United Nations
Educational, Scientific and
Cultural Organization

Intergovernmental
Oceanographic
Commission

# ANNUAL REPORT 10

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of UNESCO

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**UNESCO's Intergovernmental Oceanographic Commission (IOC) promotes international cooperation and coordinates programmes in marine research, services, observation systems, hazard mitigation, and capacity development in order to understand and effectively manage the resources of the ocean and coastal areas. By applying this knowledge, the Commission aims to improve the governance, management, institutional capacity, and decision-making processes of its Member States with respect to marine resources and climate variability and to foster sustainable development of the marine environment, in particular in developing countries.**

1. **Preventing and reducing the impacts of natural marine hazards, such as tsunamis, storm surges and sea level rise, through sustained monitoring and warning systems and community education;**
2. **Mitigating the impacts of and adapting to climate change and variability, by increasing scientific understanding, improving climate prediction through observations and process studies, increasing the understanding of the impacts of climate change on the marine environment;**
3. **Safeguarding the health of ocean ecosystems, through promoting UN Regular Process for Global reporting and Assessment , Research and monitoring for protection of the marine environment; AND**
4. **Promoting management procedures and policies leading to the sustainability of coastal and ocean environments and resources by enhancing regional cooperation and capacity-building, Science for ocean and coastal resource management and Decision-support tools.**


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# **Statement** from the Chair

Javier **VALLADARES**

Some years ago, saying we had a problem, we opened a debate in IOC which helped us to identify not just one problem, but many.

Some of our recent resolutions sought to resolve, at least partially, some of these shortcomings. A large part of our efforts were focused, with a high engagement by some member states and a passive position of others, on clarifying if IOC should be an organization within or outside the UNESCO system, assuming that this point was the basis of the solution of our problems.

But really when I said that we had a problem, I meant that we had difficulties with how we develop our internal management and the range of our mission, and not in where we apply them. Nevertheless these exercises resulted in something quite valuable, the clear demonstration that not everybody has the same interpretation of what we expect or want from an intergovernmental oceanographic organization like IOC.

As those differences of understanding emerged, we recognized our strength, the multidisciplinary diversity of our delegations, that represents the richness of our approach as an intergovernmental organization. On the other hand we saw the great weakness, that I think constitutes the root of our difficulties, that is our inability to focus on real oceanographic debate, concentrated, without distractions, on how to advance and improve the knowledge of the sea.

Within these varieties of positions, some people are comfortable compartmentalizing each IOC function, overloading our agendas with many technical and specialized meetings , and regional meetings. Other people,think, as I do, that we should streamline and concentrate our human and material assets, as our oceanographic community resources are relatively small.

As we are so dispersed, one of our present risks is that we fail to appreciate that we have categories, such as Marine Scientific Research and Operational Oceanography without clear definitions, a difficulty causing many of our oceanographic activities to migrate into Climatology, Meteorological or Maritime forums. While Marine Scientific Research is provided for in the Law of the Sea, the enormous technological evolution during the last years requires incorporation of new ideas, as for instance, real time observations, the possibility of global scale modeling of oceanographic and climate phenomena, autonomous and expendable instruments that can reach remote locations, inaccessible until just recently.

These extraordinary advances in observational capacity, transformed the way of thinking of oceanography at end of the last century and now call for a field of Operational Oceanography (which, though many people associated it with the explora-

tions in the XIX century, was not named or referred to in the Law of the Sea.). By letting many states create their own interpretation of the concepts of Operational Oceanography and Marine Scientific Research, the complementary values were lost and there is now a real difficulty for development and better implementation of the new technologies and observational capacities that are appearing every day.

Many times I heard colleagues complaining that we are an organization without a budget and operational structure, but until now, we have not opened the debate on how to solve that problem.

We must understand that improved knowledge of the sea and the delivery of more and better ocean and climate services will require changes of the procedures for adoption of the new technologies that allow improved observation of the oceans. We have a clear challenge in finding the way to develop the ocean observation systems, with free data exchange which will allow new, better, faster, more efficient and useful information products which meet the needs of our member states.

To move forward we hear many voices say: ¨we need a convention¨, ¨we need an implementation agreement for the Law of the Sea¨, ¨we need to create a new structure to meet these function from outside the IOC¨, ¨let another organization take this role.¨

Colleagues will probably also say that there are other equally important issues such as: integrated coastal management, marine spatial planning, the assessment of assessment of the oceans, but let me stress that all of them require a foundation built on ocean observations.

For that reason, in our 50th Anniversary year and with the events of the terrible recent tsunamis, I invite you, in a common effort in the intergovernmental forum, to debate this issue about how to implement the operational observations of the ocean.

Javier Valladares
Chair
Intergovernmental Oceanographic Commission of UNESCO

# **Statement** from the Executive Secretary

Wendy **WATSON-WRIGHT**

## THINKING BEYOND...

*[Oceans]... cover 71 per cent of our planet's surface, regulate its climate, and provide its ultimate waste disposal system, yet our myopic, terrestrial species still insists on naming it after the land.*

In the midst of ongoing innovative research initiatives, observing systems and services in such areas as coastal hazard alerts and information exchange, 2010 found IOC celebrating its 50th year of existence. As outlined elsewhere in this report, many member states went above and beyond to help the Commission bring attention to its importance and its longevity, and I am happy to say I was able to be involved in many of their events. In addition, some very important milestones were reached, such as the end of the Census of Marine Life and the integration of its Ocean Biogeographic Information System into our International Oceanographic Data and Information Exchange, the call into action of our tsunami warning systems and post disaster action in Haiti, Chile and Indonesia, and the opening of our first regional training and research centre in China. These are but a few of the events contained within these pages which will make 2010 memorable.

What was especially interesting and rewarding to learn through the IOC 50th anniversary and other events was the high regard in which the IOC is held in many parts of the world. This is a true testament to the excellence and commitment of the officers and staff of the past and present, and to the member delegations.

The ocean has always been important for us all – indeed it is the reason why this planet is habitable for humankind. So why is it so difficult to convince decision makers and the general public who don't make their living from the ocean that they should pay attention to its plight? Why is it only after a horrific disaster such as the BP Gulf of Mexico oil spill that, for a little while at least, the ocean receives the attention it deserves?

What has been evident to many for quite some time and to me since joining the IOC as Executive Secretary, is the absolute need for us to" think beyond ourselves" when it comes to trying to fulfill the mandate for which we exist. This is important at all levels, from within the secretariat itself to far beyond the ocean community, and I believe we have some reasons to be encouraged.

Within the secretariat, the first strategic planning exercise toward the end of 2010 produced a draft proposal for where the commission might point. Gratifyingly, a great part of the discussion centred on the need to reach out, especially to scientific institutions, for without the very direct and meaningful connections to and collaborations with excellent science, the IOC will never be able to fulfill its role as the competent international organization for marine scientific research under the United Nations Convention on the Law of the Sea. Nor we will we be able to be the body of choice to whom the scientific community will turn when their science needs require assistance in the form of intergovernmental cooperation.

But we need to think beyond the scientific community – we need to be known and respected in many other realms. First of all, we need to be better known in more IOC member states. I must say that in those countries where I was invited to help celebrate the 50th anniversary, it was very clear that there exist vibrant IOC and ocean communities, and that IOC-UNESCO is a well recognized entity. This tends to be the case where there are well functioning IOC committees

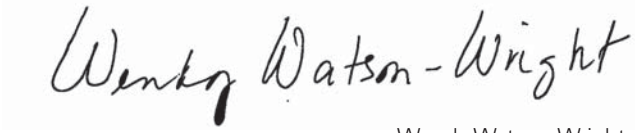
and/or very active subsidiary bodies. However, it is not the case for all countries and regions, whether developed or developing. The upcoming meeting of National Committees at the 126th IOC assembly will, I hope, encourage all member states to have such committees, and to work in earnest to keep them active and relevant.

We must also work harder to bring IOC and UNESCO delegations together. In 2010, the secretariat began an earnest effort to reach out to the UNESCO permanent delegations, with a number of information sessions being held, numerous meetings with Ambassadors, and many fruitful discussions. It has been satisfying to learn that many UNESCO permanent delegations see the IOC as a flagship program of UNESCO, and that they are anxious to know more about what we do on the ground in their countries. However, assisting them in becoming more knowledgeable about the IOC cannot be an activity that is restricted to the secretariat. Heads and members of IOC delegations should also be reaching out to the UNESCO commissions within their respective countries – this can only benefit all in the end. And we must work harder with our sister UN agencies with responsibilities for oceans. It is true that UN Ocean has existed for some time to help coordinate ocean activities within the United Nations, and that there is sincere willingness and effort within that body to bring ocean issues to the attention of the General Assembly, but the truth is that in the absence of a dedicated resource, a raised consciousness will not happen.

VERY importantly, we as part of the ocean community must work ACTIVELY with other members of the community – with ocean related agencies within member states, with nongovernmental organizations, foundations and the private sector to discuss and debate the issues, and although we may never come up with one common message, to at least agree to push ahead with solidarity on bringing to the consciousness of the general public and decision makers the critical nature of the issues currently being faced by the ocean and coasts.

But most important is that we must 'think beyond the ocean'. What is obvious to us is not obvious to those who do not make a living from the ocean or live by it. We need to get out of our traditional habits and away from our usual audiences. At almost every conference or ocean related event I attended, it became quickly obvious that, for the most part, we were talking to ourselves, we were 'preaching to the converted'. They were wonderful events, mind you, with some of the top ocean experts of the world, and much of the material presented and the ensuing discussion was fascinating, but at the end of the day, who will care besides us, the ocean community? We must find a way to make what we believe to be so obviously critical to humankind and to the planet as obvious to non-ocean people. We must try not to always focus on the gloom and doom, but rather include messages of hope and best practices, and encouragement to do better. And we must find friends in positions of power who can be convinced that for our planet, 'the ocean is us', and that we must do all we can to preserve its majesty and resources.

How do we do that? I think we all have our own ideas – the challenge is to pull these ideas into concepts, to put concepts into a plan, and to put the plan into action. We have but one planet – Planet Ocean – and the collective 'we' must take care of it. We all must accept that "there is no other ocean, there is no Planet B".



Wendy Watson-Wright
Assistant Director-General
UNESCO
Executive Secretary
Intergovernmental Oceanographic Commission of UNESCO

# Mandate and Summary of 2010 – IOC global results and achievements

**Improving governance and fostering intergovernmental cooperation to manage and protect oceans and coastal zones.**

**The 2010 Annual Report** deviates from past Annual Reports by organizing around and emphasizing priorities and strategies, rather than around secretariat actions and administration structures. The Draft IOC Biennial Priorities and Implementation Strategy 2012-2013 is built around the four High-level Objectives articulated on page 2 which are:.

1. Prevention and reduction of the impacts of natural hazards
2. Mitigation of the impacts of and adaptation to climate change and variability
3. Safeguarding the health of ocean ecosystems
4. Management procedures and policies leading to the sustainability of coastal and ocean environment and resources

During 2010 the IOC shouldered its responsibilities as the competent body and focal point for ocean matters in the UN system by working with other agencies to develop the Regular Process for reporting on ocean assessments, climate change initiatives through UNFCCC, ecosystem-based management with Convention on Biodiversity, and preparations for the RIO +20 conference, to cite just a few ways. Meanwhile IOC regional programmes are emphasizing coastal processes more and more as the necessary cornerstone of national level involvement and capacity development for developing nations, especially African and Small Island Developing states, (SIDS).

The report details the accomplishments of the IOC throughout 2010. Here are just a few of the high level issues that were impacted by IOC in 2010:

IOC hosted and funded (3-4 June) the meeting of the Group of Experts that will formulate recommendations to the United Nations General Assembly for establishing the Regular Process for the first Integrated Assessment of the Ocean. IOC is also working towards mobilising Member States to support financially the activities of the Regular Process.

To address coastal eutrophication and the linking of nutrient sources to coastal ecosystem effects, the IOC has established a steering committee and is planning a stakeholder workshop with a view to ensuring complementarity with the output from SCOR (Scientific Committee on Oceanic Research) – LOICZ (Land Ocean Interactions in the Coastal Zone) Working Group 132 (Land-based Nutrient Pollution and the Relationship to Harmful Algal Blooms in Coastal Marine Systems) and to broadening the involvement of active research groups and end users in the further refinement of the scope and focus. Through its active participation in the GOBI (Global Ocean Biodiversity Initiative) project, IOC is contributing to the selection of high seas biodiversity hot-spots that could be suggested as candidates for the creation of marine protected areas in international waters.

The Guide to Best Practices in Ocean Acidification Research and Data Reporting was released in May 2010 and is available online, including summaries for policy makers in French and Spanish. Marine Spatial Planning Guidelines published last year have been widely distributed and are now being translated by Member States into Spanish, Russian, Chinese and Vietnamese. Following the successful experi-

*Fishing boats on coast of Ghana.*

ence with the Coastal Adaptation project in West Africa (ACCC project), IOC is assisting South American member states in developing a regional GEF project on this issue.

Eight countries that have established National Tsunami Warning Centres (Japan, United States [Alaska and Hawaii], Australia, Indonesia, Malaysia, the Philippines, Thailand, and Sri Lanka) are receiving seismic data from the stations of the Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO).

Post-tsunami event assessments were organized in Haiti, Chile and Indonesia; these were not planned activities, but they were well received by Member States following the initiative launched by the Secretariat. The project on Early Recovery of Haiti's Warning Services for Coastal Hazards was launched within the Flash Appeal for Haiti and initial funding has been provided by the Swiss Agency for Development and Cooperation (SDC). A self-benefiting project (Fund-in-Trust) for the development of a national tsunami early warning system has been signed with the Government of Oman. Coordination with other UN agencies working in the field of Disaster Risk Reduction including ISDR (International Strategy for Disaster Reduction), WMO (World Meteorological Organization), or contributing with this area, including CTBTO, is ongoing. Negotiations are ongoing to establish a Caribbean Tsunami Information Centre (CTIC) in Barbados with UNDP (United Nations Development Programme) and the Government of Barbados. A project proposal for establishing a Tsunami Information Centre for the North-eastern Atlantic and the Mediterranean (NEAMTIC) has been submitted to the European Civil Protection with results expected in July 2011.

Two tsunami warning systems (Caribbean and Pacific) went into real tests. The after-event evaluations prove that the regional systems are responsive, that Tsunami Warning Focal Points (TWFP) are receiving the information and that still there is some work to be done on national inter-institutional coordination and community preparedness. The intergovernmental coordination provided by UNESCO through its secretariats for most ICGs is working. The number of recognised National Tsunami Warning Centres is increasing slowly, from seven to eight in the first semester 2010. The Secretariat may have to play a more active role to get more national

warning centres recognised and receiving data from CTBTO.

The implementation level of the Global Ocean Observing System (GOOS) has been successfully sustained above 60%, as planned. The overall system completion rate stands at 62% while the Global Drifting Buoy, Argo Float and Volunteer ship measurement component arrays were being successfully maintained at 100%.

New resources have been made available to the International Oceanographic Data and Information Exchange Ocean Data Portal. However, due to the heightened concerns about global security, countries are becoming increasingly careful about exposing their IT systems to the outside world. The installation of foreign software applications on their servers is therefore often prohibited. This considerably impedes progress with the IODE Ocean Data Portal of which the core objective is data sharing.

IOC regional goals emphasize South-South cooperation through facilities, equipment and funding, with IOC providing the inter-governmental platform or competencies when needed. Examples include project implementation for ocean-based hazards and harmful algal blooms in WESTPAC, and for erosion and climate-change impacts in the coastal zones in West Africa.

Two regional subsidiary bodies of IOC Eastern Atlantic and the Western Pacific held their meetings agreeing on work plans for the next 2 years in line with IOC higher level objectives and reflecting their regional priorities.

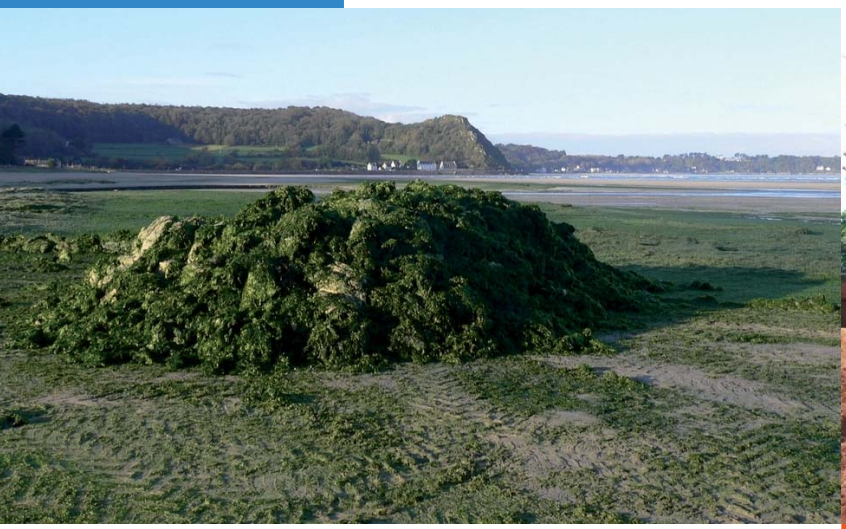
Support has been provided for experts from Kenya, Mozambique, Tanzania to attend training courses on Marine GIS, Preservation and Archiving of Digital Materials, Literature and databases of marine sciences, and participatory approach to coastal management.

The Steering Committee for ODINAFRICA-IV at its first session held at the UNESCO/IOC's Project Office for IODE from 20 - 22 January 2010 reviewed the work plans and came up with a detailed implementation schedule for 2010.

The harmonisation of IOC regional capacity development and coordination of regional subsidiary bodies is ongoing. In IOC, capacity-development is a cross-cutting action. Member States are called on for innovative suggestions for raising additional resources to implement capacity-development activities.

Gender balance is sought in all IOC actions during the planning stage and the percentage of participating women scientists increases steadily.

*Green algee invasion as a result of eutrophication*



*Coastal erosion on the coast of Mozambique*

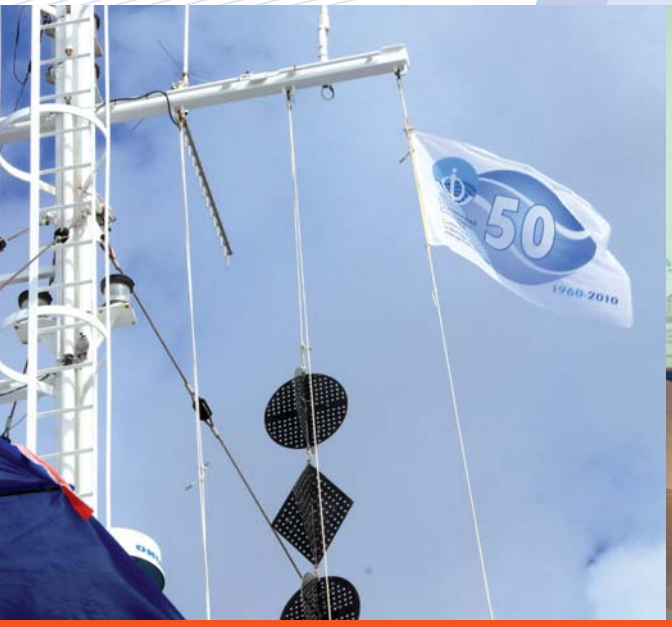
**June 8th 2010 was a special day in the History of the Intergovernmental Oceanographic Commission of UNESCO. On that day, IOC Member States launched the 50th anniversary of the Commission with the objective of creating awareness of the achievements of the past and present, and of looking into the future.**

# IOC Celebrates 50 Years of Ocean Governance and Impact


It was symbolic that the launch of the Anniversary coincided with the UN World Ocean day celebrated globally. Those present at the inauguration were welcomed by the Director General of UNESCO, Mme Irina Bokova, Mme Eleonora Mitrofanova, the Chairperson of the Executive Council of UNESCO, Mme Valerie Letard, Secretary of State, Ministry of Environment, Mme Maud Fontenoy, UNESCO spokeswoman on oceans and others.

The inauguration day was the culmination of two years of preparatory work, which started with the decision of the IOC Executive Council taken in June 2008, to celebrate the 50th anniversary, from 2010 – 50 years after the IOC establishment – to the closing in 2011 – 50 years after the first meeting of the Commission Assembly.

In 2008 the indicative plan of action was adopted which helped Member States, IOC technical and regional bodies, and partners to contribute to the anniversary. Making preparations for the Anniversary was a chal-




*IOC 50th Anniversary Flag flys from mast of Thai research vessel during transit of the Andaman Sea.*


*Javier Valladares, IOC Chair, at Cartagena, Colombia event celebrating IOC 50th Anniversary.*

lenging and daunting task as the success of the endeavour fully depended on the good will of Member States in providing funds and in kind support. Development of the anniversary web site helped to make the general public aware of the progress in meeting the objectives of the anniversary, and of different contributions made by participants to the celebration. http://www.unesco.org/en/ioc-50anniversary

The occasion of the inauguration day was used for conferring IOC 50th anniversary medals upon former Chairs and Executive Secretaries in recognition of their outstanding support to the Commission. The inauguration day culminated in the introduction of two documents: the Youth Declaration and the Ocean Call on Peoples of the World and Nations, the full texts of which can be found on the IOC 50th web page.

The programme of the inauguration day also included descriptions of many activities which have since been implemented under the logo of the IOC anniversary and in the framework of the action plan. They included scientific conferences, workshops and courses, implementation of research cruises under the anniversary flag in almost all parts of the World Ocean, development of promotional materials and much, much more. Almost fifty conferences and research cruises were undertaken as part of the anniversary celebrations:

The Fifth Global Conference on Oceans, Coasts and Islands held in Paris from 3-7 May 2010 organized a half day symposium to celebrate fifty years of IOC. A group of world renown scientists shared their knowledge and experience in marine matters with the participants of the global conference in such areas as climate change, tsunami warning system development, marine technology and others.

The International Conference "50 Years of Education and Awareness Raising for Shaping the Future of the Oceans and Coasts" was held in St.Petersburg, Russia in April 2010. The Conference brought together more than 400 participants from 32 countries to discuss capacity development, as one of the key subjects of the IOC success, and awareness raising as an important activity for fostering a climate for capacity building.

The World Ocean Week was celebrated in Xiamen, China in November 2010 under the theme "Promoting Marine Ecological Civilization – Sustainable Coastal Development: From Water Catchment to the Coastal Seas". It served as a platform for global and regional cooperation as well as for connecting marine and social science, technology, education, public awareness of policy making, management decisions and actions to achieve sustainable use of coastal and marine resources and

*IOC Executive Secretaries at IOC 50th Anniversary 2010. Left to right: Dr. Sidney Holt 1970-72, Dr. Mario Ruivo 1980-88, Cmd. Desmond Scott 1972-79, Dr. Patricio Bernal 1998-09, Dr. Wendy Watson-Wright 2010-.*


*IOC Secretariat 1985, celebrating the 25th Anniversary of IOC.*

for achieving sustainable development of the oceans.

More than a dozen research vessels plied the waters of the world ocean under the anniversary flag which not only demonstrated the relationship between the objectives of the cruises and those of the IOC and its anniversary, but also promoted world-wide awareness of the IOC and its activities.

While highlighting the IOC promotional activities it would be a mistake to not mention the publication by Cambridge Press of the book "Troubled Waters. Ocean Science and Governance" and a generous contribution by the United Nations Postal Administration of beautiful stamps dedicated to the anniversary and depicting marine life.

The book, edited by former IOC chairs Geoff Holland from Canada and David Pugh from the United Kingdom, reflects on past successes and failures in ocean management and emphasizes the need for knowledge and effective government action to direct decisions that will ensure a sustainable future of this precious resource. It also provides an attractive and accessible overview for anyone concerned about stewardship of our oceans.

The stamps were designed by marine life artist Wyland, a leading advocate for marine resource conservation, who today is considered as one of the most influential artists of the twenty-first century.

Exhibitions were organized and films were demonstrated in the headquarters of UNESCO describing the IOC programmes and the beauty and bounty of the Ocean and coasts. Thousands of people were able to get acquainted with the work implemented by the IOC and its Member States and admire films and children's paintings.

In the months after June many more contributions were made by the Member States, IOC programmes and partners in meeting the Anniversary objectives. http://www.unesco.org/en/ioc-50anniversary

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# REGIONAL ACTIVITIES

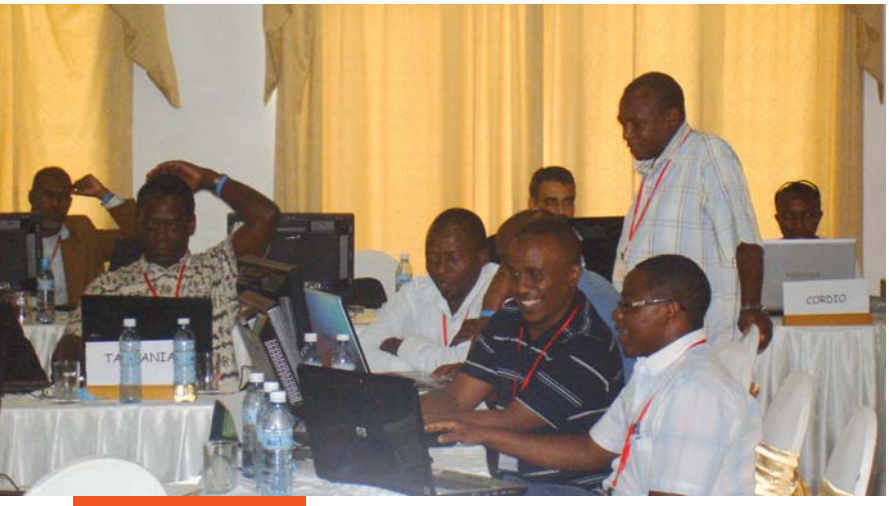
The IOC Secretariat's regional network of offices and programs continued to grow and provide benefits to Member States under the purview of the new Executive Secretary, Dr Wendy Watson-Wright, who undertook an intensive program of regional familiarisation by visiting all regions throughout the course of the year. Dr Watson-Wright provided encouragement and support to the regions, meeting with regional staff, key stakeholders, sponsors, decision makers, and institutional and political leaders. Through these visits Dr Watson-Wright made many presentations at key events, commemorating the IOC's 50th anniversary, providing historical and forward looking perspectives across the IOC's High Level Objectives (HLOs) and generally strengthening the IOC's constituency around the globe. Another much anticipated boost to the Secretariat's capacity to facilitate regional contributions to its broader program was the recent appointment of the new Deputy Executive Secretary, Mitrasen Bhikajee, whose responsibilities will include regional coordination and and integration.

This section overviews regional activities based out of the Secretariat's network suite of formalised and decentralised IOC offices and highlights the advances that have been made across the IOC's broad mission, focussing on capacity building, garnering of institutional and Governmental support for its regional activities, progressing GOOS and related services and applications and improving the scientific underpinning for the understanding, conservation and sustainable utilisation of the world's oceans and their natural resources. The network of GOOS regional alliances continued to contribute to the IOC's global mission as regional foci, characterised by programs that more directly engage end beneficiaries of the IOC's programs. The Intergovernmental Coordination Groups for the Tsunami Early Warning and Mitigation Systesms, (ICG/TWS's) form another global network giving IOC regional coordination an essential role in strengthening marine hazard and response capabilities. The IOC's subcommissions experienced important growth, resulting in expanding portfolios of activities benefiting their Members States: their work cutting across the IOC's four HLOs. Many of the advances made across these areas through the IOC's regional energies have resulted in important contributions over the spheres of advancing Priority Africa, supporting the UNFCCC, and generally supporting objectives relevant to developing countries and Small Island Developing States.

*The Colombia Naval Academy Flagship* Arc Gloria *shows her colors.*
*Photo: © IOCARIBE*

# IOC in Africa

The key achievements in 2010 in Africa from the perspective of the Global Ocean Observing System in Africa included the integration of multidisciplinary and multi-stakeholders approach for Applications of Earth Observation for Decision-Making Support for Coastal Zone Management, Water Resources and Climate Change with a strong emphasis on Science and Governance Dialogue. This Pan-African activity was implemented in Cotonou, Benin from 15-18 February 2010 upon the kind invitation of the Ministry of Environment and Protection of Nature of the Government of Benin. Major results, impacts and lessons learned include the following:




*Participants at the Coastal Atlas workshop, August 2010 Mombasa Kenya*

- Resources mobilisation: When activities are conducted in Africa with grassroots approach under the leadership and ownership of African relevant institutions and experts, then it is possible to mobilize required resources within Africa, from the African Diaspora and beyond. For the first ever time in 50 years of existence of IOC, an African Member State contributed a financial support to the IOC Trust fund to enable the implementation of this activity of primary importance to the African nations and African Union.
- High-level policy integration: A number of African countries established Parliamentary Scientific Working Groups and House Committee of Representatives in the National Assemblies on Climate Change enabling the development and adoption of National Climate bills.
- Closing the gap between science, policy and governance: The special high level governance and policy forum with the participation of top level officials including Ministers, Members of Parliaments and African Union Commissioner for Human Resources, Sciences and Technology, showed that there is a crucial need to close the gap between science and governance to foster interaction between science, policy and governance in Africa. A mechanism was set up to aid African scientists and scholars to close this gap and build trust with policy makers and the public.
- Reinforcement of intersectoral cooperation within UNESCO: The Division of Water Sciences-International Hydrological Programme and the Sector of Social and Human Sciences contributed to IOC Africa programmes.
- Reinforcement of North/South Cooperation and partnerships with international Organisations: International programmes including UNEP, WMO, the United Nations Economic Commission for Africa (ECA), GEO, LMEs, the African Association of Remote Sensing for Environment (AARSE), African, European and American research and development agencies and many other stakeholders supported the first Pan-African post-Copenhagen COP15 activity in Africa.
- Building up strategic alliances with African Diaspora: Cooperation was enhanced in the fields of earth observation and space sciences to coastal and water resources and climate change, in particular as a contribution to the International Year of People of African Descent. The output results of this activity were presented at the Eighth Conference of AARSE at the Headquarters of the ECA leading to a paper publication in the AARSE Book.

*Digitizing information for the African Marine Atlas at the Kenya Marine & Fisheries Research Institute, Mombasa, Kenya.*

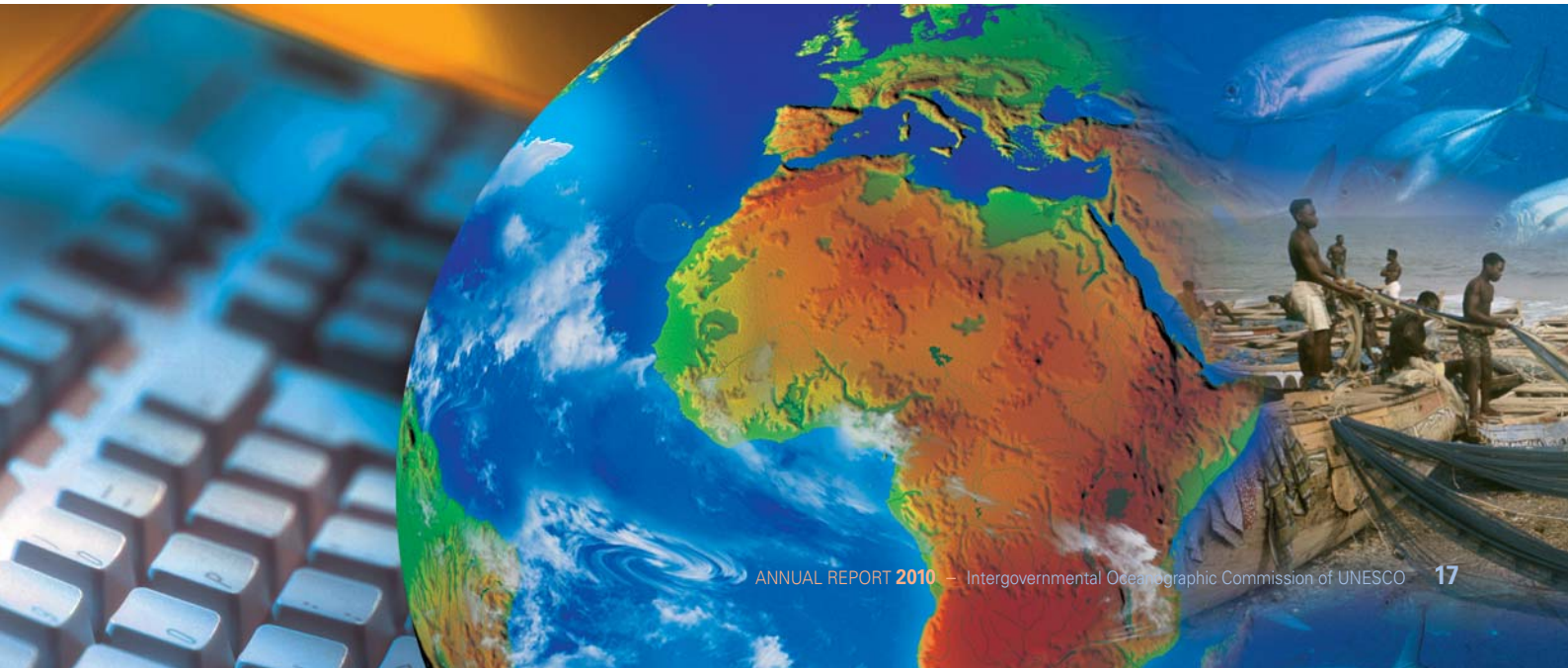
Other major results of GOOS-AFRICA in 2010 included a joint Fellowships programme with the Europe-Africa Marine Earth Observation Network (EAMNet). The EAMNet project was jointly designed by GOOS-AFRICA network and European partners to promote training and capacity building in Africa in Earth observation and operational oceanography. This fellowship program is open to scientists, technicians, graduate students (PhD) and post doctoral fellows involved in oceanographic work at centres in any African country.

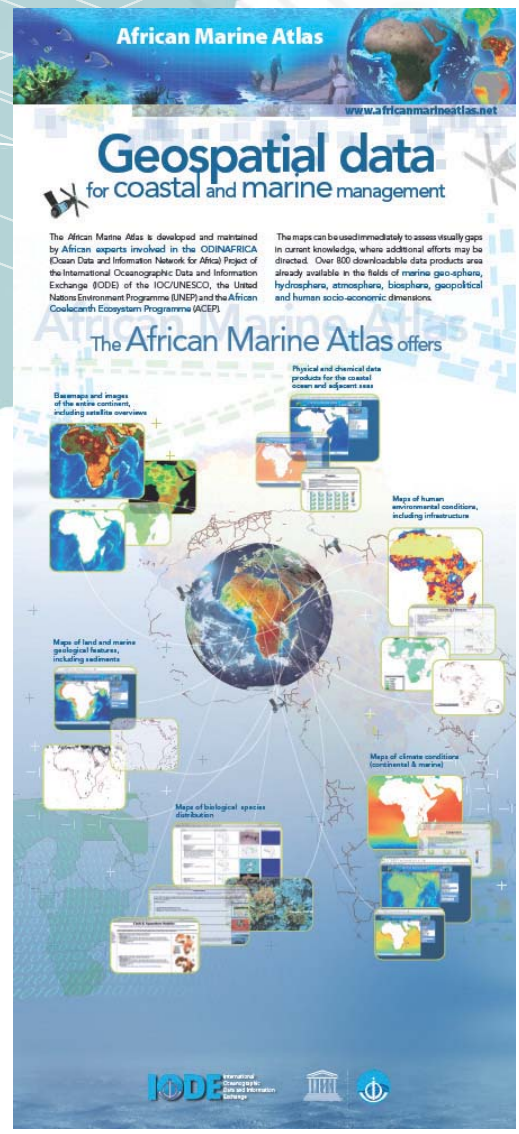
## OCEAN DATA AND INFORMATION NETWORK FOR AFRICA.

The focus of the current phase of the Ocean Data and Information Network for Africa (ODINAFRICA) is to promote the sustainable management of marine and coastal sources, to reduce the risks of ocean related hazards, based on sound scientific knowledge.

An assessment of the progress made in the development of capacities in the participating institutions commenced in 2010. Questionnaire responses were received from 46 institutions in 23 countries. This will be followed-up with assessment missions to all the participating countries in the period 2010-2011. Twelve (12) of the countries have already been visited. The assessments will assist in identifying specific challenges faced by the institutions, and the actions that can be taken to address them to enable the institutions to successfully implement the planned activities.

Training continues to be a major element of the networks activities. Training has been organized on a wide range of topics, including: Preservation and Archiving of Digital Media; Literature and Databases of the Marine Sciences; Introduction to Marine GIS; Disaster Planning and Recovery for Marine Librarians; Introduction to Marine Data for Young Scientists; Basic Marine Data Management; and Writing for Professional Publications.






*Participants at the Coastal Atlas workshop, August 2010 Mombasa Kenya*

The development of national coastal and marine atlases commenced in earnest, with a series of training courses throughout 2010 organized in, Oostende, Belgium and , Mombasa, Kenya. Equipment and software have been provided to facilitate the work of the national teams. The atlases will be assembled using datesets from GeoNetwork and the software engine developed for the Marine Irish Digital Atlas (MIDA).

The Ocean Biogeographic Information System (OBIS) will provide support for further development of the African Register of Marine Species. This will focus on assisting African countries in fulfilling their reporting obligations to UN Convention on Biodiversity. A series of activities are planned to assist in the creation or strengthening of national and regional marine biodiversity nodes to provide input for the African Register of Marine Species.

The ODINAFRICA Marine Information Management planning workshop was held in Dakar Senegal. AgriOcean/DSPACE and ABCD were selected for use for library management and cataloguing from several software reviewed. The electronic repository of publications from and about Africa has been updated and now contains more than 1,500 full text articles online, and over 900 entries for marine and freshwater professionals in the OceanExperts directory. The development of a database of ongoing/completed marine related projects along the African coast commenced.

ODINAFRICA has established strong links with the Large Marine Ecosystem (LME) projects and commissions implemented along the African coasts. This includes the Agulhas Somali Current LME project (ASCLME), The Benguela Current Commission (BCC), The Canary Current LME project (CCLME), and the Guinea Current LME project and Interim Commission (IGCC,/GCLME). Other links and collaborative initiatives have been established with the Western Indian Ocean Marine Sciences Association (WIOMSA), the UNEP Nairobi Convention secretariat and UNEP/DEWA, FAO, Coral Reef Degradation in the Indian Ocean (CORDIA), and WWF.

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

WESTPAC has been making great contributions to the IOC's 50th Anniversary year by demonstrating the value, enhancing political and public awareness of the Intergovernmental Oceanographic Commission in the Western Pacific through the conduct of a series of programmes in alignment with the IOC's High Level Objectives.

WESTPAC's contributions to major commemorative activities include:

- Development of the South East Asian-Global Ocean Observing System (SEAGOOS) through the implementation of pilot projects which aim to demonstrate the value of observations to the general public in the SEAGOOS region. Notably, pilot project "Monsoon Onsets Monitoring over Andaman Sea and its Social & Ecosystem Impact (MOMSEI) carried out first MOMSEI cruise in the Andaman Sea, 20-26 November 2010 and MOMSEI Summer School in Qingdao, China, 26-30 July 2010, with objectives to improve the understanding and forecasting of Asian monsoon at a regional scale through the development and implementation of air-sea observations over the Andaman Sea, and the study of the preconditioning role the ocean has in the monsoon onsets.
- Establishment of the first IOC Regional Training & Research Center in Qingdao, China, 11 May 2010, with focus on ocean dynamics and climate, within the Framework of "UNESCO/IOC Regional Network of Training and Research Centers on Oceanography in the Western Pacific";
- Conduct of marine scientific research to improve the knowledge on the role of ocean in climate change and variability, and safeguard the health of ocean ecosystems, specifically on: i) " Response of Marine Hazards to Climate Change", through the organization of a joint cruise in October 2010 with data sharing among all participating members; ii), Marine Non-indigenous Species through the publication of the Regional Status of Marine Non-indigenous Species and conduct of regional training workshops on Rapid Assessment Techniques for Detecting Marine Non-Indigenous Species, 20-21 September and November 2010; iii) the biogeochemistry and ecological nature of coral reefs through the evaluation of current coral status in different physical and environmental settings, Phuket, Thailand, 22-24 June 2010 and conduct of one training course on Sedimentary Impact on Coral Reef, 15-18 June 2010;

*Signing ceremony creating first Regional Training and Research Center on Ocean Dynamics and Climate in China*


*First MOMSEI Cruise in Adaman Sea, November 2010*

*Joint cruises conducted in typhoon generation area. October 2010*

*Rapid Assessment Survey Methodology for detecting non-indigenous species, September 2010*

*Joint cruises conducted in typhoon generation area. October 2010*

*Three photos above: Training on Impact of sedimentary Dynamics and Biogeochemistry on Coral Reefs, June 2010*

Dust and its Impact on Ocean Ecosystem in the Western Pacific (WESTPAC-ADOES), and Regular Process for Global Reporting and Assessment of the State of the Marine Environment (WESTPAC-GRAME) in Bali, Indonesia, 10-13 May 2010;

- Endorsement of three WESTPAC projects: Ocean Forecast Demonstration System aiming to provide ocean forecast products; DNA Taxonomy and Recruitment Monitoring of the Coral Reef Organisms to investigate the extent of marine biodiversity and its dynamics with a genetic tool called DNA bar coding; and Toxic Marine Organisms to identify natural marine biotoxins and disseminate scientific information to the general public.

- Initiation of WESTPAC Working Groups, which engage leading scientists to deliberate on specifically focused scientific topics, marine-related societal concerns and other international emerging issues which largely require marine scientific inputs. Two working groups focused on the topics of Asian

Chavanich, S., L.T.Tan, B.Vallejo, and V.Viyakarn. 2010. Report on the current status of marine non-indigenous species in the Western Pacific region. Intergovernmental Oceanographic Commission Sub-Commission for the Western Pacific (IOC/WESTPAC), Bangkok, Thailand.

# IOC/UNESCO Perth
## Regional Programme Office

The IOC/UNESCO Perth Regional Programme Office facilitated strategies and tactical activities across the IOC's High Level Objectives operating as a regional focal point of the IOC for the balanced mutual objectives of its three co-sponsoris: Australian Bureau of Meteorology (BoM), Western Australian State Government and IOC UNESCO. BoM continued hosting IOC Perth in co-location with the Secretariat of the ICG/IOTWS.

IOC Perth coordinated, facilitated and sponsored GOOS regional alliances principally through Indian Ocean GOOS (IOGOOS), Western Australia GOOS and Pacific Islands GOOS (PIGOOS). IOC Perth promoted integration between South East Asia / Australia and IOGOOS in the development of the IOGOOS Pilot Project: Modeling for Ocean Forecasting and Process Studies, a Capacity Development initiative linking ocean observations, process studies, modelling and applications for societal benefit. Other capacity development events supported by the Office engaged constituents from the region, including east SAfrica /SW Indian Ocean: the first IOC/WMO Data Buoy Cooperation Panel, In-Region Western Indian Ocean Capacity Building Workshop; the 2nd Global Ocean Data Assimilation Experiment OceanView "International Summer School for Observing, Assimilating and Forecasting the Ocean", Perth; and Societal Applications in Fisheries and Aquaculture Using Remotely-Sensed Imagery - International Symposium on "Remote Sensing and Fisheries" held in conjunction with a Chlorophyll Global Integrated Network (ChloroGIN) meeting, India.

IOC Perth supported the Australian Integrated Marine Observing System and its Western Australian node and continued as member of the Australian Oceans Policy Science Advisory Group. Both programs facilitate development of coastal GOOS in and around Australia. IOC Perth continued to attract and manage extra-budgetary sponsorship from BoM, Australia, NOAA, USA, Census of Marine Life (CoML) and Sloan Foundation.

IOC Perth hosted the 2010 meeting of IOGOOS, enabling it to meet for the first time in conjunction with some of its key project groups: CLIVAR/GOOS Indian Ocean Panel (IOP); the bio-geochemical equivalent Sustained Indian Ocean Biogeochemical and Ecological Research (SIBER); and the IndOOS Resources Forum (IRF) which assists IOP and SIBER in achieving their operational objectives. Under the IOGOOS framework, the Indian Ocean Observing System (IndOOS) continued to build GOOS. The Research Moored Array for African-Asian-Australian Monsoon Analysis and Prediction (RAMA) deep ocean mooring network.... deep ocean mooring network reached 28 of its planned 45 Indian Ocean stations. The IOP advanced Indian Ocean oceanographic science and coupled climate process studies. The work improves the characterisation of ocean processes and weather relevant to Africa, Asia and Australia and improves the understanding and prediction of climate. SIBER began its bio-geochemical science program, focusing on boundary currents, equatorial circulation, Indonesian Throughflow and studies of primary production, variability, indicators of climate change, and ecological processes in the trophic structure.

The Office assisted with the transfer of PIGOOS from South Pacific Applied Geosciences Commission (SOPAC) to South Pacific Regional Environment Program (SPREP) and helped with the employment process for a new PIGOOS Coordinator. Capacity development continued in the PIGOOS region through our collaborators in National Institute of Water and Atmospheric (NIWA), New Zealand, with delivery of a pre-tertiary oceans and climate curriculum called Scientific Educational Resources and Experience Associated with the Deployment of Argo (SEREAD) in Samoa and Tonga.

*IOC Exec Secretary Dr. Watson-Wright with Governer of Western Australia at IOGOOS meeting.*

# **IOCARIBE** IOC Sub-Commission for the Caribbean and Adjacent Regions

As part of Colombia's contribution to the IOC's 50th Anniversary commemorative activities, the IOC UNESCO participated in the International Maritime Fair to raise awareness about IOC's work both globally and in the wider Caribbean region. UNESCO held an exhibition with posters highlighting main IOCARIBE activities. The President and Vice President of Colombia and the President of the Colombian Oceanographic Commission all attended the event. IOC Chair, Javier Valladares, gave a special presentation on "Perspectives of Marine Sciences on the Future of the Oceans".

The Large Marine Ecosystem Project was advanced by the signing of a cooperation agreement with the Organization of Fisheries and Aquaculture for the Isthmus of Central America for the implementation of the Sub-regional Management of the Spiny Lobster Fisheries Pilot Project, setting a basis for advancement towards effective Ecosystem-Based Management and targeted, relevant decision making processes.

The IOCARIBE Secretary participated actively in the IOC/UNESCO, IHO Technical Mission to Haiti and Dominican Republic by providing technical assistance towards the establishment of a National Oceanographic and Hydrographic Service. In order to help prevent and reduce the impacts of natural hazards, the development of an Early Warning System with a community based participatory approach was of particular interest. The mission also included an assessment of the state of sciences facilities and human resources available following the earthquake in Haiti.

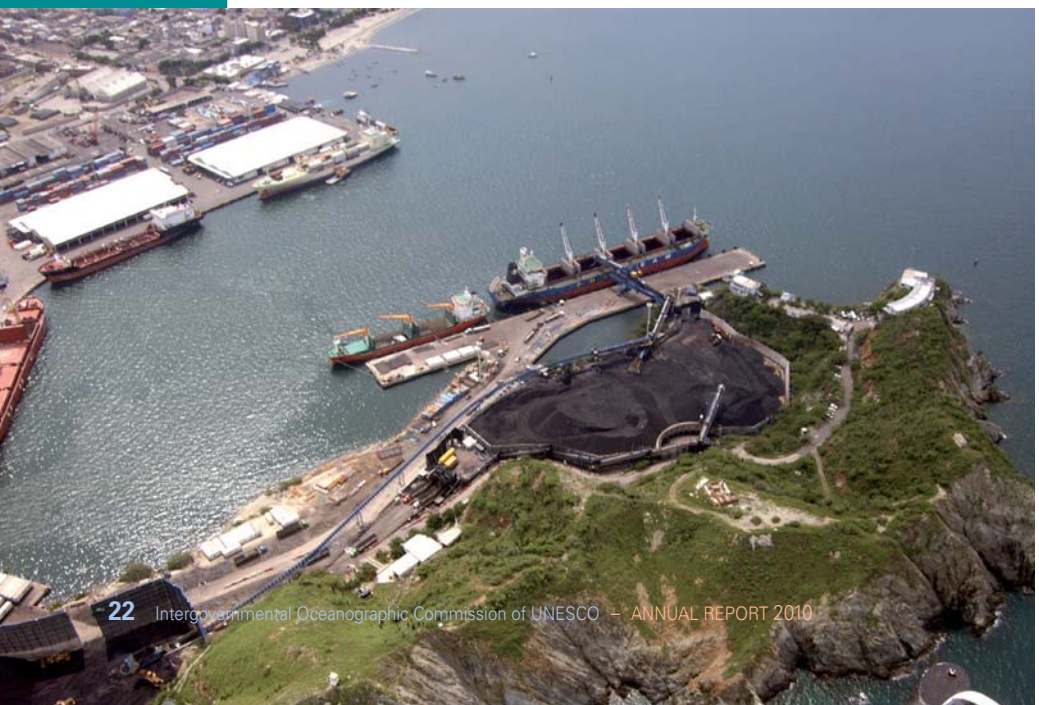
The Integrated Coastal Area Management (ICAM) Project "Demonstrate Approaches for Nutrient and Sediment Reduction at Selected Pilot Study Areas in the Wider Caribbean Region" will focus on strengthening integrated coastal area management by examining the effectiveness of Best Management Practices in the watersheds of Dominican Republic, Dominica, Grenada, and Trinidad and Tobago. The United Nations Development Programme has been designated to act as the Implementing Agency for the Project and IOCARIBE the Leading Technical Agency.

The 5th Session of Intergovernmental Coordination Group for the Tsunami and Other Coastal Hazards Warning System for the Caribbean and Adjacent Regions brought together a wide range of participants who assessed the status of the establishment of a Tsunami Warning Centre for the Caribbean. The USA, Venezuela and Nicaragua all show interest in being home for the Center.

In cooperation with Global Sea Level Observing System, (GLOSS), a project proposal to reinforce the capabilities for sea level monitoring was produced, with contributions coming from the USA Caribbean Tsunami Warning Programme. Partnerships are improving with regional organizations and national agencies, and among HQs and field offices, as well as across IOC programmes.

IOCARIBE-GOOS regional observing systems are currently in operation throughout the Americas, with the data serving to increase the understanding of the impacts of climate change and variability on marine ecosystems.

*Coastal management must address many competing economic and environmental interests in modern cities.*



# IOC Regional Activities
## in the Southwest Atlantic Ocean

**2010** was a very productive year for IOC activities in the Southwest Atlantic Ocean. Dr. Watson-Wright, IOC Executive Secretary, reinforced the importance of regional activities for the IOC Mission with a visit to the premises of Brazilian Navy Directorate of Hydrography and Navigation, and Rio GOOS Office in 2010.

In its thirteenth year of operation the PIRATA Project continues to produce excellent data collection rates while maintaining high standards of quality control necessary to contribute to the knowledge of climate change and variability. The incorporation of $CO_2$ sensors on the ATLAS buoys contributes to studies of the health of ocean ecosystem. In addition, under the scope of South Atlantic Climate Change Consortium, OCEATLAN, and with financial support of Brazilian agencies, the Oceanographic Institute of São Paulo University pursues the development of a Brazilian Prototype of the ATLAS Buoy that, in addition to the three buoys of PIRATA SW Extension, will greatly improve understanding of the South Atlantic Convergence Zone.

The GLOSS Programme continues operations on the South Atlantic west coast and ocean islands, by the maintenance of GLOSS tide stations in Argentina, Brazil and Uruguay. Progress in this programme may be expected in the region by the experience gained in the operation of the stations, the upgrade and substitution of equipment and sensors, and capacity building activities.

The International South Atlantic Buoy Programme (ISABP) and its national programmes continue on course. However, it remains reliant on donations of drifters from NOAA and other institutions. It's important to highlight that, in 2010, Servicio de Oceanografía, Hidrografía y Meteorología de la Armada (Uruguay) became an active member of ISABP.

The salinity observing satellite SAC/D Aquarius Mission is a joint programme with NASA/CONAE (Argentina) (with technical cooperation of Brazilian National Institute for Space Research – INPE and other Institutes) which will contribute to a better understanding of ocean circulation, the prediction of changes in this circulation, and its impact on Earth's climate and water cycle. The programme, by enhancing regional cooperation between Argentina and Brazil, strengthens regional ocean and coastal resource management capabilities.

Other programmes contributing to the development of marine and coastal management capabilities in the region included the project «Environmental Protection of the Rio de la Plata and its Maritime Front: Pollution Prevention and Control of Pollution and Habitat Restoration», with the participation of Servicio de Hidrografia Naval (Argentina) and SOHMA (Uruguay) among other agencies, and a new data exchange initiative integrating the regional IODE and OBIS activities under the scope of OCEATLAN, by the elaboration of a regional atlas.

*PIRATA Buoys in SW Atlantic*

# 3 NATURAL HAZARDS

Aegeo buoy

SEAWATCH Deep Sea Module (SDSM) deployment

**THE WORLD HAS WITNESSED AGAIN THAT TSUNAMIS ARE A SILENT DANGER THAT CAN CLAIM MANY LIVES AND CAUSE IMPORTANT DAMAGE TO INFRASTRUCTURE.**

This was the case of the 25 October 2010 Sumatra Tsunami that affected the Mentawai Islands off the western coast of Sumatra, Indonesia causing more than 400 deaths and more than 14,000 homeless. This event demonstrates the importance of conducting tsunami risk assessments that support decision making regarding land use planning and construction codes in coastal zones, as well as the elaboration of community response plans.

Earlier this year, on February 27th 2010, the coasts of Central-South Chile were hit by a large tsunami after a powerful magnitude 8.8 earthquake. Due to the tsunami more than 150 people died. This event took place at 3:34 AM local time on Saturday morning during the last weekend of the holiday season. Casualties could have been much higher without the extensive awareness and preparedness work performed by our partners in Chile.

These two events remind us of the need to enhance public awareness through formal and informal education in all vulnerable coastal communities. This is one of the results achieved by the featured Disaster Preparedness European Consensus on Humanitarian Aid (DIPECHO) project in this Annual Report.

In 2010, IOC organized training and workshops for over 1000 staff from more than 40 countries to improve regional and national tsunami warning systems, reaching more than 50,000 people with tsunami awareness and preparedness materials. We couldn't have delivered this without the support of Member States, institutional partners, UNESCO field offices, donors and very committed experts and practitioners working under the leadership of UNESCO and its IOC.

*Evacuation drills*

*Mangrove rehabiliation, Malaysia*

## SUMMARY OF INTERNATIONAL TSUNAMI WARNING ADVISORIES 1 JANUARY - 31 DECEMBER 2010

Compiled by The International Tsunami Information Center (ITIC) Advisories issued by international tsunami warning centres. The Pacific Tsunami Warning Center (P) issues: Tsunami Information Bulletins (TIB), Fixed and Expanding Regional Warnings (FRW, ERW), and Ocean-wide Watch/Warnings (TWW) for the Pacific (PO); Tsunami Information Bulletins (TIB), Local, Regional, and Ocean-wide Tsunami Watches (LTW, RTW, TW) for the Indian Ocean (IO); Tsunami Information Statements (TIS), Local, Regional, and Ocean-wide Watches (LTW, RTW, TW) for the wider Caribbean (CAR). The Japan Meteorological Agency (J), issues: Tsunami Advisories (NWPTA) for the Northwestern Pacific; Tsunami Watch Information (TWI) for the Indian Ocean. The West Coast/Alaska Tsunami Warning Center (A) issues: Tsunami Information Statements (TIS), Tsunami Advisories (TA), and Tsunami Watch/Warnings (TWW) for Canada, the US (including Puerto Rico, excluding Hawaii and US-affiliated Pacific Island countries), and the US/British Virgin Islands. Epicenter, depth (from GCMT solution) and Mw from the USGS (G), and Mw from PTWC (P) at action time. Wave height and period measurements from sea level (SL) gauges reported as amplitude, peak to trough, or greatest value for either inundation or runup as indicated. Tsunami fatalities from World Data Center - Tsunamis / NGDC.

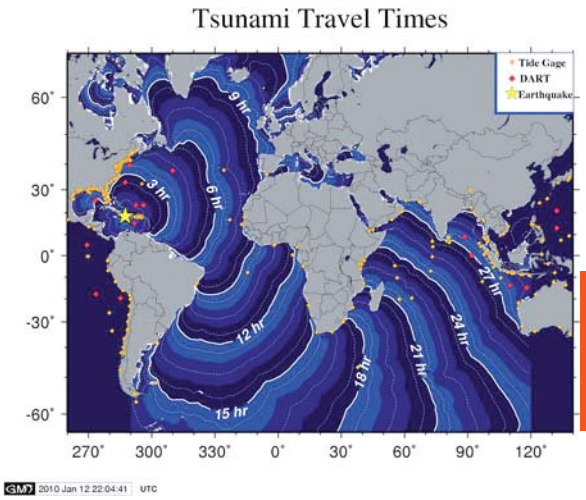
| DATE TIME (UTC) | LOCATION | EPICENTER | DEPTH (km) | Mw | PTWC (P), JMA (J), or WC/ATWC (A) ACTION | ACTION TIME (UTC) | TSUNAMI? DAMAGING? MAXIMUM MEASUREMENT and LOCATION |
|---|---|---|---|---|---|---|---|
| 03 Jan | Solomon | 8.799° S | 12 | 7.2 (G, P) | TIS (A) | 22:57 | YES 0.155 m peak to peak |
| 22:36 | Islands | 157.346° E | | 7.1 (GCMT) | TIB (P) | 23:03 | Rosslyn Bay, Australia gauge |
| | | | | | NWPTAC (J) | 23:04 | |
| | | | | | | (4 Jan) | |
| | | | | | TIB 002 (P) | 00:10 | |
| 12 Jan | Haiti Region | 18.443° N | 12 | 7.3 (A, P001) | (C) LTWatch 001 (P) | 22:03 | YES 0.12 m peak-to-trough |
| 21:53 | | 72.571° W | | 7.1 (P002,003) | (C) TIS (A) | 22:03 | Santo Domingo gauge |
| | | | | 7.0 (G, GCMT) | LTWatch 002 (P) | 22:54 | 7 dead |
| | | | | | 003--Cancel (P) | 23:45 | |
| 27 Feb | Near Coast of | 35.846° S | 24 | 8.8 (A, P, G, GCMT) | Expanding Regional | 06:46 | YES 2.61 m |
| 06:34 | Central Chile | 72.719° W | | 8.6 (A, P, revised 002) | Warning (ERW) 001 (P) | 06:49 | amplitude at Valparaiso, Chile |
| | | | | 8.5 (A, P, initial 001) | ERW-Supp 002 (P) | 07:52 | (highest measurement reported) |
| | | | | | ERW-Sup 003 (P) | 08:57 | on sea level gauges) |
| | | | | | ERW-Sup 004 (P) | 09:58 | 124 dead |
| | | | | | Widespread Warning | 10:45 | |
| | | | | | (WW)-Initial 005 (P) | | |
| | | | | | Tsunami Advisory (TA) | 10:55 | |
| | | | | | | 28 Feb | |
| | | | | | Cancel Message 25 (A) | 07:13 | |
| | | | | | WW-Cancel (P) | 09:40 | |
| 11 Mar | Near Coast of central | 34.290° S | 15 | 7.2 (A, P) | TIB | 14:53 | YES 0.29 m. peak-to-peak |
| 14:40 | Chile | 71.891° W | | 6.9 (GCMT) | TIS | 14:51 | San Antonio, |
| | | | | 6.8 (G) | | | Chile tide gauge |
| 06 Apr | Northern | 2.360° N | 20 | 7.8 (GCMT) | (IO) LTW 001(P) | 22:22 | YES 0.04 m |
| 22:15 | Sumatra, | 97.132° E | | 7.7 (G) | LTW 002 | 23:22 | NO (Peak-to-peak) |
| | Indonesia | | | 7.5 (A,P) | LTW 003 | 00:15 | Meulaboh tide station |
| | | | | | TIS (A) | 22:27 | |
| | | | | | (IO) TWI 001 (J) | 22:42 | |
| | | | | | | (7April) | |
| | | | | | (IO) TWI 002 (J) | 01:20 | |
| 27-May | Vanuatu | 13.710° S | 42 | 7.6 (A, J, P001) | FRW 001 (P) | 17:27 | NO |
| 17:15 | Islands | 166.507° E | | 7.2 (G, P002) | TIS (A) | 17:27 | NO |
| | | | | 7.1 (GCMT) | NWPTAC (J) | 17:35 | |
| | | | | | FRW--Sup. (P) | 17:39 | |
| | | | | | FRW--Cancel (P) | 18:38 | |
| 12-Jun | Nicobar Islands, | 7.748° N | 37 | 7.6 (A, J, P) | (IO) RTWB (P) | 19:34 | YES .06 m (peak-to-trough) |
| 19:27 | India | 91.938° E | | 7.5 (G) | (IO) TWI (J) | 19:47 | |
| | Region | | | 7.4 (GCMT) | LTWB (P) | 20:18 | Trincomalee, Sri Lanka Tide gauge |
| | | | | | TWatch Cancel 003 (P) | 21:46 | |
| 25-Oct | Southern | 3.484° S | 12 | 7.5 (P,A,J) | LTW (P) 001 | 14:49 | YES 0.38 m (amp) |
| 14:42 | Sumatra | 100.114° E | | 7.7 G) | TIS (A) | 14:53 | Padang ,Indonesia |
| | Indonesia | | | 7.8 (GCMT) | TWI (J) 001 | 15:01 | 431 dead |
| | | | | | LTW (P) 002 | 15:49 | |
| | | | | | TWI (J) 002 | 16:20 | |
| | | | | | Cancel (P) | 16:42 | |
| | | | | | TWI (J) 003 | 17:20 | |
| | | | | | TWI (J) 004 | 20:10 | |
| | | | | | TWI (J) 005 | 21:30 | |
| | | | | | TWI (J) 006 | 1:00 | |

# **ICG/CARIBE EWS:** 12th January 2010 Earthquake and tsunami in Haiti

The Intergovernmental Coordination Group for the Tsunami and other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (ICG/CARIBE EWS) was established because the Caribbean is an area of relatively high seismicity as it is surrounded by subduction zones that are potential sources of tsunamigenic earthquakes. As a consequence, large zones of the Caribbean region are vulnerable to earthquake, volcano and landslide-induced tsunamis. During the last 500 years, the Caribbean has experienced devastating tsunamis that have caused incalculable damage. As an example, the tsunami in Dominican Republic in 1946 claimed over 1500 lives.

The magnitude 7.0 earthquake in Haiti on the 12 January 2010 was one of the most severe earthquakes to occur in this country in the last 100 years. It caused a large number of casualties and material destruction. The earthquake generated tsunami, caused a runup of 3m at both Jacmel and Petit Paradis, Haiti and 1m in Pedernales, Dominican Republic. The Pacific Tsunami Warning Center, PTWC, in Hawaii, responsible *ad interim* for the Caribbean, issued a Tsunami Message distributed to Tsunami Warning Focal Points registered with UNESCO, 10 minutes after the earthquake (at 22:03 UTC) containing a Tsunami Watch for Haiti/Cuba/Bahamas/Dominican Republic. The tsunami watch was canceled at 23:45 UTC after readings from real time sea level monitoring stations confirmed a tsunami measuring 12 cm crest-to-trough was recorded at Santo Domingo in the Dominican Republic and a tsunami less than 1 cm crest-to-trough was recorded on a deep ocean gauge in the East-central Caribbean.

This is the third reminder in the period of only three years that the Caribbean has a distinct potential to be affected by a tsunami. On May 28, 2009, an earthquake magnitude 7.3 struck off Honduras at 2:25 AM local time with a depth of 10 Km. Pacific Tsunami Warning Center, issued at that time a Tsunami Watch for Honduras/Belize/Guatemala, 8 minutes after the earthquake. Local field surveys demonstrated later on that a small tsunami was generated, flooding some low-lying areas on the border Guatemala/Honduras. This occurred a few months after a similar event of magnitude 7.4 happened on Thursday, November 29, 2007 at 15:00 local time UTC in the region of Martinique, French Antilles.




*Tsunami travel time simulation for Haiti event*

*Post-tsunami measurement of run up Haiti following January 2010 event.*

# ICG/IOTWS
## Progress and Achievements in 2010

The main focus of the Indian Ocean Tsunami Warning System, ICG/IOTWS, in 2010 was on the workplan and programme for the transition from the Interim Advisory Service provided by PTWC and Japan Meteorological Agency to the Regional Tsunami Warning Provider (RTWP) service for the Indian Ocean. The three Indian Ocean RTWPs of Australia, India and Indonesia continued to exchange bulletins among themselves on a trial basis, while work continued on the development of warning products and services. The trial exchange will be extended to the National Tsunami Warning Centers in 2011, together with training in the new RTWP service.

Building on the successful development of tsunami risk assessment guidelines and the completion of a regional workshop on risk assessment and mitigation in 2009, country level workshops were conducted in Sri Lanka and Indonesia in 2010. The Indonesian workshop was used as a platform to develop specific guidelines for risk assessment at the national level. With the support of the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) Multi-donor Trust Fund, training workshops on the assessment and awareness of Makran tsunami hazards were held in Iran and Pakistan followed by a field workshop in Iran.

The Mentawai tsunami of 25 October 2010, which resulted in the loss of over 400 lives, highlighted the need to focus on the last mile of the tsunami warning chain, including the need for more training at the community level, better understanding of the role of the national and regional tsunami warning systems, and better communication with the media. The Tsunami Unit continued to conduct training in the development of end-to-end Standard Operating Procedures (SOP) for tsunami warning and emergency response, with regional training workshops undertaken in Malaysia for South China Sea countries and Tanzania for East African and Western Indian Ocean countries. As part of the transition process, further training workshops will be conducted in 2011 to assist Member States to adapt their SOPs to the new RTWP service.

# ICG/NEAMTWS
## Progress and Achievements in 2010



**Promote integrated and sustained monitoring and warning systems**

The seventh 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) was held in Paris at UNESCO on 23-25 November 2010, attended by 69 participants from 16 member countries, two observers and one cooperating organization. The session adopted the Operation Users Guide and established a task team on the multi-hazard approach to coastal inundation. However, the ICG still needs to agree upon the detailed architecture and procedures for the regional watch service.

Turkey, Greece and Portugal plan to start providing operational services as Regional Tsunami Watch Centres (RTWCs) by 2011 while France and Italy will follow in 2012.

**A total of 92 sea level stations in the NEAMTWS countries are now transmitting data in real time.**

3 new Tsunami National Contacts were nominated (Germany, March 2010, Slovenia, March 2010, Russian Federation, May 2010), now totaling 27 or 84% of the members of ICG/NEAMTWS.

Two communication test exercises among the candidate RTWCs were performed, led by the National Observatory of Athens (NOA), Greece (June 2010) and the Institute of Meteorology (IM), Portugal (September 2010) respectively.

Challenges for the NEAMTWS remain the slow pace of development of the TWS and the full involvement of North African countries in NEAMTWS, in particular real-time sharing of sea level and seismic data.

**Educate communities at risk with respect to natural hazards impact prevention, preparedness and mitigation measures**

The Tsunami Information Centre for the North-eastern Atlantic and Mediterranean (NEAMTIC) project was approved by the European Commission. The project partners, IOC, France (Commissariat à l'energie atomique), Greece (National Observatory of Athens), Italy (Dipartimento della Protezione Civile), and Portugal (Fundação da Faculdade de Ciências da Universidade de Lisboa), aim to develop awareness and education materials on tsunami and other sea-level related hazards for the North-eastern Atlantic and Mediterranean region.

For SEAWATCH Deep Sea Module (SDSM) see the fugro website: http://www.geos.com/services/ocean/tsunami.asp

*The Poseidon Pylos research time series station (http://www.eurosites.info/pylos.php) is the first (mooring) in the NEAMTWS region with a bottom platform for tsunami detection.*

# **ICG PTWS:** Chile earthquake and tsunami, 27th February 2011

A series of severe earthquakes hit Central Chile on Saturday, 27th February 2010. The major one off Concepcion at 06:34 UTC (3:34 AM local time) had a magnitude of 8.8 Mw. The Pacific Tsunami Warning Center, PTWC, in Hawaii, USA issued a regional warning at 06:46 UTC (12 minutes after the event). This was the first ocean wide test of a system that was put in place nearly 45 years ago by UNESCO's Member States through its Intergovernmental Oceanographic Commission (IOC), after a 9.5 magnitude earthquake on May 22, 1960 off Chile triggered a wide ocean tsunami that caused 61 fatalities in Hawaii and 142 fatalities in Japan, several hours after the earthquake.

As indicated above, 12 minutes after the 27th February 2010 earthquake the Pacific Ocean Tsunami Warning and Mitigation System (PTWS) went into action, with timely and adequate information produced and disseminated across the Pacific Ocean. There were no fatalities reported far from the epicenter, however, near the epicenter off the Chilean coast, official accounts indicate over 156 fatalities due to the tsunami. Preliminary measures of a Rapid Survey Team deployed the week after the event by UNESCO showed run up measurements as high as 30 meters with most common measurements between 6 and 10 meters in the most affected area of the Chilean coast.

Based on data and information collected from Member States the PTWS acted promptly and efficiently throughout the Pacific. However, at the same time, this event demonstrated the need to reinforce the work of PTWS for near field events, particularly with denser sea level monitoring networks close to active subduction areas.

*Post-tsunami measurement of run up at Tirua Chile following Feb 2010 event*

# Six South American cities get wise to tsunamis

A 15-month UNESCO project to prepare coastal communities in Chile, Colombia, Ecuador and Peru for the eventuality of a tsunami via education and contingency planning wound up on 15 October 2010. Funded to the tune of US$779,000 within the Sixth Action Plan for Disaster Preparedness in South America sponsored by the European Commission Humanitarian Aid department (DIPECHO programme), the project was piloted by UNESCO's Intergovernmental Oceanographic Commission and the UNESCO Regional Bureau for Education in Latin America and the Caribbean in Santiago de Chile and implemented together with UNESCO's offices in Quito (Ecuador) and Lima (Peru).

The project targeted six cities along the South American Pacific coast which are particularly vulnerable to tsunamis: Penco, Tomé and Coronel in Chile's Bio Bio region, Tumaco in Colombia's Nariño region, Esmeraldas in Ecuador and El Callao in Peru.

Education specialists from the three UNESCO offices, the Ministries of Education and universities of the four participating countries and the Colombian Red Cross worked with primary and secondary school teachers and more than 10,000 pupils. In each country, educational materials on tsunamis were developed in line with the national curriculum and reflecting the national context. In Chile, the materials were even adapted for use in kindergartens. The schools from each participating country also seized this opportunity to test and review their security plans via evacuation drills.

In parallel, the project ran an awareness-building campaign for parents' associations and community leaders. Key messages were conveyed via posters, pamphlets, radio spots and videos posted on the internet and broadcast on television. In Ecuador, the campaign included door-to-door canvassing.

In order to improve contingency planning for tsunamis, specialists helped local authorities to update existing plans and improve the local tsunami early warning systems through the installation of sirens and signs indicating safe areas, hazard zones and evacuation routes. The efficacy of each contingency plan was then tested via desktop simulations and drills in the targeted communities.

One aim of the project was to establish or strengthen co-ordination mechanisms both at the national level and between countries as a step towards establishing a regional tsunami early warning system. Two regional meetings were organized in Quito in September 2009 and in Santiago de Chile in October 2010 to exchange information on the strengths and weaknesses of each country's national tsunami early warning system and explore opportunities for the regular exchange of information. UNESCO brought to the table its own diagnosis of the current situation and a set of recommendations for the regional early warning system.

*Tsunami evacuation drill organized in 2010 by teachers at the Institucion Educativa Heroinas Toledo, a secondary school in El Callao, Peru*

For the past couple of years, the Permanent Commission of the South Pacific and its Co-ordinating Committee have been laying the foundations for a regional tsunami early warning system which would allow for the real-time exchange of seismological and oceanographic information between countries and institutions. By bringing on board the Ministries of Education, UNESCO was able to emphasize the importance of education for an 'end to end' tsunami early warning system.

Countries bordering the Pacific Ocean are vulnerable to earthquakes and tsunamis. Most earthquakes occur in this part of the world, which is why it is known as the Ring of Fire. The Pacific Ocean not only covers one-third of the Earth's surface but is also surrounded by a series of mountain chains, deep-ocean trenches and island arcs. On 27 February 2010, Chile was the victim of a destructive earthquake which generated a tsunami. Chile was also the theatre of the biggest earthquake ever recorded (magnitude 9.5), on 22 may 1960.

For details (in Santiago): a.hollander@unesco.org; (in Paris) b.aliaga@unesco.org

Watch a film on the project (in Spanish): www.youtube.com/user/UNESCOSantiago

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# 4

# CLIMATE CHANGE AND VARIABLITY

## Mitigation of the impacts of and adaptation to climate change and variability

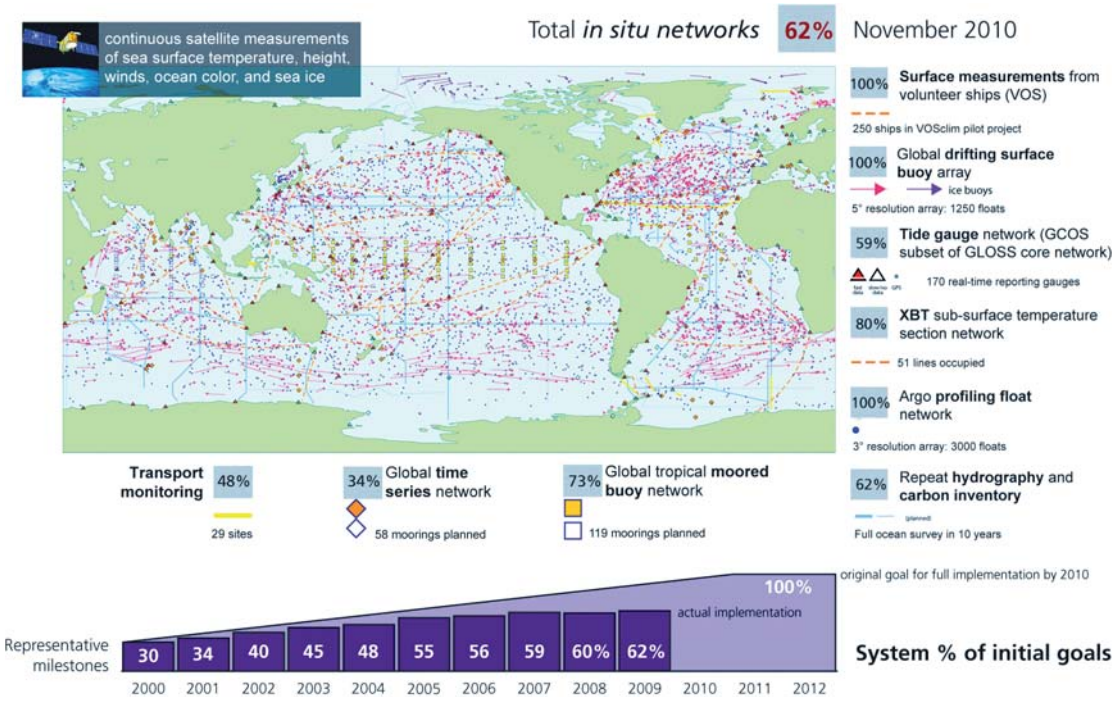
**"Climate Change is the greatest collective challenge we face as a human family."**

**UN Secretary-General**
**Ban Ki Moon**

The past decades have seen the development of a global ability to observe the physical oceanographic and meteorological parameters of climate change. Combined with sophisticated understanding and models, the prognosis of climate change has become more convincing and little doubt amongst scientists, environment managers and professionals exists: climate change is happening and will demand a strong response. Political, economic and environmental responses to climate change will be needed at all levels of society from intergovernmental levels to national levels and even personally.

IOC's climate change activities are now defined by the shift of climate change science from global attribution of the human role in climate to the effects on regional ecosystems and the local need for adaptation. IOC programmes and member states must continue to support the Global Ocean Observation System, GOOS, a lynch pin of ocean climate change observation, research, and prediction. However open ocean GOOS has been languishing at just 62% of projected completion for several years now and will require an infusion of energy and support to bring the other systems, data buoys and ship hydrography programmes up to required levels. The results of the OceanObs'09 conference are being codified in a Framework for Ocean Observing, which promises to focus needs and requirements of the observing system and provide a new blueprint for GOOS. GOOS must adapt as well to growing societal needs and embrace biogeochemistry and ecology dimensions to enable investigation and documentation of climate change in ecosystems. Direct measurements of marine carbon coordinated by the International Ocean Carbon Coordination Project (IOCCP) are now recognized to be much more useful than just providing data to close the global carbon budget. The distribution of $CO_2$ flux across the ocean has a great influence on how ocean acidification will affect oceanic and coastal ecosystems. Quantified changes in biodiversity is a first order indicator of climate change and will be addressed with the Ocean Biogeographic Information System (OBIS) system now part of IOC's IODE. The development of quantifiable climate

*PIRATA Buoys in SW Atlantic*




*Adequacy of the Global Ocean Observing System for Essential Ocean Climate Variables reported to the UN Framework Convention on Climate Change COP-16 Cancun, 2010.*

change biodiversity and ecosystem indicators is an essential step in the process of developing the new framework for new essential environmental climate variables of the next observation systems.

Climate change science has a new role today. It must be able to inform the most vulnerable societies, e.g. Africa and Small Island Developing States, SIDS, for development of effective climate change adaptation strategies. Again, we see how the science must be stretched to address difficult regional scale issues. Climate change science must now also work with the socio-economic realm to inform policy and management decisions. But even more important than these science challenges, we have learned that the people most affected by climate change are also the ones most motivated and able to respond, if given the tools and knowledge to act. IOC's development of Coastal Planning tools and Capacity Development programmes are essential parts of the IOC climate change strategy.

# **Increase the understanding of the ocean's role** in climate variability and climate change

A number of programmes coordinated through the Ocean Sciences Section work to increase our understanding of the ocean's role in climate variability and change. This understanding underpins improved climate projections and regional forecasts, key knowledge in developing national strategy and action in climate mitigation and adaptation.

The WMO-ICSU-IOC World Climate Research Programme (WCRP) coordinates climate research focused on predictability of the climate system. The WCRP's Implementation Strategy for 2010– 2015 (WMO/TD-No. 1503) is aimed at meeting the information needs of society, and includes a focus on regional and decadal climate prediction, providing information better adapted to local needs, and building capacity regionally and globally in the next generation of climate experts. In September 2010, WCRP held a workshop at UNESCO on Metrics and Methodologies for Estimation of Extreme Climate Events, examining extremes in precipitation, temperature, tropical cyclones and extratropical storms, and risk assessment. WCRP and its Climate Variability and Predictability project (CLIVAR) also developed two events planned for 2011, a joint WCRP-IOC activity on regional sea level prediction, and the large WCRP Open Science Conference (OSC, 24-28 October 2011, Denver, USA). The OSC will assess our current state of knowledge on climate variability and change, identify the most urgent scientific issues and research challenges, and ascertain how WCRP can best facilitate research and develop partnerships critical for progress.

*Teaching sailing vessel Lady Amber deployed Argo profilers in South Atlantic and Indian Ocean*

The International Ocean Carbon Coordination Project (IOCCP) promotes the development of ocean carbon observations for research through technical coordination and communications services, international agreements on standards and methods, and advocacy and links to the global observing systems. Major activities of the IOCCP include The Surface Ocean $CO_2$ Atlas Project (SOCAT), the Global Ocean Ship-based Hydrographic Investigations Panel (GO-SHIP), and Ocean Acidification.

SOCAT was established in April 2007 to develop a global surface $CO_2$ data set that would bring together, in a common format, all publicly available $CO_2$ data for the surface oceans. The SOCAT data set now includes over 7 million measurements from more than 2100 cruises collected between 1968-2007. Version.1.3 will be published in mid-2011.

GO-SHIP developed the strategy document "Ship-based Repeat Hydrography: A Strategy for a Sustained Global Program" (Hood et al., 2010) and the "GO-SHIP Repeat Hydrography Manual: A Collection of Expert Reports and Guidelines" in 2010. The manual provides detailed instructions for the high quality collection and analysis techniques of numerous ocean parameters, both physical and biogeochemical. Sixteen chapters covering CTD methods, discrete samples, and underway measurements have been reviewed and revised by more than 50 experts.

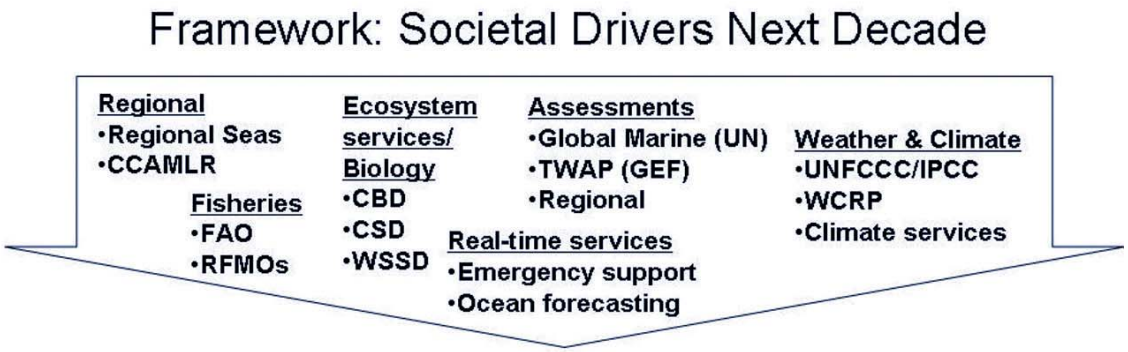
The Intergovernmental Oceanographic Commission (IOC) of UNESCO, Scientific Committee on Oceanic Research (SCOR), and International Geosphere-Biosphere Programme (IGBP) will sponsor the third symposium on "The Ocean in a High-$CO_2$ World" in September 2012 in Monterey, California. The symposium aims to attract more than 300 of the world's leading scientists to discuss the impacts of ocean acidification on marine organisms, ecosystems, and biogeochemical cycles. It will also cover socio-economic consequences of ocean acidification, including policy and management implications. The International Planning Committee and the sponsors met in December 2010 to develop the scientific program for the symposium.

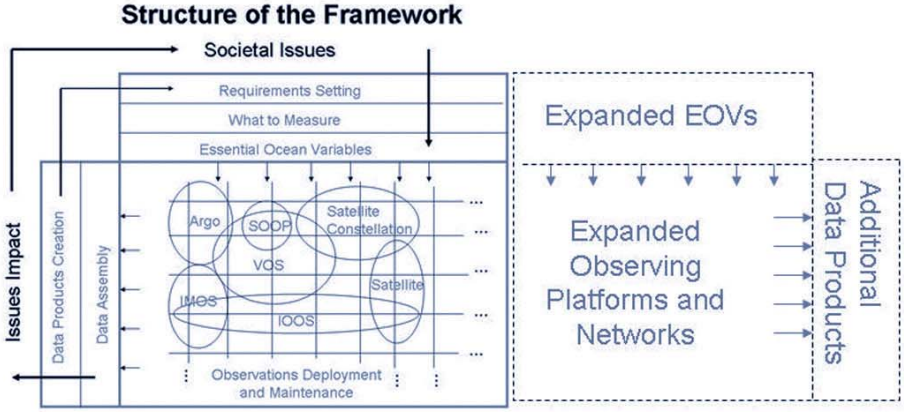
# **Contribute to the better prediction of climate** through ocean observations and process studies, at regional and global scales

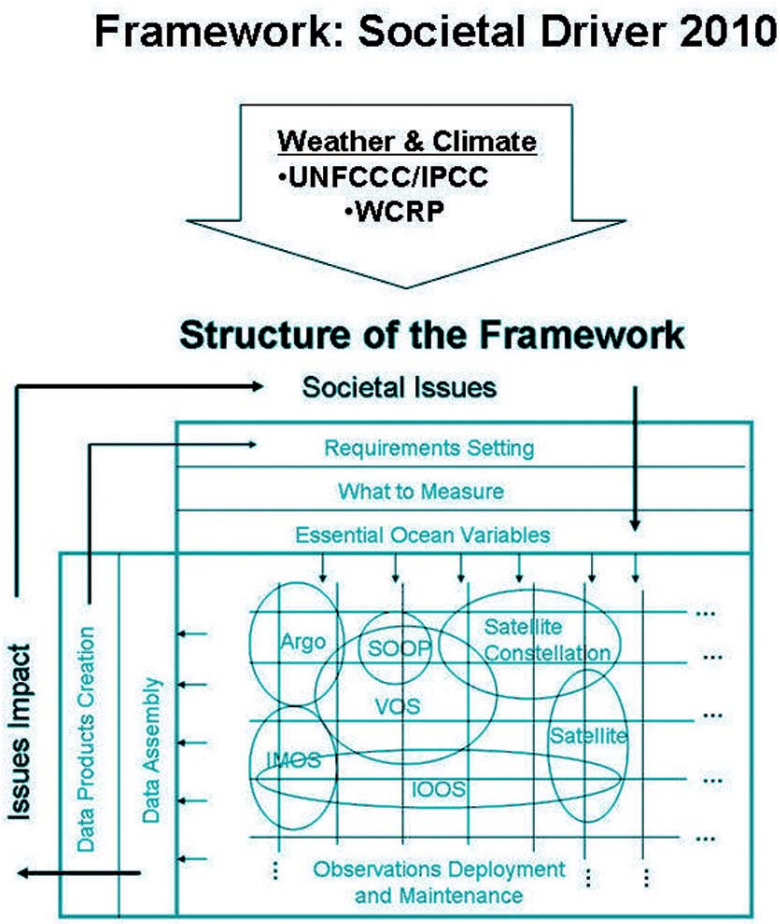
## A FRAMEWORK FOR OCEAN OBSERVING

Over the next decade, Global Ocean Observing Systems will be integrating new physical, biogeochemical, and biological observations while sustaining present observations. This common vision was put forward at the IOC co-sponsored OceanObs'09 conference (21-25 September 2009, Venice, Italy, oceanobs09.net) which brought together more than 600 scientists from 36 nations, supported by 99 peer-reviewed Community White Papers and 47 Plenary Papers. The envisioned systems will provide for routine and sustained global information on the marine environment sufficient to meet society's needs for many purposes. These include describing, understanding and forecasting marine variability (including physical, biogeochemical, ecosystems and living marine resources), for weather, for seasonal to decadal climate variability, for climate change, for sustainable management of living marine resources, and for assessment of longer term trends. Compared to the OceanObs'99 conference which launched the global ocean observing system for climate, this conference brought a much more interdisciplinary group of scientists together. The Conference made a number of calls, asking the many sponsors of ocean observations to embrace a framework for planning and moving forward with an enhanced global sustained ocean observing system

A post-OceanObs'09 Task Team made up of representatives of the all the international sponsors of the conference (www.oceanobs09.net/wg/) worked through 2010 to develop their recommendations for such a Framework, supported by the IOC Secretariat.






*The Benefit of Using the Framework: Alignment of more of the requirement-setting processes, observing elements, and systems producing data and information will allow an expansion of the societal benefits of the ocean observing system.*

The Task Team's objective was to glean lessons learned from the successes of past ocean observing efforts, and outline a Framework that would guide the ocean observing communities to establish the requirements for a sustained global observing system, the essential variables to be measured, the approach to measuring these, and the way in which their data and products will be managed and made widely available. It based its recommendations on building from the successes of the ocean climate observing system described by Global Climate Observing System, GCOS, and GOOS, with implementation by JCOMM and IODE.

The Task Team agreed that Framework processes should be organized around "essential ocean variables (EOVs)," rather than by observing system, platform, program, or region. The group also agreed that implementing new EOVs would be carried out according to their readiness levels, and agreed to encourage formal efforts to improve readiness. Systems engineering approaches provide a common language and consistent handling of requirements, observing technologies, and information flow among different, largely autonomous, observing elements. The Framework is a collaborative system with voluntary participation, self-funding and self-managing elements, that takes best advantage of existing structures. Three existing ocean observing communities are reviewed according to their application of these principles, showing the advantages to be gained from applying these Framework approaches.

The Task Team agrees that alignment within the Framework will result in broad community unity; will foster scientific discoveries not yet imagined through improved communications and data sharing across the ocean community; will provide more, faster and better coordinated information to support both science and societal needs; will contribute to capacity building and enhancement of ocean observations in developing countries; and is expected to increase confidence and support among sponsoring and funding entities.

The Intergovernmental Committee for GOOS Board met in December 2010 to consider these Framework ideas, and will bring them to the IOC Assembly in June 2011 for consideration as they examine the streamlining of GOOS to better achieve its objectives for Member States.

# **Increase the understanding of the impacts** of climate change and variability on marine ecosystems and their living resources

Impacts of climate change on marine ecosystems, biological diversity and living resources are diverse and far from understood. The IOC implementation strategy is aimed towards a better knowledge of impacts of climate change on fish/fisheries, coral reefs and the development of the Ocean Biogeographic Information System (OBIS) to support adaptation to climate change.

The successful completion of Global Ocean Ecosystem Dynamics programme, GLOBEC, in 2010 was a landmark in the story of global projects under the patronage of IOC. Through CLIOTOP (CLimate Impacts on Oceanic TOp Predators) IOC promotes observations and research in the open ocean ecosystems which occupy the largest area of the world oceans. There is evidence that migratory species like tunas and billfishes, that move worldwide, from the equator to temperate regions have modified their migratory routes in response to ocean warming and changes in the environment.

IOC has also adopted IndiSeas (Indicators for the Seas) which is developing a second phase to evaluate the effects of fisheries and climate change on marine ecosystems using a suite of ecological indicators. Promising results have been obtained showing some trends in the indicators that can explain the evolution and state of an ecosystem. Key scientists of GLOBEC, CLIOTOP and IndiSeas met in the international Symposium Climate Change Effects on Fish and Fisheries held in Sendai for which IOC supported five young scientists.from developing countries.

Coral reef ecosystems represent areas rich in marine biodiversity. They are sensitive to both natural phenomena and anthropogenic perturbations, making them unique for studies on the impact of climate change and human activities on marine systems. Following the 2009 publication 'Monitoring Coral Reef Marine Protected Areas', IOC and WESTPAC is now involved in the production of the volume 'Effective Catchment Management and Coral Reef Conservation: Best Practice Case Studies'. This volume will include 25 case studies from Caribbean, Pacific and Asia coastal waters.


*The IODE OBIS contains data on new species, such as this bizarre new copepod, Ceratonotus steiningeri, first discovered 5400 meters deep in the Angola Basin in 2006*

## OCEAN BIOGEOGRAPHIC INFORMATION SYSTEM (OBIS)

OBIS was created as the data integration component of the Census of Marine Life. The OBIS is an on-line, user-friendly system for absorbing, integrating, and assessing data about life in the oceans. OBIS is stimulating research, generating new hypotheses concerning evolutionary processes and species distributions. OBIS includes software tools for data exploration and analysis and integrates data from many sources, over a wide range of marine themes, from poles to equator, from microbes to whales.

Created by Resolution 4 of the 25th session of the IOC Assembly, OBIS is now an IOC activity, under IODE. OBIS will bring a strong biodiversity component to IODE's traditional role of a repository of physical data. Discussions are underway to integrate the OBIS governance structures into the IOC/IODE. The international portal is hosted by Rutgers University, New Jersey. A global network of Regional, Thematic and Technical OBIS Nodes assures the world-wide scientific support needed to fulfill the global mandate.

As of April 2011, OBIS contains over 30 million distribution records, from well over 100,000 different marine species, extracted from nearly 1000 individual data sets. It is the largest provider of marine species distribution information, and one of the largest contributors to the Global Biodiversity Information Facility. All data are freely available over the internet and interoperable with similar databases.

# Climate Change Adaptation for Africa and SIDS

Insufficient awareness of climate change impacts beyond emergency and reactive measures, as well as low awareness that oceans are also being affected by climate change poses a major threat to achieving the Millennium Development Goals (MDG) (IPCC, 2009). In coastal nations, long-term adaptation will be increasingly needed, as climate change will impact coastal societies and biodiversity. In Cancun, the COP 16 of UNFCCC recognized the importance of collectively addressing the long-term challenges of climate change including adaptation, agreed to help developing nations deal with climate change, and stated that adaptation must be addressed with action and support, with the same priority as mitigation. Climate change adaptation and building resilience are of major importance for developing nations to continue implementing for Agenda 21 from the 1992 UN Conference on Environment and Development, including Local Agendas 21, the Johannesburg Plan of Action and the Mauritius Strategy for Implementation for oceans and coasts.

Adaptation requires more efficient management mechanisms, that are very site-specific, as well as community, culture , country and politically specific. Climate change adaptation is particularly challenging when human resources are scarce, marine governance systems are inadequate, and populations struggle with survival issues, as is often the case in the vulnerable societies of Africa and Small Island Developing States.

## THE ROLE OF IOC IN ADAPTATION

IOC implements long-term adaptation in coastal areas in Africa for building resilience of coastal communities' livelihoods and biodiversity. During 2010, the actions targeting adaptation in Africa and SIDS were multiple and built on previous projects undertaken as part of the IOC Self-Driven Capacity Development Strategy (whose funding came to an end in 2009). Previous training in coastal modeling and the use of Decision Support Tools (DST) for coastal management can also be used for long-term adaptation, as they allowed visualizing results of the simulation of scenarios to support planning and decision making processes, and to better communicate and raise awareness of communities for the need for adaptation. These tailored activities have helped countries manage sites, and can become key assets for building resilience in coastal zones.

IOC coordinates the UNESCO Platform for Action on Climate Change, taking stock of UNESCO's competences, programmes, activities and networks to develop synergies and to better assist coastal communities with long-term adaptation to climate change, particularly in Africa, SIDS and LDCs. Countries are increasingly requesting IOC's assistance for coastal adaptation, and climate seasonal forecasts and in the case of some African nations, for accessing the Adaptation Fund for building resilience in coastal communities and their environments. UNESCO developed numerous actions in Long-term Climate Change Challenges and with the collaboration of the Platform, IOC initiated the process of accreditation of UNESCO to serve the Adaptation Fund Board as a Multilateral Implementing Entity. This effort will allow UNESCO, its programmes and sectors to further serve more closely and efficiently, vulnerable countries.

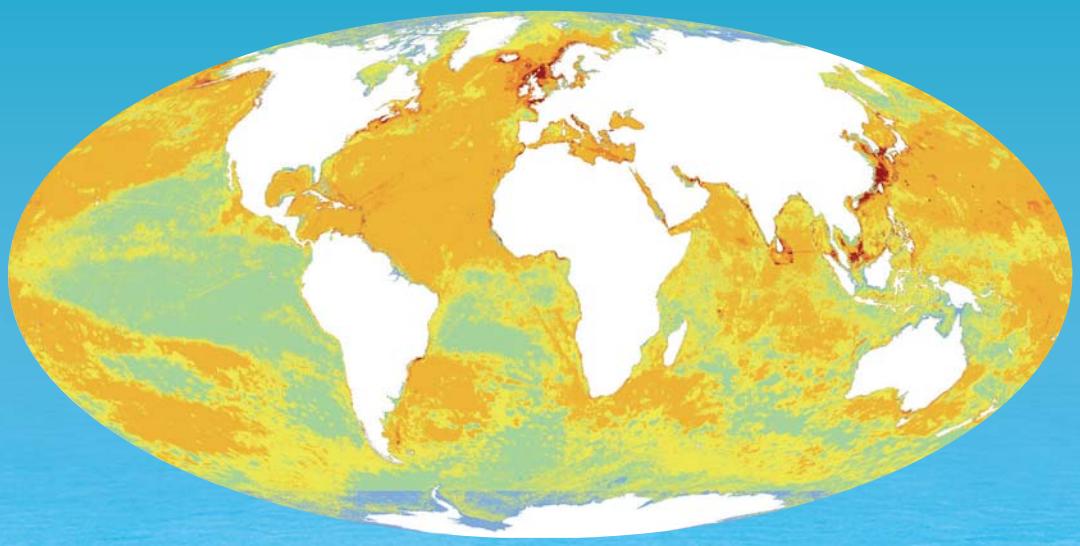
Institutional weakness, national bottlenecks, scarcity of human resources and baseline data continue to challenge access to funds and mainstream adaptation. For long term adaptation in SIDS and Africa, IOC is being asked to adapt and apply its global and regional scientific repertoire and experience to promoting local and national adaptation measures in coastal areas. If this mission is embraced by IOC Members, future regional coordination and resilience building for African countries will require flexible resources to assist countries mainstreaming climate change adaptation for oceans and coasts.

# Observations — beyond climate

Over the past decade the Global Ocean Observing System for Climate has been built up from a patchwork of unrelated research efforts to become an integrated, sustained remote sensing and in-situ monitoring system for Essential Ocean Climate Variables. Our understanding of seasonal variations such as El Niño, sealevel rise and ocean heat (both content and transports) have been completely rewritten thanks to this data boon. IOC now routinely reports on the adequacy of this system to the Conference of the Parties to the UN Framework Convention on Climate Change (GCOS, 2010) and the underlying data are made freely available in near real time. Monitoring and technical support for the in-situ system, which includes moored and drifting buoys, tide gauges, Argo profiling floats and ships (page 33), is carried out by IOC and WMO through the JCOMMOPS facility in Toulouse, France.

Over the same decade, a global network of researchers in more than 80 nations completed the Census of Marine Life, vastly improving our understanding of marine biodiversity (Snelgrove, 2010; COML 2011). The data portal containing the results of the census, the Ocean Biogeographic Information System (www.obis.org) was transitioned from temporary funding provided primarily by the Sloan Foundation, to sustained operation as a component within IOC's International Oceanographic Data and Information Exchange (IODE) in 2010.

Alongside these developments, indeed in large part because of them, the scientific community has recently begun to produce initial efforts to quantitatively map and assess global patterns and trends in marine ecosystems, and to correlate these changes with climatic and anthropogenic drivers. For example, Halpern et al (2008) provides a global map showing patterns of cumulative human impact on the world oceans. In the realm of biodiversity, Tittensor et al (2010) provide global maps of marine biodiversity across a number of open ocean and coastal taxa and highlight the unfortunate positive correlation that exists between 'biodiversity hotspots' (the 10% of cells with highest mean species richness) with areas that have experienced the most dramatic human impacts.



*Global map of human impact on marine ecosystems, Halpern et al, 2008*

The ocean is becoming more acidic. Modeling projections show global patterns of aragonite saturation levels, a measure of stress on shell forming organisms and corals, are strongly influenced by synergies between the combined impacts of carbon dioxide inputs from the atmosphere alongside changes in climatic variables including temperature, salinity and sea ice extent (Steinacher et al. 2009). Sometime this century, when atmospheric $CO_2$ levels are at 550ppm, nearly the entire Arctic and Southern oceans will be corrosive to animals that make their shells with aragonite. Outside the Arctic, ocean acidification will also have substantial effects on ecosystems, and potentially even human food security (UNEP, 2010).

These studies clearly demonstrate the underlying importance of monitoring beyond climate. In order to assess, understand, and eventually manage global marine ecosystems requires that we monitor them, and ensure we are able to combine such data in a transparent and integrated fashion with existing climate variable monitoring. The challenge for the next decade for GOOS will be to build on these efforts, just as the physical climate community has done over the past decade, to catalyze sustained and systematic monitoring of global patterns and trends in ocean biogeochemistry and ecosystems, with underlying data and information freely available in common formats (eg Claustre et al, in press; Feely et al, in press; Vanden Berghe et al, in press).

Even though physical oceanographic data is today increasingly available in real time, and a system of remote sensing and in-situ platforms to monitor 'essential climate variables' in the ocean is in place, observation of ecosystem variables remains almost entirely in the realm of research projects. There is no agreed and systematically reported ecosystem observing system in the ocean. Now is the time to push beyond the state of the art by bringing ecosystem monitoring and data into the sustained and operational physical oceanographic, climate oriented Global Ocean Observing System.

Such an effort will need to draw first and foremost on existing records from space, such as ocean color, as well as in-situ measurements, such as the continuous plankton recorder, and timeseries from Bermuda (BATS) and Hawaii (HOT). It must also catalyze the development and maintenance of nascent systems such as the Ocean Tracking Network, a global network of acoustic curtains for fish and marine mammal tagging, and piggyback biological and chemical measurements on existing platforms, such as through carbon measurements on repeat hydrography cruises, coordinated by GO-SHIP), and installing biological sensors on Argo floats and Buoys.

In the long term, sustaining such a system will require that the scientific community is able to agree to a clearly defined set of essential ocean biological and chemical variables. In particular those that are technologically and financially feasible to measure, and underpin data and model based ocean information products on threats to ocean ecosystems and threats to society from changes in the ocean environment. Additionally, it will require that countries have the political will to engage multilaterally in systematically monitoring these variables. One mechanism IOC is actively pursuing in order to ensure such national engagement may be to develop a reporting relationship with the Convention on Biological Diversity analogous to the one that we have developed with UNFCCC over the years for climate monitoring. Another will of course be the UN General Assembly's call for Global Reporting and Assessment of the State of the Marine Environment.

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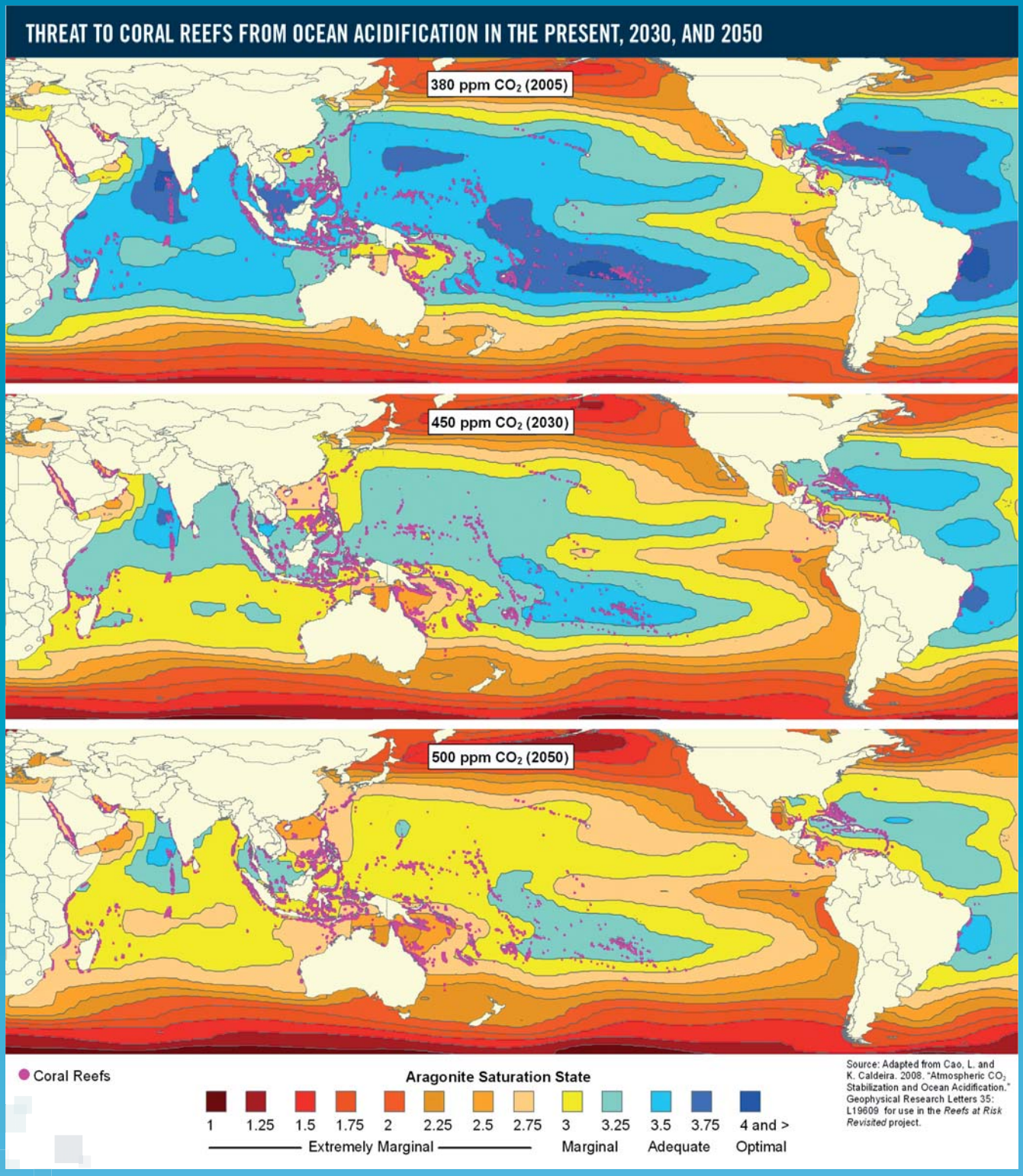



*Aragonite saturation levels estimated in 2005, at atmospheric $CO_2$ concentration levels of 380ppm, and predicted for sometime in the second half of the 21st century when $CO_2$ concentration in the atmosphere reaches 550ppm.* Data were adapted from Cao, L. and K. Caldeira. 2008. "Atmospheric $CO_2$ Stabilization and Ocean Acidification." Geophysical Research Letters 35: L19609 for use in the Reefs at Risk Revisited project.

5

# SAFEGUARDING THE HEALTH OF

The scientific understanding, monitoring and forecasting of the response of ocean ecosystems to anthropogenic and natural changes in the biological, chemical and physical characteristics have become crucially important. As an integral part of these challenges, there is a strong need to address scientific issues concerned with the indicators of the health of the ocean ecosystems that are reliable in their ability to detect driving forces, powerful in their ability to discriminate between anthropogenic vs. natural sources of stress, and easy to use and broadly applicable in different parts of the world.

This High Level Objective, HLO, is primarily focussed on the development of research and monitoring required for the protection of marine environment, the maintenance of biodiversity for maintaining healthy ocean ecosystems and the sustainable use of marine habitats. The core activities under this HLO include the UN Regular Process (RP) of reviewing the state of the marine environment, including socio-economic aspects. The RP intends to keep the world's ocean and seas under continuing review by integrating existing information from different disciplines, which will help to improve the responses from national governments and the international community, to the unprecedented environmental changes now occurring. The achievement of this goal will require research at all geographic scales through a variety of habitats and climatic regions. Obtaining data with an increased spatial and temporal resolution requires an international effort and broad cooperation and it will be a crucial and necessary step to take the pulse of the oceans on a planetary scale.

The General Assembly of the United Nations agreed in 2009 on the objective, scope, principles and cyclical approach for the Regular Process, and, in 2010, set the deadline for the first integrated assessment of the RP as 2014 and invited IOC, UNEP, IMO, FAO to provide scientific and technical support to the RP under the coordination of the secretariat in the Division of Ocean Affairs and the Law of the Sea, DOALOS.

To achieve the goals of the RP, a major challenge that must be met is the development of scientific mechanisms for the understanding of ocean processes, especially with respect to the functioning of marine ecosystems. The development of robust, simple, and globally applicable indicators of health of marine ecosystems is an integral part of this challenge and the objective of the preparatory phase of the GEF Transboundary Water Assessment Programme (TWAP), for assessing the conditions of the world's 64 LMEs and Open Ocean areas. These include indices of contamination and pollution in the marine environment; among the new pollutants, plastics and microplastics are a major cause of concern.

The project Nutrient Export from Watersheds 2, User Scenario Evaluation, NEWS2USE, was established to investigate some of the scientific aspects to develop models to combat the adverse economic, social, environmental and public-health effects of eutrophication caused by the excess of high nutrient inputs arising from river run-off and from land-based activities, into regional and national sustainable development strategies and their implementation.

# OCEAN ECOSYSTEMS

Harmful Algal Bloom, HAB, and Global Ecology and oceanography of Harmful Algal Blooms, GEOHAB. Programmes already constitute successful activities that are interdisciplinary and take into account the need for the knowledge of the related ocean ecosystem dynamics. The IOC HAB Programme aims to assist Member States to better understand and mitigate the effects of harmful algal blooms on national economies, aquatic living resources, public health and the aquatic ecosystem. This is achieved through a broad programme including capacity enhancement, five regional networks, working groups, Science and Communication Centres in Copenhagen (Denmark) and in Vigo (Spain), publication of manuals and guides, and the Global Ecology and Oceanography of Harmful Algal Blooms (GEOHAB) research programme. The programme is multidisciplinary and relates to many scientific and societal issues in the coastal oceans. GEOHAB (IOC-SCOR) is aimed, through a comparative system approach, to advance our understanding of the mechanisms underlying the population dynamics of harmful algae and to enhance our ability to model and forecast harmful algal events through development of improved observation systems.

Human activity and impacts are moving progressively into deeper waters requiring improved knowledge of vulnerable deep sea ecosystems. The open ocean beyond the 200 nm limit comprises approximately 50% of the Earth's surface. In the open ocean and deep-sea, there exists a variety of habitats and features of scientific and economic interest, including hydrothermal vents, polymetallic nodules, gas hydrates, transboundary fish stocks, and deep-sea coral reefs. Our knowledge of life in the deep-sea environment is limited and many species or habitats in these environments remain unknown. Potential high-seas Marine Protected Areas must be identified and monitored before damage to these fragile ecosystems occurs. Under the auspices of IOC a pilot project on biodiversity and distribution of megafaunal assemblages in the abyssal nodule province of the eastern equatorial Pacific, was completed in 2010, and reported in the IOC Technical series No. 69, 'Options for the management and conservation of the nodule ecosystem in Clarion Clipperton fracture Zone'.

In 2010 the UN General Assembly approved the Intergovernmental Science-Policy Interface on Biodiversity and Ecosystem Services (IPBES), which will demand data on biodiversity in a range of geographic scales through a variety of habitats and climatic regions. In this regard, IOC is prepared to deliver georeferenced data from the recently adopted databank OBIS (Ocean Biogeographic Information System), which is the largest provider of marine species distribution information currently hosting over 30 million distribution records, from well over 100,000 different marine species, extracted from nearly 1000 individual data sets.

# **Actively contribute** to the "Regular Process of the State of the Marine Environment,

For more than a decade, IOC has been strongly committed to the establishment of the Regular Process – a UN global mechanism for assessing the state of world's ocean on a regular basis. This was reiterated in 2009 and 2010 by our Member States during the IOC Assembly and Executive Council. As requested by the UN General Assembly (Resolution 60/30), IOC and UNEP as co-lead agencies, transmitted to the UN Secretary-General their report on the results of the 'Assessment of Assessments', after three years of intensive work, resulting in the first ever comprehensive overview of the marine assessment landscape. The General Assembly, based on the recommendations of the a dedicated Ad Hoc Working Group, took note of the report and on that basis agreed on the objective, scope, principles and a cyclical approach for the Regular Process. In 2010, further discussions took place at the UN, during the second meeting of the ad hoc Working Group (New York, USA, 30 August–3 September 2010) which led to the following recommendations, which were integrated into the UN Resolution 65/37 (adopted by the UNGA in December 2010):

- Set the deadline for the first integrated assessment under the 1st cycle of the RP as 2014;
- Establish Ad Hoc Working Group of the Whole of the General Assembly composed of all UN Member States that will be the body overseeing the implementation of the Regular Process;
- Invite (through the Secretary General) IOC, UNEP, IMO, FAO to provide scientific and technical support to the RP;
- Decided to establish a group of experts (appointed by MS) to be an integral part of the Regular Process, that will prepare the assessment report, and as a first step will be tasked with developing a set of options necessary to achieve the deadline of 2014.
- Organize the 1st meeting of the Ad Hoc Working Group of the Whole from 14-18 February 2011, where the set of options prepared by the Group of Experts was discussed and agreed upon.
- Establish a UN Trust Fund to support the RP cycle and invite Member States and other organizations to contribute to the Trust Fund and to make other contributions

Over the last year, IOC has continued to promote the objectives of the Regular Process and to mobilize support from the international community. In this respect, logistical and travel support was provided to the UN Group of Experts. Together with UNEP and UNDOALOS, side events were organised during the Global Ocean Conference held in Paris in May 2010 on the occasion of IOC's 50th Anniversary, and during the Convention on Biological Diversity, CBD, meeting in Nairobi the same month.

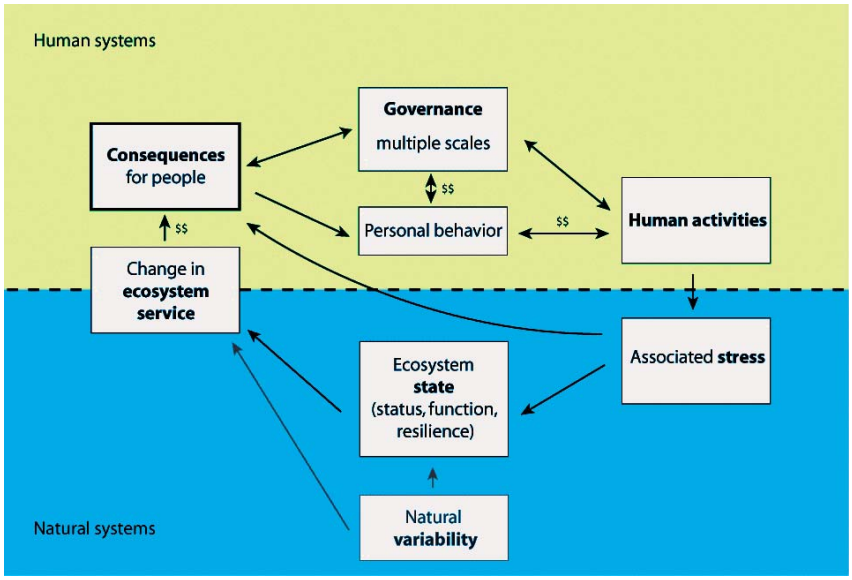
Together with Korea Ocean research and Development Institute, KORDI, IOC organised a regional workshop on Regional Capacity Building for the Regular Process, which was held from 21-22 October 2010 in Ansan, Republic of Korea, with the objectives of identifying capacity needs of South Eastern Asia and Eastern Asia regarding assessment of the marine environment; and possible strategies to initiate regional activities in support of the UN Regular Process.

Issues relating to marine pollution, fish stock levels and climate variability show that better information and more informed decision-making have big economic pay offs, and direct societal benefits. The added value that the Regular Process will provide is considerable and this level of support by the international community spread over a period of years should be seen as a sure investment.

## TRANSBOUNDARY WATER ASSESSMENT PROGRAMME, TWAP

The ecosystem services provided by the world's water systems (groundwater aquifers, lake basins,

# for Global Reporting and Assessment including Socio-economic Aspects"




*Map of cumulated impact on oceans makes link between human and natural systems clear.*

river basins, large marine ecosystems and the open ocean) support the socioeconomic development and wellbeing of the world's population. Many of these systems extend across, or lie beyond, national boundaries, and are referred to as "transboundary waters". These resources, which cover most of the planet, continue to be impacted and degraded by multiple and complex human-induced and natural stresses that threaten their sustainability and, in turn, human survival and wellbeing. Management of transboundary waters is increasingly constrained by limited availability of funds, requiring better prioritization of the allocations of limited financial resources.

One of the major constraints to the effective management of transboundary waters is the lack of a systematic, periodic global comparative assessment of their changing conditions in response to changing stresses. To respond to these challenges and as a direct contribution to the UN Regular Process, IOC took a leading role in the preparatory phase of the GEF Transboundary Water Assessment Programme (TWAP), in developing an indicator based-methodology for assessing the conditions of the world 's 64 Large Marine Ecosystems and Open Ocean areas. To identify key environmental, socio-economic and governance indicators, IOC established two expert working groups on Large Marine Ecosystems and Open Ocean, that met in February, June and July of 2010. The final reports were delivered to GEF and UNEP in December 2010. It is expected that in 2011, GEF will fund the implementation of the TWAP Assessment which will be conducted through a partnership of more than 40 institutions, from 2012 to 2014. The assessment products of the TWAP will feed directly into the Regular Process cycle of work. IOC is expected to lead the implementation of the two marine components, in collaboration with UNEP. Such assessment has never before been undertaken for all transboundary waters.

# **Further develop the research and monitoring** required for the prevention of marine environmental degradation, and the maintenance of biodiversity and the sustainable use of marine habitats

The objective of the IOC programme on Harmful Algal Blooms (HABs) is to foster the effective management of, and scientific research on, harmful algal blooms in order to understand their causes, predict their occurrences, and mitigate their effects. Capacity development remains a core component of the implementation strategy set by the IOC Intergovernmental Panel on Harmful Algal Blooms (IPHAB). Throughout 2010 IOC organised or co-organised 5 training course opportunities via the IOC Science and Communication Centres in Copenhagen (Denmark) and Vigo (Spain) providing enhanced skills in observations and management of HABs.

The research component of the IOC's HAB activities, GEOHAB, is operated jointly with SCOR to foster international co-operative research on HABs in ecosystem types sharing common features, key species and their population dynamics. The GEOHAB Implementation Plan covers Core Research Projects related to five ecosystem types—upwelling systems, fjords and coastal embayments, eutrophic systems, stratified systems, and benthic systems. A Science Plan for GEOHAB research and cooperation in Asia was published in May. A Core Research Project on HABs in Benthic Systems was launched to study algae that contribute to ciguatera, probably the most widespread of all algae-related poisonings. A special issue of the 'Journal of Marine Systems' on HAB Modelling was published. The International Ocean Colour Coordination Group and GEOHAB have established a joint working group on HABs and Ocean Colour to summarise the relevance of ocean colour-based harmful algal bloom observation systems and to summarise the wide variety of harmful algal bloom types with regard to ecosystem function.

Systematized data compilation and exchange and enhanced capabilities for monitoring and research are key components of IOC HAB activities. A joint HAB Programme and IODE activity compiles data on HAB events and HAB species biogeography (with OBIS). During 2010 data formats were harmonized with OBIS and more HAB event data were compiled.

The IOC initiative 'Integrated Coastal Research' fosters research to deliver improved tools for management of nutrient loading to the marine environment via quantitative analysis of impacts of nutrient loading and changing nutrient stoichiometry in coastal ecosystems. During 2010 the plan adopted by IOC for development of models for nutrient export from watersheds - user scenario evaluation (NEWS2USE) was integrated into a Global Environment Facility proposal and there coupled with testing of developed models in two field studies.

Deep seafloor ecosystems harbour a rich biodiversity with many species new to science and for which the international community lack a comprehensive strategy for conservation and management. For this reason IOC supported a project on the biodiversity and distribution of megafaunal assemblages of the eastern equatorial Pacific with focus on management of the impacts of deep seabed mining. The main findings are compiled in a 3-volume publication (IOC Technical Notes Series n° 69) The findings support the hypothesis that megafauna, with its wide distribution and preferential habitats, would serve as good indicator of environmental change and mining impact.

# **Identify and develop the capacity-development** necessary for maintenance of healthy ocean ecosystems, focusing on the regional needs

## IODE - CAPACITY-DEVELOPMENT NECESSARY FOR MAINTENANCE OF HEALTHY OCEAN ECOSYSTEMS FOCUSING ON THE REGIONAL NEEDS AND OBIS

High quality reliable data and information are essential elements in developing national, regional and global policies underpinning coastal and ocean management. International Oceanographic Data Exchange, IODE, national oceanographic data centres (NODCs) and marine information centres have contributed for 50 years in the management and dissemination of ocean research and observation data. The global nature of ocean processes requires data and information management expertise to be available in all Member States and IODE has a long tradition in providing training and education in this regard through its regional "Ocean Data and Information Networks" ODINs, strategy, its OceanTeacher training system and its OceanTeacher Academy based in Oostende, Belgium.

In 2010 the ODINs have continued to grow and develop user services and products. Each network is managed by local experts (i.e.. self-driven) and focuses on national and regional needs.

The OceanTeacher Academy based at the IOC Project Office for IODE, Oostende, Belgium organized eight training courses in 2010, welcoming 155 participants. Whereas in the past courses focused on mainly "traditional" data and information management, 2010 has seen an increasing focus on partnerships with other organizations (IOC ICAM, POGO, SCOR, EUMETSAT, NOAA, WMO, JCOMM) thereby offering data management training to a wider audience and across IOC disciplines and programmes which complies fully with the IOC Strategic Plan for Oceanographic Data and Information Management.

Related to the training programme is the publishing of the "GTSPP Real-Time Quality Control Manual – revised edition" in 2010 and volumes 1 and 2 in the Ocean Data Standards series.

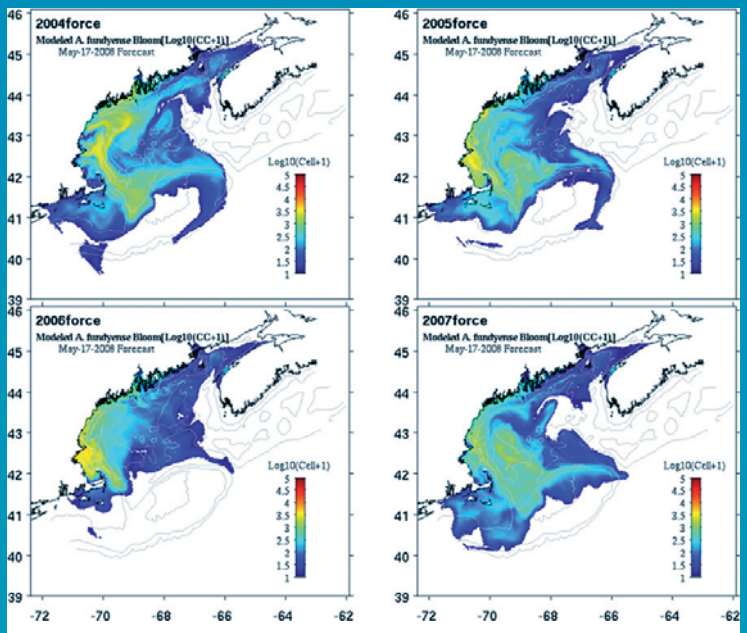
# GEOHAB plants the seeds for the future of modeling harmful algal blooms

**D.J. McGillicuddy, Jr., P.M. Glibert, E. Berdalet, C. Edwards, P. Franks, and O. Ross (eds. GEOHAB Modelling: A Workshop Report 2010)**

In June 2009, a workshop was convened under the auspices of the Global Ecology and Oceanography of Harmful Algal Blooms (GEOHAB a joint program of IOC and the Scientific Committee on Oceanic Research) to develop strategies for using observations and models to address the overarching science questions that have previously been articulated in the individual Core Research Projects (CRPs) of GEOHAB. These CRPs focus on different physical or chemical forcing factors related to harmful algal blooms (HABs), including Nutrents and Eutrophication, Upwelling, and Stratification (Pitcher et al., 2005; Glibert, 2006; Gentien et al., 2008). Additional Core Research Projects have since been identified by GEOHAB, but were not represented at the workshop: Fjords and Coastal Embayments (Cembella et al., 2010) and Benthic Systems. A total of 80 participants from 26 nations, including 20 students and postdoctoral fellows met for one week at the National University of Ireland in Galway and represented all facets of the work on HABs from the small scales of laboratory experimentation to wider field observations and including modelling. The workshop led to the publication of a special issue of the Journal of Marine Systems (McGillicuddy, 2010) and a Report (GEOHAB Modelling: Linking Observations to Predictions, A Workshop Report; www.geohab.info) representing only a fraction of the work accomplished during the week. The Report reflected the active and stimulating scientific discussions among all participants. Some highlights are summarized here.

One important objective of the workshop was to develop and improve the ways in which we use observations and models to address the fundamental scientific issues of HAB dynamics. The workshop participants recommended that we aim for higher-resolution sampling of appropriate variables, such as could be achieved through the nascent coastal observing systems. These enhanced data sets are particularly important for HABs that are patchy in time and space, and thus easily missed by infrequent or sparse sampling. High-resolution data would significantly improve our ability to formulate, parameterize and test HAB models, and would support the development of the next generation of HAB models. In particular, these data sets could be assimilated into new models to improve estimates of critical nutrient fluxes, HAB transport and dispersion, or plankton web interactions. Such models constitute powerful tools for the advance of our comprehension on HABs events, and thus contribute to its prediction and management.

To enhance the use of modeling in GEOHAB CRPs the workshop participants recommended that there be future joint training sessions for experimentalists and modelers. These training sessions could concentrate on species-specific issues that are relevant to HABs such as organism behavior, toxin production, life cycles and organism interactions. To improve the utility of models it was recommended that students, postdoctoral fellows and faculty work to enhance the linkages among models, in situ observations, and remotely sensed data. One particularly promising technique for realizing these linkages is data assimilation – using the data to improve the model. By assimilating data into models, one can improve model forecasts through improved estimates of the initial conditions (e.g., the distribution of HAB organisms), the factors forcing the model (e.g., wind speed or freshwater input), and the model




*Numerical model forecast of HAB dispersion throughout Gulf of Maine*

dynamics (e.g., growth and mortality rates). A few powerful examples demonstrate the use of data assimilation to improve our understanding of HAB dynamics exist, but more work needs to be done in this quite new and exiting research area. In particular, modelers and observationalists must work together to identify the types and density of data that would be most effective in testing and improving our models.

Once models are running, we have to test their ability to accurately reproduce the observed HAB dynamics. In the last decade, modelers have become much more quantitative in their model-data comparisons, and the field of "skill assessment" has developed significantly. Quantifying model skill requires sufficient data, and tools for comparing the model and data that take into account inherent errors and inaccuracies of both. Workshop participants recommended that training in skill assessment be provided for HAB researchers. Such training would enhance our ability to tease out dynamics driving local HABs, and potentially lead to improved predictive ability and reduced societal and economic impacts.

The activities performed during the GEOHAB Modelling Workshop confirmed that models are superb tools for synthesizing diverse observations and data types. Physical flows can be merged with phytoplankton growth rates, nutrient concentrations can be linked to mixing and coastal inputs, and wind stress can be related to local concentration changes of the HAB species. Models can thus be a platform to stimulate interactions among modelers, observationalists, laboratory experimentalists from all disciplines. Furthermore, modelers studying different aspects of the ocean such as biogeochemical cycling, ecosystem dynamics, and population dynamics, should be better entrained into HAB modeling activities. Together, these synergies and positive feedbacks can provide tools for prediction and mitigation of HAB events, and thus contribute to HAB management.

The sixteen papers contained in the special issue of Journal of Marine Systems put together from the workshop (McGillicuddy, 2010) illustrate some of the wide variety of approaches being brought to bear on HAB phenomena, spanning conceptual, empirical, and numerical approaches. These papers comprise a broad but incomplete survey of the field of HAB modeling. Future progress in this field depends heavily not only on the creativity and innovation of individual investigators developing new models and new approaches, but also on integration with the broader community of researchers dealing with physical-biological interactions of plankton populations. As indicated above, it became clear at the workshop that progress in modeling will rely heavily on progress in observations. This will require the HAB community to actively engage the leadership of the emerging Global Ocean Observing System and articulate their sampling needs so that systems are developed that are capable of sampling relevant variables at the time and space scales necessary for resolving HAB dynamics. Merging such data sets with new models will create powerful synergy, generating significant leaps in our understanding and predictive capability for HABs worldwide.

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# Micro-plastics in the oceans

## an additional cause for concern?

**Dr. Tim Bowmer**
**Chair Group of Experts on the Scientific Aspects of Marine Environmental Protection, GESAMP**

That litter enters the oceans is nothing new – timber and other debris has been washed up on the shoreline since time immemorial. However, with the advent of plastics in the mid 20th century, a form of persistent litter has been created which can enter the coastal seas and the open ocean. Clearly not all marine litter consists of plastics but a substantial proportion does.

Land-based sources are expected to have a greater contribution than maritime activities. There is however a lack of information on the actual inputs of plastics to the oceans. Global production of plastics increased from 1.5 million metric tonnes (mmt) in 1950 at an average rate of ca. 9% per year to reach 245 mmt by 2008; it dropped briefly to 230 mmt in 2009 but post-recession, is picking up rapidly again. The effectiveness of solid waste management varies markedly around the globe. The input of marine plastic litter to the oceans can therefore be expected to increase in those rapidly developing regions of the world lacking adequate solid waste management practices.

Litter may circulate the ocean currents and gyres for many years, or can be cast up on shore causing an impact often far from its point of entry. There are increasing numbers of known litter hotspots around the world, e.g. the Azores or the Coastal Barrier Islands of the Western Gulf of Mexico. It is well documented that plastic litter causes physical harm to several hundred species of whales, dolphins, seals, seabirds fish and invertebrates. Instances of death by entanglement, asphyxiation or blockage of organs are common. Such pictures are often stark and graphic and partly as a result of this, marine litter as an issue of public concern has grown rapidly in recent years.

Recent UNEP reports on marine litter provide some statistics on 'standing stocks' of litter (kg/km) on beaches around the world. Cleaner beaches have generally a few kg/km of litter, intermediate beaches have tens to hundreds of kg/km and occasionally, heavily littered beaches have one to several tonnes/km of coastline. However, a recent survey of beach litter in Japan demonstrated between 2.2 and 46 tonnes/km/year of marine litter on 11 beaches monitored during a 1 year survey; this consisted of 11 to 39% of plastics.

In addition to the physical damage that larger plastic litter can cause, we are beginning to understand that smaller plastic fragments, termed micro-plastics (less than 5mm) may pose a different type of threat to the marine environment, one highlighted in a recent report by the Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection – GESAMP1 (www.gesamp.org).

Micro-plastic particles can arise from several processes and sources:

Deterioration of larger plastic items over long time-scales (decades to centuries) e.g. containers, packaging, cordage and films, assisted variously by UV radiation, mechanical forces in the seas or through biological activity leads to ever smaller plastic fragments;

Plastics enter waterways and thereby the sea already in micro-plastic form, e.g. as scrubs and abrasives in household, personal care and industrial cleaning products containing plastic particles, as shot for cleaning hard surfaces such as ships hulls, or in the form of grinding or milling waste;

Industrial raw materials, e.g. pellets or powders used to make plastic articles, may be accidentally lost at sea or into surface waterways during transport or trans-shipment;

Macerated wastes such as sewage sludge entering the sea through rivers or dumped at sea may be a further source of micro-plastic input.

Knowledge of the distribution and fate of micro-plastics is only beginning to emerge but surveys of beaches, the water column and the seabed tell us that micro-plastics have become more or less ubiquitous worldwide. Relatively constant levels of plastic particles in the Western North Atlantic Ocean have been recorded in the last decade. There

Accumulation of plastic debris in the coast [© KIMO, 2010]

has also been little or no increase in beached and oceanic litter in recent years; only one of three sectors of Eastern US coastline showed increases. A similar situation appears to exist in the NE Pacific. This may be due to regional improvements in sea or land-based waste management. However, the characteristics and behaviour of the plastic particles may also have a role to play in determining the quantities we are able to sample and measure.

For much of the oceans we have little or no information on trends, either at the macro or micro level. In this regard, recent guidance from IOC and in the USA, NOAA may help to standardize collection and quantification of micro-plastics from sea water, bottom sediments and coastlines.

Plastic particles are well known to accumulate persistent, bioaccumulating and toxic contaminants (PBT) such as PCBs, DDT and PBDEs. Micro-plastics have larger surface to volume ratios, potentially facilitating contaminant exchange and have been shown to be ingested by a wide range of organisms. One of the greatest uncertainties is whether this leads to the bioaccumulation of the contaminant load (absorbed and/or plastic additives), and hence whether micro-plastics represent an additional and significant vector for transferring pollutants.

Recent modelling studies show that the flux to remote areas of contaminants associated with micro-plastics is small compared with that from oceanic and especially long-distance atmospheric transport processes. The difference is that plastics with their accumulated contaminant load are directly ingestible by organisms. A definite cause for concern is that particles, including microplastics have recently been found in the circulatory systems and other tissues of filter feeding organisms such as the blue mussel following experimental exposure and caused typical inflammatory responses. Whether the presence of acid conditions or surface active digestive substances in the guts of such marine organisms can desorb and release contaminants in significant quantities to cause such effects, or whether such a response is to their physical presence, remains to be answered and research is ongoing.

The problem of micro-plastics stems clearly from plastic waste entering the oceans and the ultimate solutions are to be found in improved solid waste management on land and at sea. Better waste management which includes far improved plastics recovery and recycling is obviously a major factor in preventing waste plastic reaching the sea; if Germany, Switzerland and Scandinavia can achieve high levels of over 80% plastics recovery, then why not the rest of Europe, the USA and Japan as a starting point? With petrochemical feed-stocks declining inevitably over the coming decades, the potential raw materials locked up in plastic may yet prove economically viable to reconvert in the future.

Plastic pellets (5 mm) used in the manufacture of plastic products. These pellets are found in all the beaches around the world. [© Hideshige TAKADA, Tokyo University of Agriculture and Technology, 2010]

Once in the sea, recovery of most micro and macro-plastics is impossible, and even beach cleanup is expensive and time consuming. The costs of beach cleanup for municipalities are considerable, particularly where tourism is involved – net-covered broken coral reefs and littered strands do not encourage tourists to return! Therein, lies a potential socio-economic solution involving municipalities and their citizens trading off services, e.g. regions with more advanced solid waste management could assist regions with less infrastructure, with the long-term aim of ultimately reducing their own cost of clean-up.

Several recent publications have anticipated the importance of plastics as a major cause of concern in need of attention of marine scientists. The scientific community, but also the industry, the policy makers and the general public will welcome the leadership of an expert body with the authority of the UN and IOC to guide the research, set up sampling and analytical protocols and assess best practices to alleviate if not solve this global scale problem.

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overview

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# MANAGEMENT LEADING TO SUSTA

**Management procedures and policies leading to the sustainability of coastal and ocean environment and resources.**

Marine ecosystem-based management requires well-defined and established planning tools to empower marine managers to implement best policies. This HLO is primarily focussed on the development of methodologies, and capacity building, which is underpinned by an interdisciplinary approach for the analysis of management tools and by the efficient delivery of information and outreach. The ultimate objective is to "Improve management procedures and policies leading to the sustainability of coastal and ocean environment and resources". Activities were grouped in (a) Enhancing regional cooperation and involvement of Member States, (b) Facilitating science related to ocean and coastal resource management, (c) Enhancing development and implementation of decision-support tools that improve integrated ocean and coastal management, and (d) Facilitating the development and adoption of standards.

The IOC is **enhancing regional cooperation** oriented towards the use of management tools in the Southeast Pacific (Chile, Colombia, Ecuador, Panama and Peru) in support of Integrated Coastal Area Management and enhanced Regional Capacity for Coastal Sustainability and Climate Change Adaptation. Activities included gathering of data, workshops and production of training tools. These activities were successful, and there are lessons to be learned. For instance the establishment of a communication network is needed to support the sharing of information about the existing experiences not only among the countries, but even within the countries, among different agencies, institutions, and stakeholders with shared interests in the coastal zones.

Other countries in Atlantic Latin America have shown interest in this programme and a GEF project is being prepared. During 2010 IOC agreed to coordinate a South-South project of cooperation that will involve the participation of countries on both sides of the South Atlantic. This project is led and funded by Brazil and will include access to a new Brazilian research vessel that will be used in 6 trans-Atlantic surveys from 2012-2014.

Within the framework of **facilitating science related to ocean and coastal management**, IOC is working together with International Union for Conservation of Nature (IUCN), Conservation International (CI), European Science Foundation (ESF) and Convention on Biological Diversity (CBD) in the Global Ocean Biodiversity Initiative (GOBI) defining and assessing scientific criteria to establish Marine Protected Areas (MPAs). GOBI will elucidate how the location, geographical extent and connectivity of key habitats and species may impact an area's needs

*ReCoMaP (EU) funded project "Empowering Non State Actors in Tanzania to plan for sustainable coastal livelihoods using Decision Support Tools"*

# INABILITY OF OCEAN ENVIRONMENT

and conservation tools. GOBI will also make recommendations for best practices of global regulation and governance of high-seas MPAs and the consequent protection of biodiversity, and regulation of high-seas biodiversity.

IOC recognizes the role of ocean management based in proven science to address the concern of Member States in using ocean fertilization techniques with micro- or macronutrients (e.g., iron) as a potential technological solution to reduce or slow the increase of the concentration of $CO_2$ in the atmosphere. The ocean represents a large potential sink for atmospheric $CO_2$; however, the long-term effectiveness and potential environmental consequences are unknown. IOC has coordinated with experts from Surface Ocean Lower Atmosphere Study (SOLAS) to produce an Ocean Fertilization Scientific Summary for Policy Makers, which contains substantial information and was very well received by the scientific community and covered by the media.

IOC has a role in **development and implementation of decision-support tools that improve integrated ocean and coastal management**, and continues as a lead organization in both Integrated Coastal Area Management (ICAM) and Marine Spatial Planning (MSP). ICAM is a continuing interdisciplinary activity where natural and social scientists, coastal managers and policy makers focus on how to manage the diverse problems of coastal areas. Worldwide issues related to coastal management are becoming increasingly urgent with the rapid exploitation and development of coastal areas where population growth and urbanization have led to environmental degradation of marine ecosystems. Coastal and offshore areas are economically important zones where fishery, mineral, oil exploitation and tourism contribute significantly to the economy of coastal countries. Consequently, coastal management has become an important programme for stakeholders who are working towards sustainable development of the coastal area.

MSP is a public process of analysing and allocating the spatial and temporal distribution of human activities in marine areas to achieve ecological, economic, and social objectives that have been specified through a political process. The IOC guide "Step-by-Step Approach for Marine Spatial Planning toward Ecosystem-based Management" published in 2009 was translated in 2010 to several different languages including Russian, Chinese and Vietnamese, and assessment and training courses are delivered to the Member States. IOC is currently developing an e-training tool on MSP. Lessons learned within the context of ICAM and MSP show that decision making should seek integration between different objectives (such as when regulating the exploitation of resources), but can also involve both losing some benefits and gaining others. It is therefore important to understand the implications of the different management options in marine planning and to engage with affected communities as part of the decision-making process.

Finally, IOC has continued as a facilitator for the **development and adoption of standards** and is developing both reliable reference materials for use when measuring nutrients in seawater and procedures to implement an International Nutrients Standards Scale. This work is essential if the potential feedbacks between concentrations of nutrients in the ocean and climate change are to be detected and verified.

# **Facilitate science** related to ocean and coastal resource management

Marine Protected Areas (MPAs) appear to be one of the most efficient mechanisms for the protection of marine biodiversity and ecosystems, and also for the sustainable management of natural resources and correlated activities. In order to foster an international dialog on this important issue, IOC and the Marine Board of the European Science Foundation are supporting a working group to compile key scientific and policy features surrounding establishment, management and review of MPAs. The group met three times, in Paris and Brussels, and decided to deliver a peer-reviewed Strategic Position Paper on MPAs in 2011.

IOC is also searching for new solid arguments to justify the protection of marine ecosystems. Coastal vegetated ecosystems have demonstrated capacity for sequestering carbon in both the plant biomass above ground and in the subsurface sediment layers. For that, IOC hosted the the first 'Blue Carbon" International Scientific Meeting last February , which encouraged the inclusion these ecosystems in national carbon accounting and mitigation strategies. IOC and partner organizations are building a program to coordinate and guide the establishment of coastal "Blue Forests" as conservation and management tools under a GEF funded proposal entitled "Blue Forest Carbon Accounting Methodologies for Coastal Management".

IOC-UNESCO is participating in cooperation projects in Ocean Sciences addressing our incomplete knowledge related to the oceanographic and biological processes in the deep ocean and high-seas, particularly in the South Atlantic. IOC-UNESCO is helping organize oceanographic expeditions led by Brazil, in the framework of the Zone of Peace and Cooperation of the South Atlantic (ZOPACAS), an organization that includes all 24 countries surrounding the South Atlantic Basin. The first activity of this South-South cooperation project took place in Paris last March, with the expert meeting "Understanding deep-water biodiversity in the South Atlantic". ZOPACAS experts identified research and knowledge gaps in the South Atlantic processes, biodiversity and resources and prepared recommendations for the upcoming ZOPACAS oceanographic expedition. The group also launched an initiative to identify potential Ecologically and Biologically Significant Areas (EBSAs) in the South Atlantic.

For the protection of the Deep-Sea environment and identification of EBSAs, IOC is actively participating in the advisory board of the Global Ocean Biodiversity Initiative (GOBI), an international partnership advancing the scientific basis for conserving biological diversity in the deep seas and open oceans. GOBI and IOC prepared reports, posters and brochures illustrating the various scientific methods and techniques relevant to the seven CBD scientific criteria for the selection of EBSAs, including examples of species, habitats and oceanographic features. GOBI met five times during the last two years and provided input for the CBD and DOALOS processes.

Geoengineering techniques, the intentional alteration of the climate system on large scale, have the potential for major disruption of ocean ecosystems. Proposed interventions in the high seas range from ocean fertilization to large-scale oceanic cloud seeding and storage of $CO_2$ in deep-sea wells. IOC and the Science Sector of UNESCO convened an international expert meeting "Geoengineering, the way forward?" discussing the status of both the science and governance of this rapidly evolving field. During the meeting, experts recommended the creation of an international research programme, similar to the World Climate Research Programme, to address the technological and scientific challenges of geoengineering and ensure that legitimate scientific research into this controversial issue may proceed.

# Enhance development and implementation of decision-support tools

Under the IOC/ICAM programme, work has continued to support the needs of Member States in providing decision support tools for coastal and ocean management at local, national and regional scales.

Following completion of the first Moore Foundation grant in August 2009, a second grant was received by the IOC to continue its work on marine spatial planning (MSP). Technical expertise was provided to help British Columbia's Pacific North Coast Integrated Management Area (PNCIMA), including Coastal First Nations, and the Commonwealth of Massachusetts (and later the Northeast Regional Ocean Council) to use elements of UNESCO's Guide "Marine Spatial Planning: a first step toward ecosystem-based management" (IOC Manual and guide 52). The schedule for completing the first PNCIMA plan was shortened considerably from four years to two years. In New England, the output of the initial regional MSP process was improved through the inclusion of measurable objectives and consideration of performance monitoring and evaluation. The UNESCO MSP Guide was also translated into Chinese, Vietnamese and Russian at the initiative of Member States.

In 2010, a new collaboration was also established with UNESCO's World Heritage Centre. The collaboration allows IOC to promote marine science and observations within WHC marine sites and propose the application of marine spatial planning methodology developed by IOC and MAB, to assist site managers to achieve ecosystem-based management. Out of nearly 6,000 marine protected areas now designated worldwide, only 43 have the highest internationally recognized status for conservation, UNESCO World Heritage Listing. Places as unique as the Phoenix Islands Protected Area in Kiribati, the Galapagos Marine Reserve in Ecuador, or Wrangel Island Reserve in Arctic Russia, among others, have reached World Heritage status. This year the U.S.'s Papahanaumokuakea Marine National Monument has also joined their ranks. IOC will continue to support WHC marine sites in 2011 as a joint IOC-WHC plan of action was finalised.

ICAM regional projects such as the Southeast Pacific Data and Information Network in support of Integrated Coastal Area Management worked during 2010 to develop a set of common Regional Indicators that will provide information on Marine Protected Areas, Population Dynamics, Water Quality, Biodiversity and Planning Tools in ICAM. The partner countries, Chile, Colombia, Ecuador, Panama and Peru, also organized national workshops to define a set of National Indicators related to socio-economic, environmental and governance aspects. The Southeast Pacific data and Information Network in support to Integrated Coastal Area Management (SPINCAM) National Focal Points have focused their efforts in reinforcing institutional networks in data management, one of the main challenges observed by the project in 2010. These challenges were discussed within the 3rd Steering Committee Meeting held in November, Santa Marta (Colombia) where the work plan was reviewed and new training activities on data management were programmed for 2011 in response to the capacity building requirements of each country and with the facilitation of IODE-ODINCARSA. In addition, it was agreed that the Permanent Commission for the Southeast Pacific (CPPS) will host the SPINCAM Regional Atlas.

2010 also saw the completion of the COASTMAPIO Project, funded by the Government of Italy, which focused on enhancing safety from ocean-based marine hazards in the Indian Ocean, for the benefits of 12 Indian ocean countries.

The Assessment missions in twelve countries involved in COAST-MAP-IO were completed between 2006 and 2010. Three types of training programs were adapted to countries' needs leading to a total of sixteen meetings, training courses and workshops conducted by the National Hydrographic School of Indian Navy (Goa, India), the Training and Education Centre in Hydrography at Alfred Wegener Institute for Polar and Marine Research, Bremerhaven (Germany), the International Coordination Group for the Indian Ocean Tsunami Warning System (Jakarta, Indonesia), and the Indian National Centre for Ocean Information Services (INCOIS) (Hyderabad, India). Modern hardware and software for data and tsunami modeling was supplied to all twelve countries. About 170 specialists were trained since 2007. The project obtained significant additional voluntary contributions from both from governments and private corporations, including from the Indian Navy, the Government of the Kingdom of Norway, the Government of the Kingdom of Sweden, ESRI Europe, and the Canadian company CARIS – amounting to more than 800,000 USD.

*Studying and testing UNESCO BILKO software and modules, RSHU, St. Petersburg, Russian Federation*

# Facilitate the development and adoption of standards

## IOC-ICES STUDY GROUP ON NUTRIENT STANDARDS (SGONS) ACTIVITIES IN 2010/11

The Group working with the KANSO-TECHNOS(1), will develop both reliable reference materials for use when measuring nutrients in seawater and procedures to implement an International Nutrients Standards Scale. This work is essential if the potential feedbacks between concentrations of nutrients in the ocean and climate change are to be detected and verified. The group published their recommended methods for nutrient measurement procedures in the new GO-SHIP Methods Manual(2) in 2010.

A key development is "certification" seawater reference solutions. The National Meteorology Institute of Japan (NMIJ) is doing this work. Three batches of samples will be certified. Waters containing the appropriate ranges of concentrations have now been collected and processed by KANSO and passed to NMIJ. It is now expected that the results of the NMIJ certification will be available in summer 2012. A stability test of Reference Materials for Nutrients in Seawater (RMNS) by ten core laboratories of SGONS, which started in 2009, will continue for two more years. Future arrangements are being considered for the collection of more batches of seawater for the preparation of RMNS waters suitable for use in all major water masses. For example the ICES Marine Chemistry Working Group meeting in 2011 formulated a request for water appropriate for work in North West European Shelf seas.

The group is also working on the development of related standards for dissolved oxygen and dissolved organic matters. KANSO has made first batches of these solutions and their stability is being evaluated. The intention is to provide them for wide scale testing as part of the International Inter-Comparison (IC) study currently being planned for 2011/12. Planning for this next IC study started at the first official meeting of the Group in Paris, France on 23-24 March 2010(3).

The Group will meet in June to finalise the planning for the next inter-laboratory comparison study; there is the capacity to include about 70 laboratories. It is import to extend the involvement in the next phase to improve the global coverage to Africa and South America for example. Additionally a shipboard workshop during which major groups would carry out a full inter-comparison of all procedures will be planned for 2013/14.


The General Environmental Technos Co. Ltd. (http://ww.knso.co.jp)

Hydes, D. J. et al., (2010) GO-SHIP Repeat Hydrography Manual IOCCP Report No. 14, ICPO Publication Series No. 134.

Aoyama, M. (2010) Joint IOC-ICES study group on Nutrient standards (SGONS) First Meeting UNESCO Headquarters, Paris, France 23-24 March 2010 IOC Reports of Meetings of Experts and Equivalent Bodies, 223. UNESCO 2010. (English)



*Kansos Technos Co. now produces nutrient reference standards in use around the world. Image: Kanso Technos.*

# Summarising the science of ocean fertilisation

**Phil Willamson**
**School of Environmental Sciences**
**University of East Anglia**
**Norwich NR4 7TJ**

Many decisions at the national and international level need to be made in the next decade in response to the threats – and opportunities – of climate change. Such policy responses should be evidence-based, yet they cannot wait until every scientific uncertainty has been resolved. Economic, ethical and ideological issues also need to be taken into account. Three main strategic options, not exclusive, are adaptation (preparing to live with the consequences of what seems likely to occur); mitigation (action to reduce the problem at source, by reducing greenhouse gas emissions); and geoengineering (application of technologies to slow or reverse undesirable climate trends on a global scale).

The potential use of the ocean for geoengineering is suggested by its large capacity as a carbon store, currently containing 20 times more carbon than soil and vegetation together, and around 50 times more than the atmosphere. There is also clear linkage between past changes in ocean carbon storage with major natural climate perturbations, such as the geologically-recent ice age cycle. At present, each square kilometre of the ocean surface is responsible, on average, for the net removal from the atmosphere of 7 tonnes of carbon per year – globally amounting to 2,500 million tonnes (2.5 Pg). That net absorption is around a third of the amount of carbon added annually to the atmosphere by human activities; thus the ocean has greatly slowed the pace of climate change in the past 50 years. Could its net carbon uptake be doubled or trebled in the next 50 years, at relatively low cost and perhaps with other benefits arising from increased marine productivity?

In the early 1990s, the answer to that question seemed to be "yes". In the same way that many soils can be made more productive by adding fertiliser, the addition of extra nutrients to the upper ocean can stimulate the growth of microscopic plants (phytoplankton) that support the marine food web. Moreover, for much of the ocean, the nutrient in short supply is iron, with only trace amounts being needed. Indeed, the ratio of iron to carbon and other elements in phytoplankton indicates that just a few grams of soluble iron might be sufficient to increase their biomass by around a tonne, with enhanced photosynthesis

converting inorganic carbon dissolved in seawater, mostly as bicarbonate ions, to organic carbon in phytoplankton cells. Chemical dynamics and air-sea exchanges would subsequently cause atmospheric $CO_2$ to enter the ocean, to replace the bicarbonate removed. If these processes were uni-directional and fully efficient, it might – in theory – only need the annual addition of around 60 thousand tonnes of iron, less than 0.005% of the total mined worldwide, to offset the other two-thirds of societal carbon emissions.

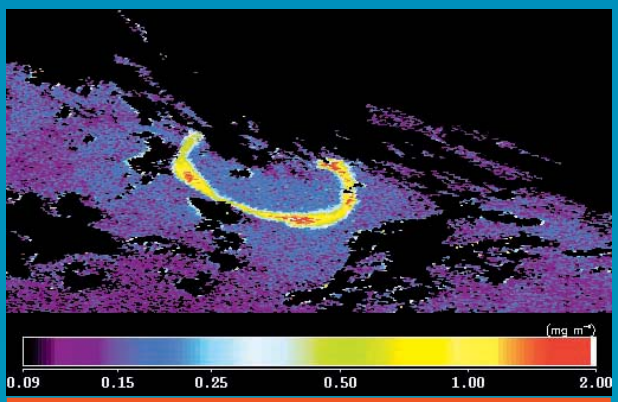
Not surprisingly, it isn't that simple. Phytoplankton are relatively short-lived, and the carbon in their tissues is returned to seawater when they decompose or following respiration by animals that eat them. Only a small fraction is removed from circulation on a long-term basis, through the sinking of organic material to very deep water and deposition on the ocean floor. There is also some risk that the benefits of removing $CO_2$ from the atmosphere by ocean fertilisation may be reduced if other, more powerful, greenhouse gases are generated, as an indirect result of greatly increased marine production. Nevertheless, the idea that nutrient additions or other forms of fertilisation might at least contribute to solving the problem of climate change has attracted serious commercial interest, as well as providing an indirect impetus for research attention.

*Experimental addition of ferrous sulphate on the UK-German FeeP study, 2004. Photo: Plymouth Marine Laboratory*

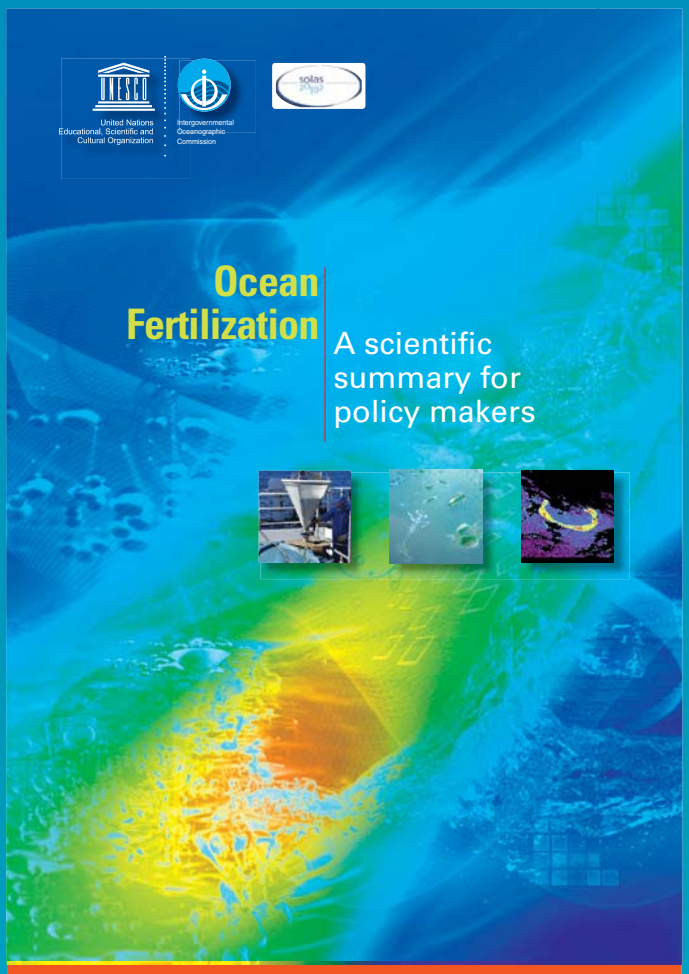
IOC has had longstanding scientific interests in the ocean carbon cycle and the factors affecting marine productivity. Such interests complement the regulatory roles of the London Convention and its Protocol (LC/LP) and the biodiversity-directed interests of the Convention on Biological Diversity (CBD). In 2007, the LC/LP expressed concern that large-scale ocean fertilisation might have negative impacts. In May 2008, the CBD went further, deciding that a precautionary approach should limit further research on open ocean fertilisation until appropriate safeguards could be established. In response to these developments, the 41st session of the IOC Executive Council decided that a scientific synthesis should be undertaken in this area, working closely with partner organisations.

IOC's review of ocean fertilisation was subsequently carried out jointly with the non-governmental Surface Ocean-Lower Atmosphere Study (SOLAS), which is sponsored by the International Geosphere Biosphere Programme, Scientific Committee on Ocean Research, World Climate Research Programme, and the International Commission on Atmospheric Chemistry and Global Pollution. The review involved experts from seven nations, discussions with Member States at the 43rd IOC Executive Council in June 2010, a peer review, and circulation for comments by IOC Member States to the final draft. Results from 13 field-based iron fertilisation experiments, two phosphate addition experiments, associated modelling studies and other relevant research were reviewed (Wallace et al., 2010).

The overall conclusion was that, whilst large-scale ocean fertilisation would undoubtedly enhance the uptake of carbon by the ocean, the long-term retention of that carbon is likely to be much less impressive (by around an order of magnitude) than had been calculated in the 1990s. Furthermore, if such geoengineeering were to be deployed, the actual amount of carbon removed from the atmosphere for at least 100 years would be inherently extremely difficult to determine. Such verification, clearly demonstrating that the desired positive effects had been achieved without undesired or unexpected impacts, would inevitably cost very much more than the process of adding iron or other nutrients. These issues are crucial if ocean fertilisation were to be developed for climate-control purposes, since quantitative carbon accounting (e.g. by carbon credits) would necessarily be involved.




*Satellite image of a phytoplankton bloom arising from the 1999 SOIREE study in the Southern Ocean. Image: Plymouth Marine Laboratory.*




*Ocean Fertilization A Scientific Summary for Policy Makers" considers the practicalities, opportunities and threats associated with large-scale ocean fertilization. IOC 2010.*

A separate rationale for considering large-scale stimulation of marine primary production relates to the potential benefits for fisheries: in general terms, areas with high phytoplankton abundance, such as shelf seas and upwelling regions, also show high fish production. The IOC review was more cautious in drawing conclusions on this topic, since the experimental studies carried out to date have not been on a large enough spatial scale, nor carried out for long enough, to demonstrate effects on non-planktonic organisms. The cost-effectiveness of such an approach would, however, also require careful scrutiny. At present it is considered economic to catch 'industrial' fish to turn them into fertiliser, and a first stage would be to end that ecologically dubious process before attempting the opposite (of turning fertiliser into fish).

Further research is undoubtedly still needed. Yet any new scientific studies involving large-scale nutrient additions to the open ocean – to improve our knowledge of either fishery enhancement or geoengineering – will need to satisfy criteria for societal acceptability, as defined by the regulatory criteria under development by LC/LP with IOC-UNESCO's scientific guidance.

## REFERENCES

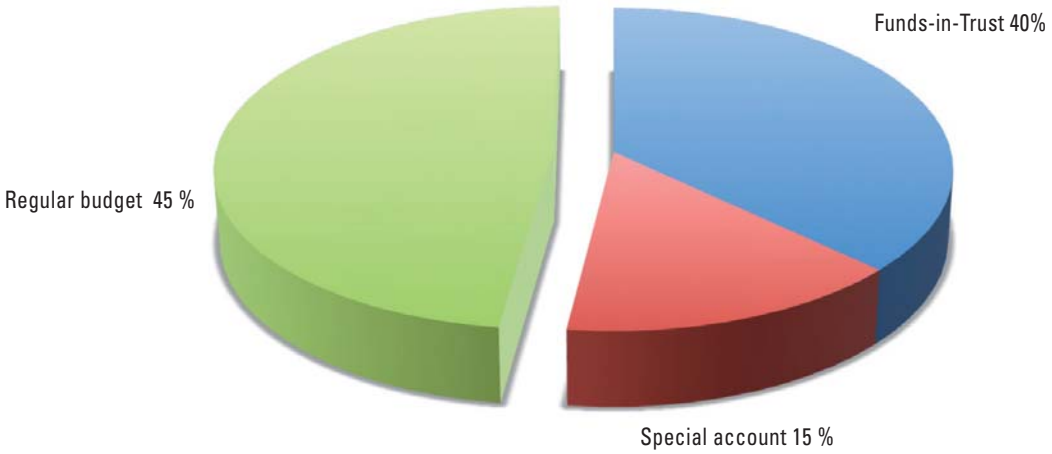
Wallace DWR, Law CS, Boyd PW, Collos Y, Croot P, Denman K, Lam PJ, Riebesell U, Takeda S & Williamson P (2010) Ocean Fertilization. A Scientific Summary for Policy Makers. IOC/UNESCO, Paris (IOC/BRO/2010/2). 17 pp. http://unesdoc.unesco.org/

# 7 ANNEXES

## Funding for IOC programmes

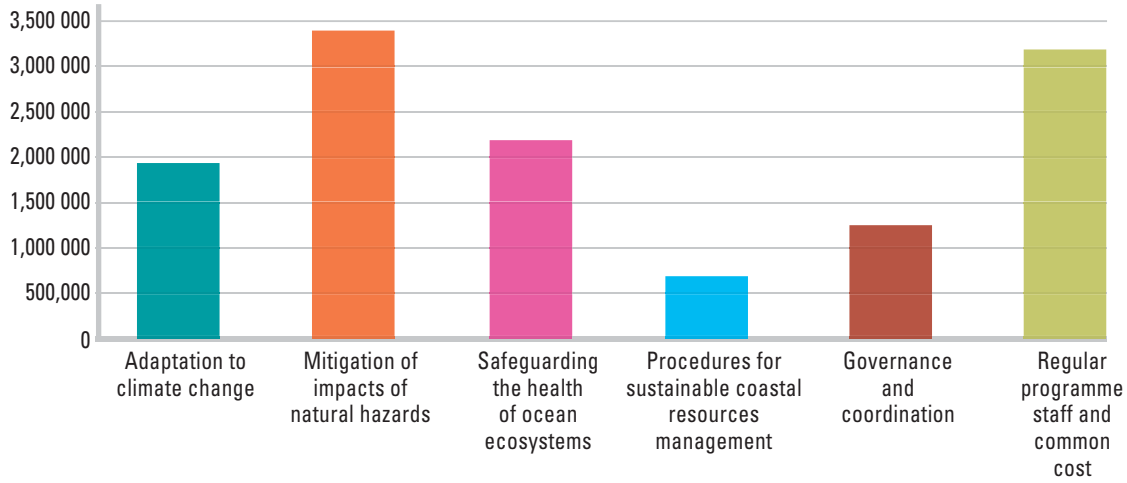
### INTRODUCTION: GENERAL OVERVIEW

This Annual Report describes a wide spectrum of activities that highlight the relevance of the Intergovernmental Oceanographic Commission of UNESCO's programmes in 2010. Programme implementation and related staff costs during 2010 were financed from regular programme allocation approved by the General Conference of UNESCO as part of the Organization's programme and budget for 2010-2011 (35 C/5), 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. More detailed financial information, including the very substantial direct funding of the IOC Offices in Ostend, Perth and Vigo can be found in the 'Report on budget execution 2010 and anticipated funding for 2011[1] prepared for the Twenty-sixth Session of the IOC Assembly (document IOC-XXVI/2 Annex 2).




2010 Expenditure by source (Regular Programme Budget vs Extrabudgetary – Total: US$12,065,149.62

1. Authoritative figures are those contained in the financial statements prepared by the Bureau of Financial Management




Expenditure by Main Programme Areas -Total US$12,065,149.62

## 1. REGULAR PROGRAMME

The General Conference of UNESCO at its 35th session adopted the Organization's Programme and Budget for 2010-2011 (35 C/5), with the total appropriation of US$653 million.

In this context, the budgetary allocation to the IOC for the biennium 2010-2011 was as follows:

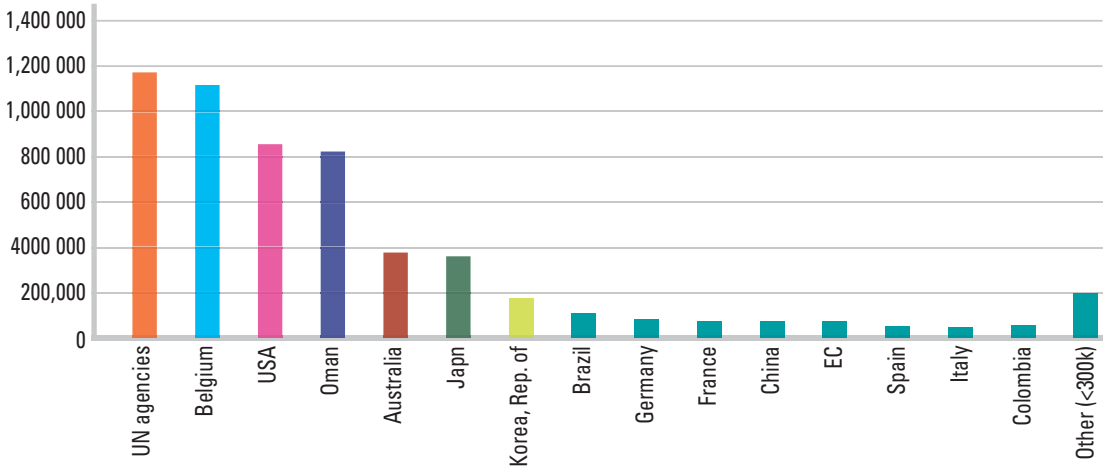
| | |
|---|---|
| Programme activities | $ 3,449,900 (compared to $ 4,052,100 in 34 C/5) |
| Staff | $ 6,037,300 (compared to $ 4,974,100 in 34 C/5) |
| TOTAL | $ 9,487,200 (compared to $ 9,026,200 in 34 C/5) |

The allocation of regular budget resources by programme activities was guided by Resolution XXV-14 of the IOC Assembly (June 2009) and further reviewed and adjusted by Resolution EC-XLIII.9 of the Executive Council (June 2010).

## 2. EXTRABUDGETARY FUNDING

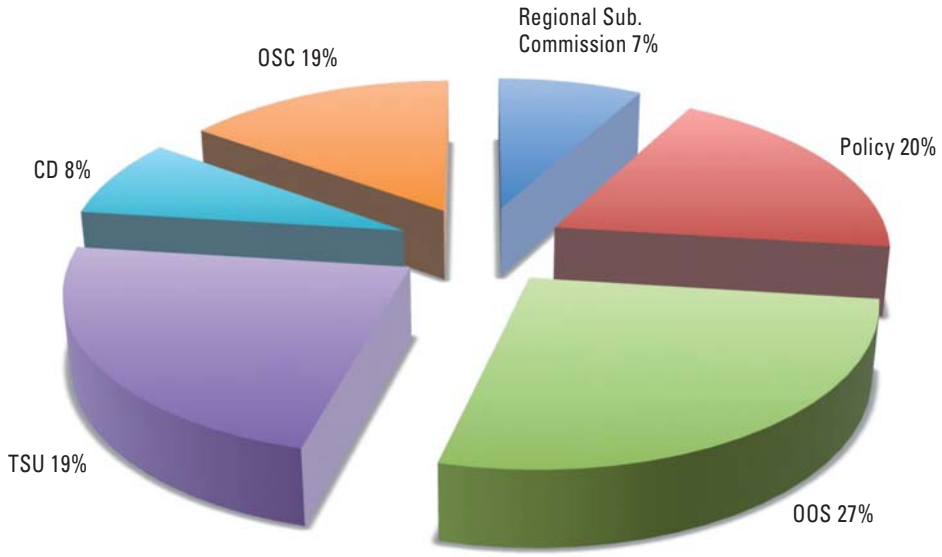
IOC's extrabudgetary resources include voluntary contributions to the IOC Special Account and contributions to specific projects under Funds-in-Trust agreements.

Details on contributions to and expenditures from the IOC Special Account and Funds-in-Trust can be found in the 'Report on budget execution 2010 and anticipated funding for 2011' prepared for the Twenty-sixth Session of the IOC Assembly (document IOC-XXVI/2 Annex 2).

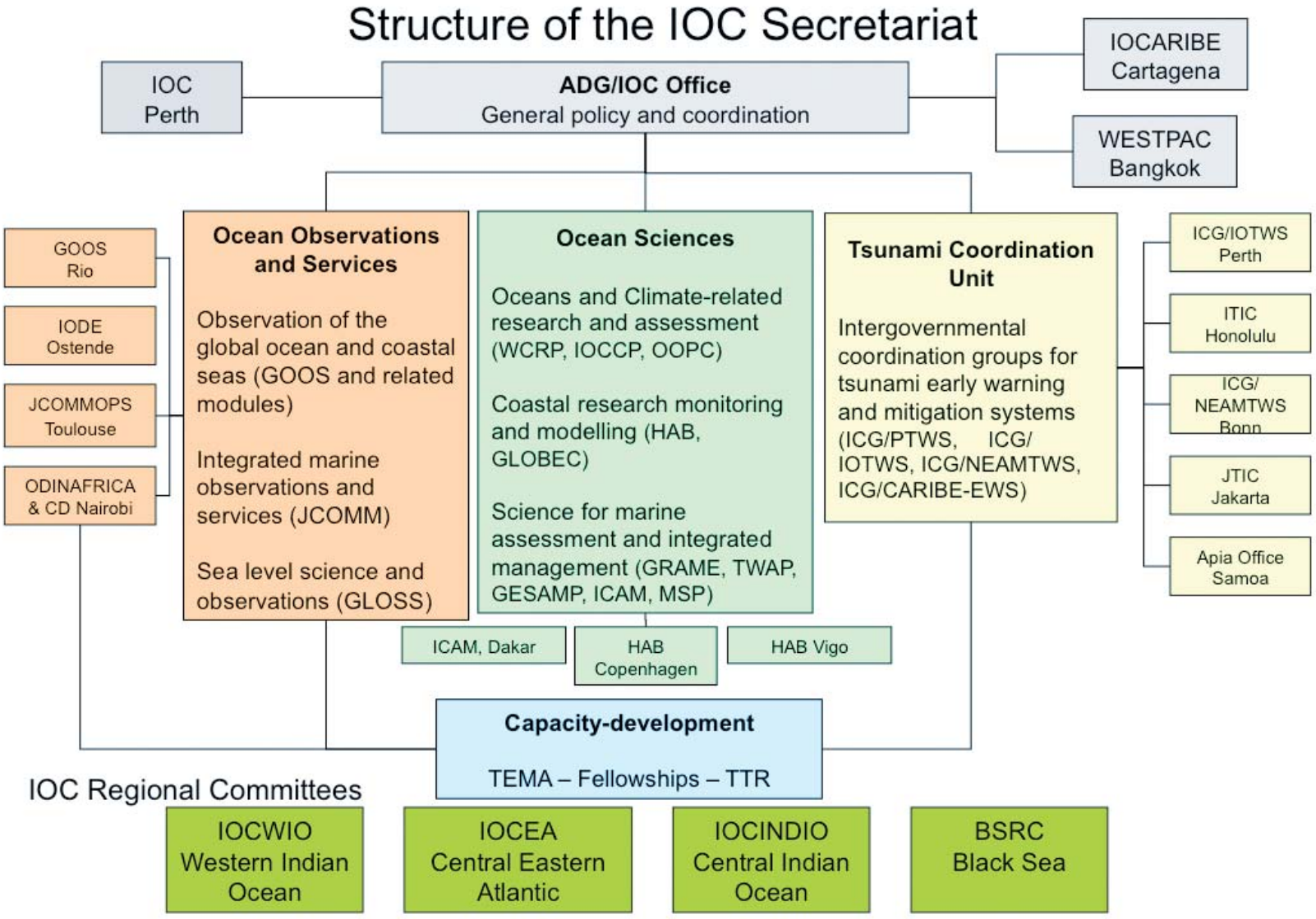


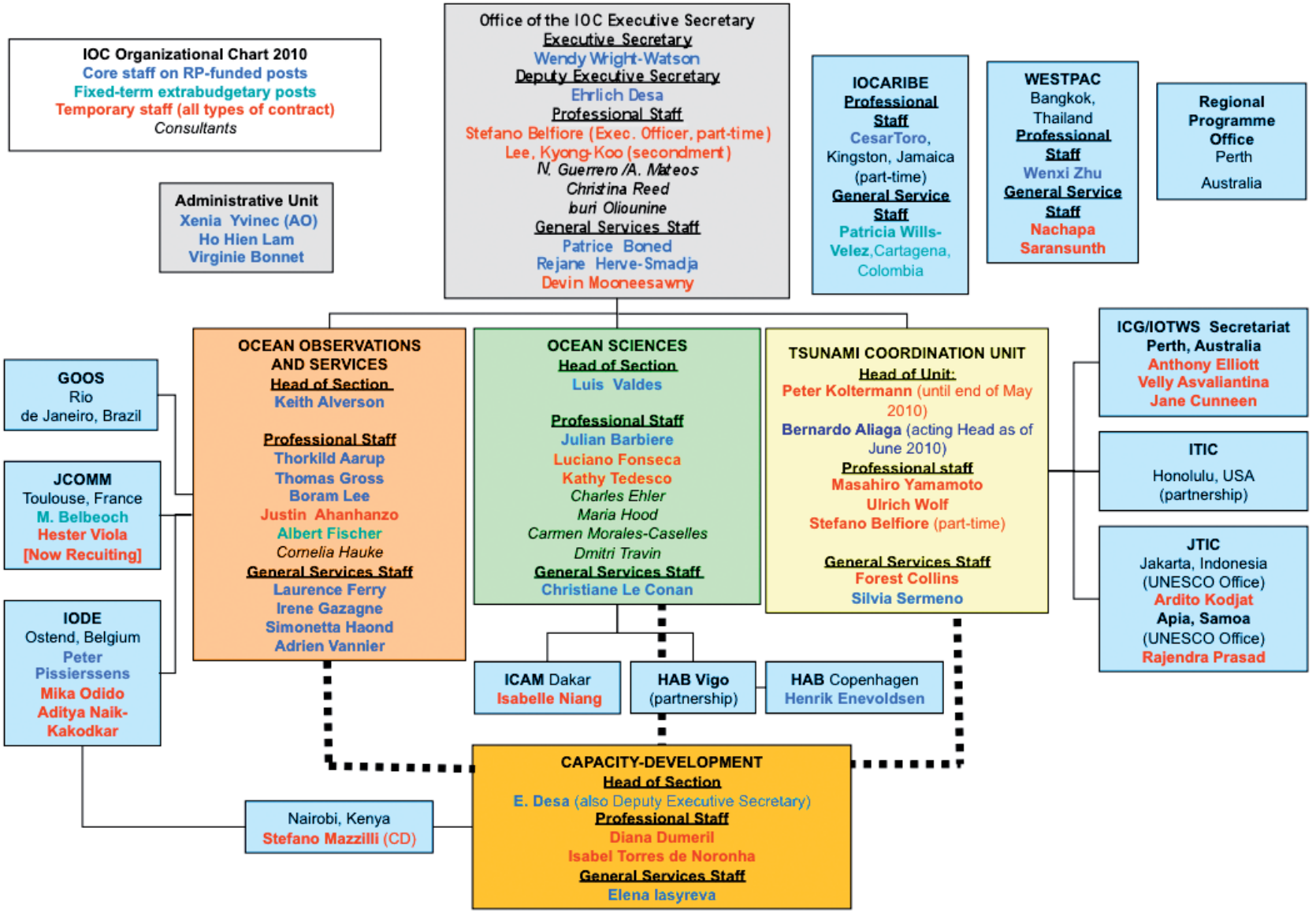
## 3. OVERVIEW OF THE IOC STAFFING SITUATION

The most relevant fraction of the fixed cost of the IOC's operation is personnel, with core staff funded by UNESCO's regular budget allocation for staff representing 26% of the total 2010 expenditure. In addition, another 24% of expenditure covers all types of temporary assistance, including consultants and other individual contractors. During 2010, the IOC counted approximately 59 employees (52 person/year) of which 42 were at Headquarters and 17 in the Field (respectively 42 and 20 in 2009). Of these, 43 were professional staff and 16 provided administrative and secretarial assistance. 1 (one) professional, Mr Lee, Kyung-Koo, was seconded to the IOC Secretariat by the Republic of Korea. 25 staff on established posts were funded by UNESCO's regular budget staff allocation (35 C/5 Approved): 14 professional staff and 11 administrative and secretarial assistants. The total of regular budget-funded posts in the approved 35 C/5 was 27. 2 posts (a P4 in Nairobi, Kenya and a NOC in Apia, Samoa) were under recruitment in 2010. The rest of the IOC personnel are funded by other sources, mainly extrabudgetary.



# Structure of the IOC Secretariat




IOC Organizational Chart 2010
Core staff on RP-funded posts
Fixed-term extrabudgetary posts
Temporary staff (all types of contract)
Consultants
Administrative Unit
Xenia Yvinec (AO)
Ho Hien Lam
Virginie Bonnet
Office of the IOC Executive Secretary
Executive Secretary
Wendy Wright-Watson
Deputy Executive Secretary
Ehrlich Desa
Professional Staff
Stefano Belfiore (Exec. Officer, part-time)
Lee, Kyong-Koo (secondment)
N. Guerrero /A. Mateos
Christina Reed
Iouri Oliounine
General Services Staff
Patrice Boned
Rejane Herve-Smadja
Devin Mooneesawny
IOCARIBE
Professional Staff
CesarToro, Kingston, Jamaica (part-time)
General Service Staff
Patricia Wills-Velez, Cartagena, Colombia
WESTPAC
Bangkok, Thailand
Professional Staff
Wenxi Zhu
General Service Staff
Nachapa Saransunth
Regional Programme Office
Perth
Australia
GOOS
Rio de Janeiro, Brazil
JCOMM
Toulouse, France
M. Belbeoch
Hester Viola
[Now Recuiting]
IODE
Ostend, Belgium
Peter Pissierssens
Mika Odido
Aditya Naik-Kakodkar
OCEAN OBSERVATIONS AND SERVICES
Head of Section
Keith Alverson
Professional Staff
Thorkild Aarup
Thomas Gross
Boram Lee
Justin Ahanhanzo
Albert Fischer
Cornelia Hauke
General Services Staff
Laurence Ferry
Irene Gazagne
Simonetta Haond
Adrien Vannier
OCEAN SCIENCES
Head of Section
Luis Valdes
Professional Staff
Julian Barbiere
Luciano Fonseca
Kathy Tedesco
Charles Ehler
Maria Hood
Carmen Morales-Caselles
Dmitri Travin
General Services Staff
Christiane Le Conan
TSUNAMI COORDINATION UNIT
Head of Unit:
Peter Koltermann (until end of May 2010)
Bernardo Aliaga (acting Head as of June 2010)
Professional staff
Masahiro Yamamoto
Ulrich Wolf
Stefano Belfiore (part-time)
General Services Staff
Forest Collins
Silvia Sermeno
ICG/IOTWS Secretariat
Perth, Australia
Anthony Elliott
Velly Asvaliantina
Jane Cunneen
ITIC
Honolulu, USA
(partnership)
JTIC
Jakarta, Indonesia
(UNESCO Office)
Ardito Kodjat
Apia, Samoa
(UNESCO Office)
Rajendra Prasad
ICAM Dakar
Isabelle Niang
HAB Vigo
(partnership)
HAB Copenhagen
Henrik Enevoldsen
CAPACITY-DEVELOPMENT
Head of Section
E. Desa (also Deputy Executive Secretary)
Professional Staff
Diana Dumeril
Isabel Torres de Noronha
General Services Staff
Elena Iasyreva
Nairobi, Kenya
Stefano Mazzilli (CD)

# IOC Meetings Calendar 2010

| | | |
|---|---|---|
| **January 2010** | | |
| 19 - 22 | OOPC-14: 14th Meeting of the GCOS-GOOS-WCRP Ocean Observations Panel for Climate | Miami, United States |
| 20 - 22 | ODINAFRICA-IV Project Steering Committee meeting | Oostende, Belgium |
| 25 - 26 | IOC Officers Meeting | Paris, France |
| 25 | ICG/IOTWS WG1 Meeting: ICG/IOTWS Working Group 1 Intersessional Meeting | Citeko, Indonesia |
| 27 | IOC-WMO Joint Officer's Meeting | Paris, France |
| **February 2010** | | |
| 02 - 05 | IOC Mission to Dominican Republic: IOC/UNESCO Technical Mission to the Dominican Republic | Santo Domingo, Dominican Republic |
| 03 - 05 | TWAP LME and OO WGs: GEF Transboundary Water Assessment Programme: LME and Open Ocean Working Groups | Paris, France |
| 08 - 11 | IODE Workshop on QC/QA of Chemical Oceanographic Data | Oostende, Belgium |
| 08 - 12 | ETMC-3: Third Session of the Expert Team on Marine Climatology | Melbourn, Australia |
| 08 - 11 | ODINAFRICA Coordinators meeting for GCLME region | Kribi, Cameroon |
| 08 - 11 | CLIOTOP mid-term workshop: CLIOTOP into the future: Building scenarios for oceanic ecosystems in the XXI Century | Paris, France |
| 15 - 17 | Decision-Making Support for Coastal Zone Management, Water Resources and Climate Change in Africa: Pan-African Workshop | Cotonou, Benin |
| 15 - 19 | 37th session of GESAMP: 37th session of GESAMP | Bangkok, Thailand |
| 15 - 19 | WCRP Joint Scientific Committee 2010 | Antalya, Turkey |
| 22 - 26 | Consultation Meeting on cooperation between the IODE OceanDataPortal (ODP) and the Integrated Marine Observing System (IMOS) | Hobart, Australia |
| 22 - 24 | ROPME/IOC Regional Workshop on ways and means of addressing the emergencies concerning Harmful Algal Blooms | Tehran, Islamic Rep of Iran |
| 25 - 26 | EMODnet Workshop on Biological Data Products | Oostende, Belgium |
| 27 | PP-WET SC2: 2nd PP-WET Steering Committee meeting: | Portland, United States |
| **March 2010** | | |
| 01 - 05 | ETSI-IV: 4th Session of the JCOMM Expert Team on Sea Ice (ETSI) | St.Petersburg, Russian Federation |
| 03 - 04 | SGONS: Study Group On Nutrients Standars | Paris, France |
| 08 - 11 | 2010 Session of the IODE Officers | Oostende, Belgium |
| 08 - 10 | IOCES-IOC-IMO WGBOSV: ICES-IOC-IMO Working Group on Ballast of Ships and other Vectors | Hamburg, Germany |
| 08 - 12 | GSSC-XIII: GOOS Scientific Steering Committee Thirteenth Session | London, United Kingdom |
| 08 - 10 | GLOBEC SPM Workshop: Global Ocean Ecosystem Dynamics Summary for Decisionmakers Workshop | Paris, France |
| 11 | I-GOOS Board VI: 6th session of the Board of the IOC-WMO-UNEP Intergovernmental Committee for the Global Ocean Observing System | London, United Kingdom |
| 15 - 17 | ICG/CARIBE EWS V: Fifth Session of the Intergovernmental Coordination Group for the Tsunami and Other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (ICG/CARIBE EWS-V) | Managua, Nicaragua |
| 18 - 19 | ICG/NEAMTWS/TT-V: Fifth Meeting of the ICG/NEAMTWS Task Team on Regional Tsunami Warning System Architecture | Paris, France |
| 18 - 20 | ODINECET Workshop | Oostende, Belgium |
| 19 | ICG/NEAMTWS/TT-2-I: First Meeting of the ICG/NEAMTWS Task Team on Communication Test Exercises | Paris, France |
| 22 - 26 | OceanTeacher Academy MIM: Training Course on Preservation and Archiving of Digital Media | Oostende, Belgium |
| 22 - 26 | GOOS-AFRICA/OGP/MetOCean Committee Meeting | Paris, France |

| | | |
|---|---|---|
| 23 - 24 | ICES-IOC SG on Nutrient Standards | Paris, France |
| 24 | 50 Years of Deep Ocean Observations. Speaker: Don Walsh, Trieste pilot and deepest ocean diver | Paris, France |
| 25 - 26 | OceanSITES DMT meeting 2010: OceanSITES Data Management Team Meeting 2010 | Paris, France |
| 25 - 26 | IOC/WESTPAC Preparatory meeting for the 8th IOC/WESTPAC International Scientific Symposium | Bangkok, Thailand |
| 28 - 30 | IOCEA-VI: Sixth Session of the IOC Regional Committee for the Central Eastern Atlantic (IOCEA-VI) | Accra, Ghana |
| 28 - 29 | IOC/WESTPAC Editing Group meeting for the Regional Status on the Marine Non-indigenous Species | Bangkok, Thailand |
| 29 - 31 | IMDIS 2010: International Conference on Marine Data and Information Systems | Paris, France |
| 30 Mar - 15 Apr | 184 EX: 184th Session of the UNESCO Executive Board | Paris, France |
| **April 2010** | | |
| 01 - 02 | 4th SeaDataNet Plenary Meeting | Paris, France |
| 02 | SCOR/IODE/MBLWHOI Library Workshop on Data Publication | Paris, France |
| 02 | First EMODNET Chemical lot annual meeting | Paris, France |
| 06 - 10 | ICES-IOC WGHABD: ICES-IOC Working Group on Harmful Algal Bloom Dynamics | Bermuda |
| 06 - 07 | ETDMP-II: Second Session of the JCOMM/IODE Expert Team on Data Management Practices | Oostende, Belgium |
| 08 - 09 | DMCG-IV: Fourth Session of the JCOMM Data Management Coordination Group | Oostende, Belgium |
| 08 - 10 | NEARGOOS-CC XIII: Thirteenth Session of IOC/WESTPAC Coordinating Committee for the North-east Asian Regional-Global Ocean Observing System | Vladivostok, Russian Federation |
| 13 - 15 | RMIC-RA-IV-1: WIGOS/JCOMM Training Workshop on Marine Instrumentation for the Regional Association IV | Stennis Space Center, USA |
| 13 - 14 | World-wide Network of marine stations and labs | Paris, France |
| 14 - 16 | ICG/IOTWS-VII: Seventh Session of the Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWS-VII) | Banda Aceh, Indonesia |
| 19 - 23 | WIO-DBCP I: 1st DBCP Africa/Western Indian Ocean Capacity Building Workshop | Cape Town, South Africa |
| 26 - 30 | OceanTeacher Academy Course MIM : Literature and databases of the Marine Sciences | Oostende, Belgium |
| 26 - 29 | Climate Change Effects on Fish and Fisheries | Sendai, Japan |
| 27 - 30 | RSHU International Conference: International Conference 50 Years of Educational and Awareness Raising for Shaping the Future of the Oceans and Coasts | St. Petersburg, Russian Federation |
| **May 2010** | | |
| 03 - 07 | 5th GCOCI: Global Oceans Conference 2010 | Paris, France |
| 03 - 06 | MSS workshop: Maritime Safety Services Enhancement Workshop | Melbourne, Australia |
| 04 | Third Joint GOSUD/SAMOS Workshop | Oostende, Belgium |
| 05 - 07 | GTSPP Annual Meeting 2010 | Oostende, Belgium |
| 05 - 06 | TOWS-3: Third Meeting of the Working Group on Tsunamis and Other Hazards related to Sea Level Warning and Mitigation Systems (TOWS-WG) | Lisbon, Portugal |
| 05 | UN-OCEANS VIII | Paris, France |
| 05 | Blue Carbon Meeting | Paris, France |
| 07 - 08 | SCG-5: 5th session of the Services and Forecast Systems Program Area Coordination Group | Melbourne, Australia |
| 09 | First IOC/WESTPAC Advisory Group Meeting | Bali, Malaysia |
| 10 - 13 | WESTPAC-VIII: Eighth Session of the IOC Sub-Commission for the Western Pacific (WESTPAC-VIII) | Bali, Indonesia |
| 10 - 11 | VUB-UA-ECOMAMA Course | Oostende, Belgium |
| 17 - 21 | OceanTeacher Academy Course DM: Introduction to Marine GIS | Oostende, Belgium |
| 18 - 22 | ETWS-3: 3rd meeting of the Expert Team on Wind Waves and Storm Surges | Toronto, Canada |
| 25 - 28 | GEMIM-XI: IODE Group of Experts on Marine Information Management, 11th Session | Oostende, Belgium |
| 31 May - 2 June | International Symposium on Boundary Current dynamics: its connection with open-ocean and coastal processes and responses to global climate change | Qingdao, China |

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| **June 2010** | | |
| 02 - 18 | XI Curso COI-AECID-IEO: Taxonomia de Fitoplancton Nocivo | Vigo, Spain |
| 07 | IOC-Off: IOC Officers Meeting | Paris, France |
| 07 | Chairpersons of IOC Regional Subsidiary Bodies Meeting | Paris, France |
| 08 - 16 | IOC/EC-XLIII: 43rd Session of IOC Executive Council | Paris, France |
| 08 - 18 | WMO EC-LXII: Sixty-second Session of the WMO Executive Council | Geneva, Switzerland |
| 08 | IOC 50th: World Ocean Day and Inaugural Ceremony of the IOC 50th Anniversary | Paris, France |
| 08 | Biodiversité: world ocean day in Algeria | Algeria |
| 15 - 18 | IOC/WESTPAC Training Course "Impact of Sedimentary Dynamics and Biogeochemistry on Coral Reefs" | Koh Samui, Suratthani, Thailand |
| 21 - 23 | IOC-SCOR GEOHAB Open Science Meeting on Benthic Harmful Algal Blooms | United States |
| 21 - 25 | GHRSST-XI: Eleventh Meeting of the Group for High Resolution Sea Surface Temperature (GHRSST) Science Team | Lima, Peru |
| 21 - 23 | Second meeting of the GEF/TWAP Open Ocean Working Group | Arendal, Norway |
| 22 - 24 | ICSU Visioning Institutional Frameworks for Global Sustainability Research Meeting | Paris, France |
| 22 - 24 | Second IOC/WESTPAC Workshop on the "Coral Reefs under Climate and Anthropogenic Perturbations" (IOC/WESTPAC-CorReCAP) | Phuket, Thailand |
| 23 - 25 | Second Meeting of the GEF/TWAP Large Marine Ecosystem Working Group | Arendal, Norway |
| 24 - 27 | Training Workshop: 'Taxonomy challenges and identification of benthic dinoflagellates' | United States |
| 26 - 28 | IOC-SCOR Scientific Steering Committee Meeting for GEOHAB | United States |
| 28 - 30 | GESAMP International Workshop on micro-plastic particles as a vector in transporting persistent, bioaccumulating and toxic substances in the oceans | Paris, France |
| **July 2010** | | |
| 01 - 07 | OceanTeacher Academy Course on Disaster Planning and Recovery for Marine Librarians | Oostende, Belgium |
| 05 - 09 | ASFA Advisory Board Meeting 2010 | Casablanca, Morocco |
| 08 - 09 | LME: IOC/UNESCO-IUCN-NOAA Large Marine Ecosystem Meeting | Paris, France |
| 09 - 10 | Perth Project Planning Workshop: Ocean Forecasting Demonstration Project for IOGOOS & SEAGOOS | West Perth, Australia |
| 12 - 16 | IOGOOS VII: Indian Ocean Global Ocean Observing System and associated project groups | West Perth, Australia |
| 12 - 23 | Seismic and TEW Training: International Workshop on Seismology, Seismic Hazard and Tsunami Early Warning | Suva, Fiji |
| 25 - 30 | First Summer School of IOC Sub-Commission for the Western Pacific (WESTPAC) on the Monsoon Onset Monitoring and its Social & Ecosystem Impacts (WESTPAC-MOMSEI) | Qingdao, China |
| 26 Jul - 6 Aug | First ODINAFRICA-IV training course on Coastal and Marine Atlas development | Mombasa, Kenya |
| **August 2010** | | |
| 02 - 05 | Caribbean Marine Atlas review and planning workshop | Castries, Saint Lucia |
| 08 - 13 | AGU - 2010 Meeting of Americas | Foz do Iguaçu, Brazil |
| 17 - 27 | IOC Training Course and Identification Qualification in Harmful Marine Microalgae 2010 | Copenhagen, Denmark |
| 17 - 20 | ICG-PTWS Steering Committee: Pacific Tsunami Warning and Mitigation System (ICG-PTWS) Steering Committee meeting | Honolulu, United States |
| 25 - 27 | XBT Bias and Fall-Rate Workshop | Hamburg, Germany |
| 25 - 27 | GEF Project Planning Meeting | Copenhagen, Denmark |
| **September 2010** | | |
| 01 03 | IFSOO-TT-2: Second meeting of the Integrated Framework for Sustained Ocean Observations task team | Paris, France |
| 02 - 04 | PIM-XXIII: Pacem in Maribus XXXIII | Beijing, China |
| 06 - 10 | OceanTeacher Academy Course DM: Introduction to Marine Data for Young Scientists | Oostende, Belgium |
| 06 - 07 | PEGASO Project Meeting | Paris, France |
| 13 - 24 | OceanTeacher Academy Course DM: Basic Marine Data Management: (i) ocean data collection development; (ii) intro to marine metadata; (iii) Ocean data products and synthesis | Oostende, Belgium |
| 13 - 17 | SSC2010: Storm Surges Congress - Risk and management of current and future storm surges | Hamburg, Germany |
| 13 - 15 | International Coastal Atlas Network (ICAN): ICAN-Great Lakes 2010 Workshop | Madison, United States |

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| 16 | 2nd Marine Board Forum: Towards a European Network of Marine Observatories for Monitoring and Research | Brussels, Belgium |
| 20 - 22 | Meeting of the IODE Steering Group for the IODE OceanDataPortal | Oostende, Belgium |
| 20 - 24 | Oceanography and ecology of HABs: physical/biological interactions; Session at the ICES Annual Science Conference 2010, | Nantes, France |
| 20 | International Coastal Atlas Network (ICAN): Meeting of European and African participants | London, United Kingdom |
| 20 - 22 | CIFDP-II: 2nd Meeting for the Coastal Inundation Forecasting Demonstration Project | Geneva, Switzerland |
| 20 - 21 | IOC/WESTPAC Workshop on Rapid Assessment Survey of Marine Biodiversity and Non-Indigenous Species in the Western Pacific Region (I) | Bangkok, Thailand |
| 27 - 30 | DBCP-XXVI: 26th session of the Data Buoy Cooperation Panel | Oban, United Kingdom |
| 27 - 29 | WCRP-UNESCO Workshop on metrics and methodologies of estimation of extreme climate events | Paris, France |
| 30 Sep - 1 Oct | SEAGOOS Pilot Project Meeting on Ocean Forecasting Demonstration | Phuket, Thailand |
| **October 2010** | | |
| 01 02 | ITP-6 meeting: Sixth Meeting of the International Tsunameter Partnership | Oban, United Kingdom |
| 01 - 02 | JTA-30: 30th Meeting on the Argos Joint Tariff Agreement | Oban, United Kingdom |
| 04 - 06 | GOVST-II: 2nd meeting of the GODAE OceanView Steering Team | Tokyo, Japan |
| 04 - 06 | PICO IV: Panel for Integrated Coastal Observations | Lisbon, Portugal |
| 04 - 08 | ETMSS-3: 3rd session of JCOMM Expert Team on Maritime Safety Services (ETMSS) | St.Petersburg, Russian Federation |
| 04 - 05 | 2nd ESF-IOC evaluation meeting of the Working Group on the "The use of Marine Protected Areas (MPAs) for ecosystem-based management". | Paris, France |
| 04 - 08 | Sub-Regional Workshop on Tsunami Warning Centre Standard Operating Procedures for South China Sea Countries | PETALING JAYA, Malaysia |
| 07 - 09 | 3rd meeting of the JCOMM Expert Team for Operational Ocean Forecast Systems | Tokyo, Japan |
| 07 - 08 | ICG/NEAMTWS-TT1-VI: Sixth Meeting of the ICG/NEAMTWS Task Team on Regional Tsunami Warning System Architecture | Paris, France |
| 08 | ICG/NEAMTWS-TT2-II: Second Meeting of the ICG/NEAMTWS Task Team on Communication Test Exercises | Paris, France |
| 09 20 | Makran palaeotsunami field workshop: Field Workshop on Assessment and Awareness of Makran Tsunami Hazards | Tehran, Iran Islamic Rep of |
| 16 - 17 | OceanTeacher Academy Course MIM : Grant Writing for MIM Projects or Federated searching software tools | Mar del Plata, Argentina |
| 17 - 21 | 36th IAMSLIC Conference | Mar del Plata, Argentina |
| 19 - 21 | International Conference "Climate and Water Balance Changes in the Caspian region" | Astrakhan, Russian Federation |
| 21 - 22 | Third Session of the ODIN Black Sea Steering Committee | Oostende, Belgium |
| 22 Oct - 25 Nov | WESTPAC Joint Cruise on the Response of Marine Hazards to Climate Change (WESTPAC-ROSE) | SSC |
| 25 - 29 | ODINAFRICA Marine Biodiversity data digitization for Guinea | Oostende, Belgium |
| **November 2010** | | |
| 01 - 05 | 14th International Conference on Harmful Algae | Hersonissos, Greece |
| 01 - 03 | Third Meeting of the Joint Steering Group for the IODE Ocean Data Portal and the WIGOS Pilot Project for JCOMM | Oostende, Belgium |
| 03 - 05 | Implementing Adaptation to Climate Change in Western and Eastern Africa | Nairobi, Kenya |
| 10 - 12 | IOC Programmes: Past, Present and Future | Tokyo, Japan |
| 10 | Panel discussion : Exploitable mineral resources in the abyssal and bathyal domains: options for the conservation and management of the biodiversity of associated ecosystems | Paris, France |
| 15 - 19 | Regional Workshop on Standard Operating Procedures for Tsunami Warning and Emergency Response for East African and Western Indian Ocean Countries | Dar es Salaam, Tanzania |
| 16 - 19 | 8th session of the JCOMM Management Committee | Paris, France |

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| 17 - 18 | Third IOC/WESTPAC Workshop on the Fluvial Sediment Supply to the South China Sea | Manila, Philippines |
| 18 - 19 | Ad hoc meeting of the IODE Steering Group for OBIS | Oostende, Belgium |
| 22 | IOC Information session with UNESCO Group Africa/Session d'information avec le Groupe Afrique de l'UNESCO | Paris, France |
| 22 - 26 | OceanTeacher Academy Course DM: Marine and Coastal Atlas Development | Oostende, Belgium |
| 22 - 28 | IOC/WESTPAC-MOMSEI Joint Cruise: IOC/WESTPAC-MOMSEI Joint Cruise (WESTPAC/SEAGOOS-MOMSEI) | Andaman Sea |
| 23 - 25 | ICG/NEAMTWS-VII: 7th 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-VII) | Paris, France |
| 29 Nov - 3 Dec | OceanTeacher Academy Course MIM : Writing for Professional Publications | Oostende, Belgium |
| 29 Nov - 1 Dec | Inter ICG Task Teams meeting: Inter ICG Task Teams meeting (Res XXV-13) | Seattle, United States |
| 29 Nov - 2 Dec | ODINAFRICA Marine Information Management Planning meeting | Dakar, Senegal |
| 29 Nov - 3 Dec | INDISEAS: INDISEAS Meeting | Paris, France |
| **December 2010** | | |
| 01 - 03 | World Heritage Marine Sites meeting | Honolulu, United States |
| 06 - 08 | 2nd ODINAFRICA Project Steering Committee | Oostende, Belgium |
| 06 - 09 | IOC/WESTPAC Workshop on Rapid Assessment Survey of Marine Biodiversity and Non-Indigenous Species in the Western Pacific Region (II) | Bangkok, Thailand |
| 07 - 09 | I-GOOS Board VI Meeting | Paris, France |
| 08 - 10 | Fourth International Port Meteorological Officers (PMO) Workshop, and Support to Global Ocean Observations using Ship Logistics | Orlando, United States |
| 10 - 12 | 2nd Meeting of PTSFG: 2nd meeting of Post-Tsunami Survey Field Guide | San Francisco, United States |
| 13 - 15 | IOC/WESTPAC Workshop on «Enhance the Awareness on Toxic Marine Organisms» | Nha Trang, Vietnam |
| 14 | IOC Information session with European Union States at UNESCO/Session d'information avec le Groupe des pays de l'Union Européenne à l'UNESCO | Paris, France |
| 16 | IOC information session with Small Island Developing States Group/Session d'information avec le groupe des Petits Etats insulaires en development à l'UNESCO | Paris, France |
| 19 - 20 | IOC/WESTPAC International Scientific Steering Committee Meeting of the 8th IOC/WESTPAC International Scientific Symposium | Ansan/Busan, Korea Rep |
| 27 - 29 | Fourth IOC/WESTPAC Expert Workshop on the Pilot Project of SEAGOOS on the Monsoon Onset Monitoring and its Social and Ecosystem Impacts (WESTPAC-MOMSEI) | Melaka, Malaysia |

# PUBLICATIONS AND PUBLIC AWARENESS
## IOC publications

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 2009. Paris, UNESCO, 2009. 56 p. (Annual Report Series, 16) (English, French) |
| **IOC TECHNICAL SERIES** |
| Biodiversity and distribution of faunal assemblages. Vol. 3. Options for the management and conservation of the nodule ecosystem in the Clarion-Clipperton Fracture Zone: scientific, legal and institutional aspects. Paris, UNESCO/IOC, 2010 (IOC Technical Series, 69; SC-2006/WS/11Vol.3.) ( |
| 12 January 2010 Haiti Earthquake and Tsunami Event Post-Event Assessment of CARIBE EWS Performance. 2010. 70 p., maps. (Technical Series, 90; IOC/2010/TS/90.) (English.) |
| 27 February 2010 Chile Earthquake and Tsunami Event – Post-Event Assessment of PTWS Performance (Pacific Tsunami Warning System). 2010. 159 p., illus., maps. (Technical Series, 92, IOC/2010/TS/92.) (English, summary in French, Spanish and Russian.) |
| Exercise CARIBE WAVE 11—A Caribbean Tsunami Warning Exercise 23 March 2011. Participant Handbook / Exercise CARIBE WAVE 11—Exercice d'alerte au tsunami dans les Caraïbes. Manuel du participant /Ejercicio Caribe Wave 11. Un ejercicio de alerta de tsunami en el Caribe, 23 de marzo de 2011. Manual del participante. 2010. 101 p. in various pagings, illus., maps. (Technical Series, 93; IOC/2010/TS/93.) (Plurilingual.) |
| **IOC WORKSHOP REPORTS** |
| Reunión subregional de planificación de ODINCARSA (Red de Datos e Información Oceanográficos para las Regiones del Caribe y América del Sur) /ODINCARSA (Ocean Data and Information Network for the Caribbean and South America region) Latin America sub-regional Planning Meeting, Universidad Autónoma de Baja California (UABC), Ensenada (México), 7–10 December 2009. 2010. 120 p., illus. (Workshop Reports, 225; IOC/2010/WR/225.) (English/Spanish.) |
| OBIS (Ocean Biogeographic Information System) Strategy and Work plan Meeting, IOC Project Office for IODE, Ostend, Belgium, 18–20 November 2009. 2010. 34 p. (Workshop Reports, 226; IOC/2010/WR/226.) (English.) |
| ODINAFRICA-IV Project Steering Committee, First Session, Ostend, Belgium, 20–22 January 2010. 2010. 38 p. (Workshop Reports, 227; IOC/2010/WR/227.) (English.) |
| First IODE Workshop on Quality Control of Chemical Oceanographic Data Collections, Ostend, Belgium, 8–11 February 2010. 2010. 48 p., illus. (Workshop Reports, 228; IOC/2010/WR/228.) (English.) |
| Surface Ocean CO2 Atlas Project Equatorial Pacific, North Pacific, and Indian Ocean Regional Workshop, Tokyo, Japan, 8–11 February 2010. 2010. 36 p. (Workshop Reports, 229; IOC/2010/WR/229; IOCCP Report Number 18.) (English.) |
| SCOR/IODE/MBLWHOI Library Workshop on Data Publication, Paris, France, 2 April 2010. 2010. 23 p. (Workshop Reports, 230; IOC/2010/WR/230.) (English.) |
| First ODINAFRICA Coastal and Marine Atlases Planning Meeting, Ostend, Belgium, 12–14 October 2009. 2010. 52 p., illust. (Workshop Reports, 231; IOC/2010/WR/231.) (English.) |
| Eleventh International Workshop on Wave Hindcasting and Forecasting and Second Coastal Hazard Symposium, Halifax, Canada, 18–23 October 2009. 2010. Various abstracts and material available at http://www.waveworkshop.org/11thWaves/index.htm. (Workshop Reports, 232; JCOMM Technical Report 52; WMO/TD-No. 1533) (English.) |
| 2010 Meeting of the Joint IODE-JCOMM Steering Group on the Global Temperature-Salinity Profile Programme Ostend, Belgium, 5–7 May 2010. 2010. 37 p., illus. (Workshop Reports, 233; IOC/2010/WR/233.) (English.) |
| Southern and Indian Surface Ocean CO2 Atlas (SOCAT) Workshop, CSIRO Marine Laboratories, Hobart, Tasmania, 16-18 June 2010. 2010. 26 p. (Workshop Reports, 234; IOC/2010/WR/234; IOCCP Report Number 21) (English.) |
| The Caribbean Marine Atlas (CMA) Review and Planning Workshop and Saint Lucia National Coastal Atlas Stakeholder Event, Bay Gardens Inn, Rodney Bay, Saint Lucia, 2–6 August 2010. 2010. 64 p., illust. (Workshop Reports, 235; IOC/2010/WR/235.) (English.) |

| IOC MANUALS AND GUIDES |
|---|
| GTSPP Real-time Quality Control Manual, First revised edition. 2010. 145 pp. (English.) (manuals and Guides, 22 rev., IOC/2010/MG/22Rev.) (English.) |
| Ocean Data Standards: vol. 1. Recommendation to adopt ISO 3166-1 and 3166-3 country codes as the standard for identifying countries in oceanographic data exchange. 2010. 16 P. (Manuals and Guides, 54; IOC/2010/MG/54.) (English.) |
| Microscopic and Molecular Methods for Quantitative Phytoplankton Analysis by Karlson, Bengt; Cusack, Caroline; Bresnan, Eileen. 2010. 113 p., illus. (Manuals and Guides, 55; IOC/2010/MG/55.) (English.) |
| The International Thermodynamic Equation of Seawater, 2010: calculation and use of thermodynamic properties; TEOS-10 manual (IOC; SCOR; International Association for the Physical Sciences of the Sea, 2010.) 196 p. (Manuals and Guides, 56; IOC/2010/MG/56.) (English.) |
| **INFORMATION DOCUMENTS** |
| IOC/INF-1269. Oceanographic Data and Information Networks for Africa (ODINAFRICA-I): final report, 1998–2000 (including report for 2000). 2010. 57 p. (English.) |
| IOC/INF-1270. Oceanographic Data and Information Networks for Africa (ODINAFRICA-II): final report, 2001–2003. 2003; 2010. 37 p. (English.) |
| IOC/INF-1271. Oceanographic Data and Information Networks for Africa (ODINAFRICA-III): final report, 2004–2009. 2009; 2010. 32 p., maps. (English.) |
| IOC/INF-1272. 2010 IODE Officers Meeting: summary report. 2010. 43 p. (English.) |
| IOC/INF-1273. Planning and implementation for GOOS. 2010. 35 p. (English.) |
| IOC/INF-1274. IOC contribution to UNESCO Priority Africa: Overarching objective 2: Mobilizing science knowledge and policy for sustainable development for the biennium 2008–2009. 2010. 14 p. (English.) |
| IOC/INF-1275. Ship-based repeat hydrography: a strategy for a sustained global programme. 2010. 15 p. (English.) |
| IOC/INF-1276. Empowering Developing Countries to Sustainably Use their Coastal Resources (self-driven capacity-building): closure report on the SIDA funded project. 2010. 63 p. (English.) |
| IOC/INF-1277. IOC-EU cooperation for the governance of EU oceans and seas. 2010. 9 p. (English.) |
| **REPORTS OF GOVERNING AND MAJOR SUBSIDIARY BODIES** |
| Twenty-fifth Session of the Assembly, Paris, 16–25 June 2009. 2010. 213 p. (IOC-XXV/3; Reports of Governing and Major Subsidiary Bodies, 141.) (English, French, Spanish, Russian.) |
| Third Session of the Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology, Marrakesh, Morocco, 4–11 November 2009 — Abridged final report with resolutions and recommendations. 2010. 197 p. (WMO-IOC/JCOMM-III/3; OMM-N° 1049; Reports of Governing and Major Subsidiary Bodies, 142.) (English, French, Spanish, Russian.) |
| Ninth Session of the IOC Intergovernmental Panel on Harmful Algal Blooms, Paris, France, 22–24 April 2009. 2010. 165 p. (IOC/IPHAB-IX/3; Reports of Governing and Major Subsidiary Bodies, 143.) (English.) (Executive Summary available separately in English, French, Spanish, Russian; IOC/IPHAB-IX/3s) |
| Fifth Session of the Intergovernmental Coordination Group for the Tsunami and other Coastal Hazards Warning System for the Caribbean Sea and Adjacent Regions, Managua, Nicaragua, 15–17 March 2010. 2010. 58 p. (IOC/ICG/CARIBE EWS-V/3, Reports of Governing and Major Subsidiary Bodies, 144. Executive Summary included in English, French, Spanish, Russian.) |
| Sixth Session of the IOC Regional Committee for the Central and Eastern Atlantic Ocean, Accra, Ghana, 28–30 March 2010. 2010. 41 p. (IOCEA-VI/3; Reports of Governing and Major Subsidiary Bodies, 145. (Executive Summary included in English, French, Spanish, Russian.) |
| Forty-second Session of the Executive Council, Paris, 15, 19 & 20 June 2009. 2010. 45 p. (IOC/EC-XLII/3; Reports of Governing and Major Subsidiary Bodies, 146.) (English, French, Spanish, Russian.) |
| Forty-third Session of the Executive Council, Paris, 8–16 June 2010. 2010. 147 p. (IOC/EC-XLIII/3; Reports of Governing and Major Subsidiary Bodies, 147.) (English, French, Spanish, Russian.) |

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| Sixth Session of the Intergovernmental Coordination Group for the Tsunami Early Warning and Mitigation System in the North Eastern Atlantic, the Mediterranean and Connected Seas, Istanbul, Turkey, 11–13 November 2009. 2010. 67 p., maps. (ICG/NEAMTWS-VI/3 Rev.; Reports of Governing and Major Subsidiary Bodies, 148. (English.) Executive Summary available separately in Arabic, English, French, Spanish, Russian; ICG/NEAMTWS-VI/3s.) |
| Seventh Session of the Intergovernmental Coordination Group for the Tsunami Early Warning and Mitigation System in the North Eastern Atlantic, the Mediterranean and Connected Seas, Paris, France, 23–25 November 2010. 2010. 45 p. (ICG/NEAMTWS-VII/3; Reports of Governing and Major Subsidiary Bodies, 149. (English.) Executive Summary available separately in Arabic, English, French, Spanish, Russian; ICG/NEAMTWS-VII/3s.) |
| **REPORTS OF MEETINGS OF EXPERTS AND EQUIVALENT BODIES** |
| First Meeting of the joint IOC-ICES Study Group on Nutrient Standards (SGONS), Paris, France, 23–24 March 2010. 2010. 45 p. (IOC-ICES/SGONS-I/3 Rev.; Reports of Meetings of Experts and Equivalent Bodies, 223; IOCCP Reports, 20.) (English.) (Executive Summary in English, French, Russian, Spanish included.) |
| Third Session of the Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems (TOWS-WG), Lisbon, Portugal, 5–6 May 2010. 2010. 72 p. (IOC/TOWS-WG-III/3; Reports of Meetings of Experts and Equivalent Bodies, 224.) (English.) (Executive Summary in English, French, Russian and Spanish included.) |
| Eleventh Session of the IOC Group of Experts on the Global Sea level Observing System (GLOSS), Paris, 13–15 May 2009. 2010. 55 p. (IOC/GE-GLOSS-XI/3; Reports of Meetings of Experts and Equivalent Bodies, 225.) (English.) |
| Second Session of the Panel for Integrated Coastal Observation (PICO-II), Paris, 24–26 February 2009. 2010. 30 p. (IOC-WMO-UNEP-ICSU/PICO-II/3; Reports of Meetings of Experts and Equivalent Bodies, 226; GOOS report no. 180.) (English.) |
| **NEWSLETTERS** |
| Harmful Algae News, Paris, No. 41, April 2010; No. 42, August 2010 (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. 27, Spring 2010; No. 28, Summer 2010; No. 29, Autumn; No. 30, Winter 2010. Electronic only (English.) http://ioc3.unesco.org/ioccp/NewsArchives.html |
| JCOMM Newsletter. WMO-IOC Joint Technical Commission for Oceanography and Marine Meteorology. No. 6, January 2010; No. 7, June 2010; No. 8, December 2010. Electronic only (English.) |
| Tsunami News. UNESCO/IOC electronic newsletter. No. 5, April 2010; No. 6, September 2010. (English.) http://www.ioc-tsunami.org/ |
| Tsunami Newsletter. International Tsunami Information Centre, Honolulu, Hawaii, USA; [no issue in 2010.] http://ioc3.unesco.org/itic/ |
| GCOS Newsletter. Global Climate Observing System. No. 1, February 2010; No. 2, May 2010; No. 3, September 2010. Electronic only. [English.] With the IOC sponsorship. http://www.wmo.int/pages/prog/gcos/index.php?name=Newsletter |
| Fifty years of ocean studies. A World of Science, Paris, pp. 14, Vol. 8, No. 3, July–September 2010, (UNESCO Natural Sciences Quarterly Newsletter) (English, French, Russian, Spanish.) |
| **BROCHURES** |
| The Global Ocean Observing System – A portray by marine illustrator Glynn Gorick. 2010. 28 p., illus. (IOC Brochure 2010-1 (IOC/BRO/2010/1).) (English.) |
| Ocean Fertilization: A Summary for Policy Makers by Wallace, Doug; Law, Cliff; Boyd, Philip W.; Collos, Yves; Croot, Peter; Denman, Ken; Lam, Phoebe; Riebesell, Ulf; Takeda, Shigenobu; Williamson, Phil. 2010. 17 p., illus. (IOC Brochure 2010-2 (IOC/BRO/2010/2).) (English.) |
| Principles and Strategy in Capacity Development. 2010. 6 p., illus. (IOC Brochure 2010-3 (IOC/BRO/2010/3 Rev.).) (English.) |

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| Where the first wave arrives in minute – Indonesian lessons on surviving tsunamis near their sources by Yulianto, Eko; Kusmayanto, Fauzi; Supriyatna, Nandang; Dirhamsyah, Mohammad. 2010. 36 p., illus., maps. ISBN 978-979-19957-9-5. (IOC Brochure 2010-4 (IOC/BRO/2010/4).) (English, Spanish.) |
| Sea-level Rise and Variability: A Summary for Policy Makers by Aarup, Thorkild; Church, John A.; Wilson, W. Stanley; Woodworth, Philip L. 2010, 8 pp., illus. (IOC Brochure 2010-5 (IOC/BRO/2010/5).) English, French, Spanish.) |
| Why monitor the Arctic Ocean? Services to society from a sustained ocean observation system by Bates, Peter; Alverson, Keith. 2010. 16 pp., illus. (IOC Brochure 2010-6 (IOC/BRO/2010/6).) (English, French, Russian, Greenlandic.) |
| The International Thermodynamic Equation of Seawater – 2010: A Summary for Policy Makers . IOC, SCOR and IAPSO, 2010. 16 pp., illus. (IOC Brochure 2010-7 (IOC/BRO/2010/7).) (English.) |
| OceanTeacher Academy – Training Course Prospectus 2010. 2010, 16 pp., illus. (IOC Brochure 2010-8 (IOC/BRO/2010/8).) (English.) |
| **SALES PUBLICATIONS** |
| **UNESCO Publishing**<br>The IOC was committed to the creation of two series of the UNESCO Publishing House: |
| IOC Ocean Forum series and Oceanographic Methodology series |
| **Others with IOC participation** |
| Troubled Waters – Ocean Science and Governance by Holland, Geoff; Pugh, David (Editors). Cambridge University Press, 2010. 316 p. illus. ISBN 978-0-521-76581-7. (English.) |
| Understanding sea-level rise and variability by Church, John A.; Philip L. Woodworth; Thorkild Aarup; S. Stanley Wilson (Editors). Chichester, UK, Wiley-Blackwell, 2010. 428 p., illus. 978-1-4443-3451-7 (English.) |
| Guide to best practices for ocean acidification research and data reporting by Riebesell U., Fabry V. J., Hansson L. & Gattuso J.-P. (Eds.), 2010. 260 p. illus. ISBN 978-92-79-11118-1 (English.) Luxembourg: Publications Office of the European Union. |
| Ocean acidification: a summary for policymakers from the second Symposium on the Ocean in a High-CO2 World. SCOR; IAEA. Marine Environment Laboratories. 2010. 8 p., illus., maps. (English, French, Spanish, Portuguese.) |
| Fifty Years of Education and Awareness Raising for Shaping the Future of the Oceans and Coasts, 27–30 April 2010 (Proceedings). IOC-Russian State Hydrometeorological University, 2010. 580 p. (English/Russian.) |
| Oceanography, Vol. 23, No 3, September 2010. Special issue: Celebrating 50 years of the Intergovernmental Oceanographic Commission. 188 p. illus. ISSN 1042-8275 (English.) |
| CMOS Bulletin (Canadian Meteorological and Oceanographic Society), Vol. 38, No 5, October 2010. Fifty years of IOC in the service of society; 16-172 pp. Canada 2010. ISSN 1195-8898 (English/French.) |
| GEOHAB 2010. Global Ecology and Oceanography of Harmful Algal Blooms, GEOHAB Core Research Project: HABs in Fjords and Coastal Embayments by A. Cembella, L. Guzmán, S. Roy, J. Diogène (Eds.), IOC and SCOR, Paris, France and Newark, Delaware USA, 57 p. (English.) |
| GEOHAB 2010. Global Ecology and Oceanography of Harmful Algal Blooms, Harmful Algal Blooms in Asia by K. Furuya, P.M. Glibert, M. Zhou and R. Raine (eds.), IOC and SCOR, Paris and Newark, Delaware. 68 p. (English.) |
| **UNESCO PRESS RELEASES AND MEDIA ADVISORIES** |
| 28 October 2010. Indonesian tsunami shows more work needed to prepare vulnerable populations. UNESCO Press release. |
| 8 June 2010. The Intergovernmental Oceanographic Commission celebrates its 50th anniversary in a context dominated by climate change. UNESCO Press release. |
| 8 June 2010. Message by Ms Irina Bokova, Director-General of UNESCO, on the occasion of the press conference on Cousteau-UNESCO cooperation, delivered on her behalf by Ms Wendy Watson-Wright, Assistant Director-General and Executive Secretary of the Intergovernmental Oceanographic Commission (IOC), UNESCO. (DG/2010/059) (English, French.) |

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| 8 June 2010. Address by Irina Bokova, Director-General of UNESCO, on the occasion of the World Ocean Day and the inauguration of the 50th anniversary of the Intergovernmental Oceanographic Commission during the 43rd session of its Executive Council. (DG/2010/058) (English/French.) |
| **EXHIBITIONS AND EVENTS** |
| Paris, 16 December 2010. IOC information session with Small Islands Developing States. |
| Paris, 14 December 2010. IOC information session with European Union Member States. |
| Paris, 22 November 2010. IOC information session with UNESCO Group Africa. |
| Southampton, U.K., 29 September 2010. Launch of the book: Troubled Waters: ocean science and governance. Institute of Marine Engineering, Science & Technology (IMarEST). |
| Paris, 10 June 2010. The Roger Revelle Memorial Lecture, 2010: Dr Manuel Barange, Director of Science at the Plymouth Marine Laboratory, in Plymouth, UK on "Learning to swim: exploring the challenges to marine resource sustainability". On this occasion, the Chairman presented Manuel Barange with the IOC Roger Revelle Medal. |
| Paris, 8 June 2010. World Ocean Day and Inaugural Ceremony of the IOC 50th Anniversary. Ceremony and exhibitions. UNESCO Headquarters. |
| Paris, 8-29 June 2010. Poster exhibition on fence surrounding UNESCO headquarters. "Taking the Pulse of the Blue Planet" co-sponsored with European Space Administration and Total Foundation. |
| 6 May 2010. The United Nations Postal Administration issued six se-tenant mini-sheets of four stamps each (for a total of 24 commemorative stamps) designed by marine-life artist Wyland on the theme "One Planet, One Ocean", on the occasion of the fiftieth anniversary of the Intergovernmental Oceanographic Commission. A philatelic bulletin, first day covers and prestige books were also issued on the same occasion. The first day covers were stamped at UN Offices in New York, Geneva and Vienna. |
| Paris, 24 March 2010. Fifty Years of Deep Ocean Observations, talk with Don Walsh, Trieste pilot and deepest ocean diver. UNESCO Headquarters. |
| London, 8-12 March. Oceanology International '10 floor exhibtion for Global Ocean Observing System, co-sponsored with European Environment Agency |

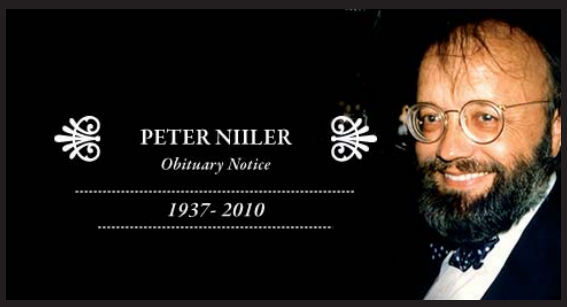

# PATRICK GENTIEN

By Beatriz Reguera, Spanish Institute of Oceanography, Vigo,
President of the International Society for the Study of Harmful Algae (ISSHA)

Patrick Gentien passed away on Sunday 9 May 2010 after a brief fight against cancer. Since 2009, Patrick was head of the IFREMER « Oceans and Health » programme, and Principal Investigator of the project « Sensors, methods and systems" within this same programme. Patrick was a chemical engineer by the Hautes Etudes d'Ingénieur (HEI, Lille, 1973) and doctor in oceanography (University of Brest, 1977). He joined the IFREMER in 1982 as a researcher in chemistry and hydrobiology at the department of "Environnement littoral et Gestion du Milieu Marin". Soon became the head of the Hydrobiology Laboratory and ever since, always had positions of responsibility, which included Director of CREMA-L'Homeau (La Rochelle) between 2000 and 2005. Until the very end, he kept in touch with his projects and collaborators in a hard attempt to leave things in order. A great conversationalist for some, a visionary scientist for others, a ruthless critic for those who did not like his blunt comments on flawed scientific statements, but above all, a pioneer, an intelligent and unique human being who has left very fond memories in many colleagues of the international HAB community.

Beginning in the early 1990's, Patrick became deeply involved in international cooperation on harmful algal blooms (HABs) research and management, while retaining his responsibilities at IFREMER. In 1992 he joined, as French delegate, the ICES-IOC Study Group on HAB Dynamics (SGHABD) which 2 years later became a working group with the same name (ICES-IOC WGHABD). Patrick chaired this group between from 1996 to 1999, when he became Chair of the IOC-SCOR Global Ecology and Oceanography of Harmful Algal Blooms (GEOHAB) programme. His inputs to the WGHABD meeting, and in particular to the join sessions of the WGHABD with the ICES Shelf Seas Oceanography group (WGSSO) were very valuable because he could speak both, the language of modellers and physical oceanographers with ease and understand the biology; in addition, he had a great capacity to synthesize and convert into a single question intricate discussions on physical-biological interactions. Patrick continued being a faithful member of the WGHABD until the end. Reports of the meetings he chaired can be downloaded from the IOC HAB website ioc-unesco.org/hab/ (Activities).

Patrick strongly influenced the concepts of GEOHAB with his early focus on the necessity of a species-specific approach and recognition of the diversity of factors controlling population dynamics in different systems. He accepted the challenge of chairing the GEOHAB Scientific Steering Committee (SSC) whose main task was to design the new programme and implement it. It was not an easy task to lead democratically a group of world-known HAB scientists, each one with his/her strong opinions, and reach a consensus for the design of an international plan. Patrick's honest and direct approach spurred many good discussions and helped sharpen the GEOHAB Science Plan The results were great, though, and the published Science and Implementation Plans are now available at www.geohab.info. The last participation of Patrick in GEOHAB activities was at the GEOHAB Modelling Workshop held in Galway, Ireland, on June 15-19 2009.




# PETER NIILER

Peter Niiler, a driving force behind the creation of GOOS, and proponent of ocean observation systems, aand distinguished emeritus professor of physical oceanography at Scripps Institution of Oceanography, UCSD passed away Oct. 15 at age 73. Peter imagined a world with ocean instrumentation covering the remote seas at a time when most oceanographers were content to contrive thought experiments about ocean circulation patterns. Through his insistence upon fundamental measurements the Ocean Drifter programme and other components of the GOOS were conceived.

For the past 40 years, Niiler's work has helped shape how scientists study the ocean. His early understanding of the linkage between ocean circulation and the world's climate served as a catalyst for improved global ocean observations. He conceived and designed the Global Drifter Program, which in 2005 became the first fully completed component of the Global Ocean Observing System. At the time of his death, Niiler was deploying drifters in front of tropical storms and typhoons to further the knowledge of the interaction of the ocean with these deadly weather systems.

"Peter had the rare gift of inspiring people around him and to bring out the positive part of their character," said Luca Centurioni, a Scripps physical oceanographer. "He was enthusiastic, tenacious and was driven by a genuine interest in understanding the dynamics of the ocean. He was an exceptionally skilled engineer and was able to spin-up amazingly fruitful oceanographic experiments. He was uncommonly generous with his ingenious insights and ideas and guided his colleagues to investigate new creative ways of solving scientific problems."

Niiler spent decades designing ocean instruments for directly measuring ocean circulation and using them in increasingly comprehensive observations to learn the ocean's dynamics. Motivated by a growing interest in the role that ocean-atmosphere interactions have in shaping climate, Niiler became a world expert in the upper "mixed layer" of the ocean that interacts most directly with the atmosphere.

When Niiler arrived at Scripps in 1982, surface temperature readings and circulation patterns were a mystery in large parts of the world, especially in the Southern Ocean. Niiler's vision was that such information gaps could only be filled with a completely new global ocean observing system. "A large part of the world simply could not be sampled," he said in a 2005 interview, "because most of the world's ships don't go there. We needed a new way." Niiler's deployment of sophisticated technologies confirmed a 60-year-old ocean circulation theory known as the Sverdrup balance. Niiler predicted the existence of the "Great North Pacific Garbage Patch," a massive zone of floating debris. He detected the presence of an even larger debris accumulation site in the southern Pacific Ocean and was involved in preliminary planning for a research expedition there at the time of his death.

*SOURCE: Scripps Institution of Oceanography, UCSD*

# DAN WRIGHT

Colleagues and friends across Canada and around the world have been shocked and deeply saddened to learn of the sudden passing of Dr. Daniel (Dan) G. Wright on Thursday, July 8, 2010. Dan was a highly-regarded scientist with the Ocean Sciences Division (OSD) of Fisheries and Oceans Canada at the Bedford Institute of Oceanography (BIO).

Dan obtained his B.Sc. in Mathematics from Laurentian University in 1975, and his Ph.D. in Applied Mathematics and Oceanography from the University of British Columbia in 1978 under the mentorship of Professor Lawrence Mysak. He was then a Postdoctoral Fellow at the Woods Hole Oceanographic Institution (1978-1979) with Dr. Harry Bryden, and a Research Associate at Dalhousie University (1979-1981) with Professor Chris Garrett.

In late 1981 Dan accepted a Research Scientist position in the Ocean Circulation Section of BIO where, until his passing, he was a highly productive, generous and respected scientist, and an advisor, colleague and friend to many in the oceanographic and atmospheric research communities. In 2008 Dan was promoted to the Government of Canada's highest Research Scientist level, recognizing his outstanding scientific and other contributions both nationally and internationally. Dan was also a long-time Adjunct Professor in the Department of Oceanography at Dalhousie University where he cherished the opportunity to interact with students and young scientists.

Dan used his elite mathematical skills and clear thinking to advance our understanding of a very broad range of physical oceanographic phenomena and their role in the broader Earth system, building on both theory and observations. He made major contributions on topics ranging from the thermodynamics of sea water to the role of the ocean in climate dynamics, including baroclinic instability, tidal rectification and other continental shelf dynamics, regional- to global-scale ocean circulation, physical-biogeochemical interactions, the development of innovative circulation models, and the oceanography of the Northwest Atlantic. At the time of his death, he was completing the publication of the final results of SCOR/IAPSO WG127 which was charged with developing new expressions for the computation of all the thermodynamic properties of seawater.

He co-authored over 70 papers in international scientific journals, and many other reports and communications. His scientific excellence and impact were recognized by the Canadian Meteorological and Oceanographic Society through his receipt of its President's Prize in 1992, and by his selection as a CNC-SCOR Tour Speaker.

Above all, Dan Wright was a very decent human being - being gifted yet generous and humble, rigorous yet compassionate, motivated yet fair and honest, and devoted to his profession yet also very devoted to his family. He will be greatly missed.

Dan was survived by his wife of 37 years, Donna Wright; and his children, Christa (Geoff Lunn), Dave (Michelle Wright), Nicole (Daniel Perks); his mother, Constance, sister, donna, and brothers, Ted, Sonny and Bob. Dan had five grandchildren whom be loved unconditionally. They will remember him with love through memories and stories. Dan was predeceased by his father, Fred who supported him throughout his life and was so proud of the man he was.

**Intergovernmental Oceanographic Commission (IOC)**

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