. This IOC Annual Report includes Dr Pachauri's presentation that day.

The international community was genuinely surprised when later in the year the Norwegian Nobel Committee awarded the 2007 Nobel Peace Prize to the Intergovernmental Panel on Climate Change (IPCC) and to Albert Arnold (Al) Gore Jr '*for their efforts to build up and disseminate greater knowledge about man-made climate change, and to lay the foundations for the measures that are needed to counteract such change*'. The Nobel Committee further added, '*Extensive climate changes may alter and threaten the living conditions of much of mankind. They may induce large-scale migration and lead to greater competition for the earth's resources. Such changes will place particularly heavy burdens on the world's most vulnerable countries. There may be increased danger of violent conflicts and wars, within and between states*'.

These are the same compelling reasons for the UN drive, led by Secretary-General Ban Ki-moon during 2007, to put climate change at the top of the international agenda, calling for nations to take urgent action to mitigate the causes of climate change and embark immediately on a negotiation to set up the targets and plan of action for the international community beyond 2012. We can say with satisfaction that this coordinated effort succeeded. First, there was a High-Level Meeting of Head of States, called at the beginning of the UN General Assembly in September in New York. Later, in December at the United Nations Climate Change Conference in Bali, Member States that are Parties to the UN Framework Convention on Climate Change and to the Kyoto Protocol adopted the 'Bali roadmap' that will take the negotiations through Poznan in December 2008 to a final international agreement on climate change in Copenhagen in 2009.

Without attempting to take away any of the shine and well-deserved recognition received by the IPCC and Al Gore, the IOC, together with the World Meteorological Organization and the International Council for Science, has many reasons to join them in their celebration and to be extremely proud of these collective achievements. The IOC through its long and sustained focus on the Ocean and Climate programme, and especially through the support to the World Climate Research Programme (WCRP), has contributed significantly to build and constantly improve the knowledge base on climate, highlighting the key role that oceans play in regulating climate. Furthermore, the IOC performs a unique and essential function to the community of nations by coordinating the regular, real-time gathering of ocean data through GOOS, the Global Ocean Observing System. Given the size of the scientific community in this field, it is not surprising that 99 per cent of the contributing authors and 66 per cent of the coordinating lead authors of the IPCC Report, *The Physical Science Basis*, are WCRP scientists.

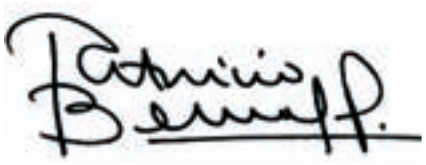
But there is no time for complacency. The scientific endeavour must continue and, moreover, at an accelerated pace. The WCRP is putting emphasis on its cross-cutting themes that interconnect different projects. There is a need to increase efforts in regional modelling that aim to downscale the impacts of global climate models to regional scales and provide regional detail in finer resolution. The Abdus Salam International Centre for Theoretical Physics in Trieste, run under the international umbrella of UNESCO and the International Atomic Energy Agency, is attempting to lend support to an emerging network of regional centres just starting to do precisely this. The IOC must join them and support the ocean science groups that are ready to participate. Work on extreme events must expand. The development of empirical efforts by operational systems to increase the forecast window of numerical models has given us many insights into how weather and climate function, and the role of oceans as the memory of weather, determining the nature of climate. Consolidating effective working links between the WCRP, IGBP1 and IHDP2 as part of the Earth System Science Partnership is a necessity. We cannot afford to have parallel efforts.

Nevertheless, the forecasted effects of climate change, such as the regional increases of temperature and rainfall, the increase of extreme events, and rising sea level, will require immediate actions to mitigate their long-term negative consequences. The question now is not only what is required to avoid dangerous climate change, the focus of the IPCC report, but also what we can do to live under the effects of a changing climate. The big challenge is to move our societies in the direction of adapting to climate change. The knowledge base we have now results from the work of thousands of scientists addressing the causes of climate change. This upstream flow of new science has increased our understanding of this extremely complex set of interconnected processes. But there is a path downstream from the available knowledge base to society by using this knowledge towards adapting societies to the effects of climate change. Today we need to focus on both directions at the same time: upstream to continue to improve our understanding, and downstream to be able to offer societies the best possible technical, scientific and socio-economic information available as a basis for their many decisions on how to adapt to climate change.

The big challenge is to move our societies in the direction of adapting to climate change.

There is a significant amount of work being done on adaptation to climate change. The United Nations Framework Convention on Climate Change (UNFCCC) has established the Nairobi work programme that has nine areas of action, all of them important to increasing the ability of countries to adapt. The State Parties to the Convention and to the Kyoto Protocol have agreed to create an Adaptation Fund. At the Bali conference, Parties decided that the operating entity of the fund would be the Adaptation Fund Board ('the Board'), serviced by an independent secretariat and trustee. Parties invited the Global Environment Facility (GEF) to provide secretariat services ('the Secretariat') to the Board, and the World Bank to serve as the trustee ('the Trustee') of the fund, both on an interim basis. This is an extremely important development.

With GEF funding, the IOC is implementing an adaptation project to look at coastal erosion in northwest African countries and the potential impact of sea level change. We are doing something similar in cooperation with the Democratic Republic of the Congo in the Gulf of Guinea. Some specialized groups are bridging the gap between the natural sciences, the social and human sciences and the economy to address adaptation. However the sheer dimension of the effort and the information flow needed for successful adaptation worldwide requires new instruments and institutions. This is why the IOC is joining other UN agencies and programmes to contribute to the World Climate Conference-3 (WCC-3) organized by the World Meteorological Organization in 2009 in Geneva, which will address precisely these issues. The Director-General of UNESCO has called upon the IOC to play a leading role in the field of climate change. Working together, Member States and the IOC Secretariat can rise to this new challenge.



Patricio A. Bernal
Assistant Director-General, UNESCO
Executive Secretary, IOC

1. The International Geosphere-Biosphere Programme (IGBP)
2. The International Human Dimensions Programme (IHDP)

Public **awareness**

Climate change: Main conclusions of the Fourth Assessment Report of the IPCC

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Nobel Peace Prize laureate **Rajendra K. Pachauri** (Chairman of the Intergovernmental Panel on Climate Change; Director-General, The Energy and Resources Institute)

On 2 October 2007, some two months before the Norwegian Nobel Committee distinguished both the Intergovernmental Panel on Climate Change (IPCC) and Albert Arnold (Al) Gore Jr. with the Nobel Peace Prize for 2007 '*for their efforts to build up and disseminate greater knowledge about man-made climate change, and to lay the foundations for the measures that are needed to counteract such change*', Dr R. K. Pachauri, Chairman of the IPCC, gave a presentation to the Executive Board of UNESCO as part of the 'Knowledge Societies and Climate Change' thematic debate.

"Mr Chairman of the Executive Board, your Excellency Director-General of UNESCO, moderator of this session, Excellency Luiz Filipe de Macedo Soares, distinguished ladies and gentlemen,

Let me at the outset express my gratitude for the opportunity to address this august gathering. I am particularly heartened by the fact that UNESCO is devoting such time and effort to assessing the opportunities and challenges that exist in this field. I think this is significant, coming as it does after what happened at the United Nations last week; I had the privilege of addressing the UN at a high-level event organized by the Secretary-General and I doubt if ever there has been an assembly of so many heads of state and heads of government spending an entire day discussing climate change. So I think the portents are right and that we are seeing an enormous amount of resolve in the international community to take action on climate change: necessarily, UNESCO will be an important part of this.

In my presentation today, I will essentially cover a bit of background about the IPCC, then issues related to understanding climate change: what are the expected impacts of climate change? What are the adaptation and mitigation challenges that lie ahead of us? I will define that we are now at a stage when it is time for action.

UNESCO/IOC programmes in climate research and monitoring – including the World Climate Research Programme (WCRP) co-sponsored with WMO and ICSU, the World Water Assessment Programme, the Global Climate Observing System (GCOS, co-sponsored with WMO, UNEP, and ICSU), the Global Ocean Observing System (GOOS), and the World Network of Biosphere Reserves – contribute to the body of scientific knowledge on climate change assessed by the IPCC.

The role of the IPCC

The IPCC was jointly established by the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP) in 1988, in keeping with a decision by the United Nations General Assembly. The role of the IPCC is to assess, on a comprehensive, objective, open and transparent basis, all aspects of climate change and to promote an understanding of the scientific basis of the risk of human-induced climate change, its poten-

tial impacts and options for adaptation and mitigation.

To do this, the IPCC carries out a regular, comprehensive assessment exercise. It mobilizes a large number of the world's most distinguished experts to carry out a reporting exercise approximately every five years. The First Assessment Report was brought out in 1990; we are now at the stage of compiling the Fourth Assessment Report, three parts of which have been completed. The fourth part, the synthesis report, will be completed in the middle of November when the IPCC meets in Valencia for this purpose.

What the IPCC has produced, essentially, is a set of reports that mobilize, as I mentioned, a team of authors: those who have directly written the fourth assessment report total close to six hundred experts from all over the world. And we try very hard to see that there is a geographical balance because one needs to get perspective, one needs to get local knowledge from every part of the globe. But if you want to count the number of people who carry out reviews of these reports - and that is also done in a systematic and transparent manner - as well as those who provide inputs as what we term 'contributing authors', it really is a mammoth exercise, involving literally thousands of experts all over the world, including government officials, because governments also have the opportunity to comment on the drafts and each comment has to be taken seriously. We have a group of review editors who document what is done with every single comment received. Of course, the final word lies with the authors and ultimately, governments have to accept and approve the reports that we produce.

Progress in knowledge that is included in the Fourth Assessment Report is based on new and more comprehensive data, more sophisticated analysis of data and improvements in the understanding of processes. So, knowledge has moved forward substantially. And I might mention that in February, when we released the Working Group 1 report in this very building in the precincts of UNESCO conference facilities, I was amazed to see the number of media representatives present; there must have been close to five hundred journalists packed into that room. That, I surmise, is an indication of the interest that exists about what the IPCC produces. I think the reason this interest has been sparked is because it is now well known that the science has advanced substantially.

Key findings from the Fourth Assessment Report

The graphs in the Figure 1 below show the picture as it looks going back to the start of the industrial age, from the period of the industrial revolution. The top graph shows the increase in global average temperature; the second one shows global average sea-level rise; and the third, northern hemisphere snow cover, which has gone down significantly.

Just to give you some numbers, in the twentieth century, the average surface temperature has increased by 0.74 ºC, but varies in different parts of the globe. The Arctic is warming at twice the rate of the average of the rest of the globe. Sea level rise in the last century was in the range of 17 centimetres and, both in terms of temperature increases and sea level rise, there has

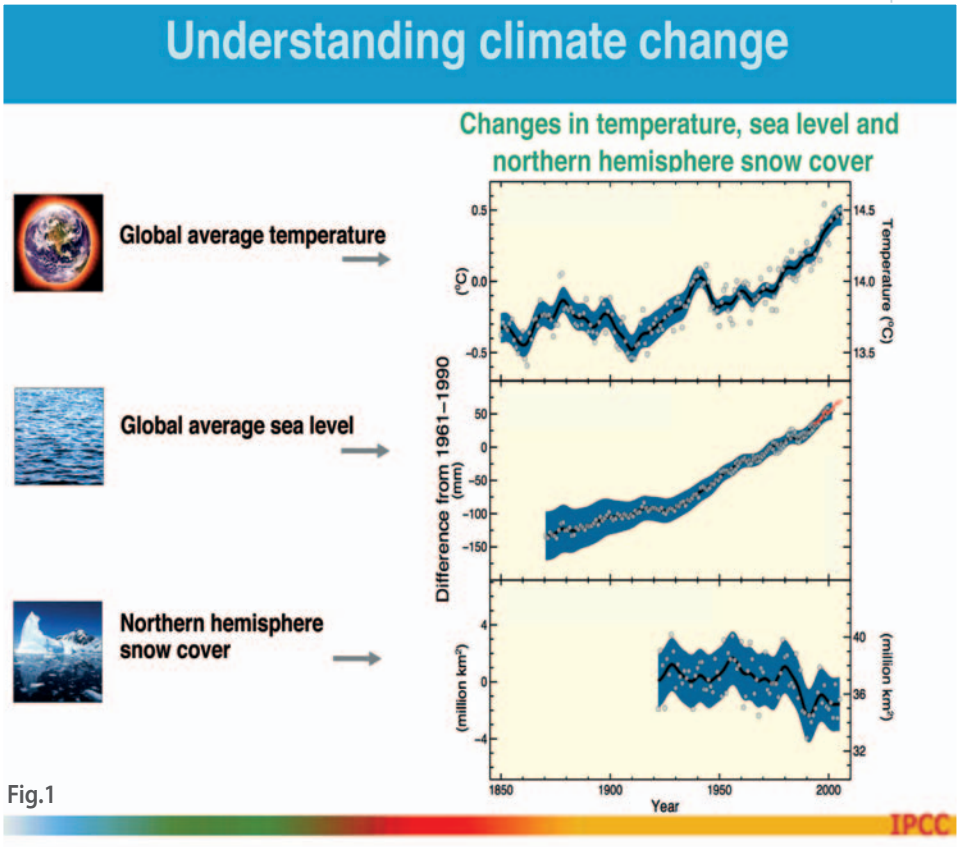


Fig.1

been acceleration in the last decade or two.

Another area that is causing enormous concern is the rate at which the glaciers are melting around the world. I come from a region where we are extremely dependent on water flows originating in the Himalayan glaciers. The result of this change in the glaciers would be that water supply could be an issue affecting about 500 million people in the next couple of decades in South Asia and perhaps 250 million people in China.

New data confirm that losses from the ice sheets have contributed to sea level rise from 1993 to 2003. There are also changes taking place in precipitation levels. In general, what we find is (without defining each of the areas) in the temperate regions, there is increasing precipitation but in the tropics, sub-tropics and Mediterranean regions, there is a decline. This trend is likely to continue in the future. But what is even more important is the fact that there is an increase in extreme precipitation events, which means that you get large quantities of rainfall or snow in very short periods of time. And that has major implications, not only in terms of protection of life and property but also in terms of water availability. Therefore, we have been seeing - and we are likely to continue to see - more intense, longer droughts, widespread changes in extreme temperature and increasing intense cyclone activity. All this is based on systematic observations. There is no speculation, there is no imaginary science being presented here. This is based on hard data that has been analysed very carefully.

Projections have been produced using very sophisticated models

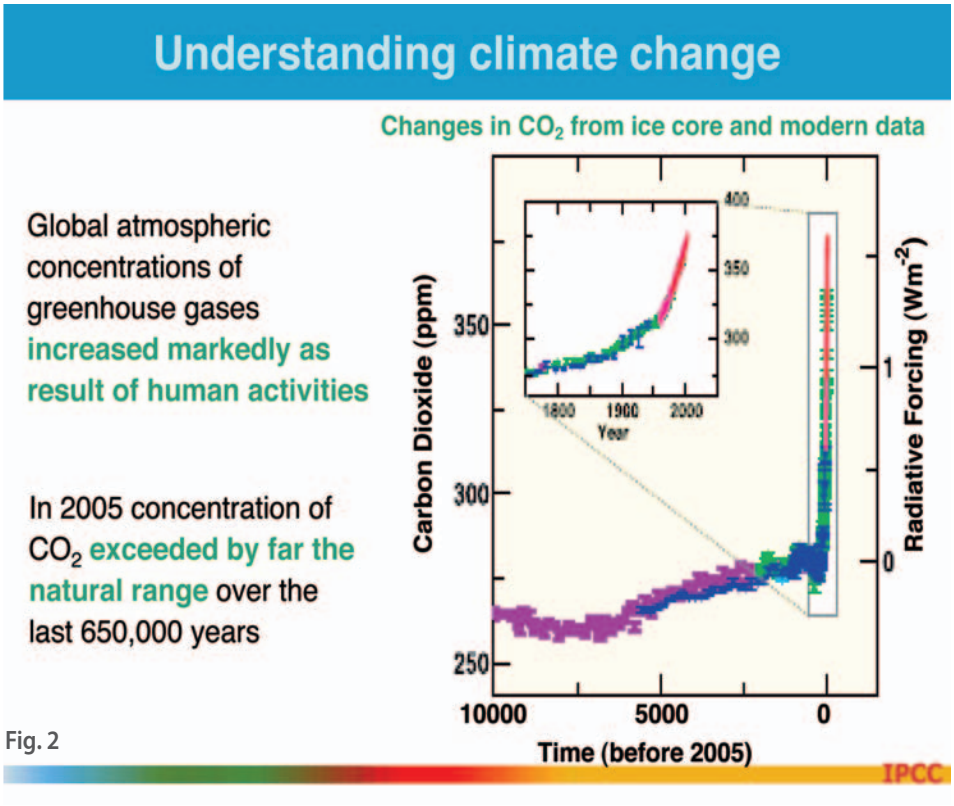


Fig. 2

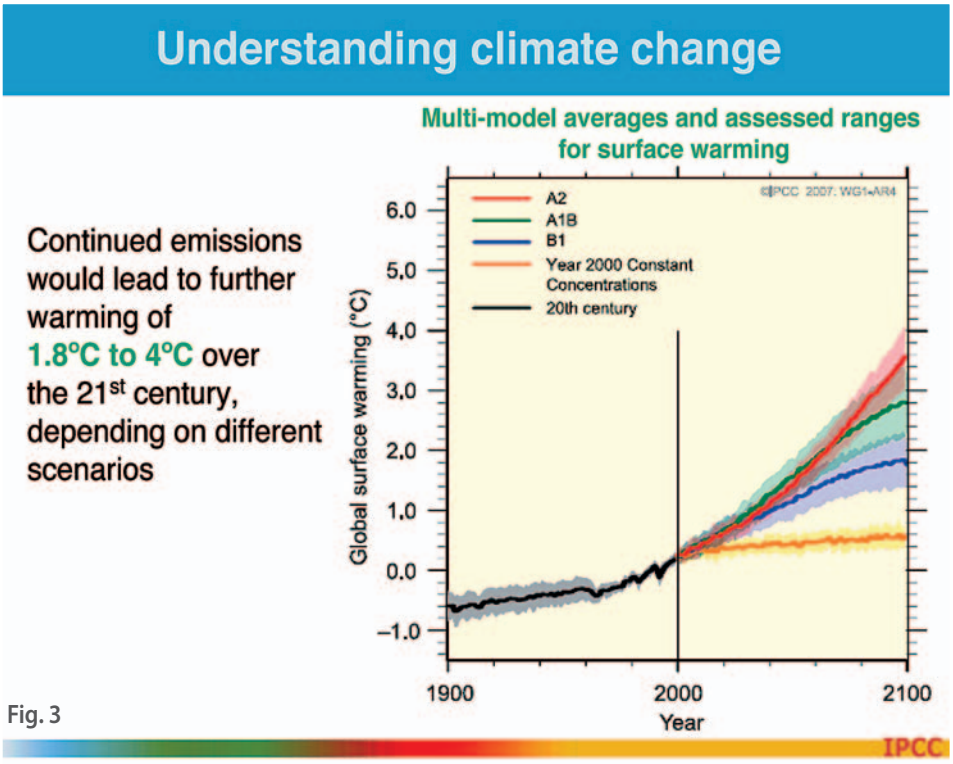


Fig. 3

that look at the impact of natural forcing (meaning natural changes in climate that are the result of solar activity as well as volcanic activity) and then models using both natural and anthropogenic forcing, plus plotted observations. The most convincing part of this kind

of analysis is that today our models are able to predict a separation not only of the factors that are driving changes in the climate, but also a combination of these, which gives us results that are very close to the actual observations. So what I am saying is that the validity of science and our models today is very strong and very compelling.

The graph in Figure 2 shows a familiar diagram. Those of you who have seen the movie 'An Inconvenient Truth' will have seen former Vice-President Al Gore climbing onto a mechanical lift to reach up to the top of this particular spike. But what is important is to see that, relative to the period of time that is plotted here, increase in recent years has been quite sharp as far as the concentration of greenhouse gasses is concerned.

This is a significant observation: in 2005, the concentration of CO_2 exceeded by far the natural range that has existed over the last 650,000 years. And this is where I think science has made an enormous difference.

This graph in Figure 3 shows projections for the twenty-first century. What we have done is examine a number of plausible scenarios on how the economy, technology and social factors will change over a period of time and, based on that, we have come up with best estimates for each scenario. At the lower end of the projections, we have a figure of 1.8 ºC warming by the end of this century. If you look at the upper end of the scenarios that have been assessed, we get a best estimate of 4 ºC. This should be viewed in conjunction with the 0.74 ºC increase that has already taken place in the twentieth century.

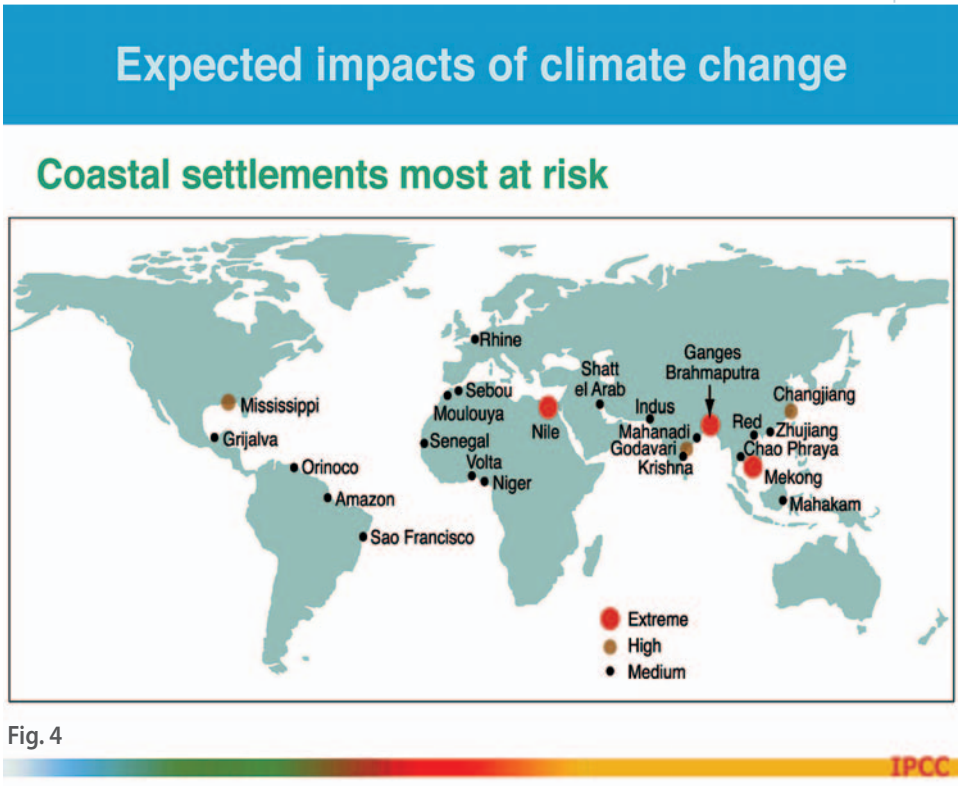


Fig. 4

The effects of climate change

Now, the effects of climate change are not geographically uniform. Some regions are more vulnerable than others, particularly poor regions: this includes poor regions everywhere, even in rich countries (I don't want to link Hurricanes Katrina and Rita with human-induced climate change, but we have seen that the worst sufferers as a result of those weather events were the poor people who were affected). In the Sahelian region, rain-fed agriculture might be affected by a decline of up to 50 per cent by 2020. Between 75 and 250 million people could be exposed to increased water stress by 2020 in Africa; this has to be seen in the context of the fact that this is a region that already experiences scarcity of water availability. Food insecurity and loss of livelihoods could also be exacerbated by the loss of cultivated land and nursery areas for fisheries by inundation and coastal erosion in low-lying areas of tropical Asia.

There is, therefore, a need for adaptation because, whatever we do, climate change will continue, even if we were to stabilize the concentration of greenhouse gasses today.

Coastal areas and island locations are going to be particularly at risk. There are some locations that are at extreme risk, others that are high risk and a third, medium risk category. The IPCC has found in our Fourth Assessment Report that the mega-deltas in Asia are particularly vulnerable, including cities like Dhaka, Calcutta and Shanghai. These are locations that have very high population density and are certainly vulnerable to coastal flooding and sea level rise.

Impacts on natural ecosystems

Climate change will reduce biodiversity and perturb the functioning of most ecosystems, compromising the services they currently provide. Ecosystems provide a wealth of services, particularly those that are dependent on the growth of various species around them. And this is true of both plant and animal species. The IPCC has also assessed that between 20 and 30 per cent of plant and animal species are at risk of extinction if increases in global average temperature exceed 1.5 to 2.5 ºC.

Some systems are highly vulnerable, such as coral reefs, tundra, boreal forests and Mediterranean regions. These vulnerabilities are now fairly well established and well known.

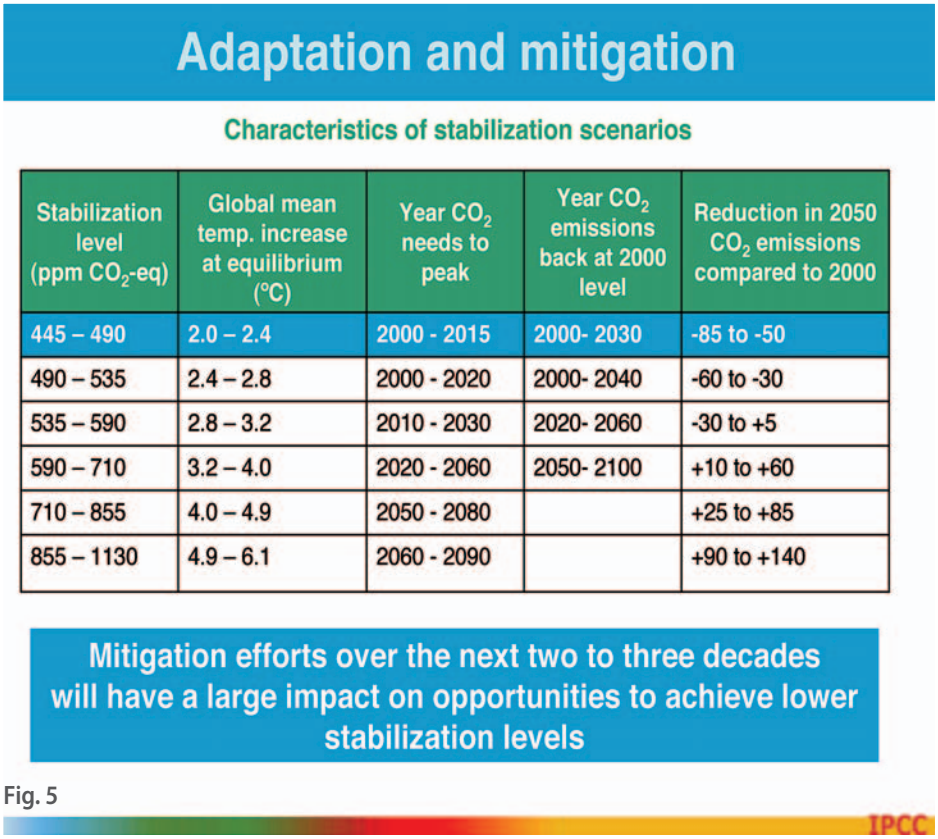


Fig. 5

Adapting to climate change

There is, therefore, a need for adaptation because, whatever we do, climate change will continue, even if we were to stabilize the concentration of greenhouse gasses today. So adaptation is inevitable and I think an organization like UNESCO, which is directly involved in the welfare of specific cultures and communities, looking at social as well as other aspects, would perhaps do well to look at this issue of adaptation to climate change. It is not a technical challenge; it is a challenge that really involves society in its widest sense and a multidisciplinary body like UNESCO can make a huge difference. Adaptation is taking place already and we need to build on those practices; however, adaptation capacity is limited and uneven within and across societies. Now climate change poses new risks that will require new investments in adaptive processes.

For example, I was in The Netherlands a couple of weeks ago and the dykes there are being raised simply because those investments are required to protect against sea level rise. Let me emphasize that adaptation alone cannot cope with all the projected impacts of climate change and the costs of adaptation and impacts will increase as global temperature increases.

There is a need for a mix of strategies that involve adaptation and mitigation. The ultimate objective of Article 2 of the United Nations Framework Convention on Climate Change is essentially to stabilize greenhouse gas concentrations at a level that would prevent dangerous anthropogenic interference with the climate system. Now this is a question that science cannot answer, because it involves value judgements. What science can do is to provide the basis on which those judgements can be exercised.

I submit that this is an issue that UNESCO could perhaps take up as an intellectual exercise because what is dangerous in one part of the world may not be dangerous in another and, when we are arriving at a global norm or benchmark, it is essential to consider those who are most vulnerable. I'd like to mention at this stage that today, for those of us in India, is an extremely auspicious day. It marks the birthday of Mahatma Gandhi. And Gandhi-ji reminded us that, whatever we do, we must look at the impacts of our ac-

tions on the poorest of the poor. His slogan of *swaraj*, meaning the welfare of the last, the one who is the least privileged, is extremely important. Intellectually, we need to use the same framework when we look at the impacts of climate change on different communities around the world. So I am highlighting this as an issue that the global community has to address with great rigour.

Mitigation

What you see in Figure 5 is an assessment that we have carried out of mitigation at different levels of concentration of greenhouse gasses. The upper row is what I would like to draw your attention to. If we stabilize at 445-490 parts/million of CO_2 equivalent, this will probably limit temperature increase over a period of time to between 2 to 2.4 ºC. Now, if we need to do that, then all we can allow is for emissions to increase up to 2015, beyond which they will have to decline. Let me emphasize that, if we decide to stabilize at this level, then by 2015 we will have to reduce emissions from between 85 to 50 per cent. That is a major challenge.

Mitigation efforts over the next two to three decades will have a large impact on opportunities to achieve lower stabilization levels. Therefore, if we want to stabilize in the future, we need to start acting today. We are often told that the cost of mitigation is going to be crippling for several world economies. What the IPCC has assessed – and this has been very rigorously reviewed and commented on – is that if we stabilize at the level indicated earlier, 445-535 parts/million, then the cost in 2030 will be less than 3 per cent of the global gross domestic product (GDP). What does this imply? It means that the level of prosperity that we are likely to reach in 2030 will simply be postponed by a few months. On an annual basis, the cost amounts to 0.12 per cent of the GDP.

Actions that need to be taken

We have assessed a number of policies and found that what is needed are appropriate incentives for development of technologies. Furthermore, what is critically important is to place a price on carbon. Developing appropriate technologies will not be enough unless there is a price signal that moves producers and consumers in that direction.

Also, when we invest in energy infrastructure, we necessarily have to look at the long-term impacts of those investments, simply because the infrastructure that we create is there for thirty, forty or fifty years and you can't change it once you have made that investment, unless you incur very high costs.

Perhaps the most important finding that we have come up with is changes in lifestyle and behaviour. Attitudes have to change and behaviour has to change. For instance, when a child brushes his or her teeth, you first turn on the tap, but it takes a few minutes before the water is really utilized. Or, even though the lighting technology that we use in a room may be economically viable, it is not always the best. We also leave lights on, we keep temperatures very high when it is cold in the room where we have central heating, and so on. We need a change in values, lifestyle and behaviour and may I submit, Mr Director-General, that this is an area where UNESCO can perhaps do some meaningful work.

How UNESCO can make a difference

What are UNESCO's advantages? Well, intellect: UNESCO has a multidisciplinary set of capabilities and, when we look at interlinked impacts and solutions, that is what we need. It is not a technical or an economic issue, it is a social, cultural and scientific issue.

UNESCO can set up programmes using its decentralized network, which will be extremely important. We have found a major shortfall in studies of climate change in different parts of the world. If we want to look at the impacts on, for example, sub-Saharan Africa, we need localized studies that will tell us what those impacts will be. Those studies are not simple and require sophisticated modelling abilities and capacity. It is also important to look at linkages with the World Heritage Centre and the impacts on natural and cultural common goods; implications for future generations; the need for behavioural change.

One of the things that gives the IPCC a great deal of satisfaction as a scientific assessment organization is the fact that what has happened so far in terms of attention to climate change is purely the result of knowledge being generated and disseminated. I think the IPCC has played a small but, if I may humbly submit, critical role in determining this level of awareness and understanding. Therefore, what we really need to do is to ensure that UNESCO, with its charter for bringing about change in knowledge and

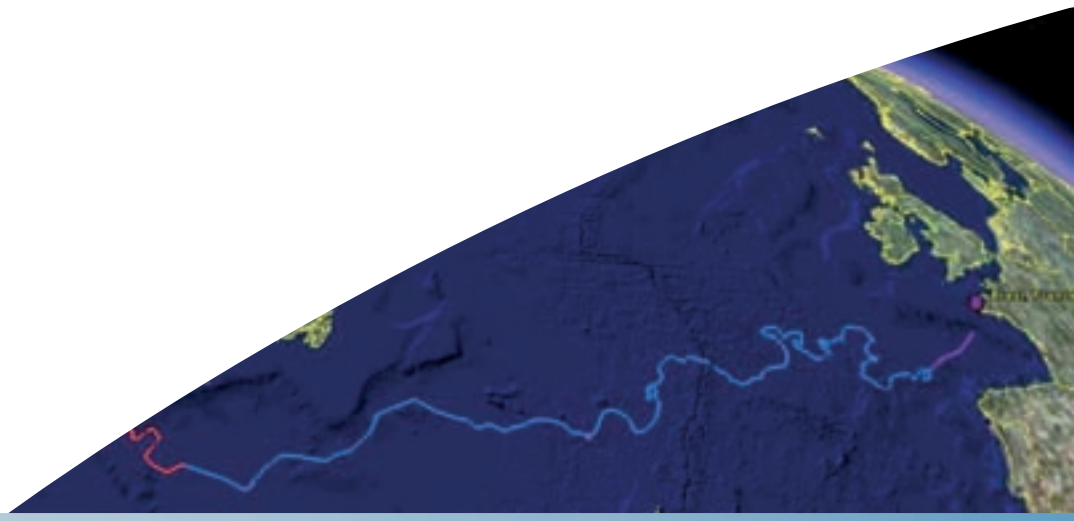
education, can perhaps perform a major role.

There are other dimensions that perhaps need some consideration, one of which is the ethical and equity dimension of climate change. This requires a great deal of intellectual study and debate that UNESCO is well placed to carry out. UNESCO has enormous convening power and therefore would be able to create the conditions for such a debate. Also, as I indicated earlier, to study the impacts of climate change on a local and regional basis, you really need to upgrade the level of knowledge, higher education and research capabilities in different parts of the world. This is where UNESCO can join hands with other partner organizations to ensure that adequate research, adequate knowledge generation takes place in different regions of the world.

I end all my presentations with some very wise quotation from Gandhi and today is especially significant since it is the anniversary of his birth. So finally, I turn to Mahatma Gandhi who said, 'Technically, society has two choices. First it can wait until catastrophic failures expose systemic deficiencies, distortion and self-deceptions. Secondly, a culture can provide social checks and balances to correct the systemic distortion prior to catastrophic failures'.

I think the time has come for us to look at these choices seriously.

Thank you.



Policy

Mandate and summary of 2007
IOC global results and achievements

The Intergovernmental Oceanographic Commission (IOC) of UNESCO is the ocean sciences and services focal point in the United Nations system.

The IOC supports the sustainable development and assessment of oceans and coasts by improving the scientific understanding of the marine environment, setting international standards for the collection and open exchange of ocean data, and building the capacities of developing countries to use new knowledge and apply new tools. Through the broad use of information and communication technology and its ocean portal, the IOC supports networks of scientists, practitioners and decision-makers.

IOC's programme during 2007

The IOC's plan of action was centred on six high-level objectives, specifically:

(i) The improvement of scientific knowledge and understanding of oceanic and coastal processes with a view to **assisting Member States in the design and implementation of sustainable policies for the ocean and coastal zones** through the organization and coordination of major scientific programmes; [1]

(ii) The continued development of **operational oceanography and information and data systems** through the Global Ocean Observing System (GOOS), the International Oceanographic Data and Information Exchange programme (IODE) and the IOC/WMO Joint Technical Commission for Oceanography and Marine Meteorology (JCOMM);

(iii) The **coordination of the establishment of a tsunami warning system in the Indian Ocean region**, building upon the forty-year experience of the Tsunami Warning System for the Pacific;

(iv) Strengthening the capacities of Member States to **monitor and predict the transfer of harmful algal species** and other introduced non-native species by oil tanker traffic;

(v) The continued implementation of **regional coastal management projects** contributing to the operational phase of the African Process in the framework of the environment component of the New Partnership for Africa's Development (NEPAD);

(vi) **Capacity-building in developing countries** to establish science-based management systems for the coastal resources and ecosystems in their exclusive economic zone.

Measuring the progress and performance of IOC's programmes

The UNESCO System of Information on Strategies, Tasks and the Evaluation of Results (SISTER) provides detailed quantitative and qualitative information to establish clear performance indicators against which progress in programme implementation can actually be measured. These indicators are valuable tools in monitoring projects and ensuring that any implementation problems are recognized and dealt with quickly.

1. (Responding to the mandate of the United Nations Law of the Sea (UNCLOS), Chapter 17 of Agenda 21/the United Nations Conference on Environment and Development (UNCED), the Barbados Programme of Action for the Sustainable Development of Small Island Developing States, the Johannesburg Plan of Implementation (JPOI) adopted at the World Summit on Sustainable Development (WSSD), the United Nations Framework Convention on Climate Change, the Convention on Biological Diversity, the Millennium Development Goals and the relevant regional conventions and programmes).

IOC's Main Lines of Action (MLAs) towards accomplishing the objectives outlined in its 2007 programme::

(1) Addressing scientific uncertainties for the management of the marine environment and climate change.
(2) Developing the monitoring and forecasting capabilities needed for the management and sustainable development of the open and coastal ocean:
I. Developing operational capabilities for the management and sustainable development of the open and coastal ocean.
II. Developing and strengthening a global mechanism to ensure full and open access to ocean data and information for all.
III. Prevention and mitigation of tsunamis and other marine hazards.
(3) Strengthening the capacity of Member States in marine science for the coastal ocean.

MAIN LINE OF ACTION: **1**

Addressing scientific uncertainties for the management of the marine environment and climate change

UNESCO/IOC contributes to the coordination of scientific research for improving climate change prediction (e.g. sea level rise) and the sustainable development and management of the open and coastal ocean. To achieve this, the IOC convenes leading experts to develop internationally-agreed scientific strategies; works directly with expert groups, Member States, United Nations conventions and NGOs to facilitate and coordinate the implementation of the research and observations; and communicates the results of implementation progress and research findings to partners and the general public.

Photo by Chris Linder, Woods Hole Oceanographic Institution

Result

International cooperation reinforced on scientific research in marine environment.

Progress achieved as related to performance indicators:

- **A number of publications and references to IOC documents in UN documents and scientific and international literature**:

'A Guide to Best Practices for Oceanic CO_2 Measurements' (IOCCP Report no. 8). Surface Ocean CO_2 Variability and Vulnerability Workshop Report, *Deep-Sea Research II* special issue, in press.

UNESCO Monographs on Oceanographic Methodology: Real-time Coastal Observing Systems for Marine Ecosystem Dynamics and Harmful Algal Blooms: Theory, Instrumentation and Modelling, in press to be released early 2008.

World Resources Institute/EarthTrends 2007 article references the *Ocean Acidification Network*. (http://earthtrends.wri.org/updates/node/245). The Pew Charitable Trusts report 'Carbon Dioxide and Our Ocean Legacy' refers to 'Ocean in a High CO_2 World' web information (now the ocean-acidification network).

- **Quality of participation in IOC conferences, meetings, panels and working groups**:

IOCCP became a partner in two new EU Framework 7 Research Programmes with the goal of providing international (non-EU) coordination: the European Ocean Acidification Project, and the Coordinated Action for a Carbon Observing System (start date 2008).

Global Ecology and Oceanography of Harmful Algal Blooms (GEOHAB) Core Research Projects in Eutrophic and Stratified Systems were launched.

Volunteer Observing Ships (VOS) carbon networks were re-assessed by over one hundred scientists from twenty countries in 2007, with new online tables and maps developed for international coordination.

The IOCCP established the Global Ocean Ship-based Hydrographic Investigations Panel (GO-SHIP) to develop a global strategy for post-CLIVAR hydrography.

The IOCCP established the Surface Ocean CO_2 Atlas (SOCAT) project to develop a common format global data set of publicly available surface pCO_2 data that will be the basis of an operational data management system. Regular gridded data products will be developed from this database.

An international committee was formed to implement the second 'Ocean in a High CO_2 World' symposium to assess what is known about ocean acidification. The symposium will be held in October 2008.

Result

Capacity of Member States improved to implement Integrated Coastal Area Management (ICAM).

The Intergovernmental Panel on Harmful Algal Blooms (IPHAB) established a joint IPHAB-IODE Task Team to develop a worldwide harmful algal information system as a one-stop access to HAB data.

Progress achieved as related to performance indicators:

- **Tools and guidelines for ICAM:**

A Group of Experts has been established to develop guidelines on mainstream awareness and mitigation of marine hazards through ICAM. Three meetings have been held (Paris, April 2007; Lisbon, October 2007; Paris, April 2008). The guidelines are expected to be finalized in late 2008.

Following an international workshop held in 2006 on Marine Spatial Planning (MSP), a project to develop a set of international guidelines on MSP was approved in October 2007.

- **Application of IOC guidelines for ICAM plans:**

The Handbook for Measuring the Progress and Outcomes of Integrated Coastal and Ocean Management was translated into Arabic, Chinese, Portuguese and Vietnamese by different organizations: international (PERSGA); national (Brazilian Ministry of Environment); and local (provincial authorities in China and Vietnam) for application at different scales.

A project proposal to develop an ICAM indicator framework in five countries in Latin America, in collaboration with the Permanent South Pacific Commission (CPPS) was submitted for funding.

- **ICAM projects carried out:**

The Global Environment Facility/United Nations Development Porgramme PDF-B project on Adaptation to Climate Change in Coastal Zones (ACCC) was implemented in Cape Verde, Gambia, Guinea Bissau, Mauritania and Senegal; the full project ($4 million) is expected to start within the year. A preparatory meeting was held in Praia, Cape Verde in November 2007.

MAIN LINE OF ACTION: **2**

Developing the monitoring and forecasting capabilities needed for the management and sustainable development of the open and coastal ocean.

I. Developing operational capabilities for the management and sustainable development of the open and coastal ocean.

In order to enhance the cooperation of Member States in their efforts to observe and manage their ocean and coastal resources, the IOC provides leadership in operational oceanography, and information and data systems. The three major ongoing programmes supported include:

- The Global Ocean Observing System (GOOS), which is the oceanographic component of the Global Climate Observing System (GCOS);
- The Intergovernmental Ocean Data Exchange programme (IODE); and
- The IOC/World Meteorological Organization (WMO) Joint Technical Commission for Oceanography and Marine Meteorology (JCOMM).

Through these programmes, the IOC supports operational ocean services worldwide by the observation, modelling and analysis of marine and ocean data including living resources, providing valuable and often life-saving information to end-users.

Result

Coordination of the provision and use of ocean observations, data and warning services enhanced.

Progress achieved as related to performance indicators:

- **Enhanced international collaboration to observe the global oceans and coasts**:

The Global Sea Level Observing System (GLOSS) Group of Experts has played a leading role in the upgrade of the global network of sea level stations, particularly in the Indian Ocean. The number of operational sea level stations grew by more than twenty-five units.

In cooperation with the Yellow Sea Large Marine Ecosystem Programme (YSLME) and the Northwest Pacific Action Plan (NOWPAP), a regional bio-optical dataset and Yellow Sea China Case-2 algorithm were developed under the WESTPAC-Remote Sensing Project. The Strategic Plan for NEAR-GOOS at its second phase was published.

- **Improved accessibility to ocean data, both historical and real-time operational:**

The Twenty-fourth Session of the IOC Assembly (June 2007) adopted the IOC Strategic Plan for Oceanographic Data and Information Management, thereby creating a cross-cutting approach to International Oceanographic Data and Information Exchange (IODE) operations and IOC ocean science and observation programmes.

The IODE was successfully reviewed by UNESCO/IOC. Follow-up actions were discussed at the IODE Officers meeting (November 2007).

The deployment of the IODE Ocean Data Portal continued with the organization of a first training course (October 2007).

The Oceans Biodiversity Conference was held in Dartmouth, Canada (October 2007) and attended by over one hundred participants.

Following the success of the African Marine Atlas, nine small island States in the Caribbean region decided to develop the Caribbean Marine Atlas (October 2007). Startup funds were secured.

The ODINAFRICA Project Steering Committee reviewed progress and started planning for a fourth phase of the project that will focus on increased services for coastal zone management and decision support, as well as continued support of the GLOSS sea level stations that support the Indian Ocean Tsunami Warning System (IOTWS).

- **Protection of vulnerable coastal communities from ocean related hazards, particularly tsunamis:**

In the Western Pacific, new regional projects related to natural hazards were established. The Seventh WESTPAC International Scientific Symposium will take place from 21-25 May 2008, based on the theme of 'Natural Hazards and the Changing Marine Environment in the Western Pacific'. WESTPAC is assisting IOC Headquarters in implementing 'Adaptive Learning in Disaster Management for Community Awareness and Resilience (ALDCAR)' in Thailand.

II. Developing and strengthening a global mechanism to ensure full and open access to ocean data and information for all.

The UNESCO/IOC community-based ocean sub-portals for the African, Latin American and Caribbean regions aim, as part of UNESCO's knowledge portal, to facilitate access to information and data on all aspects of ocean and coastal research and management.

Result

Portals recognized by local and international stakeholders as reference information tools on oceans and coastal areas; knowledge bases on ocean/coastal areas and related issues improved; agreements on the transfer of ownership of the Portals to partner organizations reached.

Progress achieved as related to performance indicators:

Use of the African Ocean Portal has increased due to recognition by local and international stakeholders. The chief editor of the Portal was invited to meetings of the United Nations Environment Programme (UNEP) Clearing House Mechanism for the Western Indian Ocean, the UNEP/Global Environment Facility WIOLab project, and the African Coelacanth Project. The number of knowledge objects doubled to more than 4,280; topics to more than 280; and site visits to more than 22,600. Twelve issues of the *COSMARNews* newsletter were produced and circulated in collaboration with the New Partnership for Africa's Development Coastal and Marine Programme (NEPAD/COSMAR) to publicize the portal.

In Latin America, there was a 200 per cent increase in the number of editors/content providers to offer better coverage of the information needs of all focus audiences. Training was provided to editors in science writing through a specific tutorial. Publication of printed newsletters as well as national public awareness campaigns continued.

III. Prevention and mitigation of tsunamis and other marine hazards.

Following the Indian Ocean tsunami of December 2004, UNESCO/IOC was mandated by the United Nations as the lead agency for coordinating the planning and implementation of tsunami early warning and mitigation systems, based on its accumulated experience of four decades of coordinating the Pacific Tsunami Warning System (PTWS).

Through the PTWS, the IOC has accumulated experience and knowledge on how to assess tsunami risks at the national and local levels; how to promote awareness and preparedness among populations; and how to build national and regional tsunami warning systems. The IOC is now building a global tsunami warning system by expanding tsunami warning coverage to other regions of the world. This coverage takes an integrated multi-hazard approach and includes preparedness and awareness components as well as detection networks and risk assessment.

Result

Tsunami warning and disaster preparedness integrated into national curricula and community education programmes, especially in countries at high risk of earthquakes, floods and tsunami.

Progress achieved as related to performance indicators:

- **Coordination of the provision and use of ocean observations, data and warning services enhanced.**

Buoys/sea level gauges of the Global Ocean Observing System (GOOS) and the Global Sea Level Observing System (GLOSS) were deployed combined with the coordination of oceanographic data and information exchange in the framework of IODE-JCOMM.

- **Cooperative networks on knowledge management and capacity-building for assessing natural hazards and fostering disaster risk mitigation strengthened and operational.**

UNESCO/IOC is coordinating activities to realize effective tsunami and multi-hazard warning systems in the Indian Ocean as well as worldwide. Six training courses and workshops on inundation modelling, bathymetric data processing, hazard assessment and tsunami watch information in the Indian Ocean region were conducted; four intersessional ICG/IOTWS working group meetings were held. Technical support was provided through several country visits, instrumentation provision, and an assessment mission to Timor-Leste.

- **Tsunami warning and disaster preparedness.**

Efforts are underway to build natural hazard warning, including tsunami warning and disaster preparedness, into national curricula and community education programmes, especially in countries at high risk of earthquakes, floods and tsunami. Resource materials are being developed, including documentation of local knowledge of natural warning signals.

MAIN LINE OF ACTION: **3**

Capacity of Member States in marine science for the coastal ocean strengthened.

UNESCO/IOC supports the capacity-building of Member States so that marine scientific research can be conducted effectively and sustained observation programmes can be maintained. In this way, Member States will be able to respond adequately to the international conventions to which they are parties.

Since the end of 2005, starting in East Africa, the IOC has been steadily implementing targeted workshops in national marine science institutes in order to strengthen capacities in three particular areas, namely:

a. Developing the leadership ability of directors, project leaders and scientists;
b. Sharpening the skills of project leaders to draft proposals for high priority national projects; and
c. Communicating techniques in modelling, remote sensing and GIS to bench level scientists, in addition to improving their output through participation in teamwork.

Result
Marine scientific research capacities enhanced.

Progress achieved as related to performance indicators:

- **Level of capacity-building interventions steered and harmonized according to IOC capacity-building principles:**

Principles for capacity-building were formulated and endorsed by the Twenty-third Session of the IOC Assembly in 2005 (Resolution XXIII-10).

Guidelines and procedures relating to the UNESCO/IOC Regional Training and Research Centre in the Western Pacific on Oceanography were drafted.

- **Level, number, and type of capacity-building interventions using technology for synoptic understanding and prediction of the coastal ocean:**

There was a harmonization of activities with IOTWS fellowships through the training of students in the use of coastal modelling for both safety in coastal zones and applications to high priority local coastal issues in Kenya and Mozambique.

The IOCWIO proposal for important coastal modelling components was finalized, and two coastal modelling proposals were submitted in Kenya and Tanzania.

- **Level, number, and type of capacity-building interventions empowering IOC constituencies:**

The following workshops were conducted:

- First team-building workshop for the Western Indian Ocean region;
- Second leadership and first team-building workshops for the Eastern Atlantic region;
- First team-building and first proposal writing workshop for the Latin American and Caribbean region.

Result
Capacities built to implement the articles on Marine Scientific Research (Part XIII) and Transfer of Marine Technology (Part XIV) of UNCLOS.

Progress achieved as related to performance indicators:

- **Technical, legal and scientific information provided:**

A compilation of national legislation and analysis of Member States' practices in marine scientific research were made available on the internet.

- **Technical advice provided:**

A roster of nationally designated experts was established to promote and facilitate the development and conduct of marine scientific research.

- **Capacity-building modalities implemented:**

Through a dedicated website, demands for marine technology transfer from Member States can now be circulated.

IOC Programme **sections**

overview

Capacity development

EHRLICH DESA
Head of Section

Considering that institutes are key to better governance of the ocean and coasts, the Capacity Development section has been implementing the IOC Assembly-approved strategy through targeted workshops in national marine science institutes. The strategy is implemented by strengthening capacities in institutes in three areas:

- Developing the leadership ability of directors, project leaders and scientists;
- Sharpening the skills of project leaders to draft proposals for high priority national projects; and
- Communicating techniques in modelling, remote sensing and GIS to bench level scientists, in addition to improving their output through participation in teamwork.

Implementation has been a work in progress starting in East Africa since the end of 2005 and has attracted funding from several agencies listed at the end of this report. Enough time has elapsed for us to gain our first sense for if the proof of concept of self-driven capacity development is working or not. It is also time to record learning from the workshops held, and to develop an impression of how to adapt and implement the second phase of the Capacity Development (CD) strategy, being aware of the many different and successful approaches to CD around the world.

The best way to measure success is through performance indicators (although for capacity development, indicators remain debatable). The most telling indicators for us are those where we estimate how much institutes have changed 'culture' in line with the set of skills promoted at the workshops. This would be a clear indication that implementation is underway. Indeed this has been our experience, specifically in leadership, proposal writing and modelling. Some examples are:

- At least three organizations consider the workshops important enough to have subsequently funded leadership workshops for their own staff. Additionally, some 32 per cent of out-of-country participants have underwritten their travel costs to IOC workshops, whilst IOC partners have sponsored a further 21 per cent of participants.
- The first step in creating awareness on the uses of modelling coastal waters was through a series of two week-long workshops in Kenya, Mozambique and Tanzania. These workshops have aroused such an active interest that some institutes have gone ahead and acquired the necessary resources to continue modelling activities independently. The IOC has been

strengthening their interest in modelling by coordinating further longer training programmes with different partner institutes.
- Proposal writing has been conducted in two regions. The IOC has been a catalyst for institutes to collaborate in drafting several new proposals for a diverse variety of funds. All proposals have centred on using numerical models as a tool in good governance of coastal waters.

The second phase of capacity development implementation should have components that build on the first phase and add to it as well. Some important lessons learned that will assist this process are:

- The most important element to drive regional CD is to include a dedicated professional in the region, in addition to a coordinating group at the IOC headquarters.
- The IOC CD strategy must continue addressing nationally funded institutes, because they are created to support policies for common good. The Decision Support Tools (DST) of modelling, GIS and Remote Sensing need to be further enhanced to support institutes make their cases to decision makers, communities and the media.
- Skills focusing on leadership, proposal writing, teamwork, and DST need to be embedded as post-graduate modules in universities so that institutes can engage in continuous education and training that is locally available.
- Finally, given that most institutes are already close to full staff strength, the lack of placements in national institutes reflects the quality of students attracted to marine sciences. Considering the poor infrastructures and salaries, it is indeed surprising that any students at all take up marine sciences as a career. Radical steps are needed to break this degenerative cycle. We aim to follow the example of forward thinking universities that are incubating programmes geared towards high technology, and research organizations that are encouraging scientists to implement their science through start-ups. This approach was tested with our partners and received favourable responses.

It appears that proof-of-concept of 'self-driven capacity development' has been well established, and the time is right to implement the second phase of the strategy. Member States are increasingly aware of the importance of their role in developing their own capacities. In this context it is our belief that the future for marine sciences looks bright.

Actions taken

Leadership workshops

During 2007, the first Leadership Workshop for Directors in the WESTPAC region was organized in Bangkok, Thailand (28 February-3 March). The first and second Leadership Workshops for the Eastern Atlantic (IOCEA) region were organized in Libreville, Gabon (13-16 March) and Accra, Ghana (1-3 October). Each of these workshops was attended by many of the key personnel in marine sciences in the region. The workshops discussed ways for participants to improve their capabilities to lead their organizations. They also provided an opportunity for participants to share their experiences and challenges, along with the solutions they encounter as directors. Furthermore, these meetings were an opportunity to agree on regional priorities that would be addressed as a group, and to define a way forward for developing necessary capacities in the region.

Proposal writing workshops

At the proposal writing workshops, project scientists were delegated by their directors to develop a proposal as a means to increasing their competitive edge at attracting external funding for the regional priorities that were agreed on at the leadership workshop. The first proposal writing workshop for the Western Indian Ocean region (IOCWIO) was held in Mombassa, Kenya (April); and the first for Latin America in Cananéia, Brazil (10-13 December). The proposal from IOCWIO was finalized later in the year and is being actively promoted with potential sponsors.

Team building workshops

The teams of project scientists who

Particpants attending the first leadership workshop in the Eastern Atlantic region.

Training workshops, such as this one in Mozambique, initiate participants in the use of modelling tools that can be applied towards existing urgent issues in their countries. The participants shown here are in the field studying erosion coastal processes in order to understand more about effective dredging of channel and ports.

attended the proposal writing workshop in Mombassa and Cananéia also attended a team building workshop, respectively in Durban, South Africa (25-30 September) and Cananéia, Brazil (5-8 December). These workshops greatly enhanced the effectiveness of cooperation during the proposal development. Another team building workshop was organized in Accra, Ghana (26-29 September), specifically for Ghanaian institutes, to strengthen collaboration between marine related institutes in the country. The participants also agreed on a way forward for the more cohesive management of the marine environment and coastal resources in the country.

Decision support tools

During the leadership workshops in IOCWIO, directors agreed that developing coastal modelling capabilities as part of Decision Support Tools was a high priority. Such tools were seen as important in managing their country's coastal zones. As extensive data collection of *in situ* marine data is expensive, modelling is a particularly promising way to obtain a cost-effective first order understanding of coastal processes using available data. Three two-week long training workshops were organized in Mozambique, Tanzania and Kenya, in March and April 2007. During these workshops, participants were initiated in the use of modelling tools. They then applied them towards existing urgent issues in their countries (e.g. applications of hydrodynamics modelling to pollution, such as optimum timing of release of sewage outflows, and an improved understanding of coastal processes such as erosion and sediment transport for more effective dredging of channel and ports). Several institutes have subsequently continued their efforts to develop modelling capabilities; the Institute of Marine Sciences in Zanzibar, for example, accepted a young modelling expert from April to July 2007 in order to help setup the Regional Ocean Modelling System (ROMS) for the Zanzibar Channel. This occurred as a result of a collaboration brought about by the IOC with organizations in the United States.

At-sea training

Within the international Training-through-Research programme (TTR) a series of cruises were carried out in the Baltic Sea and Southwest Pacific Ocean (see table below).

Capacity-building activities also included:

(i) TTR annual post-cruise conference (29 January-1 February, Bremen, Germany);
(ii) Caspian Floating University International workshop on 'Natural resources of the Caspian Sea and sustainable socio-economic development of its coastal zone' (27-30 March, Astrakhan, Russia);
(iii) Fifteenth Baltic Floating University mid-cruise workshop (20 July, Stockholm, Sweden) and a post-cruise seminar (31 July, St. Petersburg, Russian Federation);
(iv) Fourth International Youth Ecological Camp (2-13 August, Aktau, Kazakhstan); and
(v) TTR Session at the First Congress of the Moroccan Petroleum Geologists (28 October-2 November, Marrakech, Morocco).

IOC efforts in capacity development include Training-Through-Research (TTR), such as this shipboard training operation with the Baltic Floating University onboard the RV *Professor Shtokman*. TTR provides effective training for students and young researchers through their participation in advanced multi-disciplinary research programmes.

Programme	Region	Research Vessel (country)	Dates	Participants	Participating countries
Baltic Floating University	Baltic Sea	RV *Shtokman* (Russia)	12-29 Jul.	27	Namibia, Russia, UK
Baltic Floating University	Gulf of Finland (Baltic Sea)	RV *Centaurus-II* (Russia)	18-31 Jul.	18	Colombia, Russia, Spain
University of the Sea	Southwest Pacific Ocean	RV *Tangaroa* (New Zealand)	8 Oct.-21 Nov.	12	Australia, Brazil, Canada, Fiji, Papua New Guinea, Spain, Sri Lanka

For more information: The Baltic Floating University: http://www.rshu.ru/eng/bfu/ The University of the Sea: http://uos.anu.edu.au/about.html

UNESCO/IOC Chairs

- The UNESCO Chair in Remote Sensing and Modelling in Oceanography (CRSMO) has been established since 1 January 2007 at the Russian State Hydrometeorological University (RSHU), St. Petersburg (Russian Federation). The Chair will address the capacity-building goals for Remote Sensing. In 2007, the Chair gave courses at B.Sc. and M.Sc. level to thirty-six students. Three field training courses were organized. Several lessons based on comparisons between remotely sensed and *in situ* data of sea ice, sea surface temperature and sea colour were prepared. Seven papers were published, and students prepared twelve presentations at the conferences in Moscow (Russia), Frascatti (Italy) and Sebastopol (Ukraine).
- The UNESCO Chair in Marine Geosciences (Moscow State University, Russia), established in 1995, has an international responsibility for implementing the Training-through-Research (TTR) programme. In 2007, the Chair was involved in the international TTR-16 Post-cruise Conference (29 January-1 February, Bremen, Germany). One Ph.D. and eight M.Sc. dissertations were successfully defended.
- The UNESCO Chair of Marine Sciences and Oceanography of the Eduardo Mondlane University, Mozambique, successfully completed a project on the 'Development of technical capacity for assembling and servicing a satellite transmitter of oceanographic data'.
- The UNESCO Chair in Oceanography and Coastal Management of the University of Concepción, Chile, established in 1993, held its annual 'Austral Summer Institute VIII' in a variety of topics, including climate change, aimed at high level training of graduate students from the South America region, 17 December 2007-25 January 2008.

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overview

Ocean observations and services

KEITH ALVERSON
Head of Section

Observing the global oceans is a big task. Too big, believe it or not, even for the Ocean Observations and Services (OOS) section of UNESCO/IOC, through the efforts of our Member States, to handle alone. Thus, over the past decade we have developed a wide range of partnerships with international and intergovernmental programmes whose mandates overlap to some degree with our own core mission of observing the global oceans and, from this observational base, enabling the provision of services of benefit to society. As an indicator of the vital importance of these many partnerships to the success of OOS programmes, this year's Annual Report section overview is dedicated primarily to them.

The **World Meteorological Organization (WMO)** is without doubt our primary partner. Indeed WMO is a co-sponsor of two of the three programmes in the OOS section: the Joint Technical Commission for Oceanography and Marine Meteorology (JCOMM) and the Global Ocean Observing System (GOOS). Through WMO, OOS programmes maintain a vital link to the meteorological community and meteorological agencies in our Member States. Like all clichés, the commonly heard paradigm that oceanographers are following in the footsteps that the meteorological community laid down about forty years ago is based on some nuggets of truth. Indeed, the meteorological community developed a convention underpinning their intergovernmental work at the WMO in 1947 whereas an oceanographic equivalent for the IOC does not yet exist (see IOC Annual Report 2006 page 35). Similarly the meteorological community has been observing the Earth's atmosphere in a systematic, sustained manner backed by intergovernmental cooperation for more than fifty years and ingesting these observations into numerical forecast models delivering societal services for more than a decade. Similar activities in the ocean are carried out primarily as research projects by academics. Just as developing countries are developing widespread wireless communication networks, leapfrogging the need to build and maintain costly fixed line infrastructure, the ocean community is much better off working with, and deriving benefit from, but not trying to reproduce, many of the advances developed by our meteorological colleagues.

For example, the Global Ocean Observing System has long been a beneficiary of the WMO Global Telecommunications System (GTS). Due to the rapidly increasing density of *in situ* observation platforms as well as an increasing need for near real-time data transmission, the community has at times been frustrated with limited capacity for data transmission over the GTS and the lack of long term stewardship of and open access to data that goes out over the GTS. The oceanographic community must contribute to, and cooperate with, WMO as these weaknesses are improved through the ongoing development of a WMO Integrated Information System and Integrated Global Observing System (WIGOS/WIS). Of course, developing a comprehensive ocean observing system is substantially more challenging than the analogous atmospheric problem, for both political and scientific reasons. On the political level, there is a relative lack of empowerment of national institutions analogous to national meteorological services with a clear ocean-observing mandate. On a technical level, the opacity of seawater to electromagnetic radiation inhibits the effectiveness of both remote sensing from satellites and communications with and amongst *in situ* observing system platforms, requiring maintenance of a diverse, remote and extensive array of satellites along with Eulerian and Lagrangian *in situ* monitoring platforms. Furthermore, the majority of observations continue to be funded and conceived in a hypothesis driven, process oriented, research funding driven mode with few truly operationally funded and operated observing system components. To help ameliorate these weaknesses, the oceanographic community stands to gain enormously from participating fully in the WMO lead development of an integrated information system and global observing system.

The Joint Technical Commission for Oceanography and Marine Meteorology (JCOMM) continues to be a primary mechanism for cooperation with WMO. The IOC and WMO jointly sponsor the Commission and many of its panels derive strong inputs from both the oceanographic and meteorological communities. The array of 1,250 drifting surface buoys, for example, provides surface air pressure measurements from the atmosphere alongside sea surface temperature and surface ocean drift data from the ocean. Both data sets are valuable to both communities. Although the JCOMM structure is unnecessarily top heavy, with ample room to improve the cost effectiveness of the meetings of the Commission and of its subsidiary working structure at the top, at the level of the working groups at the bottom of the structure, real synergy is being developed. In the January 2008 issue of the monthly *Bulletin* of the WMO, Mike Johnson, in his article titled *Implementing the Global Ocean Observing System* nicely sums up the value of JCOMM stating that 'Bringing together the oceanographic and marine meteorological observing networks under the JCOMM umbrella has demonstrated the effectiveness of a systems approach to Earth Observation.' Candyce Clark provides a comprehensive overview of JCOMM activities in 2007 further on in this section. In addition to JCOMM, in 2007 the OOS section took the lead in UNESCO/IOC's engagement with a number of additional programmes co-sponsored with WMO including the World Climate Research Programme (WCRP) and the Global Climate Observing System (GCOS). The OOS Head of Section is now representing UNESCO/IOC in the ongoing review of the World Climate Research Programme (WCRP).

There remain a few voices in the oceanographic milieu expressing caution against ceding our ground (well, really our water) to the WMO. Fears exist of infringement on the IOC mandate by an aggressive WMO, perhaps even through the infamous clause (Article 26, paragraph c) in its convention giving WMO a mandate to 'take over from any other international organization or agency, the purpose and activities of which lie within the purposes of the Organization.' Such concerns are ill founded. OOS engagement with WMO remains one of our most valuable assets.

The **United Nations Environment Programme (UNEP)** is also a co-sponsor of GOOS. UNEP, through its Regional Seas Programme and Large Marine Ecosystems Global Environment Facility projects for example, has a clear requirement for ocean observations and services. UNEP goals such as sustainable development of coastal resources and assessment of marine ecosystem change simply cannot occur without sustained monitoring of the marine environment. As UNEP's global ocean observing system, GOOS must be continuously challenged to meet the ocean observing requirements for relevant UNEP programmes. One prerequisite for such a challenge to be met is an increase in the current degree of UNEP engagement as a sponsor of GOOS.

Interaction with the **Food and Agriculture Organization (FAO)** has also been limited to date. UNESCO/IOC Member States and GOOS committees have discussed at various meetings, with various results, the idea of merging the GOOS Panel for Integrat-

ed Coastal Observations (PICO) with the FAO sponsored coastal panel of the Global Terrestrial Observing System (GTOS) in order to develop synergies between our existing independent efforts. The idea has assumed many forms, but one suggestion has been that this Panel would be something akin to the Ocean Observations Panel for Climate (OOPC) for ocean climate observations co-sponsored by GOOS, the Global Climate Observing System (GCOS) and WCRP. Discussions on the potential integration of the GOOS coastal module with FAO and/or UNEP efforts, possibly through joint sponsorship, remain a possibility for future development.

In May 2007, the OOS Head of Section stepped down after a year's term as Co-Chair from the IOC of the **Integrated Global Observing Strategy Partners (IGOS-P)** as well as Chair of the **United Nations Interagency Coordination and Planning Committee for Earth Observations (ICPC)**. Members of the ICPC include FAO, UNESCO, IOC, UNEP, WMO and the International Council for Science (ICSU). As sponsors of the global observing systems these agencies formed the ICPC in order to provide the observing systems with strategic guidance, increase their visibility and facilitate implementation of their mandates. The terms of reference for the Committee are to ensure interagency coordination and collaboration in the realm of Earth observing systems, including preparing joint inputs to the Group on Earth Observations (GEO). In 2007, the IOC turned over chairmanship of the ICPC to UNESCO, but continues its active engagement through our joint participation in the ICPC and this sunset year of operation for the IGOS Partnership as it transitions its efforts into the umbrella of the **Group on Earth Observations (GEO).**

The OOS Director and professional staff continued to represent the IOC and GOOS respectively as participating organizations in GEO in 2007, including at the Cape Town, South Africa Ministerial Summit and Plenary, thereby ensuring continued support and recognition of GOOS as the oceanic component of the **Global Earth Observing System of Systems (GEOSS).** Tom Gross provides a comprehensive overview of the OOS presence at the GEO Ministerial in 2007 further on in this section. GEO was conceived as a way to increase the political recognition of the importance of Earth observations by concentrating on societal benefits rather than, as had often previously been the case, constituent thematic observing systems, such as GOOS for the oceans, or even technical elements, such as individual satellite altimeters and *in situ* tide gauge networks for sea level monitoring. Through enhanced political recognition of societal benefits, it was hoped that GEO would enhance national support for the underlying observations themselves. As *Nature* stated in its editorial pages on 24 February 2005: 'Ultimately, GEOSS must make the case for, and oversee, an upgrading of systems such as GCOS and GOOS.'

Unfortunately, given the woefully low political presence at the GEO Ministerial, and little if any evidence yet available of enhanced support for GOOS via the GEO process, it is not at all clear that the founding aspirations will be achieved. One change that GEO has enabled, and touts as a success, is the transition of IGOS Partners themes into GEO. This transition was a process that the OOS Head of Section led and supported during his tenure as Chair of the IGOS Partnership since, irrespective of whether GEO eventually does succeed, it was manifestly clear that asking the community to participate in two organizations with entirely overlapping participants and mandates was an enormous inefficiency. The transition of the IGOS ocean theme, which is Co-Chaired by the OOS Head of Section, has been very smooth. The strategy setting role of the ocean theme team within IGOS has been seamlessly replaced by GOOS inputs to GEO, supported and complimented by numerous partners in the informal grouping of GEO participating organizations with primarily ocean oriented mandates known as '**Ocean United**'.

Often OOS programmes are accused of concentrating on *in situ* observations at the expense of, or without full recognition of the value of, remote sensing. This could not be further from the truth. Remote sensing is an integral component of the GOOS. As such, the OOS Head of Section represented both the IOC and GOOS as independent associates of the **Committee on Earth Observing Satellites (CEOS)** during 2007. At the 2007 CEOS plenary, the OOS Head of Section 'confirmed continued IOC and GOOS engagement with CEOS and in particular expressed strong support for the Ocean Surface Topography Constellation.' Additionally, the OOS Head of Section represents the IOC on the **Coordination Group for Meteorological Satellites (CGMS).** Although financial constraints did not allow IOC participation in the Thirty-fifth CGMS meeting in 2007, the IOC has periodically, since taking up membership in 1991, provided working documents supporting oceanographic remote sensing missions to the Group.

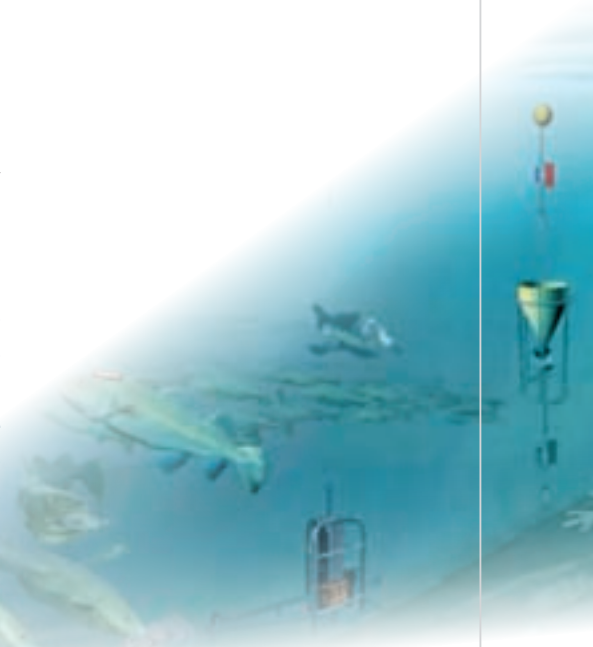
As highlighted in the OOS overview section of the IOC Annual Report

2005: 'To be effective, GOOS needs to break down the often cited, but unhelpful, distinction between research and operations. A comprehensive ocean observing system simply cannot exist without the full engagement of the oceanographic research community'. To this end we work with several international groups that bring the interests of this community as both providers and users of global ocean observations. The **Partnership for Observation of the Global Oceans (POGO)** brings together oceanographic research institutions worldwide to promote long-term cooperation in comprehensive global ocean observations. POGO provides a very important link to these oceanographic research institutions given that much of the sustained observing system is in fact being maintained through their efforts, not by the operational government agencies that come together at meetings of the intergovernmental committee for GOOS. GOOS has worked particularly extensively and effectively with POGO in the GEO context, for example in the development of the ChloroGIN pilot project to promote *in situ* measurement of chlorophyll in combination with satellite derived estimates. Additionally, the OOS Head of Section represents the IOC and GOOS at annual POGO meetings of participating institute directors.

At the grass roots, working scientist level, OOS works in the context of groups such as the **American Geophysical Union (AGU)** and **International Union of Geodesy and Geophysics (IUGG)** including its **International Associations for the Physical Sciences of the Oceans (IAPSO)** and **Meteorology and Atmospheric Sciences (IAMAS)** all of which co-exist with GOOS in the family of members and programmes of the **International Council for Science (ICSU).** In 2007, for example, the OOS Head of Section served on the Ocean Sciences Executive Committee of the AGU and on the Executive Committee of IAMAS in his capacity as President of the **International Commission on Climate (ICCL).** As part of these activities GOOS organized a plenary 'union' session 'Global Earth Observing Systems' as well as an associated regular scientific session at the IUGG XXIV General Assembly 'Earth, Our Changing Planet' which drew more than four thousand scientists to Perugia, Italy, during the first two weeks of July.

In 2007, due to the vacant Head of Ocean Sciences section post at the IOC, the OOS section additionally took on liaison duties for IOC with the **World Climate Research Programme (WCRP)** and the **International Geosphere-Biosphere Programme (IGBP)**. Thus, the OOS Head of Section represented IOC as a sponsor at the Twenty-eighth WCRP Joint Steering Committee meeting and continues to serve on the ICSU/WMO/IOC/IGFA Panel carrying out an ongoing review of the WCRP. Finally, the OOS section has taken the lead IOC role in participation in the International Polar Year (IPY) in 2007, including representing IOC in an ex-officio capacity on the WMO/ICSU Joint Scientific Committee for the IPY. In an effort to ensure that a sustained observational legacy arises from the burst of interest in polar research the IOC, through GOOS, is one of thirteen international science partners in the **Sustained Arctic Observing Network Initiating Group (SAON-IG)** (www.arcticobserving.org) and is working together with the **Scientific Committee for Antarctic Research (SCAR)** and **Scientific Committee for Ocean Research (SCOR)** on the development of a **Southern Ocean Observing System (SOOS).** Keith Alverson provides a comprehensive overview of IPY further on in this section.

Without a doubt, many of our partner organizations have been left out of this brief report. This is of course due to space limitations, not any limitation on the number of partners providing benefit to OOS programmes. National agencies and regional alliances, for example, play an enormously important role in implementing OOS programmes. Though sometimes frustrated by financial and human resource constraints limiting our capacity to engage as much as we would like with the wide number of partners we work with, OOS takes the opportunity of this year's Annual Report to pay them tribute, and thank them all. In conclusion, it is clear that OOS programmes and our Member States cannot design, sustain or implement the Global Ocean Observing System in isolation. Our only chance at success is in leveraging the good will of our many partners in this endeavour.



Artwork for these pages kindly provided by Glynn Gorick.

Websites

Websites for partner organizations listed in this report

AGU	http://www.agu.org/sections/oceans
CEOS	http://www.ceos.org/
CGMS	NA
FAO	http://www.fao.org
GEO/GEOSS	http://www.earthobservations.org
IAMAS	http://www.iamas.org
IAPSO	http://iapso.sweweb.net
ICPC	NA
ICSU	http://www.icsu.org
IGBP	http://www.igbp.kva.se
IGFA	http://www.igfagcr.org/
IGOS-P	http://www.igospartners.org
IPY	http://www.ipy.org
IUGG	http://www.iugg.org
Ocean United	http://www.ocean-partners.org/oceanunited.htm
POGO	http://www.ocean-partners.org/
SAON-IG	http://www.arcticobserving.org/
SCAR	http://www.scar.org
SCOR	http://scor-int.org
UNEP	http://www.unep.org
WCRP	http://wcrp.wmo.int/wcrp-index.html
WMO	http://www.wmo.int

Reports published

Reports published in 2007 by OOS included:

- *Third GOOS Regional Forum Report*. GOOS Report no. 159.
- *Report of the Tenth Session of the Scientific Steering Committee of the Global Ocean Observing System*. GOOS Report no. 161.
- *Report of the Eighth Session of the Intergovernmental Committee for the Global Ocean Observing System*. GOOS Report no. 165.
- *Southern Ocean Observing System Interim Report*. GOOS Report no. 168.

Outreach publications

Outreach publications co-authored by OOS staff included:

- Allison, I. et al. 2007. *The Scope of Science for the International Polar Year 2007-2008*. World Meteorological Organization, WMO/TD-No. 1364, 79 pp.
- Alverson, K. 2007 (a). Why the World Needs a Global Ocean Observing System. *The Full Picture*, Tudor Rose, pp. 76-78.
- Alverson, K. 2007 (b). Why the World Needs a Global Ocean Observing System. The Marine Scientist, 21, pp. 25-28.
- Baker, J. et al. 2007. The Blue Planet – Observations of the Global Oceans. *The Full Picture*, Tudor Rose, pp. 72-75.
- Brundrit, G. et al. 2007. New Marine Observing Systems around Africa. *The Full Picture*, Tudor Rose, pp. 92-94.
- Summerhayes, C. et al. October 2007. Observing the Polar Oceans during the International Polar Year and Beyond. *WMO Bulletin*, 56 (4), pp. 270-283.

A new set of three one-page brochures on GOOS, JCOMM and IODE for broad distribution.

Presentations and exhibitions

Presentations and exhibitions made by OOS staff during 2007 included:

- Plenary 'union' presentation at the International Union of Geology and Geophysics (IUGG) Congress, 3 July, Perugia, Italy.
- GOOS-Africa Exhibition, GEO Ministerial Summit 27-30 November, Cape Town, South Africa.
- Ocean United Exhibition, GEO Ministerial Summit, 27-30 November, Cape Town, South Africa.

Meetings

Meetings during 2007 organized and supported by OOS staff included:

- The Eighth Meeting of the **Argo** Steering Team, 7-9 March, Paris, France;
- The Nineteenth Session of the IOC Committee on the International Oceanographic Data and Information Exchange (**IODE**), 12-16 March, Trieste, Italy;
- The Tenth Meeting of the Global Ocean Observing System (**GOOS**) Scientific Steering Committee, 13-16 March, Seoul, Republic of Korea;
- The Twelfth Session of the Ocean Observations Panel for Climate (**OOPC**), 2-5 May, Paris, France;
- The Fourteenth Session of the Integrated Global Observing Strategy Partners (**IGOS-P**), 30 May, Paris, France;
- High Level Scientific Workshop on the Critical Role of Satellite Remote Sensing Applications for Africa's Sustainable Development, 30 May-1 June, Paris, France;
- The Tenth Session of the Global Sea Level Observing System (**GLOSS**) Group of Experts, 5-8 June, Paris, France;
- The Eighth Session of the Intergovernmental Committee for the Global Ocean Observing System (**GOOS**) 13-16 June, Paris, France;
- **JCOMM** Scientific and Technical Symposium on Storm Surges, 2-6 October, Seoul, Korea;
- The Sixth Meeting of the Joint Commission on Oceanography and Marine Meteorology (**JCOMM**) Management Group, 3-6 December, Paris, France.

This list of 2007 activities and publications comprises selected highlights. Comprehensive lists of all meetings, publications, reports and presentations are available on the GOOS, IODE and JCOMM websites.

Sustaining an Arctic Ocean observing system as a legacy of the International Polar Year

KEITH ALVERSON
Head of Section
Ocean Observations
and Services

Is the Arctic Ocean a vast, beautiful, wild and unsullied natural refuge or a small, fragile and vulnerable body of water suffering the brunt of global warming? The only way to know is through observation. In the early twentieth century, those following Admiral Peary and his competitors in their scramble to be the first humans to set foot on the North Pole would certainly have claimed the former. The science that was being done in and around the Arctic Ocean at the time was largely one of discovery and exploration. To some extent, the Arctic Ocean remains an unexplored refuge today. For example, a recently produced global map of human impact on marine ecosystems resulting from a variety of climatic and non-climatic drivers (Figure 1, Halpern et al., 2008) suggests the entirety of the meager 3.7 per cent of the world oceans that can be classified as 'very low impact areas' occur in the Arctic and Southern oceans.

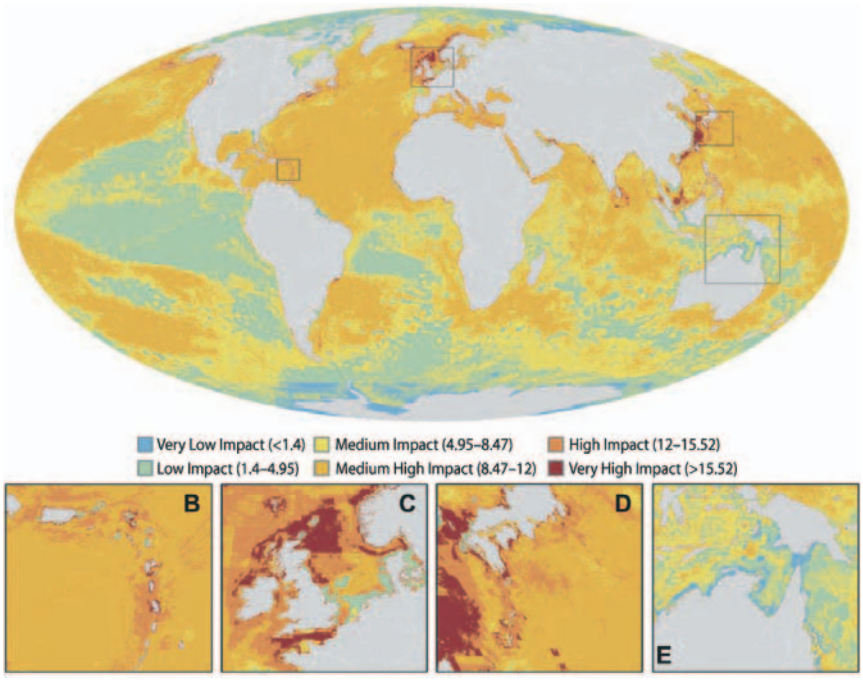


Fig. 1. A global map of the cumulative human impact across 20 ocean ecosystem types. The Arctic comprises a substantial portion of the mere 3.7% of the world oceans designated as 'very low impact'
From Halpern et al. 2008. A Global Map of Human Impact on Marine Ecosystems. Science, *Vol. 319, pp. 948-952. Reprinted with permission from AAAS.*

But the Arctic Ocean is changing fast. In 2007, summer minimum sea ice extent in the Northern Hemisphere plummeted to a record low. The average extent of sea ice in the Arctic for the month of September stood at 4.28 million km^2, shattering the previous absolute minimum of 5.32 million km^2 measured on 20-21 September 2005 (Stroeve et al., 2008). As summer sea ice melts, the dark waters of the Arctic will become increasingly exposed to light and air. This will have an immense environmental impact, through the well known 'ice albedo feedback' associated with reduced surface albedo, as well as through dramatic increases in exchanges of heat, moisture and greenhouse gases across the air-sea interface which can be expected to radically alter the climate, environment and ecosystems in the region. On 14 May 2008 the polar bear became the first species placed by the US Department of the Interior under the protection of the Endangered Species Act not because of an actual measured population decline – numbers have roughly doubled since the 1960s – but in response to projected future global warming and an associated loss of sea ice habitat for this iconic top marine predator. Environmental changes in the Arctic Ocean have also been reported to threaten the walrus and several species of whale.

Today, Arctic vulnerability to climate change and other human impacts is

Photo courtesy of Chris Linder, Woods Hole Oceanographic Institution.

a clear cause for concern. How can the scientific community best bring its expertise to bear in addressing this concern? I argue that the answer is to provide sustained and integrated monitoring of the integrated Arctic system, including of course its ocean. Only from such monitoring can we understand Arctic system changes well enough to test hypotheses and make appropriate policy decisions at the national and international levels. Even as the International Polar Year (IPY, 2007-09) first began, the Global Ocean Observing System's satellites, tide gauges and drifting ice moored buoys were already systematically observing the Arctic Ocean twenty-four hours a day and providing publicly accessible data in near real-time (Figure 2, Summerhayes et al., 2007). Several ambitious IPY projects are improving this level of data availability. These include both improvements to existing networks (for example, projects to enhance the number of ice drifting buoys in operation and to broaden the Argo float network into ice covered waters), as well as the development of new networks (for example, through deployment of an integrated Arctic Ocean Observing System [iAOOS] and arrays of acoustic curtains for monitoring the movements of tagged fish and marine mammals). A major challenge will be to sustain some of these IPY efforts in the future as a legacy of the IPY and a contribution to the Global Ocean Observing System (GOOS).

One of the greatest differences in ocean sciences in the Arctic between Peary's day and today has been the shift in our observations from discov-

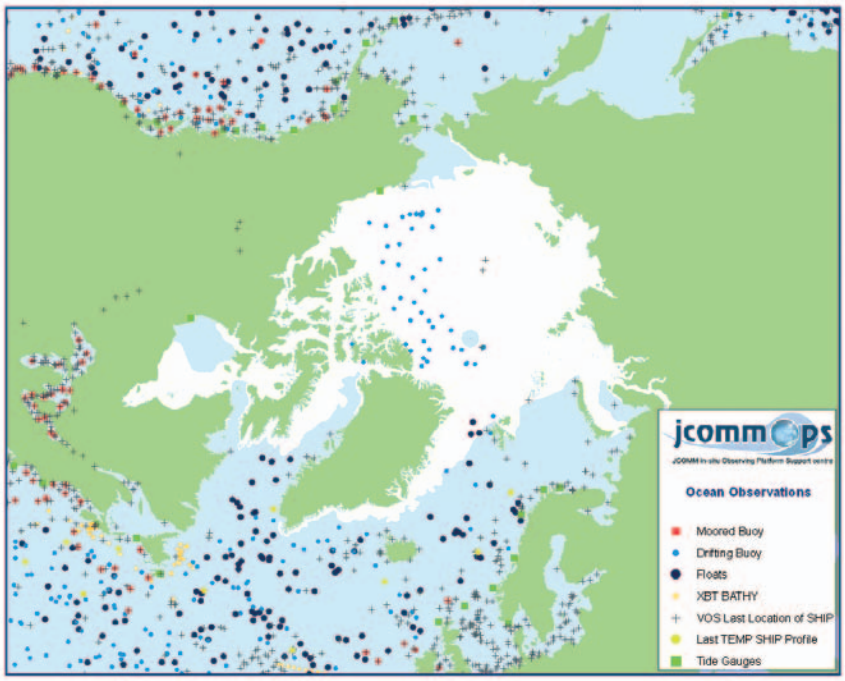
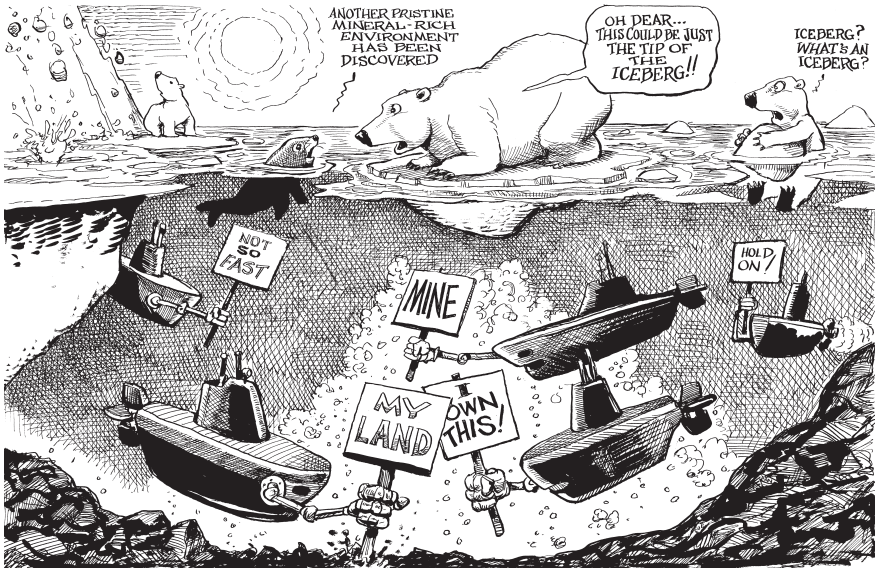


Fig. 2. Near real-time GOOS data availability in the Arctic on 23 July 2007 from the Observing Platform Support Centre (JCOMMOPS) of the Joint IOC/WMO Technical Commission for Oceanography and Marine Meteorology.



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ery to sustained and systematic monitoring. This monitoring is increasingly important in the context of another mad dash towards the pole – this time not for the glory of discovery, but for the use of resources. Indeed, the social, political and economic landscape in the Arctic is changing as fast, or faster, than the natural one. Russia, the world's largest country and second largest oil producer, is currently preparing the observational data to back up its existing claim under the United Nations Law of the Sea Treaty that the Lomonosov Ridge, which crosses much of the Arctic Ocean, is an extension of its continental shelf, and hence an extension of its exclusive economic zone. With 9 to 10 billion tons of fuel equivalent, roughly the same as Russia's existing total oil reserves, estimated to exist below the Arctic seabed, the stakes are high. Adding fuel to the fire, on 2 August 2007 a Russian submersible engaged in observation research in the Arctic Ocean planted a titanium flag on the seabed 4,200 metres below the North Pole.

The United States is also no stranger to offshore Arctic oil and gas reserves – the US Minerals and Management Service website announced on 6 February 2008 the completion of the first Chuckchi Sea sale since 1991, comprising a total of $3.4 billion in leases bid by seven major oil companies – a surprisingly large increase compared to past sales, indicating industry confidence that long standing environmental controversies are manageable, that the Alaskan Arctic has substantial potential, and that production activity will soon be increasing markedly off the Alaskan coast. One of the beauties of lobbying for an integrated observing system is that it is one of the few major policy investments that can be strongly supported on both sides of this environment/development controversy since environmentalists need monitoring to ensure accurate environmental impact statements with real teeth and the offshore industry needs it to protect its infrastructure from inclement ocean and atmospheric conditions.

Meanwhile, in the speech from the throne on 16 October 2007 the Canadian Government stated that as 'part of asserting sovereignty in the Arctic' it 'will complete comprehensive mapping of Canada's Arctic seabed' and it plans to defend Canadian sovereignty in the North with new Arctic patrol ships, expanded aerial surveillance, and expansion of the Arctic Rangers in order to guard Canada's Far North and the Northwest Passage. This emphasis on Arctic sovereignty has already had substantial consequences in the private sector. An example was when Canada blocked a $1.3 billion bid for its space equipment and satellite maker by a US company in part due to the fact that Radarsat-2, which was launched last October and provides high resolution sea ice information to the world scientific community, was promoted by the government as a critical component of Canada's efforts to assert its control of the Arctic. Indeed, in the summer of 2007, the Northwest Passage – itself both a subject of conflicting territorial claims as well as a potentially lucrative shipping route – was free of ice for the first time since records began. In addition to Canada and Russia, Denmark, Norway and the United States all also have coasts within the Arctic Circle, making for numerous potentially conflicting claims.

Natural variability, especially in the Arctic, is large. The early part of 2008 was colder than average and, in some regions, sea ice extent expanded substantially. Mid-2008 may well have far more extensive sea ice than 2007 did. But Pandora has done her work and political and economic interest in the ever more accessible Arctic cannot be put back in the box. Climate extremes are not new, especially in the Arctic, which from a global perspective even has an extreme mean. What is new is the magnitude of human and financial vulnerability to extremes. Globally, increased development (primarily in rich countries) and population pressure (primarily in low lying developing countries) mean that it does not matter, as far as adaptation measures are concerned, whether or not there is conclusive proof that 'extreme events' are becoming stronger or more frequent, because we know that our vulnerability to them has increased. As the Arctic opens to

human development, in a warming background climate, it will face both increasing vulnerabilities (increases in expensive infrastructure such as shipping and oil platforms) and increasing population pressure. These combined changes will also add to the vulnerability of the Arctic's indigenous populations. Thus, it is a critical time for Arctic Ocean science to move beyond being carried out in remote wilderness and published in remote journals. Scientists must now take up the challenge of making their work visible and relevant to multilaterally agreed policy decisions that can shape the kind of Arctic that humanity would like to have in the coming century.

Under pressure from both the rapidly developing political landscape as well as the rapidly changing climatic situation, the Global Ocean Observing System (GOOS) is working with its Member States and sponsor agencies, the Intergovernmental Oceanographic Commission of UNESCO, the United Nations Environment Programme (UNEP), the World Meteorological Organization (WMO) and the International Council for Science (ICSU) to put in place, and sustain, an Arctic Ocean Observing System to provide the observational underpinnings to understand and predict the changing climate while simultaneously ensuring that neither the Arctic environment nor Arctic societies are the losers in a Wild West-like scramble for resources that could compromise universal access to, and benefit from, the Arctic Ocean. This system can only be maintained through multilateral governmental commitments (Alverson and Baker, 2006) and these have regrettably not yet materialized to any large extent.

Research and implementation plans driven by science priorities abound, but what is needed now is sustained monitoring driven not by a 'science push' but by the pull from derived societal benefits, primarily among these the protection of humankind's Arctic heritage in the face of the accelerating transformation of environmental, social and cultural landscapes across the Arctic. Thus, Arctic Ocean scientists need to engage their expertise in driving the political processes that will shape the future Arctic. To this end, UNESCO, as part of its Strategy for Action on Climate Change and with the sponsorship of Prince Albert II of Monaco, is initiating a comprehensive analysis of the multilayered and multiform interactions connecting global and Arctic processes though an international and interdisciplinary approach. An initial meeting in early 2009, timed to coincide with the conclusion of the International Polar Year, will bring together natural scientists, economists, social and human scientists, legal experts, circumpolar indigenous peoples, and representatives from environmental NGOs, industry and concerned countries. Partnership in this effort will be sought from a wide range of interested intergovernmental and international organizations. UNESCO, for its part, will facilitate the participation of Member States from outside the Arctic region that will nevertheless be impacted by the changes anticipated in the polar regions and will provide an intergovernmental forum with foci on sustainable development, environmental ethics, indigenous peoples and knowledge, intangible heritage, Arctic World Heritage and coordinated international monitoring of the Arctic Ocean as a component of its Global Ocean Observing System.

On 1 December 1959, shortly after the successful conclusion of the International Geophysical Year of 1957-58, twelve nations signed the Antarctic Treaty in Washington, D.C. in the USA, to ensure 'in the interests of all mankind that Antarctica shall continue forever to be used exclusively for peaceful purposes and shall not become the scene or object of international discord'. What better success could the International Polar Year have than to bring nations together to show their mutual resolve to protect, preserve and sustainably manage our Arctic heritage by supporting an integrated and sustained observing system for the Arctic?

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Stroeve, J. et al. 2008. Arctic Sea Ice Extent Plummets in 2007. *Eos Trans. AGU*, 89(2), p. 13.

Summerhayes, C. et al. 2007. 'Observing the Polar Oceans during the International Polar Year and Beyond' *WMO Bulletin*, 56(4) pp. 270-283.

Argo: Global ocean observing array reaches milestone and faces challenges

Argo Steering Team
Argo Information Centre
http://argo.jcommops.org

The Argo array is the centrepiece of the *in situ* ocean observing system promoted by the Joint Technical Commission for Oceanography and Marine Meteorology (JCOMM), co-sponsored by the Intergovernmental Oceanographic Commission of UNESCO and the World Meteorological Organization. Argo is a programme of the Global Ocean and Climate Observing Systems.

The IOC-WMO Argo Information Centre (AIC), responsible for the international coordination of Argo, assists as appropriate in the implementation of a global network, provides day to day support to float operators and data users, and encourages international cooperation and transparency for the programme. In particular, the AIC provides a real-time web based monitoring system for floats entering Member States' Exclusive Economic Zones.

In November 2007, the Argo ocean observing array reached its initial target of operating 3,000 robotic floats worldwide. By systematically measuring the temperature and salinity to a depth of 2,000 metres, Argo has already improved estimates and forecasts of sea level rise caused by thermal expansion and is playing a key role in improving seasonal climate forecasts and giving new insights into hurricane activity.

Argo floats being deployed in the Pacific Ocean (NOAA/PMEL).
Photo courtesy of John Poling, California Polytechnic

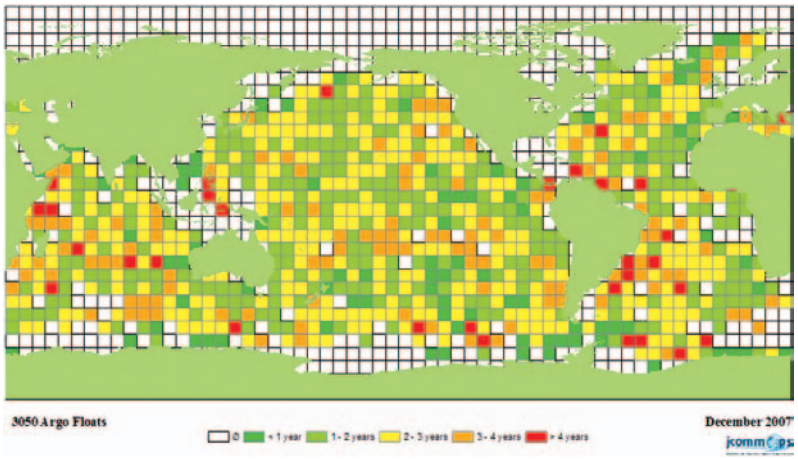
Maintaining the array's size and global coverage in the coming decades is the next challenge if Argo is to build on these initial achievements and establish a system for monitoring and forecasting our seas similar to that operated and used by meteorologists.

In 1998, an international consortium presented plans for an array of 3,000 autonomous instruments that would revolutionize the collection of critical information from the upper, climatically important, layers of the world's oceans. That vision is now a reality and the Argo array of profiling floats has reached its target and each year provides over 100,000 high-quality temperature and salinity profiles and global-scale data on ocean currents.

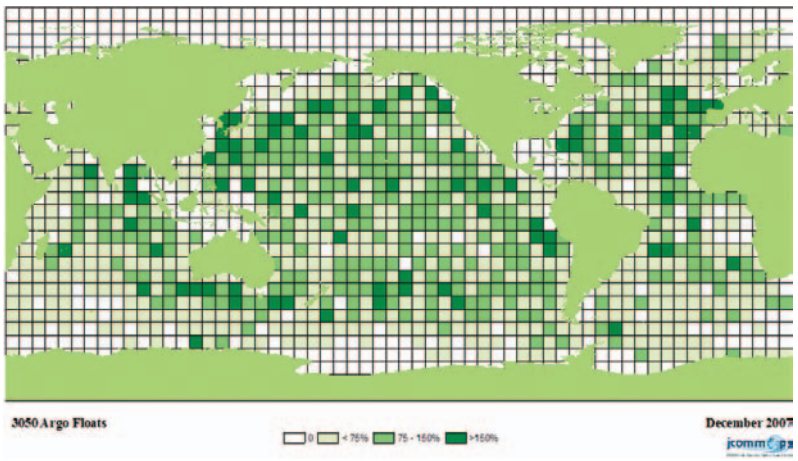
This is twenty times greater than the rate of collection of comparable ship-based profile measurements and provides immediate access to high quality data throughout the oceans, without seasonal bias. (Most ship measurements, particularly in high latitude regions, are made during the summer season).

The most obvious benefit from Argo has been a marked reduction in the uncertainty of ocean heat storage

One of the greatest achievements of Argo is to have developed international cooperation amongst thirty nations. More partners will join Argo in the future through the IOC Argo Donor Programme.



A simple view of the Argo network mean age (mean for 6º x 6º grid) helps in anticipating future gaps in array coverage. Even though Argo reached its initial target, and the float reliability has dramatically improved in recent years, many floats will still need to be replaced each year to maintain full coverage.



A simple view of the Argo network density helps in identifying gaps on a 6º x 6º grid (normalized on the 3º x 3º Argo standard). With most of Argo funding countries in the northern hemisphere it is still a challenge to fill the Southern Ocean.

calculations. These calculations are a key factor in determining the rate of global climate warming and sea level rise, and in projecting their future progression. The steady stream of Argo data coupled with global scale satellite measurements from radar altimeters has also made possible huge advances in the representation of the oceans in coupled ocean-atmosphere models, leading to seasonal climate forecasts and the routine analysis and forecasting of the state of the subsurface ocean. These are advances that could only have been dreamed of a decade ago and have practical applications such as predicting the fate of oil spills in the open ocean, and aiding fisheries.

Argo data are also being used in an ever-widening range of research applications that have led to new insights into how the ocean and atmosphere interact in extreme as well as normal conditions. Two examples are the processes in polar winters when the deep waters that fill most of the ocean basins are formed and, at the other temperature extreme, the transfer of heat and water to the atmosphere beneath tropical cyclones. Both conditions are crucial to global weather and climate and could not be observed by ships.

The Argo array has been deployed by the collaboration of more than thirty countries plus the European Union. A guiding principle of Argo is that the programme should benefit everyone, so the data are openly and immediately available to anyone wishing to use them.

The total annual operating cost of Argo is approximately US$24 million (the sum of all national contributions). Maintaining the array will require annual deployments of around 800 floats, giving each float an estimated through-life cost of approximately US$30,000.[1]

Having deployed the array and built an effective data delivery system the next challenge is to maintain the full array for a decade in a pre-operational 'sustained maintenance' phase. This will allow the array's design to be optimized and its value fully demonstrated and exploited. The USA has committed to maintaining half of the array and other contributing countries are striving to continue the array's strong international nature. As more is learned about floats and their sensors, float lifetimes will be extended further to improve the cost-effectiveness of the programme.

Some Argo applications

http://www.metoffice.gov.uk/research/ncof/foam
http://www.mercator-ocean.com
http://www.jamstec.go.jp/frcgc/jcope

1. The present generation of floats has a design life of four years when profiling to two kilometres depth every ten days. The through-life cost includes the cost of deployment, data processing and distribution.

The Global Sea Level Observing System (GLOSS)

THORKILD AARUP
Technical Secretary
for GLOSS

The Global Sea Level Observing System (GLOSS) is an international programme, established in 1985 to provide oversight and coordination for global and regional sea level networks in support of international climate, oceanographic, and coastal sea level research. GLOSS is coordinated by IOC and is now one of the observing components under the WMO/IOC Joint Technical Commission for Oceanography and Marine Meteorology (JCOMM).

The GLOSS programme seeks to increase the number of operational tide gauge stations reporting to the Permanent Service for Mean Sea Level (PSMSL) hosted at the Proudman Oceanographic Laboratory (Liverpool, UK), as well as the number of stations providing data in near real-time for ocean monitoring and operational numerical modelling and forecasts.

A main component of GLOSS is the Global Core Network (GCN) of 290 tide gauge stations, selected to provide an evenly distributed sampling of global coastal sea level variations. Additional GLOSS station networks are focused on Long Term Trends (LTT), altimeter calibration (ALT), and Ocean Circulation (OC). GLOSS also seeks to specify land motion at tide gauges through collaboration with the International GPS Service (IGS) and the GPS Tide Gauge Benchmark Monitoring Project (TIGA).

A measure of the current status of GLOSS is the number of operational stations in the GCN. Of the 290 stations, 217 (75 per cent) have provided data recently to one of the GLOSS data centres, which represents the participation of 69 nations. Approximately 50 per cent of the GCN stations are providing data in near real-time via the Global Telecommunication System (GTS) or the internet. Data are received in 'Fast Delivery' mode (that means within approximately one month) from 175 stations (60 per cent); 131 stations have continuous GPS or Doris at or near the tide gauge.

In appreciation of the multiple uses of tide gauges, GLOSS has also sought to provide water level data that meets the standards and requirements for tsunami warning and storm surge monitoring. Numerous GLOSS Core Network stations have for many years contributed to the Pacific Tsunami Warning System and, following the 2004 Sumatra earthquake, the IOC and GLOSS have taken an active role in coordinating and implementing the water level network for the Indian Ocean Tsunami Warning System.

In 2007, ten stations in the Indian Ocean were upgraded to provide observations in real-time and since 2005 more than fifty sea level stations in the Indian Ocean have been upgraded and report data to the international tsunami watch centers via the GTS. The upgrades have been carried through bilateral and multilateral arrangements with the assistance of the German Research Centre for Geosciences (GFZ), the University of Hawaii Sea Level Center, and the Proudman Oceanographic Laboratory and funded by the Governments of Finland, Germany, Norway, and the International Strategy for Disaster Reduction (ISDR), the Asian Disaster Preparedness Center (ADPC), the United States Agency for International Development (USAID) and the Ocean Data and Information Network for Africa (OdinAfrica). In support of national tsunami and storm surge warning systems, many nations are also densifying their national sea level observing networks.

GLOSS and some of its participating institutions have been active for the last two years in exploring broad-

band two-way communication via Inmarsat's Broadband Global Area Network (BGAN). Such service can offer more frequent real-time data transmission than presently possible with the bandwidth available on the public meteorological satellites. On 20 December 2007, the IOC and Inmarsat signed an agreement under which Inmarsat will provide BGAN transmission service free of charge for fifty sea level stations in the Indian Ocean. This is a supplementary service that will offer added redundancy but it will not replace the existing public transmission service.

An important element of the GLOSS programme is its training activities carried out with national tide gauge agencies and partner programmes such as OdinAfrica and regional tsunami warning systems. Short-term practical training in support of GLOSS was provided by the Proudman Oceanographic Laboratory for participants from Egypt, Germany and Iran.

A visiting sea level fellowship programme, initially for participants from Indian Ocean countries, in sea level science and applications was started in 2007 in collaboration with the IOC Tsunami Unit. The objective of the fellowship programme is to encourage further use of the sea level observing network for research and applications within the framework of a regional multi-purpose observing system. In the longer term, expected outcomes are the strengthening of links between the sea level observing institutions (i.e. hydrographic, port agencies) and the scientific institutions (universities, oceanographic, fisheries and environment), as well as regional and international cooperation between participating institutions. The fellowships will enable short-term visits at selected sea level institutions in the GLOSS network.

The Tenth Session of the GLOSS Group of Experts (GLOSS-GE-X) was held from 6-8 June 2007 in connection with a workshop on 'Real-time transmission and processing techniques: improving the Global Sea Level Observing System's contribution to multi-hazard warning systems'.

The Group of Experts (GE) reviewed the status of its actions and developed a consolidated list for the next intersessional period. The GLOSS-GE decided to update its Implementation Plan, with particular emphasis on specific technical development of the Network, and on the impact of technological changes on station design, including data delivery. The revised plan will be aimed at moving the GLOSS Core Network from a research-support service to an operational, multi-purpose, real-time system, especially for tsunami warning and climate change purposes. The revised plan will also clarify the obligations of those Member States participating in the Network.

The Group reviewed the specific regional developments in the Indian Ocean, the Pacific Ocean, the Caribbean, the northeast Atlantic Ocean (including the Mediterranean and other regional seas), Africa, as well as Polar Networks. Representatives of the participating Member States informed the Group of advances in the national water level monitoring systems and more than thirty country reports were provided.

Following a request from the IOC ad hoc working group of the Global Ocean Hazards Warning and Mitigation System (GOHWMS), the GLOSS Group of Experts declared its readiness to expand its activities to include technical advice and strategic planning for water level stations intended for hazards monitoring.

More information about GLOSS and GLOSS-GE-X is available at (www.gloss-sealevel.org) and (www.ioc-goos.org).

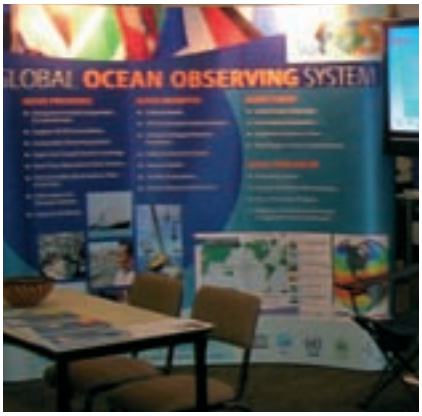
The Group on Earth Observations
Ministerial Summit

TOM GROSS
Programme Specialist

The Group on Earth Observations (GEO) is establishing the Global Earth Observation System of Systems (GEOSS) with the mandate to create societal benefits by developing and integrating nearly all terrestrial, oceanic, atmospheric and space environmental observation platforms, data and services. This mammoth undertaking will be accomplished by collaborations of existing systems that are already accomplishing these goals within separate domains. The Global Ocean Observing System (GOOS) has been named by GEO as the ocean component of GEOSS and has already played an important role in the creation of GEOSS through contributions by GOOS experts and organizers. GOOS will benefit from the GEOSS process by the wide recognition of the importance to society of sustained environmental observations. GEO has brought the issues and values of earth observations to the attention of national ministers, governments and private industry through other channels that complement the UNESCO/IOC assemblies.

GOOS participation at the GEO Ministerial Summit

To maintain our leadership and role within the GEO planning process and to benefit from the exposure provided by GEO, the GOOS and ocean sciences community must maintain visibility and involvement with GEO. The GEO Ministerial Summit in Cape Town, South Africa, 26-30 November 2007, afforded the ocean community an opportunity to showcase the advanced coordination and collaboration of GOOS. A consortium of ocean institutes dedicated to outreach and promotion organized an 'Ocean United' themed series of events and exhibits for the GEO Ministerial Summit. Working closely with the Partnership for Observation of the Global Oceans (POGO), the Sir Alister Hardy Foundation for Ocean Science (SAHFOS), the Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM) and others, the GOOS programme was represented by an impressive exhibit hall display. Ten large displays, ten video screens, numerous demonstration objects, two Magic Planet 3D globe displays and several new video movies showcased not only the ocean observation theme, but the unity of the GOOS programmes in presentation and cooperation. Complimenting the floor exhibits a strong outreach effort with press conferences and press releases put the 'Ocean United' message into the mainstream media with articles in many international newspapers. Finally the GEO special publication, *The Full Picture*, had five separate contributions from GOOS programme participants to show strongly that GOOS is, in fact, the ocean component of GEOSS.



Lessons learned from the outreach effort at the GEO Ministerial Summit are that with a concerted effort the GOOS message can be delivered strongly and given wide distribution. The effort this requires cannot be discounted, and future events will require sustaining the outreach accomplishments and building upon them. The benefit of collaborative outreach efforts by GOOS, POGO, JCOMM, the GOOS Scientific Steering Committee (GSSC) and others was demonstrated by the Ocean United group, which will continue to grow and represent GOOS goals at future GEO/GEOSS events, as well as other events, such as the upcoming 2009 United Nations Framework Convention on Climate Change (UNFCCC) conference in Copenhagen, Denmark.

International Oceanographic Data and Information Exchange (IODE)

PETER PISSIERSSENS
Head of IOC Project Office for IODE, Ostend, Belgium

IODE Committee meets in Italy for its Nineteenth Session

The Nineteenth Session of the Intergovernmental Oceanographic Commission Committee on International Oceanographic Data and Information Exchange (IODE-XIX) was held at the Abdus Salam International Centre for Theoretical Physics (ICTP) in Trieste, Italy, 12-16 March 2007. The event was co-hosted between the ICTP and OGS (L'Istituto Nazionale di Oceanografia e di Geofisica Sperimentale).

The Committee:

(i) Completed the implementation process of the IODE review (2004-2005) recommendations;
(ii) Recommended a new strategy and structure of IODE Groups of Experts;
(iii) Revised the terms of reference of the IODE Group of Experts on Biological and Chemical Data Management and Exchange Practices (GEBICH);
(iv) Recommended the development of the IODE Ocean Data Portal project;
(v) Established Ocean Data and Information Networks (ODINs) for European Countries in Economic Transition (ODINECET), the WESTPAC region (ODINWESTPAC) and the Black Sea region (ODINBLACKSEA);
(vi) Recommended the establishment of the OceanDocs e-repository project; and
(vii) Recommended the joint HAB/IODE development of a Harmful Algal Event Information System.

The Committee further reviewed the draft IOC Strategic Plan for Oceanographic Data and Information Management for submission to the Twenty-fourth Session of the IOC Assembly (19 to 28 June 2007).

The Committee elected Dr Malika Bel-Hassen Abid (Tunisia) and Mr Gregory Reed (Australia) as IODE Co-Chairs.

IODE reviewed by UNESCO

UNESCO's work plan for the biennium 2006-2007 included the need for a review of the IODE Programme for the period 2002-2006. The review was managed by UNESCO's Internal Oversight Service and took place between March and June 2007 and was carried out by Prof. Juan Carlos Villagrán de León.

(From left to right) Dr Malika Bel-Hassen Abid (elected IODE Co-Chair), Mr Ricardo Rojas (IODE former Vice-Chair), Dr Lesley Rickards (IODE past Chair) and Mr Greg Reed (elected IODE Co-Chair).

The review found that the programme is highly relevant, both with respect to UNESCO's mandate and priorities in water, and from the viewpoint of the needs of Member States for oceanographic data and information. This is particularly true for the developing countries. The IOC's IODE programme is well respected by Member States. In terms of impact, IODE's greatest achievement is in the area of capacity-building concerning training and the provision of relevant hardware and software for use in the management of oceanographic data and information. The main teaching tool employed by IODE, 'Ocean Teacher', (www.oceanteacher.org) has proved to be very popular among Member States. IODE is an efficiently managed programme, despite the scarcity of resources.

In terms of challenges, it was stated that data archiving should be improved and more work has to be undertaken with respect to the policy issues covering national security when managing (and exchanging) oceanographic data and information, including the willingness (or unwillingness) of some Member States to exchange data. The quality assurance function of IODE is underdeveloped; IODE has not been able to create global data sets of the same (consistent) quality. IODE activities in Latin America, the Caribbean, and Eastern Europe should be increased, and lessons learned in Africa used, where applicable, in these areas.

The recommendations made by the external evaluator include:

(i) IODE needs to promote the replication of efforts related to ocean and marine data and information in other regions of the world where oceanographic networks are being established, such as the Indian Ocean, Countries in Economic Transition (CET), and the Black Sea;
(ii) The IODE Committee should review the translation of 'Ocean Teacher' into other languages, notably Spanish for Latin America, and Russian for several Member States in the former Soviet Union; and
(iii) The IODE Committee should assess how best to proceed in order to reduce the existing gaps in its coverage between the various regions of the world. One possibility could be to explore existing contributions from the Government of Flanders, which could be targeted to such regions.

The IODE Officers, during their 2007 meeting (27-30 November 2007) reviewed the report and identified actions that will respond to the recommendations.

The final evaluation report was submitted to the 2008 spring session of the UNESCO Executive Board (179 EX/20).

IOC Strategic Plan for Oceanographic Data and Information Management

In 2007, the important role of oceanographic data and information management and exchange was anchored in the IOC through the adoption of the 'IOC Strategic Plan for Oceanographic Data and Information Management (2008-2011)' by the Twenty-fourth Session of the IOC Assembly (19-28 June 2007). The IOC Data and Information Management Strategy will result in:

(i) Processing and archiving of data on a diverse range of variables according to scientifically sound and well-documented standards and formats;
(ii) Distributing data on a diverse range of variables (observations and model outputs) in both real-time and in 'delayed' modes depending on the needs of user groups and their technical capabilities (automatic dissemination as well as 'on demand'); and
(iii) Enabling efficient access to data on core variables and derived products (including forecasts, alerts and warnings) by users who have a broad range of capabilities.

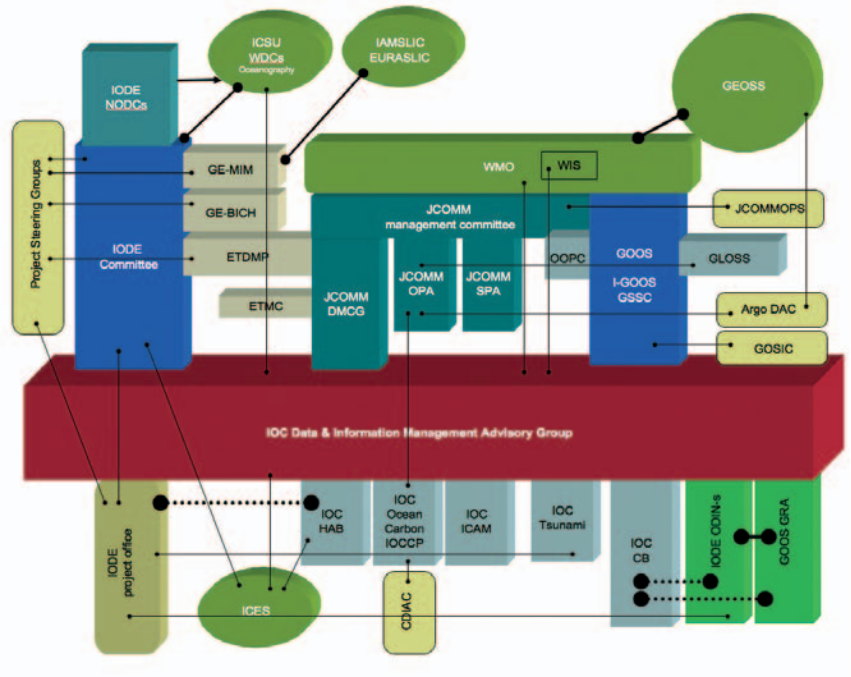
The IOC data and information system will, like that of the Global Earth Observing System of Systems (GEOSS), be a system of systems. Each of these should be an end-to-end system, handling data from the point of collection, through processing and quality control, to archival and dissemination. There is no 'one size fits all', but standards interoperability between the systems can be achieved. As noted by GEOSS in its Implementation Plan, the informal definition of interoperability is very useful in scoping the problem: 'What few things must be the same so everything else can be different.' Increasingly standards are available, which have been designed elsewhere but which are applicable to ocean or marine data.

There are many IOC and IOC-related programmes and projects with a data management component. Presently there are also many mechanisms to coordinate the various individual ocean and marine data systems. Whilst these are essential to the continued operation of data management and the exchange of various data streams, an overarching coordination must be put into place to encourage adoption of standards, protocols, technologies, etc. The IODE and the JCOMM Data Management Coordination Group (DMCG) will coordinate this effort, through a 'Data and Information Management Advisory Group', and develop the implementation plan, building

on the existing expert groups and continuing close links with groups external to the IOC.

The organigram to the right shows the IOC Data and Information Management System with the central IOC Data and Information Management Advisory Group that will bring together the various programme elements of the IOC, as well as those of bodies and organizations collaborating closely with the IOC.

A key tool that will be developed as part of the system is the IODE Ocean Data Portal, the foundations of which were built in 2006 through the JCOMM/IODE ETDMP end-to-end data management prototype (E2EDM) (http://www.oceandataportal.net). The necessary technologies were tested in 2006-2007 and are now ready for wide implementation. In 2007, cooperation was also established between the E2EDM/ODP initiative and the World Meteorological Organization Information Systems (WIS).



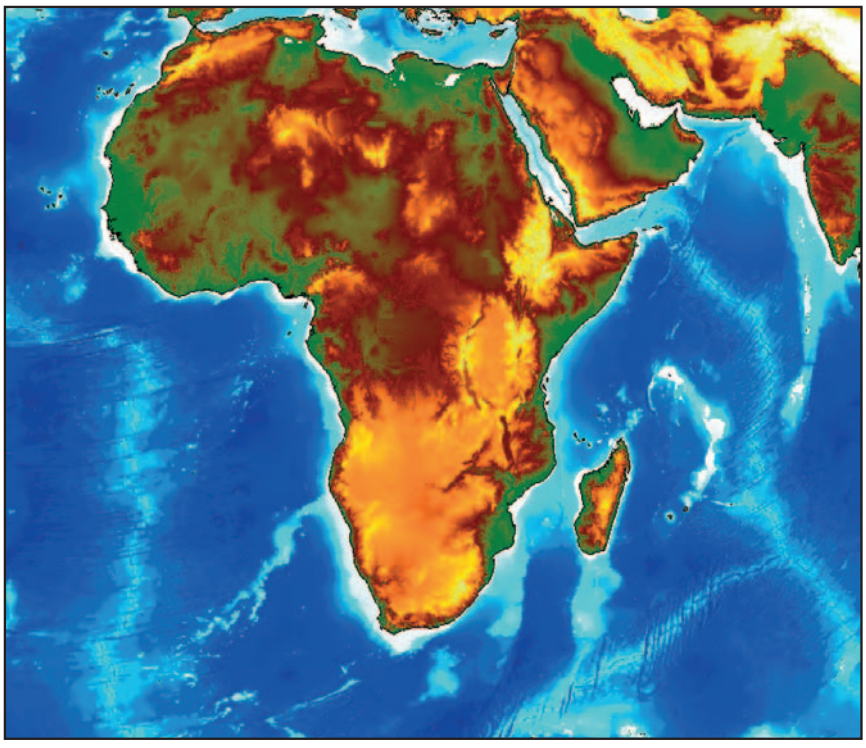
The IOC Data and Information Management System: the central IOC Data and Information Management Advisory Group will bring together the various programme elements of the IOC, as well as those of bodies and organizations collaborating closely with the IOC.

IODE continues building regional platforms for integrated capacity development

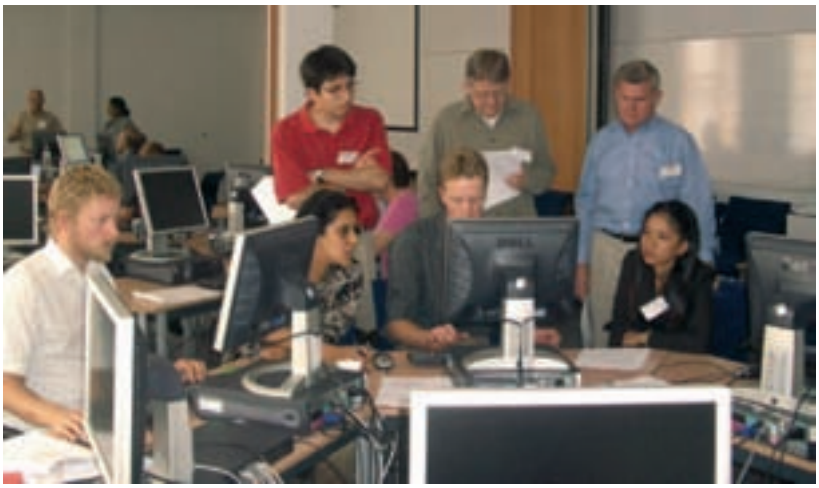
The Ocean Data and Information Network for Africa (ODINAFRICA) and Ocean Data and Information Network for the Caribbean and South America (ODINCARSA) have demonstrated the effectiveness of the ODIN approach: actions that assist Member States to develop ocean data and information management capability at the national level, as well as working together at the regional level to build joint products and services. The ODINAFRICA-III project has now almost reached its completion date (October 2008). The latest achievement is the development of the African Marine Atlas (http://www.africanmarineatlas.net).

Following the success of the African Marine Atlas, nine Member States in the Caribbean region embarked on the development of a Caribbean Marine Atlas (http://www.caribbeanmarineatlas.net) in 2007 with a pilot project that will lead to a sample Atlas by the end of 2008.

The development of ODINs is continuing steadily and networks are now established in addition to those already mentioned, for the Indian Ocean (ODINCINDIO), European Countries in Economic Transition (ODINECET), WESTPAC region (ODINWESTPAC) and Black Sea region (ODINBlackSea).



The latest achievement of the ODINAFRICA-III project is the development of the African Marine Atlas.



The IOC Project Office for IODE in Ostend, Belgium provides different kinds of training ranging from general marine data and information management courses to specialized courses, such as Geographical Information Systems, web development, digital modelling and related data issues.

The IOC Project Office for IODE, established in Ostend, Belgium in April 2005 is now the global training centre for Ocean Data and Information Management of the IODE Programme and is also increasingly used by other IOC and partner organizations and programmes.

Events during 2007 organized and supported, or co-funded, by IODE

- The New Partnership for Africa's Development Coastal and Marine programme (NEPAD COSMAR)/ ODINAFRICA Coordination Meeting, 1-2 February, IOC Project Office for IODE, Ostend, Belgium.
- SeaDataNet Data Management Training Course, 12-17 February, IOC Project Office for IODE, Ostend, Belgium.
- IODE-XIX: Nineteenth Session of the IOC Committee on IODE, 12-16 March, The Abdus Salam International Centre for Theoretical Physics (ICTP), Trieste, Italy.
- IODE/MarBEF Marine Biodiversity Data Management Course, 19-23 March, IOC Project Office for IODE, Ostend, Belgium.
- IODE/EC Project ASCABOS training for young scientists (issues related to capacity-building in the Black Sea region towards Operational Status of Oceanographic Services), 23-27 April, IOC Project Office for IODE, Ostend, Belgium.
- E-repository Training Course, 23-28 April, IOC Project Office for IODE, Ostend, Belgium.
- ODINAFRICA Marine Biodiversity Data Mobilization Workshop, 4-15 June, IOC Project Office for IODE, Ostend, Belgium.
- African Marine Atlas (AMA) Workshop (final), 4-8 June, IOC Project Office for IODE, Ostend, Belgium.
- Young Scientist Training Course, 4-9 June, IOC Project Office for IODE, Ostend, Belgium.
- BCP 2007 Training Course: A Training Course on Buoy Programme Implementation and Data Management, 11-15 June, IOC Project Office for IODE, Ostend, Belgium.
- GE-MIM-IX: Ninth Session of the IODE Group of Experts on Marine Information Management, 17-20 September, IOC Project Office for IODE, Ostend, Belgium.
- OBI '07: Oceans Biodiversity Conference 2007, 2-4 October, Dartmouth, Nova Scotia, Canada.
- Stakeholder Meeting towards the Development of a Caribbean Marine Atlas, 8-10 October, Barbados.
- Training on the Management of the End to End Data Management (E2EDM) Prototype System, 22-25 October, IOC Project Office for IODE, Ostend, Belgium.
- ODINAFRICA PSC: ODINAFRICA Project Management and Steering Committees, 13-16 November, IOC Project Office for IODE, Ostend, Belgium.
- ODINECET MIM Training: ODINECET Marine Information Management Training Course, 19-23 November, IOC Project Office for IODE, Ostend, Belgium.
- IODE Officers Meeting, 2007 Session, 27-30 November, IOC Project Office for IODE, Ostend, Belgium.
- MAN-VI: Joint Technical Commission for Oceanography and Marine Meteorology (JCOMM) Management Committee, Sixth Session, 3-6 December, UNESCO/IOC, Paris, France.

Progress made by the Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology

CANDYCE CLARK
JCOMM Secretariat

JCOMM has made progress in the past year in a number of key cross-cutting issues. Significant results and ongoing activities include:

(i) The Observations Programme Area estimates the *in situ* system has reached 60 per cent of the initial planned array, as specified in the 2004 Global Climate Observing System Implementation Plan (see details of the network coverage in Figure 2 on page 50). A major highlight was the deployment of the 3,000th profiling float in the Argo array (as detailed by the Argo Steering Team earlier on in this Annual Report). A major challenge will be both completing the entire array as well as sustaining all elements of the observing system.

(ii) The Services Programme Area has focused its activities toward oceanographic and meteorological requirements for Maritime Safety Systems, and is organizing itself to foster continuing support for ocean forecast systems after the end of the Global Ocean Data Assimiliation Experiment (GODAE).

(iii) The Data Management Programme Area has completed its Implementation Strategy and made significant progress working with the International Oceanographic Data and Information Exchange (IODE) on End to End Data Management (E2EDM), an oceans Data portal and the development of oceanographic data management and exchange standards.

(iv) Organization and conduct of the successful Scientific and Technical Symposium on Storm Surges, hosted by the Korean Government in Seoul, Republic of Korea, 2-6 October 2007.

(v) Finalization of a detailed JCOMM capacity-building strategy, which identifies the key strategic goals, as well as the means for achieving these.

(vi) Finalization of the Implementation Plan, now renamed the JCOMM Operating Plan, and the provision of JCOMM input to the overall reporting to the Executive Councils of the IOC and the World Meteorological Organization (WMO) on the implementation of the respective organizations' strategic plans.

(vii) Development of the rationale, structure and methodology for preparing a JCOMM virtual (web based) handbook on standards and best practices. This handbook will: (a) provide an easy access reference book and guide to all the existing material relating to standards and best practices prepared under JCOMM and its predecessors, covering observations, data management and services; (b) allow for the identification of gaps in such material; and (c) facilitate input to WMO Quality Management Framework (QMF) and International Organization for Standardization (ISO) accreditation.

(viii) Support for the International Polar Year and its legacy, including the proposed integrated Arctic Ocean Observing System (iAOOS) and the Southern Ocean Observing System (SOOS).

(ix) Progress in the establishment of an Observing Programme Support Centre to support the technical coordination of the Global Ocean Observing System (GOOS) and expand the existing highly regarded JCOMMOPS.

(x) Identification of key results and decisions in all programme and cross-cutting areas, for presentation to JCOMM-III in 2009.

Scientific and technical support for coastal hazard forecasting systems: JCOMM symposium on storm surges

BORAM LEE
Programme Specialist

Bangladesh, record holder of the worst cyclone-induced storm surges, was again battered by a major storm surge in November 2007. Thousands of houses along the southwestern coast were destroyed and 650,000 villagers fled to shelters immediately after the warning was issued; nevertheless a significant number of fishermen were feared drowned.

The national authority, as well as many international expert groups in storm surge modelling, produced and disseminated warnings to ensure timely evacuation. However, the predicted storm surge value of up to three metres was much below the actual reported levels. It was stated by many scientists and experts that any operational storm surge model in the world at the present time could not have predicted the intensity of this event close to the actual values.

This points to the necessity of upgrading the storm surge warning system for Bangladesh, and further for the entire globe.

This particular issue was discussed during the JCOMM Scientific and Technical Symposium on Storm Surges (2-6 October 2007, Seoul, Republic of Korea, http://www.surgesymposium.org). The experts participating in this symposium noted that, although a storm surge is a regional event, its causes may extend well beyond the region. They reported that two very important meteorological forcing terms, namely meso-scale and remote forcing, should be included in the operational models. None of the existing operational models has such a module at the present time.

Indeed, this was the case in Bangladesh: the simulation of this case making use of available data accounting for the contribution from the missing forcing terms resulted in a maximum surge level of about seven metres, close to the actual intensity of the storm surge caused by Cyclone Sidr. The additional contribution to the surge height was made up of edge waves, continental shelf waves and topographic Rossby waves.

Global efforts to improve regional storm surge models

The JCOMM Symposium on Storm Surges was the first such scientific event devoted solely to storm surges in at least the past three decades. It aimed to support the development of marine multi-hazard warning systems by providing a forum for the exchange of ideas related to storm surge modelling, forecasting and hindcasting. The JCOMM Expert Team on Wind Waves and Storm Surges (ETWS) played a major role in programming this symposium.

More than 120 experts from over 20 countries contributed to this effort, and were appreciative of the quality input and fruitful discussion during the symposium. Overall, it was deemed to be a great success.

The symposium also provided an excellent opportunity to exchange information on the status in different regions of storm surge analysis, modelling and warning services, and further to identify areas for future research and development.

A key component of the symposium was the panel discussion session, designed to draw conclusions and point the way forward in storm

surge modelling and forecasting. The agreed set of recommendations and actions were addressed to researchers, IOC-World Meteorological Organization and JCOMM, and Member States, covering the following subjects:

- Future research and development
- Research to operations
- Observations and data
- Capacity-building and outreach
- Future commitment.

Elaborating science to mitigate coastal disasters

The real impact on coastal areas is not from just one reason: various factors (such as sea level rise, increased storminess, inundation) combine and cause greater damage to low-lying coastal regions. One of the most important messages delivered at the JCOMM Symposium on Storm Surges was that in order to improve the predictability of coastal hazards, these various factors should be considered altogether.

Mr Javier Valladares, IOC Chairman, delivering his opening address.

The symposium inspired experts on storm surges around the world to move toward the next step for coastal prediction by working together with related communities. To improve the predictability of storm surge and coastal hazards, it is important to consider all related factors including hydrologic, hydraulic, meteorological, and oceanographic aspects. The symposium provided an opportunity for experts from various communities to discuss the common issue of mitigating coastal disasters through scientific and technical development. The discussion resulted in identifying clear ways and methods for future improvement.

In a recent survey of national agencies carried out by JCOMM it was apparent that very few climatologies of storm surge existed. The symposium was a milestone to raise awareness of this deficiency within the marine climate community, to propose steps to rectify this situation and to promote storm surge activity within the marine climatology envelope. This should be integrated with work on sea level and waves, in order to generate climate information on total water level.

Results from the symposium comprised the dynamic part of the JCOMM 'Storm Surge Manual'. Through peer review, selected presentations from this symposium are to published as special editions of the journals *Natural Hazards* (Springer, ISSN:0921-030X) and *Marine Geodesy* (Taylor and Francis Ltd, ISSN:0149-419).

Working in tandem for integrated coastal management

One of the strongest recommendations from the symposium was to strengthen collaboration between JCOMM and Integrated Coastal Area Management (ICAM) to increase recognition of the importance of the total water level problem in coastal prediction, as well as to provide sound scientific and technical input for the coastal management and decision-making process.

As Mr Javier Valladares, IOC Chairman, emphasized during his opening address, the symposium initiated close collaboration between two related activities – developing the JCOMM 'Storm Surge Manual' and developing the ICAM guidelines – to ensure consistent advice on scientific and technical development in the modelling, forecasting, and warning schemes in coastal zones and on storm surges in particular.

Storm surge modelling, along with wave modelling in the coastal and open ocean area, should carry forward toward an integrated coastal hazard prediction. In this context, a future symposium on storm surges will be convened in conjunction with the ongoing series of the International Workshop on Wave Hindcasting and Forecasting, and with the Coastal Hazard Symposium.

Slow but steady progress in open-ocean observations as the issue of climate change climbs the political ladder

ALBERT FISCHER
IOC Programme Specialist

In 2007, the issue of climate change moved decisively from the scientific sphere into the public and political arenas, starting in February 2007 with the release at UNESCO headquarters in Paris of the Intergovernmental Panel on Climate Change (IPCC) summary assessment *Climate Change 2007 – The Physical Science Basis*. It called the warming of the climate system 'unequivocal', stated it was 'very likely' due to human activity, and noted that the oceans had absorbed more than 80 per cent of the heat added to the climate system (shown in Figure 1).

The year was capped in December 2007 by the contentious United Nations Climate Change Conference in Bali, Indonesia, which finally agreed to further negotiations on mitigation and adaptation to climate change with a focus on finding political solutions by the end of 2009. During the year UNESCO developed a draft strategy for its response to climate change, which gives a prominent place to the Intergovernmental Oceanographic Commission and its actions in monitoring and researching the ocean climate system.

Many scientists felt a shift in their discourse with decision-makers, from that of one trying to identify evidence of the human influence on climate, to one that will, in future, need to support politicians with scientific knowledge. Such knowledge will help policy makers make specific decisions on how to mitigate greenhouse gas emissions and on how to adapt society to the impacts of a changing climate.

A robust ocean observing system will be needed to make more accurate regional climate forecasts of change and variability, to identify potential impacts of climate change on coastal regions and on precipita-

Secretary-General Ban Ki-moon addresses the opening of the High-Level segment of the United Nations Climate Change Conference in Bali, Indonesia, December 2007. *© UN Photo/Evan Schneider*

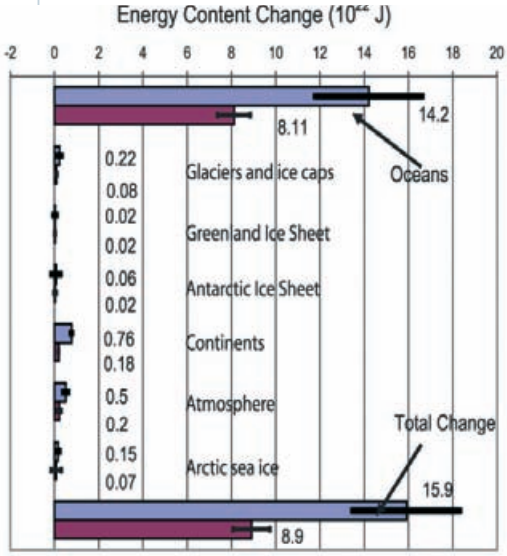


Fig. 1 *Energy content changes in different components of the Earth system for two periods (1961–2003 and 1993–2003). Blue bars are for 1961 to 2003, burgundy bars for 1993 to 2003. The ocean heat content change is from this section and Levitus et al. (2005c); glaciers, ice caps and Greenland and Antarctic Ice Sheets from Chapter 4; continental heat content from Beltrami et al. (2002); atmospheric energy content based on Trenberth et al. (2001); and arctic sea ice release from Hilmer and Lemke (2000). Positive energy content change means an increase in stored energy (i.e., heat content in oceans, latent heat from reduced ice or sea ice volumes, heat content in the continents excluding latent heat from permafrost changes, and latent and sensible heat and potential and kinetic energy in the atmosphere). All error estimates are 90% confidence intervals. No estimate of confidence is available for the continental heat gain. Some of the results have been scaled from published results for the two respective periods. Ocean heat content change for the period 1961 to 2003 is for the 0 to 3,000 m layer. The period 1993 to 2003 is for the 0 to 700 m (or 750 m) layer and is computed as an average of the trends from Ishii et al. (2006), Levitus et al. (2005a) and Willis et al. (2004).*

Reproduced from Climate Change 2007 – The Physical Science Basis *Working Group I, Contribution to the Fourth Assessment Report of the IPCC.*

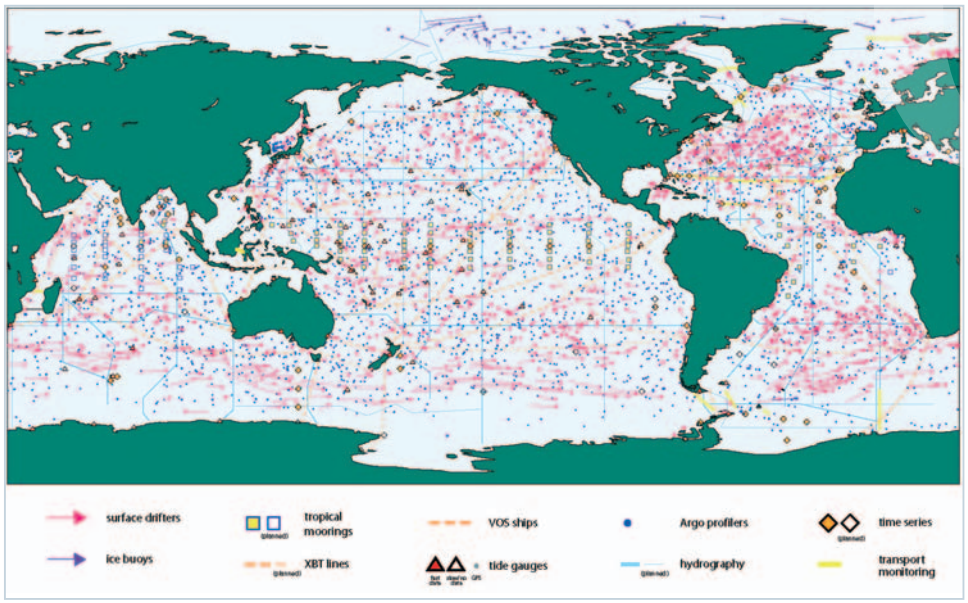


Fig. 2 The *in situ* elements of the open-ocean component of GOOS at the end of 2007 were estimated to be at 60% of the planned network coverage, with density highest in the North Atlantic.

tion patterns, and to underpin the scientific research that helps increase our knowledge and forecasting capability.

The open-ocean component of GOOS made slow but steady progress towards the goals outlined in the 2004 Global Climate Observing System (GCOS) Implementation Plan, with the JCOMM Observations Programme Area estimating the *in situ* system at 60 per cent of its planned density at the end of 2007 (see Figure 2 above). The Eighth Session of the IOC-WMO-UNEP Intergovernmental Committee for GOOS (I-GOOS-VIII) at UNESCO headquarters in Paris, France, 13-16 June, focused in part on a stock-taking of national contributions to GOOS, but made only marginal progress in getting commitments from nations for sustained support of the system.

A major highlight in the implementation of the open-ocean component of GOOS came from the Argo profiling float array, as it reached its target of 3,000 active floats in November 2007 (as detailed by the Argo Steering Team earlier on in this Annual Report). Constant effort will be needed to sustain the array at its target density, and to build and sustain the other elements of the observing system. Further challenges faced by the open-ocean observing system are the continuity of critical ocean satellite missions, as well as finding national models that maintain a base of sustained support for the observations that allow scientific innovation. Researchers continue to be the primary customer and primary implementer of the observing system.

The Ocean Observations Panel for Climate (OOPC), which makes scientific recommendations for the open-ocean component of GOOS, focused the initial network on the physical system. In 2007, the OOPC continued a process of working with scientific groups that will extend the recommendations for the system towards global biogeochemical and ecosystems observations, taking into account the evolution of observing technology and better responding to the needs both of the scientific community and of society.

None of the challenges cited above are new. The Member States of the IOC will need to continue and redouble their national efforts in building and arguing for the merits of the Global Ocean Observing System in order to reap the future benefits.

Ocean sciences

JULIAN BARBIÈRE
Acting Head of Section

It was an intense year for the Ocean Sciences section. In June 2007, the Twenty-fourth Session of the IOC Assembly passed a resolution emphasizing the section's following priorities for the 2008-2009 biennium and beyond:

(i) The role of the ocean in climate variability and climate change, and the impacts of climate variability and climate change on the marine environment and on its living resources and ecosystems;

(ii) Coastal research as a primary element, including: climate impacts, direct human influences on coastal-ocean functioning and ecosystem health, integrated coastal management, natural marine hazards, and forecasting;

(iii) Science and modelling for the prevention and reduction of the impacts of natural hazards, including tsunamis;

(iv) Marine assessment as a primary element, with emphasis on the science that will underpin the Regular Process for GRAME, and its Assessment of Assessments;

(v) Marine modelling as a basic and cross-cutting element of IOC programmes.

Climate impacts on the marine environment

The **International Ocean Carbon Coordination Project (IOCCP)**, co-sponsored by the Scientific Committee on Oceanic Research (SCOR), continued its work to promote the development of a global network of ocean carbon observations for research. In February, IOC, SCOR, the IAEA-Marine Environmental Laboratory, and the International Geosphere-Biosphere Programme (IGBP) initiated plans for the second 'Ocean in a High CO_2 World' conference, to be held in Monaco in October 2008, to assess what is known about ocean acidification. In April, the International Ocean Carbon Coordination Project (IOCCP), SOLAS[1], IMBER[2], and the Global Carbon Project co-sponsored the Surface Ocean CO_2 Variability and Vulnerability Workshop, which brought together over one hundred scientists from twenty countries to review the current knowledge base and enhance international cooperation to resolve the magnitude, variability and processes governing ocean sources and sinks of carbon. A special issue of the journal *Deep-Sea Research-II* is in final preparation. As a follow-

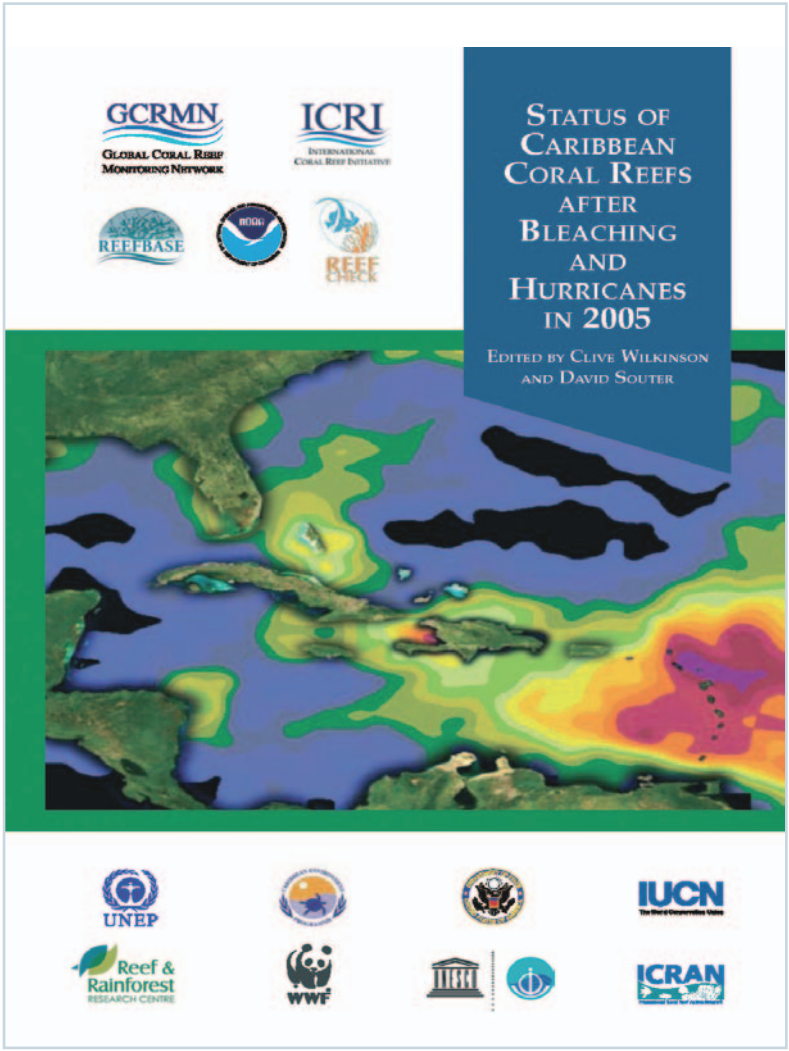
1. The SOLAS (Surface Ocean Lower Atmosphere Study) Research Network.
2. IMBER (Integrated Marine Biogeochemistry and Ecosystem Research Project).

up activity, the Surface Ocean CO_2 Atlas (SOCAT) project was initiated to develop a common format global data base and gridded data product of publicly available surface CO_2 data, building on an initial database composed of more than 1,250 cruises from 1972-2007 with approximately 4.5 million measurements of carbon parameters. In November, IOCCP, CLIVAR[3], SOLAS, and IMBER established the Global Ocean Ship-based Hydrographic Investigations Panel (GO-SHIP) to develop an integrated strategy for post-CLIVAR hydrography. In December, final editing was completed on the PICES4-IOCCP *Guide to Best Practices for Ocean CO_2 Measurements*, which was published in early 2008. www.ioccp.org

The IGBP-IOC-SCOR core project, **GLOBEC International**, aims to advance our understanding of the structure and functioning of the global ocean ecosystem, its major subsystems, and its response to physical forcing so that a capability can be developed to forecast the responses of the marine ecosystem to global change. GLOBEC is in its synthesis phase with a focus on a number of major symposia and publications, and will complete its activities in December 2009. GLOBEC was highly active in 2007, hosting twenty-nine workshops/symposia, publishing five special issues (in *Deep Sea Research, Progress in Oceanography, Journal of Marine Systems and Ecological Modelling*), four GLOBEC Reports and two Newsletter issues. The most significant activities were:

i) The GLOBEC ESSAS workshops on 'The role of seasonal sea ice cover in marine ecosystems' and on 'Evaluation of future climate scenarios in Sub-Arctic regions' in June in Hakodate, Japan;
ii) The ICES[5]-GLOBEC Workshop on 'The integration of environmental information into fisheries management strategies and advice' (WKEFA) in June in Copenhagen, Denmark;
iii) The meeting of the lead authors of the GLOBEC synthesis book in July in Dartington, UK;
iv) The GLOBEC CLIOTOP First Symposium 'Climate impacts on oceanic top predators' in December in La Paz, Mexico;
v) The GLOBEC/PICES/ICES Fourth International Zooplankton Production Symposium 'Human and climate forcing of zooplankton populations' in May in Hiroshima, Japan; and
vi) The GLOBEC National Synthesis Symposia (March in Valencia, Spain; and November in Hamburg, Germany) and Regional Synthesis Symposia in Southern Africa (BENEFIT Symposium, November in Swakopmund, Namibia) and Southeast Asia (December, Hokkaido, Japan).

Details on GLOBEC integration and synthesis activites can be found at (www.globec.org).

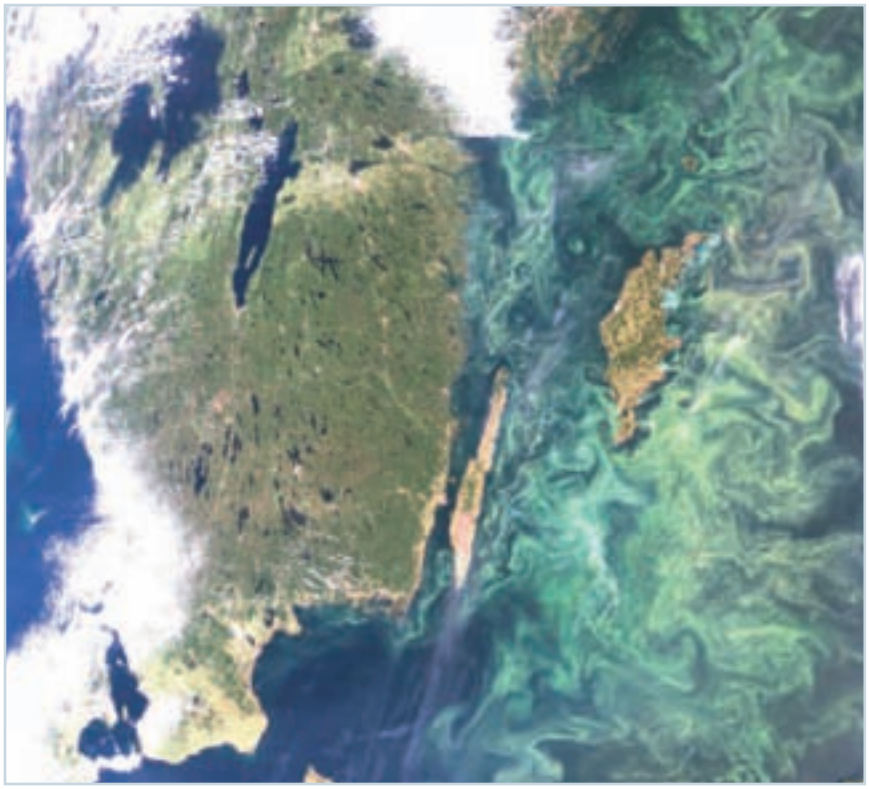


The latest GCRMN Status Report was released in January 2008. The year 2005 was the warmest year in the Northern Hemisphere since 1998 and as the year progressed there were alarming levels of coral bleaching throughout the wider Caribbean.

3. Climate Variability and Predictability Study (CLIVAR)
4. The North Pacific Marine Science Organization (PICES)
5. The International Council for the Exploration of the Sea (ICES)

The Global Coral Reef Monitoring Network (GCRMN) is a joint undertaking of the IOC, the United Nations Environment Programme (UNEP), the Global Environment Facility (GEF), the Convention on Biological Diversity (CBD), the International Coral Reef Initiative (ICRI), the Australian Institute of Marine Science (AIMS) and the World Fish Center. The GCRMN works to improve management and conservation of coral reefs by providing manuals, equipment, databases, training, problem solving, and helps with finding funds for reef monitoring; all coordinated in a global network. The year 2005 was the warmest year in the Northern Hemisphere since 1998 and as the year progressed there were alarming levels of coral bleaching throughout the wider Caribbean. The GCRMN Report *Status of Caribbean Coral Reefs Following Bleaching and Hurricanes in 2005* was written throughout 2007 and published in January 2008. The book has 152 pages with chapters on bleaching, hurricanes, prediction and a special feature with extracts from Coral-List detailing the sequence of events in 2005.

The GCRMN SocMon (Socioeconomic Monitoring Initiative for Coastal Management) formed a SocMon Advisory Committee. SocMon has produced user manuals for Southeast Asia, the Western Indian Ocean, the Pacific and the Caribbean. These manuals have been produced in English and local languages, as appropriate. Planning is well advanced for SocMon manuals for the Red Sea and South Asia. The GCRMN is also producing the CoReMo III database for release in 2008 to assist developing countries manage monitoring data. During 2007, the GCRMN started to prepare the 'Status of Coral Reefs of the World: 2008' which is scheduled for publication in October 2008.



UNESCO/IOC training courses assist Member States to enhance their capacity to manage and mitigate harmful algal events.

Integrated coastal research

Harmful Algal Blooms (HAB)

The IOC HAB programme has two main foci: (i) to facilitate and focus international research toward improved operational capabilities for modelling and forecasting harmful algal events and thereby protecting resources, human health, markets and the environment in which harmful algal event occur; and (ii) to provide opportunities for self driven capacity development in developing Member States facing problems caused by harmful microalgae to their fisheries, aquaculture, tourism, human health, etc.

The IOC-SCOR Global Ecology and Oceanography of Harmful Algal Blooms programme, (GEOHAB) has been established to focus and stimulate international cooperative research. It also implements a series of core research projects addressing harmful algae in eutrophic, stratified, upwelling systems, fjords and coastal embayments. It is central to the overall objectives of GEOHAB to deliver understanding and results that will enable improved observation and forecasting systems. The GEOHAB Scientific Steering Committee is working with the GOOS Scientific Steering Committee in this respect. More details can be found at (www.geohab.info).

During 2007 training courses assisting Member States to enhance their capacity to manage and mitigate harmful algal events were implemented for South America 19-30 November in Argentina; for North Africa 18-20 October in Morocco; for Southern Africa 7-11 May in Namibia; for Latin America and North Africa 7-23 February at the IOC Science and Communication Centre on Harmful Algae in Vigo, Spain; as an international course at the IOC Science and Communication Centre on Harmful Algae, University of Copenhagen, Denmark; as E-learning May-June; and a practical course and examination 20-30 August. As of 2006, the interna-

tional courses are offered as an identification qualification in harmful marine microalgae. Furthermore, the IOC Science and Communication Centres on Harmful Algae at the Spanish Institute of Oceanography, Vigo, Spain and at University of Copenhagen received individual training visits and Ph.D. students in cooperation with the host institutions. In the WESTPAC region, capacity development is offered within the framework of a Training Through Research network where participants are collaborating over a three-year period and being trained in research methods.

At the regional level, the HAB programme has established networks that serve both as platform for the implementation of IOC activities as well as for activities implemented among members of the network. The networks formulate biannual workplans that are submitted to the IOC Intergovernmental Panel on Harmful Algal Blooms (IPHAB). The networks are: Harmful Algae in North Africa (HANA); Harmful Algae in the Caribbean (ANCA); Harmful Algae in South America (FANSA); and WESTPAC/HAB. These networks strengthen regional knowledge sharing and give strong root to the IOC HAB programme in the regions. At the global level the programme provides a network to more than 2,000 subscribers through the publication of the IOC newsletter *Harmful Algae News*.

The ICES-IOC Working Group on Harmful Algal Blooms Dynamics acts as a scientific forum for formulating new programme elements and ideas as well as a review group for the data compiled in the IOC-ICES-PICES Harmful Algal Information System. The ICES-IOC-SCOR Working Group on GEOHAB Implementation in the Baltic has been established to develop and implement a cooperative GEOHAB research project in the Baltic. The ICES-IOC-IMO Working Group on Ballast of Ships and Other Vectors is providing scientific input to the process in the International Maritime Organization (IMO) revolving around the development of guidelines for the implementation of the IMO Ballast Water Convention.

The IOC HAB programme is developed and reviewed by IPHAB, which is a platform for Member State representatives to agree on priorities in international cooperation regarding HABs. The programme office has been decentralized to the IOC Science and Communication Centre on Harmful Algae, at University of Copenhagen, Denmark.

Integrated Coastal Area Management (ICAM)

Following the work carried out in the last and previous biennium, the IOC is continuing its work on the development of methodologies and tools for Integrated Coastal Area Management. A new initiative, jointly implemented with the IOC Tsunami Unit, concerns the development of a set of international guidelines on the mitigation of coastal hazards (namely tsunami, storm surges, and other sea level related hazards) through ICAM. This project is being carried out in response to specific requests from Member States to develop guidelines on the development and integration of hazard awareness, emergency preparedness and mitigation, and adaptation practices into coastal development planning within the wider ICAM framework. These guidelines are being defined by an international expert group convened from a wide range of relevant disciplines, including representatives of United Nations organizations (UNEP[6], UNU[7], WMO[8]) and the prospective IOC-coordinated Global Ocean-related Hazards Warning and Mitigation System, known as GOHWMS. This group, activated for a period of eighteen months, started its work in the occasion of the First Expert Group Meeting at UNESCO/IOC headquarters in Paris, France, 31 May-1 June 2007. A second meeting was organised in Lisbon, Portugal in November 2007. The guidelines should be published by the end of 2008.

Building on the existing collaboration with the Permanent South Pacific Commission (CPPS) and the previous work on ICAM indicators (*A Handbook for Measuring the Progress and Outcomes of Integrated Coastal and Ocean Management,* IOC Manuals and Guides 46), IOC has launched the preparation of a new project, the SPINCAM Project, designed to establish an ICAM indicator framework in each country of the CPPS region (Chile, Colombia, Ecuador, Panama and Peru), focusing on environmental and socio-economic conditions within the context of sustainable development and integrated coastal area management. A planning meeting to finalize the project proposal was organized with country representatives and CPPS in January 2007, at the IOCARIBE Secretariat in Cartagena, Colombia. The project will be implemented over a three-year period and is partly funded by the Government of Flanders (Belgium). Funding for the proposal was finally granted in April 2008 and the project will start in June 2008. More information about this project can be found in the IOCARIBE article further on in the Regional Activities section of this Annual Report.

Work on Marine Spatial Planning (MSP) continues effectively and successfully under the technical leadership of consultants, Dr Charles Ehler and Ms Fanny Douvere, and the direct supervision of the IOC and the Man and Biosphere (MAB) programme.

After the publication of the report, *Visions for a Sea Change* (IOC Manuals and Guides 48) in 2007, a project proposal was jointly prepared by the IOC and MAB and successfully submitted to the Moore and Packard Foundations for funding. The aim of the project is to develop a set of international guidelines on ecosystem-based Marine Spatial Management. Future steps will involve identifying pilot sites and testing the above-mentioned guidelines. The Ha Long Bay World Heritage site and Cat Bà Biosphere Reserve in Viet Nam and the Gulf of Mannar Biosphere Reserve in India have been identified among the pilot sites.

Marine assessments

The Regular Process

The World Summit on Sustainable Development (Johannesburg, South Africa, 26 August-4 September 2002) agreed to establish by 2004 a regular process under the United Nations for the global reporting and assessment of the state of the marine environment, including socio-economic aspects, both current and foreseeable, building on existing regional assessments (called 'the Regular Process'). After several years of debate and subsequent UN General Assembly resolutions, a mandate was given in 2005 to IOC and UNEP to implement the first phase of the Regular Process for Global Reporting and Assessment of the State of the Marine Environment (Regular Process).

The first phase, known as the Assessment of Assessments (AoA), started its work in March 2007, with the organization of the First Group of Experts meeting held at the UNESCO/IOC Headquarters in Paris. The AoA's primary aims are to assemble information on, and carry out a constructive appraisal of, past or ongoing assessments relevant to the marine environment; to identify gaps and uncertainties in scientific knowledge and current assessment practices and assess how these assessments have been communicated to policy makers at the national, regional and global levels; and to produce a framework and options for establishing the Regular Process itself.

The organizational elements of the AoA include: (i) an ad hoc Steering Group to oversee the implementation of the AoA, which is composed of Member States representatives; (ii) two United Nations agencies to co-lead the process (IOC and UNEP); and (iii) a dedicated Group of Experts to undertake the AoA.

A second meeting was also held in Paris, France in November 2007. The final AoA report is expected to be ready in June 2009 and then submitted to the UN General Assembly (UNGA) for its follow up.

For more information, please see (www.unga-regular-process.org).

High Seas Biodiversity

Following the recent international debate on issues related to the conservation and sustainable use of marine biodiversity beyond areas of national jurisdiction (which led to the establishment of an Ad Hoc Working Group by the UN Assembly in 2004), an International Workshop on Biogeographic Classification Systems in Open Ocean and Deep Seabed Areas Beyond National Jurisdiction was convened in Mexico, 22-24 January 2007, at the Universidad Nacional Autónoma de Mexico (UNAM), Mexico City. The workshop was coordinated by the Institute of Marine Sciences and Limnology (ICML) of UNAM, the National Commission for the Study and Utilization of Biodiversity (CONABIO), the Intergovernmental Oceanographic Commission (IOC) of UNESCO and the International Union for Conservation of Nature (IUCN). The workshop was funded by Australia, Canada, Mexico and the J.M. Kaplan Fund under the co-sponsorship of IOC/UNESCO.

This workshop represented a major step in consolidating efforts to develop a comprehensive biogeographic classification of open-ocean and deep seabed areas beyond national jurisdictions. The workshop built on existing relevant global and regional collaborative research programmes; the experience of coastal States and regional management bodies in developing representative classification systems; and the latest information made available from science experts. The main output of the Mexico workshop is a state of the art report on Global Open Oceans and Deep Sea-Habitats (GOODS) bioregionalization. The GOODS Report was peer-reviewed and submitted to the Conference of the Parties of the Convention on Biological Diversity. GOODS achievements were also presented to the second meeting of the Ad Hoc Open-ended Informal Working Group to study issues relating to the conservation and sustainable use of marine biological diversity beyond areas of national jurisdiction, held 28 April-2 May 2008. The final GOODS report will be published by UNESCO/IOC in October 2008. Follow-up activities are now planned by the Mexico workshop organizers.

6. The United Nations Environment Programme (UNEP)
7. The United Nations University (UNU)
8. The World Meteorological Organization (WMO)

Coping with sea level related hazards: Increasing awareness, reducing risk

RUSSELL ARTHURTON
UNESCO Consultant

Following a field career spanning thirty-five years with the British Geological Survey (NERC), including assignments in Hong Kong, Iran and Pakistan, Russell Arthurton is an independent consultant in environmental science, with a focus on land-ocean interaction issues. He has worked on water-related projects with LOICZ-IGBP[1] and the United Nations Environment Programme (Africa Environment Outlook 2 and Global Environment Outlook 4), as well as on various coastal management topics for UNESCO/IOC. He is currently working with UNESCO/IOC on tsunami and other sea level related hazards and has particular training and coastal research interests in the Western Indian Ocean region.

UNESCO/IOC's programmes in respect to sea level related hazards focus on 'end-to-end' early warning systems, risk assessment of coastal communities through the assessment of its hazard and vulnerability components, and the effective reduction of risk through awareness, preparedness and strategic responses, both structural and adaptive.

1. International Geosphere-Biosphere Programme, Land-Ocean Interactions in the Coastal Zone

For centuries, tsunami and storm surge hazard events have been known to result in catastrophic loss of life and economic damage through the inundation of low-lying coastal areas. The disasters in the Indian Ocean tsunami of 2004 and the storm surge associated with the Hurricane Katrina in 2005 have given a fresh impetus to improving our understanding of such events and to extending the global provision of detection and early warning systems for these devastating hazards.

UNESCO/IOC and JCOMM (the Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology) is at the forefront of these activities. In addition, UNESCO/IOC, through its Integrated Coastal Area Management (ICAM) programme (http://ioc3.unesco.org/icam/), is addressing the needs of Member States by compiling guidelines for coping with all sea level related marine hazards. These hazards include extreme wind-forced waves and those occurring over much longer timescales, namely sea level rise and coastal erosion.

Assessing risk, probability and vulnerability

A key element of an effective warning system for any natural hazard event is an awareness of the risks posed by that hazard to the community and its supporting assets. A careful and credible assessment of these risks is needed by policy makers in order to determine appropriate courses of action for risk reduction. There are two aspects of awareness. One concerns the nature of the hazard, its location, magnitude and frequency expressed in terms of the probability of its occurrence. The other is about the vulnerability of the community in its exposure to the hazard.

Knowledge of the probability of a sea level hazard event is an essential part of risk assessment. For the long-term or 'creeping' hazards of sea level rise and coastal erosion, this knowledge can usually be acquired with a high level of confidence. The rates of global sea level rise are being determined with ever-greater precision despite the uncertainties associated with climate change. Even where there are local variations in the rates of sea level change due, for example, to differential movements of the Earth's crust, the probability of the hazard can be forecast with some assurance. For countries that are subject to sea level hazards caused by physical atmospheric forcing – notably storm surges and extreme wind-forced waves – the probability of these events is linked inextricably with atmospheric events including tropical cyclones and extra-tropical storms. The documented record provides the data needed to determine the likely geographic coverage, frequencies and magnitudes of these extreme events, while modelling may give indications of how these in-

cidences may be modified by climate change.

The probabilities of tsunami events are by far the most difficult to determine, both in magnitude and frequency. Unlike storm surges, tsunamis are caused by geological events that are largely unpredictable within the time scale of relevance to coastal policy makers. They are an ocean's response to a sudden vertical displacement of its floor, whether by earthquake, volcanism or submarine landslide. Again, the documented record gives an indication of the geographic extent of tsunami impacts, while a growing knowledge of the Earth's tectonic environment is providing information on earthquake hot spots and active arcs. Nevertheless, even with this information, there are many coastal countries where the incidence of tsunamis is so sporadic that estimations of probability are bound to have low levels of confidence.

For tsunamis and the atmosphere-driven hazards of storm surges and extreme waves, the coastal facing direction, inshore bathymetry and coastal topography (including existing coastal defences) are all important modifiers of the hazard's magnitude. The height of a tsunami wave may increase greatly as it traverses the nearshore zone and the force of the wave may cause a runup of the inundation of coastal lowland to heights well in excess of the wave height at the shore. Similarly with a storm surge, a shoaling bathymetry towards the shore causes a buildup of the surge level that exacerbates the inundation of coastal lowland. For both of these hazards, the modelling of a range of scenarios can provide predictions

The probabilities of tsunami events are by far the most difficult to determine, both in magnitude and frequency.

of inundation, usually expressed through inundation mapping, that provide much of the basis for the risk assessment. The methodologies of storm surge inundation modelling, as well as the broader aspects of storm surge forecasting, are described in the 'Storm Surge Manual', recently compiled by JCOMM.[2]

The second essential part of the risk assessment process involves measuring or assessing the vulnerability of the coastal community. Vulnerability is an intrinsic state with respect to each of the sea level related hazards. For example, whereas a community's vulnerability to sea level rise might be very high, it may be relatively low to storm surge. A further complexity in this assessment is the recognition of various dimensions of vulnerability in the community. 'Social vulnerability' covers the safety and security of people (including sensitive locations such as schools and hospitals); 'economic vulnerability', economic assets including utilities infrastructure; 'ecological vulnerability', ecosystems that support human well-being (for example, through food resources or wave buffering); and 'institutional vulnerability' that considers the capacity of local authorities and agencies to cope under emergency conditions. For each of these dimensions, and within a defined geographical management unit, judgements are made on the levels of vulnerability with reference to the inundation maps produced by the hazard assessment. These vulnerability levels may be expressed as zoned vulnerability maps with hot spots identified. The vulnerability maps and their hot spots need to be reviewed in line with societal and land use changes, particularly those resulting from the rapid urbanization of low-lying coastal areas.

For each hazard, the level of risk can be determined for each of the vulnerability dimensions as the product of

Disasters such as the storm surge associated with the Hurricane Katrina in 2005 have given a fresh impetus to improving our understanding of such events and to extending the global provision of detection and early warning systems for these devastating hazards.

Photo courtesy of Dr Donald Resio

2.'Storm Surge Manual' available for download at http://www.jcomm.info/index.php?option=com_oe&task=viewDocumentRecord&docID=1437.

the probability of the hazard event and the assessed level of vulnerability. These risk assessments are qualitative judgements based on the best available science. They represent the knowledge that is available to policy makers and coastal management practitioners that can potentially support their decision-making with the aim of risk reduction.

Turning knowledge and awareness into risk reduction

Connecting knowledge of the risks to the appropriate application of that knowledge in risk management response – bridging the science-practice interface – is a major challenge that is the subject of much research. Experience of the Indian Ocean tsunami of 2004 and the storm surge associated with Hurricane Katrina of 2005 has highlighted the limitations of existing institutional structures and systems in translating such knowledge and awareness into responses that are effective in reducing risk. These shortcomings apply not only to preparedness and emergency response procedures but also to the ways in which coastal communities, through improved governance, could reduce their own exposure and vulnerability to the hazards by strategic measures of structural mitigation and adaptation.

The impediments to the effective bridging of the science-practice interface are complex. They may be the consequences of dysfunctional governance at many levels. In developed and developing countries alike, decision-making may be hampered by commercial pressures and the clashing or competing interests of different agencies. Part of the difficulty may also involve the knowledge producers – the science research community – who may be poorly connected to the users of its research, the policy makers and practitioners. One of the ways in which the science-practice interface may be improved is to enhance the involvement and co-ownership of the user community and public in the research agenda. This may help to establish the credibility, legitimacy and relevance of the research-based knowledge output among practitioners, and to lower the barriers to the take-up of risk assessment findings by policy makers.

Integrated Coastal Area Management (ICAM): Collaboration for risk management

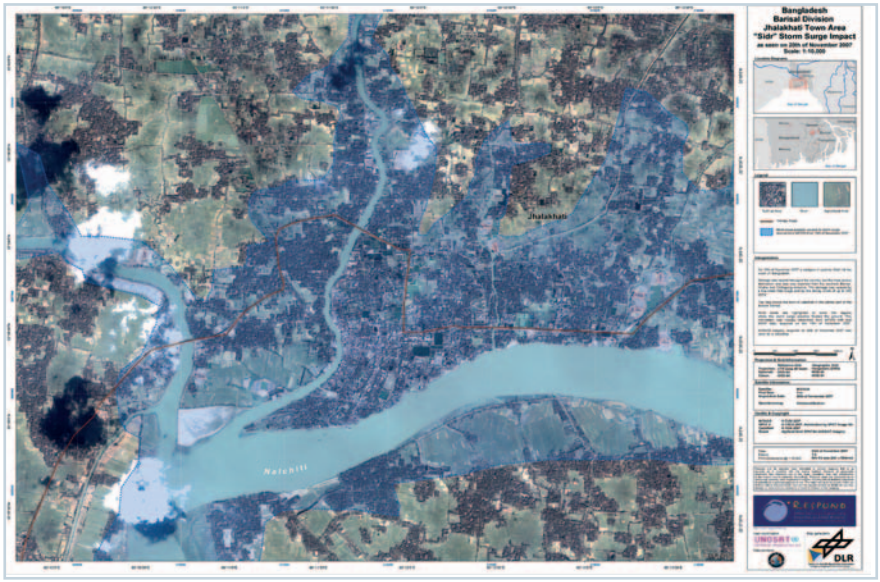
The ICAM process may help to resolve many of these barriers to the application of successful risk reduction measures, providing a forum for all stakeholders to develop consensual decision-making that benefits the community as a whole. The ICAM approach promotes sustainability and the effective management of ecosystems that support the coastal community, both of which are important considerations in the present conditions of rapid societal change (notably the growth of coastal megacities) and environmental change (e.g. sea level rise, increased storminess) in low-lying coastal areas across the globe.

Although they may not yet be implemented, the management options for reducing risk from natural hazards are generally well known and understood, thanks to work by a wide range of national and international bodies (notably the UN International Strategy for Disaster Reduction) and non-governmental organizations as well as private sector interests. In particular, following the Indian Ocean event of 2004, much guidance has been issued about preparing coastal communities to cope with tsunamis.

Tsunami Warning Systems (TWSs)

UNESCO/IOC is contributing to the goal of tsunami risk reduction by co-ordinating the establishment of three new tsunami warning systems (TWS) to be owned and operated by Member States (http://www.ioc-tsunami.org/). The new systems cover the Indian Ocean (IOTWS); the Northeastern Atlantic, Mediterranean and Connected Seas (NEAMTWS); and the Caribbean (CARIBE-EWS). Like the PTWS (established initially as ITSU in 1968) currently covering the Pacific Ocean, the new systems will collect, interpret and distribute all available seismic and sea level data indicating the possible existence and propagation of a tsunami. Alerts will be transmitted to national warning centres that will issue warnings to coastal communities at risk. When fully operational, the new systems are envisaged as having multi-hazard capability, including warning of storm surges.

The provision of early warning facilities to coastal communities is a key part of the development of the preparedness of those communities for coping with the sudden onset or catastrophic hazards of tsunamis and storm surges. The other crucial part of community preparedness is about knowing what to do in the event of a warning. The planning and practising of emergency evacuation and of procedures for dealing with vulnerable people and utilities infrastructure are priorities. These plans will be informed by the inundation, vulnerability and risk mapping information produced by the risk assessment procedure. A particular challenge for local authorities and agencies is to maintain an awareness



Satellite image showing impact of Bangladesh storm surge, 2007. When fully operational, the new tsunami warning systems are envisaged as having multi-hazard capability, including warning of storm surges.

Every effort must be made to place realistic levels on the risks. Just as risks should not be understated, so should they not be overstated, thus diminishing their credibility over the long term.

of hazard events that may recur only after lapses of several decades or even centennia. Here, education may offer a means of maintaining awareness in the collective memory. There may also be a need to review plans and procedures in line with societal and environmental changes over the decades. The new tsunami warning systems, with their 'end-to-end' remits, include warning training, emergency response and preparedness within their comprehensive risk reduction programmes.

Structural and adaptive responses

Other management options for risk reduction are more strategic and are about planning for the longer term. Essentially these options are of two types: structural responses that eliminate or reduce the hazard's impact on coastal communities; and adaptive responses that are about changing human behaviour. These responses are not mutually exclusive and strategic risk management programmes for coping with sea level related hazards may include a mix of approaches. The risk reduction responses, structural and adaptive, can be facilitated through the ICAM process, involving and negotiating the interests of all coastal stakeholders.

In general, the structural schemes involve hard (e.g. estuarine barrages, concrete seawalls, offshore breakwaters) or soft (e.g. dune restoration) engineering. They are usually expensive and may be unsustainable over a planning timescale of decades. They tend to be employed only for the protection of high-value assets for which relocation is not considered feasible.

Adaptive responses aimed at risk reduction cover wide spatial and temporal ranges. They may be policy driven and incorporated in national legislation, such as the introduction of set-back lines constraining development on coastal land subject to inundation or erosion. Or they may entail codes of practice, such as building regulations, to improve a community's resilience to flooding events. They may involve the enforcement of land use plans and relocation to reduce the risks to vulnerable communities. Adaptive responses are potentially sustainable options and, compared with structural solutions, may be inexpensive. Their successful implementation assumes compliance on the part of the community.

Challenges to implementation

Compliance with risk reduction measures can be fostered by the ICAM process, particularly if the community feels some ownership of the policy and management decision-making and regards the risk assessments as credible. Consequently, every effort must be made to place realistic levels on the risks. Just as risks should not be understated, so should they not be overstated, thus diminishing their credibility over the long term. While the levels of vulnerability in respect of the various hazard scenarios may be accepted by most coastal communities, the low probabilities of storm surges and, more particularly, tsunamis affecting many of the world's coasts may make the risks seem so remote that no expensive response actions are undertaken. In such circumstances, the best that may be achieved is that coastal managers take all reasonable steps to minimize risk, for example, through sustainable land use planning in low-lying coastal areas and education.

Ocean Carbon programmes

MARIA HOOD
Programme Specialist

The International Ocean Carbon Coordination Project (IOCCP), co-sponsored by the Scientific Committee on Oceanic Research (SCOR), continued its work to promote the development of a global network of ocean carbon observations for research.

In February, IOC, SCOR, the International Atomic Energy Agency Marine Environmental Laboratories (IAEA-MEL), and the International Geosphere-Biosphere Programme (IGBP) initiated plans for the second 'Ocean in a High CO_2 World' conference, to be held in Monaco in October 2008, in order to assess what is known about ocean acidification.

In April, the IOCCP, The Surface Ocean-Lower Atmosphere Study (SOLAS), the Integrated Marine Biogeochemistry and Ecosystem Research (IMBER) Project and the Global Carbon Project co-sponsored the Surface Ocean CO_2 Variability and Vulnerability Workshop, which brought together over one hundred scientists from twenty countries to review the current knowledge base and enhance international cooperation to resolve the magnitude, variability and processes governing ocean sources and sinks of carbon. A special issue of the journal *Deep-Sea Research-II* is in final preparation. As a follow-up activity, the Surface Ocean CO_2 Atlas (SOCAT) project was initiated to develop a common format global database and gridded data product of publicly available surface CO_2 data, building on an initial database composed of more than 1,250 cruises from 1972-2007 with approximately 4.5 million measurements of carbon parameters.

In November, IOCCP, CLIVAR, SOLAS, and IMBER established the Global Ocean Ship-based Hydrographic Investigations Panel (GO-SHIP) to develop an integrated strategy for post-CLIVAR hydrography.

In December, final editing was completed on the North Pacific Marine Science Organization (PICES)-IOCCP *Guide to Best Practices for Ocean CO_2 Measurements* (published in early 2008). See cover above.

Find out more about IOCCP activities: www.ioccp.org

1.Dickson, A.G., Sabine, C.L. and Christian, J.R. (Eds.) 2007. *Guide to best practices for ocean CO_2 measurements*. PICES Special Publication 3, 191 pp.

Reflections from the Global Ecology and Oceanography of Harmful Algal Blooms (GEOHAB) Scientific Steering Committee

ICARUS ALLEN is a marine ecosystem modeller with an interest in the forecast of phytoplankton blooms in shelf seas. He has been particularly involved in the development of marine ecosystem models and techniques for model validation with a special focus on comparison of models with ocean colour data. He is Head of Biogeochemistry and Systems Science at the Plymouth Marine Laboratory and a member of the GEOHAB Scientific Steering Committee.

MARCEL BABIN is an oceanographer specialized in marine optics, phytoplankton photosynthesis and ocean colour remote sensing. He studies the role of light-related processes in marine ecosystems and biogeochemical cycles. He has been actively involved with the GEOHAB Scientific Steering Committee (as a regular member and as Vice-Chair), and with the Coastal Ocean Observations Panel of GOOS. He served as Associate Editor of the peer-reviewed journal *Limnology and Oceanography* from 2003 to 2008.

STEWART BERNARD is a research scientist in the research group on Earth Observations at South Africa's Council of Scientific and Industrial Research (CSIR). He works primarily with ocean colour and buoy based observing systems in the productive Benguela system, with a particular focus on harmful algal bloom detection. He has been involved with the development of phytoplankton scattering models, analytical reflectance algorithms and ocean colour validation in high biomass waters. He is an International Ocean Colour Coordinating Group (IOCCG) committee member, and sits on the ChloroGIN steering committee in addition to the GEOHAB Scientific Steering Committee.

Ocean colour remote sensing and harmful algal blooms: a rush of blood?

Development and application of optical sensors and remote sensing is central to many marine research programmes, agencies and activities. GEOHAB addresses the development of improved remote observation systems for harmful algae.

GEOHAB activities have included a science workshop on real-time observation systems for harmful algae, and publication (scheduled for early 2008) of a UNESCO Monograph on Oceanographic Methodology titled *Real-time Coastal Observing Systems for Marine Ecosystem Dynamics and Harmful Algal Blooms: Theory, Instrumentation and Modelling* edited by Marcel Babin, Collin Roesler and John Cullen. A critical role of these activities is to identify gaps in knowledge and to stimulate development and improved application of relevant techniques.

Ocean colour remote sensing offers considerable potential for the observation of harmful algal blooms (HABs); such potential remains largely unfulfilled due to the sizeable uncertainties associated with applications in the coastal zone. Recent studies suggest that space based

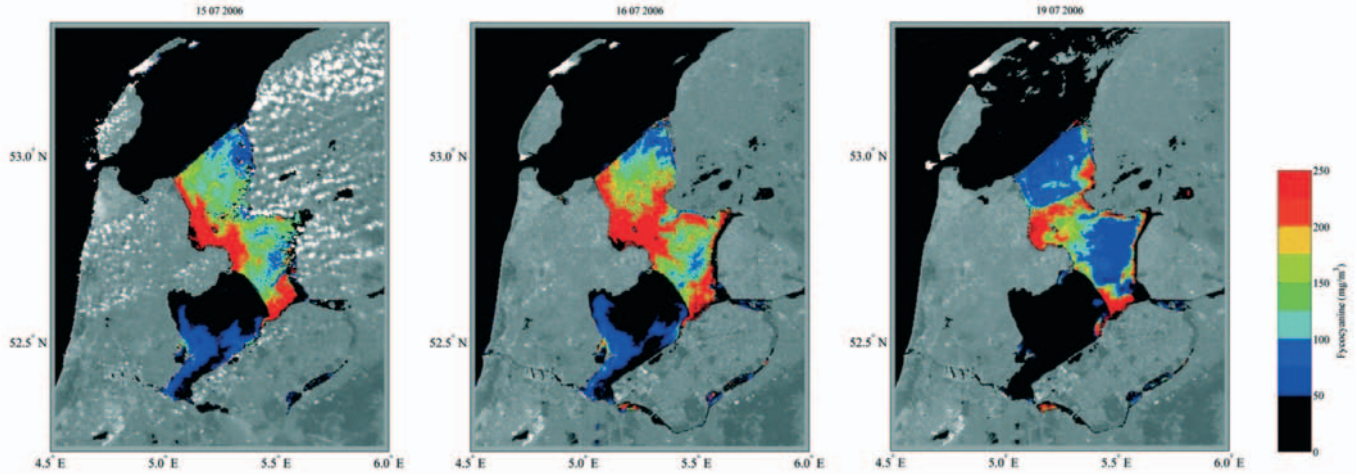


Fig. 1. Spatial distribution of the phycocyanin pigment in the Netherlands eutrophic Lake IJsselmeer (courtesy of Stefan Simis). Phycocyanin is associated with the presence of cyanobacteria such as *Aphanizomenon flos-aqua* and *Microcystis sp.* Those results were obtained using the algorithm from Simis et al. (2007) applied to imagery from the European sensor MERIS (full resolution), collected over three days during the July 2006 heatwave. This short time series illustrates the potential of ocean colour remote sensing for monitoring with great spatial detail the temporal evolution of highly dynamic phytoplankton blooms[1].

ocean colour sensors allow the routine coastal detection of high biomass phytoplankton blooms, or the identification of phytoplankton functional types. However, there are still fundamental problems with the application of rigorous ocean colour techniques in optically complex coastal waters. The ocean colour and harmful algal bloom scientific communities would gain a great deal by identifying and addressing these problems, rather than prematurely adopting underdeveloped techniques.

Ocean colour radiometry has several fundamental steps: Radiance is measured at the top of the atmosphere; to get the oceanic signal the atmospheric signal has to be removed (typically accounting for more than 80 per cent of the total signal). The derivation of geophysical parameters such as chlorophyll-a concentrations from this corrected signal uses various empirical or analytical algorithms. Further ecologically meaningful products, such as anomalies, can then be calculated. In the HAB-prone coastal zone, all of these steps suffer from considerable uncertainty. Atmospheric correction schemes considered suitable for the open ocean often perform poorly in turbid, atmospherically complex coastal waters where a lack of suitable validation data hampers our ability to analyse and improve these vital procedures. In addition, an incomplete understanding of the underlying causes of ocean colour variability means that the various techniques typically employed to derive HAB products are at best ambiguous.

There are five broad techniques employed with regard to HAB or phytoplankton assemblage type detection:

1. Bright water is historically often used to discriminate non-harmful coccolithophore blooms and can be used for operational, i.e. non-quantifiable, detection of abnormally high turbidity waters that can circumstantially be associated with given groups such as harmful cyanobacteria (e.g. *Nodularia spumigena* in the Baltic Sea).
2. Discrimination based on spectral signature of targeted phytoplankton species or groups is successful for a small number of cases such as cyanobacterial blooms containing the spectrally distinctive phycocyanin pigment (see Figure 1).
3. Several approaches based on chlorophyll anomalies relative to climatologies have been proposed as a means to raise warning of possible high biomass HAB events. While operationally promising to some extent, those approaches are subject to ambiguities caused by the anomalies being partially or wholly due to variability in atmospheric properties, dissolved organic colour, or non-chlorophyllous particles. As illustrated in Figure 2, the use of ocean colour to detect phytoplankton is often, in coastal waters, limited by the fact that other seawater constituents (e.g. coloured dissolved organic matter) are present in such high quantities that they simply hide any other constituents. Other approaches alternative to the use of the blue and green part of the reflectance spectrum may allow circumventing this problem.
4. Analytical algorithms, based upon inverse optical modelling of water column constituents,

1. Simis, S. G. H., A. Ruiz-Verdú, J. A. Domínguez, R. Peña-Martinez, S. W. M. Peters, and H. J. Gons. 2007. Influence of Phytoplankton Pigment Composition on Remote Sensing of Cyanobacterial Biomass. *Remote Sensing of Environment* Volume 106, Issue 4, Pages 414–427. Publisher: Elsevier

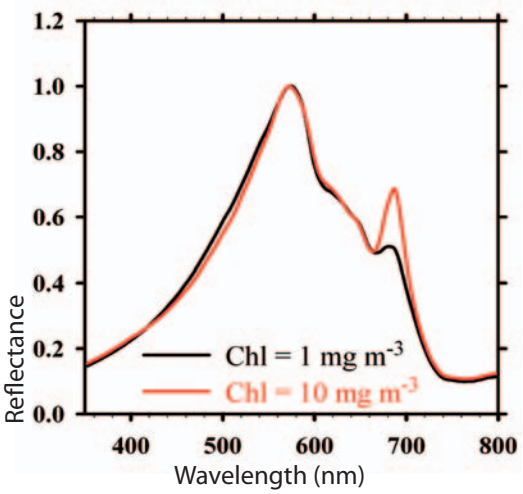


Fig. 2. Spectra of the water-leaving reflectance calculated using a radiative transfer code (Hydrolight 4.2) and optical properties for coloured dissolved organic matter and suspended non-algal particles typical of the Baltic Sea. Two different concentrations of chlorophyll-a were used to set the optical properties of phytoplankton. Note that the two spectra were normalized to their respective area under the curve. This figure illustrates the fact that increasing the amount of phytoplankton by an order of magnitude in such coastal water has only subtle effects on the shape of the reflectance spectrum in the blue and green domains. It has, however, a very significant impact on reflectance in the red part of the spectrum where chlorophyll-a fluorescence stimulated by sunlight can be readily observed (peak centred around 683 nm).

are promising as alternatives to standard geophysical algorithms but also suffer from poor atmospheric correction, and an incomplete understanding and parameterisation of the variable optical properties of phytoplankton and other water constituents.

5. The use of anomalies in the reflectance spectrum has recently been proposed to distinguish broad phytoplankton groups, based primarily on statistical relationships with chemotaxonomic data derived from High Performance Liquid Chromatography (HPLC) pigment measurements. However, recent studies suggest that the variability in the reflectance targeted by such algorithms is primarily associated with the varying concentration of non-algal constituents and that such methods are not robust.

Aside from atmospherically-related problems with absolute radiometric measurements, many of the problems lie in the fundamental question of identifying phytoplankton groups or species, and whether such groups can be distinguished using ocean colour. For example, HPLC pigment methods are potentially a very precise means of measuring phytoplankton pigment concentrations, but variations in accessory pigmentation are often only a minor source of ocean colour variability, and the chemotaxonomic interpretation of HPLC data can often be ambiguous. Allometric or size based ocean colour techniques also show promise, but whilst phytoplankton size variability across marine systems is characterized to some degree, our ability to translate this into useful information is limited by a lack of routine particle size observations. There is therefore a need for the ocean colour community to engage constructively with the phycological community, to adopt less ambiguous routine means of identifying phytoplankton community structure, e.g. traditional cell counts, flow cytometry, genetic techniques, or cell sizing techniques, if it is to pursue HAB or phytoplankton functional type research in an ultimately meaningful way.

The way forward

The way forward lies in a suite of measures: true validation rather than rationalization of results as plausible; sensitivity studies exploring the causal influences and assemblage detection limits across a wide variety of water types; a drive to put confidence limits on ocean colour products from a regional perspective. Consequently there is a requirement for a skill assessment strategy for ocean colour products which requires both the quantification of product uncertainty and the definition of minimum acceptable performance levels. Ocean colour techniques that do not outline plausible causal mechanisms may be of regional operational value, but are unlikely to be useful across a variety of marine ecosystems and are therefore of limited value in advancing our understanding and global observation of HABs as ecologically prominent phenomena. The greater involvement of multi-disciplinary scientific communities is extremely important – most notably HAB phycologists and oceanographers, in addition to ecophysiological modellers, who have specific and theoretically demanding requirements with regard to error analyses. The challenge is to give these distinct scientific communities some degree of ownership of ocean colour products as experimentalists. Considerable gains can be made from better understanding mechanisms underlying variability in the red portion of the ocean colour spectrum, most sensitive to phytoplankton backscattering at high biomass as demonstrated by research in hypertrophic freshwater systems. Red wavelengths may also yield valuable information on physiology and phytoplankton functional type through sun-induced fluorescence, currently measured by several ocean colour sensors but remaining very much an underexploited phenomenon. However, the starting point almost certainly lies not only in the ocean, but in the ocean-atmosphere system: validation and improvement of the atmospheric correction across a variety of coastal regions is critical.

overview

Tsunami unit

The tsunami early warning systems that Member States are coordinating through UNESCO/IOC meet constant and unexpected challenges

PETER KOLTERMANN
Head of Tsunami Unit

The Bengkulu earthquake and tsunami on 12 September 2007 generated the first basin wide advisory and warnings three years after the Indian Ocean tsunami on 26 December 2004. For the Interim Advisory Service provided by the Pacific Tsunami Warning Center (PTWC) in Hawaii and the Japan Meteorological Agency (JMA) in Tokyo, as well as all national tsunami warning systems around the Indian Ocean, this was a great challenge and an important system test for the **Indian Ocean Tsunami Warning and Mitigation System (IOTWS).**

A review of the reaction to this warning has provided important insights into the degree of readiness, and action taken or to be taken in Member States. The Intergovernmental Coordination Group (ICG) for the IOTWS had already been moving strongly towards defining and deciding on a regional watch provider scheme; the results of this review further reinforce the ICG's commitment to implementing the scheme and thus move through a transition phase into full operational responsibility.

Two other new systems, **CARIBE-EWS** for the Caribbean, and **NEAMTWS** for the Mediterranean and Northeast Atlantic Ocean and Connected Seas are progressing well towards defining their systems and operations.

The oldest system, the Pacific Tsunami Warning System (PTWS), took important steps at its ICG Meeting in Guayaquil, Ecuador in September 2007 towards enhanced regional coverage within the PTWS area of operation and the threat of near-field earthquakes. Data and communication systems and procedures in all systems are improving rapidly, and arrangements to oversee the implementation of these systems with an increasing commonality are underway. They will enable truly global coverage for tsunami and sea level related risks and hazards.

UNESCO/IOC's mandate for tsunami early warning systems was endorsed by the United Nations General Assembly, which decided that Member States should be responsible for identifying their communication with the IOC's Secretariat through Tsunami National Contacts (TNC), and with and between Tsunami Warning Centres through Tsunami Warning Focal Points (TWFP).

At its Twenty-eighth Session in Brussels, Belgium, 6-7 December 2007, the meeting of the Council of the European Union welcomed UNESCO/IOC's NEAMTWS as an initiative for an international mandated institution and, in order to avoid duplication, emphasized the importance of integrating all other proposals for multi-hazard systems into it in future. As such, it was effectively adopted as the sole European early warning system initiative.

More recently in 2008, both cyclone Narghis in Myanmar and the Sichuan earthquake in China highlight the need to constantly look at all components of end-to-end warning systems, and the importance of timely and dedicated measures to increase awareness and preparedness at all levels in Member States.

In 2007 the UNESCO/IOC tsunami programme was directly supported, either in kind or in cash, by Australia, Belgium, Canada, Chile, Czech Republic, Finland, France, Germany, Ireland, Israel, Italy, Japan, New Zealand, Norway, Republic of Korea, Spain, USA and the following UN-system partners: UNDP, UNESCAP, UN-ISDR, WMO. This continuing support is highly appreciated.

Cyclone Narghis in Myanmar left huge destruction in its wake.

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Tsunami and Other Coastal Hazards
Warning System for the Caribbean and Adjacent Regions (CARIBE-EWS)

BERNARDO ALIAGA
Technical Secretary,
ICG/CARIBE-EWS

Background

Since 1498 there have been at least 94 tsunamis with run ups reported in the Caribbean region causing 4,652 deaths. Most of these tsunamis were associated with submarine earthquakes, although the Caribbean Sea region has all of the potential tsunami-generating sources: submarine earthquakes, sub-aerial or submarine landslides, and underwater explosions. In addition to the 40 million people living in the region, 22 million people visit the Caribbean, making the region extremely vulnerable to tsunamis.

In consideration of great risk from tsunamis in the Caribbean and the lessons learned from these events in the Caribbean and elsewhere in the world, under the leadership of the Intergovernmental Oceanographic Commission of UNESCO, the Intergovernmental Coordination Group for the Tsunami and other Coastal Hazards Warning System for the Caribbean Sea and Adjacent Regions (ICG/CARIBE-EWS) was established in 2005.

The Caribbean system, unlike for other regions, has a multi-hazard approach and focuses on all coastal hazards. The ICG/CARIBE-EWS met for its Second Session in Cumana, Venezuela, 12-14 March 2007.

What is already operating in the CARIBE-EWS?

A limited interim warning system started to operate in 2005 relying almost exclusively on seismic data. The interim warning service is provided by the NOAA Richard H. Hagemeyer Pacific Tsunami Warning Center (PTWC) located in Hawaii, and hosted by the National Weather Service, United States.

A Communication Plan for the Interim Tsunami Advisory Information Service to the Caribbean Sea and Adjacent Regions was developed by PTWC. According to this plan:

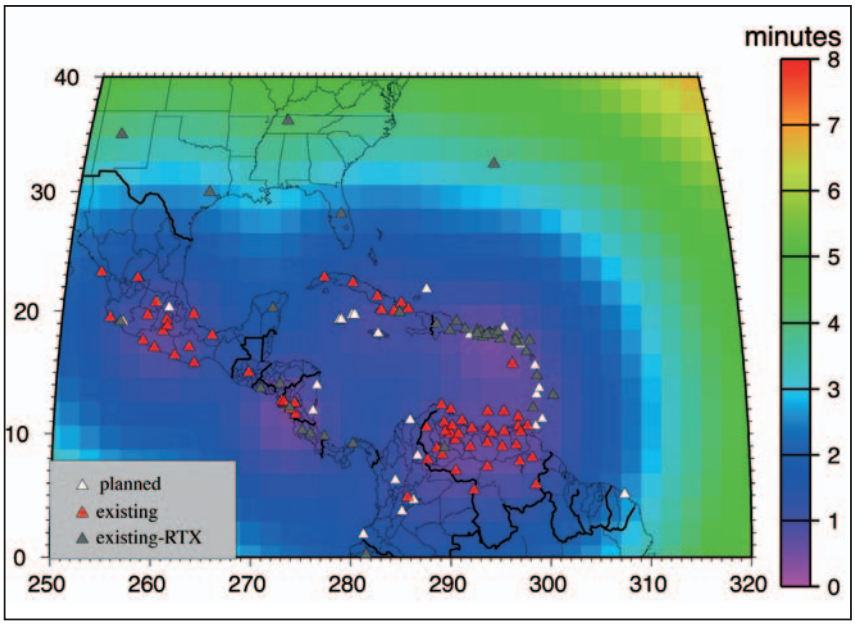
- Currently available seismic data from the region will permit a preliminary earthquake evaluation within ten to twenty minutes of the rupture. As additional stations become added, this response time will decrease.
- Currently available sea level data from the region are neither sufficient to quickly detect if a tsunami exists nor measure its size from all the potential source regions. However, new deep ocean gauges have recently been deployed and new coastal gauges are planned to improve this coverage.

Progress made in 2007

In 2007 the ICG/CARIBE-EWS moved ahead with the following activities:

- In December 2007 all four working groups met intersessionally in Cartagena, Colombia to develop strategies for the different components of the system. Chairs and Vice Chairs were also elected at the meeting.
- Key regional organizations were invited and accepted to become Permanent Observers, including the Caribbean Disaster Emergency Response Agency (CDERA), the Seismic Research Unit of the University of the West Indies, and the Latin America and Caribbean Office of the United Nations International Strategy for Disaster Reduction (UN/ISDR).
- In furtherance of regional collaboration, the World Meteorological Organization Region IV Hurricane Committee contacted the Secretariat indicating its

Vieques Tide Gauge Station, Puerto Rico.



This map shows the network detection after adding planned and other Caribbean seismic stations currently operational into the Caribbean Tsunami Warning System monitoring network. The network detection time will be less than one minute for much of the region when all stations are contributing to an international monitoring system. *(Courtesy of Dan McNamara, Seismologist, USGS/ANSS/NEIC)*

wish to participate in the ICG-III; reciprocally it has also invited the participation of the CG/CARIBE-EWS at its annual meeting in April 2008.

- Member States made progress in the nomination of their Tsunami Warning Focal Points and Tsunami National Contacts: 23 out of 29 Member States have made complete or partial nominations.
- A regional workshop on the Caribbean tsunami warning system for national Tsunami Warning Focal Points was held in Trinidad, 25-30 June 2007. The six-day training saw the participation of thirty-one people from across the region. The course was held in fulfillment of Recommendation ICG/CARIBE-EWS II.4. The meeting was sponsored by the Disaster Risk Reduction Centre of the UWI, USAID/OFDA , USGS , UNDP and UNESCO/IOC.
- A draft Implementation Plan was produced by the Secretariat based on input received from Working Groups. It addresses a phased implementation of the warning system.

Ongoing initiatives include deployment of new sea level gauges by the Puerto Rico Seismic Network (PRSN) of the University of Puerto Rico. PRSN successfully installed and is operating a network of six tsunami-ready tide gauges and meteorological stations. The stations are located in Arecibo, Fajardo, Mayagüez, Peñuelas, Isabel II in Vieques, and Yabucoa. These are joining other tsunami-ready tide gauges that are operated by the National Oceanic and Atmospheric Administration (NOAA) in Puerto Rico (Aguadilla, Culebra, Mona, Parguera, San Juan, and Esperanza in Vieques) and the Virgin Islands (St. John, St. Thomas, and two in St. Croix). However, while good progress and commitments from Member States are strongly in evidence, more is required for a fully-fledged tsunami dedicated sea level monitoring network.

Indian Ocean Tsunami Warning and Mitigation System (IOTWS)

Progress and Achievements in 2007

TONY ELLIOTT
Technical Secretary
ICG/IOTWS

The Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWS) held its Fourth Session in Mombasa, Kenya in late February 2007. Over 110 delegates attended the meeting to discuss progress in the implementation of the IOTWS and to agree on work plans for the intersessional period. The main outcome was the decision to create a Task Team to develop an implementation plan for an interoperable system of Regional Tsunami Watch Providers (RTWP), including the transition from the interim advisory service providers, the Pacific Tsunami Warning Center (PTWC) and the Japan Meteorological Agency (JMA). The Task Team held its first meeting in June 2007 and there was broad agreement on the general capability criteria for RTWPs, although further work on the service levels to be provided by RTWPs and an implementation schedule for the transition remained to be completed at a second meeting scheduled for early 2008.

Continuous progress has been made throughout the year in the implementation of seismic and sea level detection networks, including deep ocean tsunameters, and sharing of data from these networks is also improving.

Good progress was made towards the development of risk assessment guidelines. Two workshops were organized to bring together experts in seismic hazard and tsunami risk assessment, the outcomes of which were decisions to develop a seismic hazard assessment map for the entire Indian Ocean and to develop a standardized methodology for tsunami risk assessment by the end of 2008.

Capacity-building in numerical tsunami inundation modelling was a key activity of 2007. Three courses were organized, in Bangkok, Jakarta, and Melbourne, and 47 participants from 16 countries were trained. The ICG's goal is to train at least two people from each ICG/IOTWS Member State, and a further three courses are planned for 2008.

In November 2007, UNESCO/IOC obtained funding from the UNESCAP[1] regional Multi-Donor Voluntary Trust Fund to conduct capacity-building in the development of Standard Operating Procedures (SOP) for end-to-end tsunami warning systems. The project will be conducted during 2008 and is aimed at assisting UNESCAP Member States from the Indian Ocean and South-East Asia to build the capacity to develop their own SOPs, based on best international practices.

A significant activity undertaken by the UNESCO/IOC Secretariat during late 2007 was to conduct a survey of Member States' response to the 12 September 2007 Indian Ocean tsunami. This event presented an ideal opportunity to evaluate the performance of the IOTWS, to highlight both the strengths and weaknesses of the system, to identify areas that require further attention, and to provide a benchmark of the present status of the system. The main objectives of the survey were to confirm that the National Tsunami Warning Centres (NTWC) received bulletins from the interim advisory service providers in a timely manner, to determine what actions were taken by the NTWCs, and to find out which Member States had activated their emergency response plans.

The survey produced many positive results indicating that significant progress has been made in the development and implementation of the IOTWS. However some gaps and weaknesses were also identified, and the survey results provide valuable information for the ICG and its Working Groups to consider when reviewing and updating the IOTWS Implementation Plan.

1. UNESCAP, the United Nations Economic and Social Commission for Asia and the Pacific.

The Tsunami Early Warning and Mitigation System in the North Eastern Atlantic, the Mediterranean and Connected Seas (NEAMTWS)

Progress and Achievements in 2007

ULI WOLF
Technical Secretary
ICG/NEAMTWS

The Fourth Session of the Intergovernmental Coordination Group for the Tsunami Early Warning and Mitigation System in the North Eastern Atlantic, the Mediterranean and Connected Seas (ICG/NEAMTWS-IV) was held in Lisbon, Portugal, 21-23 November 2007. The ICG reviewed the progress made during the intersessional period and adopted updates to the NEAMTWS Implementation Plan. The plenary asked all Member States to nominate national Tsunami Warning Focal Points (TWFP) and Tsunami National Contacts (TNC) and to consider hosting a Tsunami Information Centre (TIC) for the NEAM region. The ICG also decided to harmonize methods and software among regional centres and welcomed the initiative of Working Group II to install SeisComP 3 in the candidate Regional Tsunami Watch Centres (RTWC) within the first half of 2008. In order to clarify the detailed roles and requirements of RTWCs the ICG established a Task Team on the NEAMTWS Regional Structure of Tsunami Watch Centres to report back at the next ICG session. The Member States confirmed the need and expressed their support for the establishment of a framework for a global tsunami and other ocean-related hazards early warning system. The ICG will hold its Fifth Session (ICG/NEAMTWS-V) on 3-5 November 2008 and has accepted the kind offer of Greece to host it.

At its Twenty-eighth Session in Brussels, Belgium, 6-7 December 2007, the meeting of the Council of the European Union welcomed the initiative undertaken by UNESCO/IOC for the North Eastern Atlantic, the Mediterranean and Connected Seas Tsunami Warning and Mitigation System (NEAMTWS), as the international mandated Institution for the establishment of such a system in the NEAM region, and emphasized, in order to avoid duplications, the importance of integrating forthcoming proposals into the ongoing IOC's NEAMTWS initiative and other multi-hazard systems or approaches, and encouraged the Commission and the Member States to further explore possibilities to promote real-time data sharing of seismic and sea level information, including an assessment of possible financial implications, and to support ongoing initiatives (including those of UNESCO/IOC) aimed at Member States' installation of additional detection systems (e.g. buoys, sea level gauges).

The Pacific Tsunami Warning System (PTWS)

LAURA KONG
Director,
UNESCO/IOC
International Tsunami
Information Center (ITIC)

Progress and achievements in 2007

The PTWS international tsunami warning centres are providing interim advisory services for the Indian Ocean and the Caribbean and Northwest Atlantic. Altogether, the PTWC issued 49 bulletins for Pacific earthquakes ranging from M6.5 to M8.6, and 4 bulletins for earthquakes in the Caribbean and Atlantic greater than M6.0. The Japan Meteorological Agency Northwest Pacific Tsunami Advisory Center (JMA NWPTAC) issued 18 advisories for the Northwest Pacific and South China Sea region in coordination with PTWC. The PTWC and JMA issued 6 advisories for the Indian Ocean. The seas surrounding Indonesia were the source for 11 earthquakes, for which the PTWC and JMA issued Pacific or interim Indian Ocean information. In total, the PTWC issued 330 preliminary observatory messages for earthquakes greater than M4.7.

A number of PTWS meetings focused on improving the international tsunami warning and mitigation system through the strengthening of national systems:

- The Twenty-second Session of the International Coordination Group for the Tsunami Warning System in the Pacific (ICG/PTWS-XXII) was held 17-20 September 2007, hosted by Instituto Oceanográfico de la Armada (INOCAR) in Ecuador. It was attended by 45 participants from 19 ICG/PTWS Member States, Officers from the ICG/CARIBE-EWS, ICG/IOTWS, and ICG/NEAMTWS, representatives from four organizations, and observers. Among the recommendations endorsed were:
  - Continued interim tsunami advisory service of PTWC/JMA for the South China Sea Region;
  - Conduct of 'Exercise Pacific Wave 08' during the third quarter of 2008, led by a Task Team with PTWC as its Chair, with support from Australia and Russia;
  - Revision of the 'Pacific Tsunami Warning System Operational

Dr Tokiyoshi Toya, WMO RA II and V Regional Director, welcoming participants to the opening ceremony of the April 2007 IOC-WMO Seminar on Tsunami Warning Operations under the PTWS.
(*Seated from left to right)*: Noud Leenders (SOPAC); Dr Laura Kong (IOC/ITIC); Dr Peter Koltermann (UNESCO/IOC); Y.B. Dato' Abdul Hanan bin Alang Endut (MOSTI); Arona Ngari (WMO RA V President, Cook Islands); Dean Salofa (SPREP); Dr KS Yap (Malaysia Met. Dept.).

User's Guide' by the Pacific Tsunami Warning Center (PTWC), JMA, and ITIC;
- Establishment of an intersessional Working Group on Emergency Communications to document and provide Member States with information on technologies available for warning dissemination; three sub-regional Working Groups; a Working Group on the near-field detection of tsunamigenic earthquakes to take action on the need for addressing local-regional tsunami threats; and continuation of Working Groups on Sea Level Measurement, Data Collection, Exchange and Interoperability;
- Holding of the ICG/PTWS-XXIII meeting in Samoa in the first quarter of 2009, and for ICG/PTWS-XXIV to be hosted by Japan in 2011.

- In response to the Pisco earthquake off Peru on 15 August 2007, the PTWS Inter-sessional Working Group for the Southeast Pacific was formed. The group met in Guayaquil, Ecuador in November to assess and agree on improvements in its detection systems and in information sharing and warning coordination among South American countries.
- Continuing the activities in the Southwest Pacific, Samoa and the SOPAC Community Risk Programme convened a Southwest Pacific Tsunami Working Group at the STAR Session (SOPAC's Science, Technology and Resources Network) prior to the SOPAC Annual Session in November 2007, to bring science and PTWS issues together and to discuss both prior and upcoming actions.

The PTWS continued to improve its regional seismic and sea level detection networks at the initiative and under the lead of Member States and international organizations such as the IOC's Global Sea Level Observing System (GLOSS), the Incorporated Research Institutions for Seismology (IRIS), the Global Seismographic Network (GSN), and its partner organizations.

The ITIC met in 2007 for coordination in April in Japan, and in July in Hawaii. An outcome of this coordination was a significant revision of the Communication Plan for the Tsunami Warning System in the Pacific.

The ITIC continues to provide the PTWS with technical monitoring and capacity-building, including:

- Monitoring the warning system;
- Providing and organizing training and technology transfer opportunities;
- Distribution of materials and tools, including earthquake and sea level monitoring tools;
- Collecting and providing event information. The Japan Meteorological Agency provided a compilation of its national database (2,500 entries between 1927 and 2003) for inclusion in the global database managed by the World Data Center/NOAA's National Geophysical Data Center (NGDC), and the Novosibirsk Tsunami Laboratory, Russia (Historical Tsunami Database project).

The IOC welcomes a new specialist to the Tsunami Unit

Belén Martín Míguez joined UNESCO/IOC in April 2007 as a Programme Specialist to support the development of regional tsunami warning systems and the Global Sea Level Observing System (GLOSS). Among her responsibilities, she manages a visiting sea level fellowship training programme for scientists and technicians from Indian Ocean countries.

Belén received her Ph.D. in Physical Oceanography from the University of Vigo, Spain in 2003. She has worked at the state-owned Spanish Harbour System and the University of La Rochelle (France), where she concentrated on the development of the French Coastal Sea Level Service Infrastructure (SONEL). Before joining UNESCO/IOC, Belén was a research fellow at the Marine Research Institute in Vigo (Spain) studying currents and sea level variation along the northwest coast of Spain.

Regional **activities**

GOOS-Africa in the year 2007

The 'premier fruits' of the first Pan-African Leadership Workshop of the Global Ocean Observing System in Africa (GOOS-AFRICA) and the Large Marine Ecosystems (LME)

By Justin Ahanhanzo[1], Geoff Brundrit[1], Steward Bernard[1], Valborg Byfield[2], John Field[1], Kouadio Affian[1], George Wiafe[3]

In 2007, there was commendable progress as a result of the highly successful Pan-African Leadership Workshop on Operational Oceanography and Remote Sensing in Africa, organized earlier in November 2006 by GOOS-AFRICA and the African Large Marine Ecosystem networks at the University of Cape Town in South Africa:

1. In situ *observing stations in the coastal ocean*

Several ongoing projects are contributing towards the improvement of coastal ocean stations including national and regional programmes. Preliminary results are compiled in the publication of the GOOS-AFRICA Working Group responsible for this component (www.sealevelstation.net).

2. Remote sensing of marine and coastal environments

The most significant progress in the implementation of GOOS-AFRICA relates to this component which strongly benefits from the contribution of the **UNESCO Intersectoral programme on the Applications of Remote Sensing for Integrated Management of Ecosystems and Water Resources in Africa** and **FET-REMSENS**, the newly extrabudgetary funded project.

ALTICORE-AFRICA, a joint initiative between GOOS-AFRICA and the UK National Oceanography Centre, is intended to boost the enhanced use of coastal altimetry for the complex ocean processes around the Southern African coast. For more information, see: (realtime.sea.uct.ac.za), (www.rsmarinesa.org.za) and (www.unesco.org/remotesensing/africa).

3. Ocean modelling, data assimilation, hindcasts/nowcasts/ forecasts

The newly created **African Centre for Climate and Earth System Science (ACCESS)** under the leadership of Professor George Philander is aimed at attracting young and talented African scientists in order to build future generations of African ocean climate modellers. The three main thrusts are research, education and knowledge transfer that will build on and complement (not compete with) existing activities. An international modelling workshop is scheduled for early 2008 by ACCESS, the University of Cape Town, South Africa, and the Atmospheric and Oceanic Sciences programme at Princeton University, USA (more information is available at: www.africaclimatescience.org).

4. End-to-end users communications and information delivery

GOOS-AFRICA, together with the National Oceanography Centre, Southampton, UK and the Plymouth Marine Laboratory, UK, played key roles in introducing the ocean component into the **GEONETCAST initiative** leading to the development of the DevCoCast Project. This initiative is developed through the Group on Earth Observations (GEO) and is designed to disseminate environmental satellite and *in situ* data and products (e.g. ocean colour and Sea Surface Temperature) from participating data providers within GEO to all users through a global network of communications satellites, using a multicast access controlled broadband capability. GOOS-AFRICA is leading the capacity-building component of this initiative and will be hosting a kick off meeting, 14-15 May 2008.

1. Justin Ahanhanzo, GOOS-AFRICA Coordinator, UNESCO/IOC
1. Geoff Brundrit, GOOS-AFRICA Chairman, University of Cape Town, South Africa
1. Steward Bernard, Co-Leader Remote Sensing, Council for Scientific and Industrial Research, South Africa
2. Valborg Byfield, GOOS-AFRICA Member, National Oceanography Centre, Southampton, UK
1. John Field, Chairman, Global Ocean Observing System Scientific Steering Committee
1. Kouadio Affian, Vice-Chairman, Intergovernmental Committee for GOOS Board
3. George Wiafe, GOOS-AFRICA/Large Marine Ecosystems Expert

5. Strategic business and industry partnerships

GOOS-AFRICA pursued cooperation with the oil industry. It is expected that ongoing discussions should lead to a Joint Industry Project (JIP) and free access to data from oil industries operating in Africa. In September 2007, GOOS-AFRICA participated in the launching of the BP's **Deep Ocean Environmental Long-Term Observatory System (DELOS)** project that will be implemented off Angola. The DELOS project provides great opportunities for empowering national and regional capacity towards advancing scientific research in the deep ocean through: (i) improved understanding of deep water environmental impacts; (ii) increased understanding of climate change effects on deep water ecology; and (iii) contribution to individual and institutional capacity development.

6. Project management, integration, coordination and fundraising

With the full support of the GOOS-AFRICA network, the Programme Coordinator developed strong partnerships with relevant programmes and institutions in Africa and overseas, leading to the development and implementation of joint projects. Key partners include: African Large Marine Ecosystem networks; Ocean Data and Information Network in Africa; space agencies and remote sensing networks; business and industry associations (notably the International Association of Oil and Gas Producers); regional economic groupings; academic and research institutions; nongovernmental and intergovernmental organizations. Concrete results achieved due to this indispensable coordinating role included the following:

- Africa Breakout Session at the World Climate Research Programme Conference, June 2007, Barcelona, Spain.
- A joint GOOS-AFRICA-JRC[1]-IOCCG[2] *Bilko* workshop: Training of Trainers in 'Methods and Applications of Ocean Colour Remote Sensing in African Coastal and Regional Seas', 24 September-5 October 2007, Mombasa, Kenya.
- GOOS-AFRICA contribution to GEO/GEOSS: Harnessing Earth Observations for Global Benefits.
- GEO Capacity-Building Donor Workshop, September 2007, Seville, Spain.
- The African Ocean Partnership Exhibition and contribution to the Fourth Ministerial Summit, 27-30 November 2007, Cape Town, South Africa.
- Training of Trainers and Research Strategy Workshop on Hyperspectral Imaging Spectroscopy, 19-23 November 2007, University of Stellenbosch, South Africa.
- GOOS-AFRICA contribution to the European Union high-level workshop on 'Space for Development: The Case of GMES[3] and Africa' in the framework of the joint African Union/European Union Summit of Heads of States, 6-7 December 2007, Lisbon, Portugal.

7. Publications

GOOS-AFRICA leaders and members contributed to the global body of knowledge on operational oceanography in peer reviewed specialized journals. In addition, the Chair and Coordinator were co-opted as Co-Editors of the newly created international *Journal of Operational Oceanography*. The following is a non-exhaustive selected list of publications in 2007:

The African Ocean Partnership Exhibition
From left to right: The Director-General of the Department of Sciences and Technology (DST) of South Africa; His Excellency, the Minister of Sciences, Technology and Culture of South Africa, and GEO Co-Chair; The General Manager of International Relations, DST; The General Coordinator of the Ministerial Exhibition, DST.
Picture by Justin Ahanhanzo, GOOS-AFRICA Coordinator

1. Joint Research Centre, Ispra, Italy.
2. International Ocean Colour Coordinating Group
3. Global Monitoring for Environment and Security

Dr Patricio Bernal, IOC's Executive Secretary, plants a commemorative tree during a visit to the Kenya Marine and Fisheries Research Institute (KMFRI) on 28 February 2007. KMFRI kindly hosted and co-sponsored an IOC numerical modelling awareness workshop showcasing the possibilities offered using coastal modelling tools. *(Photo courtesy of IOCWIO)*

Brundrit, G. et al. 2007. New Marine Observing Systems around Africa. *The Full Picture*, Tudor Rose, pp. 92-94. (www.earthobservations.org)

Masalu, D.C.P. 2007. Coastal Data and Information Management for Integrated Coastal Management: The Role of IODE. *Marine Policy*, 32(4), pp. 544-550.

Woodworth, P.L., Aman, A. and Aarup, T. 2007. Sea Level Monitoring in Africa. *African Journal of Marine Science*, 29(3), pp. 321-330.

The Third Forum of the GOOS Regional Alliances coordinated by the GOOS-AFRICA Coordinator, online report at (http://www.ioc-goos.org/).

8. Meetings organized by GOOS-AFRICA Coordinating Committee in 2007

- UNESCO/African Union high-level scientific workshop on the Critical Role of Satellite Remote Sensing Applications for Africa's Sustainable Development, 30 May-1 June 2007, UNESCO Headquarters, Paris, France.
- Hyperspectral Remote Sensing Training Course in Imaging Spectroscopy, 19-22 November 2007, University of Stellenbosch, Stellenbosch, South Africa.
- Hyperspectral Remote Sensing Research Strategy Workshop, 23 November 2007, University of Stellenbosch, Stellenbosch, South Africa.

9. Some useful websites

www.sealevelstation.net
Tsunami sea level station monitoring facility

www.unesco.org/remotesensing/africa The application of remote sensing for integrated management of ecosystems and water resources in Africa

www.rsmarinesa.org.za
Remote sensing server for marine sciences

www.africanmarineatlas.net
The African Marine Atlas developed by the Ocean Data and Information Network for Africa (ODINAFRICA)

www.africaclimatescience.org
ACCESS (Africa Centre for Climate and Earth System Science)

10. Conclusion and plans for future

The GOOS-AFRICA Coordinator raised more than US$500,000 to support the activities mentioned in this report. While GOOS-AFRICA will reinforce itself through the implementation of the above initiatives, there are plans to make 2008 an even more successful year with the Seventh Conference of the African Association of Remote Sensing of the Environment (AARSE) in Accra, Ghana and the International Council for Science (ICSU) Twenty-ninth General Assembly in Maputo, Mozambique. GOOS-AFRICA will play a key scientific and technical role at these two assemblies in fostering regional, South/South and North/South cooperation towards empowering ocean observing systems.

The UNESCO/IOC Rio Office
Rio de Janeiro, Brazil

JANICE TROTTE
Officer in Charge

The Rio GOOS Office is an IOC platform to develop several relevant programmes and projects in the South Atlantic.

'The Rio GOOS Programme Office has wider opportunities than just ocean observations and services and is positioned to represent a much broader set of IOC activities in the region', states the Committee's Report from the Independent Performance Evaluation process that was convened at the request of the IOC Executive Secretariat on 4-5 June 2007. The Review Committee was chaired by Prof. Luiz Antonio Barreto de Castro, Secretary for Policy and Scientific Development of the Brazilian Ministry of Science and Technology (MCT) and comprised of sponsors' representatives from Brazil, the GRULAC[1] region and abroad: Dr Richard Spinrad (U.S. National Oceanic and Atmospheric Administration), Dr Hector Soldi (I-GOOS Vice-Chair), Rear-Admiral José Eduardo B. Souza (Executive Secretary of the Interministerial Commission for Sea Resources - CIRM) and Dr Keith Alverson (IOC Secretariat).

The Rio Office is served by a part-time professional with administrative support provided by the Directorate of Hydrography and Navigation (DHN) of the Brazilian Navy.

Originally conceived in 2003 to serve as a facilitator for the GOOS Programme in the region, the Rio GOOS Office very rapidly became an IOC platform to develop several relevant programmes and projects in the South Atlantic, and within the limits of its sponsorship.

A long-awaited 'Regional Alliance in Oceanography for the Upper Southwest and Tropical Atlantic' (OCEATLAN) was finally created on 15 March 2005 by a Letter of Intent signed by thirteen institutions from Argentina, Brazil and Uruguay. OCEATLAN will primarily be the GOOS Regional Alliance (GRA) in the Southwest Atlantic, with the Rio GOOS Office serving as its Technical Secretariat. During the Twenty-fourth IOC Assembly, held in June 2007, OCEATLAN was formally recognized by IOC Member States.

In order to improve the sampling strategy in the South Atlantic, the Rio GOOS Programme Office is particularly involved with enhancing the existing network of observations there. This includes coordinating the network of ocean observations based on fixed and drifing buoys, the mean sea level network, Argo float deployments, and XBT high-density lines, among other operational activities.

The IOC is benefiting from substantial leverage on its investment through 'extra-budgetary' contributions to the Rio GOOS Programme Office and towards programme implementation. The level of financial commitment from local partners devoted to the GOOS programme implementation is significant and, in the case of Brazil, overlooked by a High-level Ministerial Commission (CIRM) that supervises the implementation of the national contribution to GOOS in the

1. GRULAC: Latin American and Caribbean Group

country. Important initiatives at the governmental level are also being developed in Argentina in close interaction with the Rio GOOS Office, particularly the Ministries of Science and Technology in Argentina and Brazil.

It should be noted that the Brazil-Argentina High-Level Management Committee on Science and Technology has charged OCEATLAN, through the Rio GOOS Office, to develop its programme in oceanography, climate and coastal zone management. The Management Committee met from 6 to 7 March 2008, and the IOC presented an update on the Regional Alliance's existing activities. Planning is underway to present bilateral financial proposals to the respective National Research Councils of Argentina and Brazil, seeking more secured funds to develop OCEATLAN activities.

At the project level, the Rio GOOS Office has been able to incorporate existing projects, such as the Antares network (encompassing institutions from Argentina, Chile, Peru and Venezuela) under the GOOS banner. The objective of 'Antares' is to understand the variability of the coastal environment on a continental scale through the development of an online tool to examine satellite data together with *in situ* measurements, and to generate continental-scale high-resolution (1 km) maps of chlorophyll and of sea surface temperature, offered daily on the web. Originally, the coverage included just coastal zones of South America and the Caribbean Sea but the 'Antares network' will soon extend its coverage on an intercontinental basis to bridge with a similar project being carried out in Africa.

The India-Brazil-South Africa Ocean Alliance (IBSA-OCEAN) focuses on global ocean research and stresses the importance of cooperation between peers among emerging economies of the world. Working together will enable the IBSA countries to strengthen their key institutions and scientific and technical skills. It will bring new opportunities for immediate development of the three primary drivers for this cooperation:

(i) Regional consequences of climate change, including seasonal and decadal regional climate prediction;
(ii) Regional ocean observation systems, encompassing regional GOOS and ocean GEOSS and where a demonstration of integrated ocean observing systems is sought;
(iii) Dissemination networks, in order to get knowledge to the user community and to develop interpretation systems aimed at the distribution and analyses of a wide variety of marine data and products tailored to those countries' needs.

The IBSA-OCEAN short-term objectives, whenever fulfilled, may bring an urgently needed ocean climate perspective to the Millennium Ecosystem Assessment, due in 2010.

Capacity-building activities in satellite applications and data management are also taking place among partners to OCEATLAN and Africa; yearly student and scholar exchange programmes on modelling and analysis are planned to take place under IBSA-OCEAN.

The Rio GOOS Programme Office is well positioned to play a significant role in the ocean monitoring of carbon for climate studies. Of the carbon that is injected into the atmosphere by burning fossil fuel, how much will remain in the atmosphere? How much gets into the ocean? Taking advantage of existing projects such as PIRATA[2], the air-sea CO_2 flux and its variability will be estimated by extending the CO_2 network to this region. In this endeavour, UNESCO/IOC should define a role for the Rio Office with agencies in local governments and global programmes, among others, in coordinating climate change monitoring, particularly ocean carbon observations in the South Atlantic.

Essentially, according to the Independent Performance Evaluation process, the Rio GOOS Office is considered a good 'experiment that could serve as a proof of concept that will lead IOC to move in the same direction with respect to other offices towards accumulating knowledge and accomplishing more in the area of oceanography with the limited IOC budget made available.

Despite the understanding of the importance of the Rio GOOS Office as a 'propeller' for most initiatives at the bilateral, trilateral and multilateral level under the IOC, funding to run the office is not guaranteed on a permanent basis. It depends fully on the level of commitment from UNESCO/IOC and the Government of Brazil, which allocates resources locally on behalf of IOC programme implementation and visibility. Interventions from interested parties may eventually correct this situation, as is hoped by participants in OCEATLAN, IBSA-OCEAN, IOC and several other initiatives, which have only been made possible because a regional coordination mechanism was in place.

2. Pilot Research Moored Array in the Atlantic

The UNESCO/IOC Sub-Commission for the Caribbean and Adjacent Regions (IOCARIBE)

CESAR TORO
UNESCO/IOC Secretary
for IOCARIBE

IOCARIBE Headquarters, located in Cartagena, Colombia

Highlights from the year 2007

IOCARIBE-GOOS

The International Conference on Ocean Security in the Wider Caribbean (10-12 February, Corpus Christi, USA)

IOCARIBE-GOOS and the United Nations International Strategy for Disaster Reduction (UN/ISDR) submitted a proposal at this conference to donors titled 'Strengthening early warning systems and disaster risk reduction in the Caribbean and adjacent regions' for the formation of a Caribbean regional observing system.

The proposal describes the IOCARIBE-GOOS/ISDR-coordinated multi-partner project and outlines the purpose of the observing system: to achieve comprehensive, coordinated and sustained observations of the Caribbean region in order to improve monitoring of the state of the region; increase understanding of Earth processes; and enhance prediction of the behaviour of the Caribbean ecosystem.

Proposal for 'Sea level Observations Network for Multi-Hazard Early Warning in the Wider Caribbean Region'

In June, the U.S. National Oceanic and Atmospheric Administration (NOAA), a partner of IOCARIBE-GOOS, developed this proposal to build on previous Third Border Initiative (TBI) and other U.S. investments. It supports the work of existing U.S. centres and engages international and regional partners through intergovernmental cooperation to strengthen the sea level observations network as an essential contribution to a fully operational multi-hazard regional warning and mitigation system.

Integrated Coastal Area Management (ICAM)

IOC-Flanders Planning Workshop for the Formulation of an IOC/ICAM Regional Pilot Project in Latin America

This workshop was sponsored jointly by UNESCO/IOC's ICAM programme and the Government of Flanders, and was held in Cartagena, Colombia, 15-17 January 2007. Experts from Colombia, Chile, Ecuador and Peru, and representatives from the Permanent Commission for the South Pacific (CPPS) and from the Flanders Government, Belgium, participated in the workshop. The pilot project aims to establish an ICAM indicator framework in each country of the Southeast Pacific region (Chile, Colombia, Ecuador, Panama and Peru), focused on environmental and socio-economic conditions within the context of sustainable development and integrated coastal area management. This initiative will give support to the implementation and sustainability of ICAM in the region. The project is expected to be carried out over a three-year period.

The Caribbean Large Marine Ecosystem (CLME) Project

'Sustainable Management of the Shared Living Marine Resources of the Caribbean Large Marine Ecosystem and Adjacent Regions'

This CLME Project is designed to strengthen regional cooperation to reverse degradation of shared living marine resources. Its regional scope provides a platform for governments and other stakeholders to collectively pursue the shared goals of economic and environmental sustainability. This effort is supported with funds of over US$900,000 from the Global Environment Facility (GEF), twenty-six participating countries in the Wider Caribbean Region, UNESCO/IOC, the United Nations Development Programme (UNDP), a number of other collaborating agencies and organizations, and the University of the West Indies.

Fisheries, marine conservation and ocean governance experts from around the Caribbean and beyond met in Kingston, Jamaica to discuss major areas of concern affecting the shared living marine resources in the Caribbean and the activities for inclusion in the CLME project. Two main activities were held: a Project Concept and TDA/SAP Synthesis Workshop (28 February-3 March), and a Causal Chain Analysis Workshop for the Technical Task Team (27 March).

Final CLME Steering Committee Meeting

Senior environmental and sustainable development officials from over twenty countries in Central and South America and the Caribbean met in Cartagena, Colombia, 6-8 June, to review and approve a Full-Sized Project (FSP) proposal to be submitted to GEF aimed at developing a strategic, integrated approach for the CLME Project. The FSP proposal for discussion by the members of the CLME Regional Steering Committee outlines the major components of a US$7,000,000 proposal to GEF, namely: the identification and agreement of major transboundary living marine resource management issues and their root causes; actions needed to address these constraints, including filling knowledge gaps and the implementation of governance reforms for living marine resource management; and ecosystem-wide monitoring, reporting and evaluation. In addition to the funds being requested from GEF, member countries and regional partners will contribute an additional US$47,800,000 in support of the activities proposed over a four-year period.

Thirty-six experts from Barbados, Brazil, Colombia, Cuba, Dominica, Guatemala, México, Panama, Venezuela and the IOC Science and Communication Centre in Vigo, Spain participated in the activities of the HAB workshops.

For further information, visit: (http://cavehill.uwi.edu/cermes/clme_eng.html)

Harmful Algal Blooms (HABs) in the IOCARIBE region

The Fourth IOC Regional Science Planning Workshop on Harmful Algal Blooms in IOCARIBE (ANCA-IV), 22-24 May, and the **ANCA FANSA[1] Portal Workshop**, 25-27 May, were

1. FANSA: IOC HAB Working Group (Grupo COI sobre Floraciones de Algas Nocivas en Sudamerica, FANSA), which functions as a regional mechanism for exchange of information, planning of coordinating activities, regional training and inter-calibration as well as cooperative research projects.
ANCA: IOCARIBE Working Group, (Grupo COI sobre Algas Nocivas en Caribbean, ANCA) equivalent to FANSA.

held on the island of San Andrés, Colombia.

These workshops were sponsored by the Instituto de Estudios Caribeños at the National University of Colombia and UNESCO/IOC. As in previous meetings, the participants actively exchanged knowledge of the different regions, building up a fruitful discussion for establishing general agreements related to diverse aspects of HABs. Advances in research and communication actions were also reviewed from the perspective of future

Participants at ICG/CARIBE-EWS II met to discuss a Communications Plan for the region.

developments and compliance with regional interests and needs.

Tsunami activities

Intergovernmental Coordination Group for the Tsunami and Other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (ICG/CARIBE-EWS)

The Second Session of ICG/CARIBE EWS was held in Cumana, Venezuela, 12-14 March 2007. The meeting was attended by almost sixty participants from eleven countries in the Caribbean region and three organizations. The ICG recommended the adoption of the Communications Plan developed for the Caribbean and Adjacent regions by the Pacific Tsunami Warning Center (PTWC). (An account of this meeting can be found in the Tsunami Unit section of this Annual Report.)

Caribbean training course in Seismology and Tsunami Warnings

The Seismic Research Unit (SRU) of the University of the West Indies, Trinidad and Tobago, hosted this training course, 25-30 June, to develop the region's understanding of the science of tsunamis, hazard and risk assessment, preparedness, education, and outreach, and operational best practices of tsunami warning centres and tsunami emergency response agencies.

The course was sponsored by the Office of U.S. Foreign Disaster Assistance (USAID OFDA) and the United Nations Development Programme (UNDP), and was organized jointly by the United States Geological Survey (USGS), UNESCO/IOC's International Tsunami Information Center (ITIC), the Puerto Rico Seismic Network (PRSN), and the SRU.

A total of forty-three participants from twenty-one countries and territories, representing meteorological, emergency management, and seismological institutions in the region attended presentations from experts from UNESCO/IOC, the Pacific Tsunami Warning Center (PTWC), SRU, the University of Puerto Rico (UPR), and USGS.

Caribbean Marine Atlas

The IOC's International Oceanographic Data and Information Exchange (IODE)-ICAM Stakeholders Meeting for the Development of a Caribbean Marine Atlas was held in Bridgetown, Barbados, 8-10 October, with the participation of experts from Barbados, Cuba, Grenada, Jamaica, St. Lucia, Trinidad and Tobago, Turks and Caicos. The workshop outlined a detailed analysis of available data for defined priority issues and a comprehensive work plan for the upcoming year, resulting in the Caribbean Marine Atlas prototype.

To find out more about the Atlas, visit: (http://www.iode.org/)

Capacity development

A Proposal Writing Workshop was held in Cananéia (Sao Paulo, Brazil) 10-13 December, as part of a series of workshops implemented through the UNESCO/IOC Capacity Development Programme (CDP) for the Latin American Region. (Further information about these workshops can be found in the Capacity Development section of this Annual Report.)

Future action will now be to carry out a review of present or past (five years) projects in the region involving multi-country inputs from external funding; to discuss the development of identified projects with respective institutes; and to formulate a targeted plan for project development and submission.

Participants at last June's Seismology and Tsunami Warnings training course in Trinidad and Tobago.
Photo courtesy of the Public Seismic Network, Dominica)

The UNESCO/IOC Regional Programme Office
Perth, Western Australia

NICK D'ADAMO
Head of the UNESCO/IOC Perth Programme Office

Bureau of Meteorology building, Perth Office home in Perth, Western Australia..

The UNESCO/IOC Perth Regional Programme Office continued as an IOC focal point under sponsorship from the Western Australian State Government (WA), UNESCO/IOC and the Australian Bureau of Meteorology (BoM). It is situated in BoM's West Perth offices, Western Australia, and co-located with the Secretariat of the Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning System (ICG/IOTWS), which it helped establish in Perth during 2005/06.

The Perth Office services its partners' objectives across the broad range of ecological and socio-economic imperatives that map onto UNESCO/IOC key priority areas specified by the Twenty-fourth Session of the IOC Assembly. It works mainly through the four regional Global Ocean Observing System (GOOS) alliances it helped establish and supports:

- Indian Ocean GOOS (IOGOOS);
- Pacific Islands GOOS (PIGOOS);
- South East Asia GOOS (SEAGOOS); and
- Western Australia GOOS (WAGOOS), with which the Perth Office also provides global linkages between UNESCO/IOC and many national Western Australian and Australian ocean observing and marine science initiatives.

Nick D'Adamo, Officer-in-Charge, coordinated a formal review of the Perth Office in November 2007, involving progress reporting and a proposed way forward beyond the current Memorandum of Understanding (MoU) that expires in July 2008. The Review Panel was chaired by Professor John Zillman (Chair, Global Climate Observing System [GCOS]) and comprised sponsors' representatives: Dr Patricio Bernal (UNESCO Assistant Director-General and IOC Executive Secretary); Professor Lyn Beazley (Chief Scientist, WA); and Dr Neville Smith (Deputy Director, Research and Systems, BoM). The Panel endorsed the Perth Office's performance and encouraged it to continue to increase its portfolio of relevance to UNESCO/IOC GOOS objectives (including Coastal GOOS) and the general ocean sciences, capacity-building and hazards spheres of the IOC. The Panel recommended that the MoU be renewed for a five-year period, a proposition that has been accepted by the three sponsoring institutions.

Selected highlights during 2007

The Indian Ocean Panel (IOP) of IOGOOS/CLIVAR made significant progress in the Indian Ocean Observing System (IndOOS) and

associated integrated science programme of oceanographic observations, process characterization, and analytical and theoretical modelling. The IOP's work improves the characterization of the Indian Ocean's dynamics and coupled atmospheric processes, thereby advancing the understanding and prediction of marine and coastal processes, and climate change effects, which have profound influences on the Indian Ocean's rim and island nations.

There was significant progress in the development of **SIBER (Sustained Indian Ocean Biogeochemical and Ecological Research**), a biogeochemical equivalent panel to the IOP.

IOGOOS resolved to establish an **Indian Ocean BLUElink User Group** to integrate with the proposed expansion of BLUElink (an operational ocean forecast model) from its current Australian domain to the whole Indian Ocean. BLUElink currently provides online forecasts of currents, salinity, temperature and sea surface height anomaly at 10 km resolution up to 1,000 km offshore of Australia. The user group will also integrate with other regional forecasting capacities, including waves through the Indian National Centre for Ocean Information Services (INCOIS). IOGOOS made progress in a project to integrate satellite data (INCOIS) with *in situ* coastal monitoring around the ocean rim by Member States.

The year was also notable for the establishment of Australia's first national **Integrated Marine Observing System (IMOS)** by the Australian Federal Government in collaboration with State governments. The Perth Office provided links between the global/coastal GOOS outcomes of IMOS and the UNESCO/IOC framework, as well as providing a conduit to inform the global community of other ocean observing and marine science programmes underway through Australian institutional networks and relevant to UNESCO/IOC's broad spectrum of objectives. These programmes include biodiversity conservation and related Marine Protected Area programmes; climate change programmes (such as the Indian Ocean Climate Initiative Stage III); and strategic marine science initiatives (such as the Western Australian Marine Science Institution).

WAGOOS, with the Australian Academy of Technological Sciences and Engineering and the Perth Office co-sponsored **an economic analysis of the cost-benefit ratio of ocean observations**. The result was a published report that concludes that, for Australia, the ratio of return is better than 1:20 (based on only a sub-set of benefiting industries). This study has generic relevance. Plans are also developing for a WAGOOS proposal to review the current marine observing networks underpinning marine operations for sectors off North West Australia.

The Perth Office, in collaboration with Sultan Qaboos University (Sultanate of Oman) and under sponsorship from the Sloan Foundation, coordinated a **Census of Marine Life (CoML) Workshop** that brought together marine scientific expertise and information from the region in and around the Gulf of Oman as a contribution to the objectives of the CoML and associated Ocean Biogeographic Information System (OBIS).

The formation of the **SEAGOOS Coordinating Committee** was initiated during the year, as was the important development of the **SEAGOOS Strategic Plan** through the collaborative resources of IOC/WESTPAC, the SEAGOOS Secretariat and the Perth Office.

PIGOOS continued to strengthen and develop, with the appointment of Paul Eastwood as the new PIGOOS Coordinator in the host agency of the Pacific Islands Applied Geoscience Commission (SOPAC), Fiji. The Perth Office, BoM, the U.S. National Oceanic and Atmospheric Administration (NOAA) and SOPAC continued their collaborative resourcing of PIGOOS, with NOAA announcing that it would provide major sponsorship of PIGOOS for five years. NOAA will also provide five years of funding to SEREAD (an oceans curriculum development and delivery programme for schools of the PIGOOS region; a project managed by Dr Julie Hall, New Zealand National Institute of Water and Atmospheric Research). PIGOOS began issuing its newsletter, *Vai Pacifika*, and progressed regional initiatives facilitating and/or contributing to sea level and climate monitoring, capacity-building (e.g. through SEREAD), marine atlas development, CoML, OBIS, aerial mapping, water quality assessment and monitoring and data/information management.

The IOC Project Office for ODINAFRICA and IOCWIO

MIKA ODIDO
Head of Project Office for
ODINAFRICA and IOCWIO

The Intergovernmental Oceanographic Commission Project Office for ODINAFRICA[1] and IOCWIO[2] is located at the UNESCO Office in the United Nations complex in Nairobi, Kenya. The UNESCO Nairobi Office also functions as the Regional Office for Science and Technology in Africa. The Project Office had a very busy year implementing a wide range of activities within the framework of the Ocean Data and Information Network for Africa (ODINAFRICA), and the IOC's Capacity Development programme.

ODINAFRICA

ODINAFRICA continued to provide support to institutions in twenty-five coastal countries of Africa, hosting National Oceanographic Data and Information Centres (NODCs) to enable development of a core set of data and information products. These included, but were not limited to, library catalogues, catalogues of national data sets and data sources (meta-databases), directories of marine and freshwater professionals, directories of marine related institutions, marine data archives and marine biodiversity databases.

The **African Marine Atlas** (www.africanmarineatlas.net) was officially launched on 23 February 2007 to provide access to maps, images, data and information to coastal resource managers, planners and decision-makers from various administrative institutions and specialized agencies in Africa. The Atlas incorporates existing geo-referenced datasets available in the public domain. Six editorial groups were created to mobilize data for different aspects of the Atlas, namely: (i) Base Maps; (ii) Geosphere; (iii) Atmosphere; (iv) Hydrosphere; (v) Biosphere; and (vi) Human Environment.

Other activities implemented by ODINAFRICA included:

- National consultation workshops on data and information products necessary for Integrated Coastal Area Management (ICAM);
- Installation of new tide gauges in the Democratic Republic of the Congo and Djibouti and the upgrade of a sea level station at Dakar, Senegal;
- Collaboration with the Instituto Geofísico D. Luís (IDL), Lisbon, Portugal to collocate Global Navigations Satellite Systems (GNSS) receivers at sea level stations in Mozambique (Inhambane and Pemba, respectively);
- Development of the ODINAFRICA Data Facility (www.sealevelstations.net);
- Development of the electronic repository of marine publications from and concerning Africa (OceanDocs Africa: www.oceandocs.net);
- Development of national websites with the format www.nodc-countryname.org (e.g. www.nodc-mozambique.org); and
- Development of marine biodiversity databases for molluscs, sponges and decapods.

Capacity Development

The Capacity Development programme focused on strengthening institutional capacities in three particular areas, namely, the management of organizations, proposal writing, and team building.

Building on the progress of workshops offered in previous years targeting advanced leadership skills for heads of institutions and senior role models, a **workshop in proposal and bid writing skills** was held in Mombasa, Kenya, 16-20 April 2007. This workshop provided training to principal investigators and programme managers from marine in-

1. Ocean Data and Information Network for Africa
2. The IOC Regional Committee for the Western Indian Ocean

stitutions in the region to improve skills in order to attract additional funding for institutions. A provisional proposal and a consortium of collaborating institutes were developed at the workshop. The proposal involves the implementation of three key steps at selected pilot sites in each participating country: (i) modelling of the physical driving forces; (ii) linking the dynamics to the socio-economic situation of the site; and (iii) developing spatial decision support tools (DST) with communities and decision-makers. Participants in the bid writing workshop have since developed other proposals that have been submitted to different agencies and programmes.

Following this workshop, a **workshop in team building** was held, 28-31 October 2007, in Durban, South Africa. Participants from the region received training to address the challenges of working together in a team and advancing participants' skills for effective networking and collaboration between key institutes addressing national and transboundary issues.

During February and March in 2007, **national modelling awareness workshops** were held in Kenya, Mozambique, and Tanzania. These workshops covered the development of coastal models for research and commercial applications and showcased the possibilities offered by coastal modelling tools. In November and December 2007, two researchers from Kenya and Mozambique undertook five weeks of training at the National Institute of Oceanography in Goa, India sponsored by the Indian Ocean Tsunami Warning and Mitigation System Fellowship programme. This training focused on the use of sea level data to develop hydrodynamic models in support of coastal management.

The Project Office, together with United Nations Environment Programme (UNEP) and the Western Indian Ocean Marine Science Association (WIOMSA) co-sponsored a special session on capacity development at the **Fifth WIOMSA Scientific Symposium**, 22-26 October 2007, in Durban, South Africa. The special session took stock of the capacity development activities in the Western Indian Ocean, and provided a forum to discuss ways to move forward in unified capacity development regional initiatives.

The **Memorandum of Understanding** signed between UNESCO/IOC and the Government of Kenya to provide a framework for collaboration with the Secretariat for the Coastal and Marine Sub-theme of the New Partnership for Africa's Development (NEPAD/COSMAR) was renewed in February 2007. The activities implemented include:

(i) Publication and distribution of COSMAR Newsletter;
(ii) Development and maintenance of the NEPAD/COSMAR website (http://www.nepadcosmar.org), which has become a useful source of information on coastal and marine programmes in Africa;
(iii) Development of a directory of marine and freshwater professionals from Africa; and
(iv) A review of projects and programmes on coastal and marine issues in Africa. An assessment titled 'Assessment of Africa's Capacity-Building Needs for the Development and Implementation of Ecosystem-based Ocean Governance' was completed.

The **Fourth Session of the Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System** (ICG/IOTWS) was held in Mombasa, Kenya from 28 February to 2 March 2007. Member States from the region participated actively in working groups of the ICG/IOTWS, including: 1) Kenya, as the Vice-Chair of Working Group 5 on 'A System of Interoperable Advisory and Warning Centres'; and 2) The Seychelles as the Chair of Working Group 6 on 'Mitigation, Preparedness and Response'.

UNESCO/IOC was identified as a partner in the implementation of several activities during the **Fifth Session of the Conference of Contracting Parties** (COP5) to the Convention for the Protection, Management and Development of the Marine and Coastal Environment of the Eastern African Region (also known as the Nairobi Convention), held 5-8 November 2007 in Johannesburg, South Africa. These activities include data and information management, as well as developing skills for managing organizations and programmes. UNESCO/IOC also joined UNEP in the initiation of the 'Consortium for Conservation of Coastal and Marine Ecosystems in the Western Indian Ocean' (WIO-C). The Consortium was formally launched during COP5 and brings together major non-governmental and other organizations in the Western Indian Ocean dealing with marine science. These include CORDIO (Coral Reef Degradation in the Indian Ocean), EAWLS (The East African Wildlife Society), IUCN (The World Conservation Union), NEPAD (New Partnership for Africa's Development), WIOMSA (Western Indian Ocean Marine Science Association), WCS (Wildlife Conservation Society) and WWF.

The IOC Sub-Commission for the Western Pacific (WESTPAC)

WENXI ZHU
IOC/WESTPAC Secretariat

WESTPAC was formally established in 1989, with a mandate to translate UNESCO/IOC global programmes into the region, and develop and coordinate required regional activities based on priority interests of the Member States in the region. During 2007, WESTPAC has been making every effort to revitalize itself through enhancing the participation and increasing support of its Member States, restructuring WESTPAC activities, improving regional capability in marine scientific research, strengthening regional cooperation with other organizations/programmes, and raising public awareness.

The ministry building in Bangkok, Thailand housing WESTPAC Headquarters.

Participants in the First NEAR-GOOS-NOWPAP Joint Training Course on Remote Sensing Data Analysis.

Ocean observations

WESTPAC has been operating the North-East Asia Regional Global Ocean Observing System (NEAR-GOOS) with four participating countries, namely China, Japan, Korea and Russia. Main activities in 2007 included the following highlights:

(i) The NEAR-GOOS database system was successfully put into operation. By the end of December 2007, the total volume of oceanographic/marine and meteorological data available in the Regional Delayed Mode Database (RDMDB) was about 44.7GB. The volume of downloading data in 2007 was about 25.7GB. The data volume and number of products had steadily increased, and satellite altimetry is available from the Regional Real-Time Database (RRTDB);

(ii) The First NEAR-GOOS-NOWPAP Joint Training Course on Remote Sensing Data Analysis, 3-9

The NEAR-GOOS database system for oceanographic/marine and meteorological information was successfully put into operation. The data volume and number of products have steadily increased and satellite altimetry is now available.

Country	Japan (i.e. regional)	People's Republic of China	Republic of Korea	Russian Federation
RTDB Host	Japan Meteorological Agency (JMA) **http://goos.kishou.go.jp/**	National Research Center for Marine Environmental Forecasts (NMEFC) **http://neargoos.nmefc.gov.cn**	Korea Ocean Research and Development Institute (KORDI) **http://near-goos.kordi.re.kr**	Far Eastern Hydrometeorological Research Institute (FERHRI) **http://rus.ferhri.ru/Projects/Neargoos**
DMDB Host	Japan Oceanographic Data Center (JODC) **http://near-goos1.jodc.go.jp/**	National Marine and Data Information Service (NMDIS/SOA) **http://near-goos.coi.gov.cn**	National Fisheries Research and Development Institute (NFRDI) **http://kodc2.nfrdi.re.kr:8001/home/eng/main/projects/near-intro.php**	Pacific Oceanological Institute (POI) **http://pacificinfo.ru/near-goos**

WESTPAC has made significant progress in better assessing and monitoring the marine environment through its remote sensing project.

September 2007, was held in Japan, with the kind contribution of Government of Japan. Twenty-three participants from the Western Pacific attended this training course. The training course aims to acquaint young scientists with the NEAR-GOOS and further build their capacity in monitoring and assessing the marine and coastal environment through ocean remote sensing techniques.

(iii) The Strategic Plan for NEAR-GOOS in its Second Phase was published with the kind contribution of National Marine Data and Information Service of China, which provides a blueprint for NEAR-GOOS in the near future.

The South East Asian Global Ocean Observing System (SEAGOOS) is on track after being adopted in 2002. The strategy is under development, aiming to gather some baseline information for regional capability in observing and date management.

Marine Environment

WESTPAC has made significant progress in better assessing and monitoring the marine environment through its remote sensing project. The New Generation Sea Surface Temperature (NGSST) demonstration operation was conducted smoothly, and the regional high-resolution Sea Surface Temperature digital data has been continuously provided (http://www.ocean.caos.tohoku.ac.jp/%7Emerge/sstbinary/actvalbm.cgi?eng=1). In cooperation with the Yellow Sea Large Marine Ecosystem (YSLME) and NOWPAP (Northwest Pacific Action Plan), a regional Ocean Colour Expert Group was formed with members from China, Japan and Korea. The Group has developed the regional bio-optical dataset (YOC-2007 common dataset) and the Yellow/East China Sea Case-2 algorithm.

Capacity-building

A region-specific capacity-building activity was initiated in WESTPAC with the establishment of UNESCO/IOC Regional Training and Research Centres in Oceanography. This initiative aims to promote regional capability in marine science more systematically and sustainably through further exploration of regional institutional and human resources. Procedures and guidelines have been finalized and advertised. The first centre is expected to be set up in 2008.

The first IOC/WESTPAC Leadership Advanced Workshop took place 28 February-3 March, in Bangkok, Thai-

The IOC/WESTPAC Leadership Advanced Workshop strengthens marine science institutes by empowering directors with required leadership skills.

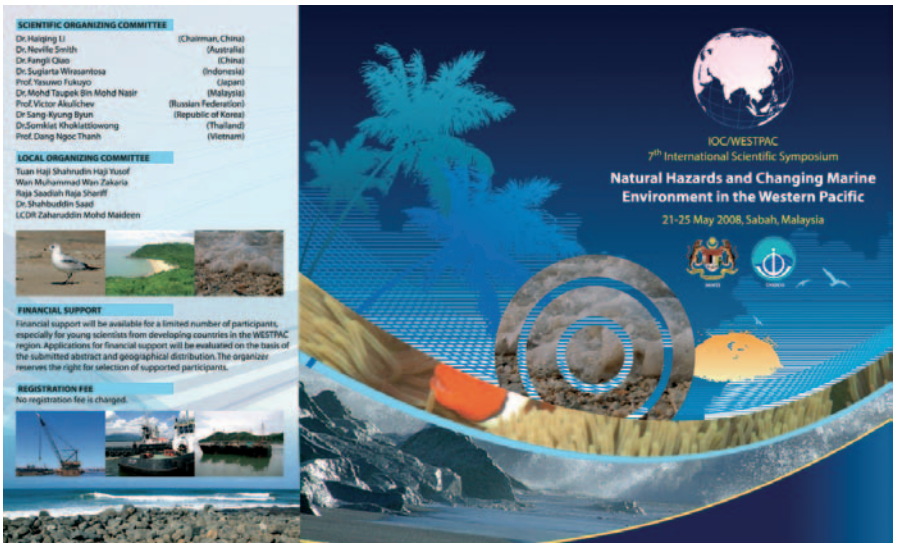
land. Approximately twenty directors/heads of marine science related institutes/academic faculties, and officials responsible for national marine science projects in the region attended the workshop. The workshop aims at strengthening marine science institutes by empowering these directors with required leadership skills.

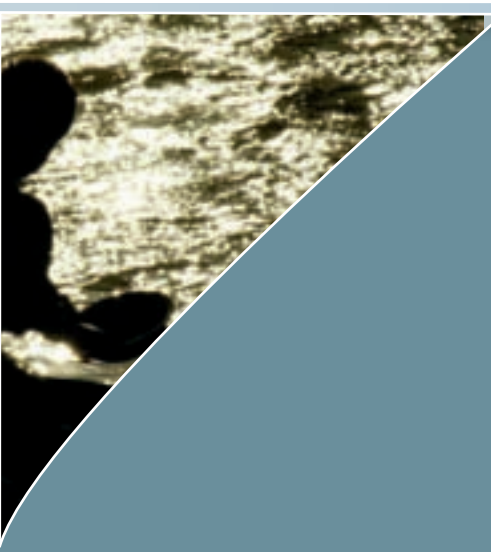
Tsunami

WESTPAC is assisting the UNESCO/IOC Tsunami Unit and Thailand's Natural Disaster Warning Centre in the implementation of Adaptive Learning in Disaster Management for Community Awareness and Resilience Project (ALDCAR) in Thailand. This project aims to enhance learning and participating in planning and coordinating disaster warnings, preparedness, response, mitigation, and recovery, in order to build up awareness and resilience at the community level. The project will provide strategic integrated approaches for all related stakeholders for implementation at the community level. About 24 pilot communities, 240 teachers, district and provincial government officers, and 1,200 school children in six coastal provinces participated in these activities.

Regional network on marine science

The National Oceanographic Directorate of the Malaysian Ministry of Science, Technology and Innovations has generously agreed to host the Seventh WESTPAC International Scientific Symposium. The theme will be 'Natural Hazards and Changing Marine Environment in the Western Pacific'. The symposium will provide a forum for the presentation and discussion of programmes and activities in marine scientific research and marine service, and is designed to foster regional cooperation among Member States in the Western Pacific region in the context of sustainable development and climate change. The IOC/WESTPAC symposium has been an important venue since 1989 for marine scientists and managers to review progress, formulate new WESTPAC programmes and exchange information and experience. The symposium will take place in Sabah, Malaysia, 21-25 May 2008.





Annexes

IOC Officers

Meeting of the IOC Officers at the Smolnii Institute of Saint Petersburg, Russian Federation 23-25 January 2007

From left to right: Neville Smith (Australia) [Vice-Chair]; Javier Armando Valladares (Argentina) [Vice-Chair]; Su Jilan (China) [Past Chair]; Patricio Bernal (Chile) [Executive Secretary]; David Thomas Pugh (UK) [Chair]; Alexander V. Frolov (Russian Federation) [Vice-Chair]; Mário Ruivo (Portugal) [Vice-Chair].

Not pictured: Alphonse M. Dubi (Tanzania) [Vice-Chair].

The Twenty-fourth Session of the IOC General Assembly, held in June 2007, elected its Officers for the coming two years:

Chair
Javier Armando Valladares
Dirección de Relaciones Internacionales
Ministerio de Ciencia,
Tecnología e Innovación Productiva
Argentina

Vice-Chair
Neville Smith
Deputy Director (Research and Systems)
Bureau of Meteorology
Australi

Vice-Chair
Savithri Narayanan
Dominion Hydrographer/
Director-General Ocean Sciences
Canadian Hydrographic Service Fisheries and Oceans
Canada

Vice-Chair
Nikolai Mikhailov
Head of the Oceanographic Data Centre
Russian Federal Service for Hydrometeorology
and Environmental Monitoring
All-Russia Research Institute of
Hydrometeorological Information – WDC
Russian Federation

Vice-Chair
Julián Augusto Reyna Moreno
Capitán de Navío
Comisión Colombiana del Océano
Colombia

Vice-Chair
Chérif Sammari
Head of the Marine Environment Laboratory
Institut National des Sciences et
Technologies de la Mer
Tunisia

Past-Chair
David Thomas Pugh
Marine Science Advisor
United Kingdom

Executive Secretary
Patricio Bernal
Executive Secretary of IOC
Assistant Director-General of UNESCO

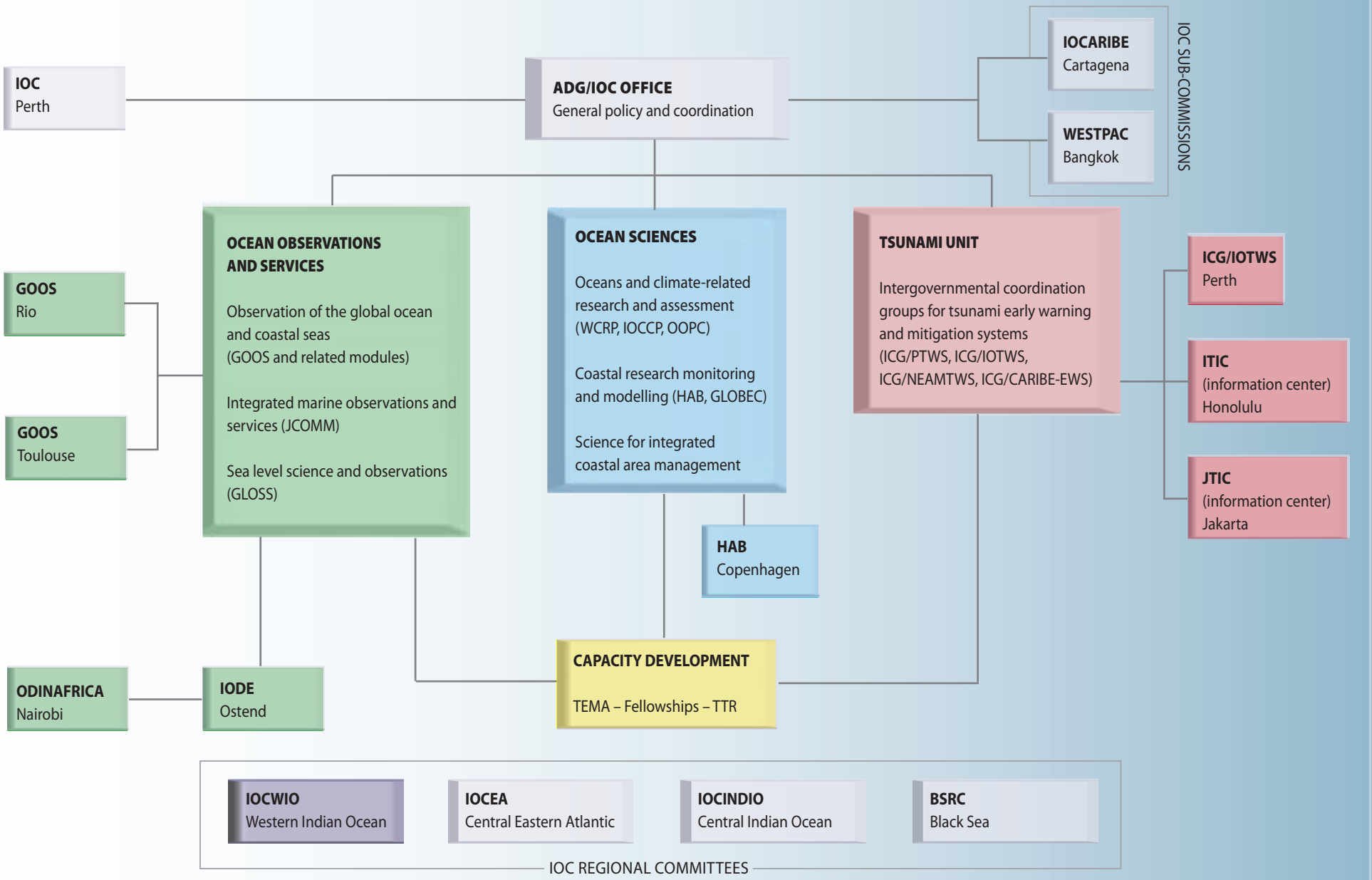
The IOC Rules of Procedure indicate that the Officers of the Commission shall consist of the Chair and five Vice-Chairs. The five Vice-Chairs shall be nationals of Member States of different electoral groups (as listed in Appendix II of the Rules of Procedure.) The IOC Officers are elected every two years for a maximum of two terms.

Member States of the Commission (136)*

AFGHANISTAN	(11 March 1991)
ALBANIA	(26 January 1993)
ALGERIA	(July 1964/November1965)
ANGOLA	(26 October 1982)
* ARGENTINA	(Before November 1961)
* AUSTRALIA	(Before November 1961)
AUSTRIA	(October 1962/June 1964)
AZERBAIJAN	(27 January 1998)
BAHAMAS	(29 January 1979)
BANGLADESH	(29 October 1982)
BARBADOS	(18 December 1985)
* BELGIUM	(Before November 1961)
BELIZE	(22 September 1995)
BENIN	(23 October 1986)
* BRAZIL	(Before November 1961)
BULGARIA	(October 1967/December 1969)
CAMEROON	(November 1971/November 1973)
* CANADA	(Before November 1961)
CAPE VERDE	(20 August 1984)
* CHILE	(Before November 1961)
* CHINA	(Before November 1961)
COLOMBIA	(October 1967/December 1969)
COMOROS	(8 February 2000)
CONGO	(November 1961/September 1962)
COOK ISLANDS	(25 January 2006)
COSTA RICA	(28 February 1975)
COTE D'IVOIRE	(Before November 1961)
CROATIA	(24 December 1992)
* CUBA	(Before November 1961)
CYPRUS	(5 December 1977)
CZECH REPUBLIC	(20 June 2005)
DENMARK	(Before November 1961)
DJIBOUTI	(6 January 2006)
DOMINICA	(21 September 1999)
* DOMINICAN REP.	(Before November 1961)
* ECUADOR	(Before November 1961)
* EGYPT	(October 1969/November1971)
EL SALVADOR	(16 February 1993)
ERITREA	(12 November 1993)
ESTONIA	(10 March 1992)
ETHIOPIA	(5 March 1976)
FIJI	(9 July 1974)
FINLAND	(Before November 1961)
* FRANCE	(Before November 1961)
GABON	(26 October 1977)
GAMBIA	(30 August 1985)
GEORGIA	(9 July 1993)
* GERMANY	(Before November 1961)
* GHANA	(Before November 1961)
* GREECE	(October 1962/June 1964)
GUATEMALA	(December 1965/October 1967)
GUINEA	(1 May 1982)
GUINEA-BISSAU	(26 January 1984)
GUYANA	(20 July 1977)
HAITI	(23 March 1976)
ICELAND	(October 1962/June 1964)
* INDIA	(Before November 1961)
* INDONESIA	(October 1962/June 1964)
* IRAN, Islamic Republic of	(3 June 1975)
IRAQ	(October 1969/November 1971)
IRELAND	(7 November 1978)
ISRAEL	(Before November 1961)
ITALY	(Before November 1961)
JAMAICA	(October 1967/December 1969)
* JAPAN	(Before November 1961)
JORDAN	(6 April 1975)
KAZAKHSTAN	(24 March 2005)
* KENYA	(November 1971/November 1973)
KOREA Democratic People's Republic of	(31 October 1978)
KUWAIT	(13 November 1974)
LEBANON	(October 1962/June 1964)
LIBYAN ARAB JAMAHIRIYA	(11 March 1974)
* MADAGASCAR	(December 1965/October 1967)
MALAYSIA	(July 1964/November 1965)
MALDIVES	(20 May 1987)
MALTA	(October 1969/November 1971)
MAURITANIA	(Before November 1961)
* MAURITIUS	(October 1969/November 1971)
MEXICO	(Before November 1961)
MONACO	(Before November 1961)
MOROCCO	(Before November 1961)
MOZAMBIQUE	(8 April 1981)
MYANMAR	(7 June 1988)
NAMIBIA	(25 April 2001)
NETHERLANDS	(Before November 1961)
NEW ZEALAND	(November 1961/September 1962)
NICARAGUA	(17 November 1977)
* NIGERIA	(November 1971/November 1973)
* NORWAY	(Before November 1961)
OMAN	(16 November 1982)
PAKISTAN	(Before November 1961)
PANAMA	(October 1967/September 1969)
* PERU	(December 1965/October 1967)
PHILIPPINES	(October 1962/June 1964)
POLAND	(Before November 1961)
* PORTUGAL	(October 1969/November 1971)
QATAR	(20 July 1976)
* REPUBLIC OF KOREA	(Before November 1961)
ROMANIA	(Before November 1961)
* RUSSIAN FEDERATION	(Before November 1961)
SAINT LUCIA	(14 September 1992)
SAMOA	(10 April 1978)
SAUDI ARABIA	(14 June 1978)
SENEGAL	(October 1967/September 1969)
SERBIA	(23 May 2005)
SEYCHELLES	(27 February 1979)
SIERRA LEONE	(19 April 1974)
SINGAPORE	(December 1965/October 1967)
SLOVENIA	(16 June 1994)
SOLOMON ISLANDS	(11 May 1982)
SOMALIA	(10 July 1974)
* SOUTH AFRICA	(October 1967/September 1969)
* SPAIN	(Before November1961)
* SRI LANKA	(June 1976/January 1977)
SUDAN	(26 August 1974)
SURINAM	(21 January 1977)
SWEDEN	(July 1964/November 1965)
SWITZERLAND	(Before November 1961)
SYRIAN ARAB REPUBLIC	(October1969/November 1971)
* THAILAND	(Before November 1961)
TIMOR-LESTE	(19 October 2005)
TOGO	(22 October 1975)
TONGA	(3 January 1974)
TRINIDAD and TOBAGO	(October 1967/September 1969)
* TUNISIA	(Before November 1961)
* TURKEY	(November 1961/September 1962)
* UKRAINE	(November 1961/September 1962)
UNITED ARAB EMIRATES	(2 June 1976)
* UNITED KINGDOM OF GREAT BRITAIN and NORTHERN IRELAND	(Before November 1961)
* UNITED REPUBLIC OF TANZANIA	(October 1967/September 1969)
* UNITED STATES OF AMERICA	(Before November 1961)
URUGUAY	(Before November 1961)
* VENEZUELA	(October 1962/June 1964)
VIET NAM	(Before November 1961)
YEMEN	(22 May 1960)

* Members of the Executive Council

IOC programme structure



Permanent Staff/Fixed-term/
Temporary posts/ALDs/Supernumerary/
Consultants *(unless otherwise specified)*

IOC
Perth, Australia

N. D'Adamo

GENERAL POLICY AND COORDINATION
Office of the IOC Executive Secretary

EXECUTIVE SECRETARY
Patricio Bernal
PROFESSIONAL STAFF
S. Belfiore
A. Mateos
GENERAL SERVICES STAFF
R. Hervé-Smadja
K. Yvinec
P. Boned
S. Sermeño

IOCARIBE
Cartagena, Colombia

PROFESSIONAL STAFF
C. Toro
GENERAL SERVICES STAFF
P. Wills-Velez

WESTPAC
Bangkok, Thailand

PROFESSIONAL STAFF
(under recruitment)
W. Zhu (seconded China)
GENERAL SERVICES STAFF
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GOOS
Rio de Janeiro, Brazil

J. Trotte

DBCP
Toulouse, France

M. Belbéoch
H. Viola

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PROFESSIONAL STAFF
T. Gross
C. Clark (Seconded USA)
T. Aarup
A. Fischer
B. Lee
J. Ahanhanzo
GENERAL SERVICES STAFF
I. Gazagne
A. Vannier
H.H. Lam
L. Ferry

OCEAN SCIENCES

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Vacant (under recruitment)
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M. Hood
J. Barbière
N. Fernandez
C. Ehler
F. Douvere
GENERAL SERVICES STAFF
C. Le Conan
V. Bonnet

HAB
Copenhagen, Denmark

H. Enevoldsen

TSUNAMI UNIT

HEAD OF SECTION
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PROFESSIONAL STAFF
M. Yamamoto
B. Aliaga
U. Wolf
B. Martin Miguez
R. Badal
D. Travin
GENERAL SERVICES STAFF
F. Collins
B. Nzomini

ICG/IOTWS
Perth, Australia

A. Elliot
J. Cunneen

ITIC
Honolulu, USA

JTIC
Jakarta, Indonesia

CAPACITY DEVELOPMENT

HEAD OF SECTION
E. Desa
PROFESSIONAL STAFF
J. Berque
GENERAL SERVICES STAFF
SC-320 G6 Vacant - B. Lwanga

ODINAFRICA
Nairobi, Kenya

M. Odido
(also IOCWIO Office)

IODE
Ostend, Belgium

V. Vladymyrov (until October)
P. Pissierssens

© Marcel Salvaro/UNESCO

Headquarters personnel shown in the photo (left to right)

Front row: Laurence Ferry, Maria Hood, Ksenia Yvinec, Patricio Bernal, Aurora Mateos, Peter Pissierssens, Boram Lee, Stefano Belfiore, Dmitri Travin, Thorkild Aarup, Julian Barbière.

Second row: Joannès Berque, Henrik Enevoldsen, Peter Koltemann, Masahiro Yamamoto, Cigié Pontes, Candyce Clark, Uli Wolf, Nick D' Adamo, Wenxi Zhu.

Third row: Mika Odido, Albert Fischer, Tom Gross, Belén Martin-Miguez, Bernardo Aliaga, Keith Alverson, Patrice Boned.

See the full list of IOC Personnel under Organization of Secretariat Staff

in memoriam

Photo courtesy of A. Suzyumov

Dale C. Krause (1929–2007)

Marine geophysicist and UNESCO diplomat

Dale C. Krause, who, from 1973 until his retirement in 1989 was Director of UNESCO's (then) Division of Marine Sciences (OCE), died on 17 August 2007.

Dr Krause enriched UNESCO with his broad and extensive professional knowledge, as well as his varied research and teaching experience in marine science – particularly geology, geophysics and pelagic ecology.

With considerable determination, he led the effective implementation of the OCE Division's programme, cooperating with UNESCO/IOC and many other bodies in the field of ocean and coastal marine research and development. He was a firm believer in interdisciplinary and intersectoral cooperation and strongly supported scientific capacity-building by facilitating advanced training in ocean sciences and engineering, and empowering scientists and institutions in developing countries to participate more effectively in international programmes.

After leaving UNESCO, he continued his active involvement in marine science academic programmes as Senior Research Scientist at the University of California at Santa Barbara, USA.

Dr Krause earned his Ph.D. in 1961 at the Scripps Institution of Oceanography, USA, where he was a pioneer in the investigation of active submarine geological features and systems and plate tectonic processes. He contributed to early discoveries of the ocean basins at a time when relatively little was known or understood about their character and formation. In 1960, he discovered evidence of submarine volcanic activity and was later honoured in October 2005 by the naming of the 'Krause Volcano', a sea floor volcano in waters off Mexico, near Guadalupe Island, identified and mapped by a team of scientists from Scripps.

Fellow scientists recall Krause's passion for world-class science, collaboration across boundaries, nations and frontiers, and his commitment to managing the Earth's environment and declining resources through sustainable development. Many young marine scientists around the world, who were trained and supported through the OCE Programme, as well as his own university students and colleagues in UNESCO and elsewhere, remember Dale Krause not only as a one who strove for academic rigour, but also as a thinker with an intense interest in the pursuit of knowledge and an understanding of the natural world.

Text kindly provided by Tara Krause and Gary Wright.

Photo courtesy of Instituto Nazionale di Oceanografia e di Geofisica Sperimentale

Carlo Morelli (1917–2007)

Geophysical researcher and former Vice-President of UNESCO/IOC

Carlo Morelli, a scientist who inspired a whole generation of geophysical researchers in Europe, passed away on 30 December 2007.

He served as Vice-President of the Intergovernmental Oceanographic Commission from 1970 to 1972 and was a lifelong member of the Editorial Board for the International Bathymetric Chart of the Mediterranean (IBCM), and Vice-Chairman of the IOC Consultation Group for Ocean Mapping (CGOM).

Carlo Morelli set and achieved many scientific goals, but it is for his experimental research in Gravimetry that he will be best remembered. His twenty-year study of the global gravity net culminated in its standardization being officially adopted by the International Association of Geodesy at the Moscow 1971 General Assembly. Today this reference system (IGSN 71: International Gravity Standardization Net) has been universally adopted and is recognized as a basic instrument for international cooperation.

His work began in Italy, where he actively participated in the compilation of the first two Gravity Maps of Italy using remotely controlled grav-

ity meters, and cooperating in gravity data processing. These measurements were a fundamental contribution to the knowledge of the geological structure of the Italian seas, Mediterranean tectonics and, in particular, the Italian Peninsula. These studies were later extended to the entire Mediterranean Sea and resulted in the compilation of the IBCM 1:1.000.000 for UNESCO/IOC, published in ten sheets in 1981. Subsequent overlay sheets indicating gravity and magnetic anomalies, seismicity and other geological and geophysical parameters were produced between 1985 and 1999.

In 1949 he founded the Osservatorio Geofisico Sperimentale (OGS) in Trieste, Italy, where he served first as director until 1963 and then president until 1975. He established the 'Istituto di Miniere e Geofisica Applicata' at the University of Trieste, where he was Professor Emeritus from 1993 onwards.

Carlo Morelli's work in solid earth geophysics has contributed important scientific knowledge towards the economic exploitation of geo-resources and the prevention of geological risks, and led to the professional education of hundreds of highly specialized researchers. Remembered for his action and zeal, he was blessed with a talent for bringing out the best in those around him and inspiring enthusiasm in everyone he worked with.

Extracted and adapted with the kind cooperation of Rinaldo Nicolich, IASPEI.

John Portmann (1940–2007)

Marine chemist and member of the UK delegation to UNESCO/IOC

John Portmann, who dedicated four decades to helping clean up and protect the marine environment, sadly passed away unexpectedly recently. He was a member of the UK delegation to UNESCO/IOC for many years and played a key role as the Coordinator of the National Committee for the Global Ocean Observing System under the auspices of the UK Inter-Agency Committee on Marine Science and Technology.

As a driving force in the Global Oceans Observations System Action Group (GOOSAG), Dr Portmann was particularly effective in using his huge range of marine contacts to bring the scientific community together and organize networking events. He was well-known for his helpful and positive contributions at the IOC's annual meetings in Paris, France, not only in plenary sessions but also in working groups, where he used his drafting abilities to great effect.

Dr Portmann participated in many national and international committees, including UNESCO's Global Investigation of Pollution of the Marine Environment, and the International Council for the Exploration of the Sea. He led the delegations of Croatia, Egypt, France and Greece to undertake a review of the Mediterranean Action Plan, the first-ever plan adopted as a Regional Seas Programme under the United Nations Environment Programme's umbrella.

Dr Portmann became head of the Burnham Laboratory, UK, in the 1980s. Under his guidance, its environmental work expanded and he was subsequently appointed Deputy Director of the Directorate of Fisheries Research (DFR), later overseeing its successful transition to the Centre for Environment, Fisheries and Aquaculture Science (Cefas). After taking early retirement, he worked as a consultant to the Department for Environment, Food and Rural Affairs (Defra) and to the Inter Agency Committee on Marine Science and Technology. He was commissioned by Defra to write the integrated assessment section of 'Charting Progress', an important document assessing the overall state of the seas surrounding the UK, as part of the UK Government's 2002 commitment to safeguarding its seas.

He was regarded as a man with a calm, professional manner and excellent negotiating skills. His expertise has contributed to the way we manage our regional seas today and his efforts in reducing pollution and conserving marine animals have surely left the seas cleaner than when he found them.

Photo and extracts from text kindly provided by Mike Waldock (Cefas).

Photo courtesy of Stéphane Barbery

Publications and Public Awareness

Each year the IOC publishes numerous documents and other publications. These publications support its programme activities and communicate the scientific and organizational information resulting from the various conferences, meetings, training courses and other activities that have benefited from IOC's support. Many of these publications are available on the internet; certain titles are also available in print where the internet is not an option.

IOC ANNUAL REPORT SERIES

Annual Report 2006. 2006. Paris, UNESCO, 106 pp. (Annual Report Series, 13.) (English.)

IOC TECHNICAL SERIES

Anderson, Donald M. *Bruun Memorial Lectures, 2005. The Ecology and Oceanography of Harmful Algal Blooms: Multidisciplinary Approaches to Research and Management*. 2007. 28 pp. (Technical Series, 74.) (English.)

Deep-water Cold Seeps, Sedimentary Environments and Ecosystems of the Black and Tyrrhenian Seas and the Gulf of Cadiz (Preliminary results of investigations during the TTR-15 cruise of RV *Professor Logachev*.) 2007. 134 pp. (Technical Series, 72.) (English.)

Implementation Plan for the Tsunami Early Warning and Mitigation System in the North-Eastern Atlantic, the Mediterranean and Connected Seas (NEAMTWS), 2007–2011. 2007. 40 pp. (Technical Series, 73, Version 3.2.) (English, electronic copy only.) *Regularly updated on (http://ioc3.unesco.org/neamtws/).*

IOC WORKSHOP REPORTS

International Conference on Marine Biodiversity Data Management: Ocean Biodiversity Informatics; Hamburg, Germany, 2004. 2007. 192 pp. (Workshop Reports, 202.) (English.) ISSN 1377-0950.

IOC-Flanders Planning Workshop for the Formulation of a Regional Pilot Project on Integrated Coastal Area Management in Latin America, Cartagena de Indias, Colombia, 16–18 January 2007. 2007. 34 pp. (Workshop Reports, 203.) (English.)

Geo-marine Research along European Continental Margins. International Conference and Post-cruise Meeting of the TTR Programme, Bremen, Germany, 29 January–1 February 2007. 2007. 62 pp. (Workshop Reports, 204.) (English.)

IODE/ICAM Workshop on the Development of the Caribbean Marine Atlas (CMA), United Nations House, Bridgetown, Barbados, 8–10 October 2007. 2007. 68 pp. (Workshop Reports, 205.) (English.)

IOC MANUALS AND GUIDES

Visions for a Sea Change. Report of the First International Workshop on Marine Spatial Planning. 2007. 83 pp. (Manuals and Guides, 48; ICAM Dossier No. 4.) (English.)

TRAINING COURSE REPORTS

ODINAFRICA Marine Biodiversity Data Mobilization Workshop on Sponges, 4–18 November 2006, Ostend, Belgium. 2007. 36 pp. (Training Course Reports, 89.) (English, electronic copy only.)

ODINAFRICA Marine Biodiversity Data Mobilization Workshop on Decapoda, 4–15 June 2007, Ostend, Belgium. 2007. 30 pp. (Training Course Reports, 90.) (English, electronic copy only.)

INFORMATION DOCUMENTS

IOC/INF-1232. *IGOS. A Coastal Theme for the IGOS Partnership: For the Monitoring of our Environment from Space and from Earth*. 2006. Paris, UNESCO. 60 pp. (English.)

IOC/INF-1233. *IOC Seminar on Tsunami Warning Operations under the Pacific Tsunami Warning And Mitigation System (PTWS): Protocols, Procedures and Best Practices for Monitoring, Evaluation and Alerting the Public, 2–3 April*

2007, Kuala Lumpur, Malaysia. 2007. Paris, UNESCO. 26 pp. (English.)

IOC/INF-1234. *Future Path of the World Climate Research Programme, Relevance to IOC, and the Proposed WCRP Budget and Extra-budgetary Resources Sought for 2008–2009*. 2007. Paris, UNESCO. 9 pp. (English.)

IOC/INF-1235. *Summary Report of the First Meeting of the Advisory Group for the IOC Ocean Sciences Section (OSS)*. 2007. Paris, UNESCO. 41 pp. (English.)

IOC/INF-1236. *Improving the IOC's Performance Management System: IODE; Reporting as a Pilot Project*. 2007. Paris, UNESCO. 20 pp. (English.)

IOC/INF-1237. *Improving the IOC's Performance Management System: Tsunami Reporting as a Pilot Project*. 2007. Paris, UNESCO. 8 pp. (English.)

IOC/INF-1238. *Future Development of the WMO-IOC-UNEP-ICSU Global Climate Observing System (GCOS)*. 2007. Paris, UNESCO. 4 pp. (English.)

IOC/INF-1239. *Report of the Intersessional Working Group on Regional Programmes and the Role of IOC Regional Subsidiary Bodies*. 2007. Paris, UNESCO. 22 pp. (English.)

IOC/INF-1240. *Activities of the Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology, 2006–2007*. 2007. Paris, UNESCO. 32 pp. (English.)

IOC/INF-1241. *Revised Rules of Procedure Applying to IOC Subsidiary Bodies (Draft)*. 2007. Paris, UNESCO. 8 pp. (English.)

IOC/INF-1242. *Compilation of Relevant References Related to the Work of IOC (2004–2007)*. 2007. Paris, UNESCO. 21 pp. (English.)

IOC/INF-1243. [Cancelled]

IOC/INF-1244. *Exercise Pacific Wave '06, 16–17 May 2006, Summary Report*. 2007. Paris, UNESCO. 45 pp. (English.)

REPORTS OF GOVERNING AND MAJOR SUBSIDIARY BODIES

Fourth Session of the Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWS-IV), Mombassa, Kenya, 30 February–2 March 2007. 2007. 88 pp. (Reports of Governing and Major Subsidiary Bodies, 123.) (Executive Summary available separately in English, French, Russian and Spanish.)

Nineteenth Session of the IOC Committee on International Oceanographic Data and Information Exchange, Trieste, Italy, 12–16 March 2007. 2007. 159 pp. (Reports of Governing and Major Subsidiary Bodies, 124). (Executive Summary available separately in English, French, Russian and Spanish.)

Third Session of the Intergovernmental Coordination Group for the Tsunami Early Warning and Mitigation System in the North-Eastern Atlantic, the Mediterranean and Connected Seas, Bonn, Germany, 7–9 February 2007. 2007. 105 pp. (Reports of Governing and Major Subsidiary Bodies, 125.) (Executive Summary available separately in English, French, Russian and Spanish.)

Second Session of the Intergovernmental Coordination Group for the Tsunami and other Coastal Hazards Warning System for the Caribbean Sea and Adjacent Regions, Cumaná, Venezuela, 15–19 January 2007. 2007. 42 pp. (Reports of Governing and Major Subsidiary Bodies, 126.) (English, Spanish; Executive Summary available separately in English, French, Russian and Spanish.)

Twenty-first Session of the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System, Melbourne, Australia, 3–5 May 2006. 2007. 155 pp. (Reports of Governing and Major Subsidiary Bodies, 127.) (Executive Summary available separately in English, French, Russian and Spanish.)

Twenty-fourth Session of the Assembly, Paris, 19–28 June 2007. 2007. 180 pp. (Reports of Governing and Major Subsidiary Bodies, 128.) (English, French, Russian and Spanish.)

Fourth Session of the Intergovernmental Coordination Group for the Tsunami Early Warning and Mitigation System in the North-Eastern Atlantic, the Mediterranean and Connected Seas, Lisbon, Portugal, 21–23 November 2007. 2007. 42 pp. (Reports of Governing and Major Subsidiary Bodies, 129.) (Executive Summary available separately in English, French, Russian and Spanish.)

Twenty-second Session of the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System, Guayaquil, Ecuador, 17–21 September 2007. 2007. 42 pp. (Reports of Governing and Major Subsidiary Bodies, 130). (Executive Summary in English, French, Russian and Spanish included.)

REPORTS OF MEETINGS OF EXPERTS AND EQUIVALENT BODIES

Seventh Meeting of the IOC Advisory Body of Experts on the Law of the Sea (IOC/ABE-LOS), 19–23 March 2007, Libreville, Gabon. 2007. 33 pp. (Reports of Meetings of Experts and Equivalent Bodies, 210.) (English, French.)

NEWSLETTERS

Argonautics. Newsletter of the international Argo Project. Argo Information Centre. No. 9, December 2007. (English.)

BFU Research Bulletin. Baltic Floating University, RSHU, St. Petersburg, Russian Federation, No. 9, 2007. (English.) ISBN 5-86813-155-X. With the IOC's sponsorship.

COSMAR News. A NEPAD Coastal and Marine Programme and the African OceanPortal Newsletter, Kenya, Tanzania. No. 10, April 2007; No. 11, August 2007; No. 12, October 2007; No. 13, December 2007. (English.) With the IOC's sponsorship.

Harmful Algae News, Paris. No. 33, June 2007; No. 34, October 2007; No. 35, December 2007. (English.) ISSN 0020-7918.

IOCCP e-Newsletter. The International Ocean Carbon Coordination Project: A joint project of SCOR and IOC, and an affiliate programme of the Global Carbon Project. Paris. No. 15, February 2007; No. 16, May 2007; No. 17, August 2007; No. 18, November 2007. (English.) (http://ioc3.unesco.org/ioccp/NewsArchives.html).

JCOMM Newsletter. WMO-IOC Joint Technical Commission for Oceanography and Marine Meteorology. Paris. No. 4, February 2007; No. 5, June 2007. (English).

Tsunami Newsletter. International Tsunami Information Centre, Honolulu, Hawaii, USA. Vol. XXXIX, No. 1, Jan-Mar 2007; No. 2, Apr-Jun 2007; No. 3, Jul-Sep 2007. (English.)

Vai Pacifika. Joint newsletter of the Pacific Islands Observing Systems, Suva, Fiji. Issue No. 1, December 2007. (English.) With the IOC's sponsorship.

Window. (Western Indian Ocean Waters), ODINAFRICA Project Office, Nairobi, Kenya. Vol. 18, No. 1, May 2007; No. 2, July 2007; No. 3, October 2007; No. 4, December 2007. (English.) ISSN 1024-4158.

Watching the oceans for signs of climate change. *A World of Science*. October 2007, Special Issue (Retrospective on Climate Change), pp. 34–40. Paris. (UNESCO Natural Sciences Quarterly Newsletter.) (English, French, Spanish.)

A carbon sink that can no longer cope? *A World of Science*. October 2007, Special Issue (Retrospective on Climate Change), pp. 41–44. Paris. (UNESCO Natural Sciences Quarterly Newsletter.) (English, French, Spanish.)

BROCHURES

Climate Change and Ocean Science: UNESCO in a Longstanding Leading Role. 2007. UNESCO/IOC. 2 pp., illus. (English.)

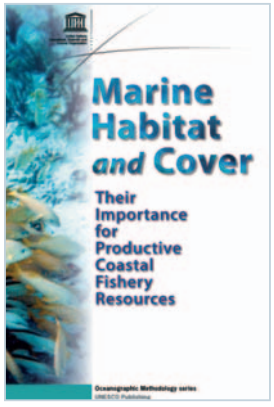
The Intergovernmental Oceanographic Commission and Priority Africa. 2007. UNESCO/IOC. 2 pp., illus. (English.)

Alverson, K. and D.J. Baker. 2007. Taking the Pulse of the Oceans. From *Science* 15 December 2006: Vol. 314, no. 5806, p.1657. 1 page. (English.)

Sales Publications

UNESCO Publishing

The IOC was committed to the creation of two series of the UNESCO Publishing House: **IOC Ocean Forum** series and **Oceanographic Methodology** series.



Caddy, John F. 2007. *Marine Habitat and Cover – Their Importance for Productive Coastal Fishery Resources*. Paris, 256 pp. (Oceanographic Methodology series.) ISBN 978-92-3-104035-1. (English.)

Coming soon:

Babin, Marcel, C.S. Roesler and J.J. Cullen (eds). *Real-time Coastal Observing Systems for Marine Ecosystem Dynamics and Harmful Algal Blooms – Theory, Instrumentation and Modelling*. Paris, 830 pp. (Oceanographic Methodology series.) Format: 24.8 x 16.5 cm (Hardback). (English.) ISBN 978-92-3-104042-9.

OTHERS

African Marine Atlas. Online atlas originally developed in June 2006 by ODINAFRICA with support from UNESCO/IOC and the Flemish community, Belgium. The atlas involves the participation of sixteen marine scientists and GIS experts from national institutions in Benin, Ghana, Kenya, Mauritania, Mauritius, Mozambique, Namibia, Senegal, Seychelles, South Africa and Tanzania. It offers information on areas along the African coastline of intense use in need of careful management. Maps, images and data are available for free and will be of broad interest to a variety of users, including coastal resource managers, planners, decision-makers, NGOs, hotel managers, and teachers. See the atlas at (http://iodeweb2.vliz.be/omap/OMAP/index.htm). For further information, contact Mika Odido at m.odido@unesco.org. (www.odinafrica.net).

Bernal, Patricio. 2007. *L'océan, bien commun de l'humanité*. Foreword in *Atlas de l'océan mondial*. Editions Autrement. 80 pp. (French.) ISBN 978-2-7467-0942-3.

UNESCO PRESS RELEASES AND MEDIA ADVISORIES

5 April 2007. 'Pacific tsunami reveals need for stronger emergency response in most vulnerable nations.' The Director-General of UNESCO, Mr Koïchiro Matsuura, expressed sorrow over the loss of life and the extensive damage caused by the tsunami that struck the Solomon Islands in the Pacific Ocean, and offered UNESCO's support in recovery efforts. (Press Release No. 2007-34.)

15 June 2007. 'Safeguarding the oceans and tackling climate change.' Safeguarding the oceans and tackling natural disasters and climate change will top the agenda of the Assembly of UNESCO's Intergovernmental Oceanographic Commission (IOC) when it meets at UNESCO Headquarters from 19 to 28 June. (Media Advisory No. 2007-44.)

19 June 2007. Address by Mr Koïchiro Matsuura, Director-General of UNESCO, on the occasion of the Twenty-fourth Session of the IOC General Assembly. (Director-General's speech DG/2007/085.)

1 November 2007. 'Ocean observing flotilla hits 3,000 mark.' Seven years after the launch of the first robotic Argo float, the Argo ocean observing array reached its initial target of 3,000 operating floats worldwide on 1 November 2007. (GOOS Outreach Information Document.)

13 November 2007. Address by Mr Koïchiro Matsuura, Director-General of UNESCO, on the occasion of the Information Meeting with the permanent delegates and observers on the development of UNESCO's strategy on global climate change. (Director-General's speech DG/2007/142.)

19 November 2007. 'Establishment of Tsunami Early Warning and Mitigation System in Mediterranean and North-Eastern Atlantic Ocean.' The Intergovernmental Coordination Group (ICG) of the Tsunami Early Warning and Mitigation System in the North-Eastern Atlantic, Mediterranean and Connected Seas (NEAMTWS) will meet in Lisbon, Portugal from 21 to 23 November to take stock of progress on the system's development. The meeting is organized by UNESCO's Intergovernmental Oceanographic Commission (IOC) and the Government of Portugal. (Media Advisory No. 2007-81.)

14 December 2007. 'Articulating science and education to face the challenge of global climate change: a UNESCO dialogue.' Dr Patricio Bernal introduced the 'UNESCO strategy for action on global climate change' as a side event at the United Nations Climate Change Conference in Bali.

20 December 2007. 'UNESCO and Inmarsat sign agreement to improve tsunami warning system in Indian Ocean.' The Intergovernmental Oceanographic Commission of UNESCO (IOC) signed an agreement today in London with Inmarsat (LSE: ISAT), the leading provider of global mobile satellite communications, to further upgrade and enhance the Indian Ocean Tsunami Warning System. (Press Release No. 2007-162.)

EXHIBITIONS

Paris, 26 March–6 April 2007. 'Deeper than light', an international, multi-lingual travelling exhibition produced by Bergen Museum and the MARECO Project (Census of Marine Life).

Paris, 16 October–3 November 2007. 'Planet Earth: from Space to Place', side event of the Thirty-fourth General Conference of UNESCO.

CERTIFICATE OF APPRECIATION AWARDED

Ingénieur Général André Roubertou for his contribution to the IOC/International Hydrographic Organization GEBCO Project and the successful development of the International Bathymetric Chart of the Central Eastern Atlantic. Paris, 5 November 2007.

IOC MEMORIAL LECTURES

The Anton Bruun Memorial Lecture, 2007: Professor Leonid A. Timokhov, Director of the German-Russian Laboratory for Polar and Marine Research at the Arctic and Antarctic Research Institute (AARI), St Petersburg, Russian Federation, on 'The Arctic and Southern Oceans: Origin, Physical and Chemical Properties, Circulation and Variability, and its Role in the World Ocean and the Global Climate System'. On this occasion, the Chairman presented Professor Timokhov with the IOC Anton Bruun Medal.

The IOC N.K. Panikkar Memorial Lecture 2007: Dr R.A. Mashelkar, FRS, President, Global Research Alliance, National Chemical Laboratory (NCL), Pune, India, on 'Information Exchange and Development: the Challenges Ahead for the Intellectual Property Regime.'

Further information is available at: http://ioc.unesco.org

Enquiries or requests for any of the above titles may be addressed to the IOC Documentalist: p.boned@unesco.org Fax: +33 1 45 68 58 10

IOC Meetings in 2007

Event	Date	Venue	IOC Department
Regional Workshop on the IOC LAC-ICAM Project	16–18 January	Cartagena, Colombia	Ocean Sciences/ IOCARIBE
Eleventh Session of IOC/WESTPAC Coordinating Committee for the North–East Asian Regional Global Ocean Observing System (NEAR-GOOS-CC-XI)	18–19 January	Bangkok, Thailand	IOC/WESTPAC
IOC Officers Meeting	23–25 January	Saint Petersburg, Russian Federation	Secretariat
Joint IOC-WMO Officers Meeting	26 January	Saint Petersburg, Russian Federation	Secretariat
Sixteenth Training-Through-Research Post Cruise Meeting	30 January –4 February	Bremen, Germany	Capacity Development
NEPAD COSMAR/ODINAFRICA Coordination Meeting	1–2 February	Ostend, Belgium	Ocean Observations and Services
Third Session of the Intergovernmental Coordination Group for the Tsunami Early Warning and Mitigation System in the North-Eastern Atlantic, the Mediterranean and Connected Seas (ICG/NEAMTWS)	7–9 February	Bonn, Germany	Tsunami Unit
African Ocean Portal Editorial Workshop	7–10 February	Nairobi, Kenya	Ocean Observations and Services
SeaDataNet Data Management Training Course	12–17 February	Ostend, Belgium	Ocean Observations and Services
ODINAFRICA African Marine Atlas Launch	12–23 February	Ostend, Belgium	Ocean Observations and Services
Fourth ODINAFRICA Project Management Committee Meeting	13–15 February	Nairobi, Kenya	Ocean Observations and Services
IODE Training Course on Oceanographic Data Management for the Caribbean Marine Atlas	13–20 February	Ostend, Belgium	Ocean Observations and Services/IOCARIBE
Fourth Session of the Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWS)	28 February –2 March	Mombasa, Kenya	Ocean Observations and Services
IOC-CLIVAR Indian Ocean Panel	28 February –3 March	Mombasa, Kenya	Ocean Observations and Services
Caribbean Large Marine Ecosystem Project Concept/Transboundary Diagnostic Analysis Synthesis Technical Workshop	28 February –3 March	Kingston, Jamaica	IOCARIBE
First Advanced Leadership Development Workshop for Directors of Marine Science Research Institutes in the Western Pacific Region	28 February –3 March	Bangkok, Thailand	Capacity Development/ WESTPAC
Eighth Session of the Argo Steering Team	7–9 March	Paris, France	Ocean Observations and Services
Second Session of the Intergovernmental Coordination Group for the Tsunami and Other Coastal Hazards Warning System for the Caribbean Sea and Adjacent Regions (CARIBE-EWS)	12–14 March	Cumana, Venezuela	Tsunami Unit
Nineteenth Session of the IOC Committee on International Oceanographic Data and Information Exchange (IODE-XIX)	12–16 March	Trieste, Italy	Ocean Observations and Services
IOC-SCOR Scientific Steering Committee for the Global Ecology and Oceanography of Harmful Algal Blooms (GEOHAB)	12–17 March	Tokyo, Japan	Ocean Sciences
Tenth Session of the GOOS Scientific Steering Committee (GSSC-X)	13–16 March	Pusan, Republic of Korea	Ocean Observations and Services
First Advanced Leadership Development Workshop for Directors of Marine Science Research Institutes in the East Atlantic Region	13–16 March	Libreville, Gabon	Capacity Development
SeaDataNet Plenary Meeting	19–20 March	Trieste, Italy	Ocean Observations and Services
Seventh Session of the Advisory Body of Experts on the Law of the Sea	19–23 March	Libreville, Gabon	Secretariat
IODE/MarBEF Biodiversity Data Management Course	19–23 March	Ostend, Belgium	Ocean Observations and Services

Event	Date	Venue	IOC Department
Second Meeting of the Expert Team on Wind Waves and Storm Surges	20–24 March	Geneva, Switzerland	Ocean Observations and Services/JCOMM
IOC Regional Science Planning Workshop on Harmful Algal Blooms in IOCARIBE (ANCA-IV Meeting)	21–26 March	San Andres Islands, Colombia	Ocean Sciences/ IOCARIBE
Second Session of the JCOMM Expert Team on Marine Climatology	26–27 March	Geneva, Switzerland	Ocean Observations and Services/JCOMM
Third Meeting of the Expert Team on Sea Ice	28–31 March	Geneva, Switzerland	Ocean Observations and Services/JCOMM
ADRICOSM-Ext Data Management Workshop	29–31 March	Trieste, Italy	Capacity Development
Surface Ocean CO_2 Variability and Vulnerability	11–14 April	Paris, France	Ocean Sciences
First Bid Writing Workshop for Directors of Marine Science Research Institutes in East Africa	16–20 April	Mombasa, Kenya	Capacity Development
Fourth Session of the Ship Observations Team (Volunteer Observing Ship Panel [VOSP], the Ship of Opportunity Programme Implementation Panel [SOOPIP], and the Automated Shipboard Aerological Programme Panel [ASAPP])	16–21 April	Geneva, Switzerland	Ocean Observations and Services
Third ODINAFRICA Marine Biodiversity Data Compilation Workshop (Decapods)	16–27 April	Ostend, Belgium	Ocean Observations and Services
Eight Session of the IOC Intergovernmental Panel on Harmful Algal Blooms	17–20 April	Paris, France	Ocean Sciences
Second Session of the JCOMM Observations Coordination Group	23–25 April	Geneva, Switzerland	Ocean Observations and Services/JCOMM
Fourth Session of CLIVAR/GOOS Indian Ocean Panel	23–25 April	Pretoria, South Africa	Ocean Observations and Services
IODE/EC Project ASCABOS Training for Young Scientists (a supporting programme for capacity-building in the Black Sea region towards operational status of oceanographic services)	23–26 April	Ostend, Belgium	Ocean Observations and Services
E-repository Training Course	23–28 April	Ostend, Belgium	Ocean Observations and Services
Twelfth Session of the GCOS-GOOS-WCRP Ocean Observations Panel for Climate (OOPC-XII)	2–5 May	Paris, France	Ocean Observations and Services
Group of Experts on Scientific Aspects of Marine Pollution (GESAMP)	7–11 May	Paris, France	Ocean Sciences
IOC/WESTPAC Consultative Meeting	17–18 May	Hangzhou, China	WESTPAC
Fourth Regional Science Planning Workshop on Harmful Algal Blooms in IOCARIBE	22–24 May	San Andres Islands, Colombia	Ocean Sciences/ IOCARIBE
ANCA-FANSA Portal Workshop	25–27 May	San Andres Islands, Colombia	Ocean Sciences/ IOCARIBE
Final African Marine Atlas (AMA) Workshop	4–8 June	Ostend, Belgium	Ocean Observations and Services/Africa
Young Scientist Training Course	4–9 June	Ostend, Belgium	Ocean Observations and Services/Africa
ODINAFRICA Marine Biodiversity Data Mobilization Workshop	4–15 June	Ostend, Belgium	Ocean Observations and Services/Africa
Eleventh Session of the IOC-WMO-CPPS Working Group on the Investigations of El Niño	5–6 June	Lima, Peru	Ocean Sciences
Tenth Session of the GLOSS Group of Experts (GE-GLOSS)	5–8 June	Paris, France	Ocean Observations and Services
DBCP Training Course on Buoy Programme Implementation and Data Management	11–15 June	Ostend, Belgium	Ocean Observations and Services
Third Session of the Executive Board of the IOC-WMO-UNEP Committee for the Global Ocean Observing System (I-GOOS)	12–16 June	Paris, France	Ocean Observations and Services
Eighth Session of the IOC-WMO-UNEP Intergovernmental Committee for the Global Ocean Observing System (I-GOOS-VIII)	13–16 June	Paris, France	Ocean Observations and Services
Fortieth Session of the Executive Council	18 June	Paris, France	Secretariat
Capacity-Building Team Building Workshop	19 June	Paris, France	Capacity Development
Twenty-Fourth Session of the Assembly	19–28 June	Paris, France	Secretariat
Ninth Consultative Committee Large Marine Ecosystems Meeting	10–11 July	Paris, France	Ocean Sciences
Task team to revise and adapt the English version of *Tsunami Teacher* to Spanish	18–19 July	Mayagüez, Puerto Rico	Secretariat
ASFA Advisory Board	3–7 September	Mombasa, Kenya	Ocean Observations and Services/Africa

Event	Date	Venue	IOC Department
Ninth Session of the IODE Group of Experts on Marine Information Management (GE-MIM)	17–20 September	Ostend, Belgium	Ocean Observations and Services
Twenty–Second Session of the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS)	17–21 September	Guayaquil, Ecuador	Tsunami Unit
Ocean Colour 2007 Africa: Training Course on Methods and Applications of Ocean Colour Remote Sensing in African Coastal and Regional Seas	24 September –5 October	Mombasa, Kenya	Ocean Observations and Services/Africa
In–House Leadership Training for Ghanaian Marine Related Institutions	26–29 September	Accra, Ghana	Capacity Development
Second Advanced Leadership Development Workshop for Directors of Marine Institutes in the Eastern Atlantic Region	1–3 October	Accra, Ghana	Capacity Development
Planning Meeting for the Ocean Carbon in the Southern Ocean Observing System (SOOS)	1–3 October	Bremen, Germany	Ocean Observations and Services/Ocean Sciences
Oceans Biodiversity Conference 2007	2–4 October	Dartmouth, Canada	Ocean Observations and Services
JCOMM Scientific and Technical Symposium on Storm Surges	2–6 October	Seoul, Republic of Korea	Ocean Observations and Services/JCOMM
Stakeholder meeting towards the development of a Caribbean Marine Atlas	8–10 October	Barbados	IOCARIBE
2007 GODAE (Global Ocean Data Assimilation Experiment) Coastal Workshop	10–11 October	Liverpool, UK	Ocean Observations and Services/JCOMM
Twenty-Third Session of the Data Buoy Cooperation Panel	15–19 October	Jeju, Republic of Korea	Ocean Observations and Services/JCOMM
Regional Working Group on Harmful Algae in North Africa (HANA)	18–20 October	Casablanca, Morocco	Ocean Sciences
Twenty-Seventh Meeting of the Argos Joint Tariff Agreement	22–24 October	Jeju, Republic of Korea	Ocean Observations and Services/JCOMM
Training on the Management of the End -to-End Data Management (E2EDM) Prototype System	22–25 October	Ostend, Belgium	Ocean Observations and Services
COAST-MAP-Indian Ocean Kick-Off Meeting	24–26 October	Bangkok, Thailand	WESTPAC
Round Table of S&T Ministers: Special session on best policy practices to foster growth of research institutes	26–27 October	Paris, France	Capacity Development
First Team Building Workshop for Project Leaders in the Western Indian Ocean Region	28–31 October	Durban, South Africa	Capacity Development
First Meeting of the Global Ocean Ship-Based Hydrographic Investigations Panel (GO-SHIP)	1–2 November	Victoria, BC, Canada	Ocean Observations and Services/JCOMM
GODAE-OOPC Meeting on Ocean Observing System Evaluation and Observing System Simulation Experiments	5–7 November	Paris, France	Ocean Observations and Services
International Workshop on Wave Hindcasting and Forecasting	11–17 November	Oahu, Hawaii, USA	Ocean Observations and Services/JCOMM
Fourth ODINAFRICA Project Steering and Management Committee Meeting	13–16 November	Ostend, Belgium	Ocean Observations and Services
HyperTeach@SADC Training Course in Imaging Spectroscopy	19–22 November	Stellenbosch, South Africa	Ocean Observations and Services
ODINECET Marine Information Management Training Course	19–23 November	Ostend, Belgium	Ocean Observations and Services
Fourth Session of the Intergovernmental Coordination Group for the Tsunami Early Warning and Mitigation System in the North-Eastern Atlantic, the Mediterranean and Connected Seas (ICG/NEAMTWS)	21–23 November	Lisbon, Portugal	Tsunami Unit
Hyperspectral Research Strategy Workshop	23 November	Stellenbosch, South Africa	Ocean Observations and Services
IODE Officers Meeting	27–30 November	Ostend, Belgium	Ocean Observations and Services
IOGOOS Workshop and Fifth Annual Meeting (IOGOOS-V) and Second High-Level Review Meeting of the Indian Ocean Panel (IOP)	30 November –3 December	Bangkok, Thailand	Ocean Observations and Services/Perth Programme Office
Sixth Session of the JCOMM Management Committee	3–6 December	Paris, France	Ocean Observations and Services/JCOMM
Team Building for Networks of Latin American Scientists	5–8 December	São Paulo, Brazil	Capacity Development
Bid Writing Workshop for Latin American Institutes	10–13 December	São Paulo, Brazil	Capacity Development

Funding for IOC Programmes

Introduction: general overview

This Annual Report describes a wide spectrum of activities that highlight the relevance of the Intergovernmental Oceanographic Commission of UNESCO's programmes in 2007. Together with national and non-governmental initiatives, the implementation and related staff costs during 2007 were financed through income from UNESCO as part of its **regular programme allocation**, as approved by the UNESCO General Conference, and from extra-budgetary resources, notably those provided by IOC Member States and partner organizations through their contributions to the **Intergovernmental Oceanographic Commission of UNESCO Special Account** and contributions for specific projects through the creation of **UNESCO Funds-in-Trust**. This financial report does not consider other contributions (either direct or in-kind) provided by Member States (which are rather substantial but do not enter the budgetary flow of IOC[1]) in support of the Commission's programme execution.

In accordance with the biennial Programme and Budget cycle and financial period of UNESCO, and following the provisions of the Financial Regulations of UNESCO applicable to the IOC, the following report covers the biennial accounts showing the income and expenditure of all funds, as well as the assets and liabilities of the IOC Special Account, for the financial period 2006–2007.

Table 1. Consolidated Report on Expenditure (Disbursements) 2006–2007: All sources of funding

	A. Regular Programme Allocation (33 C/5)			B. Special Account		C. Funds-in-Trust			TOTAL
	Activities	Staff	Common Charges	Activities	Staff	Activities	Staff	PSC	
MLA 1 Science	660,700.94	64,068.20	108,146.62	1,016,724.41	465,574.88	1,208,086.79	227,940.70	35,502.21	**3,786,744.75**
MLA 2 GOOS (including JCOMM)	601,569.26	296,325.74	183,340.05	604,395.99	705,021.14	0.00	0.00	0.00	**2,390,652.18**
MLA 2 Services (including Tsunami)	219,559.71	158,445.38		1,070,745.10	1,132,265.62	3,902,063.68	1,199,482.68	488,641.78	**8,171,203.95**
MLA 3 Policy (with 'One UN')	373,310.72	195,343.44	264,850.47	253,776.42	185,824.74	25,902.07	14,795.54	2,395.89	**1,316,199.29**
MLA 3 Capacity-Building and Regions	383,189.50	352,084.65		119,404.60	100,580.78	1,983,341.18	230,639.84	170,594.19	**3,339,834.74**
TOTAL	**2,238,330.13**	**1,066,267.41**	**556,337.14**	**3,065,046.52**	**2,589,267.16**	**7,119,393.72**	**1,672,858.76**	**697,134.07**	**19,004,634.91**
Regular Programme Staff Allocation		**4,143,890.94**							
GRAND TOTAL			**8,004,825.62**		**5,654,313.68**			**9,489,386.55**	**23,148,525.85**
								TOTAL ACTIVITIES	**12,422,770.37**
								TOTAL STAFF (INCL. TEMPORARY)	**9,472,284.27**
								TOTAL SUPPORT/CHARGES	**1,253,471.21**

1a. Programme

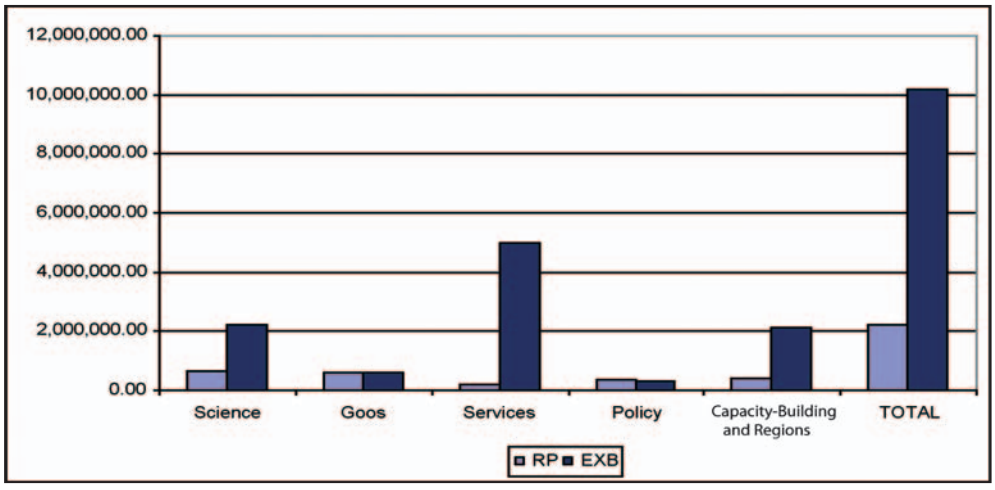
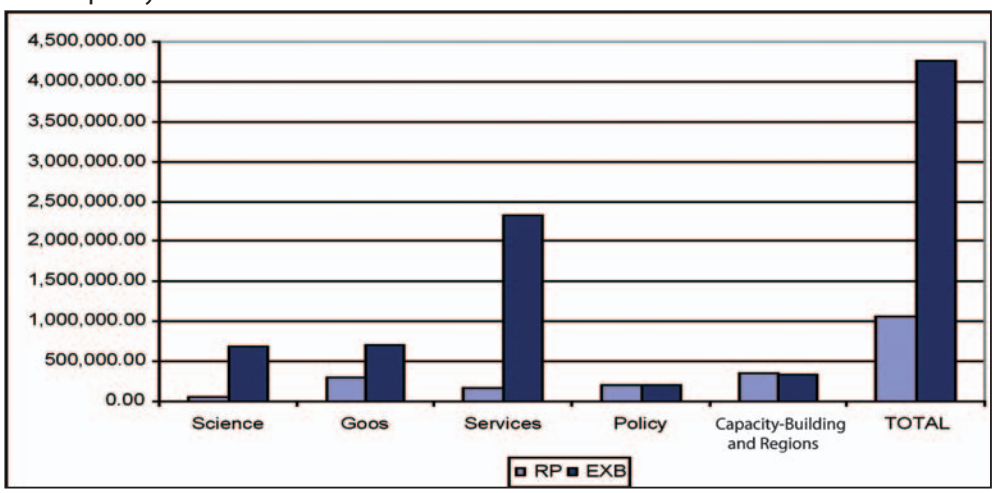


Fig. 1. Expenditure under Regular Programme (RP) and Extrabudgetary (EXB) by Main Activity Axes
(not taking into account common charges, support costs and global IOC regular programme staff allocation)

1. Please note that the authoritative figures are those contained in the financial statements prepared by the UNESCO Comptroller's Office that are presented at the end of this financial report.

1b. Temporary Assistance



DETAILED INFORMATION BY SOURCE OF FUNDING

1. Regular programme implementation

The Twenty-third Session of the IOC Assembly (21-30 June 2005) considered the Draft Programme and Budget for the biennium 2006–2007 as presented by the Executive Secretary in Document IOC-XXIII/2 Annex 3 rev. The Executive Secretary referred to the Zero Nominal Growth (ZNG) budget ceiling approved as a guideline for finalizing the Draft 33 C/5 by the 170th Session of the Executive Board of UNESCO. He informed the Assembly that the Executive Board did not mark the IOC as a principal priority. As a consequence, the IOC envelope for planning 2006–2007 was reduced by approximately $900,000 from $4,721,600 to $3,821,600. The Executive Secretary explained that the net impact on programmes would be a reduction of 20 per cent as a reduction in staff costs was not considered to be an option, given the already understaffed situation of the Commission.

This budgetary reduction led the Executive Secretary to propose a reduction in the number of the Main Lines of Actions (MLAs) integrated in the Draft 33 C/5, concentrating the programme from five to only three of the MLAs initially adopted by the Thirty-seventh Session of the IOC Executive Council: Science, Operational Services and Capacity-Building, cutting significantly into the support for policy and regional activities. He reported to the Assembly that a specific reinforcement of one additional professional staff post was included in the Draft Programme and Budget. An additional reinforcement of the Tsunami Programme is included in the Draft 33 C/5 for an amount of $1,000,000, as part of a special voluntary fund.

The proposed budget was then examined and discussed by the sessional Programme and Budget Committee, chaired by Captain Javier Valladares. The Committee, after a long and detailed discussion, decided to modify the budget proposed by the Executive Secretary in Document IOC-XXII/2 Annex 3 rev. The criteria applied by the Committee to translate the general reduction of the IOC's regular budget to different programmes were: (a) no budget reduction for staff (all posts); (b) flat-rate reduction for all programme activities; (c) no priorities to be set until proper performance metrics are developed, agreed and applied.

The Assembly adopted Resolution XVIII-16, containing the following budget breakdown for 2006–2007:

Table 2. Resolution XVIII-16: Budget Breakdown for 2006–2007

TITLE	Amount
MLA 1 Addressing scientific uncertainties for the management of the marine environment and climate change	*(in thousands)*
Oceans and Climate	186,930
Ecosystem Protection and Marine Environment Protection*	177,585
*of which HAB activities	60,348
ICAM	286,800
Sub-total MLA 1	**651,315**
MLA 2 Developing operational capabilities for the management and sustainable development of the open and coastal ocean	
GOOS	606,423
Rio GOOS Staff	*66,000*
Perth Office Staff	*160,000*
GOOS-Africa Staff	*50,000*
ITSU	72,123
JCOMM	139,831
JCOMM Staff	*50,000*
IODE Activities	143,510
Ostend Office Staff	*120,000*
Ocean Mapping	60,348
Sub-total MLA 2	**1,468,235**
MLA 3 Capacity of Member States in marine science for the coastal ocean strengthened	
Capacity-building	430,494
Ocean Governance and UNCLOS	135,415
UNCLOS/ABE-LOS Consultant.	*100,000*
Governing bodies and Public Awareness	235,504
ADG/Office Staff	*250,000*
Regional activities	95,637
WESTPAC Staff	*125,000*
IOCARIBE Staff	*230,000*
HAB Office Staff	*100,000*
Sub-total MLA 3	**1,702,050**
TOTAL ALLOCATION*	**3,821,600**

*As reflected in the current UNESCO Draft Programme and Budget (610-baseline scenario).

A further reduction of approximately 13.4% to programme activities lines is anticipated in order to cover the IOC's share of running costs.

The UNESCO General Conference subsequently endorsed this total allocation for programmes ($3,821,600) as part of the Approved Programme and Budget for 2006–2007 (33 C/5).

The Thirty-ninth Session of the IOC Executive Council (Paris, France, 21-28 June 2006) in its Resolution EC-XXXIX.10 'IOC Programme and Budget' provided further guidelines for the allocation of regular programme funding.

Table 3. Regular Programme Expenditure: Disbursements as at 31 December 2007: Programme vs Personnel
(based on SAP reports prior to accounts closure)

Budget Code	Short Title	Allocation 2006–2007	Expenditure 2006	Expenditure 2007		TOTAL	ULOs	Exec. Rate	TOTAL 2006–2007
				Activities	Temp. Assist.				
MLA 1									
32131101 IOC	IOCCP	27,936.00	13,803.22	1,659.96	12,471.00	14,130.96		99.99	27,934.18
32131102 IOC	OOPC	59,871.00	37,532.55	22,269.22	69.23	22,338.45		100	59,871.00
32131103 IOC	WCRP	250,000.00	124,999.72	125,000.00		125,000.00		100	249,999.72
32131104 IOC	UNESCO at the UNFCCC*	1.00		6,280.68		6,280.68	10,857.74		17,138.42
32131201 IOC	Harmful Algal Blooms	49,112.00	5,008.26	44,100.85		44,100.85		99.99	49,109.11
32131202 IOC	Environmental Variability and Ecosystems	88,613.00	37,684.07	49,074.06		49,074.06	1,854.87	100	88,613.00
32131301 IOC	Indicators for ICAM	60,920.00	27,642.71	23,361.88	8,657.32	32,019.20	1,258.00	100	60,919.91
32131302 IOC	Guidance for ICAM Implementation	60,930.00	18,405.47	22,963.17	14,355.01	37,318.18	5,206.35	100	60,930.00
32131401 IOC	ICAM Implementation in Africa	38,327.00	10,730.40	12,905.80	2,078.50	14,984.30	12,612.30	100	38,327.00
32131402 IOC	Reg.Implementation of ICAM	57,930.00	25,954.14	31,495.03	55.01	31,550.04	422.62	99.99	57,926.80
32131403 NAI	Support to COSMAR NEPAD Secretariat	14,000.00		14,000.00		14,000.00		100	14,000.00
Sub-total	***MLA 1 - net programme***	***707,640.00***	***301,760.54***	***353,110.65***	***37,686.07***	***390,796.72***	***32,211.88***		***724,769.14***
Sub-total	***MLA 1 - 'common charges'***	***108,600.00***	***29,659.22***	***69,181.93***	***7,914.09***	***77,096.02***	***1,391.38***		***108,146.62***
TOTAL	MLA 1	816,240.00	331,419.76	422,292.58	45,600.16	467,892.74	33,603.26		832,915.76
MLA 2									
32132101 IOC	GOOS	748,873.00	337,416.88	221,184.86	143,115.24	364,300.10	47,156.02	100	748,873.00
32132201 IOC	JCOMM Coordination	149,022.00	50,087.53	89,802.26	1,225.98	91,028.24	7,906.23	100	149,022.00
	Sub-total	897,895.00	387,504.41	310,987.12	144,341.22	455,328.34	55,062.25		897,895.00
32132301 IOC	IODE-1	61,782.00	24,730.83	35,851.09		35,851.09	1,200.00	100	61,781.92
32132302 IOC	IODE-2	21,861.00	7,997.01	13,863.56		13,863.56		100	21,860.57
32132303 IOC	IODE-3	12,071.00		11,925.45		11,925.45	145.31	100	12,070.76
32132304 IOC	IODE-4	184,001.00	104,059.85	8,094.08	57,658.00	65,752.08	4,025.00	94.48	173,836.93
32132305 QUI	ODINCARSA	7,000.00	6,990.00				10.00	100	7,000.00
32132401 IOC	Tsunami	54,200.00	27,064.59	16,911.93	4,908.00	21,819.93	5,311.00	99.99	54,195.52
32132402 IOC	Ocean Mapping	47,260.00	24,741.14	12,449.23	9,926.02	22,375.25	143.00	100	47,259.39
	Sub-total	388,175.00	195,583.42	99,095.34	72,492.02	171,587.36	10,834.31		378,005.09
Sub-total	***MLA 2 - net programme***	***1,286,070.00***	***583,087.83***	***410,082.46***	***216,833.24***	***626,915.70***	***65,896.56***	***0.00***	***1,275,900.09***
Sub-total	***MLA 2 - 'common charges'***	***183,600.00***	***53,910.08***	***105,872.56***	***3,820.48***	***109,693.04***	***19,736.93***		***183,340.05***
TOTAL	MLA 2	1,469,670.00	636,997.91	515,955.02	220,653.72	736,608.74	**85,633.49**		1,459,240.14

MLA 3									
32133101 IOC	TTR	51,945.00	19,018.99	25,219.10	4,076.68	29,295.78	3,629.68	100	51,944.45
32133102 IOC	Mobility and Linkages	44,290.00	28,275.00	14,200.07	1,665.38	15,865.45	149.55	100	44,290.00
32133201 IOC	UNESCO Chairs	20,000.00	5,000.00	11,103.00	2,895.50	13,998.50	1,001.00	100	19,999.50
32133202 IOC	Remote Sensing and Modelling	10,000.00	10,000.00					100	10,000.00
32133301 IOC	Integrated TEMA Website	20,000.00	2,071.35	17,506.54	401.11	17,907.65	21.00	100	20,000.00
32133302 IOC	Statements on Capacities of Member States	120,000.00	48,503.96	19,485.42	49,618.66	69,104.08	2,391.96	100	120,000.00
	Sub-total	266,235.00	112,869.30	87,514.13	58,657.33	146,171.46	7,193.19		266,233.95
32133401 IOC	Promotion UNCLOS Implementation	87,000.00	47,583.65	29,218.64	9,467.00	38,685.64	729.57	100	86,998.86
32133402 IOC	UNCLOS/ABELOS Consultant	75,540.00	32,587.41	526.35	42,336.55	42,862.90	88.77	100	75,539.08
32133501 IOC	Governing Bodies and Public Awareness	177,600.00	75,994.44	101,567.50		101,567.50	34.94	100	177,596.88
32133502 IOC	ADG/IOC Office Staff	182,900.00	80,849.69	42,626.89	52,257.11	94,884.00	7,165.62	100	182,899.31
	Sub-total	523,040.00	237,015.19	173,939.38	104,060.66	278,000.04	8,018.90		523,034.13
32133503 IOC	Regional coordination	36,160.00	12,247.66	23,593.83	13.10	23,606.93	305.15	100	36,159.74
32133504 IOC	IOCARIBE Office Staff	230,000.00	121,135.24	13,653.48	95,211.27	108,864.75	0.01	100	230,000.00
32133505 IOC	HAB Office Staff	100,000.00	10,827.68	89,087.92		89,087.92	83.89	100	99,999.49
32133506 IOC	WESTPAC Office Staff	103,055.00	57,108.26	24,427.63	20,370.00	44,797.63	975.08	99.83	102,880.97
	Sub-total	469,215.00	201,318.84	150,762.86	115,594.37	266,357.23	1,364.13		469,040.20
Sub-total	***MLA 3 - net programme***	***1,258,490.00***	***551,203.33***	***412,216.37***	***278,312.36***	***690,528.73***	***16,576.22***	***0.00***	***1,258,308.28***
Sub-total	***MLA 3 - 'common charges'***	***264,900.00***	***92,432.39***	***125,522.00***	***20,972.53***	***146,494.53***	***25,923.55***		***264,850.47***
TOTAL	**MLA 3**	**1,523,390.00**	**643,635.72**	**537,738.37**	**299,284.89**	**837,023.26**	**42,499.77**		**1,523,158.75**
32133508 BSP	Country Programme 'ONE UN'	34,000.00		30,000.00	0.00	30,000.00	4,000.00	100	34,000.00
32133609 SCA	CCA/UNDAF and 'ONE UN'**	33,100.00		3,295.97	0.00	3,295.97	8,324.06	35.11	11,620.03
Sub-total	***'ONE UN' Exercise***	***67,100.00***	***0.00***	***33,295.97***	***0.00***	***33,295.97***	***12,324.06***		***45,620.03***
TOTAL IOC	**Programme**	3,252,200.00	**1,436,051.70**	1,175,409.48	532,831.67	**1,708,241.15**	114,684.66		3,258,977.51
	with 'One UN'	3,319,300.00	**1,436,051.70**	1,208,705.45	532,831.67	**1,741,537.12**	127,008.72		3,304,597.54
TOTAL IOC	**COMMON CHARGES**	**557,100.00**	**176,001.69**	**300,576.49**	**32,707.10**	**333,283.59**	**47,051.86**		**556,337.14**
32130000 HEQ	**Staff Cost IOC - HQ**	**4,417,639.00**	**2,116,520.60**			**2,018,732.95**	**8,637.39**		**4,143,890.94**
GRAND TOTAL		**8,294,039.00**							**8,004,825.62**

* *Funds transferred to IOC by DG decision - not part of the initial allocation*
** *50% reverting to IOC of the contribution to 'One UN' pool - all programme taxed*

2. IOC SPECIAL ACCOUNT

2 - Account – 194IOC9090 – Programme Activities: Income

Table 4. 2006–2007 Contributions to the IOC Special Account – 194IOC9090 – Programme Activities

Donor	Amount		Purpose
	2006	2007	
MLA 1 - SCIENCE (191SCI2020)			
Great Barrier Reef Marine Park Authority, Australia		2,287.10	Marine Spatial Planning
Belgium		12,839.95	Marine Spatial Planning
Canada		23,364.49	Marine Spatial Planning
USA NOAA	10,000.00		Marine Spatial Planning
USA NOAA	10,000.00		Marine Spatial Planning
The Nature Conservancy, USA	10,000.00		Marine Spatial Planning
Gordon and Betty Moore Foundation, USA	15,000.00		Marine Spatial Planning
English Nature, UK	9,300.00		Marine Spatial Planning
WWF	12,807.68	26,771.86	Marine Spatial Planning
Conservation International Foundation	7,500.00	2,500.00	Marine Spatial Planning
Canada		17,794.17	ICAM
UNEP		73,500.00	ICAM
Mexico		16,062.60	ICAM
WMO		20,000.00	ICAM
USA NOAA	35,000.00		GEOHAB
Denmark		30,500.79	HAB Centre (activities)
USA (Department of State)		30,000.00	HAB
USA NOAA	10,000.00	40,000.00	HAB
USA NOAA	15,000.00		HAEDAT
Pierre and Marie Curie University (UPMC), France	2,005.02		HAB
Pierre and Marie Curie University (UPMC), France	10,000.00		HAB
Transfer from 193DEN2020 (closed project)	28.11		HAB
Spain	38,379.00	44,214.00	HAB/Vigo
Transfer from 193UKM2041 (closed project)	832.00		Coral Reefs project
USA NOAA	30,000.00	30,000.00	Global Marine Assessment
Republic of Korea	19,985.00		Global Marine Assessment
Canada		27,027.03	Global Marine Assessment
USA (Department of State)		30,000.00	GNEWS working group event
SCOR		3,500.00	Ocean Carbon project
Sub-total	**235,836.81**	**430,361.99**	
MLA 2 - GOOS (191GOS2040)			
United Nations Environment Programme (UNEP)	18,000.00		GOOS
United Nations Environment Programme (UNEP)	2,000.00		GOOS
World Meteorological Organization (WMO)		30,330.38	GOOS
United Kingdom, Natural Environment Research Council (NERC)	18,000.00	18,000.00	GOOS
USA NOAA		66,500.00	GOOS
Republic of Korea		980.00	GOOS
USA NOAA		10,000.00	GOOS LME
USA (Department of State)	20,000.00		GOOS Regional Forum
USA NOAA		15,000.00	I-GOOS
France		21,276.60	I-GOOS
USA NOAA		84,000.00	GODAE project office support
USA NOAA	20,000.00		JCOMM/GLOSS
USA NOAA		40,000.00	GLOSS
United Kingdom, Natural Environment Research Council (NERC)	10,000.00	10,000.00	GLOSS
USA NOAA		15,000.00	JCOMM secretariat
USA NOAA	20,000.00	40,000.00	Rio-GOOS

Donor	Amount		Purpose
	2006	2007	
USA NOAA	30,000.00	192,000.00	Rio-GOOS (Argo floats deployment)
USA NOAA		30,000.00	SEREAD for Argo in South Pacific Ocean
USA NOAA		32,000.00	Argo in South Atlantic to Southern Ocean
USA NOAA		25,000.00	Pacific Island GOOS Regional Alliance
USA NOAA	20,000.00		Tech. Services of Dr J.Baker (GOOS/JCOMM)
USA NOAA	20,000.00		Tech. Services of Dr J.Baker (GOOS)
Italy, International Marine Centre (IMC)	7,384.61		MAMA Project
Germany (institute for Coastal Research/GKKS)	2,405.84		GLOSS/Sea Level Rise meeting, June 2006
International Association for the Physical Sciences of the Oceans (IAPSO)	2,100.00		GLOSS/Sea Level Rise meeting, June 2006
France, Institute of Research for Development (IRD)	2,570.70		GLOSS/Sea Level Rise meeting, June 2006
France, National Centre for Scientific Research (CNRS)	9,640.13		GLOSS/Sea Level Rise meeting, June 2006
France, Institut Géographique National (IGN)	6,377.55		GLOSS/Sea Level Rise meeting, June 2006
UK Met Office	9,251.00		GLOSS/Sea Level Rise meeting, June 2006
Asia Pacific Network for Global Change Research	5,000.00		GLOSS/Sea Level Rise meeting, June 2006
USA NOAA	58,041.00		GLOSS/Sea Level Rise meeting, June 2006
European Environment Agency (EAS)	11,556.12		GLOSS/Sea Level Rise meeting, June 2006
Sub-total	**292,326.95**	**630,086.98**	
MLA 2 - IODE (191SER2030)			
France, French research institute for exploitation of the sea (IFREMER)	8,464.33		IODE - EurOcean
HR Wallingford Ltd	13,881.78		IODE - SIMORC
HR Wallingford Ltd		17,305.88	IODE-SIMORC
USA NOAA	20,000.00	70,000.00	IODE Meetings and Data Portal
USA (Department of State)	20,000.00		IODE Data ATM Programme
Sub-total	**62,346.11**	**87,305.88**	
MLA 2 - Ocean Mapping (191SER2030)			
International Landkartenhaus (Germany)	745.34		Ocean Mapping
RMIB Geoscience, The Netherlands	271.68		Ocean Mapping
Republic of Korea (Permanent Delegation)	254.45		Ocean Mapping
Republic of Korea (Permanent Delegation)	527.01		Ocean Mapping
Sub-total	**1,798.48**	**0.00**	
MLA 2 - Tsunami Warning System (191SER2030)			
Vassar College	505.00	225.00	Tsunami Education
World Meteorological Organization (WMO)	18,751.46		ICG/CARIBE-EWS, January 2006, Barbados
USA (Department of State)		30,000.00	CARIBE-EWS
Israel	5,000.00	5,000.00	TWS/Mediterranean
Canada	22,328.80		TWS
USA (Department of State)	20,000.00		ICG-II Meeting TWS-Caribbean
Republic of Korea	1,000.00		TWS
Geohazards International	1,000.00		TWS
New Zealand		10,096.50	PTWS
USA (Department of State)		30,000.00	
Sub-total	**68,585.26**	**75,321.50**	
MLA 3 - Capacity-Building (191CAP2050)			
University of Southampton,UK	20,699.48		HERMES Project
European Space Agency (ESA)	12,722.60		ESA/KARI/PORSEC/IOC Training Course, Daejon
France		7,092.20	Capacity-Building Activities
Sub-total	**33,422.08**	**7,092.20**	

Donor	Amount		Purpose
	2006	2007	
MLA 3 - REGIONS (191CAP2050)			
China (People's Republic of)	20,000.00	19,978.00	Regional Cooperation WESTPAC
China (People's Republic of)	20,000.00		Regional Cooperation WESTPAC
World Agency of Planetary Monitoring and Earthquake Risk Reduction (WAPMERR)	76,915.00		Post-Disaster Assess.IO and Asian Waters
United Nations University (UNU)	5,000.00		Post-Disaster Assess.IO and Asian Waters
USA NOAA	10,000.00	20,000.00	IOCARIBE
Colombia		13,055.00	IOCARIBE Office Expenses
USA NOAA	10,000.00		IOCARIBE-GOOS Integration into TWS
Sub-total	**141,915.00**	**53,033.00**	
MLA 3 - POLICY (191POL2050)			
Spain, Spanish Institute of Oceanography (IEO)	7,108.98		ABELOS
Spain (MFA)	19,505.83		ABELOS
Greece	10,204.08	16,393.44	ABELOS
France		14,184.40	ABELOS
Netherlands		4,463.45	ABELOS
International Tribunal for the Law of the Sea (ITLOS)		3,841.05	ABELOS
Greece		9,536.80	ABELOS and Policy
Consortium for Oceanographic Research and Education	935.48		ADG/IOC Travel Costs (reimbursement)
Australia, Bureau of Meteorology (BOM)	2,250.91		IOC Officers Meeting Buenos Aires
Deusches Komitee Katastrophenvorsorge (Germany)	844.59		ADG/IOC Travel Costs (reimbursement)
Japan, Asian Disaster Reduction Center (ADRC)		6,570.00	ADG/IOC Travel Costs (reimbursement)
USA (Department of State)	50,000.00		Revision of the IOC Website
USA (Department of State)	30,000.00		Performance Metrics
USA (Department of State)		15,000.00	Working Group 'Future of IOC'
Sub-total	**120,849.87**	**69,989.14**	
STAFF			
Australia, Commonwealth Scientific and Industrial Research Organization (CSIRO)	7,470.00	7,853.00	Argo Coordinator
Canada	8,582.52	9,009.01	Argo Coordinator
France, French research institute for exploitation of the sea (IFREMER)	12,853.50	13,333.30	Argo Coordinator
USA NOAA	120,000.00	240,000.00	Argo Coordinator
UK Met Office	13,850.00	14,868.00	Argo Coordinator
India, Indian National Centre for Ocean Information Services (INCOIS)		10,000.00	Argo Coordinator
Germany		6,839.95	Argo Coordinator
USA NOAA	110,000.00	267,000.00	Technical Secretary for OOPC
USA NOAA	115,000.00		Ocean Carbon Research Project Officer
Denmark		74,127.64	Head of HAB Centre
Sub-total	**387,756.02**	**643,030.90**	
NON-EARMARKED			
Canada	12,844.67	12,954.47	Programme Activities Support
Sub-total	**12,844.67**	**12,954.47**	
INTEREST			
First quarter	54,176.00	56,301.00	
Second quarter	54,136.00	55,752.00	
Third quarter	55,230.00	58,978.00	
Fourth quarter	59,329.00	82,462.00	
Sub-total	**222,871.00**	**253,493.00**	
TOTAL	**1,580,552.25**	**2,262,669.06**	
GRAND TOTAL FOR THE BIENNIUM	**3,843,221.31**		

2.1 - Account – 194IOC9090 – Programme Activities: Expenditure

For the sake of clarity, it should be explained that voluntary contributions to the IOC Special Account are deposited into the IOC General Revenue Account (194IOC9090) from which funds are allotted to the five accounts established in accordance with the IOC programme structure. The expenditure is recorded on the following operational sub-accounts:

191POL2010 – General/Policy
191SCI2020 – Ocean Science
191SER2030 – Ocean Services
191GOS2040 – Global Ocean/Coastal Observing Systems
191CAP2050 – Capacity Building/Regional Cooperation

Table 5. Programme Activities: Expenditure on operation codes

	Disbursements			Undelivered	Total
	2006	2007	Total disbursed		
Ocean Sciences					
11 - Experts and Consultants	394,161.40	52,035.29	446,196.69	13,996.00	460,192.69
13 - Administrative Support Personnel	602.38	3,769.97	4,372.35	1,009.84	5,382.19
16 - Mission Costs	17,494.01	12,540.48	30,034.49	1,296.86	31,331.35
17 - National Professionals	0.00	0.00	0.00	0.00	0.00
10 - Other Personnel Costs	0.00	0.00	0.00	0.00	0.00
20 - Sub-Contracts	187,795.26	90,112.50	277,907.76	28,142.14	306,049.90
32 - Training and Seminars	28,881.20	76,757.31	105,638.51	7,061.47	112,699.98
40 - Equipment and Maintenance	3,589.62	867.98	4,457.60	13,483.76	17,941.36
50 - Sundry Expenditure	422.09	12,102.19	12,524.28	218.35	12,742.63
Sub-total	**632,945.96**	**248,185.72**	**881,131.68**	**65,208.42**	**946,340.10**
Global Ocean/Coastal Observing Systems					
11 - Experts and Consultants	289,717.39	264,092.34	553,809.73	0.00	553,809.73
13 - Administrative Support Personnel	7,843.60	1,282.25	9,125.85	0.00	9,125.85
16 - Mission Costs	55,646.50	35,918.29	91,564.79	10,093.70	101,658.49
17 - National Professionals	0.00	0.00	0.00	0.00	0.00
10 - Other Personnel Costs	0.00	0.00	0.00	0.00	0.00
20 - Sub-Contracts	174,756.83	45,615.68	220,372.51	24,313.00	244,685.51
32 - Training and Seminars	146,002.57	3,449.71	149,452.28	0.00	149,452.28
40 - Equipment and Maintenance	26,305.68	2,308.41	28,614.09	4,140.38	32,754.47
50 - Sundry Expenditure	39,909.20	1,220.05	41,129.25	17.87	41,147.12
Sub-total	**740,181.77**	**353,886.73**	**1,094,068.50**	**38,564.95**	**1,132,633.45**
Ocean Services					
11 - Experts and Consultants	10,006.00	21,518.85	31,524.85	6,236.50	37,761.35
13 - Administrative Support Personnel	0.00	16,285.66	16,285.66	0.00	16,285.66
16 - Mission Costs	28,571.66	19421.26	47,992.92	100.00	48,092.92
17 - National Professionals	0.00	0	0.00	0.00	0.00
10 - Other Personnel Costs	0.00	5899.72	5,899.72	0.00	5,899.72
20 - Sub-Contracts	27,502.53	17193.96	44,696.49	0.00	44,696.49
32 - Training and Seminars	17,728.36	48783.63	66,511.99	9,171.50	75,683.49
40 - Equipment and Maintenance	22,233.51	7057.25	29,290.76	5,841.77	35,132.53
50 - Sundry Expenditure	18,946.46	624.20	19,570.66	3,265.47	22,836.13
Sub-total	**124,988.52**	**136,784.53**	**261,773.05**	**24,615.24**	**286,388.29**
General Policy					
11 - Experts and Consultants	24,010.80	43,803.62	67,814.42	0.00	67,814.42
13 - Administrative Support Personnel	61,953.60	56,056.72	118,010.32	0.00	118,010.32
16 - Mission Costs	20,878.23	31,168.55	52,046.78	0.00	52,046.78
17 - National Professionals	0.00	0.00	0.00	0.00	0.00
10 - Other Personnel Costs	0.00	0.00	0.00	0.00	0.00
20 - Sub-Contracts	28,861.30	54,376.21	83,237.51	34,809.25	118,046.76

32 - Training and Seminars	55,423.04	1,699.35	57,122.39	0.00	57,122.39
40 - Equipment and Maintenance	2,393.22	8,338.51	10,731.73	10.49	10,742.22
50 - Sundry Expenditure	10.00	10,448.06	10,458.06	5,360.21	15,818.27
Sub-total	**193,530.19**	**205,891.02**	**399,421.21**	**40,179.95**	**439,601.16**
Capacity-Building/Regional Cooperation					
11 - Experts and Consultants	1,445.53	42,770.27	44,215.80	6,701.00	50,916.80
13 - Administrative Support Personnel	28,148.10	16,487.08	44,635.18	0.00	44,635.18
16 - Mission Costs	10,673.90	12,659.59	23,333.49	0.00	23,333.49
17 - National Professionals	0.00	2,400.80	2,400.80	2,628.00	5,028.80
10 - Other Personnel Costs	0.00	0.00	0.00	0.00	0.00
20 - Sub-Contracts	56,376.00	11,699.88	68,075.88	4,820.02	72,895.90
32 - Training and Seminars	10,781.92	5,825.44	16,607.36	0.00	16,607.36
40 - Equipment and Maintenance	0.00	0.00	0.00	0.00	0.00
50 - Sundry Expenditure	46.45	6,233.30	6,279.75	288.10	6,567.85
Sub-total	**107,471.90**	**98,076.36**	**205,548.26**	**14,437.12**	**219,985.38**
TOTAL	**1,799,118.34**	**1,042,824.36**	**2,841,942.70**	**183,005.68**	**3,024,948.38**

2.2 Earmarked Activities – Income and Funds Availability

Table 6. Income and Expenditure under Earmarked Activities (193-series)

Budget code	Project title (short)	Total approved budget	Donor	Income 2006	Disbursements 2006		Income 2007	Disbursements 2007		ULOs	Available 31 December 2007
					Activities (including travel)	Personnel		Activities (including travel)	Personnel		
MLA 1 - Ocean Science											
193INT2000	LMEs	995,000.00	UNEP	0.00	280,383.94	0.00	125,000.00	127,575.25	0.00	128,000.00	133,154.40
193DEN2020	HAB	CLOSED*	Denmark	-28.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00
193UKM2041	GCRMN	CLOSED*	UK	-832.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sub-total				**-860.11**	**280,383.94**	**0.00**	**125,000.00**	**127,575.25**	**0.00**	**128,000.00**	**133,154.40**
MLA 2 - GOOS											
193GLO2001	DBCP	1,880,596.04	DBCP MS	0.00	5,034.23	55,151.91	270,000.00	27,867.25	86,933.65	1,796.64	277,695.15
Sub-total				**0.00**	**5,034.23**	**55,151.91**	**270,000.00**	**27,867.25**	**86,933.65**	**1,796.64**	**277,695.15**
MLA 2 - Tsunami											
193INT2001	IOTWS		Israel	5,000.00			5,000.00				
			ISDR	250,000.00							
			Belgium				233,625.76				
			Germany				212,349.80				
			USA				200,000.00				
		2,961,447.79	Sub-total	255,000.00	119,203.02	223,961.25	650,975.56	293,477.93	351,936.80	129,835.95	1,750,754.08
193INT2002	ICG Sec	1,077,523.55	Australia	427,541.50	114,057.38	148,971.26	455,312.05	161,656.05	347,449.58	26,073.21	267,097.64
Sub-total				**682,541.50**	**233,260.40**	**372,932.51**	**1,106,287.61**	**455,133.98**	**699,386.38**	**155,909.16**	**2,017,851.72**
TOTAL				**681,681.39**	**518,678.57**	**428,084.42**	**1,501,287.61**	**610,576.48**	**786,320.03**	**285,705.80**	**2,428,701.27**
* Projects terminated, balances transferred to 194IOC9090											
TOTAL INCOME 2006–2007											**2,182,969.00**
TOTAL EXPENDITURE 2006–2007											**2,629,365.30**

3. UNESCO FUNDS-IN-TRUST FOR SPECIFIC PROJECTS

Table 7. Expenditure under funds-in-trust

Budget code	Project title (short)	Donor	Valid from	Valid to	Total Alloc.	Disbursements 2006-2007			ULOs	TOTAL	Available 31/12/2007
						Activities	Personnel	PSC			
MLA 1 - Ecosystem and Marine Environment Protection											
213INT2002	CME	UNEP	15/7/04	31/7/06	10,577.23	10,577.23	0.00	0.00	0.00	10,577.23	0.00
513RAS2000	Biodiversity	Flanders	1/1/04	31/12/07	66,000.00	25,463.83	0.00	2,546.38	0.00	28,010.21	0.00
Sub-total					76,577.23	36,041.06	0.00	2,546.38	0.00	38,587.44	0.00
MLA 1 - Integrated Coastal Area Management (ICAM)											
213GLO2003	Global Dialogue	UNEP	1/9/05	31/8/07	994,600.00	575,280.08	43,433.90	0.00	12,000.00	630,713.98	59,849.05
RAF0047695	Climate Change	UNDP	1/10/05	31/3/07	700,000.00	304,438.29	55,053.51	0.00	35,000.00	394,491.80	**
RAS0050713	Caspian Sea	UNDP	1/9/06	28/2/07	50,000.00	33,857.68	5,850.19	0.00	0.00	39,707.87	**
513GLO2007	ICAM tools	Flanders	1/6/06	31/3/07	92,194.00	75,558.42	4,157.00	7,971.53	0.00	87,686.95	0.00
513GLO2009	MSP	Flanders	13/7/07	1/1/08	13,718.00	0.00	12,335.50	1,233.55	0.00	13,569.05	148.95
570GLO2005	MSP	Priv.F.	1/10/07	1/4/09	295,022.00	0.00	25,211.00	3,277.43	47,234.31	75,722.74	221,044.26
570GLO2006	MSP	Priv.F.	17/12/07	30/6/09	150,000.00						150,000.00
513RLA2001	Service Platforms	Flanders	1/7/06	30/4/07	16,500.00	8,812.48	0.00	881.25	0.00	9,693.73	6,806.26
534INT2001	Coastal Hazards	Italy	1/2/07	31/1/09	1,251,644.00	57,270.20	81,899.60	18,092.07	7,594.31	164,856.18	1,124,631.82
Sub-total					3,563,678.00	1,055,217.15	227,940.70	31,455.83	101,828.62	1,416,442.30	1,562,480.34
MLA 1 - Global Marine Assessment (GMA)											
513GLO2008	UN GMA	Flanders	12/10/06	31/12/07	16,500.00	14,999.96	0.00	1,500.00	0.00	16,499.96	0.00
213GLO2004	UN GMA	UNEP	26/7/07	31/108/08	200,000.00						80,000.00
Sub-total					216,500.00	14,999.96	0.00	1,500.00	0.00	16,499.96	80,000.00
TOTAL MLA 1					**3,856,755.23**	**1,106,258.17**	**227,940.70**	**35,502.21**	**101,828.62**	**1,471,529.70**	**1,642,480.34**
MLA 2 - International Oceanographic Data and Information Exchange (IODE)											
513GLO2002	ODIMEX	Flanders	1/1/04	31/12/07	382,800.00	173,994.86	0.00	17,399.49	0.00	191,394.35	64,807.41
513GLO2005	Ocean Forum Series	Flanders	1/9/05	15/12/06	10,000.00	7,893.08	0.00	789.31	0.00	8,682.39	0.00
513GLO2006	METADATA	Flanders	20/12/05	7/3/07	15,000.00	9,444.19	0.00	944.42	0.00	10,388.61	0.00
513RAF2003	ODINAFRICA III	Flanders	1/1/04	31/12/07	2,530,000.00	1,126,617.39	151,718.79	127,833.62	37,279.89	1,443,449.69	264,286.49
513RAF2004	African Depository	Flanders	1/1/04	31/12/07	111,100.00	27,697.46	0.00	2,769.74	0.00	30,467.20	0.00
513RAF2007	Electronic Repository	Flanders	11/5/06	30/6/08	33,000.00	7,743.33	0.00	774.33	2,247.96	10,765.62	22,234.38
513RAF2008	FET-REMSENS	Flanders	28/6/06	30/6/10	350,000.00	80,384.89	0.00	8,038.50	16,833.12	105,256.51	44,743.49
513GLO2010	Part.in PIM	Flanders	1/10/07	5/2/08	13,200.00	10,631.47	0.00	1,063.15	1,080.75	12,775.37	424.63
513RLA2002	Caribbean Marine Atlas	Flanders	1/9/07	5/2/08	22,000.00	4,475.26	0.00	447.53	16,857.21	21,780.00	220.00
549RER2000	SEADATANET	EC	5/7/06	1/4/11	261,953.00	1,376.52	0.00	275.30	0.00	1,651.82	76,627.39
Sub-total					3,729,053.00	1,450,258.45	151,718.79	160,335.39	74,298.93	1,836,611.56	473,343.79
MLA 2 - Tsunami											
216RAS2000	TW Centre	UNDP	17/10/06	28/2/07	81,400.00	73,871.81	0.00	7,387.18	0.00	81,258.99	0.00
230RAS2000	Training on Tsunami Warning	ESCAP	1/10/07	30/9/08	444,730.00						100,000.00
248INT2000	IOTWS	UN-ISDR	1/2/05	28/2/07	3,193,399.77	1,765,818.64	223,109.83	159,114.28	3,097.38	2,151,140.13	3,097.38
248RAS2000	IOTWS	UN-ISDR	20/9/06	22/12/06	15,120.00	14,000.00	0.00	1,120.00	0.00	15,120.00	0.00
504INT2000	IOTWS	Norway	1/9/05	21/5/08	1,842,465.00	332,201.64	539,107.28	113,270.16	59,863.43	1,044,442.51	842,677.10
561INT2000	IOTWS	Ireland	1/11/05	31/12/08	600,960.00	55,359.46	241,417.31	38,580.98	0.00	335,357.75	290,105.48
534INT2002	NEAMTWS	Italy	15/11/05	31/12/07	121,065.00	18,872.36	44,129.47	8,190.24	0.00	71,192.07	0.00
514GLO2000	Tsunami Teacher	Spain	16/11/07	31/5/08	37,739.00	4,950.41	0.00	643.55	0.00	5,593.96	32,145.04
490GLO2200	SATWS**	Vol.Con.	1/1/06	31/12/07	1,000,000.00	49,471.17	0.00	0.00	0.00	49,471.17	26,973.65
Sub-total					7,336,878.77	2,314,545.49		328,306.39	62,960.81	3,753,576.58	1,294,998.65
TOTAL MLA 2					**11,065,931.77**	**3,764,803.94**		**488,641.78**	**137,259.74**	**5,590,188.14**	**1,768,342.44**

Budget code	Project title (short)	Donor	Valid from	Valid to	Total Alloc.	Disbursements 2006-2007			ULOs	TOTAL	Available 31/12/2007
						Activities	Personnel	PSC			
MLA 3 - Capacity-Building											
503GLO2000	Self-Driven Capacity-Building	Sweden	15/12/05	31/12/08	952,225.94	398,062.16	12,441.74	53,365.51	146,064.81	609,934.22	342,291.72
534RER2002	ADRICSCOM	Italy	15/4/05	10/2/07	1,184,830.00	823,892.49	49,354.65	56,761.06	0.00	930,008.20	0.00
513RAF2005	Geo-Biosphere	Flanders	1/1/04	31/12/07	285,000.00	68,828.95	7,131.80	7,596.08	1,371.70	84,928.53	58,307.92
809RAF2000	Associate Expert	Italy	15/12/06	31/5/09	247,500.00	0.00	110,385.60	13,246.28	1,590.40	125,222.28	**
Sub-total					2,669,555.94	1,290,783.60	179,313.79	130,968.93	149,026.91	1,750,093.23	400,599.64
MLA 3 - Policy											
549GLO2002	UNCLOS	Europe	22/12/06	6/4/08	20,034.00	8,763.19	3,417.06	852.62	6,470.53	19,503.40	**
549GLO2003	TMT Guidelines	Europe	22/12/06	5/2/08	24,402.59	10,668.33	11,378.48	1,543.27	0.02	23,590.10	**
Sub-total					44,436.59	19,431.52	14,795.54	2,395.89	6,470.55	43,093.50	0.00
MLA 3 - Regions											
RLA0047861	Caribbean LMEs	UNDP	17/1/06	30/4/07	700,000.00	443,989.78	51,326.05	39,625.26	99,540.89	634,481.98	**
506RAS2005	WESTPAC	Japan	1/1/03	1/1/08	66,001.00						1,845.75
Sub-total					766,001.00	443,989.78	51,326.05	39,625.26	99,540.89	634,481.98	1,845.75
TOTAL MLA 3					**3,479,993.53**	**1,754,204.90**	**245,435.38**	**172,990.08**	**255,038.35**	**2,427,668.71**	**402,445.39**
TOTAL IOC					18,402,680.53	6,625,267.01	1,672,858.76	697,134.07	494,126.71	9,489,386.55	**3,813,268.17**

* Part of the UNESCO Special Account (additional $25M to Regular Budget) - IOC ceiling/allocation = $1M, but funds available= income received

** Special case funds (funds either advanced by UNESCO based on agreements or, in the case of the Associate Expert, replenished from the Global Associate Expert Fund, as needed).

Funding provided to IOC projects through funds-in-trusts managed by UNESCO Regional Offices (Bangkok and Jakarta)*											
506RAS2012	Sea Surface temp.	Japan	1/9/05	31/12/08	11,300.00						11,300.00
506RAS2015	8 NEAR-GOOS	Japan	1/9/05	22/10/07	25,425.00	22,500.00	0.00	2,925.00	0.00	25,425.00	0.00
506RAS2016	HAB	Japan	8/5/06	10/2/07	19,210.00	14,876.22	0.00	1,933.91	0.00	16,810.13	0.00
506RAS2017	1 NEAR-GOOS	Japan	15/11/61	30/7/07	39,447.00	22,600.00	20,000.00	0.00	2,600.00	0.00	0.00
506RAS2018	3 IOC Workshops	Japan	30/7/07	31/12/08	39,889.00						39,889.00
506GLO2000	TTR	Japan	13/7/06	10/2/07	21,357.00	18,900.00	0.00	2,457.00	0.00	21,357.00	0.00
506GLO2001	GODAR-WESTPAC	Japan	6/11/06	25/10/07	25,497.24	22,563.93	0.00	2,933.31	0.00	25,497.24	0.00
525RAS2000	TWS	Canada	21/7/06	30/9/08	438,596.00	68,561.98	78,481.23	19,115.60	85,437.89	251,596.70	11,330.56

**This list of funds managed by administrative entities other than the IOC may not be exhaustive as it is based on information from programme specialists, not on SAP records.*

OVERVIEW OF THE IOC STAFFING SITUATION

The most relevant fraction of the fixed cost of the IOC's operation is personnel, representing 41 per cent of 2006–2007 expenditure. During 2006–2007, the IOC counted approximately 59 employees (51 persons/month compared to 43.74 persons/month during the biennium 2004–2005) of which 43 were at Headquarters and 15 in the field. Of these, 40 were professional staff and 19 provided administrative and secretarial assistance. Two (2) professionals (C. Clark and W. Zhu) were seconded to the IOC Secretariat by the United States of America and China, respectively. Only 21 out of 58 employees are core UNESCO staff (posts funded by the UNESCO staff allocation): 9 of these posts are professionals (P) and 12 are administrative and secretarial assistants (G). This person per month ratio improved compared to the biennium 2004–2005 due to the creation of the Tsunami Unit (funded by extra-budgetary posts).

Table 8. IOC Staff by Type of Funding

Core staff on UNESCO posts	21
Seconded staff (directly paid by governments)	2
Associate experts	1
Staff paid by earmarked extrabudgetary funds	24
Staff paid from staff savings	2
Staff paid from non-earmarked extrabudgetary funds	2
Staff paid from UNESCO regular programme allocation for programme	8
TOTAL	**59**

Table 9. IOC Staff by Main Programme Axes

2006–2007	Permanent Staff (UNESCO core posts)		Temporary Staff (All types of contracts)		TOTAL
	(P)	(G)	(P)	(G)	
Ocean Sciences	2	2	6	1	**11**
GOOS (and JCOMM)	4	3.5	8	1	**16.5**
Ocean Services (without Tsunami)	1	1	2	0	**4**
Tsunami	0	0.5	8	2	**10.5**
Capacity-Building	1	1	1	0	**3**
Policy	1	4	2	1	**8**
Regions – Field	0	0	4	2	**6**
TOTAL	**9**	**12**	**31**	**7**	**59**

INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION (IOC)

STATEMENT OF INCOME AND EXPENDITURE AND CHANGES IN RESERVES AND FUND BALANCES FOR THE PERIOD 1 JANUARY 2006 TO 31 DECEMBER 2007

(EXPRESSED IN US DOLLARS)

	Programme Activities	Earmarked Activities	Total Biennium 2006/2007	Total Biennium 2004/2005
INCOME				
Voluntary Contributions - Schedule 1.3	3,365,997.20	-	3,365,997.20	4,087,020.25
Other income:				
Interest	476,364.00	-	476,364.00	143,044.00
Earmarked - Schedule 1.3	-	2,183,829.11	2,183,829.11	3,606,645.23
Transfers	860.11	(860.11)	-	-
TOTAL INCOME	3,843,221.31	2,182,969.00	6,026,190.31	7,836,709.48
Cash Disbursements Schedule 1.2	2,841,942.70	2,343,659.50	5,185,602.20	4,464,816.67
Increase (Decrease) in balance of unliquidated obligations	4,500.25	(31,692.98)	(27,192.73)	274,262.46
TOTAL EXPENDITURE	2,846,442.95	2,311,966.52	5,158,409.47	4,739,079.13
EXCESS (SHORTFALL) OF INCOME OVER EXPENDITURE	996,778.36	(128,997.52)	867,780.84	3,097,630.35
Reserves and fund balances, beginning of the period	1,681,487.58	2,557,614.90	4,239,102.48	1,141,472.13
Reserves and fund balances, end of the period	2,678,265.94	2,428,617.38	5,106,883.32	4,239,102.48

Approved _____
John Haigh
Chief Accountant

UNESCO

INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION (IOC)

STATEMENT OF ASSETS, LIABILITIES, RESERVES AND FUND BALANCES
AS AT 31 DECEMBER 2007

(EXPRESSED IN US DOLLARS)

	31.12.2007	31.12.2005
Assets:		
Cash and term deposits	5,575,594.80	4,735,006.69
Total Assets	5,575,594.80	4,735,006.69
Liabilities:		
Accrued Payables unliquidated obligations (see schedule 1.2)	468,711.48	495,904.21
Total liabilities	468,711.48	495,904.21
Reserves and fund balances:		
Earmarked activities	2,428,617.38	2,557,614.90
Operating reserves	2,678,265.94	1,681,487.58
Total reserves and fund balances	5,106,883.32	4,239,102.48
Total liabilities, reserves and fund balances	5,575,594.80	4,735,006.69

Acronyms

ABE-LOS	Advisory Body of Experts on the Law of the Sea (IOC)
ADRISCOM	ADriatic sea integrated COastal areaS and river basin Management system
ANCA	Harmful Algae in the Caribbean
ASFA	Aquatic Sciences and Fisheries Abstracts
BFU	Baltic Floating University
BOM	Australia's Bureau of Meteorology
CARIBE-EWS	Tsunami and Other Coastal Hazards Warning System for the Caribbean and Adjacent Regions
CDERA	Caribbean Disaster Emergency Response Agency
CLIVAR	Climate Variability and Predictability Programme (WCRP)
CLME	Caribbean Large Marine Ecosystem
CoML	Census of Marine Life
CPPS	Permanent South Pacific Commission
DBCP	Data Buoy Cooperation Panel (WMO-IOC)
E2EDM	'End-to-End' Data Management
EU	European Union
FANSA	Working Group on Harmful Algal Blooms in South America
GCN	Global Core Network
GCOS	Global Climate Observing System (WMO-ICSU-IOC-UNEP)
GCRMN	Global Coral Reef Monitoring Network
GEBCO	General Bathymetric Chart of the Oceans (IOC-IHO)
GEF	Global Environment Facility (World Bank-UNEP-UNDP)
GEO	The *Ad Hoc* Group on Earth Observations
GEOHAB	Global Ecology and Oceanography of HABs (IOC-SCOR)
GEOSS	Global Earth Observation System of Systems
GIS	Geographic Information Systems
GLOBEC	Global Ocean Ecosystem Dynamics
GLOSS	Global Sea Level Observing System (IOC)
GODAE	Global Ocean Data Assimilation Experiment
GODAR	Global Oceanographic Data Archaeology and Rescue Project (IOC/IODE)
GOOS	Global Ocean Observing System (IOC-WMO-UNEP-ICSU)
GRA	GOOS Regional Alliance
GTS	Global Telecommunications System
HAB	Harmful Algal Blooms (IOC)
IASPEI	International Association of Seismology and Physics of the Earth's Interior
iAOOS	integrated Arctic Ocean Observing System
ICAM	Integrated Coastal Area Management (also name of IOC programme)
ICG	Intergovernmental Coordination Group (IOC)
ICSU	International Council for Science
IGBP	International Geosphere-Biosphere Programme
IGFA	International Group of Funding Agencies for Global Change Research
IMOS	Integrated Marine Observing System
IndOOS	Indian Ocean Observing System
IOC	Intergovernmental Oceanographic Commission (UNESCO)

IOCARIBE	IOC Subcommission for the Caribbean and Adjacent Regions
IOCCP	International Ocean Carbon Coordination Project (SCOR-IOC)
IOCWIO	IOC Regional Committee for the Western Indian Ocean
IODE	International Oceanographic Data and Information Exchange (IOC)
IOGOOS	Indian Ocean Global Ocean Observing System
IPCC	Intergovernmental Panel on Climate Change
IPY	International Polar Year
ISDR	International Strategy for Disaster Reduction (UN)
ITIC	International Tsunami Information Center
ITSU	International Coordination Group for the Tsunami Warning System in the Pacific (IOC)
JCOMM	Joint Technical Commission for Oceanography and Marine Meteorology (WMO-IOC)
JCOMMOPS	JCOMM *in situ* Observing Platform Support Centre
JMA	Japan Meteorological Agency
JTIC	Jakarta Tsunami Information Centre
LAC-ICAM	Integrated Coastal Area Management network in Latin America and the Caribbean
LME	Large Marine Ecosystem
LOICZ	Land-Ocean Interaction in the Coastal Zone (IGBP)
MLA	Main Line of Action
MPA	Marine Protected Area
MSP	Marine Spatial Planning
NEAMTWS	Tsunami Early Warning and Mitigation System in the North-Eastern Atlantic, the Mediterranean and Connected Seas
NEARGOOS	North East Asia GOOS
NEPAD	New Partnership for Africa's Development
NEPAD-COSMAR	Coastal and Marine Sub-theme of NEPAD Environment Programme
NGO	Non-Governmental Organization
NOAA	National Oceanic and Atmospheric Administration (USA)
NODC	National Oceanographic Data Centre
NTWC	National Tsunami Warning Centres
OBIS	Ocean Biogeographic Information System
ODIMeX	Oceanographic Data and Information Management
ODIN	Ocean Data and Information Network (IOC)
ODINAFRICA	Ocean Data and Information Network for Africa (IOC and Flanders)
ODINECET	Ocean Data and Information Network for European Countries in Economic Transition
OOPC	Ocean Observations Panel for Climate (GCOS-GOOS-WCRP)
PICO	GOOS Panel for Integrated Coastal Observations
PIGOOS	Pacific Islands GOOS
PIM	Pacem in Maribus (Peace in the Oceans)
POGO	Partnership for Observation of the Global Oceans
PSMSL	Permanent Service for Mean Sea Level
PTWC	Pacific Tsunami Warning Center
RTWP	Regional Tsunami Watch Providers
SCOR	Scientific Committee on Oceanic Research
SEAGOOS	South East Asia GOOS
SIBER	Sustained Indian Ocean Biogeochemical and Ecological Research
SOPAC	Pacific Islands Applied Geoscience Commission

TEMA	Training, Education and Mutual Assistance in the Marine Sciences (IOC cross-cutting provision/programme)
TIC	Tsunami Information Centre
TMT	Transfer of Marine Technology
TNC	Tsunami National Contacts
TTR	Training-through-Research (IOC)
TWC	Tsunami Warning Centres
TWFP	Tsunami Warning Focal Points
TWS	Tsunami Warning System
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific
UNESCO	United Nations Educational, Scientific and Cultural Organization
WAGOOS	Western Australia GOOS
WCRP	World Climate Research Programme (WMO-ICSU-IOC)
WESTPAC	IOC Subcommission for the Western Pacific
WIGOS/WIS	WMO Integrated Information System and Integrated Global Observing System
WMO	World Meteorological Organization (UN)

Intergovernmental Oceanographic Commission (IOC)

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