United Nations
Educational, Scientific and
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Intergovernmental
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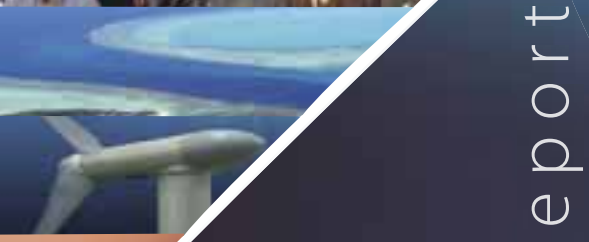
Commission

2006



Annual Report

Intergovernmental Oceanographic Commission

United Nations
Educational, Scientific and
Cultural Organization

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Commission

Annual Report 2006

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purpose and role

Intergovernmental Oceanographic Commission of UNESCO

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

The Commission will collaborate with international organizations concerned with the work of the Commission, and especially with those organizations of the United Nations system which are willing and prepared to contribute to the purpose and functions of the Commission and/or to seek advice and cooperation in the field of ocean and coastal area scientific research, related services, and capacity-building.*

* Article 2 of the Statutes of the Intergovernmental Oceanographic Commission

FROM THE **CHAIRPERSON**

For the future of the oceans, I am a determined optimist.

My personal impression, at the end of my four years as your Chairman, is that governments are increasingly aware of the need for a holistic approach to the oceans and coastal zones. As an example we have the continuing success of the UN Informal Consultative Process in New York, whose eighth annual meeting will be held in June 2007. Through this Process I believe that governments are articulating their needs as a coordinated customer for ocean services, many of which the Intergovernmental Oceanographic Commission of UNESCO should be able to provide. Even my own country, the UK, is in the advanced stages of consulting on a cross-cutting Marine Bill which will, among other things, establish a marine management organization; several other countries already have something similar in place.

Within the IOC there are many encouraging responses to these external requirements of Member States. For example, the new *Handbook for Measuring the Progress and Outcomes of Integrated Coastal and Ocean Management* has been well received; and the fourth volume of the *Manual on Sea Level Measurement and Interpretation* published by the IOC Global Sea Level Observing System (GLOSS) in 2006 has already been reprinted. I want particularly to mention the work of the Capacity-Development section that has raised funding for, and coordinated, professionally conducted leadership and marine action planning workshops in various developing regions: East Africa, the Caribbean, Latin America, Southeast Asia and West Africa. These are developing leadership skills, and regional networks of ocean leaders for the future.

Soon we will be celebrating fifty years of IOC achievements. Our Medium Term Strategy for 2008-2013 which will take us into our next half-century has four High Level Objectives:

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

Our programmes must provide the necessary data, information and knowledge to contribute to the services needed to address these ocean issues effectively.

Realistically, at present neither our budget nor our staff resources are anywhere near adequate to address our overall responsibilities effectively. It is clear that the current situation demands appropriate and urgent measures by Member States to increase the autonomy of IOC, and at the same time to address the issues of serious underfunding of our programmes.

Your elected officers will be presenting proposals for debate at our Assembly in June 2007. We believe the necessary change cannot happen through our existing relationship within UNESCO. Within UNESCO, the IOC is formally established as a body having functional autonomy under our Governing Bodies: the Assembly and the Executive Council. In my dealings elsewhere within UNESCO I have heard the IOC described as its most visible and successful programme. Nevertheless, we are also regarded as just one programme within the Natural Sciences Sector, where our Executive Secretary has to argue for his budget and programme against other priorities and restructuring plans. This dual control often leads to tensions and misunderstanding.

Despite many important achievements, I and your other elected officers believe that the IOC is in state of crisis. Cynics may say that this is normal and that one crisis is much like another. I prefer the Italian political thinker, Antonio Gramsci's definition of a crisis: 'When the old is dead and the new cannot be born'. Together we must plan for the rebirth of the IOC.

Within the Intergovernmental Oceanographic Commission, we have ongoing achievements and programmes of which we can be justly proud. Member States know that much more can and needs to be done. However, until we have a new structure, even our existing activities are increasingly vulnerable. As I said when the Director-General of UNESCO met with our Executive Council a year ago, the question is not whether intergovernmental ocean activities, including ocean monitoring and assessments, will continue to increase: they certainly will. The question is the extent to which the IOC will contribute to and lead those activities for which we were established nearly fifty years ago.

For the future of the oceans, and for the future of the IOC, I remain a determined optimist.

David Pugh
Chair
Intergovernmental Oceanographic Commission
of UNESCO

FROM THE **EXECUTIVE SECRETARY**

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Lagrange[1] and the Law of the Sea

To describe the movements of the ocean, we oceanographers use two alternative coordinate systems: Eulerian coordinates, which are fixed in place, or Lagrangian coordinates that follow a given parcel of fluid as it moves. The resulting observations, although equivalent, are contrasting and highlight different aspects of the same phenomenon. Lagrangian floats are widely used in oceanography and meteorology. The mythical Robinsonian 'message in a bottle' thrown into the ocean was a very primitive Lagrangian float. A truly Lagrangian float would have to follow all three components of oceanic velocity on all timescales.

In 1954 the Scripps Institution of Oceanography started a study of the seasonal variations of the inshore section of the California Current using drift bottles. In the next seventeen years 148,238 drift bottles were released into the sea and approximately 3.4 per cent (4,995) were recovered. These primitive Lagrangian floats gave solid proof of the seasonal reversal of the surface flows off the West Coast of North America. However, some outliers went far away in unexpected directions: one bottle released at a coastal station thirty kilometres south of the U.S.-Mexican border ended up in Pahaiki, Hawaii; another one released forty kilometres off Monterey in central California ended up in Annete Island in Alaska. This in itself is an interesting result speaking of the predictability of the ocean, an eddy-turbulent flow.

Modern day high-tech Lagrangian floats are an integral part of the Global Ocean Observing System (GOOS) of the Intergovernmental Oceanographic Commission of UNESCO. Surface drifting buoys, although originally designed to measure surface velocity, today collect data on sea surface temperature, salinity, barometric pressure, subsurface temperature and winds. The 18 September 2005 *Global Drifter No. 1250* of the 'Global Drifting Buoy Array' was deployed off the coast of Nova Scotia, Canada. Drifter observations now cover most areas of the world's oceans at sufficient density to map mean currents at one-degree resolution.

Argo is another global array of 3,000 free-drifting profiling floats that, oscillating between the surface of the ocean and a depth of 2,000 metres, measures the temperature and salinity of the upper layer of the ocean. For the first time, Argo has allowed the continuous monitoring of the temperature, salinity, and velocity of the upper ocean, with all data being made publicly available within hours after collection. Today there are 2,856 floats operating, revolutionizing the way we carry out oceanography.

Before Argo we had to use ships: navigate to a place in the ocean, stop the ship and do the same that an Argo float does, with instruments hanging from a wire. Ships move at the speed of a bicycle and cost, depending on the size, around US$20,000 for one day of operation. Everything included, each Argo profile costs much less than a similar profile collected from a ship and they are even cheaper than the counterpart measurements collected for the atmosphere using radiosondes that ascend to the stratosphere suspended from balloons.

Humanity has never before had this quality of information from the ocean, which now underpins major research programmes contributing to the reduction of the uncertainties about climate change. These instruments are also critical to interpret satellite observations of temperature, narrow down the error in the path and landing site of hurricanes, and improve the accuracy and precision of atmospheric-weather and ocean-weather forecasts. Furthermore, they contribute to the coming to age of operational oceanography, the production of forecasts and real-time services for a variety of users. Tsunami early warning is one of these services, supported by GLOSS, the IOC Global Sea Level Observing System. Other services are 24/7 warnings to vessels over 100 tons for extreme events, including tropical storms, extreme waves and storm surges under the Global Maritime Distress and Safety System (GMDSS) of the World Meteorological Organization (WMO) and the International Maritime Organization (IMO).

There is no question that these international programmes of observations under the sponsorship of the IOC and WMO, two organizations part of the United Nations system, should be welcome and receive the universal support of all nations. However, there is a hitch: Lagrangian drifters move and many of them can and do drift into the Exclusive Economic Zones (EEZ) of coastal States, where the United Nations Convention on the Law of the Sea (UNCLOS) has established a special regime. This raises concerns in some coastal States.

The EEZ was conceived to give effective jurisdiction to coastal States over the resources therein, protecting the rights to economic benefits derived from their exploitation. Through the establishment of EEZs, the largest transfer of resources in the history of humankind took place. On land, the unilateral displacement of a national border by just a few kilometres would in all likelihood trigger a war; it is

1. The Lagrangian method is named in honour of Joseph Louis Lagrange, 1736-1813, an Italian-French mathematician, notable for his important contributions to number theory and to classical and celestial mathematics.

therefore quite remarkable that this feat was achieved in peace. The extension of this new zonal (i.e. spatial) and functional jurisdiction of coastal States is fully defined by UNCLOS. However, the EEZ is not part of the territory of a nation. It is a zone where national laws and regulations must be consistent and applied in harmony with UNCLOS and other valid international agreements.

The future exploitation of oil and gas on the continental-shelf, and the immediate exploitation of fisheries, in addition to the mineral resources of the seabed, shaped much of the difficult negotiations during discussions of UNCLOS. The new jurisdiction could also affect other important non-economic rights, in particular those related to national defense and regional and global security. The freedom of navigation and overflight in and above EEZs, the right to the innocent passage of military vessels and the preservation of the 'freedoms' recognized for the high seas also played an important role in negotiations. Most of these other rights were essentially preserved: nations do not enjoy sovereignty over EEZs; they do have sovereign rights and obligations under the Convention.

Part XIII of the Convention, on marine scientific research, was built following two different conceptual lines of argument. The first one is the general need to increase the knowledge base on the ocean and its resources for their better use. This first aspect is essentially the promotion of the scientific research of the ocean as a Global Public Good, where the increased knowledge accrued can be appropriated by anybody, in particular by any nation. Traditionally this is guaranteed by the well-established practice of scientists publishing new results and discoveries in open, peer-reviewed literature, giving sufficient details on methods, so that anyone can reproduce their results anywhere in the world. This has been the universal code of conduct of the scientific profession since the establishment in 1660 of the Royal Society of London[2].

The second conceptual line is to provide closure to the economic jurisdiction created by the EEZ regime. Since the adoption of the final text of the Convention in 1982, its entry into force in 1994 and today, humankind has significantly increased the use of marine resources, especially originating in the EEZs of the world. Today about 25 per cent of the world's oil and gas production is offshore, and 80 per cent of the total fish catch comes from the EEZ. UNCLOS recognizes the right of the coastal State to benefit from the exploitation of resources contained in the EEZ and its continental shelf; therefore, activities that could directly or indirectly provide information over the nature and distribution of these resources should be conducted at least with the knowledge and consent of the coastal State.

2. The Royal Society was founded in 1660 as the Invisible College for the promoting of Physico-Mathematical Experimental Learning, and became the Royal Society of London for the Improvement of Natural Knowledge in 1663 when King Charles II sealed its charter.

Part XIII has been praised for being a balanced text. However, the way part XIII was written and the way it has been implemented, unjustifiably assumes that all marine scientific research could directly or indirectly provide information over the nature and distribution of those resources. A difficult point, nonetheless, is that UNCLOS never defined exactly what marine scientific research is, although it does address 'exploration' and 'exploitation' in the context of mining activities in the Area, that is, outside national jurisdiction.

Article 247 of UNCLOS, a provision that has never been used since its entry into force in 1994, provides for a simplified consent mechanism, applicable to scientific research projects undertaken by or under the auspices of international organizations. The International Indian Ocean Expedition (IIOE) and the World Ocean Circulation Experiment (WOCE, 1994-98) are typical examples in which Article 247 would have been extremely useful. The IIOE, the largest multinational research endeavour in oceanography at that time, lasted five years (1959-65). Research vessels from 13 countries crisscrossed the Indian Ocean and its adjacent seas, completing around 320 ship-months of research cruises, collecting data and samples to improve the knowledge of the physics, chemistry, biology, geophysics and geology of this ocean basin. As a consequence of the IOC being set up under UNESCO, special customs facilities and courtesies were arranged for ships and personnel of the expedition. At the time we did not have UNCLOS, and EEZs did not exist.

Twenty years later, for implementing the World Ocean Circulation Experiment (WOCE), each entry into an EEZ had to be negotiated on a bilateral basis between the authorities of the flag country of the research vessel and the coastal State in which a set of WOCE observations were planned to be taken. In the absence of any procedure to apply Article 247, the bilateral mechanism was the only one available. However the simplified mechanism of Article 247 could have been applied, as WOCE was part of the World Climate Research Project under the sponsorship of two UN organizations, the IOC and the WMO, as well as the International Council of Science (ICSU).

Through Resolution EC-XXXIX.7, the IOC has just approved the 'Procedure for the application of Article 247 of UNCLOS by IOC', which in essence internalizes the consent regime under the authority of the IOC's governing bodies. Only time will tell if the implementation of this procedure will become a turning point for scientific cooperation and for the IOC. In the meantime how do we deal with an Argo float or surface drifter that drifts into an EEZ?

To find a way forward with Argo, in 1999 the IOC adopted Resolution XX-6. It has functioned very well and each Member State participating in the programme has nomi-

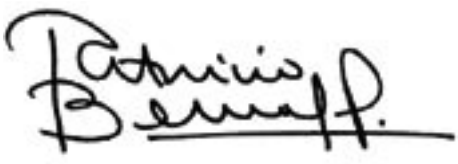
Photo courtesy of Diane Stanitski, NOAA Climate Programme Office

Ceremonial deployment of *Global Drifter 1250* in waters off Nova Scotia, Canada, 18 September 2005.

nated a National Coordinator to receive all the information of any float that might be in a position to drift into an EEZ. More importantly, on the website[3] of IOC's JCOMMOPS anyone can see where all the floats are at any given time and have free access to the data collected. A great majority of Member States participating in the Seventh Session of the IOC Advisory Body of Experts on the Law of the Sea (IOC/ABE-LOS) in Libreville, Gabon, expressed their full satisfaction with the system put in place by the IOC. The view that a float drifting into an EEZ constituted *per se* an instance that called for the application of the consent regime, although a distinct minority opinion, was also vehemently defended in Libreville.

Global Drifter No. 1250 launched off Nova Scotia, Canada, was recovered by French researchers off the coast of Brittany, close to Brest, France (see page 38 of this Report). Apparently surface drifters have attracted less attention from governments than Argo floats. Given the nature of eddy-turbulent flows, the exact position of a floating device cannot be predicted with the accuracy demanded by the consent regime requiring the identification a priori 'not less than six months' (Art. 248) of the 'precise geographical areas' (Art. 248). In fact, inaccuracy of the information is one of the reasons for denying permission (Art. 246). With all the good faith in the world, some of the requirements in the consent regime cannot accurately be complied with by drifting floats. Furthermore, it is questionable that the data from one float truly constitute a piece of scientific research. Like meteorological data, these data could be considered 'operational in nature' or part of 'surveys' and not scientific research *per se*, and accordingly be exempted from Part XIII. But a more definite solution is needed. This is why the ongoing work of IOC/ABE-LOS on the legal framework that is applicable to the collection of oceanographic data within the context of UNCLOS is so important.

We still hope that good faith, reason and flexibility will give the IOC a strong tool to maintain the observation networks required to ascertain the true impact of climate change. Observations will have to include biological, chemical and physical variables. If an agreement is not possible, the IOC has the responsibility to seek a higher level forum, such as the United Nations General Assembly, to start working towards a complementary agreement of UNCLOS and other global conventions dealing with ocean and other geophysical observations. The data that are essential to prevent the catastrophic loss of life resulting from a tsunami, a hurricane or a storm surge, should also be under the authority of such an agreement. Such data and information are vital to increasing the understanding and improving the management of climate and global change and the preservation of ecological services that maintain the life support system of our planet. They constitute a true Global Public Good, and their acquisition and open, free exchange will eventually require a special status Convention or Protocol of the highest level. After all, if things go wrong, as is the case for the 11,000 inhabitants of Tuvalu evacuating their island in the Pacific because of sea level rise, we do not have another planet to go to.



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

3. http://ioc.unesco.org/jcomm/ or www.jcomm.info

Public **awareness**

Global sea levels: past, present and future

John Church is an oceanographer with Australia's Commonwealth Scientific and Industrial Research Organisation (CSIRO) Marine and Atmospheric Research and the Antarctic Climate and Ecosystems Cooperative Research Centre. He has published across a broad range of topics in oceanography; his area of expertise is the role of the ocean in climate, particularly anthropogenic climate change. He is co-editor of the book *Ocean Circulation and Climate* (2001)[1]. He was co-chair of the international Scientific Steering Group for the World Ocean Circulation Experiment from 1994 to 1998 and is now chair of the Joint Scientific Committee of the World Climate Research Programme (WCRP). He has been a Principal Investigator on NASA/CNES Topex/Poseidon and Jason-1 Science Working Teams since 1987. He was co-convening lead author for the chapter on sea level in the Intergovernmental Panel on Climate Change (IPCC) Third Assessment Report. He co-chaired the recent WCRP Understanding Sea level Rise and Variability Workshop, hosted by the IOC in Paris, France.

John Church was awarded the 2006 Roger Revelle Medal by the Intergovernmental Oceanographic Commission of UNESCO in 2006 and was the recipient of a CSIRO Medal for Research Achievement in 2006. The 2006 Roger Revelle Lecture he presented at the IOC's Thirty-ninth Executive Council and the report from the sea level workshop form the basis of this report.

1. *Ocean Circulation and Climate*, G. Siedler, J. Church, and J. Gould, (eds), Academic Press, 2001.

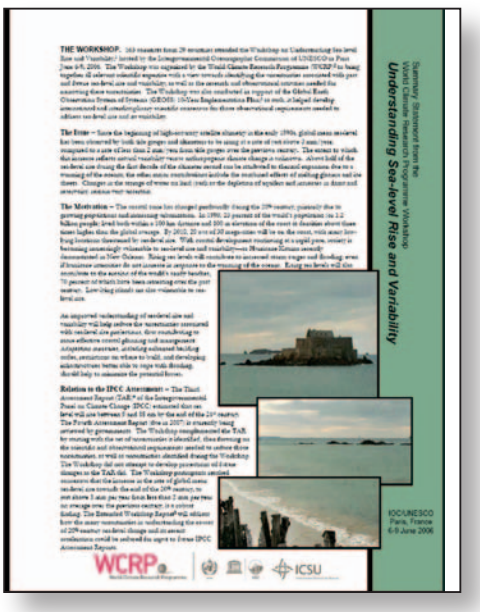
The oceans are a central part of the global climate system. As Roger Revelle, one of the founders of the Intergovernmental Oceanographic Commission of UNESCO, said many years ago, 'The oceans exert a profound influence on mankind and indeed upon all forms of life on Earth. The oceans are inexhaustible sources of water and heat, and control the climate of many parts of the world.' Revelle also recognized that 'human beings are now carrying out a large-scale geophysical experiment of a kind that could have not have happened in the past nor be reproduced in the future'. These ideas have even more importance today as we continue to alter the Earth's atmosphere with far reaching consequences for climate, conditions in the ocean and at the coast, and the habitability of our planet. What will be the impact of this experiment? What are the consequences?

One of the major consequences of climate change is rising sea levels, the focus of a World Climate Research Programme Workshop hosted by the IOC in 2006, and opened by the Executive Secretary of IOC, Patricio Bernal. The WCRP and IOC, with the generous support of the conference co-sponsors, were able to bring together many of the world's leading scientists, representatives of developing nations, and students to the workshop in Paris.

Does rising sea level matter?

We love the ocean and the coasts. Millions of people are crowded along the coastal fringes of continents, attracted by recreational opportunities, coastal and deep-sea fishing and rich fertile land. In excess of 150 million people live within 1 metre of high tide level; 250 million within 5 metres of high tide [1]. Many of the world's megacities, cities with populations of many millions, are situated at the coast, in addition to coastal infrastructures worth billions of dollars.

The impacts of sea level rise include inundation of low-lying coastal regions, particularly during extreme sea level events, coastal erosion of beaches, saltwater intrusion into coastal aquifers, deltas and estuaries, damage to coastal ecosystems, water resources and coastal infrastructure. Coastal regions at most risk include heavily populated deltaic regions, small islands, especially atolls, and sandy beaches backed by major coastal developments, and of course a number of the world's megacities located on the coast.



The statement from the WCRP Understanding Sea Level Rise and Variability Workshop, hosted by the IOC in Paris, is available at http://wcrp.wmo.int/AP_SeaLevel.html. A full meeting report will be published by Blackwell Publishing.

Fig. 1. Billions of dollars of coastal infrastructure has been built immediately adjacent to the coast. *(Photo of the Gold Coast, Australia by Bruce Miller.)*

Has sea level changed in the past?

Sea level has varied by over 100 metres during glacial-interglacial cycles as the major ice sheets have waxed and waned. Sea level was about 4 to 6 metres above present day values during the last interglacial period, when Greenland was about 3 °C warmer than today. Meltwater from the Greenland ice sheet was probably the largest single contributor to this higher sea level [2]. During the last ice age, sea level fell to more than 120 metres below present day levels as water was stored in the North American, the Northern European and the Antarctic ice sheets. As the ice melted, starting around 20,000 years ago, sea level rose rapidly at average rates of about 10 mm/yr (1 metre/century), and with peak rates of the order of 40 mm/yr (4 metres/century), until about 6,000 years ago [3].

The last few thousand years

Over the last 6,000 years, sea level rose much more slowly, with a decreasing contribution in the last few thousand years. Sea level data inferred from the location of ancient Roman fish tanks dated about 2,000 years before present indicate that there has been little net change in sea level from that time until the start of the nineteenth century [4]. Changes in local sea level estimated from sediment cores collected in salt marshes [5,6,7] have revealed an increase in the rate of sea level rise in the western and eastern Atlantic Ocean during the nineteenth century or early twentieth century, consistent with the few long tide gauge records from Europe and North America.

The rate of sea level rise over the last 20 years is 25 per cent faster than any rate during the previous 115 years, almost twice as fast as the average over the twentieth century, which was in turn an order of magnitude larger than the rate of rise over the two millennia prior to the eighteenth century.

The historical record

Coastal and island tide gauge data show that sea level has risen by just under 20 cm between 1870 and 2001, at an average rate of 1.7 mm per year during the twentieth century and an increase in the rate of rise over this period [8], consistent with the geological data and the few long records of sea level from coastal tide gauges (Figure 2). From 1993 to the end of 2006, near global measurements of sea level (between 65 °N and 65 °S) made by high quality satellite altimetres (and estimates from coastal and island tide gauges) indicate global average sea level has been rising at 3.1 ± 0.4 mm per year [9]. The uncertainty estimates of about 0.4 mm/yr relate primarily to satellite calibration and reference frame issues. The rate of sea level rise over the last 20 years is 25 per cent faster than any rate during the previous 115 years, almost twice

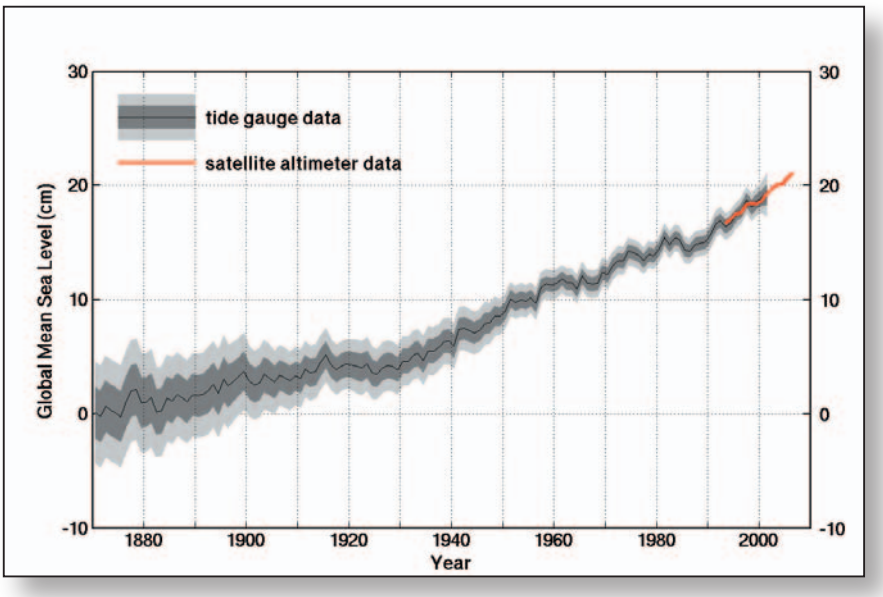


Fig. 2. Global averaged sea levels from 1870 to 2006 as inferred from tide gauge data (black, with 66% and 95% confidence limits given in dark and light shading) and satellite altimeter data (red). (Updated from Church and White, 2006 [8])

as fast as the average over the twentieth century, which was in turn an order of magnitude larger than the rate of rise over the two millennia prior to the eighteenth century.

Why is sea level rising?

The two major reasons for sea level rise are thermal expansion of ocean waters as they warm and an increase in the ocean mass, principally from land-based sources of ice (glaciers and ice caps and the ice sheets of Greenland and Antarctica). Global warming from increasing greenhouse gas concentrations is a significant driver of both contributions.

From 1955 to 1995, ocean thermal expansion is estimated to have contributed less than 25 per cent of the observed rise [10]. However, for 1993 to 2003, when the best data are available, thermal expansion is estimated to be significantly larger at about 50 per cent of the observed sea level rise of 3.1 mm per year [11]. The melting of glaciers and ice caps (excluding the glaciers surrounding Greenland and Antarctica) contributed about 25 per cent of the observed rise for both the 1961 to 1990 period and the satellite altimeter period since 1993 [12].

The ice sheets of Antarctica and Greenland [13] have the potential to make the largest contribution to future sea level rise, but they are also the greatest source of uncertainty. Since 1990, there has been increased accumulation at high elevation on the Greenland ice sheet, while at lower elevation there has been more widespread surface melting and a significant increase in the flow of outlet glaciers. The net result is a decrease in the mass of the Greenland ice sheet – a positive contribution to sea level rise. For the Antarctic ice sheet, there is greater uncertainty. Over recent years, increased glacier flow on the Antarctic Peninsula and the West Antarctic ice sheet are thought to dominate increased thickening of the East Antarctic ice sheet. There are insufficient data to make direct estimates over the preceding decades but modelling studies suggest that the Antarctic ice sheet is still responding to changes since the last ice age and thus contributing to sea level rise.

The difference between the sum of the contributions to sea level rise and the observed rise from 1993 to the present is smaller than the estimated errors. However for the 1961 to 2003 period, ocean thermal expansion and the melting of glaciers and ice caps and a reasonable allowance for an ice sheet contribution do not adequately explain the observed rise [14]. One possible reason for this discrepancy is the inadequate ocean database, particularly for the deep and southern hemisphere oceans, leading to an underestimate of ocean thermal expansion. Recent studies are revealing [15], and beginning to develop ways to deal with, long-term instrumental biases. Early results in our own studies are suggesting that allowing for these issues as well as the inadequate historical ocean database may lead to some reduction in these discrepancies. Of course there is also an inadequate database for assessing historical changes in the cryosphere. Changes in the terrestrial storage of water (changes in lakes, building of large and small dams, seepage into aquifers and mining of ground water) may also be important but the sum of these contributions in poorly known. Model studies suggest significant interannual variability of the climate related components of terrestrial water storage but with little long-term trend [16].

Projections of future sea level change

During the twenty-first century, sea level will continue to rise due to warming from both past (twentieth century and earlier) and twenty-first century greenhouse gas emissions. Ocean thermal expansion is likely to be the dominant contribution to twenty-first century sea level rise, with the next largest contribution coming from the melting of glaciers and ice caps.

Recent estimates indicate that non-polar glaciers and ice caps may contain only enough water to raise sea level by 15 to 37 cm [13]. As they melt in a warming climate, the glaciers at lower altitude and latitude reduce in size significantly, reducing their contribution to the rate of sea level rise.

For Greenland [13], both glacier calving and surface melting contribute to mass loss. Over the last few decades surface melting has increased and is expected to dominate over increased snowfall leading to a positive contribution to sea level during the twenty-first century. For the majority of Antarctica [13], present surface temperatures, and those projected for the twenty-first century, are too cold for significant melting to occur. Antarctic precipitation is balanced by glacier flow into the ocean. For the twenty-first century, climate models project an increase in snowfall, resulting in increased storage of ice in Antarctica, partially offsetting other contributions to sea level rise. However, this increase in precipitation has not been observed to date.

In addition to these surface processes, there are indications of a potential dynamical response of the Greenland and Antarctic ice sheets. In Greenland, there was a significant increase in the flow rate of many of the outlet glaciers during the early twenty-first century. One potential reason is increasing surface melt making its way to the base of the glaciers, lubricating their flow over the bedrock, consistent with increased glacier flow during the summer melt season [17]. However, a recent study has shown the flow rate of at least two of these glaciers has recently decreased to near their earlier rates, suggesting that there is significant short-term variability in glacier flow rates [18].

Another potential factor is the role of ice shelves in restraining the flow of outlet glaciers. The rapid break up of the Larsen B ice shelf in the Antarctic Peninsula was followed by a significant increase in the flow rate of the glaciers previously feeding this ice shelf, suggesting that the ice shelves played a role in restraining the flow of the outlet glaciers [19]. However, some modelling studies suggest this is a transient acceleration. Another important consideration is that the West Antarctic ice sheet is grounded below current day sea level. As the ice sheet thins and starts to float, warm ocean water can penetrate beneath and enhance melting at the base.

All of these dynamic ice sheet processes, in both Greenland and West Antarctica, could lead to a greater rate of sea level rise than in current projections. However, the processes are inadequately understood and are not included in the current generation of ice sheet models. It is therefore not possible to make robust quantitative estimates of their twenty-first century and longer-term contributions to the rate of sea level rise.

Projections of twenty-first century sea level rise

The Intergovernmental Panel on Climate Change (IPCC) provides the most authoritative information on projected sea level change. The IPCC Third Assessment Report (TAR) of 2001 projected a global averaged sea level rise of between 20 and 70 cm between 1990 and 2100 using the full range of IPCC greenhouse

From the start of the IPCC projections in 1990 to 2006, observed sea level has been rising more rapidly than the central range of the IPCC model projections and near the upper end of the total range of the projections [20] shown in Figure 3, indicating that one or more of the model contributions to sea level rise is underestimated.

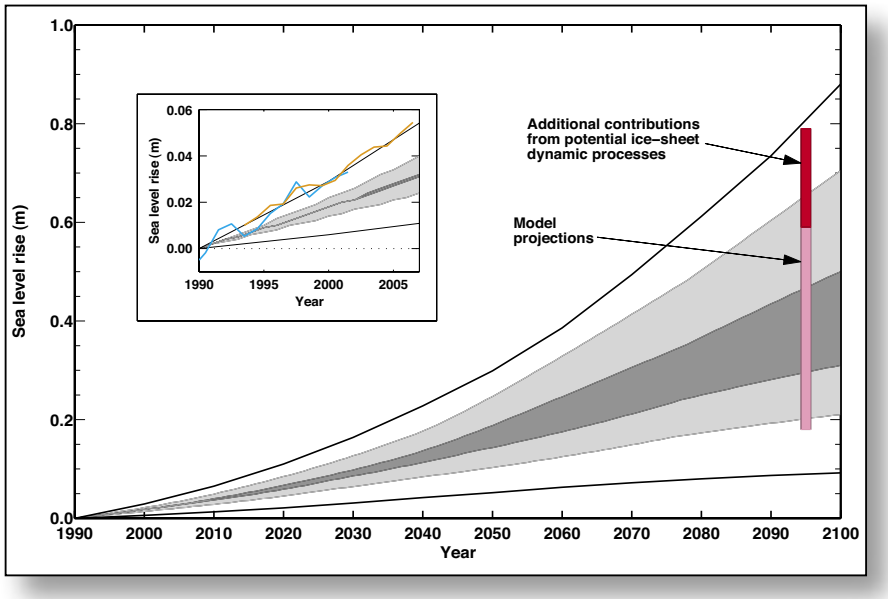


Fig. 3. Projected sea level rise for the twenty-first century. The projected range of global averaged sea level rise from the IPCC 2001 Assessment Report [3] for the period 1990 to 2100 is shown by the shaded regions. The updated AR4 IPCC projections made in 2007 are shown by the bars plotted at 2095: purple bar for the model projections (90% confidence limits) and red bar for the potential but poorly quantified additional contribution from a dynamic response of the Greenland and Antarctic ice sheets to global warming [14]. Note that the IPCC AR4 states that 'larger values cannot be excluded, but understanding of these effects is too limited to assess their likelihood or provide a best estimate or an upper bound for sea level rise.' The inset shows the observed sea levels from tide gauges (blue) and satellites (orange) tracked along the upper bound of the IPCC 2001 projections since the start of the projections in 1990. Based on Church et al. 2001[3]; information added from IPCC 2007 [14] and Rahmstorf et al. [20]

gas scenarios and a range of climate models [3]. When an additional uncertainty for land-ice changes was included the full range of projected sea level rise was 9 to 88 cm. For the IPCC's Fourth Assessment Report (AR4) [14], the sea level projections using a much larger range of models are 18 to 59 cm (90 per cent confidence limits) over the period from 1980-2000 to 2090-2100. Allowing for the ice sheet uncertainties discussed above, IPCC AR4 increased the upper limit of the projected sea level rise by 10 to 20 cm and stated that 'larger values cannot be excluded, but understanding of these effects is too limited to assess their likelihood or provide a best estimate or an upper bound for sea level rise.' While the TAR and AR4 projections are somewhat different in how they treat ice sheet uncertainties and the confidence limits quoted, a comparison of the projections (Figure 3) shows the end results are somewhat similar, except that the lower limit of the TAR projections has been raised from 9 to 18 cm.

Fig. 4. One example of the impacts of extreme events has been the devastation left by Hurricane Katrina. *Photo Courtesy of U.S. Army*

From the start of the IPCC projections in 1990 to 2006, observed sea level has been rising more rapidly than the central range of the IPCC model projections and near the upper end of the total range of the projections [20] shown in Figure 3, indicating that one or more of the model contributions to sea level rise is underestimated. Indeed in recent work, a simple statistical model relating twentieth century surface temperature change to twentieth century sea level change suggests that the projected surface temperature increases may lead to a twenty-first century sea level rise as large as 1.4 metres [21], somewhat larger than the IPCC projections.

Longer-term projections

For the next few decades, the rate of sea level rise is partly locked in by past emissions, and will not be strongly dependent on early twenty-first century greenhouse gas emission. However, sea level projections closer to and beyond 2100 are critically dependent on future greenhouse gas emissions, with both ocean thermal expansion and the ice sheets potentially contributing metres over centuries for higher greenhouse gas emissions. There is increasing concern about the longer-term contributions of the ice sheets. For example, for the Greenland ice sheet, a global average temperature increase relative to pre-industrial values of greater than 3.1 °C (with a range of 1.9 °C to 4.6 °C) leads to surface melting exceeding precipitation, resulting in an ongoing wastage of the Greenland ice sheet for centuries and millennia [22], consistent with sea levels in the last interglacial being several metres higher than today's value. This threshold or 'tipping point' could potentially be crossed late in the twenty-first century if effective mitigation measures are not adopted. A second cause for concern is associated with the poorly understood dynamic responses of the Greenland and West Antarctic ice sheets (as discussed above) that could lead to a significantly more rapid rate sea level rise than from surface melting alone.

The regional distribution of sea level rise

Climate variations and change cause the redistribution of ocean volume and sea level. From 1993 to 2006, the rate of sea level rise was not uniform [23]. There were much larger values approaching 20 mm/yr, or ten times the global average, in the western Pacific Ocean and the eastern Indian Ocean, and lower values in the eastern Pacific Ocean and the western Indian Ocean. There are even regions where sea level fell during this period. This pattern of sea level rise is a result of natural

variability, including the transition from El Niño-like conditions at the start of the altimeter record to more La Niña-like conditions at the end of the record.

When zonally averaged around the globe, the maximum rates of sea level rise were at mid to high latitudes in both hemispheres. That is at the location of the Kuroshio in the North Pacific and the Antarctic Circumpolar current in the Southern Ocean. In the Southern hemisphere this is associated with changes in the wind patterns and a poleward movement of the major oceanic features. The sea level change associated with changing ocean temperatures is very similar to that for total sea level change, indicating that the pattern of sea level rise is largely associated with changing ocean temperatures. Clearly, changes of sea level in deep ocean regions are critical for understanding coastal impacts.

Climate change, including the impact of sea level rise, will be felt most acutely through extreme events.

At this stage there is no agreed pattern for the longer-term regional distribution of projected sea level rise although there are several common features in model projections (for example, a maximum in sea level rise in the Arctic Ocean and a minimum in the Southern Ocean south of the Antarctic Circumpolar Current [24]).

The large transfers of mass from the continents to the oceans associated with glacial interglacial conditions mean large changes in the surface load of the Earth and as a result vertical movement of the Earth's surface. The Earth is still responding to the changes that have occurred since the last glacial maximum. Far from the former ice sheets, these land motions are small, perhaps a few tenths of a millimetre per year, often with the land rising. Present day changes of surface loading also contribute to large-scale vertical motion of the Earth's surface [25].

Vertical land motion also occurs on a regional and local scale. Withdrawal of groundwater and drainage of susceptible soils can cause significant subsidence. Subsidence of several metres during the twentieth century has been observed for a number of coastal megacities. Reduced sediment input to deltas is an additional factor that causes loss of land elevation relative to sea level.

Extreme events

Climate change, including the impact of sea level rise, will be felt

Fig. 5. Flood victims collecting survival assistance, Bangladesh, August 2004. *© World Food Programme*

most acutely through extreme events. One example of the impacts of extreme events has been the devastation left by Hurricane Katrina. The Bay of Bengal with its low-lying deltas has been an area of major impact of coastal storm surges. Here there have been 23 surge events that have killed at least 10,000 people (per event) since 1937, with over 300,000 people killed in 1970.

There have been few global scale studies of changes in extreme events because of the difficulty of assembling a global high-frequency data set. The few studies to date indicate that there has been a trend towards increased frequency of extreme events of a given level over the last several decades for many locations, i.e. these locations are experiencing more frequent coastal flooding events [26]. However, the few studies of sea level extremes have generally not yet indicated an increase in the intensity of extreme events compared to a changing mean sea level.

Any increase in the intensity of tropical cyclones [27,28], as indicated in some analyses of observations and as suggested should occur in theoretical studies, will result in a further increase in the intensity of extreme coastal flooding events. However, this area remains controversial and affected by the changing quality of historical data over time. This is clearly an area of major importance in need of urgent attention.

Improving our ability to adapt to sea level rise

Adaptation to both increases in sea level and any change in extreme events requires local planning based on local scientific information. Providing this local information requires improving our understanding at local, regional and global scales and across a wide range of scientific disciplines. The WCRP sea level rise workshop hosted by the IOC agreed on the priorities for research and observations (see the Workshop Statement available at http://wcrp.wmo.int/AP_SeaLevel.html).

A major concern is: 'will we pass a tipping point during the twenty-first century leading to essentially unstoppable melting of the Greenland ice sheet and a sea level rise of several metres from Greenland melting alone?'

Of prime importance is the development of the Global Climate Observing System, including the Global Ocean Observing System. An open data policy is needed with timely, unrestricted access for all. Efforts in data archaeology to extend records back in time with quality control are also needed. To the extent possible, satellite observations need to be as continuous as possible, with overlap between successive missions and coincident with the collection of appropriate *in situ* observations.

Priorities include sustained, systematic observations of:

- Sea level (extension of the Jason series of satellite altimetres and completion of the Global Sea Level Observing System (GLOSS) network of tide gauges, with absolute positioning and real-time data availability).
- Ocean volume (the Argo array of profiling floats for the upper ocean and its extension to ice covered regions and the design and implementation of a deep ocean observing system).
- Ocean and terrestrial mass (observations of the time-varying gravity field to contribute to estimating changes in terrestrial water storage, ice sheet mass balance and changes in oceanic mass).
- Ice sheet and glacier topography and thickness and ice velocity.
- Two-dimensional surface water levels on land.

These observations need to be done in the context of a strengthened International Terrestrial Reference Frame. Of course these observation programmes must be backed by ongoing research and improvement in climate and ocean models and analyses.

Key Messages

There is clear scientific consensus that sea level is rising in response to past emissions of greenhouse gases from human activity. At the same time, we are living ever closer to the coast and coastal development is continuing to occur. Many of the world's major megacities are on the coast and growing rapidly. These developments will make the issue of climate change and sea level rise even more acute.

If we only stabilize greenhouse gas emissions, sea level will continue to rise from ocean thermal expansion and melting of the Greenland ice sheet. These trends would result in sea levels rising metres over hundreds of years.

A major concern is: 'will we pass a tipping point during the twenty-first century leading to essentially unstoppable melting of the Greenland ice sheet and a sea level rise of several metres from Greenland melting alone?'

It is important to recognise that the ocean and the ice sheets have long response times. Stabilization of greenhouse gas concentrations (requiring a reduction in emissions) would result in surface temperatures rising at a much slower rate for decades. However, ocean thermal expansion only decreases slowly and thus sea level rise will continue (albeit more slowly) for centuries. Lower greenhouse gas stabilization

concentrations would result in less ocean thermal expansion.

These long response times mean that no matter how successful we are in mitigating the emission of greenhouse gases, we will need to adapt. The impacts of sea level rise will be felt most acutely through extreme events – coastal flooding events of a given level will occur more frequently and the largest flooding events will be more severe. Least developed countries and the poor are most at risk. Increasing numbers of environmental refugees will be an inevitable consequence of continued sea level rise. Environmental refugees are a here and now issue; it is not 'if' but when, where and how will we respond.

Successful adaptation could significantly reduce the impacts of sea level rise. For adequate adaptation planning, we need to narrow the current uncertainties and we need to develop partnerships between science, governments, business and the community. It is important we start planning early. One example of early planning is the investment of billions of pounds to upgrade the Thames Barrier (Figure 6) to protect the City of London from rising sea levels and storm surges.

Sea level rise is happening now and is beginning to have real impacts. It is an issue for the here and now, for the twenty-first century and for the long term.

A personal outlook

I wonder what Roger Revelle would think today? When he made his prophetic statement about a grand experiment with Planet Earth about fifty years ago, he did not know the consequences of the experiment or its impact on humanity. We are slowly learning what the consequences might be. This knowledge is revealing the need to determine more precisely the results of the experiment, for urgent action to mitigate and avoid sea level rise of metres, and to adapt to the impacts of climate change, including sea level rise. The IOC has an important leadership role in these actions. It is critical that the IOC recognises and addresses these challenges.

Acknowledgements

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Fig. 6. Plans are being formulated to upgrade the Thames Barrier to protect the City of London from rising sea levels and storm surges. *Photo courtesy of Brian Micklethwait*

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Policy

Mandate and Summary of 2006
Global results and achievements

The IOC of UNESCO is the United Nations' focal point for Ocean Sciences and Ocean Services. Our mission is to foster intergovernmental cooperation and improve governance through ocean sciences and services by focusing on four high-level objectives, namely:

(i) Prevention and reduction of the impacts of natural hazards;
(ii) Mitigation of the impacts and adaptation to climate change and variability;
(iii) Safeguarding the health of oceans ecosystems;
(iv) Management procedures and policies leading to the sustainability of coastal and ocean environment and resources.

The need to respond to the global challenges arising from marine environmental degradation and pollution, biodiversity losses, and natural hazards, while facing the increasingly complex challenges of sustainable development and ecosystems-based management shapes the work of the IOC and its main lines of action.

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

For the year 2006, SISTER performance indicators conclude that the IOC's programme (net) was implemented at a rate of 53 per cent, against a theoretical target of 52 per cent [1]. Further detailed indicators are listed next in the IOC's summary of activities, following each Main Line of Action (MLA).

1. MLA 1, 54%; MLA 2, 58%; MLA 3, 47%.

MAIN LINE OF ACTION: 1

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

The IOC effectively contributes to the coordination of scientific research tackling climate change issues and to the sustainable development of the open and coastal ocean. The reorganization of the Ocean Sciences section in June 2006 reflected the IOC's greater selectivity in activities that strengthen its programme and increase the effectiveness of everything it does. This strategy has improved the communication of research and policy-relevant results to address climate change and sea level rise and manage the marine environment, including coastal indicators in cooperation with several national agencies.

During 2006:

- The IOC's **International Ocean Carbon Coordination Project** and the **EU CarboOcean programme** brought together 23 scientists from 9 countries to establish joint international working groups to examine the ocean's role in absorbing CO_2 from the atmosphere. These working groups will focus on two areas of the ocean that represent some of our largest uncertainties for ocean uptake of CO_2: the Nordic Seas and the Southern Ocean.
- The IOC-sponsored **World Climate Research Programme** implemented a workshop at IOC on Understanding Sea Level Rise and Variability, bringing together 163 scientists from 29 countries to identify the uncertainties associated with past and future sea level rise and variability, as well as the research and observation activities needed for narrowing these uncertainties. The workshop was conducted in support of the Global Earth Observation System of Systems (GEOSS) 10-year implementation plan; as such, it helped develop international and interdisciplinary scientific consensus for those observation requirements needed to address sea level rise and variability.
- *A Handbook for Measuring the Progress and Outcomes of Integrated Coastal and Ocean Management*, published in 2006, was tested in seven integrated coastal area management programmes around the world; contacts are ongoing for its implementation in five countries of Latin America and five countries in the Western Indian Ocean.

Expected result

International cooperation reinforced on scientific research in marine environment.

Progress achieved as related to SISTER performance indicators:

- **Number of publications and references to IOC documents in UN documents and in scientific and international literature**: Thirteen technical reports or online tools have been produced and fifty-eight peer-reviewed articles from IOC-sponsored activities have been published; all technical and scientific articles from sponsored projects acknowledge UNESCO-IOC for support.

- **Quality of participation in IOC conferences, meetings, panels and working groups:** Joint research activities were carried out in the sea level programme, ocean CO_2 programme, climate and fisheries programme, coral bleaching programme, and coastal nutrient export programme. Networks were maintained and enhanced in the sea level observing system, ocean CO_2 observing network, Global Coral Reef Monitoring Network (GCRMN), and Harmful Algal Bloom (HAB) network. The IOC developed a comprehensive report on *Seamounts, Deep-Sea Corals and Fisheries: Vulnerability of deep-sea corals to fishing on seamounts beyond areas of national jurisdiction* to integrate and improve the management of risks to the marine biodiversity of seamounts, cold-water coral reefs and certain other underwater features.

Expected result

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

Progress achieved as related to performance indicators:

- **Tools and guidelines for ICAM**: In October 2006, the *Handbook on Indicators for Measuring the Progress and Outcomes of Integrated Coastal and Ocean Management* was released in its final version. Organization is underway for the development of 'Guidelines for Mainstreaming Awareness and Mitigation of Marine-related Hazards and Risks in Integrated Coastal Area Management' with a view to promoting proactive approaches to long-term planning in the coastal zone, also as a contribution to the IOC's tsunami activities.
- **Application of IOC guidelines for ICAM plans**: The *IOC Handbook on Indicators* was tested in seven integrated coastal area management programmes around the world (Canada, Chile, China, France, Germany, Thailand, and the Wadden Sea area) with very positive feedback. As a result of the test, it is being utilized for a project in cooperation with the Belgian Flemish Community to promote ICAM approaches and indicator-based state of the coast reports in Chile, Colombia, Ecuador, Panama, and Peru. In this context, the Handbook will be translated into Spanish, while plans are being discussed with Brazil for a translation of the handbook in Portuguese and with the ReCoMaP project in the Indian Ocean for its application in Comoros, Kenya, Madagascar, Mauritius, Seychelles, and Tanzania (with translation into French).
- **ICAM projects carried out:** Implementation of the project on Adaptation to Climate Change in Coastal Zones (ACCC) project (PDF-B) in Cape Verde, Gambia, Guinea Bissau, Mauritania and Senegal is continuing. In cooperation with UNDP, a preliminary project proposal to GEF has been drafted on Mainstreaming Climate Risks and Adaptation into Integrated Coastal Area Management Strategies in the Indian Ocean region, targeting Bangladesh, India, Maldives, Sri Lanka, and possibly Pakistan.

MAIN LINE OF ACTION: 2

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

(i) Developing operational capabilities for the management and sustainable development of the open and coastal ocean

The Global Ocean Observing System (GOOS) continues to make important progress. Its mission is to design and implement an integrated system of data collection and distribution, through the global coordination and enhancement of national ocean observing systems and the creation of specific data products. Coordinating the open ocean component of GOOS largely takes place through the WMO-IOC Joint Technical Committee for Oceanography and Marine Meteorology. There are rapidly growing commitments among Member States towards *in situ* ocean observation platforms, data management and international data exchange facilitated by IODE, and ocean products and services. The coastal component of GOOS is building momentum through an increasing number of GOOS Regional Alliances.

During 2006:

- The second session of JCOMM in 2005 set a work plan for operational oceanography and marine meteorology for the four-year period 2005-2009. In executing the plan, in 2006 the global drifting buoy array reached its design goal of 1,250 buoys in sustained service, thus being the first component of GOOS to be completed;
- More than 2,700 Argo profiling floats have been deployed since initiation of the project in 2001 and a substantial number of sea level stations upgraded to real-time data

2. http://ioc3.unesco.org/oopc/state_of_the_ocean/

delivery in support of tsunami warning systems (28 in the Indian Ocean);
- **Global Chlorophyll Pilot Project** launched;
- **GOOS Regional Forum** (Cape Town, South Africa, 14-17 November) held;
- **Coastal GOOS Implementation Strategy** published (GOOS Report 148)
- State of the ocean and climate indices website launched[2].

Expected Result

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

Progress achieved as related to performance indicators

Enhanced international collaboration to observe the global oceans and coasts:
The GOOS Regional Forum was considered to be the best such meeting yet convened. The report is in preparation and implementation follow-up is being monitored. Substantial work has been done in designing a list of activities that will only be possible with infusion of extrabudgetary funds. A guest editorial was published in *Science* magazine to widely publicize this effort. The JCOMM Management Committee meeting and two programme area coordination group meetings (data management; services and products) were held to advance international coordination of operational oceanography and marine meteorology. The Observing System Monitoring Centre (OSMC) database of the experimental near-real-time system monitoring tool for use by observing system managers became operational. The JCOMM Management Committee meeting and two Programme Area Coordination Group Meetings (Data Management; Services and Products) were held to advance international coordination of operational oceanography and marine meteorology. In the same period, the Observing System Monitoring Centre (OSMC) database of the experimental near-real-time system monitoring tool for use by observing system managers become operational.

(ii) Developing and strengthening a global mechanism to ensure full and open access to ocean data and information for all

The IOC's International Oceanographic Data and Information Exchange (IODE), was tasked by the IOC to support the development of GOOS and the international scientific programmes of IOC and WMO in building a sound knowledge base by providing advice and ocean data management services. During 2006, the IODE's contributions to GOOS became fully operative.

Expected Result

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

Progress achieved as related to performance indicators

Improved accessibility to ocean data, both historical and real time operational:
The goal of 1,250 buoys deployed within the Global Drifting Buoy Array has been reached and maintained; 250 more Argo profiling floats have been deployed; 28 sea level stations have been upgraded to real time data delivery in the Indian Ocean. To enhance IODE contributions to GOOS, a new prototype system for a globally accessible data portal, OceanDataPortal[3], and three clearing house services are fully operational: OceanExpert[4] (a global directory of marine scientists and institutions); OceanDocs[5] (an e-repository of publications in marine science and oceanography), and; OceanTeacher[6] (an e-learning and expert system for marine data and information management). Seventeen training courses, addressing mainly countries participating in the ODINAFRICA Project, have been carried out, and planning has started for the development of standards and best practices for the exchange and dissemination of oceanographic data and information.

(iii) Prevention and mitigation of tsunamis and other marine hazards

One of the IOC's most significant achievements in 2006 was the completion of the initial **Indian Ocean Tsunami Warning System** (IOTWS), followed by the establishment of **tsunami intergovernmental coordination groups** in the Pacific, Northeast Atlantic and Mediterranean, and Caribbean Regions. This rapid advancement would not have been possible without the generous contributions of Member States and donor agencies.

The IOTWS is composed of networks of detection, operated through international cooperation. Twenty-eight national tsunami centres, under the authority of each national government, are responsible for issuing warnings in their respective territories, as well as communicating with local authorities, the media and endangered populations. The Java Tsunami on 17 July 2006 again stressed the urgent need to be prepared for these unpredictable events.

Two key objectives now remain to improve data sharing policies to allow for the transmission of real-time data, and ensure that national authorities communicate vital information effectively to communities at risk along the coast. The **Global Consortium on Tsunami Re-**

3. http://e2edm.vliz.be/iserv/ or http://www.oceandataportal.net
4. http://www.oceanexpert.net
5. http://www.oceandocs.net
6. http://www.oceanteacher.org

covery was created in April 2006 to assist Indian Ocean Member States implement national end-to-end tsunami warning systems in harmony with the Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWS) implementation plan for the establishment of a regional tsunami warning system.

Expected Result

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

Progress achieved as related to performance indicators

Protection of vulnerable coastal communities to ocean related hazards, in particular tsunamis:

- An initial warning system has been in place since July 2006 with 28 new tide gauges, 26 new seismic stations and 4 deep ocean pressure sensors coordinated by the ICG/IOTWS. This regional network of instruments can record and measure offshore earthquakes with increased precision and detect any tsunamis triggered by the seismic event. While waiting for the full development of the system in 2007-08, tsunami information bulletins for the Indian Ocean nations are currently being provided by the existing centres operating under the IOC (the Pacific Tsunami Warning Center in Hawaii and the Japan Meteorological Agency in Tokyo).
- The IOC created a Tsunami Coordination Unit to direct the tsunami programme and assist Member States. During 2006, it conducted an innovative capacity-building programme, including training courses, national assessment missions, emergency standard operating procedures, and multi-language educational toolkits (*TsunamiTeacher*). In addition to the Indian Ocean effort, the IOC continues to coordinate and support the establishment of tsunami early warning systems: an implementation plan and a list of institutions qualifying to operate as regional tsunami watch centres have been adopted for the Mediterranean, Northeast Atlantic and Adjacent Seas (NEAMTWS); an implementation plan has been adopted for the Caribbean (CARIBE-EWS); the system in the Pacific Ocean (PTWS) continues and is being updated. Finally, preparation for a coordination mechanism on the global scale is well underway.

Expected Result

Disaster prevention and preparedness, including tsunami warning system.

Progress achieved as related to performance indicators

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

- A dozen technical training courses on tsunami modelling and seismic analysis.
- Nineteen national assessment missions on tsunami warning and mitigation capacity.
- Development of emergency standard operations procedures for Indonesia.
- Creation of *TsunamiTeacher*[7]: a multi-purpose educational toolkit in English and Bahasa Indonesia (translations into more languages underway), including segments for media, school and the general public.
- Producing and distributing educational materials on tsunamis in several Indian Ocean languages.

MAIN LINE OF ACTION: 3

Developing the capacity and effectiveness of Member States in marine scientific research, and in the management and sustainable development of the open and coastal ocean

(i) Capacity of Member States in marine science for the coastal ocean strengthened

The challenges of developing scientific capacity vary within each region or country. However, limited human and financial resources, insufficient experience/training in leadership of scientific organizations, and lack of individuals experienced in the process of developing and submitting internationally competitive funding proposals are frequently common issues. While upholding the traditional principles and strategy for capacity-building, the IOC envisions greater potential for future success by developing the 'self-drive' of countries and research institutes. As such, the individual scientist, research organization or society will be empowered to develop capacity independently, and be capably equipped to adapt and renew approaches as the institutional environment changes. Unfortunately, the IOC faces significant obstacles given the limitations of both its financial and human resources and consequently may find its leadership role in the international arena seriously compromised.

During 2006:

- Leadership development workshops for directors were held in three IOC regions and were a catalyst for collaboration, improving regional networks of institutes through the development of funding proposals for regional capacity-development projects.
- The completion of the ADRICOSM project enhanced capacity for integrated coastal waters management in the Adriatic Sea.
- Travel grants were distributed (with co-financing from ESA and PORSEC), and Training-Through-Re-

7. http://ioc.unesco.org/TsunamiTeacher

search cruises were conducted through the support of partnerships.

Expected Result
Marine scientific research capacities enhanced.
Progress achieved as related to performance indicators

Level of capacity-building interventions steered and harmonized according to IOC capacity-building principles:
All capacity-development activities implemented following the principles of capacity-building approved by the Twenty-third Session of the IOC Assembly in 2005.

Level, number, and type of capacity-building interventions using technology for synoptic understanding and prediction of the coastal ocean:
Institutes in Eastern Africa developing regional projects that enhance their modelling capacity to understand and predict the coastal ocean.

Level, number, and type of capacity-building interventions empowering IOC constituencies:
Three leadership development workshops for directors held in three IOC regions. Directors and senior decision-makers from more than fifty institutes have benefited from this training. Regional networks of institutes were enhanced through the collaborative development of proposals for funding regional capacity-development projects. The completion of the ADRICOSM project enhanced capacity for integrated coastal waters management in the Adriatic Sea. Twenty-two travel grants were distributed (with co-financing from ESA and PORSEC). The fifteenth and sixteenth Training-Through-Research cruises were conducted with partners.

(ii) Developing ocean governance issues, and increasing the effectiveness of the governing bodies of the Commission

- The IOC *Criteria and Guidelines on Transfer of Marine Technology and Procedure for the Application of Article 247 of UNCLOS by IOC* were distributed through international fora and the internet.
- A website was established to serve as clearing-house mechanism for requests of technology transfer among Member States and to compile IOC information related to the implementation of UNCLOS.
- There was progress in discussions on the legal framework, within the context of UNCLOS, which is applicable to the collection of oceanographic data at the six and seventh meetings of IOC/ABE-LOS, in which the participation of Member States has remarkably increased in both quantity and quality.
- An IOC/ABE-LOS roster of experts was established to respond rapidly to requests by Member States for advice or guidance on the development of legislation and practice regarding marine scientific research and transfer of marine technology.

Expected Result
Capacities built to implement the articles on Marine Scientific Research (Part XIII) and Transfer of Marine Technology (Part XIV) of UNCLOS.
Progress achieved as related to performance indicators

Technical, legal and scientific information provided:
Through a newly established website[8], the IOC is providing information on marine scientific research and transfer of marine technology according to the provisions of the Law of the Sea, including a compilation of national legislation and an analysis of the practice of Member States in these fields.

Technical advice provided:
A roster of nationally-designated experts was established to facilitate and promote the development and conduct of marine scientific research and transfer of marine technology, especially in developing countries. The list of Experts on Marine Scientific Research for Special Arbitration Purposes was updated according to Article 2.2 of Annex VIII of UNCLOS.

Capacity-building modalities implemented:
Through the IOC/ABE-LOS website, a mechanism to address the demands of technology transfers from Member States according to the *IOC Criteria and Guidelines on Transfer of Marine Technology* was developed. A Partnership among IOC-NEPAD and UNEP/GRIDA was established for technical assistance and raising public awareness.

8. http://ioc3.unesco.org/abelos/index.php

IOC Programme **sections**

overview

Capacity development

Supporting self-drive of marine science institutes to improve research capacities

BY EHRLICH DESA
Head of Section

Summary of significant developments

The Capacity-Development section was engaged in two major activities in 2006.

1. Leadership and Marine Action Planning workshops

The section coordinated these workshops, made possible due to a generous grant from the Swedish International Development Cooperation Agency, throughout various developing regions in order to strengthen marine science institutes. The workshops were conducted by professionals and designed to augment leadership skills of directors, proposal-writing skills of project leaders and teamwork of project scientists. These capacity-development initiatives are demonstrating major changes of attitude in the participants. In effect, the self-drive of institutes is being effectively challenged and stimulated, as witnessed by their initiatives in moving to the next stage of the process: finding the resources to address their prioritized capacity-development needs.

2. Training, Education, and Mutual Assistance [TEMA]

This long-established IOC programme was enhanced in many ways but trimmed in some others. The **Training-Through-Research** programmes that provide young scientists with the opportunities to participate in science-at-sea remained a major draw for young scientists. There are now four university-at-sea initiatives that impact an increasing variety of graduates. **Education** in marine sciences, supported by IOC designated university chairs, was more clearly harmonized with UNESCO's university education twinning and networking scheme, UNITWIN, along with fellowship and partnership programmes. The IOC provided some financial support for proposals received from the Chairs. In a similar way that the IOC Chairs Programme supports established academics, the IOC Travel Grants gave young researchers opportunities to present original research findings at conferences. **Mutual assistance** was best evidenced by the NEPAD-COSMAR effort to raise awareness of African Member States on the datelines to submit claims for extensions of their country's legal continental shelf. The New Partnership for Africa's Development (NEPAD) Coastal and Marine Programme (NEPAD COSMAR) brought African States that were experienced in this process side-by-side to the table with those that have yet to start their surveys. A second project in mutual assistance was ADRICOSM-EXT, the Italian Government funded transfer-of-technology project. This project is continuing the implementation of a state of the art monitoring and forecasting system for marine coastal areas and river catchments of countries bordering the Adriatic Sea.

By December 2006, four leadership workshops had been conducted in three regions: East Africa, the Caribbean, and Latin America. Valuable information on institutes and scientific capacities was collected in the Western Indian Ocean, the Caribbean region and Latin America. Visits after the workshops gave further insights on the institutes through discussions with directors and scientists and were an important guide in evaluating the effectiveness of IOC capacity-development activities.

Three Marine Action Planning sessions were also held immediately after each leadership workshop. These sessions provided the leads to the next steps in the process: bid-writing workshops.

(Above) Participants at the Zanzibar Leadership Workshop for directors in the Western Indian Ocean region.

East Africa

The first and second East African leadership workshops were conducted in Mozambique and Zanzibar in November 2005 and October 2006 respectively. The two events were organized and co-financed in partnership with NEPAD-COSMAR (Coastal and Marine Sub-theme of NEPAD Environment Programme) and WIOMSA (Western Indian Ocean Marine Sciences Organization). Directors and senior scientists from twenty key institutions in Kenya, Mauritius, Mozambique, Seychelles, South Africa and Tanzania participated in these workshops. Discussions during the Marine Action Planning session were particularly productive, as regional leaders in marine sciences prioritized a list of actions and datelines for developing tools in understanding and managing coastal processes.

Indicators of initiatives traceable to the workshops are:

- Following the workshop, the Institute of Marine Sciences (IMS) at the University of Dar-es-Salaam, Tanzania, reviewed and revised its strategic plan leading to the integration and characterization of research and training areas. Increasing the number of physical oceanographers was seen as being an important first step. IMS therefore hosted a stakeholders' meeting to present a proposal for a regional syllabus linked with the School of Ocean Sciences, Bangor, Wales. The lack of regional experts in computer modelling in various applications was also identified as critical for the region. IMS will host a national training workshop in numerical modelling and a sabbatical visit by a physical oceanographer under the U.S. National Sciences Foundation programme.
- After the second workshop, participants at the Marine Action Planning session prioritized two areas for improvement: excellence in science, and improvement in the sharing of resources through networking. Coastal modelling pilot projects were identified as the means of improving the quality of both.

The Caribbean

The first Caribbean leadership workshop was conducted in Kingston, Jamaica, 12-15 September. It was attended by eighteen senior scientists working in marine science institutes in the islands, as well as a representative each from Cape Verde, Fiji, Mexico, and Nigeria. The out-of-region representatives are planning similar workshops in their regions. About 50 per cent of participants made a full or partial contribution towards the cost of their attendance.

Leadership Workshop for directors of the English-speaking Caribbean region in Kingston, Jamaica.

Indicators of initiatives traceable to the workshops are:

- The University of Trinidad and Tobago (UTT) offered to host a training workshop in modelling, GIS and Remote Sensing, and improve the use of its remote sensing facilities by neighbouring island communities.
- The Faculty of Science and Agriculture of the University of The West Indies (UWI) in Trinidad and Tobago is pursuing the funds for its academic and senior administrative staff members to attend a similar leadership workshop.
- The Caribbean Regional Fisheries Mechanism is seeking funds to conduct a similar leadership workshop for its fisheries managers in 2007.

Latin America

The first Latin American leadership workshop for twenty heads of institutions in the non-English speaking Caribbean and Latin American region was held in Havana, Cuba, 30 November-4 December. Directors and senior scientists from Argentina, Brazil, Chile, Colombia, Cuba, Ecuador, Mexico and Peru attended. During the mapping session, directors identified three main areas as promising for the development of regional initiatives in capacity-development: fisheries and aquaculture, integrated coastal zone management, and extreme events. They also drafted a list of actions and an associated timetable for the way forward in these areas.

Leadership Development Workshop for directors in Havana, Cuba.

Indicators of initiatives traceable to the workshops are:

- Participants volunteered their institutes to host following workshops, and also to be the network contacts for the projects.
- Feedback from the participants indicates that the lessons learnt were immediately tried out in their workplaces and a great sense of personal learning and effectiveness is being reported. First results show improved communications in strategy planning and budgetary meetings, and improvements in building teams with senior staff in the institutes.

2. Harmonisation of capacity-development activities

A team-building workshop for IOC professionals was conducted on 19 June in Paris to coordinate IOC capacity-development activities. The workshop has resulted in marked improvements in the exchange of country and constituency information between various IOC programmes and sections. The UNESCO Science Sector and the UNESCO Institute for Statistics collaborated on approaches of how best to assess the capacity of marine science institutes to conduct research and operations. Cross-sectoral collaboration was further pursued within UNESCO, in the UNITWIN and UNESCO Chairs programme.

3. Training, Education, and Mutual Assistance (TEMA) initiatives

TEMA initiatives in training and education impact a limited number of young scientists from developing and developed countries in a substantive manner. However, even this limited reach may be reduced in 2007 because of budgetary cuts.

Training

There are presently four Training-through-Research at sea [TTR] programmes.

The University of Moscow, Russia and the National Oceanographic Centre, Southampton, UK, continued the 'original' TTR programme with three major activities jointly organized during 2006:

- A TTR15 post-cruise international conference on 'Geological Processes on Deep-Water European Margins' was held in Moscow, Russia, 29 January-4 February, devoted to the fifteenth anniversary of the TTR programme. The conference reviewed the achievements during the TTR cruises and outlined directions for future activities.
- TTR16 cruise was conducted 15 May-2 July. Thirty students participated in the cruise devoted to studying the geological processes of the Western Mediterranean Sea, the Gulf of Cadiz and the Norwegian Margin. The first results will be presented at the TTR16 Post-cruise conference in January 2007, Germany. TTR16 contributed to the training objectives of the EU funded HERMES (Hotspot Ecosystem Research on the Margins of European Seas) project to study ecosystems along Europe's deep-ocean margin.
- A capacity-development field workshop was held in Morocco, 1-5 December. Fourteen M.Sc. students from the Universities of Rabat and Tangier and fifteen students and resource people from Belgium, Italy, Mauritania, Mozambique, the Netherlands and Russia participated in the workshop. A post-graduate course in Marine Geology was launched in 2006 as a result of the capacity-building actions in Morocco, in cooperation with Ghent University, Belgium. The Flanders Fund-in-Trust provided the funding.

The Russian State Hydrometeorological University (RSHU) has been coordinating the Baltic Floating University (BFU) to train young researchers in collecting and analyzing hydrometeorological and environmental data since its establishment in 1993. Over 200 students and young researchers from 24 countries of Africa, Asia, and Europe have participated to date. Mid-cruise seminars at ports-of-call provide for enhanced regional cooperation and knowledge sharing. Shipboard seminars and round-table discussions give participants a challenging opportunity to discuss cruise research results.

BFU conducted a two-ship field programme at sea, 11-27 July, with nineteen students participating from Germany, Portugal, Russia and Spain. The two-ship operation involved a sailing catamaran in coastal waters and an oceanographic vessel in the deep Baltic Sea. The research focused on marine environmental conditions as well as collecting sea-truth for satellites (a task assigned to the IOC Chair in Remote Sensing and Modelling in Oceanography at RSHU). The BFU Research Bulletin (published annually, in English) is a forum for researchers and students of the participating countries to present the results of the BFU research.

The Caspian Fisheries Research Institute based in Astrakhan, Russia, has been coordinating the Caspian Floating Uni-

The Baltic Floating University (BFU) trains young researchers in collecting and analyzing hydrometeorological and environmental data.

Photo by RSHU

versity (CFU) to upgrade the professional abilities of students and young scientists since it was launched in 1999. Since its start, over 150 students have participated in field programmes and about 600 have participated in ten post-cruise and thematic workshops, seminars and conferences. CFU research is based on an integrated multidisciplinary approach to ecosystem studies. The training cycle includes participation in expeditions/fieldworks, mastering the methods of data collection and processing, and courses on environmental issues of the Caspian Sea. CFU results are published in the Caspian Floating University Research Bulletin (three issues since 2000) and other journals.

Senior researchers and young local scholars studied marine science issues of direct interest to the Asia-Pacific region during two short cruises in 2006 on board the Research Vessel *Marion Dufresne*.
© LEGOS.

The University of Sydney, Australia, in coordination with the IOC and several leading universities and research institutions in the Asia-Pacific region brought students from the region on board the French Research Vessel *Marion Dufresne* for two short cruises. This replication of the TTR programme in South East Asia has been dubbed the 'University of the Sea' [UoS]. UoS brings together senior researchers and young local scholars to address marine science issues of direct interest to the region. During the two cruises to date, about forty young students from eleven countries spent three weeks living and working together on the ship, immersed in an environment of scientific discovery. They have been involved in research projects that include understanding the role of the Western Pacific Warm Pool in global climate change; the sources and magnitude of sediment flux to the Gulf of Papua during the last glacial-interglacial cycle; climate records from the sediments of the New Caledonian basin; and sampling geochemical tracers of gas hydrates. They gained skills in navigation, multi-beam seafloor mapping, seismic profiling, plankton sampling, seafloor sampling and analysis.

Other TEMA training activities included:

- In partnership with the European Space Agency, the Korean Aerospace Research Institute and the Pan-Ocean Remote Sensing Conference, the IOC organized a training course in Remote Sensing for young scientists in Asia, 25-27 October in Daejeon, South Korea.
- The IOC participated in the drafting of the capacity-building strategy of the Group on Earth Observations (GEO), through exchanges with the drafting team and participation in the second meeting of the GEO Capacity-Building Committee in Brussels, Belgium, 14-15 September.

Education in TEMA

The TEMA initiatives in education continued with support to the five IOC Chairs, and travel grants disbursed to scientists from developing countries to attend conferences.

IOC Chairs

1. Since the academic year 2005, the Chair in Oceanography at the University of Concepción, Chile, has incorporated its activities into the Austral Summer Institute (ASI) held every January at the University of Concepción. During the last four years, 213 graduate and senior undergraduate students from 16 countries have participated. These activities have involved 39 lecturers from the renowned institutions of 9 countries, and have resulted in educational opportunities for students, and the scientific interaction of local faculty members with international institutions.
2. The UNESCO/IOC Chair at Moscow University, Russia, has been consistently active with activities as described under the Training-Through-Research Programme above.
3. The Chair in Marine and Coastal Sciences at Eduardo Mondlane University, Mozambique, is devoting its efforts to building capacity of the newly established School of Marine and Coastal Sciences at Quelimane, Mozambique. The Chair has applied for support to several organizations and is expecting to participate in the Agulhas/Somali Large Marine Ecosystems (LME) Programme.
4. The UNESCO/IOC Chair at Tbilisi State University, Georgia has demonstrated its full ability to participate usefully in international programmes, such as the IOC's Floating University Training-through-Research (TTR) Programme, and provide a rewarding experience for the students from Georgia. Based on these indicators, and the actual needs of Georgia for young specialists trained in marine resource prospecting, the IOC recommended the Chair activities to be supported in the UNESCO Participation Programme.
5. A new Chair has been established at the Russian State Hydrometeorological University, St Petersburg, Russia, in Remote Sensing and Modelling in Oceanography.

Travel grants

A dozen travel grants were awarded this year, in addition to the ten students from South and South East Asia that were supported to attend the training course on Remote Sensing in Daejeon (see above). Feedback from several grant recipients stresses the importance of the opportunity that the travel grant provided for their careers. Two former recipients, F. E. Msuya from Tanzania and Nguyen Van Quan from Viet Nam, cited recent peer-reviewed publications for which their IOC travel grants had been essential.

Mutual assistance in TEMA

Mutual assistance was best evidenced by regional initiatives in Africa (for extensions of countries' legal continental shelves), and in the Adriatic Sea region (in monitoring and forecasting marine coastal areas and river catchments).

African claims for legal extension of continental shelves beyond 200 miles

The United Nations Convention on the Law of the Sea [UNCLOS] enacted the orderly transfer and use of planetary resources to coastal States, without recourse to conflict. A majority of coastal States in Africa signed this Convention, providing them with seabed resources seaward of their low-tide line up to 200 nautical miles, with possible extensions to 350 miles under special conditions.

In spite of this only a few States (Kenya, Mauritius, Namibia, Nigeria, South Africa, and the Seychelles are examples) have programmes underway to meet this deadline. Having created the awareness at the highest decision-making level, and set in motion the complex process leading to submission, it is an expensive journey that can take several years of dedicated manpower for data collection, scientific analysis, and interpretation to support submissions.

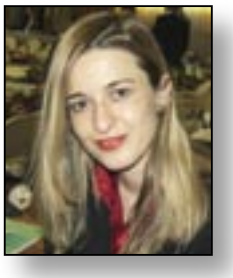
In view of this situation, the Coastal and Marine Programme (COSMAR) of NEPAD understood the need to move outside the 'business-as-usual' scenario and accelerate the process of raising awareness, developing the required capacity, and stimulating Member States to make their submissions to the Commission on the Limits of the Continental Shelf (CLCS). Therefore COSMAR, through the IOC, convened an urgent meeting at IOC headquarters in Paris, France, on 19 December. It was attended by representatives from Angola, Republic of the Congo, Kenya, Nigeria, Senegal, South Africa, and the United Nations Environment Programme Global Resource Information Database (UNEP-GRID). Participants realized the urgency and possible lost opportunity, and agreed to a set of actions in an attempt to salvage the situation. The first action agreed upon was to mount an awareness campaign at Addis Ababa, Ethiopia, where an African Union meeting will be held in January 2007.

Raising monitoring and forecasting capacities in the Adriatic Sea region

The ADRICOSM-EXT project was the Italian Government's contribution to the World Summit on Sustainable Development (WSSD) Type II Initiative involving all Adriatic countries. It enlarged the scope of monitoring and forecasting systems for marine coastal areas and river catchments. The IOC contribution was in the overall coordination and training on data management for real-time and historical data archiving, and training in data mapping and numerical modelling.

The ADRICOSM-EXT project concluded in December 2006, having successfully advanced scientific collaboration between Albania, Bosnia-Herzegovina, Croatia, Italy, Serbia and Montenegro and Slovenia for improved management of coastal areas of the Adriatic Sea. Near-real-time and forecasting data and maps of key oceanographic variables are available online from the ADRICOSM website (http://www.bo.ingv.it/adricosm/), and these products are now incorporated in the Mediterranean Operational Oceanography Network (MOON). In coordinating this project, the IOC took advantage of its strong experience in data management through its Ocean Data and Information Network (IODE/ODIN) Programme. An IODE instructor familiarized ADRICOSM participants with IODE tools and techniques. The facilities and organization were provided by the International Centre for Theoretical Physics in Trieste, Italy, a UNESCO Category I institute.

An urgent deadline for coastal States: 13 MAY 2009



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The 1982 United Nations Convention on the Law of the Sea (UNCLOS) Article 76 is the international legal framework that provides the basis for States in the exercise of their rights and duties in the use of the ocean and in the exploitation of its resources. In particular, it provides for the delimitation of maritime zones, including territorial waters, exclusive economic zones, and extended continental shelves beyond the limit of 200 nautical miles from the shore. The Convention is unique in history, because among other things it provides for the orderly transfer and use of planetary resources to States, without recourse to conflict.

Out of 39 coastal States in Africa, 33 have signed the Convention, which avails them of the right to claim seabed resources seaward of their low-tide line beyond 200 nautical miles, with possible extensions to 350 nautical miles (approximately 650 km). The expected benefits of the delineation to coastal States are enormous in terms of resources in the seabed and subsoil, the most important of which include oil and gas, minerals, gas-hydrates and pharmaceutical resources.

However, claims over the extended continental shelf up to 350 nautical miles, unlike other zones that are automatic jurisdictions, are subject to submission of scientific proof of the natural prolongation of terrestrial land into the sea. Submissions must be made to the UN Commission on the Limits of the Continental Shelf (CLCS) no later than May 2009, after which time parties may forfeit the chance to claim.

Coastal States around the world are in a rush to meet this deadline and secure their ocean resources for future generations. Nevertheless, the situation in Africa is worrying as there is limited awareness about the impending deadline and the possible loss of opportunity. Only a few countries including Kenya, Nigeria, and South Africa have active ongoing delineation programmes.

In view of this urgent situation, the Intergovernmental Oceanographic Commission of UNESCO jointly with NEPAD Coastal and Marine Coordinating Unit (NEPAD COSMAR) within the NEPAD Eastern Africa Secretariat and GRID/ARENDAL of the United Nations Environment Programme (UNEP), established a partnership to work on this matter during a meeting in Paris on 19 December to explore modalities of fast-tracking the delineation process in Africa. Recognizing the urgency, participants agreed to a set of measures in an attempt to salvage the situation.

Since that date, these organizations have been coordinating efforts to stimulate African States to make timely submissions for extensions of their continental shelves. The IOC´s mission is to sensitize the coastal States of Africa about the UNCLOS provisions on delineation of the continental shelf and the urgent need for them to make their submissions to the UN Commission on the Limits of the Continental Shelf (CLCS) by May 2009. Towards this goal, the IOC, together with its partners, attended the African Union Summit held in Addis Ababa, Ethiopia, in January 2007 and is working at creating decision makers' awareness at the most important African international fora.

The potential benefits for African Countries through the extension, if any, of the limits of their continental shelves are enormous. The resources possibly contained therein are still unknown; however, the last two decades have witnessed an increasing drive for wealth from surrounding seas. As a result, offshore oil and gas today provide 25 per cent of world production and account for about the same proportion of the world's known reserves. Drilling in deeper waters continues to reveal important new resources – oil fields, gas hydrate deposits, and extreme organisms whose bio-activity is opening up new pharmaceutical and industrial opportunities.

The last two decades have witnessed an increasing drive for wealth from surrounding seas.

overview

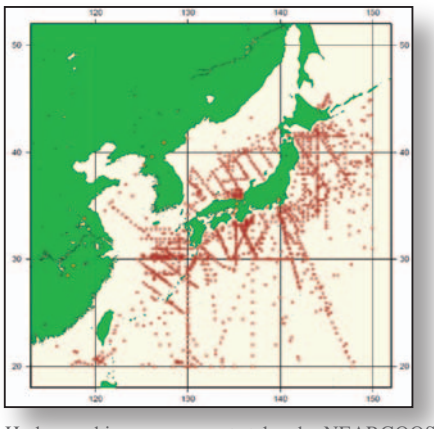
Ocean observations and services

KEITH ALVERSON
Head of Section

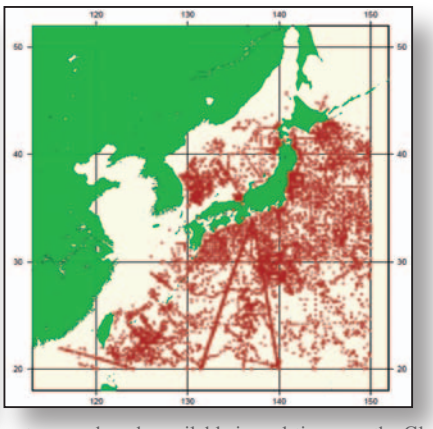
Ocean observations by themselves are of little value unless they are brought together in products and services that benefit people. Open access archives and standards of exchange are of little use without observing systems to populate them with data. Operational systems cannot exist without data exchange and scientific guidance. This is why, in 2006, the Intergovernmental Oceanographic Commission of UNESCO brought two of its intergovernmental programmes – for data exchange (IODE) and global observations (GOOS) as well as the joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM) – together into a single section. These three entities will now be able to work together more efficiently and develop mutual synergies. At the same time, there is an opportunity to rethink their organization, streamlining redundant structures and sharing responsibilities. After all, the three are intergovernmental bodies and the dozens of subsidiary task teams, groups of experts and regional guidance bodies being supported by the section are working to achieve a single mutual goal: to enable the international cooperation required to sustain, and make accessible, global observations of the oceans. In order to focus on this goal, our section needs to concentrate on activities that clearly and quantifiably help to achieve it. To achieve this focus we must reduce our confusing web of governance and guidance structures. By doing less we can accomplish more.

The Ocean Observations and Services (OOS) section can point to a number of major accomplishments in 2006. One of the most apparent has been the emergence of the GOOS Regional Alliances as true workhorses powering the implementation of GOOS at the GOOS Regional Forum in Cape Town, South Africa in November. Thorkild Aarup provides further details on this success in a following article. One example of such success at the level of GOOS Regional Alliances comes from North East Asia GOOS (NEARGOOS). The figure on the facing page shows the dramatic increase in hydrographic measurements taken by NEARGOOS partners and made available in real-time over the Global Telecommunications System (GTS) in 1996 (Panel A) as compared to 2006 (Panel B) and to the total measurements in 2006, including those shared amongst partners regionally but not available over the GTS (Panel C). Progress has indeed been dramatic.

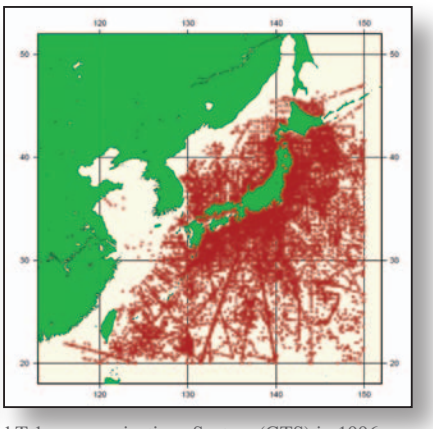
Panel A



Panel B



Panel C



Credit: T. Yoshida

Hydrographic measurements taken by NEARGOOS partners and made available in real-timeover the Global Telecommunications System (GTS) in 1996 (Panel A) as compared to 2006 (Panel B) and to the total measurements in 2006, including those shared amongst partners regionally but not available over the GTS (Panel C).

For the coming year OOS has a number of challenges to face. These include:

(1) Ensuring the activities of JCOMM and IODE are tailored in support of GOOS so that OOS moves forward as an integrated effort.
(2) Increasing intergovernmental commitments to cooperate in sustaining GOOS, exchanging ocean data and developing ocean products and services.
(3) Building upon the JCOMM *in situ* Observing Platform Support Centre (JCOMMOPS), in order to develop a robust technical support centre for the global module of GOOS.
(4) Reaching out as widely as possible, including to governments, industry and the public, to increase the awareness of the many economic and societal benefits that the ocean observing system provides.
(5) Engaging proactively in the International Polar Year and using this opportunity as a catalyst for building a legacy of sustained observing systems in the Arctic and Southern Oceans.

Photo by Terry Joyce, Woods Hole Oceanographic Institution

Meetings

- The ninth meeting of the GOOS Scientific and Technical Committee (GSSC), 6-8 March, Paris, France;
- The eleventh meeting of the Ocean Observations Panel for Climate, 16-20 May, Tokyo, Japan;
- International Conference on Understanding Sea Level Rise and Variability, 6-9 June, Paris, France;
- The fifth session of the JCOMM Management Committee, 5-7 October, Geneva, Switzerland;
- The Third GOOS Regional Alliance Forum, 14-17 November, Cape Town, South Africa.

Reports from these and all other meetings coordinated by, or participated in by, the Ocean Observations and Services section are available on the GOOS, IODE and JCOMM websites:
http://ioc.unesco.org/goos
http://ioc.unesco.org/iode
http://ioc.unesco.org/jcomm

Publications

The Secretariat was active in publicizing the work of GOOS, IODE and JCOMM in 2006. Outreach publications included:

Alverson, K. and D.J. Baker. 2006. Taking the Pulse of the Oceans. *Science*, Vol. 314, no. 5806, p. 1657.

Alverson, K. 2006. GOOS Can Help to Keep an Eagle Eye on the Oceans. *Nature*, Vol. 403, p. 148.

The Secretariat also published a number of reports in the past year. Highlights included:

Understanding the Role of the Indian Ocean in the Climate System – Implementation Plan for Sustained Observations. GOOS Report No.152.

Report of the Ninth session of the IOC-WMO-UNEP-ICSU Scientific Steering Committee of the Global Ocean Observing System (GOOS). GOOS Report No. 151.

A full list of publications is available on the GOOS, IODE and JCOMM websites.

Links with Partner Programmes

The Ocean Observations and Services section continues to participate actively in joint activities with a number of partner organizations. Highlights from 2006 included:

- On behalf of the Executive Secretary of IOC, the OOS section head took on the rotating co-chairmanship of the Integrated Global Observing Strategy Partners (IGOS-P) and chairmanship of the United Nations Interagency Coordination and Planning Committee for Earth Observations (ICPC).
- On behalf of the Executive Secretary of IOC, the OOS section head served as an *ex-officio* member of the Joint Scientific Committee for the International Polar Year.
- GOOS has remained actively engaged as the oceanic component of The Global Earth Observing System of Systems (GEOSS) and participating organization in the Group on Earth Observations (GEO).
- JCOMM continues to enable regular cooperation with the World Meteorological Organization (WMO).

The IOC welcomes two new specialists to Ocean Observations and Services

In January 2007, TOM GROSS joined the Paris IOC Secretariat office as an Ocean Observations and Services Programme Specialist. He will be responsible for coordinating the Global Ocean Observing System (GOOS) outreach efforts to focus a clear and accessible image of the GOOS purpose, products and method. Tom received his degree from the University of Washington, Seattle, USA, and has worked in the fields of ocean turbulence observations, sediment transport, bio-physical modelling, larval transport and hydrodynamic modelling. Most recently he was with the National Oceanic and Atmospheric Administration (NOAA) in Maryland, USA, working with real-time hydrodynamic modelling and web services at the Office of Coast Survey and the Chesapeake Community Model Programme (CCMP). Through the CCMP, Tom became a strong advocate of the power of open source development techniques to build communities and hopes to bring those methods to bear on improving access to the GOOS network of ocean assets.

HESTER VIOLA began work as the Technical Coordinator of the Data Buoy Cooperation Panel (DBCP) and Ship Observations Team (SOT) in mid-2006, at the Toulouse, France, office within the JCOMM *in situ* Observing Platform Support Centre, JCOMMOPS. She is from Australia, where she worked for the last few years at the Australian Bureau of Meteorology, in Melbourne. Hester has degrees in meteorology and Geographic Information Systems (GIS) from the University of Melbourne and a Master of Information Technology degree from Monash University. At the Australian Bureau of Meteorology, she worked on data management, Geographic Information Systems, web development and project management. Working within the JCOMMOPS team, she will aim to meet the immediate needs of the DBCP and SOT, and also address the many wider issues that face marine observing systems in the years ahead.

EDITORIAL

Keith Alverson is director of the Global Ocean Observing System and head of Ocean Observations and Services at the IOC of UNESCO, 1 rue Miollis, 75732 Paris, Cedex 15, France. E-mail: k.alverson@unesco.org.

D. James Baker is a former undersecretary for Oceans and Atmosphere and administrator of the National Oceanic and Atmospheric Administration and is currently a consultant at the IOC of UNESCO. E-mail: djamesbaker@comcast.net

Taking the Pulse of the Oceans

UNDERSTANDING HUMAN IMPACT ON THE GLOBAL ENVIRONMENT REQUIRES ACCURATE AND integrated observations of all of its interconnected systems. Increasingly complex models, running on ever more powerful computers, are being used to elucidate dynamic links among the atmosphere, ocean, earth, cryosphere, and biosphere. But the real requirement for integrated Earth system science is a systematic, sustained record of observations, starting from as early as we can get quantitative information and extending reliably into the future. In particular, the ocean is critically undersampled both in space and time, and national and intergovernmental observational commitments are essential for progress.

Ocean basins cover most of the planet and are filled with circulating turbulent fluid whose behavior can be modeled only by approximation. For instance, we talk of a "conveyor belt," but this is an unrealistic cartoon of actual turbulent circulation, which by transporting heat and fresh water affects the planet's climate. Knowledge about the true variability of the circulation remains elusive because long-term systematic observations are lacking.

Any seafarer knows that although one can look up from the deck of a ship and see the Moon clearly through 100 km of atmosphere, one cannot look down and see further than 1 m. Because the ocean is opaque to all wavelengths of electromagnetic radiation, Earth-observing satellites can't see below the surface either. Thus, much of the ocean must be observed from a patchwork of drifting and moored buoys, neutrally buoyant floats, coastal installations, and ship-based measurements.

Great recent progress has been made with each of these individual observing-system components. The launch of the 1250th drifting surface buoy in Halifax Harbor last year completed a network that is vital for tropical storm track prediction. The rapidly expanding international network of Argo floats has rewritten our knowledge of the temperature and salinity of the upper oceans. Moored buoy arrays in the tropics have made seasonal climate and El Niño prediction a real possibility. With tide gauges reporting in real time, not only can we predict coastal inundation hazards, but we can also disentangle the myriad processes involved in changing global sea level. Although observing the ocean is challenging, in particular cases it can be done well.

Courtesy of GFZ, Potsdam

For 15 years, a global ocean-observing system under the auspices of the Intergovernmental Oceanographic Commission (IOC) of the United Nations' Educational, Scientific, and Cultural Organization (UNESCO) has been meeting important needs of global society. However, surprisingly little progress has been made toward a truly global system with long-term funding commitments. Lacking such a system and commitments, critical scientific hypotheses will remain untested.

The IOC is now working with the Global Earth Observation System of Systems (GEOSS) to identify national focal points for ocean observation efforts and to integrate these efforts into a truly global system. Unfortunately, there is still no plan for sustaining individual measurement programs, for integrating them into a coherent observing system, or for supporting them with stable funding. With a few notable exceptions, substantial multilateral government support for coordination and integration remains elusive.

To address this flaw, we propose the development of a UNESCO convention that commits nations to sustaining an integrated ocean-observing system that will lead to better understanding of the ocean and at the same time enable the provision of hazard warnings, monitoring of climate change, and management of marine and coastal resources. UNESCO's IOC stands ready to broker the development of such a convention. Preliminary discussions, including completion of the initial GEOSS tasks in ocean observation, begin at the next meeting of the Intergovernmental Committee for the Global Ocean Observing System in June 2007 in Paris. Will your nation be at the table?

– Keith Alverson and D. James Baker

10.1126/science.1135358

CREDIT: FADLAN ARMAN SYAM/AP

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

CANDYCE CLARK
JCOMM Secretariat
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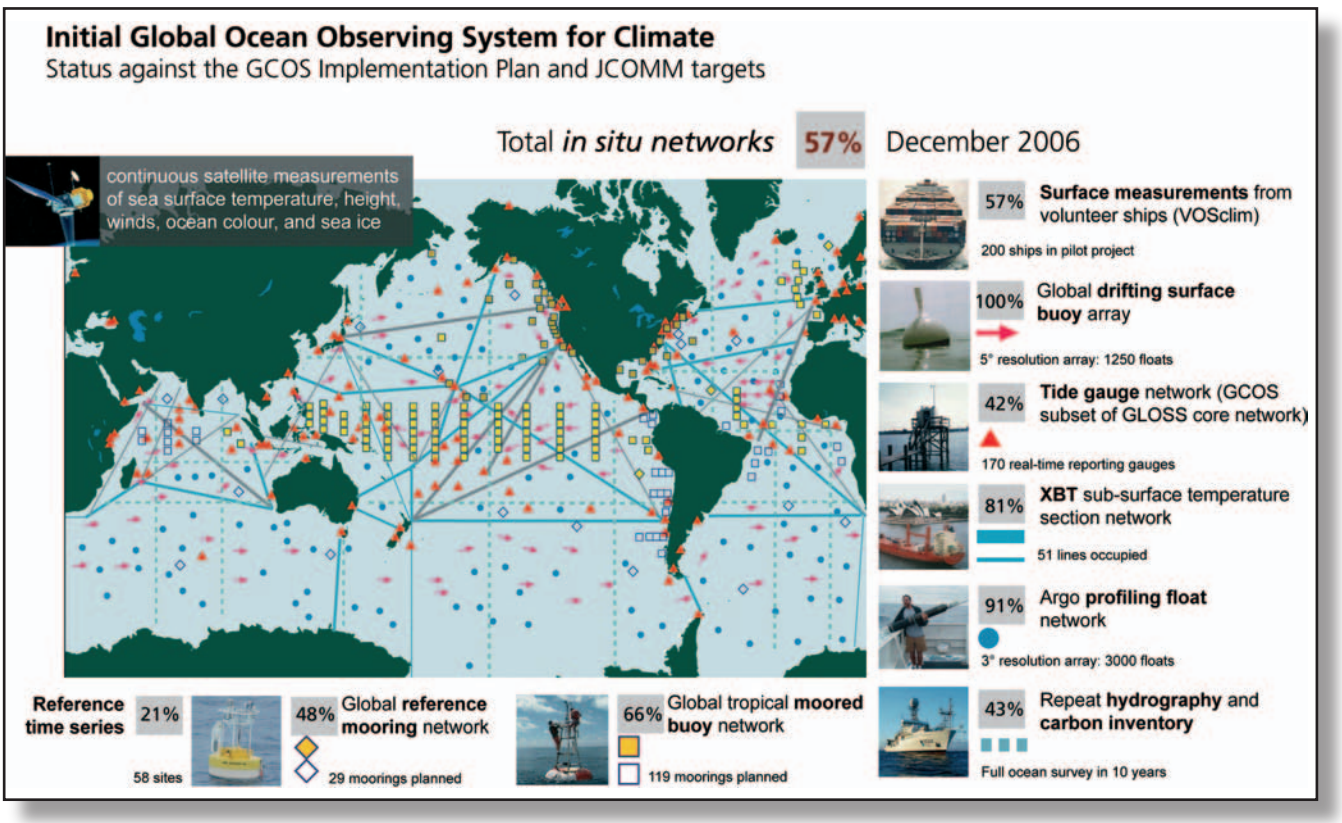
The Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM) coordinates, regulates and manages a fully integrated marine observing, data management and services system that uses state-of-the-art technologies and capabilities. It is responsive to the evolving needs of all users of marine data and products, and includes an outreach programme to enhance the national capacity of all maritime countries. It works closely with partners including: the International Oceanographic Data and Information Exchange (IODE), the Global Ocean Observing System (GOOS), and the Global Climate Observing System (GCOS).

For more information:
http://ioc.unesco.org/jcomm/

The core business of the Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM) takes place within the Observations, Services and Data Management Programme Areas. Since JCOMM-II (Halifax, Canada, September 2005), the Coordination Groups and Expert Teams have been active with plans to implement the recommendations of the JCOMM-II session, approved by the Intergovernmental Oceanographic Commission's Thirty-ninth Executive Council and the Fifty-eighth Session of the World Meteorological Organization's (WMO) Executive Council. The new or ongoing priority areas for JCOMM include:

- Continued enhancements to the observing system monitoring and performance reporting, together with proposals to further expand the work and scope of JCOMMOPS into an overall observing programme support centre, encompassing experimental and pilot observing systems such as OceanSITES and ocean carbon, as well as the existing operational components;
- Enhancing the focus of the Services Programme Area on marine service delivery (especially for maritime safety, emergency response and hazard risk reduction), accompanied by a restructuring to support the new focus, together with a new emphasis on ocean services and the follow-on to the Global Ocean Data Assimilation Experiment (GODAE), including the development of standards and recommended best practices for operational ocean products and services;
- A strategic plan for JCOMM data management is nearing completion; the JCOMM end-to-end data management pilot project is making a major contribution to the WMO Information System (WIS); and JCOMM is proceeding with the preparation of BUFR (Binary Universal Form for the Representation of meteorological data) tables for non-physical ocean variables;
- Three major scientific conferences sponsored by JCOMM are planned for the remainder of the intersessional period: a storm surge symposium, Seoul, South Korea in October 2007; the Third JCOMM Workshop on Advances in Marine Climatology (CLIMAR-III), Gdansk, Poland in May 2008; and a maritime services conference, Exeter, UK in October 2008;
- The JCOMM web presence is being substantially upgraded and unified under a new domain name (www.jcomm.info);
- A greater emphasis across JCOMM programme areas on standards and quality control practices, for observational data, metadata, products and services;
- Review and reiteration of the importance of JCOMM direct in-



Status of the global *in situ* ocean observations for climate in December 2006. The global climate component of GOOS comprises a composite network of satellite and *in situ* measurements and subsurface parametres. The *in situ* network was 56 per cent complete at the end of 2006, and will require substantial investment to reach its goal of 1,001 by 2021.

Courtesy JCOMM OPS

volvement in and input to a range of cross-cutting activities, including marine multi-hazard warning systems, the International Polar Year (IPY), the *Ad Hoc* Group on Earth Observations (GEO)/Global Earth Observation System of Systems (GEOSS), and the implementation of coastal GOOS. The Committee also supported an enhanced JCOMM interaction with other WMO technical commissions, in particular, the Commission for Basic Systems (CBS), the Commission for Climatology (CCI) and the Commission for Atmospheric Science (CAS);

- The Committee provided the co-presidents with a strong message to take to the GOOS Regional Forum in Cape Town, South Africa, 13-17 November 2006, regarding the role of JCOMM in coastal GOOS implementation, and indicating areas where JCOMM can and will provide direct input and support (including the development of new BUFR tables as noted above);
- Agreement on preparation of a JCOMM strategic implementation plan for capacity building, to be completed within three months;
- Agreement on the annotated table of contents for a JCOMM implementation plan, as well as a timetable for its preparation (by a consultant, Jim Baker) and completion (late 2007); agreement also on the preparation and implementation of a JCOMM communications strategy;
- Support for a continued and enhanced JCOMM dialogue with the private sector, as a follow-up to the recommendations of the JCOMM/GOOS/Industry task team meeting in March 2006.

Overall, it is clear that much has already been accomplished in the past year, and the Commission is well on track to achieving a substantial proportion of its objectives for the current intersessional period, despite a chronic shortfall of regular budget funding, below the required support for basic programme coordination, in both parent organizations. Efforts are underway to secure extra-budgetary funding for a range of programme implementation activities, but this still only partially addresses the problem.

Recovery of *Global Drifter 1250*: A 521-Day Journey!

After a 521-day, 14,214 kilometre journey across the Atlantic Ocean, *Global Drifter 1250* was recovered on 21 February 2007 near Brest, France. The buoy's sea surface temperature and atmospheric pressure sensors were still functioning perfectly at the time of recovery.

Fig. 1. *Global Drifter 1250* at Brest Harbour. Plenty of bio-fouling, but still ticking after a 521-day journey across the Atlantic.
(Photo courtesy of Pierre Blouch, Meteo-France)

This special buoy's odyssey began on 18 September 2005, in Halifax, Canada. Eighty-seven representatives from sixteen countries gathered to celebrate the deployment of *Global Drifter 1250* in conjunction with the second session of the Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM-II). With this deployment, the global drifting buoy array achieved its design goal of 1,250 data buoys in sustained service, becoming the first component of the Global Ocean Observing System (GOOS) to be fully implemented. This milestone also represented the first element of the Global Earth Observation System of Systems (GEOSS) to be completed.

The buoy was retrieved on 21 February 2007 by the French Naval vessel RHM *Tenace*, an open ocean tug, and was delivered to Meteo-France at Brest Harbour on 2 March 2007. The recovery was in itself a special event, since drifting buoys have seldom been recovered in the past. They usually disappear at sea. The recovery mission was organized by Pierre Blouch from Meteo-France.

In still another respect *Global Drifter 1250* proved to be a very special buoy. The average life expectancy of drifting buoys is 400 days. Yet 521 days after deployment, at the time of recovery *Global Drifter 1250* was still dutifully reporting its ocean observations via satellite communications to met-ocean centres around the world.

Discussion about the historic buoy's travels and its future immediately began to cross the internet lines. It was suggested that Global Drifter 1250 be prepared for display at the Scripps Institution of Oceanography Aquarium (the Institution in California, USA, where it was designed) for six months, and then begin a world tour of the other met-ocean centres that are collectively working to implement the Global Ocean Observing System. A plan for exhibition is being developed by the JCOMM Data Buoy Cooperation Panel.

The global drifting buoy array is one component of the ocean observation system of systems that is being implemented worldwide by the JCOMM members/Member States. The Global Ocean Observing System combines measurements from drifting and moored data buoys, profiling floats, tide gauge stations, ship based systems, and satellites to monitor and document the state of the ocean and to provide the initial conditions that drive forecast models.

Drifting buoys measure ocean temperature, currents, and atmospheric pressure. They also provide the primary calibration system, or 'ground truth', for satellite measurement of sea surface temperature. The countries participating in the Data Buoy Cooperation Panel (DBCP) of JCOMM have been working for more than ten years to collectively build the resources necessary to maintain 1,250 buoys in sustained service.

Fig. 2. The 521-day, 14,214 kilometre trackline of *Global Drifter 1250* across the Atlantic from Halifax to Brest. *(Map by Hester Viola, DBCP/SOT Technical Coordinator, JCOMMOPS)*

GOOS contributes to an assessment of 'unequivocal' warming of the global climate

ALBERT FISCHER
IOC Programme Specialist
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Improved observations of global ocean temperatures, salinity, sea level, and chemistry underpinned a number of statements and projections in the latest World Meteorological Organization (WMO)-United Nations Environment Programme (UNEP) Intergovernmental Panel on Climate Change (IPCC) report on summarizing the latest scientific knowledge of observations and projections of climate change. The report also highlighted limited data coverage in some regions. IPCC Working Group I released their approved Summary for Policymakers on 2 February 2007 at UNESCO headquarters in Paris, France, the fruit of years of work by thousands of scientists and a week-long negotiation with government representatives.

Warming of the climate system was judged by the group to be 'unequivocal', with evidence including observations of surface and subsurface ocean temperatures and rising global mean sea level (observed by satellite altimetry and tide gauges). Since 1961 the oceans have been absorbing more than 80 per cent of the heat added to the climate system, causing sea level rise through thermal expansion. Observed changes in ocean salinity confirm changes in precipitation patterns. Ocean observations also helped scientists judge it 'very likely' (greater than 90 per cent confidence) that most of the warming in the last fifty years was due to human activities.

The climate module of GOOS is designed to provide information and products for climate monitoring, forecasts, and research. It is also the ocean module of the Global Climate Observing System (GCOS). It receives scientific oversight from the Ocean Observations Panel for Climate (OOPC), supported by the Intergovernmental Oceanographic Commission (IOC) Secretariat, and is coordinated in part through JCOMM. Contributing networks implemented via national programmes include ocean satellite missions, surface drifting and profiling buoys, moorings, volunteer ship observations, sea level gauges and ship-based hydrography. Other IOC programmes that had major contributions to the science assessed by the IPCC report include the World Climate Research Programme (WCRP) and ocean carbon research and observations.

Continued accuracy in the projections will rely on a sustained observing system to underpin model development and monitoring efforts.

The IPCC report noted insufficient evidence of trends in the ocean Meridional Overturning Circulation (MOC), and limited data coverage in some regions. The *in situ* networks making up the climate module of GOOS were about 57 per cent complete at the end of 2006 compared to the scientific design goals compiled by the OOPC. Growth in coverage of some networks, such as the Argo

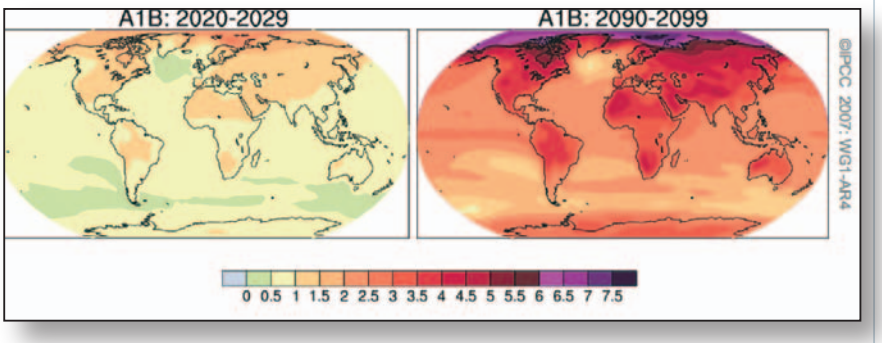


Fig. 1. IPCC projections of future increases in surface temperature based on a 'middle-of-the-road' scenario (A1B), with rapid economic growth in the twenty-first century, a global population peak mid-century before declining, rapid introduction of new and more efficient technologies, a substantial narrowing of regional differences in per capita income and a balance across all sources of energy (fossil and non-fossil).

profiling float array, the surface drifting buoy network, and GLOSS sea level gauges was impressive in 2006, but overall momentum has slowed. Many of these observations are performed with research funding, and seeking national commitments to sustained ocean observations remains a major challenge facing the climate module of GOOS.

Projections of changes in the climate are made with models whose development depends on a strong observational climate record for comparison and testing. These projections for the upcoming century include increases in surface temperature, and in the ocean's increases in temperature and global sea level, increased ocean acidity, reduction in sea ice coverage, and a slowing (but not abrupt change) of the Atlantic MOC. Even with a stabilization in greenhouse gas concentrations, warming and sea level rise are expected to continue for centuries due to the dynamical time scales of the ocean.

Regional projections of climate change were addressed in the report, and scientists had increased confidence in them compared to the last time they were assessed. But continued accuracy in the projections will rely on a sustained observing system to underpin model development and monitoring efforts.

The information provided by both the climate and coastal modules of GOOS is designed to help nations and society as a whole in understanding the impact of climate change and other variability in the ocean, and to feed into assessments of vulnerability, and adaptation and mitigation strategies. The IPCC will address vulnerability, adaptation, and mitigation in further sections of their Fourth Assessment Report to be released in 2007.

The Argo profiling float network deployed 931 floats in 2006, increasing the number of active floats from about 2,400 to 2,700 of a design goal of 3,000 (floats have a lifetime of about four years and the network needs constant replenishment). Every month, the network provides about 8,000 global profiles of the subsurface temperature and salinity in the upper 2000 m - for comparison, the eight years of the World Ocean Circulation Experiment (WOCE) programme yielded 20,000 profiles.

International Oceanographic Data and Information Exchange (IODE)

PETER PISSIERSSENS
Head of Section

The IOC Project Office for IODE, Ostend, Belgium.

Without a doubt the establishment of the IOC Project Office for IODE in Ostend, Belgium with substantial support from the Government of Flanders (Belgium) and City of Ostend has been the most important success and milestone. With the opening of the Intergovernmental Oceanographic Commission of UNESCO Project Office for IODE on 25 April 2005, the IODE programme entered a new era of capacity-building and ocean data/information services.

The main objectives of the Project Office are:

(i) To establish a creative environment facilitating the further development and maintenance of IODE and partner data and information management projects, services and products with emphasis on improving the efficiency and effectiveness of the data and product/service stream between the stage of sampling and the user; and

(ii) To assist in strengthening the capacity of Member States to manage oceanographic data and information and to provide ocean data and information products and services required by users.

In 2006 the Project Office focused on the organization of training courses, the redevelopment and migration of IODE (and other IOC) websites from UNESCO Headquarters to the Project Office, and on the development of online data and information services.

In 2006, the Project Office welcomed several high-level visitors: Mrs Fientje Moerman, Vice-Minister-President of the Flemish Government and Flemish Minister for Economy, Enterprise, Science, Innovation and Foreign Trade, on 24 April 2006, and HRH Prince Laurent of Belgium on 25 September 2006.

- Number of training courses organized: 19
- Number of trainees: 168
- Number of countries from which experts were trained: 49
- Number of the medium and long-term expert visits: 11
- Overall number of experts and trainees who visited the Project Office: 439
- Overall number of countries from which experts visited Project Office: 87
- Number of IOC/IODE related meetings and workshops hosted by the Project Office: 12
- Number of external meetings hosted by the Project Office: 34
- Number of EU Projects in which the Project Office is involved: 4
- Number of the websites hosted: 55

Visit of HRH Prince Laurent Of Belgium

From left to right: HRH Prince Laurent of Belgium; Mr Jean Vandecasteele, Mayor of Ostend; Mr Paul Breyne, Governor of the Province of West Flanders; Mr Peter Pissierssens, IOC/IODE.

HRH Prince Laurent of Belgium receiving IOC information.

Visit of Fientje Moerman, Vice-Minister-President of the Flemish Government and Flemish Minister for Economy, Enterprise, Science, Innovation and Foreign Trade

Left to right: Mr Paul Breyne, Governor of the Province of West Flanders; H.E. Mr Philippe Kridelka, Permanent Delegate of Belgium to UNESCO; Mr David Pugh, IOC Chairperson; Minister Fientje Moerman; Mr Vladimir Vladymyrov.

Minister Moerman receiving some information from participants in the ODINAFRICA seminar.

Globally accessible portal to distributed ocean data and information sources

Going back to its roots but bearing in mind today's (changed) demands of users as well as available technology, IODE is now embarking on the development of the OceanDataPortal (ODP, formerly known as Data-ATM). The objective of the Ocean Data Portal is to facilitate and promote the exchange and dissemination of marine data and services. The Ocean Data Portal will provide seamless access to collections and inventories of marine data from the National Oceanographic Data Centres (NODCs) in the IODE network and will allow for the discovery, evaluation (through visualization and metadata review) and access to data via web services. The system architecture will use web-oriented information technologies to access non-homogeneous and geographically distributed marine data and information. Through the OceanDataPortal project, cooperation will be especially strengthened with JCOMM and WMO.

In 2006 the foundations of the Ocean Data Portal were put in place through the JCOMM/IODE ETDMP end-to-end data management prototype (E2EDM) which was established at the IOC Project Office for IODE (http://www.oceandataportal.net). The technologies developed for this pilot activity will be further developed and harmonized with similar national and regional systems. As such, ODP will not duplicate or compete with existing or emerging national or regional systems, but will aim at interoperability between the

systems and to build a federating structure linking this increasing number of distributed data systems.

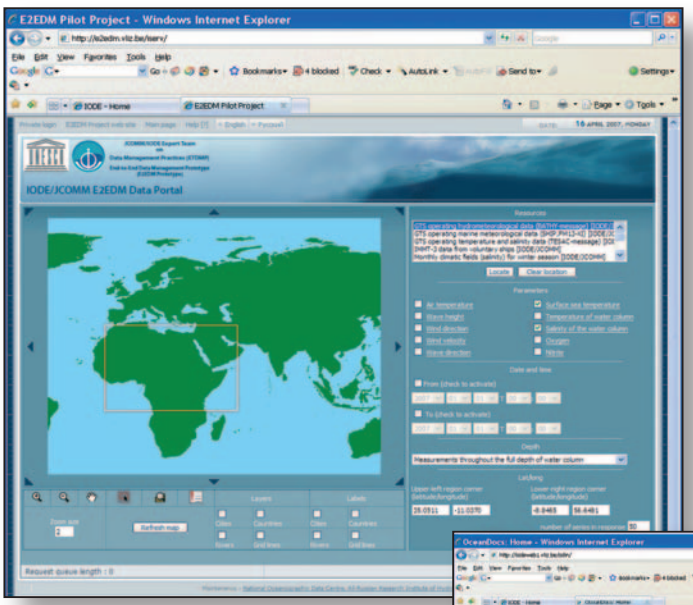
Regarding marine information management (publications) the OceanDocs (http://www.oceandocs.net) project was developed as a result of the successful ODINPubAfrica electronic repository (e-repository) project implemented under ODINAFRICA. OceanDocs aims at developing OAI (Open Archives Initiative) compliant repositories providing access to full-text publications created by scientists affiliated to oceanographic and marine institutes. Several ODINs have requested assistance to develop national and regional e-repositories.

Ocean Data and Information Networks (ODIN): creating cross-cutting capacity-building platforms at the regional level

The importance of ODINs as capacity-building mechanisms at the regional level has been widely recognized, at the national, regional and international level. Based upon the success of the ODINAFRICA network covering twenty-five African Member States, other ODINs have been established or further developed in the Caribbean and South America (ODINCARSA) and Indian Ocean (ODINCINDIO) region. Increasingly the ODINs also function as facilitators of inter-programmme cooperation (e.g. between IODE and the Indian Ocean Tsunami Warning System [IOTWS], between IODE and GOOS, between IODE and Integrated Coastal Area Management [ICAM]) thereby putting in place the end-to-end model.

The way forward

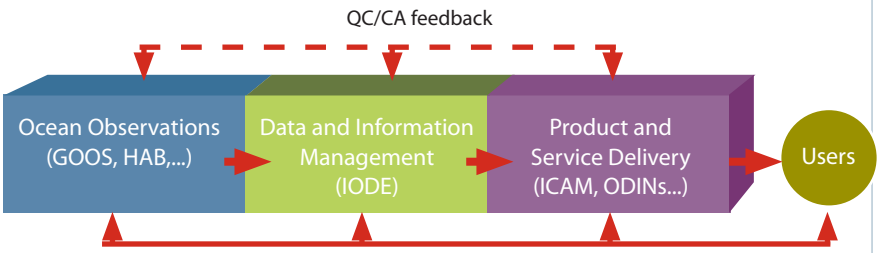
The objectives of IODE were revised by the IOC Executive Council in 2006 adding 'to support international scientific and operational marine programmes of IOC and WMO and their sponsor organizations with advice and data management services'. This clearly reinforces the end-to-end model, and cooperative projects between IODE and other IOC ocean science and observation programmes are expected to start in 2007.



The end-to-end data management prototype hosted by the IOC Project Office for IODE.

The OceanDocs e-repository website.

The role of the IOC Project Office for IODE in Ostend will be of crucial importance in this new service model: the Project Office is expected not only to consolidate its role as a global meeting and training centre related to data and information management but also increasingly to host other training events in which IODE plays a more complementary role. The Project Office will also continue its web-based service development role, hosting database and infobase services, and contribute to the development activities of such services. IODE will also return to one of its core objectives: the development and dissemination of standards, focusing first of all on standards for oceanographic data quality control and quality assurance.



Increasingly the ODINs also function as facilitators of inter-programmme cooperation thereby putting in place the end-to-end model.

The Third GOOS Regional Forum

JUSTIN AHANHANZO
Programme coordinator

THORKILD AARUP
Programme specialist

The Third Forum of the Regional Alliances of Global Ocean Observing System (GRAs) took place from in Cape Town, South Africa from 14-17 November 2006. The Third Forum was organized by the Marine Research (MA-RE) Institute of the University of Cape Town, and hosted by GOOS-AFRICA in cooperation with the African Large Marine Ecosystem (LME) programmes. The timing and venue of the Forum were conceived to allow GRAs to benefit from two relevant Pan-African meetings that occurred in Cape Town immediately before the Forum:

(i) Pan-African LMEs/GOOS-AFRICA Leadership Workshop on Operational Oceanography and Remote Sensing in Africa, 6-10 November; and
(ii) The Second Pan-African LMEs Forum, 13 November.

The GOOS Regional Forum brought all of the GRAs together and provided an opportunity to exchange information on lessons learned and best practices, to coordinate the development of Regional Coastal Ocean Observing Systems as part of GOOS, to identify capacity-building needs, and to identify funding priorities and sources of funding.

One of the major developments since the Second Forum has been the completion of the initial planning efforts of the Coastal Module of GOOS, namely:

(i) The Integrated Strategic Design Plan for the Coastal Module of GOOS (GOOS Report No. 125);
(ii) An Implementation Strategy for the Coastal Module of GOOS (GOOS Report No. 148); and
(iii) The Integrated Global Observing Strategy (IGOS) Coastal Theme Report (2006).

Successful development of GRAs globally is considered critical to successful implementation of the Coastal Module of GOOS. In this regard, the Implementation Strategy also points out that currently no mechanism exists to achieve the following:

(i) Enable GRAs to guide and participate in the development of a Global Coastal Network (as recommended in the design plans for the Coastal Module of GOOS) that meets their needs as a whole;
(ii) Coordinate implementation of the coastal module globally to enable interoperability among GRAs for data acquisition, exchange and analysis; and
(iii) Facilitate collaboration among other regional activities with common interests and interoperability among these programmes and GRAs for data acquisition, exchange and analysis.

The Forum discussed the development of governance mechanisms needed to implement the coastal module of GOOS including mechanisms for linking up all GOOS Regional Alliances together as one GOOS family beyond the diversity of their respective needs, priorities and specificities. The Forum made recommendations on:

(i) Potential governance mechanisms for a coordinated development of the Global Coastal Network of the Coastal Module of GOOS in view of the recommendations laid out in design plans for the coastal module;
(ii) GOOS Regional Alliance–Large Marine Ecosystem Partnerships;
(iii) The role of GRAs in the implementation of the *Ad Hoc* Group on Earth Observations (GEO) Coastal Zone Community of Practice, and in the development of Integrated Systems for Multi-hazard Disaster Warning Systems; and
(iv) How to address the challenges GRAs face concerning system sustainability, communication and outreach, partnership building, capacity-building and funding.

More information about the Third GOOS Regional Forum is available in GOOS Report No. 159 (http://www.ioc-goos.org/index.php?option=com_oe&task=viewDocumentRecord&docID=500)

overview

Ocean sciences

It is with great sadness that we begin this year's overview by paying homage to our dear friend and colleague, Ümit Ünlüata, Head of the Ocean Sciences section, who passed away in August after a long illness.

One of Ümit's legacies to the Ocean Sciences Section was to restructure its programmes to catalyze, coordinate, and communicate ocean science issues that were both global in scope and policy-relevant, with an emphasis on applying the ecosystem-approach to marine science research and to insist on scientific rigour and quality publications. In the following pages, we present summaries of all the activities that Ümit managed in the section as a testament to his vision and guidance over the last eight years. A further tribute to him also appears further on in this Annual Report. His no-nonsense attitude and frank views endeared him to the scientific staff of the IOC, and his boundless sense of humour won over the rest. He is truly missed.

Climate Impacts in the Marine Environment

Sea level rise

The IOC-sponsored World Climate Research Programme implemented a workshop at IOC on Understanding Sea Level Rise and Variability, which brought together 163 scientists from 29 countries to identify the uncertainties associated with past and future sea level rise and variability, as well as the research and observation activities needed for narrowing these uncertainties. The workshop was conducted in support of the Global Earth Observation System of Systems (GEOSS) Ten-Year Implementation Plan; as such, it helped develop international and interdisciplinary scientific consensus for those observation requirements needed to address sea level rise and variability.

For more information:
http://www.gloss-sealevel.org/
http://ioc3.unesco.org/unesco-climate/SeaLevelSummaryStatement.pdf

Ocean climate indicators

To improve communications about the state of the ocean climate, and as a basic tool for evaluation of the ocean observing system, the IOC Secretariat created a website of real-time updated ocean climate indices or indicators. The 'State of the Ocean Climate' page provides a quick overview of the state and trends of key physical ocean climate indicators that can be connected to major patterns of climate variability with significant social impact, such as El Niño events. Currently aimed at a science-literate audience, plans are to make it more accessible to a broader audience and to cover a wider range of indicators.

For more information: http://ioc.unesco.org/oopc/

Ocean's role in uptake of CO_2

The IOC is called on by the United Nations Conference on Environment and Development (UNCED) Agenda 21, the World Summit on Sustainable Development (WSSD) conventions, and the United Nations Framework Convention on Climate Change (UNFCCC) to carry out analyses, assessments and systematic observations of the role of the oceans as a carbon sink. In June, IOC's International Ocean Carbon Coordination Project (IOCCP) and the EU CarboOcean Programme brought together twenty-three scientists from nine countries to establish joint international working groups to examine the ocean's role in absorbing CO_2 from the atmosphere. These working groups will focus on two areas of the ocean that represent some of our largest uncertainties for ocean uptake of CO_2: the Nordic Seas and the Southern Ocean. The IOCCP is working with other regional organizations to establish similar working groups in other areas of the ocean. In October 2006, the IOCCP co-sponsored an international workshop to establish a biogeochemical observing system for ocean carbon in the Indian Ocean.

For more information: http://www.ioccp.org/

Ocean acidification

The ocean provides a valuable ecosystem service for climate by absorbing CO_2 from the atmosphere, thus reducing its impact on climate. However, this valuable service comes at a steep ecological cost - the acidification of the ocean. How marine ecosystems, coral reefs, and fisheries will respond to the current rapid acidification is unknown. The IOC and the Scientific Committee on Oceanic Research (SCOR) initiated a symposium series in 2004 to periodically assess what is known about ocean acidification and to provide sound, unbiased scientific information to decision-makers and the general public. The symposium results are compiled in a special issue of the scientific journal, the *Journal of Geophysical Research*. In 2006, an international scientific committee was formed to implement the second symposium and assessment, to be implemented in 2008, with a special emphasis on acidification impacts on fisheries.

For more information: http://ioc.unesco.org/ioccp/HighCO2/HighCO2World.htm

Climate and fisheries

The IOC-sponsored Global Ecosystem Dynamics Programme has implemented a number of activities to improve understanding of climate impacts on fisheries. In 2006 these include a symposium on climate variability and ecosystem impacts in the North Pacific, workshops on comparing the impacts of climate variability on marine ecosystems, and on the causes of the decline and recovery of cod stocks throughout the North Atlantic. In partnership with the International Council for the

© NOAA

Exploration of the Sea, planning has commenced for a workshop on the integration of environmental information into fisheries management and advice (June 2007, Copenhagen, Denmark). Other activities include the publication of a book, *Climate Change and the Economics of the World's Fisheries*, and the commissioning of a second book by Cambridge University Press on 'Climate change and Small Pelagic Fisheries', to be published before the end of 2007. The Climate Impacts on Top Predators project hosted several workshops during the past year to identify, characterize, and model key processes involved in the dynamics of oceanic pelagic ecosystems in the context of both climate variability and change, as well as intensive fishing of top predators, in order to develop reliable predictive capacity for single species and ecosystem dynamics and short, medium, and long-term scales. A major international symposium will be hosted in 2007 (December, La Paz, Mexico) to highlight the state of the art and to identify emerging direction and challenges.

For more information: http://www.globec.org/

Coral bleaching

Corals are affected by heat stress, and a 1 to 2 ºC change in their local temperature above their normal summer maximum temperatures can lead to a phenomenon called 'bleaching', whereby the corals expel their vital algal symbionts, leaving coral tissues translucent. Over the past ten years, an increasing awareness of the importance of coral reefs has been evident, especially in light of their rapid decline in many regions and their significance to developing countries. The IOC sponsors the Coral Bleaching Working Group of the Global Environment Facility (GEF)/ World Bank Coral Reef Targeted Research and Capacity-Building Project. This group carries out research required to develop indicators specifically for coral bleaching, to examine specific physiological mechanisms for coral bleaching, as well as the local ecological factors that cause bleaching and its after-effects, and differences between direct human stresses and those related to climate change. In 2006, Coral Bleaching Working Group researchers attended thirty-six conferences and have been prominent invited speakers in a large number of advisory committees and professional workshops. The research activity of the group has generated fifty-two publications in peer-reviewed journals such as *Science, Nature*, and G*lobal Climate Biology*. In 2006, this Working Group also prepared the proceedings of its key Meso-American Workshop addressing climate change and coral bleaching issues. The dissemination of this report will be a first step to ensure that coral reef managers are empowered with knowledge and tools to make better decisions and that the Coral Bleaching Working Group helps underpin the overall strategy of the project to assist science-based management of coral reef ecosystems in coral reef countries worldwide. Overall, the Coral Bleaching Working Group has established a strong collaborative network that now extends well beyond the discrete membership of the Working Group and is focused on linkages and synergies between developed and developing countries.

For more information: http://www.gefcoral.org/PublicHome/tabid/323/Default.aspx

Climate adaptation

At the request of five West African countries, the IOC is implementing a Global Environment Facility (GEF)/ United Nations Development Programme (UNDP) project on Adaptation to Coastal and Climate Change, initiated by the African Process and taken up in the Action Plan for the Environmental Initiative of the New Partnership for Africa's Development (NEPAD). The objectives of this project are to perform adaptation actions in pilot sites particularly vulnerable to natural climate changes and to anthropogenic degradation in the short, medium and long term, and to formulate national and regional adaptation strategies aimed at managing the impacts of climate change on the shorelines. The implementation phase will run from 2007-2010. A similar project is being developed for countries in the North Indian Ocean region.

UNESCO climate activities

In May 2006, the IOC Ocean Sciences section established an informal UNESCO-wide group to improve communication and coordination for climate related programmes and activities. This group currently includes approximately thirty-five programmes in all sectors of UNESCO and over fifty staff members. There are numerous synergies between IOC programmes and other UNESCO programmes, including the Man and the Biosphere Programme's coastal biodiversity and ecosystem services programme, the Coasts and Small Islands Programme, the Earth System Physics Climate Research Programme, the Bio-Sequestration of Carbon Programme, the Climate Chapter of the Education for Sustainable Development Programme, and the World Heritage Centre's Climate Change initiative and Marine Heritage Programme. In January, the group led an information session for UNESCO Permanent Delegations. The UNFCCC Secretariat contacted the group shortly after its establishment and asked to become part of the informal network to improve coordination and communication across programmes. The group has also been requested by the UNDP to contribute to its 2007 Human Development and Climate Change report.

For more information: http://ioc3.unesco.org/unesco-climate/

Integrated Coastal Research

Coral reef monitoring

In February, the IOC co-sponsored Global Coral Reef Monitoring Network (GCRMN) published its report *Status of Coral Reefs in Tsunami Affected Countries: 2005*. Development of a Global Coral Reef Socio-Economic Monitoring Database began in 2006, and will be launched in early 2007. The GCRMN also finalized its report

on the 'Status of Coral Reefs in the Caribbean After the Coral Bleaching and Hurricanes of 2005', to be published in early 2007. Work has begun on the 'Status of Coral Reefs of the World, 2008 Assessment'.

For more information: http://www.gcrmn.org/

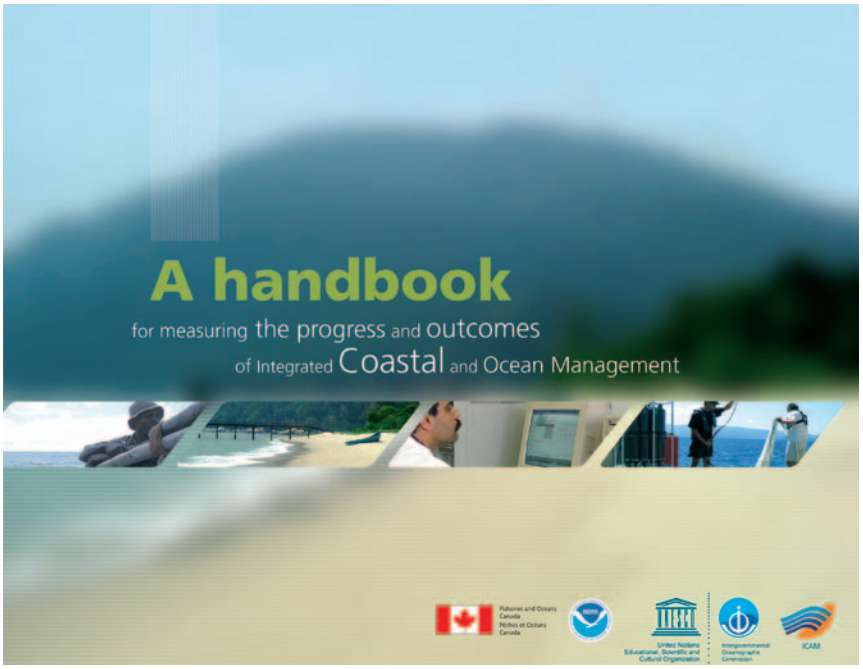
Coastal nutrient export from watersheds

IOC's Global Nutrient Export from Water(S)heds (Global NEWS) project is an international, interdisciplinary scientific taskforce focused on understanding the relationship between human activity and coastal nutrient enrichment. The project has developed nutrient export models for the Millennium Assessment (MA) scenarios, including development of the necessary suite of input databases: land use, hydrology, nitrogen and phosphorus use, population distribution, agriculture (crop type/animal production, etc.) for the years 2000, 2030 and 2050 under the four different MA scenarios. In 2006, the Global NEWS workgroup met at the IOC to analyze the results of preliminary model runs with preliminary input databases, identify major gaps/needs and to begin the process of refining the input databases. These models will then be linked to full coastal ecosystem effects, providing a powerful tool for coastal managers to understand local dynamics and predict impacts on resources.

For more information: http://www.marine.rutgers.edu/globalnews/

Integrated coastal and ocean management indicators

Several international instruments, such as *Agenda 21*, the *Plan of Implementation of the World Summit on Sustainable Development (WSSD)*, the *Convention on Biological Diversity*, the *Global Programme of Action for the Protection of the Marine Environment from Land-Based Sources (GPA)* and the *Food and Agriculture Organization (FAO) Code of Conduct for Responsible Fishing*, call for a cross-sectoral and integrated approach to the management of coastal areas. While environmental indicators have been conceived to monitor the state of the coastal and marine environment, very limited use has been made of socio-economic indicators, and the use of governance indicators has often been limited to the reporting of processes. In response to this situation, the IOC initiated a pilot programme in 2003 in collaboration with the Department of Fisheries and Oceans (Canada), the U.S. National Oceanic and Atmospheric Administration (NOAA), and the Gerard J. Mangone Center for Marine Policy (University of Delaware, USA) to promote the development and use of Integrated Coastal and Ocean Management (ICOM) indicators. In 2006, the project completed its *Handbook for Measuring the Progress and Outcomes of Integrated Coastal and Ocean Management*. The handbook provides a tool for developing, selecting, and applying indicators to measure, evaluate, and report on the progress and outcomes of integrated coastal and ocean management initiatives. The handbook is intended as a method and a series of guidelines that could assist different types of users: coastal managers and decision makers at the national and sub-national levels in the design, implementation, and assessment of ICOM initiatives, practitioners and experts engaged in evaluation research and evaluations, and donor agencies supporting coastal and marine management projects and programmes.



For more information: http://ioc3.unesco.org/icam/

Promoting ecosystem-based approaches to fisheries conservation

The IOC serves as the executing agency for this Global Environment Facility (GEF)/United Nations Environment Programme (UNEP) project supporting capacity-building through the transfer of advanced methods, practices and tools for ecosystem-based fisheries management. This project draws on work from six different research groups and organizations contributing to three major components. In 2006, the following activities were undertaken, for completion by April 2007:

(i) Development of an extensive international database of ecosys-

tem-oriented fisheries management practices, and surveys of the needs and capacity of each developing country in scientifically-sound and responsible approaches to fisheries management;

(ii) Development and expansion of an information portal for Large Marine Ecosystems (LME) where users are able to exchange information and access global-to-local LME data, maps, reports and publications from anywhere in the world via the internet;

(iii) Training in ecosystem-based fisheries assessment and management, using (a) modelling methods that consider the importance of the food web and the ecosystem's carrying capacity for marine fish stocks; (b) modelling methods employing biological particle size spectra as potential indicators of ecosystem condition; (c) GIS-based models relating land use and human activities in watersheds to nutrient transport by rivers to coastal systems; and (d) reviewing the approach to ecosystem-based management with a focus on the crossover from science to socioeconomic benefits, under various governance regimes, linking theoretical LME science with practical management practices, and promoting the sustainable use of marine resources.

For more information: http://www.iwlearn.net/iw-projects/Msp_11279949214

Control of harmful organisms and pathogens in ballast water

The International Council for the Exploration of the Sea (ICES)/Intergovernmental Oceanographic Commission (IOC)/International Maritime Organization (IMO) Working Group on Ballast of Ship and Other Vectors (WGBOSV) continues its work to:

(a) Critically review and report on the status of ballast water research with an emphasis on new developments in ballast water treatment technology, risk assessment, ballast water sampling devices, and selection of ballast water exchange zones to contribute to guidelines currently in preparation by IMO;

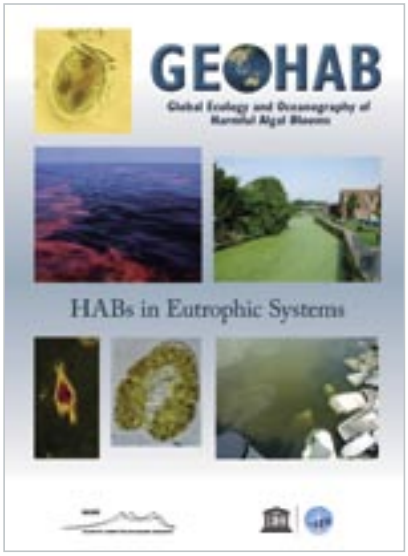
(b) Continue its global review of shipping vectors through the participation of representatives from ICES, IMO, IOC, the Mediterranean Science Commission (CIESM), the Baltic Marine Biologists (BMB) and the North Pacific Marine Science Organization (PICES) Member States and of invited experts;

(c) Finalize the ICES Ballast Water Sampling Manual;

(d) Prepare a draft ICES Code of Best Practice for the Management of Ships Hull Fouling;

(e) Continue reviewing port sampling protocols with the aim to prepare a draft ICES Code of Best Practice for Port Sampling.

For more information: http://www.ices.dk/iceswork/wgdetail.asp?wg=WGBOSV



Research Plan for the GEOHAB Core Research Project on *HABs in Eutrophic Systems*: It is central to the overall objectives of GEOHAB to deliver understanding and results that will enable improved observation and forecasting systems.

Harmful Algal blooms (HAB)

To focus and stimulate international cooperative research, the Intergovernmental Oceanographic Commission/Scientific Committee on Oceanic Research (SCOR) Global Ecology and Oceanography of Harmful Algal Blooms Programme (GEOHAB), is developing a series of Core Research Projects (CRP) addressing harmful algae in eutrophic, stratified, upwelling and fjords and coastal embayment systems. Together with national and regional research projects endorsed by the GEOHAB Scientific Steering Committee (SSC), GEOHAB provides a frame and network for cross-cutting activities that tie together the affiliated research projects. During 2006 the CRPs on upwelling and eutrophic systems developed significantly and have launched their research plans. It is central to the overall objectives of GEOHAB to deliver understanding and results that will enable improved observation and forecasting systems. The availability of such improved systems is key to the inclusion of HAB observations into regional Global Ocean Observing System (GOOS) components and the coastal module of GOOS, known as 'CGOOS'. The GEOHAB SSC is working with the GOOS SSC (or 'GSSC') in this respect. Activities and partners in GEOHAB are described at the GEOHAB website at www.geohab.info.

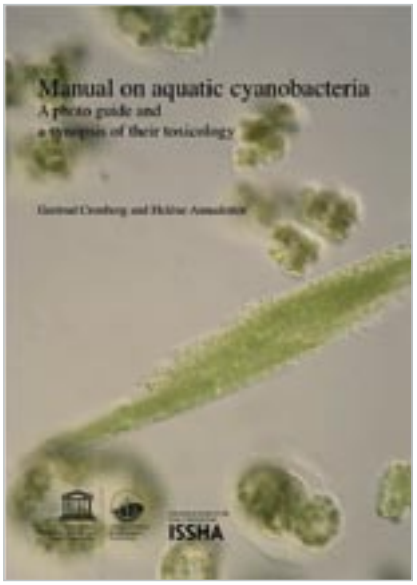
The HAB Programme is assisting Member States to enhance their capacity to manage and mitigate harmful algal events in several ways. Intensive training courses combined with e-learning have been developed over the past decade and the IOC has set the standard for such courses. During 2006 regional courses were implemented (jointly with the Regional Organization for the Protection of the Marine Environment [ROPME]):

- For the Gulf region in Tehran, Iran, 22-31 January;
- For Vietnam at Hue University of Science, 9-17 March;
- As an international course at the IOC Science and Communication Centre on Harmful Algae at the University of Copenhagen, Denmark;
- As e-learning during May-June; and
- As a practical course and examination, 10-18 September.

The international courses are, from 2006 onwards, offered as an identification qualification in harmful marine microalgae. In 2006, the IOC and the International Society for the Study of Harmful Algae (ISSHA) co-published a guide

to harmful aquatic cyanobacteria. Potentially harmful cyanobacteria occur widespread in the aquatic environment and this manual treats their taxonomy, identification, and toxicology across marine, brackish and freshwater environments.

Easy and open access to data on harmful algal events, HAB species occurrences, and monitoring and management practices worldwide has been a



priority to the programme since the beginning. Such data supports both research and capacity-building via knowledge sharing and as basis for risk assessment. The IOC, along with its partners, ICES, PICES, ISSHA, and the Aquatic Sciences and Fisheries Abstracts (ASFA), has developed a number of databases which in 2006 were reassessed with the view to integrating them into a common platform as an Harmful Algal Event Information System. The first element to be redesigned was the IOC-ICES-PICES Harmful Algal Event database, HAEDAT, which has been re-launched. Pending available funding the remainder of the data will be merged into the new integrated system in 2007.

At the regional level, the programme has established networks that serve both as a platform for the implementation of IOC activities as well as for activities implemented among members of the network. The networks formulate biannual workplans that are submitted to the Intergovernmental Panel on HABs (IPHAB). The networks are Harmful Algae in North Africa (HANA), Harmful Algae in the Caribbean (ANCA), Harmful Algae in South America (FANSA), and the IOC Sub-Commission for the Western Pacific regional HAB programme, WESTPAC/HAB. These networks provide a strong base for the programmes in the regions. At the global level, the programme provides a network to more than two thousand subscribers through the publication of the newsletter *Harmful Algae News*. The programme co-sponsored the Twelfth International Conference on Harmful Algae, organized jointly by the IOC Science and Communication Centre on Harmful Algae and the University of Copenhagen, Denmark, 4-8 September. It was attended by 550 participants.

During 2006, the programme continued to embrace a number of working groups. The ICES-IOC Working Group on Harmful Algal Blooms Dynamics acts as a scientific forum for formulating new programme elements and ideas, as well as a review group for the data compiled in the Harmful Algal Information System. The ICES-IOC-SCOR Working Group on GEOHAB Implementation in the Baltic was established to develop and implement a cooperative GEOHAB Research project in the Baltic. The ICES-IOC-IMO Working Group on Ballast of Ships and other Vectors is providing scientific input to the process in IMO centred on the development of guidelines for the implementation of the IMO Ballast Water Convention.

For more information: http://ioc unesco.org/hab/

Emerging Issues

Seamounts, deep-sea corals, and fisheries

With UNEP and Census of Marine Life, the IOC co-sponsored the development and publication of a report on the vulnerability of deep-sea corals to fishing on seamounts beyond areas of national jurisdiction, finalized in 2006. Nearly two-thirds of the ocean's area is beyond national jurisdiction, and recent advances in technology have permitted the documentation of both the rich biodiversity of deep-sea ecosystems as well as the footprint of human activities in these remote areas. In light of the concerns raised by the scientific community, the UN General Assembly has discussed vulnerable marine ecosystems and biodiversity in areas beyond national jurisdiction at its sessions over the last four years (2003-2006), and called, *inter alia*, 'for urgent consideration of ways to integrate and improve, on a scientific basis, the management of risks to the marine biodiversity of seamounts, cold-water coral reefs and certain other underwater features'. In order to support, focus and guide the ongoing international discussions, and the emerging activities for the conservation and sustainable management of cold-water coral ecosystems on seamounts, the report:

(i) Compiles and/or summarizes data and information on the global distribution of seamounts, deep-sea corals on seamounts, and deep-water seamount fisheries;
(ii) Predicts the global occurrence of environmental conditions suitable for stony corals from existing records on seamounts and identifies the seamounts on which they are most likely to occur globally;
(iii) Compares the predicted distribution of stony corals on seamounts with that of deep-water fishing on seamounts worldwide;
(iv) Qualitatively assesses the vulnerability of communities living on seamounts to putative impacts by deep-water fishing activities; and
(v) Highlights critical information gaps in the development of risk assessments to seamount biota globally.

For more information: http://www.unep-wcmc.org/resources/publications/UNEP_WCMC_bio_series/25.htm

Corals in crisis: an interview with IOC coral experts

Photo by Christian Wild

The world has effectively lost 20% of its coral reefs; 50% of those that remain are under serious threat of degradation. The IOC can bring governments, scientific institutes and NGOs together to explore techniques to identify management opportunities for protecting coral reefs.

OVE HOEGH-GULDBERG is the director of the Centre for Marine Studies at the University of Queensland, Australia, and Chair of the Global Environment Fund/World Bank Coral Reef Targeted Research and Capacity-Building Project, and the IOC sponsored Coral Bleaching Working Group. His research focuses on trying to understand the basis of stress in reef-building corals, including effect of nutrients, global warming and chemical impacts like cyanide.

CHRISTIAN WILD is the leader of Coral Reef Ecology Working Group (CORE) at GeoBio-Center, Ludwig-Maximilians-University, Munich, Germany, and the IOC's consultant for coral reefs. His expertise focuses on the cycles of energy and nutrients as well as sediment-water coupling in reef ecosystems. One of his main responsibilities for the IOC is to coordinate the IOC Working Group on Coral Bleaching within a Global Environment Fund/World Bank Coral Reef Targeted Research and Capacity-Building Project. The main objective of this project is to fill critical gaps in our understanding of what determines coral reef ecosystem vulnerability and resilience to a range of key stress factors in order to disseminate these results to managers and decision-makers, as well as to build capacity for science-based coral reef management in developing countries.

CLIVE WILKINSON is the coordinator of the Global Coral Reef Monitoring Network (GCRMN), which works to improve management and sustainable conservation of coral reefs for people by assessing the status and trends in the reefs, and how people use and value the resources. The GCRMN has been publishing regular global assessments of the Status of Coral Reefs of the World since 1998. The GCRMN is co-sponsored by the IOC, and IOC serves on the management group for this programme.

We've been hearing increasingly dire predictions about the world's coral reefs. Can you give us a brief status report of the latest reef conditions around the world and help us to understand why this is such a global threat?

Wilkinson: The latest estimates are that the world has effectively lost 20 per cent of the coral reefs and that 50 per cent of those that remain are under serious threat of degradation. These are the findings from more than 250 scientists involved in writing the *Status of Coral Reefs of the World* in 2004 for the Global Coral Reef Monitoring Network. The losses are due to direct human pressures of over-fishing and damaging fishing, pollution and sediment from activities on land and development over coral reefs. For example, in many places airports have been built on the reefs to attract tourists to come and see the reefs.

But climate change is also beginning to pose a serious threat to reefs. In 1994, the IOC assisted in the production of a book on the threats to coral reefs posed by climate change. At that time, we said that the real problems were the direct human pressures and that climate change damage was off in the distant future. However in 1998, we retracted those comments when 16 per cent of the world's reefs were virtually killed off during the massive El Niño-La Niña switch in climate, including 1,000-year-old coral colonies that died. This probably indicates that this had not occurred for many centuries. This really hit hard the reefs of the Indian Ocean, Southeast Asia and the Western Pacific. It meant that people involved in coral reef conservation had to fight on two fronts: attacking local problems at the site, often the World Heritage sites or Marine Protected Areas, and then on the global scale demanding reductions in greenhouse gases to reduce climate change impacts.

What are the links between climate change and coral reef degradation? What are the impacts, and what climate factors are causing them?

© Ove Hoegh-Guldberg

Bleached coral at Heron Island in the 2002 mass bleaching event.

Hoegh-Guldberg: Corals are very sensitive to temperature change, and even small increases in local temperature above the normal summer maximum can lead to a phenomenon called 'bleaching' whereby the corals expel their vital algal symbionts (algae which live in symbiosis with the coral), leaving the coral tissues translucent. The case for a linkage between coral bleaching and climate change is fairly strong. Firstly, mass bleaching events are only known from the scientific literature since 1979. Given that these events are very visual (sometimes hundreds of square kilometres of spectacularly bleached coral reefs) and that reefs had been studied with increasing intensity since the 1950s, it seems unlikely that they occurred but were overlooked. Secondly, we know that these events occur when water temperatures increase a mere 0.8 °C above the summer sea temperature maxima at a particular location. This is such a tight relationship that it is used to predict when bleaching events will occur with incredible accuracy. Thirdly, sea temperatures in tropical regions have increased between 0.5 to 1°C over the past fifty years. Putting the three together, we can point to climate change as a major underlying factor. The bottom line is that sea temperature has been increasing so quickly that it is outpacing the ability of coral populations to adapt to the changes in sea temperature. Despite some speculation, there is no solid evidence that corals can adapt rapidly enough to keep pace with the current rate of change in tropical sea temperatures.

Wild: But we should also point out that a new problem has developed over the last decades: the frequency and extent of bleaching events has increased drastically. In the last decade alone, three massive global or regional bleaching events (1998, 2002, 2005) have been recorded. Corals without their symbiotic algae are in a period of weakness and vulnerable to attacks of pathogens and fouling organisms. After a bleaching event, it takes time for the corals to fully regenerate. Thus, extensive bleaching events occurring in a high frequency often also result in extensive mortality of corals.

Hoegh-Guldberg: The problem with increasing sea temperatures is cause for concern alone. However, coral reefs are facing another challenge from the buildup of carbon dioxide (CO_2) in the atmosphere, which directly affects the chemistry of the oceans. Almost one half of the CO_2 that enters the atmosphere ends up in the ocean where it reacts with water to form carbonic acid. The acid releases protons that combine with carbonate ions and turns them into bicarbonate. Unfortunately, lowering the concentration of carbonate ion reduces the substrates or 'building blocks' needed for the production of calcium carbonate or limestone. The net effect is that the rate at which corals and other calcifying organisms lay down calcium carbonate is slowing down. There is a lot of concern as to whether the framework of coral reefs will start to dissolve, especially given that 90 per cent of the calcium carbonate laid down is eroded away by physical and biological mechanisms. It wouldn't take much of a decrease in the calcification rate for erosion to outpace new growth. The implications of the loss of reef frameworks is not clear, and depends

on other uncertain climate impacts such as projected increases in storm intensity and sea level rise. Coral reefs provide protection against the power of waves. In over seventy nations, the barriers provided by coral reefs play key roles in protecting human infrastructure and other ecosystems (e.g. mangroves, sea grass meadows and saltmarshes). The implications of losing these reef barriers from tropical coastal areas is of great concern. This said, the time frame for these changes is unclear and many research groups around the word are trying to fill these types of gaps in our knowledge.

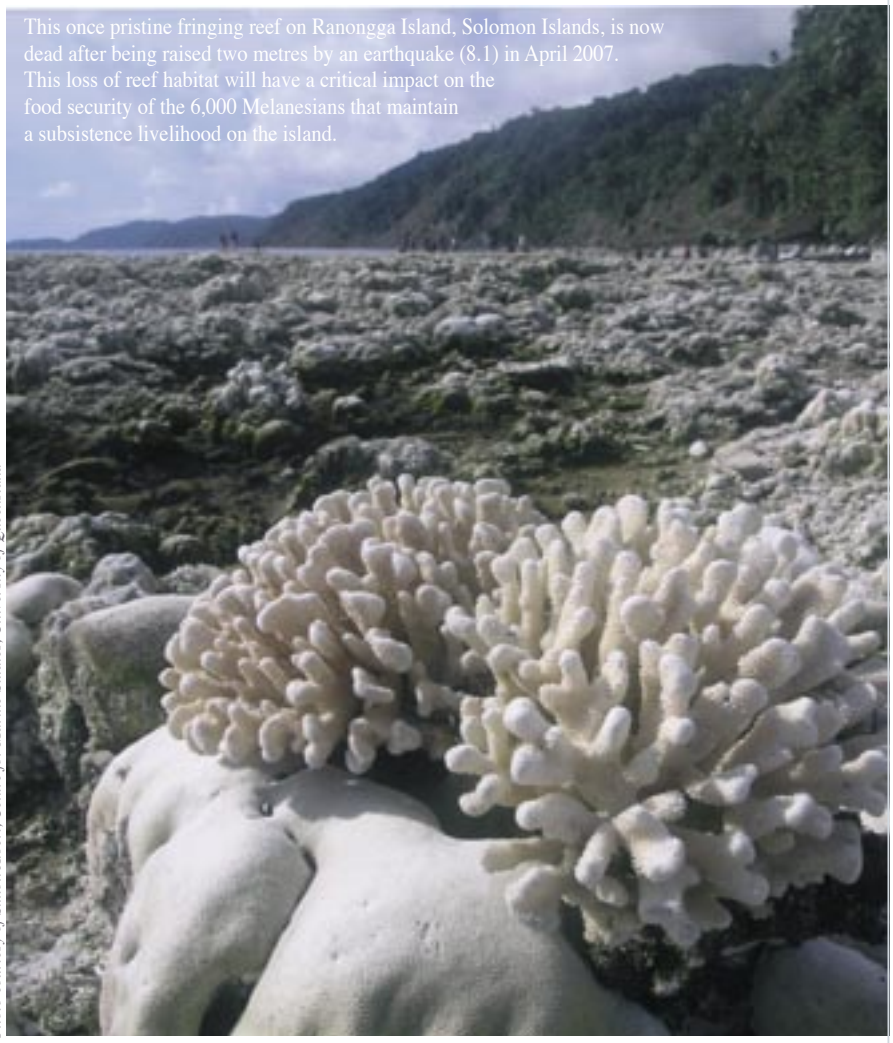
You've mentioned the importance of reefs as coastal protection - what are some of the other societal benefits of reefs? What's the human-side of these impacts?

Wilkinson: More than 100 million people depend on reefs directly for food, income and coastal protection. In addition there are another 300 to 400 million who live near reefs and are partially dependent on them. Degraded reefs will not be able to provide the same level of food as before and certainly they will be less attractive for tourism. We are recommending sustainable, low impact tourism as an alternative income source for coastal communities in the tropics since the income is much greater than from fishing and usually far less damaging. As an example, tourism on the Great Barrier Reef brings in US$4.5 billion for the Australian economy whereas all fishing on the reef, including recreational fishing, is worth US$250 million or only 5.5 per cent. Therefore it is smart economics to keep the fish on the reefs for the tourists to look at time and time again. A fisherman will make much more if he converts his boat to take tourists out to see the reef, than he will by catching fish off the reef.

This brings up an important question - what can we do to prevent these impacts and protect the natural services that reefs provide?

Wild: It's important to realize, as Clive mentioned earlier, that much of the impact on coral reefs is due to direct human pressures - things like over-fishing and pollution that we know how to control. Land-derived pollution is a serious local problem for many nearshore reefs. Growing coastal communities and the tourism industry contribute to an increase in the amount of sewage input into coral reefs. As sewage treatment plants are often non-existent in these regions, local waters can contain high concentrations of organic and inorganic nutrients as well as heavy metals and pathogens, which may damage the corals directly or indirectly by stimulating the growth of algae and bacteria. In addition, coastal agriculture and the clearing of mangrove or coastal forests lead to an increase of terrestrial sediment input into inshore reefs. Most corals are very sensitive to sedimentation in general, but in particular to the addition of fine terrestrial sediments. Intense coastal aquaculture near coral reefs has become an increasing problem during the last decade, with massive input of organic matter via faeces production of the cultured organisms (mostly fish and shrimp).

There are still a significant number of reef regions where destructive fishing practices such as bomb fishing are used in order to increase fishing efficiency. But these practices, as one can imagine, simultaneously destroy whole reef sections due to the energy of the detonation. In addition, cyanide is often used to paralyze fish so that they can be collected for the marine aquarium industry. Unfortunately, this method often leads to the death of other organisms and also kills some of the targeted fish.



This once pristine fringing reef on Ranongga Island, Solomon Islands, is now dead after being raised two metres by an earthquake (8.1) in April 2007. This loss of reef habitat will have a critical impact on the food security of the 6,000 Melanesians that maintain a subsistence livelihood on the island.

Photo courtesy of Simon Albert, Centre for Marine Studies, University of Queensland

Corals build an ecosystem that house over a million species of marine life.

Hoegh-Guldberg: There are two things that we can do to ensure that we don't lose coral reefs. The first is that we must rapidly reduce CO_2 emissions such that any further rise is ruled out. That will be one of the greatest challenges that humans will ever face. The consequences, of course, go far beyond that of coral reefs. The second is that we must increase our efforts to manage the other stresses on coral reefs, so as to maximize the ability of coral reefs to recover from climate change impacts like coral bleaching. Recent research has shown that keeping healthy populations of grazing fishes on coral reefs allows reefs to recover from bleaching up to three times faster than if the fish are removed. This type of research result helps develop the understanding of what we need to manage to build or maintain the resilience of coral reefs to climate impacts.

Wilkinson: As we've outlined in the *Status of Coral Reefs of the World* reports, we urgently need to:

- Develop more and larger Marine Protected Areas as larval reseeding grounds;
- Stop destructive fishing and reduce fishing pressure on reefs;
- Improve coastal land management by working with communities to reduce sedimentation;
- Reduce greenhouse gas emissions that are driving global climate change and threaten all coral reefs, especially those on small islands;
- Support community involvement in the fight to reverse the global coral reef crisis.

Some of these actions are relatively inexpensive and we understand the systems enough to know how to manage them; other actions will require considerable effort and political will to get effective results.

The IOC sponsors the GCRMN, targeted research on bleaching, and co-hosts a regular international symposium to assess what is known about the impacts of ocean acidification on marine ecosystems. What, in your opinions, is the principle role the IOC should be playing in the coral reef crisis?

Wild: I think that the main task of the IOC should be to report scientific findings to its Member States, to assist them to build scientific and technological capabilities for better management of coral reef resources, and to facilitate international collaborations and exchange of information. The IOC should also be the leader in integrating and linking the work and goals of marine-related UNESCO programmes, such as World Heritage sites, the World Network of Biosphere Reserves and Ramsar sites, in order to target issues such as the protection of coral reefs.

Wilkinson: Where the IOC has a particular advantage is that can bring governments, scientific institutes and NGOs together to look for solutions. We have spent the last fifty years doing the fundamental research and defining the problems facing coral reefs. Now we have to pool all that knowledge and experience to find the solutions to ensure that there will be coral reefs around for our grandchildren. Ask any concerned scientist or environmental manager what needs to be done and they will give you a range of practical things to do to conserve the corals and the reefs; where the IOC comes in is to combine these solutions into packages and get them into the hands of decision-makers. The GCRMN can assist in this through its publications, like the global status reports, and also by getting all members of communities involved in monitoring the health of the reefs and showing that applying good management practices actually can improve coral reef health. That is where the science comes in - showing that good management works.

Hoegh-Guldberg: Work done by the IOC-UNESCO Bleaching Working Group has started to look at the genetic basis for tolerance, and has identified tough and weak varieties of corals and their dinoflagellates. This may lead to techniques that allow us to identify management opportunities for protecting coral communities that may be inherently resistant to the increasing stresses associated with our rapidly changing climate. Given we actually don't know much about these aspects of coral reefs, the IOC should continue to ensure that we are supporting the science needed to underpin effective management responses.

Marine Spatial Planning:
Visions for a Sea Change

CHARLES N. EHLER
AND **FANNY DOUVERE**
UNESCO Consultants
and Workshop Co-Chairs

Marine resources, including fish, minerals, and energy, have long been exploited for their economic value. Many interests are rushing to exploit these marine resources even further from shore and deeper in the water as technology and economics change. Rapid population growth and shifting consumer demand have considerably increased the need for more food, more energy and more trade from marine areas. Because of limited resources and space on land, an increasingly larger share of goods and services is coming from coastal and marine areas. This trend will continue, and more likely accelerate, in the next decades. Future outlooks, in particular for offshore aquaculture, offshore energy, maritime transport, and tourism, predict increasing uses of marine areas in the coming years. The value of the oceans to present and future economic prosperity cannot be understated.

However, other values of the oceans are also critically important, including the benefits of the ecological goods and services that the oceans provide to humans, as well as all living organisms on the planet. In addition to the provisioning services provided by marine areas, including food, fiber, and medicine, the oceans provide regulating services (storm protection provided by coral reefs and wetlands), supporting services (carbon capture and nutrient recycling), and cultural services (including unique knowledge systems about marine resources).

Given that marine resources are limited both in space and size, economic development has had serious effects on marine biodiversity in many places. Essentially, increased development pressures on the marine environment have led to two types of conflict. First, this wide range of human activities (mostly uncoordinated among economic sectors) has resulted in a substantial and largely irreversible loss and damage to the diversity of life in marine and coastal areas, (such as use-environment conflicts, e.g. habitat loss). Second, not all uses are compatible with one another and are competing for ocean space or have adverse effects on each other (such as use-use conflicts, e.g. between shipping and offshore wind farms).

Historically, management approaches have focused on single sectors with little consideration of potential conflicts across sectors. During the past decade, the traditional sectoral approach to natural resource and environmental management has been recognized to be insufficient to address the cumulative effects of human activities on the

marine environment and has shifted to a more holistic 'ecosystem approach' that calls for comprehensive analysis of all dimensions of environmental problems. The Convention on Biological Diversity defines the ecosystem approach as 'a strategy for integrated management of land, water, and living resources that promotes conservation and sustainable use in an equitable way'. The ecosystem approach is based on the application of appropriate scientific methodologies focused on levels of biological organization, which encompass the essential processes, functions and interactions among organisms and their environment. It recognizes that humans, with their cultural diversity, are an integral component of ecosystems.

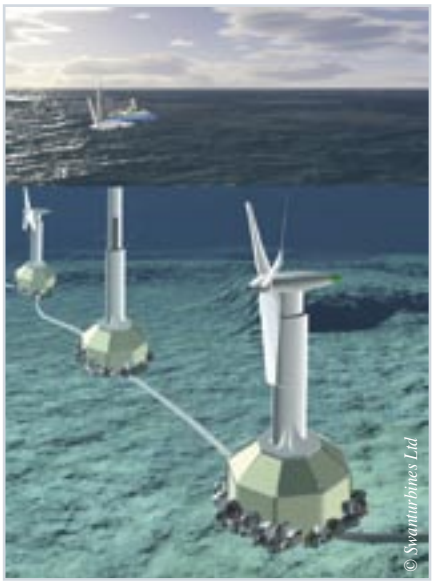
Despite its general acceptance however, so far the ecosystem approach has been more a concept, widely discussed at scientific fora, but with few examples of actual practice. It is increasingly clear that governments lack concrete tools to make an ecosystem approach operational in the marine environment. The key challenge today is to bring the ecosystem approach beyond the conceptual level. One practical way to do this is through marine spatial planning.

Marine spatial planning (MSP) is a process of analysing and allocating parts of three-dimensional marine spaces to specific uses, to achieve ecological, economic, and social objectives that are usually specified through the political process. The MSP process usually results in a broad, comprehensive plan or vision for a marine region. The place-based characteristic of marine ecosystems requires the need to look at the system from a spatial and temporal perspective. Ocean zoning, often confused with MSP, is a set of regulatory measures to implement MSP usually consisting of a zoning map and regulations for some or all areas of a marine region.

While initially the concept of marine spatial planning, and one of its primary outcomes, ocean zoning, was stimulated by international and national interests in developing marine protected areas, e.g. the Great Barrier Reef Marine Park in Australia, more recent attention has been placed on planning and managing the multiple uses of marine space, particularly in areas where use conflicts are well known and specified, e.g. the North Sea. Both Belgium and The Netherlands have drafted plans for their marine areas of the North Sea, including marine spatial plans. The United Kingdom has drafted national marine legislation that will authorize marine spatial planning in its seas. The Federal Spatial Planning Act of Germany has recently been amended to extend national sectoral competencies to its Exclusive Economic Zone (EEZ) and territorial sea. The EU Maritime Policy launched in 2006, the EU Marine Strategy, and the European Science Agenda for the Future of Ocean Research all consider marine spatial planning as a core aspect to manage a growing and increasingly competing maritime economy, while at the same time safeguarding biodiversity. The People's Republic of China already has national legislation that requires zoning of human uses in its territorial sea.

The key challenge today is to bring the ecosystem approach beyond the conceptual level. One practical way to do this is through marine spatial planning.

UNESCO held the first International workshop, 8-10 November, on the use of marine spatial planning as a tool to implement ecosystem-based, sea use management. The workshop was a cooperative initiative between the Intergovernmental Oceanographic Commission of UNESCO and the Man and the Biosphere Programme of the Ecological and Earth Sciences Divi-

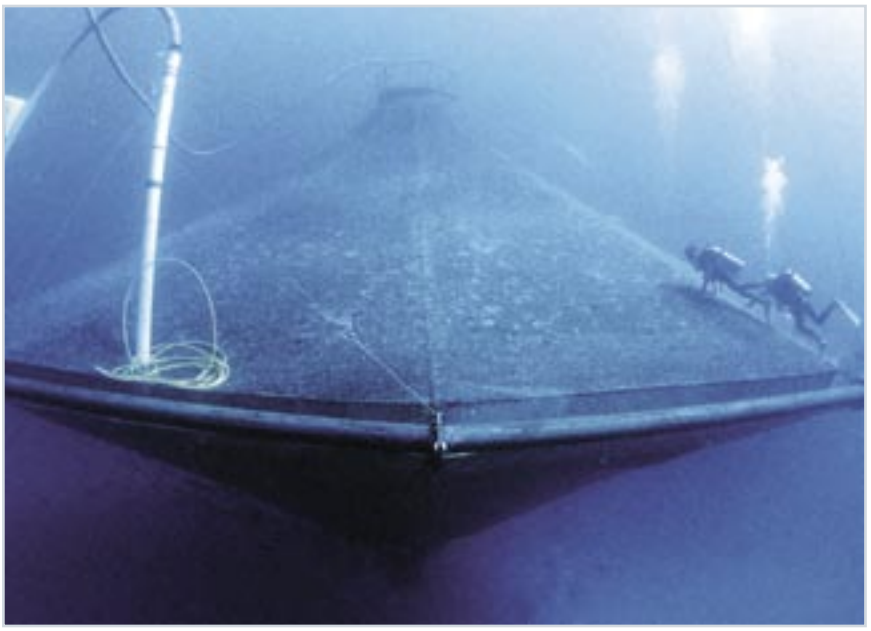


Marine spatial planning considers the challenges of managing a growing and increasingly competing maritime economy, while at the same time safeguarding biodiversity.

sion. About fifty participants from over twenty countries were invited based on their practical experience in sea use management, marine spatial planning, and ocean zoning. The purpose of the workshop was to review and document the state-of-the-art and good practices of marine spatial planning through a series of thematic presentations and discussions on the various elements of the management process, e.g., authorization, research, planning, analysis, implementation, monitoring and evaluation, institutional arrangements, and capacity-building.

Some of the main findings of the workshop are that:

(i) Zoning is only one tool of marine spatial planning and sea use management—actual applications will include a mix of control measures including regulatory and non-regulatory incentives, e.g. economic incentives and technical assistance;
(ii) Early and continuing engagement of stakeholders in a clear management process is critical to success and engenders trust and ownership of the MSP process;
(iii) Monitoring and evaluation are critical elements of the MSP process;
(iv) Integrating the human dimension into marine spatial planning requires the same diversity of disciplines/perspectives as does the ecosystem approach relative to the biophysical environment;
(v) Comprehensive, spatially explicit data on ecosystem characteristics, human uses, and offshore jurisdictions are required. These data are not readily available for most marine areas, and can be expensive and time-consuming to collect; and
(vi) Decision makers are unlikely to see the need for marine spatial planning until its benefits can be documented better.



Offshore Caged Aquaculture. Marine spatial planning can identify and resolve ocean use conflicts and compatibilities, including conflicts with nature. (*Source: Snapper Farm, Inc.*)

The workshop was supported by funds from the governments of Australia, Belgium, Canada, the European Union, the United Kingdom, and the United States. The Moore Foundation, the International Union for the Conservation of Nature and Natural Resources, and several non-governmental organizations including The Nature Conservancy, the World Wildlife Fund, and Conservation International also provided funds.

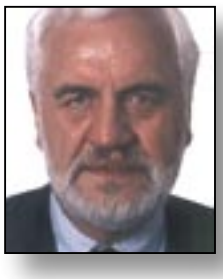
The initiative has produced a marine spatial planning website (http://ioc3.unesco.org/marinesp) that contains background documents, presentations, links to other related sites, and preliminary conclusions of the workshop. The results of the workshop have been documented in an IOC-UNESCO Manual and Guide (*Visions for a Sea Change*, 2007) and will appear as a special issue of the international journal, *Marine Policy*, in early 2008. Longer-term activities include preparation of guidelines on marine spatial management and building capacity for marine spatial planning. These results will be part of UNESCO's contributions to the implementation of the work plan of the Convention on Biological Diversity. In the longer run, UNESCO's marine spatial planning activities could provide an opportunity to develop broader international and regional partnerships that could lead to better integration of spatial management of human activities in terrestrial areas, watersheds, coasts - and oceans.

Existing ocean uses in the Belgian part of the North Sea. Marine spatial planning considers the challenges of managing growing and increasingly competing sectors of the maritime economy, while safeguarding biodiversity.
(Source: Maes et al., A Flood of Space 2005)

overview

Tsunami coordination unit

Building resilient coastal communities: two years after the Sumatra tsunami



PETER KOLTERMANN
Head of Unit

The IOC's advancements in developing a global tsunami warning and mitigation system

Two years after an undersea earthquake on 26 December 2004 triggered the strongest tsunami in living memory and caused the tragic death of more than 280,000 people, UNESCO, through its Intergovernmental Oceanographic Commission (IOC), is leading activities and actions to establish Tsunami Warning Systems (TWS) not only in the Indian Ocean but in all other oceans. In the Indian Ocean, countries bordering the ocean are, as from July 2006, capable of receiving and using tsunami advisory information provided as interim cover by the Pacific Tsunami Warning Center (PTWC) in Hawaii, USA, and the Japan Meteorological Agency (JMA). Now they have started their own Tsunami Warning Centres, cooperating under the aegis of the IOC and developing strong regional networks. They now focus on building resilient coastal communities to be better prepared for ocean-related hazards.

Tsunamis struck again on 17 July 2006 in Java and on 15 October 2006 in Hawaii. These are strong reminders that there is no time to pause in preparing coastal communities for this and similar risks. From each of these tsunamis we learn more on how to improve all the links of the warning chain, one by one. At the same time, while Member States develop science-based global warning systems, the IOC also contributes to wider partnerships entrusted to develop community awareness and preparedness.

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The IOC Assembly at its Twenty-third Session in Paris, 21-30 June 2005 confirmed this global initiative by creating three additional regional Intergovernmental Coordination Groups (ICG) as subsidiary bodies of the IOC. Together with the Intergovernmental Coordination Group for the existing Tsunami Warning System in the Pacific (PTWS, formerly ITSU), the new ICGs developed systems for the Indian Ocean (IOTWS), Northeast Atlantic, Mediterranean and Adjacent Seas (NEAMTWS), and the Caribbean (CARIBE-EWS). Jointly, supported by other relevant UN bodies, they are building blocks to form a global system of early warning systems for tsunami and other ocean- related hazards.

The reports from the eighteen national assessment missions, along with a consolidated report (prepared under the IOC's guidance) are available at: http://ioc3.unesco.org/indotsunami/nationalassessments.htm

Sustaining effective and durable systems

Following the successful national assessment missions to eighteen countries in the vicinity of the Indian Ocean to identify capacity-building needs and support requirements for the establishment of an Indian Ocean Tsunami Warning and Mitigation System (IOTWS), development, support and assistance are well underway both for the upstream part to detect and verify tsunamis and issue national warnings, as well as the downstream part to prepare communities to meet tsunami threats and react to tsunami warnings responsibly.

- Many countries have now established or strengthened their legal framework for disaster management, national platforms, and national and local coordination mechanisms to guide all-hazard disaster risk reduction and to establish clearer responsibilities for an end-to-end early warning system. Not all of them have specifically addressed the aspects of tsunami mitigation coordination.

- All IOTWS participating countries (except Somalia) receive international tsunami warnings from the PTWC and the JMA. Most countries receive these warnings at facilities with back-up systems for receiving warning messages that operate 24 hours a day, 7 days a week. The number of countries operating a national tsunami warning centre or having the capacity to receive or provide real-time seismic or sea level data has increased.

- Participating countries have further developed tsunami emergency and evacuation plans and signage or tested response procedures for tsunamis or earthquakes. They have been assisted through seminars and through workshops organized by the IOC's International Tsunami Information Centre (ITIC). But there still is an urgent need to collect information and data to further develop these procedures and plans, such as post-event surveys and inundation modelling, as well as tsunami hazard and vulnerability assessments.

- Although many participating countries have assessed local government capacity for disaster preparedness and emergency response, community preparedness still needs further attention. Community education and outreach programmes are still largely not yet in place in most of the countries and they need to be long-term efforts.

- Most countries have made progress in developing policies, assessing technological needs and establishing coordination mechanisms at a national level for tsunami warning and mitigation. In the majority of cases, local planning and preparedness activities are being carried out first in a small number of selected target areas, or cities and towns, rather than as comprehensive national programmes.

Similar efforts are underway and need to be strengthened to establish and operate the regional systems in all oceans. There is still no level playing field, and few systems have the sustained support to be ready at all times.

Establishing regional responsibilities

In the Indian Ocean progress is considerable and visible. Since July 2006, core technical elements of a regional tsunami early warning system have been ready. Significant progress in awareness raising and capacity-building has been achieved, but much work remains to build the long-term capacities of countries for effective early warning and risk management. Now regional cooperation is developing to profit from synergy effects and to improve the national cover with regional support. The entire end-to-end system is carefully being implemented, tested and improved. The ICG/IOTWS provides an inspiring example of an integrating vehicle for supporting the implementation of the Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disaster. Lessons learnt from the build-up of the Indian Ocean System are now easily being used in the other oceans where the IOC is mandated to coordinate a tsunami warning system.

Better protecting other regions at risk

In the **Pacific Ocean**, where tsunamis are much more frequent, the IOC has been active for more than forty years in ensuring that people living on the ocean's rim receive prompt forecasts and warnings of impending tsunamis through the PTWC and the JMA. This fully operational system has proven itself to be effective for many years. Nonetheless, some small islands in the southern Pacific are still not part of the TWS and there is a great need to optimize the sea level system in the southeast Pacific to be able to confirm that a tsunami has indeed been generated by a major earthquake.

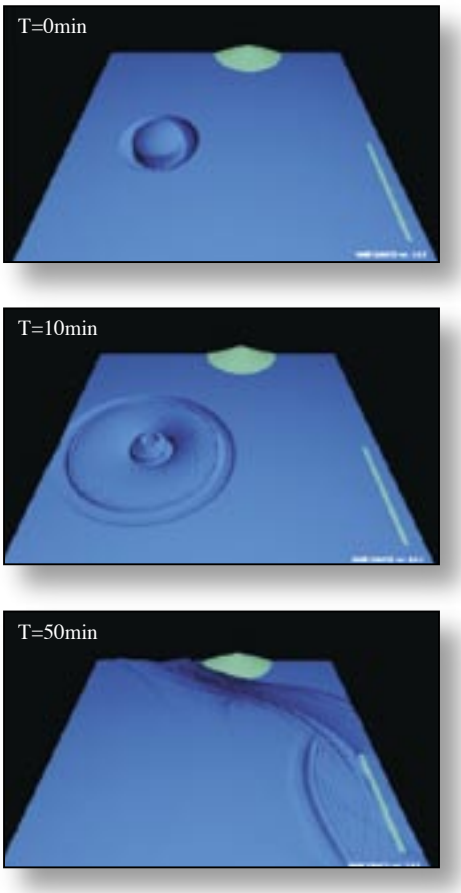
Progress has also been made in establishing the **North-Eastern Atlantic, the Mediterranean and Connected Seas** Tsunami Warning and Mitigation System. The European-North African TWS is urgently needed as the Atlantic Ocean, including the Mediterranean, is the second largest source of tsunamis around the globe. Given the short geographical distances between possible sources and coastal target regions of an impact (i.e. in the Mediterranean), a regional TWS for Europe has to rely on a dense network of seismic stations to provide timely forecasts and warnings. Now an Implementation Plan guides the work to build and operate a European system, to be ready as an initial system by the end of 2007.

The ICG for the **Caribbean and Adjacent Regions** met for the first time in Bridgetown, Barbados, 12-14 January 2006. The meeting was opened by Mr Koïchiro Matsuura, Director-General of UNESCO. Member States of the region decided to strengthen regional links and cooperation to be ready for extending the regional TWS into a multi-marine hazard warning system, with forecasts on storm surges and even hurricanes. The cooperation between Member States on seismic and sea level activities has considerably increased and training activities are underway. Efforts to establish a Secretariat in the region are in progress and several Member States are increasing their national facilities for TWS.

For all regional systems, the ICGs are developing a set of common documentation, standards and procedures. For the IOTWS the **Implementation Plan** was published in July 2006 and is constantly being updated. It gives an overview of agreed requirements, and identifies gaps, deficiencies and shortfalls. Thus the ICG/IOTWS is put into a position to define priorities and suggest remedial action. The interim **Communications Plan** is being revised, and a **Standard Operating Procedure** is being finalized for Indonesia and will be made available to Member States for adoption. It provides the master template for a **Common Operations Manual**. For the other regional systems of NEAMTWS, CARIBE-EWS and also for the PTWS a similar and consistent documentation is being initiated, drafted and will be adopted by the respective ICG meetings.

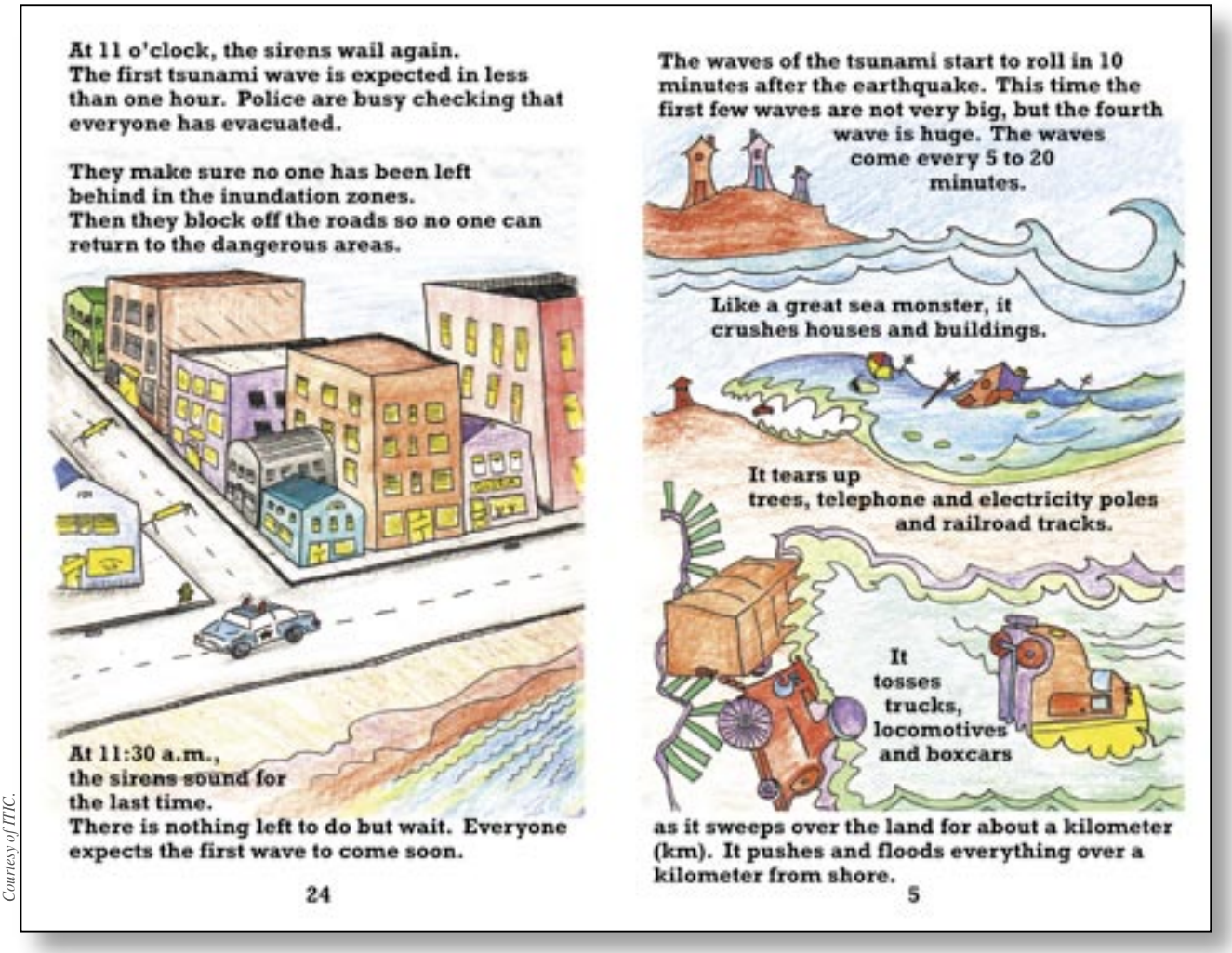
For setting standards, a number of reference documents have been developed and adopted by the relevant subsidiary bodies as a basis of common operations. The IOC's Global Sea Level Observing System (GLOSS) Working Committee has developed and published Volume IV of *Manual on Sea Level Measurement and Interpretation* which is now being officially endorsed by the respective ICGs. The International Association of Seismology and Physics of the Earth's Interior (IASPEI) Seismic Manual is in parallel being reviewed by the respective working groups and is also in the process of being formally endorsed by the ICGs.

The IOC's Ocean Mapping Programme has considerably enhanced capabilities of Member States to model the advance and impact of the tsunami wave on the shelf and at the shore. As a prerequisite for effective modelling of inundation areas, high resolution bathymetry is required.



The IOC's Ocean Mapping Programme assists the capabilities of Member States to model the advance and impact of a tsunami wave.

Through the IOC, Italy supports Member States to develop their own capacities via the project COAST MAP IO. It also contributes to the implementation of the International Bathymetric Chart of the Mediterranean and its Geological/Geophysical Series. More than 200 new names were approved by the IOC/IHO (International Hydrographic Organization) Sub-Committee for Undersea Features Names (SCUFN); a full set of the sheets of the International Bathymetric Chart of the Caribbean Sea and Gulf of Mexico at the scale of 1:1000000 has been completed by INEGI (Instituto Nacional de Estadística, Geografía e Informática) of Mexico, and is available for users. In 2006, the Editorial Boards of the International Bathymetric Chart of the Mediterranean Sea and the Arctic Ocean continued the collection of bathymetric data for the World Bathymetric Data Base.



Courtesy of ITIC.

Educational books and brochures explaining tsunami safety rules assist schools to ensure that children know what to do should a tsunami alert be issued.

Working towards community preparedness

Besides the need for technical equipment and national warning centres, the December 2004 tragedy also highlighted the imperative for ongoing education, information and capacity-building of potentially affected populations on tsunami issues. Schools need to ensure that children are aware of protective measures to be utilized should a tsunami alert be issued. Government authorities need to be provided with appropriate organizational structures to handle potential tsunami situations. The general public needs to recognize the signs of an impending tsunami and to know how to take shelter. Thus the IOC's International Tsunami Warning Centre (ITIC) in Hawaii, in co-operation with regional NGOs and in close cooperation with the International Strategy for Disaster Reduction (UN/ISDR), has been continuously providing educational material and undertaking training courses for technical staff and the public.

Moving towards a multi-hazard global coverage for ocean-related risks

The established four systems will provide strong regional cover operated by the region's Member States. Information flow and operating standards require an unprecedented commonality between the systems to ensure best use of all resources available and interoperable data and warning systems. The IOC has mandated the Secretariat to provide a framework document on the Global Ocean-related Hazards Early Warning and Mitigation System (GOHWMS) to the Twenty-fourth Session of the IOC Assembly in 2007, addressing issues of governance, standard setting and common procedures.

Recognition

In 2006 several Member States continued their strong support to the IOC to keep its leadership in building Tsunami Warning Systems. All of them are acknowledged and reported in the financial part of this report. However, we feel the need to express at this place our special gratitude to them as without their trust and confidence little of what has been done could have been achieved in the time given.

Tsunami Coordination Unit Personnel

Peter Koltermann joined the IOC Secretariat in Paris in June 2006 as Head of the new Tsunami Coordination Unit. The Unit supports the development of the four regional Tsunami Warning Systems as part of a future global ocean hazards warning and mitigation system. Peter has almost forty years' experience in physical oceanography, both in science and management, mostly with the Bundesamt für Seeschifffahrt und Hydrographie, Hamburg, Germany. He earned his Ph.D. in Oceanography from Hamburg University. From 1987–1991 he was deeply involved in the organization of the World Ocean Circulation Experiment (WOCE) at its Project Office in Wormley, UK. His science focus moved from tides and currents through polar oceanography to large-scale circulation and the ocean's role in the climate system. His management skills were enhanced in overseeing environmental assessments and work in related regulatory bodies. Working on tsunamis takes Peter back to his school years in Japan, where he experienced the first tsunami drills.

Jane Cunneen joined the Perth Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWS) Secretariat in January 2006 as Assistant Programme Specialist. She is responsible for assisting with the coordination of activities for the ICG/IOTWS. Jane received her bachelor's degree with honours in geology from the University of Western Australia in 1997, and a Ph.D. in structural geology and tectonics from the same university in 2005. Prior to joining the IOC, Jane spent four years working for an airborne geophysical survey company, and two years working in oil and gas exploration. Her research interests include fault dynamics and fault population studies, and the recent tectonics of northern Australia and South East Asia.

Tony Elliott joined the IOC of UNESCO in July 2006 as Head of Secretariat for the Perth Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWS). Tony has twenty-nine years' experience in research and commercial oceanography. He obtained a master's degree in marine earth science from University College London in 1978. During his career Tony has gained broad experience in the marine sciences, including marine geophysics, physical oceanography, numerical modelling, environmental studies, coastal zone management, and real-time met-ocean monitoring systems. In his early career he gained research experience in estuarine hydrodynamics and sediment dynamics. After moving to the commercial sector he specialized in the project management of large, multi-disciplinary studies for coastal and offshore engineering developments. More recently, he has focused on business development and consultancy relating to the development of physical oceanographic and meteorological criteria for the offshore oil and gas industry.

The IOC Tsunami Coordination Unit at UNESCO Headquarters in Paris, France

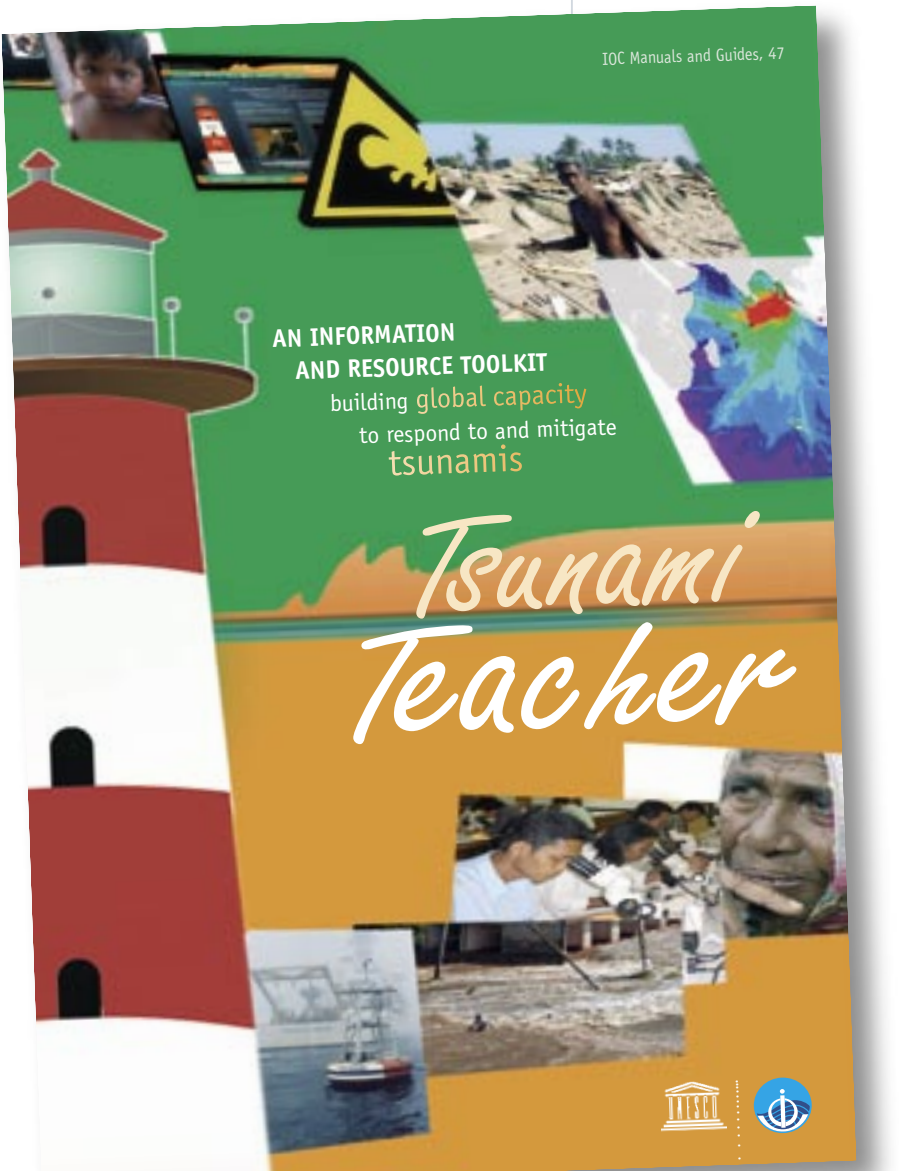
From left to right:
Bernardo Aliaga,
Michael Rottmann, Dimitri Travin,
Forest Collins, Bill Erb (retired),
Masahiro Yamamoto,
Peter Koltermann, Patricio Bernal,
Ulrich Wolf, Cesar Toro,
Jane Cunneen, Thorkild Aarup,
Laura Kong,
Françoise Ricotou (retired),
Peter Pissierssens.
Not pictured: Rezah Badal,
Nick D'Adamo, Tony Elliot,
Ardito M. Kodijat.

Tsunami Teacher:
an information and resource toolkit

Building global capacity to respond to and mitigate tsunamis

In just a few hours, stunning the world with its destructive power, the tsunami struck every country in the Indian Ocean, wreaking massive damage along coasts and causing deaths in 11 countries. Indonesia, Sri Lanka, and southeast India were the worst hit.The tsunami was largely to blame for a surge in the death toll from natural disasters in 2004, to 250,000 globally – three times higher than in 2003, 10 times more than in 2002 and three times the annual average for the decade 1994 to 2003 – according to the World Disasters Report 2005 of the International Federation of Red Cross and Red Crescent Societies.

A tsunami is an unstoppable natural hazard, but the 2004 event made it tragically clear that countries were poorly prepared for the phenomenon. The goals now are to raise the ability of people **to recognize and react in a timely manner** to an approaching tsunami, to increase the capacity of nations to respond rapidly and effectively to tsunami warnings when they are issued, and to mitigate the impacts when tsunamis occur.



In the aftermath of the 2004 tsunami, national authorities across the Indian Ocean region were charged, among other things, with developing tsunami information, awareness, education and resource materials for the media, schools, decision-makers and the public.

- *TsunamiTeacher* pulls together a wealth of information on tsunamis that already exists, gathered down the decades on individual events and responses to them, and enriched by research and scientific advances. Many organizations and countries have also produced, or are developing, locally and regionally relevant materials on tsunamis.
- *TsunamiTeacher* is the first single, reliable and verified resource that pulls this material together at the global level and makes them widely accessible to people, groups and governments around the world.
- *TsunamiTeacher* contributes to build awareness and capacity to respond and mitigate the impact of tsunamis through the sharing of knowledge, research, and best practices.

Training Modules target the Media, Schools, and the Public and Private Sectors, including governments, non-government organizations, businesses, and community groups. Within the government sector, a large amount

of training material has been assembled on earthquake and tsunami science and research, tsunami events, and the building of tsunami warning and mitigation systems. These topics include hazard and risk assessment, operational warning and dissemination systems, tsunami emergency response, alerting, and preparedness, environmental, engineering mitigation and policy, and education and outreach. Resource materials are provided as examples and guidance for decision-makers.

TsunamiTeacher is supported both as a dynamic, electronic, on-line resource that will be continually reviewed, updated, and complemented by experts on a dedicated website: www.tsunamiteacher.org and as an off-line set of DVDs which will run on PC and Macintosh platforms. The base language is English, with translations presently planned into Bahasa Indonesia, Bangladesh Bangla, French, Spanish, and Thai.

TsunamiTeacher is produced and distributed by the United Nations Educational, Scientific and Cultural Organization (UNESCO) and its Intergovernmental Oceanographic Commission. It was prepared under the supervision of the IOC's International Tsunami Information Centre in Hawaii, USA.

TsunamiTeacher is distributed free of charge to national authorities, educational institutions, IGOs, NGOs, regional training bodies, as well as technical and scientific communities. TsunamiTeacher Training Workshops, funded by the IOC of UNESCO, are in progress for participants who will use the materials in TsunamiTeacher to train other stakeholder groups.

Regional **activities**

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

WENXI ZHU
Project Expert
WESTPAC
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The Intergovernmental Oceanographic Commission of UNESCO Sub-Commission for the Western Pacific (WESTPAC) was formally established in 1989, evolving from a regional programme of IOC in the Western Pacific in 1965. Since 1994, WESTPAC has had its Secretariat in Bangkok, Thailand, which is jointly sponsored by UNESCO, through its IOC, and the Government of Thailand. In October 2005, the office, originally hosted in National Research Council of Thailand (NRCT), was moved into the Department of Marine and Coastal Resources (DMCR). The regional Secretariat is a branch of the IOC of UNESCO, carrying out its global programmes in the region whilst also implementing the projects and activities agreed upon by the three-yearly sessions of WESTPAC Member States.

Highlights in 2006

Safeguarding the health of ocean ecosystems, through enhancing the understanding and monitoring of Harmful Algal Blooms (HAB)

WESTPAC-HAB Programme held two planning meetings for the Training-Through-Research (TTR) project, those being 'Characterization of Selected HAB Species' in Bangi, Malaysia, 15-20 May, and 'Application of ELISA as a Monitoring Tool for Paralytic Shellfish Poisons' in Nha Trang, Viet Nam, 16-21 August. The objectives of the two meetings was to better understand the characterization of some HAB species with frequent occurrence, and to establish an efficient monitoring programme using the ELISA Kit to detect PSP toxins in marine organisms and seafood.

Developing a basis for an integrated ocean observing and operational forecasting system in the Northeast Asian region

The achievements during the year 2006 of the North-East Asian Regional-Global Ocean Observing System (NEAR-GOOS) can be summarized as:

WESTPAC Harmful Algal Blooms planning meetings.

(i) The NEAR-GOOS database system was successfully operated without any serious problems. Not only observational data but also oceanographic products such as sea water temperature charts, wave charts, current charts, tide forecast, and real-time display of station observations are now available through the NEAR-GOOS data bases;

(ii) The eighth IOC/WESTPAC training course on NEAR-GOOS Data Management took place 20 February-3 March in Tokyo, Japan. Eight trainees attended (one from China, one from Russia and one from the Republic of Korea, thus representing all NEAR-GOOS Member States);

(iii) Individual kick-off meetings of the Working Group on New Generation Sea Surface Temperature (WG on NGSST) and the Working Group on the NEAR-GOOS Data Management (WG on DM) were held in Japan in November and June, respectively. The WG on NGSST refined NGSST user requirements from the NEAR-GOOS aspects to develop satellite-based coastal SST monitoring techniques; and the WG on DM agreed to prepare an inventory of existing *in situ* chlorophyll-a and sediment material data and to draft a concept paper on an integrated real-time SST database pilot project;

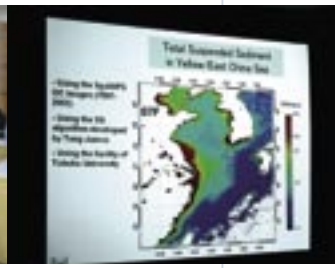
Enhancing marine research through ensuring long term archival and management of historical data

The Third International Workshop for The Global Oceanographic Data Archaeology and Rescue (GODAR) Project in WESTPAC (GODAR-WESTPAC) was held in Tokyo, Japan, 4-6 December. The workshop brought more than fifty participants from twelve countries together with regional/international organizations. The workshop presented not only the contribution of GODAR to oceanographic research but also recent developments in international data exchange systems and information technology. Emphasizing the importance of these activities, the workshop decided to continue and incorporate this activity into the ODINWESTPAC pilot project after the GODAR-WESTPAC was completed in 2006.

Development and updating of national oceanographic data and information management capacity

GODAR-WESTPAC

In order to expedite the establishment of ODINWESTPAC, the preparatory meeting for the establishment of ODINWESTPAC was held 5-6 December, in Japan. The meeting recognized the importance of the establishment of ODINWESTPAC in the Western Pacific Region and strongly recommended that the ODINWESTPAC project be approved by the seventh session of IOC/WESTPAC, which will take place in 2008. The meeting agreed on a proposal to initiate a pilot project of ODINWESTPAC before the formal approval of ODINWESTPAC. The ODINWESTPAC Pilot Project aims to:



NEAR-GOOS working groups and training courses.

(i) Develop a number of products that will promote communication and collaboration between WESTPAC Member States, and between WESTPAC Member States and other partners in the fields of ocean observations, data and information management, and product/service delivery;
(ii) Implement relevant capacity-building activities, specifically related to ocean data and information management;
(iii) Prepare a formal proposal including objectives, deliverables, work plan, time table, budget and draft recommendation to establish an Ocean and Data information Network for the WESTPAC region (ODIN-WESTPAC) to the seventh session of the IOC Regional Sub-Commission for the Western Pacific planned to be held in September 2008, for its approval.

Strengthening partnership with other regional programmes and projects

Cooperation with the UN Development Programme (UNDP)/Global Environment Facility (GEF) Yellow Sea Large Marine Ecosystem Project (YSLME).

A Memorandum of Understanding (MoU) was signed between the IOC/WESTPAC Secretariat and YSLME Project Office on 23 November, in which, *inter alia*, both sides agreed to promote the application of marine sciences and services towards the conservation and sustainable use of marine and coastal environment in the Yellow Sea. In particular, it was agreed to cooperate in data and information sharing and management, with a view to developing a regional network on data and information management in order to allow a wide use of the various data and information generated by the two organizations. In addition, joint activities on remote sensing were explored and several common interests were identified accordingly. The NEAR-GOOS Data Management Working Group is discussing ways to explore how to link the databases. The development of a regional ocean colour algorithm for the Yellow Sea is also under consideration.

Cooperation with the Global Environment Facility (GEF)/the UN Development Programme (UNDP)/ International Maritime Organization (IMO) Regional Programme on Partnership in Environmental Management for the Seas of East Asia (PEMSEA).

On 16 December, a Letter of Cooperation (LoC) and Partnership Operating Arrangement were signed between the IOC/WESTPAC Secretariat and the PEMSEA Programme Office. Both parties are committed to forging a long-term stakeholder partnership for the implementation of the Sustainable Development Strategy for the Seas of East Asia (SDS-SEA). Within this framework, WESTPAC is committed to provide scientific inputs to address critical uncertainties for the management of the coastal and marine environment and its resources in the Western Pacific region.

Celebrating twenty years of IOCARIBE

The IOC Sub-Commission for the Caribbean and Adjacent Regions (IOCARIBE) is the regional subsidiary body of the Intergovernmental Oceanographic Commission of UNESCO for the Caribbean and Adjacent Regions. It is the physical presence and representation of the IOC of UNESCO in the Caribbean region, and is dedicated to the promotion, development and coordination of the IOC's programmes there.

An unequivocal positive impact

As a direct result of developing activity over the past twenty years throughout the region, the IOC, through its IOCARIBE Association and Sub-Commission, has had an unequivocal positive impact on the development of capacities for marine sciences and technology in participating Member States. Much of the knowledge available today on the marine environment, its resources and coastal areas in the region is in some way related to IOCARIBE, or its predecessor, the Cooperative Investigations of the Caribbean and Adjacent Regions (CICAR) formed in 1968 as the first regional effort in marine sciences in the Caribbean.

IOCARIBE's establishment

IOCARIBE was created as an experimental regional association of IOC Member States in 1975 to replace CICAR. The IOC Assembly approved its creation following a request by Member States in 1982 to evaluate the successful results of CICAR. The first session of IOCARIBE as the new IOC Sub-Commission for the Caribbean and Adjacent Regions was held in August 1984 in Curacao, Netherlands Antilles.

Mr Cesar Toro, the IOC Secretary for IOCARIBE (centre) presented awards to Mr Marco Polo Bernal-Yarahuán (left) and Dr Bradford Brown (right) honouring their remarkable contributions to IOCARIBE during the last two decades.

The Regional Secretariat was formally established in the city of Cartagena de Indias, Colombia, in 1986 when the Headquarters Agreement between UNESCO and the Government of Colombia was signed and ratified by the Colombian Congress through Law 76 of 1988 for the Establishment of the IOC Sub-Commission for the Caribbean and Adjacent Regions (IOCARIBE). Prior to this date, the Secretariat had been established in Trinidad and Tobago, and in Costa Rica.

Recognizing twenty years of support and dedication

A special commemoration was held during the Ninth Intergovernmental Session of the IOCARIBE, 19-22 April in Cartagena de Indias, Colombia, in honour of IOCARIBE's twentieth anniversary in the region.

The IOC presented a Certificate of Appreciation to Mr Yesid Castro, Director of Multilateral Economic, Social and Environmental affairs at the Colombian Ministry of Foreign Affairs, acknowledging the support of the Colombian Government and to the Secretary of the Colombian Ocean Commission (CCO), Commander Julián Reyna.

The Chairman of IOCARIBE, the late Mr Marco Polo Bernal-Yarahuán, expressed his gratitude for their valuable contribution to the development of marine sciences and the protection of the environment, and especially their continuous support of the work of IOCARIBE and the goals of the IOC of UNESCO in the research and development of ocean sciences and services for the benefit of Member States in the region.

Mr Cesar Toro, the IOC of UNESCO Secretary for IOCARIBE, also presented Certificates of Appreciation to the staff of the Sub-Commission in recognition of their involvement and dedication to IOCARIBE since its initial establishment. Mr Toro also gave special awards to Dr Bradford Brown and Mr Marco Polo Bernal-Yarahuán in honour of their remarkable contribution to the work and development of the Sub-Commission.

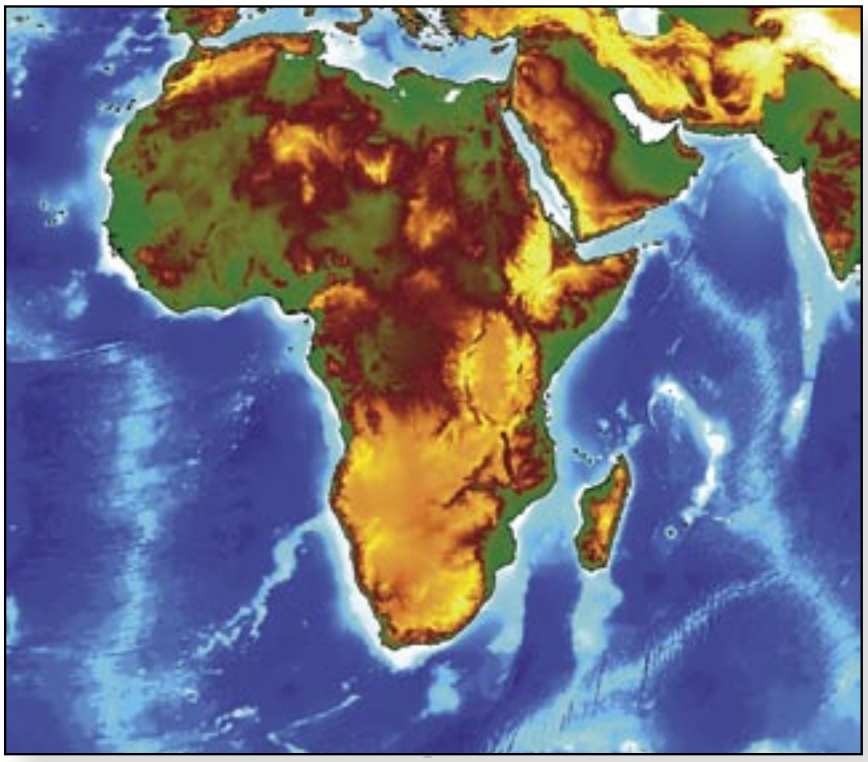
Mr Bradford Brown (left) and Mr Marco Polo Bernal-Yarahuán (right) present Mr Yesid Castro, Director of Multilateral Economic, Social and Environmental affairs at the Colombian Ministry of Foreign Affairs with the IOC's Certificate of Appreciation.

The IOC expresses its deep regret at the passing of IOCARIBE Chairman, Mr Marco Polo Bernal-Yarahuán, in August.

A tribute to him appears further on in this Annual Report.

African Marine Atlas in Africa launched

MIKA ODIDO
ODINAFRICA project coordinator
m.odido@unesco.org
m.odido@odinafrica.net



The African Marine Atlas, developed by the Ocean Data and Information Network for Africa (ODINAFRICA), was officially launched on 23 February 2007 at the IOC Project Office for International Oceanographic Data and Information Exchange (IODE) in Ostend, Belgium.

The African Marine Atlas (www.africanmarineatlas.net) provides substantial maps, images, data and information to coastal resource managers, planners and decision-makers from various administrative institutions and specialized agencies in Africa. The Atlas will be of immense benefit to national institutions and a variety of users such as environmentalists, local administrators, park managers, the scientific community, fishing cooperatives, tourists, hoteliers, teachers, NGOs, the general public, and other interested persons. It has over 800 downloadable data products derived from the marine geosphere, hydrosphere, atmosphere, biosphere, geopolitical and human socio-economic dimensions.

The Atlas indicates areas of intense use along the coastline requiring careful management and provides potential foresight on likely consequences of specific decisions. Furthermore, the Atlas indicates gaps in knowledge and information bases, where additional efforts may be directed. The Atlas will also act in other ways as a guide to recreational opportunities and tourist attractions.

In developing the Atlas, the main objective was to collate available geospatial datasets and information on the marine environment and to summarize it into an African Marine Atlas suite.

The website is one of a set of Marine Atlas products that will include web data services, web mapping and an atlas publication when completed.

The Atlas was accomplished after nine months of intensive work by a team of sixteen marine scientists and Geographic Information System (GIS) experts from National Oceanographic Data Centres (NODCs) in Benin, Ghana, Kenya, Mauritania, Mauritius, Mozambique, Namibia, Senegal, Seychelles, South Africa, and Tanzania. International ocean data experts provided key inputs in data analysis. It is based on an extensive survey of coastal and marine data needs undertaken in early 2006 in all the countries participating in ODINAFRICA.

Primary partners in this project were the United Nations Environment Programme (UNEP), and the African Coelecanth Ecosystem Programme (ACEP). UNEP will develop a clearinghouse and information system on coastal and marine resources of Eastern Africa from the regional atlas. The Atlas has brought great benefits to participating national institutions and Africa as a whole, by encouraging scientists to work together, learn new techniques, and build teams that will continue to regularly update the Atlas with national and local scale data sets.

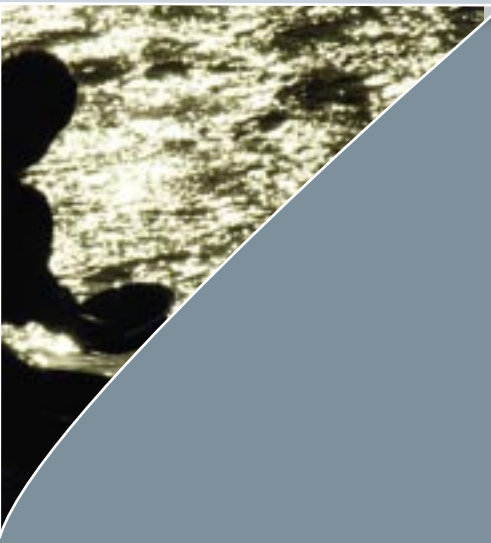
The IOC Perth Programme Office

NICK D'ADAMO
Head of the IOC
Perth Programme Office

Bureau of Meteorology building, Perth Office home in West Perth.

In January 2007 Nick D'Adamo replaced William Erb as Head of the Perth Regional Programme Office of the IOC. The IOC Perth Office was established in 1998 under a tripartite agreement between the IOC of UNESCO, the Western Australian State Government and the Australian Bureau of Meteorology. The Office coordinates regionally the full range of UNESCO/IOC activities, while focusing on the balanced development of the Global Ocean Observing System (GOOS). The IOC Perth Office helped establish and facilitates a number of regional alliances that provide effective vehicles in support of the IOC's issues and activities: Indian Ocean GOOS, South East Asia GOOS, Western Australian GOOS and Pacific Islands GOOS. The Office reports formally to the IOC Executive Secretary and works closely with IOC section heads to promote and advance the IOC's oceanic and coastal GOOS aspirations.

Nick received his Bachelor's and Master's degrees (engineering) from the University of Western Australia and a Ph.D. in physical oceanography from the University of Canterbury, New Zealand. He has studied and modelled the role of physical processes in stratified and well mixed inland, coastal and open water systems, with a focus on the relationships between physical and biological processes in ecosystem-based studies of pristine and degraded environments, in Australia and Europe. Nick recently spent ten years working in the establishment of multiple-use Marine Protected Areas (MPAs) and in the associated coordination of multi-disciplinary marine research and monitoring protocols and programmes within a comprehensive MPA programme for Western Australia. The range of MPAs included tropical, mixed and temperate ecosystems, as part of the Australian National Representative System of MPAs. The link between ocean-atmosphere processes, and biodiversity conservation, ecologically sustainable utilization of marine natural resources and the characterization and modelling of biophysical processes that threaten natural and human populations is fundamental to Nick's interests and responsibilities through the IOC Perth Office, which continues to explore and promote new initiatives to expand on the IOC's existing regionalized portfolio out of Perth and Australia.



Annexes

IOC Officers

Palacio San Martin,
Headquarters of the Foreign Ministry,
Buenos Aires, Argentina

Meeting of the IOC Officers at Palacio San Martín, Buenos Aires, Argentina, 20 January 2006.

Sitting left to right
Dr David Thomas Pugh (UK) [Chair]; Dr Patricio Bernal (Chile) [Executive Secretary]

Standing left to right
Prof. Su Jilan (China) [Past-Chair]; Dr Alphonse M. Dubi (Tanzania); C. de Navío Javier Armando Valladares (Argentina); Dr Alexander V. Frolov (Russia); Dr Neville Smith (Australia); [Vice-Chairs]

Not pictured
Prof. Mário Ruivo (Portugal) [Vice-Chair]

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

IOC Member States (136)

The IOC welcomes three new Member States

The Intergovernmental Oceanographic Commission of UNESCO would like to extend a special welcome to the three Member States that joined us in 2006:

- Cook Islands
- Djibouti
- Papua New Guinea

AFGHANISTAN	(11 March 1991)
ALBANIA	(26 January 1993)
* ALGERIA	(Jul. 1964/Nov.1965)
ANGOLA	(26 October 1982)
* ARGENTINA	(Before November 1961)
* AUSTRALIA	(Before November 1961)
AUSTRIA	(Oct. 1962/Jun. 1964)
AZERBAIJAN	(27 January 1998)
BAHAMAS	(29 January 1979)
BANGLADESH	(29 October 1982)
BARBADOS	(18 December 1985)
* BELGIUM	(Before November 1961)
BELIZE	(22 September 1995)
BENIN	(23 October 1986)
* BRAZIL	(Before November 1961)
BULGARIA	(Oct. 1967/Dec. 1969)
CAMEROON	(Nov. 1971/Nov. 1973)
* CANADA	(Before November 1961)
CAPE VERDE	(20 August 1984)
* CHILE	(Before November 1961)
* CHINA	(Before November 1961)
COLOMBIA	(Oct. 1967/Dec. 1969)
COMOROS	(08 February 2000)
CONGO	(Nov. 1961/Sep. 1962)
COOK ISLANDS	(25 January 2006)
* COSTA RICA	(28 February 1975)
COTE D'IVOIRE	(Before November 1961)
CROATIA	(24 December 1992)
* CUBA	(Before November 1961)
CYPRUS	(05 December 1977)
CZECH REPUBLIC	(20 June 2005)
DENMARK	(Before November 1961)
DJIBOUTI	(6 January 2006)
DOMINICA	(21 September 1999)
DOMINICAN REP.	(Before November 1961)
* ECUADOR	(Before November 1961)
* EGYPT	(Oct. 1969/Nov. 1971)
EL SALVADOR	(16 February 1993)
ERITREA	(12 November 1993)
ESTONIA	(10 March 1992)
ETHIOPIA	(05 March 1976)
FIJI	(09 July 1974)
* FINLAND	(Before November 1961)
* FRANCE	(Before November 1961)
* GABON	(26 October 1977)
GAMBIA	(30 August 1985)
GEORGIA	(09 July 1993)
* GERMANY	(Before November 1961)
GHANA	(Before November 1961)
GREECE	(Oct. 1962/Jun. 1964)
GUATEMALA	(Dec. 1965/Oct. 1967)
GUINEA	(01 May 1982)
GUINEA-BISSAU	(26 January 1984)
GUYANA	(20 July 1977)
HAITI	(23 March 1976)
ICELAND	(Oct. 1962/Jun. 1964)
* INDIA	(Before November 1961)
* INDONESIA	(Oct. 1962/Jun. 1964)
* IRAN, Islamic Republic of	(03 June 1975)
IRAQ	(Oct. 1969/Nov. 1971)
IRELAND	(07 November 1978)
ISRAEL	(Before November 1961)
* ITALY	(Before November 1961)
* JAMAICA	(Oct. 1967/Dec. 1969)
* JAPAN	(Before November 1961)
JORDAN	(06 April 1975)
KAZAKHSTAN	(24 March 2005)
* KENYA	(Nov. 1971/Nov. 1973)
KOREA Democratic People's Republic of	(31 October 1978)
KUWAIT	(13 November 1974)
LEBANON	(Oct. 1962/Jun. 1964)
LIBYAN ARAB JAMAHIRIYA	(11 March 1974)
MADAGASCAR	(Dec. 1965/Oct. 1967)
* MALAYSIA	(Jul. 1964/Nov. 1965)
MALDIVES	(20 May 1987)
MALTA	(Oct. 1969/Nov. 1971)
MAURITANIA	(Before November 1961)
MAURITIUS	(Oct. 1969/Nov. 1971)
* MEXICO	(Before November 1961)
MONACO	(Before November 1961)
MOROCCO	(Before November 1961)
MOZAMBIQUE	(08 April 1981)
MYANMAR	(07 June 1988)
NAMIBIA	(25 April 2001)
NETHERLANDS	(Before November 1961)
NEW ZEALAND	(Nov. 1961/Sep. 1962)
NICARAGUA	(17 November 1977)
* NIGERIA	(Nov. 1971/Nov. 1973)
NORWAY	(Before November 1961)
OMAN	(16 November 1982)
PAKISTAN	(Before November 1961)
PANAMA	(Oct. 1967/Sep. 1969)
* PERU	(Dec. 1965/Oct. 1967)
* PHILIPPINES	(Oct. 1962/Jun. 1964)
POLAND	(Before November 1961)
* PORTUGAL	(Oct. 1969/Nov. 1971)
QATAR	(20 July 1976)
* REPUBLIC OF KOREA	(Before November 1961)
ROMANIA	(Before November 1961)
* RUSSIAN FEDERATION	(Before Nov. 1961)
SAINT LUCIA	(14 September 1992)
SAMOA	(10 April 1978)
SAUDI ARABIA	(14 June 1978)
* SENEGAL	(Oct. 1967/Sep. 1969)
SERBIA	(23 May 2005)
SEYCHELLES	(27 February 1979)
SIERRA LEONE	(19 April 1974)
SINGAPORE	(Dec. 1965/Oct. 1967)
SLOVENIA	(16 June 1994)
SOLOMON ISLANDS	(11 May 1982)
SOMALIA	(10 July 1974)
* SOUTH AFRICA	(Oct. 1967/Sep. 1969)
* SPAIN	(Before Nov.1961)
SRI LANKA	(Jun. 1976/Jan. 1977)
SUDAN	(26 August 1974)
SURINAM	(21 January 1977)
SWEDEN	(Jul. 1964/Nov. 1965)
SWITZERLAND	(Before Nov. 1961)
SYRIAN ARAB REP.	(Oct.1969/Nov. 1971)
THAILAND	(Before Nov. 1961)
TIMOR-LESTE	(19 October 2005)
TOGO	(22 October 1975)
TONGA	(03 January 1974)
TRINIDAD & TOBAGO	(Oct. 1967/Sep. 1969)
* TUNISIA	(Before Nov. 1961)
* TURKEY	(Nov. 1961/Sep. 1962)
* UKRAINE	(Nov. 1961/Sep. 1962)
UNITED ARAB EMIRATES	(02 June 1976)
* UNITED KINGDOM OF GREAT BRITAIN and NORTHERN IRELAND	(Before Nov. 1961)
* UNITED REPUBLIC OF TANZANIA	(Oct. 1967/Sep. 1969)
* UNITED STATES OF AMERICA	(Before Nov. 1961)
URUGUAY	(Before Nov. 1961)
VENEZUELA	(Oct. 1962/Jun. 1964)
VIET NAM	(Before Nov. 1961)
YEMEN	(22 May 1960)

* Members of the Executive Council

IOC structure

ASSEMBLY
EXECUTIVE COUNCIL
EXECUTIVE SECRETARY
SECRETARIAT

OCEAN SCIENCES

- Oceans and Climate (WCRP, JGOFS, CLIVAR, El Niño, SCOR-IOC Advisory Panel on Ocean CO_2)
- Science for Ocean Ecosystems and Marine Environmental Protection (HAB, Indicators for Ecosystem Health, Nutrient Enrichment, LME, Biosphere-Geosphere Coupling)
- Marine Science for Integrated Coastal Area Management (COASTS, LOICZ-Basins, ICAM Indicators, Global Web Service, Coastal Megacities, ICAM Methodological Manual)
- United Nations Convention on the Law of the Sea (IOC/ABE-LOS, ABLOS, Special Arbitration)

OCEAN OBSERVATIONS AND SERVICES

- Global Ocean Observing System (GOOS)
- GOOS Modules, Regional Bodies and Pilot Projects (OOPC, COOP, GODAE, Argo)
- Integrated Global Observing Strategy (IGOS)
- Joint Technical Commission for Oceanography and Marine Meteorology (JCOMM) (DBCP, SOOP, TIP, GLOSS)
- Global Climate Observing System (GCOS)
- Satellite Remote Sensing
- International Oceanographic Data and Information Exchange (IODE) (GODAR, MIM, GTSPP, MEDI, ASFA, GETADE, GEBCDMEP, GEMIM, Ocean Teacher, OceanPortal, OceanExpert, MarineXML)
- IODE regional projects (ODINAFRICA, ODINCARSA, Regional Ocean Portals, MEDAR/MEDATLAS)
- IDNDR-Related Activities Pacific Tsunami Warning System (PTWS, former ITSU)
- Ocean Mapping (GEBCO, GAPA, IBCM)
- Public Information (IOC website, newsletters, other publications, posters, brochures and leaflets, public events)

TSUNAMI COORDINATION UNIT

- Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS)
- Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWS)
- Intergovernmental Coordination Group for the Tsunami Early Warning and Mitigation System in the North-Eastern Atlantic, the Mediterranean and Connected Seas (ICG/NEAMTWS)
- Intergovernmental Coordination Group for Tsunami and other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (ICG/CARIBE-EWS)

CAPACITY-BUILDING
TEMA • POGO • FELLOWSHIPS • TTR

REGIONS

2 Regional Sub-Commissions, 4 Committees and 8 Programme/Project offices

- IOCARIBE, Cartagena, Colombia
- WESTPAC, Bangkok, Thailand
- IOCINDIO
- IOCWIO
- IOCEA
- Black Sea
- HAB Office, Copenhagen, Denmark
- HAB Office, Vigo, Spain
- DBCP/Argo Office, Toulouse, France
- GOOS Office, Perth, Australia
- GOOS Office, Rio de Janeiro, Brazil
- IOCWIO Project office, Nairobi, Kenya
- ITIC Honolulu,Hawaii
- ICG/IOTWS Secretariat Perth, Australia

organization of secretariat staff

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

ADG/IOC OFFICE

ADG/IOC – Executive Secretary
. Patricio Bernal

Professional Staff
. S. Belfiore
. A. Mateos

General Services Staff
. R. Hervé-Smadja
. K. Yvinec
. P. Boned
. S. Sermeño
. C. Pontes

OCEAN SCIENCES

HEAD OF SECTION
. Vacant

Professional Staff
. M. Hood
. H. Enevoldsen
(Copenhagen, Denmark)
. J. Barbière
. R. Dargaville

General Services Staff
. C. Le Conan
. V. Bonnet

COMMON SUPPORT UNIT
CAPACITY-DEVELOPMENT

HEAD OF SECTION
E. Desa

Professional Staff
J. Berque

General Services Staff
S. Guiraud

OCEAN OBSERVATIONS AND SERVICES

HEAD OF SECTION
. K. Alverson

Professional Staff
. T. Gross (hired Jan. 2007)
. C. Clark (Seconded)
. P. Pissierssens
. T. Aarup
. A. Fischer
. M. Belbéoch (Toulouse, France)
. H. Viola (Toulouse, France)
. B. Lee
. V. Vladymyrov (Ostend, Belgium)
. N. D'Adamo (Perth, Australia)
(Participating in Tsunami Coordination Unit)
. J. Trotte, Rio Office
. J. Ahanhanzo

General Services Staff
. I. Gazagne
. A. Vannier
. H.H. Lam
. L. Ferry
. P. Coghlan

REGIONAL PROJECT OFFICES/
SUB-COMMISSIONS

Professional Staff
. C. Toro, IOCARIBE Office
(Cartagena, Colombia)
. W. Zhu, WESTPAC Office
(Bangkok, Thailand)
. M. Odido, IOCWIO Office
(Nairobi, Kenya)

General Services Staff
. P. Wills-Velez, IOCARIBE
(Cartagena, Colombia)
. N. Saransunth, WESTPAC
(Bangkok, Thailand, local)

TSUNAMI COORDINATION UNIT

HEAD OF SECTION
. P. Koltermann

Professional Staff
. M. Yamamoto
. B. Aliaga
. U. Wolf
. A. Elliot (Perth, Australia)
. J. Cunneen (Perth, Australia)
. D. Travin
. B. Sims (IT support)

General Services Staff
. F. Collins
. S. Taheri

Personnel at IOC Headquarters, Paris, France, June 2006 (left to right):
Front row: Ehrlich Desa, Ümit Ünlüata, Laura Kong, Masahiro Yamamoto, Ho Hien Lam, Christiane Le Conan, Aurora Mateos, Cigié Pontes, Peter Pissierssens, Candyce Clark, Stefano Belfiore, Bernardo Aliaga; **Second row**: William Erb, Jane Cunneen, Albert Fischer, Boram Lee, Ksenia Yvinec, Patricio Bernal, Réjane Hervé-Smadja, Mika Odido, Françoise Ricotou, Adrien Vannier, Patrice Boned, Dimitri Travin; **Third row**: Thorkild Aarup, Peter Koltermann, Benjamin Sims, Ulrich Wolf, Henrik Enevoldsen, Fabio Ledda, Joannés Berque, Julian Barbière.

Not pictured: Justin Ahanhanzo, Keith Alverson, Mathieu Belbéoch, Virginie Bonnet, Pamela Coghlan, Forest Collins, Roger Dargaville, Nick D'Adamo, Anthony Elliot, Laurence Ferry, Miguel Fortes, Irène Gazagne, Tom Gross, Sonia Guiraud, Maria Hood, Mónica Lión, N. Saransunth, Aurélie Sécheret, Silvia Sermeño, Sima Taheri, Cesar Toro, Janice Trotte, Hester Viola, Vladymyr Vladymyrov, Patricia Wills-Velez, Wenxi Zhu.

in memoriam

Ümit Ünlüata (1945–2006)

Head, Ocean Sciences section
Intergovernmental Oceanographic Commission of UNESCO

The IOC's valued colleague and friend, Ümit Ünlüata, passed away on 12 August 2006 in Paris, France, after a long illness. Ümit joined the IOC in 1998, serving first as Head of the Marine Pollution Unit and then as Head of the Ocean Sciences section in 1999.

Ümit was born in Gaziantep, Turkey, on 23 June 1945. He obtained his Ph.D. in Fluid Dynamics from the Massachusetts Institute of Technology, USA in 1973. He joined the faculty of the University of Florida, USA as an Assistant Professor for three years before returning to Turkey as the Assistant Director of the Institute of Marine Sciences of the Middle East Technical University (IMS-METU). In 1984 he was appointed Director of IMS, and served in this position for fourteen years.

His professional interests covered many areas including thermal discharges, mass transport by gravity waves, nonlinear shallow water waves, long wave excitation in harbors, harmonic distortion of long waves past a narrow opening, weakly non-linear internal waves, and offshore nuclear power plants.

Ümit authored over sixty-five peer-reviewed scientific articles and technical reports. He was an active contributor to the Mediterranean oceanographic community with works covering: tsunamis in the Eastern Mediterranean; continental shelf dynamics; topographic Rossby waves in the Cilician Basin; resonant tuning of inertial oscillations by sea-breeze along the southern Turkish coast; mean circulation on the continental shelf; dynamics of the Bosphorus Sea of Marmara-Dardanelles; meso-scale ocean dynamics of the Levantine; interactions of the Bosphorus with, and the ventilation of the Black Sea; dynamics of the Black Sea and interactions with the Anatolian Coast; and ecohydrodynamics of the Black Sea.

In 1994, in recognition of his long career he received the 'Mediterranean Prize' award of the Community of Mediterranean Universities.

He served on numerous national and international scientific committees, among them:

- Member, Executive Committee for National Council For Oceanography (since 1984).
- Member, Executive Group For Environmental and Marine Sciences, Scientific and Technical Research Council of Turkey (1985-1987, 1991-1994).
- Vice President, Physical Oceanography Committee, International Commission for the Scientific Exploration of the Mediterranean (1984-1988).
- President, Physical Oceanography Committee, International Commission for the Scientific Exploration of the Mediterranean (1988-1992).
- Member, Steering and Executive Committee of the Cooperative Marine Science Programme for the Black Sea (1991-1996).
- Co-Chairman, Steering and Executive Committee of the Cooperative Marine Science Programme for the Black Sea (since 1996).
- Director, NATO Science for Stability Programme TU-Black Sea Project (since 1993).
- Member, Turkish Committee for Scientific Committee on Oceanic Research (SCOR) (since 1993).
- Editor, Journal of Marine Systems (since 1997).
- Scientific and Technical Research Council of Turkey (TUBITAK) Coordinator, National Marine Science Programme (since 1997).

Ümit was a close friend and collaborator who was frank and direct with his comments and views. He will be sadly missed.

Photo courtesy of Stéphane Barbet

Marco Polo Bernal-Yarahuán (1948-2006)

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

The IOC of UNESCO Regional Sub-Commission for the Caribbean and Adjacent Regions (IOCARIBE) expresses deep sorrow at the passing of Marco Polo Bernal-Yarahuán on 15 August 2006 in Mexico City, Mexico. He was an extraordinary friend and colleague.

Mr Bernal-Yarahuán was the Under-Secretary of Education and Technological Research of Mexico, and served in several main posts, among them:

- General Director of the National School of Biological Sciences (IPN) (1983-1986)
- Mexico representative to the Intergovernmental Oceanographic Commission (1996-)
- Vice-Chairman and Chairman of the IOC of UNESCO Sub-Commission for the Caribbean and Adjacent Regions IOCARIBE (1997-)
- Member of the Mexican Delegation before the UNESCO General Assembly for the Programme Science and Technology (1997-)

Mr Bernal-Yarahuán participated in several national and international fora and committees, and published various manuals for supporting the biochemistry engineering curricula.

His remarkable contribution to the development of marine sciences will remain as his legacy for the benefit of the IOCARIBE Member States and the community of the region. The Sub-Commission deeply regrets his loss.

Courtesy of Shirshov Institute of Oceanology

Sergey Sergeevich Lappo (1938-2006)

Pioneer in oceanic climate research and interactions of ocean and atmosphere

Sergey Sergeevich Lappo, the Director of the P.P. Shirshov Institute of Oceanology of the Russian Academy of Sciences (IO RAS), died suddenly in Moscow, Russia, on 5 January 2006.

Dr Lappo became the Director of IO RAS in 1995. Under his direction, the Institute became one of the most successful research centres in Russia. During this time, Dr Lappo led the work and obtained unique results in the field of North Atlantic circulation research, explained the role of oceanic processes at intermediate and greater depths in global climate formation, and initiated new research in many state and international projects.

Dr Lappo was a member of the Intergovernmental Committee on Tropical Ocean and Global Atmosphere (TOGA) (1990); a member of the IOC section on oceanic processes and climate (1992); a member of the Scientific Committee on GOOS (1993); a member of the Climate Change Committees for the Ocean (CCCO) (1991-1993); a member of the World Ocean Circulation Experiment (WOCE) Hydrographic Programme Planning Committee (1991-1993); and Coordinator of the Russian project under the international WOCE.

He was Vice-President of the Scientific Committee on Oceanic Research (SCOR) of the International Council of Scientific Unions (ICSU) (1996-2000); and a member of the WMO/ICSU/IOIC Joint Scientific Committee (JSC) of the World Climate Research Programme (1997-2000). Since 1999 he had been a member of the committee of directors of the oceanographic institutes of the world for the Partnership for Observation of the Global Ocean (POGO). He was Chairman of a section of the Scientific Advisory Panel of the Marine Board at the Government of the Russian Federation and Vice-Chairman of the National Oceanographic Committee.

Dr Lappo was the author of more than 300 scientific works and more than 10 monographs, and received many prestigious awards from the Government of Russia.

He was man who taught his students to love and understand the ocean with the same passion he possessed. Sergey Sergeevich Lappo will always be remembered as a man of modesty and honesty, human kindness and knowledge.

Photo courtesy of Stéphane Barbery

Publications and Public Awareness

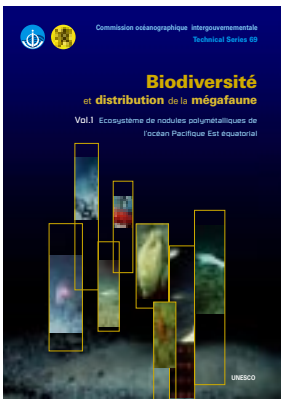
Each year the IOC publishes numerous documents and other publications. These publications support its programme activities and communicate the scientific and organizational information resulting from the various conferences, meetings, training courses and other activities that have benefited from IOC's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

IOC ANNUAL REPORT SERIES

Annual Report 2005. 2006. Paris, UNESCO, 112 pp. (Annual Report Series, 12.) (English.)

IOC TECHNICAL SERIES

Biodiversity and Distribution of the Megafauna [Biodiversité et distribution de la mégafaune]. (2 volumes) Volume 1: The Polymetallic Nodule Ecosystem of the Eastern Equatorial Pacific Ocean [Ecosystème de nodules polymétalliques de l'océan Pacifique Est equatorial].



Volume 2: *Annotated Photographic Atlas of the Echinoderms of the Clarion-Clipperton Fracture Zone* [Atlas photographique annoté des échinodermes de la zone de fractures de Clarion et de Clipperton]. 2006. (Technical Series, 69.) (English, French.)

Interdisciplinary Geosciences Studies of the Gulf of Cadiz and Western Mediterranean Basins. 2006. 153 pp. (Technical Series 70.) (English.)

Indian Ocean Tsunami Warning and Mitigation System. *Implementation Plan*. 2006. 95 pp. (Technical Series, 71.) (English.)

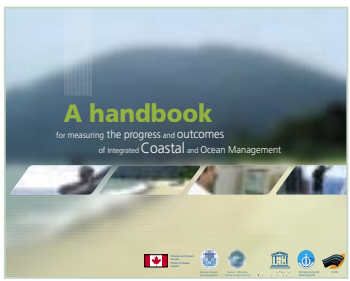
IOC WORKSHOP REPORTS

Geological Processes on Deep-water European Margins - International Conference and 15th Anniversary Post-cruise Meeting at the Training-Through-Research Programme, Moscow/Zvenigorod, Russian Federation, 29 January-4 February 2006. 2006. (Workshop Reports, 201.) (English.)

IOC MANUALS AND GUIDES

Manual on Sea Level Measurement and Interpretation, Volume IV: An Update to 2006. 2006. 80 pp. (Manuals and Guides, 14.) (English.)

Manual on Aquatic Cyanobacteria - A photo guide and synopsis of their toxicology. 2006. Copenhagen, International Society for the Study of Harmful Algae/UNESCO-IOC, 106 pp. (Manuals and Guides, 39.) (English.) ISBN 87-990827-0-5.



A Handbook for Measuring the Progress and Outcomes of Integrated Coastal and Ocean Management. 2006. Paris, 217 pp. (Manuals and Guides, 46.) (English.)

Tsunami Teacher. 2006. DVD. (Manuals and Guides, 47.) (English, Bahasa Indonesia, Thai.)

TRAINING COURSE REPORTS

IOC/JCOMM Training Course for the Global Sea Level Observing System (GLOSS) on Sea Level Observation Analysis, 15-26 May 2006, Tokyo, Japan. 2006. (Training Course Reports, 87.) (English, electronic copy only.)

IOC/JCOMM/GLOSS/ODINAFRICA Training Workshop on Sea-Level Measurement and Interpretation, 13-24 November 2006, Ostend, Belgium. 2006. (Training Course Reports, 88.) (English, electronic copy only.)

INFORMATION DOCUMENTS

IOC/INF-1220. *IGOS. A Coastal Theme for the IGOS Partnership - For the Monitoring of our Environment from Space and from Earth*. 2006. Paris, UNESCO, 60 pp. (English.)

IOC/INF-1221. *Tsunami Glossary*. 2006. Paris, 39 pp. (English.)

IOC/INF-1224. *IODE Officers Meeting, IOC Project Office for IODE, Ostend, Belgium, 6-7 February 2006, Summary Report*. 2006. Ostend, 46 pp. (English)

IOC/INF-1225. *Third Session of ODINAFRICA PROJECT Management Committee Meeting, IOC Project Office for IODE, Ostend, Belgium, 30 January-3 February 2006*. 2006. 44 pp. (English, electronic copy only.)

IOC/INF-1226. *Meeting on the Development of a Sea Level Metadata Web Service Demonstrator Project, IOC Project Office for IODE, Ostend, Belgium, 28-29 March 2006*. 2006. 33 pp. (English, electronic copy only.)

IOC/INF-1227. *Meeting on the Development of an ODINAFRICA Sea Level Data Facility, IOC Project Office for IODE, Ostend, Belgium, 29-30 March 2006. 2006*. 24 pp. (English, electronic copy only.)

IOC/INF-1228. *Agreement between the World Meteorological Organization, the International Council of Scientific Unions and the Intergovernmental Oceanographic Commission on the World Climate Research Programme*. 2006. Paris, 15 pp. (English.)

IOC/INF-1229.*Capacity-Building Section, Report on Capacity-Development Activities, July 2005 to May 2006*. 2006. Paris, 23 pp. (English.)

IOC/INF-1230. *ODINAFRICA Project Steering Committee Meeting, IOC Project Office for IODE, Ostend, Belgium, 26-28 April 2006 Summary Report*. 2006. 27 pp. (English, electronic copy only.)

IOC/INF-1231. *JCOMM Composition*. 2006. Paris, 4 pp. (English.)

REPORTS OF GOVERNING AND MAJOR SUBSIDIARY BODIES

First 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), Rome, Italy, 21-22 November 2005. 2006. 60 pp. (Reports of Governing and Major Subsidiary Bodies, 110.) (English.)

Eighth Session of the IOC Sub-Commission for the Caribbean and Adjacent Regions (IOCARIBE), Recife, Brazil, 14-17 April 2004. 2006. 68 pp. (Reports of Governing and Major Subsidiary Bodies, 111.) (English, Executive Summary French, Russian, Spanish.)

First Session of the Intergovernmental Coordination Group for the Tsunami and Other Coastal Hazards Warning System for the Caribbean Sea and Adjacent Regions (ICG/CARIBE-EWS), Bridgetown, Barbados, 10-12 January 2006. 2006. 67 pp. (Reports of Governing and Major Subsidiary Bodies, 112.) (English.)

Ninth Session of the IOC Sub-Commission for the Caribbean and Adjacent Regions (IOCARIBE), Cartagena de Indias, Colombia, 19-22 April 2006. 2006. 78 pp. (Reports of Governing and Major Subsidiary Bodies, 113.) (English, Executive Summary French, Russian, Spanish.)

Second Session of the Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWS), Hyderabad, India, 14-16 December 2005. 2006. 68 pp. (Reports of Governing and Major Subsidiary Bodies, 114.) (English.)

Second Session of the WMO-IOC Joint Technical Commission for Oceanography and Marine Meteorology, Halifax, Canada, 19-27 September 2005. 2006. 156 pp. (Reports of Governing and Major Subsidiary Bodies, 115.) (Abridged final report with resolutions and recommendations, English, French, Russian, Spanish.)

Sixth Session of the IOC Regional Committee for the Western Indian Ocean (IOCWIO), Maputo, Mozambique, 2 November 2005. 2006. 46 pp. (Reports of Governing and Major Subsidiary Bodies, 116.) (English, Executive Summary French, Russian, Spanish.)

Fourth Session of the IOC Regional Committee for the Central Indian Ocean, Colombo, Sri Lanka 8-10 December 2005. 2006. 66 pp. (Reports of Governing and Major Subsidiary Bodies, 117.) (English, Executive Summary French, Russian, Spanish.)

Thirty-eighth Session of the Executive Council, Paris, 20 June 2005. 2006. 33 pp. (Reports of Governing and Major Subsidiary Bodies, 118.) (English, French, Russian, Spanish. Electronic copy only.)

Thirty-ninth Session of the Executive Council, Paris, 21-28 June 2006. 2006. 143 pp. (Reports of Governing and Major Subsidiary Bodies, 119.) (English, French, Russian, Spanish.)

Third Session of the Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWS), Bali, Indonesia, 31 July-2 August 2006. 2006. 100 pp. (Reports of Governing and Major Subsidiary Bodies, 120.) (English.)

Second 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), Nice, France, 22-24 May 2006. 2006. 57 pp. (Reports of Governing and Major Subsidiary Bodies, 121.) (English.)

Seventh Session of the IOC Intergovernmental Panel on Harmful Algal Blooms, Paris, France, 16-18 March 2005. 2006. 155 pp. (Reports of Governing and Major Subsidiary Bodies, 122.) (English, Executive Summary French, Russian, Spanish.)

REPORTS OF MEETINGS OF EXPERTS AND EQUIVALENT BODIES

Sixth Meeting of the Advisory Body of Experts on the Law of the Sea (IOC/ABE-LOS), Spain, 2006. 2006. (Reports of Meetings of Experts and Equivalent Bodies, 206.) (English, French.)

NEWSLETTERS

Harmful Algae News. Paris. No. 30, April 2006; No. 31, August 2006; No. 32, December 2006.

Window. Western Indian Ocean Waters. Paris. Vol. 17, No. 1, July 2006; No. 2, September 2006; No. 3, November 2003; No. 4, December 2006.

Watching the oceans for signs of climate change. *A World of Science*. Jan-Mar 2006, Vol. 4, No. 1. Paris, pp. 2-8 (in focus). (UNESCO Natural Sciences Quarterly Newsletter.) (English, French.)

Progress towards ocean targets too slow. *A World of Science*. Apr-Jun 2006, Vol. 4, No. 2. Paris, pp. 7. (UNESCO Natural Sciences Quarterly Newsletter.) (English, French.)

A tsunami warning system for the Caribbean. *A World of Science*. Apr-

Jun 2006, Vol. 4, No. 2. Paris, pp. 10-11. (UNESCO Natural Sciences Quarterly Newsletter.) (English, French.)

The last frontier. *A World of Science*. Apr-Jun 2006, Vol. 4, No. 2. Paris, pp. 19-23. (UNESCO Natural Sciences Quarterly Newsletter.) (English, French.)

The red tide. *A World of Science*. Jul-Sep 2006, Vol. 4, No. 3. Paris, pp. 2-7 (in focus). (UNESCO Natural Sciences Quarterly Newsletter.) (English, French.)

Human bigger danger for coral reefs than tsunami. *A World of Science*. Jul-Sep 2006, Vol. 4, No. 3. Paris, pp. 9-10. (UNESCO Natural Sciences Quarterly Newsletter.) (English, French.)

Pacific tsunami warning system put to the test. *A World of Science*. Jul-Sep 2006, Vol. 4, No. 3. Paris, pp. 12-13. (UNESCO Natural Sciences Quarterly Newsletter.) (English, French.)

Experts appeal for greater support for sea level rise research. *A World of Science*. Oct-Dec 2006, Vol. 4, No. 4. Paris, pp. 10-12. (UNESCO Natural Sciences Quarterly Newsletter.) (English, French.)

National tsunami preparation - an absolute priority. *A World of Science*. Oct-Dec 2006, Vol. 4, No. 4. Paris, pp. 12. (UNESCO Natural Sciences Quarterly Newsletter.) (English, French.)

BROCHURES

From Commitments to Action: Advancements in Developing an Indian Ocean Tsunami Warning and Mitigation System. 2006. 30 pp., illus. (English.)

The Great Waves. 2006. 16 pp., illus. (English.)

IOC Project Office for IODE. 2006. 6 pp., illus. (English.)

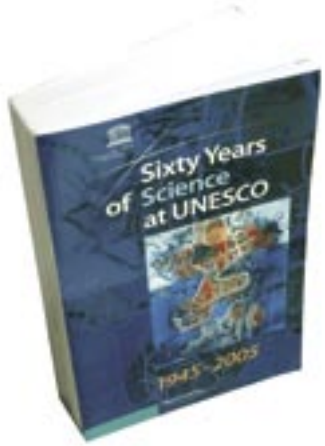
SALES PUBLICATIONS

UNESCO PUBLISHING

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

Voituriez, Bruno. 2006. *The Gulf Stream*. Paris, 221 pp. (IOC Ocean Forum.) (English, French, Spanish.)

Iwan, Wilfred D. (ed.) 2006. The Great Sumatra Earthquakes and Indian Ocean Tsunamis of 26 December 2004 and 28 March 2005; Reconnaissance Report. *Earthquake Spectra*, Vol. 22, Special issue III. Oakland, CA., 5900 pp.



Holland, Geoffrey. 2006. Observing and Understanding Planet Ocean; History of the Intergovernmental Oceanographic Commission (IOC). *Sixty Years of Science at UNESCO 1945–2005*. Paris, UNESCO, pp. 332-353. ISBN 13: 978-92-3-104005-4. (English.)

OTHERS WITH THE IOC SPONSORSHIP

Wilkinson, Clive, D. Souter and J. Goldberg (eds). 2006. *Status of Coral Reefs in Tsunami Affected Countries: 2005*. Townsville, Darwin, Perth, Australian Institute of Marine Science. 154 pp. (English.) Also available on compact disk.

UNEP-WCM. 2006. *Seamounts, deep-sea corals and fisheries*. Cambridge, 80 pp. ISBN: 978-92-807-2778-4.

COSMAR News. A NEPAD Coastal and Marine Programme and the African OceanPortal newsletter supported by the IOC of UNESCO, 2006, Nos. 6-8, (http://www.nepad-cosmar.org/).

PRESS RELEASES AND MEDIA ADVISORIES

Observing and Understanding Oceans (BPI/Infosheet/16). In-house presentation of the Commission given on 20 December 2005. '60 themes–60 weeks' presentations are part of the UNESCO 60th anniversary celebration.

Statement by the Director-General of UNESCO, Koïchiro Matsuura, on the second anniversary of the Indian Ocean tsunami of 26 December 2004. 26 December 2006. (Press Release No. 2006-156.)

Establishment of a Tsunami warning system for the Caribbean. 5 January 2006. (Media Advisory No. 2006-01.)

Third Global Conference on Oceans, Coasts, and Islands warns progress towards international targets on oceans too slow. 30 January 2006. (Press Release No. 2006-08.)

Pacific tsunami warning system put to the test. 27 April 2006. (Media Advisory No. 2006-25.)

Exercise Pacific Wave 06 seeks to consolidate tsunami warning system. 15 May 2006. (Media Advisory No. 2006-28.)

Building the tsunami warning system for the Northeast Atlantic and Mediterranean. 16 May 2006. (Media Advisory No. 2006-29.)

UNESCO Director-General hails successful test of Pacific tsunami warning system. 17 May 2006. (Press Release No. 2006-43.)

Experts to discuss why sea level is rising. 19 May 2006. (Media Advisory No. 2006-31.)

Governments urged to strengthen support for North East Atlantic and Mediterranean Tsunami Warning System. 25 May 2006. (Press Release No. 2006-48.)

Indian Ocean Tsunami Warning System up and running. 28 June 2006. (Press Release No. 2006-69.)

First real test of Indian Ocean Tsunami Warning System highlights strengths and gaps. 20 July 2006. (Press release No. 2006-85.)

National tsunami preparations an absolute priority for Indian Ocean tsunami warning system. 31 July 2006. (Press Release No. 2006-89.)

Local knowledge and planning the key to a successful tsunami warning system. 2 August 2006. (Press Release No. 2006-91.)

CERTIFICATES OF APPRECIATION AWARDED

Dr Tatiana Eremina, Russian State Hydrometeorological University (St. Petersburg) for her outstanding contribution to the IOC Capacity-Development Programme through the Baltic Floating University project, St. Petersburg, Russia. (29 May 2006.)

Professor Dr Alexei Nekrasov, Russian State Hydrometeorological University (St. Petersburg) for his outstanding contribution to the IOC Capacity-Development Programme through the coastal component of the Baltic Floating University project, Saint Petersburg, Russia. (29 May 2006.)

The Colombian Ocean Commission for the support provided to the IOC of UNESCO Sub-Commission for the Caribbean and Adjacent Regions (IOCARIBE) 1986 to 2006; a clear and unselfish commitment of the Government of Colombia in support of the goals of the IOC of UNESCO in the research and development of ocean sciences and services for the benefit of Member States in the region, Cartagena, Colombia (IOCARIBE-IX). (19 April 2006.)

Dr Elena Kozlova (Moscow State University, Russia) in recognition of her contribution to the IOC of UNESCO and, in particular, to the Capacity-Development Programme and its Training-through-Research project. (26 January 2006.)

Professor Naima Hamoumi (Mohammed V University at Agdal, Rabat, Morocco) in recognition of her contribution to the IOC of UNESCO and, in particular, to capacity-building in Morocco through the Geosphere-Biosphere Coupling Project. (26 January 2006.)

ROGER REVELLE MEDAL

Dr John Church (left) being presented with the Roger Revelle Medal by IOC Chairperson, Dr David Pugh (right) during the Thirty-ninth Session of the IOC Executive Council.
© Marcel Salvaro/UNESCO

To Dr John Church, of Australia's Commonwealth Scientific and Industrial Research Organization (CSIRO), and Chair of the Joint Scientific Committee of the World Climate Research Programme (WCRP), for his outstanding contribution to the ocean sciences. The award was presented following Dr Church's 2006 Roger Revelle Memorial Lecture 'Global sea levels: past, present and future' at the Thirty-ninth Session of the IOC Executive Council.

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

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

IOC Meetings in 2006

Event	Date	Venue	IOC Department
European Space Agency GlobCOLOUR Project - System Requirements Review (Hosted by the International Ocean Carbon Coordination Project and UNESCO-IOC)	3-4 January	Paris, France	Ocean Sciences
First Meeting of the IOC Intergovernmental Coordination Group for Tsunami and other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (ICG/CARIBE-EWS-I)	10-12 January	Bridgetown, Barbados	IOCARIBE Sub-Commission
IOC Officers Meeting	18-19 January	Buenos Aires, Argentina	Secretariat
Joint Meeting of IOC and WMO Officers	20-21 January	Buenos Aires, Argentina	Secretariat
Scientific Steering Committee for the International Science Programme on the Global Ecology and Oceanography of Harmful Algal Blooms	22-26 January	Villefranche-sur-Mer, France	Ocean Sciences
IOC/IOCINDIO-ROPME Regional Training Workshop on Harmful Algae	22-31 January	Tehran, Iran	Ocean Sciences
First Workshop on Nutrient Transport from Watersheds Model	23-27 January	Paris, France	Ocean Sciences
Global Environment Facility Large Marine Ecosystem Nutrient Modelling Workshop	23-26 January	Paris, France,	Ocean Sciences
Global Forum on Oceans, Coasts and Islands	23-27 January	Paris, France	Ocean Sciences
International Post Cruise Conference - Training-Through-Research 15	30 January-4 February 06	Moscow, Russia	Capacity-Development
IOC-EU Information Day on Tsunami Early Warning System Call for Proposals	31 January	Paris, France	Secretariat
Third Steering Committee of the Ocean Data and Information Network for Africa (ODINAFRICA)	31 January-1 February	Ostend, Belgium	Ocean Observations and Services
IODE Officers Meeting	6-7 February	Ostend, Belgium	Ocean Observations and Services
OceanTeacher Steering Group Meeting	8-10 February	Ostend, Belgium	Ocean Observations and Services
ODINCINDIO Marine Information Management Training Course	13-24 February	Ostend, Belgium	Ocean Observations and Services
IOC-DMCR (Department of Marine and Coastal Resources, Thailand) International Workshop Post-Disaster Assessment and Monitoring of Changes in Coastal, Ocean and Human Systems in the Indian Ocean and Asian Waters	20-23 February	Phuket, Thailand	WESTPAC Sub-Commission
Eighth IOC/WESTPAC Training Course on NEAR-GOOS Data Management	20 February-3 March	Tokyo, Japan	WESTPAC Sub-Commission
IOCARIBE-GOOS Sea Surface Elevation Network and Data Workshop	21-22 February	Nassau, Bahamas	IOCARIBE Sub-Commission
IOC-CLIVAR Indian Ocean Panel	27 February-6 March	Hawaii, USA	Ocean Sciences
Twenty-seventh Joint Scientific Committee of the World Climate Research Programme	6-11 March	Pune, India	Ocean Sciences
Joint IOC/IODE-MarBEF Marine Biodiversity Data Training Course	6-11 March	Ostend, Belgium	Ocean Observations and Services
Ninth Scientific Steering Committee of the Global Ocean Observing System (GSSC)	6-8 March	Paris, France	Ocean Observations and Services
First Board of Intergovernmental Committee for the Global Ocean Observing System (I-GOOS Board)	9-10 March	Paris, France	Ocean Observations and Services
Marine Information Management Training Course for the Eastern European Countries	13-14 March	Ostend, Belgium	Ocean Observations and Services
ICES-IOC-IMO Working Group on Ballast and Other Ship Vectors	13-15 March	Ostend, Belgium	Ocean Sciences
First ODINAFRICA Marine Biodiversity (Molluscs) Data Mobilization Workshop	13-22 March	Ostend, Belgium	Ocean Observations and Services
DBCP Workshop on Users and Technology and OCG Workshop on Metadata	27-29 March	Reading, UK	Ocean Observations and Services
International Conference on Early Warning (EWC)	27-29 March	Bonn, Germany	Tsunami Coordination Unit
Meeting on the Development of an ODINAFRICA Sea Level Data Facility	29-30 March	Ostend, Belgium	Ocean Observations and Services
ADRICOSM-EXT Data Management Workshop	29-31 March	Trieste, Italy	Capacity-Development
Tsunami Teacher Workshop	30 March-1 April	New Delhi, India	Tsunami Coordination Unit
Seismology Training	1-7 April	Colombo, Sri Lanka	Tsunami Coordination Unit

Inter-Agency Consultation on the Caribbean Large Marine Ecosystem Project	3-4 April	Panama City, Panama	IOCARIBE Sub-Commission
ICES-IOC Working Group on the Dynamics of Harmful Algal Blooms	3-6 April	Gdans, Poland	Ocean Sciences
Sixth Advisory Body of Experts on the Law of the Sea (IOC/ABE-LOS)	3-7 April	Malaga, Spain	Secretariat
Coral Bleaching Group	8-10 April	Paris, France	Ocean Sciences
Ninth IOC Sub-Commission for the Caribbean and Adjacent Regions IOCARIBE	17-21 April	Cartagena de Indias, Colombia	IOCARIBE Sub-Commission
CLIVAR Scientific Steering Group-14	19-22 April	Buenos Aires, Argentina	Ocean Sciences
Second ODINAFRICA-III Project Seminar	24-26 April	Ostend, Belgium	Ocean Observations and Services
Twenty-first Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS)	1-5 May	Melbourne, Australia	Tsunami Coordination Unit
International Training Course on Territorial Planning with Emphasis on Natural Risks in Coastal Zones	2-12 May	Ostend, Belgium	Tsunami Coordination Unit
ODINCINDIO Ocean Data Management Course	8-19 May	Ostend, Belgium	Ocean Observations and Services
Seismology Training	8-17 May	Jakarta, Indonesia	Tsunami Coordination Unit
Roundtable on JCOMM *in situ* Observing Platform Support Centre (JCOMMOPS)	9 May	Silver Spring, MD, USA	Ocean Observations and Services
Global News Workshop	10-12 May	Paris, France	Ocean Sciences
Kick-Off Meeting of the Caribbean Large Marine Ecosystem Project	15-17 May	Bridgetown, Barbados	IOCARIBE Sub-Commission
Seismology Training	15-18 May	Bangkok, Thailand	Tsunami Coordination Unit
Technical Standardization Meeting for Training-Through-Research Project 'Characterization of Selected HAB Species for the IOC/WESTPAC Harmful Algae Blooms Programme'	15-20 May	Bangi, Malaysia	WESTPAC Sub-Commission
IOC-GLOSS Training Workshop Course on Sea Level Measurement and Interpretation and Related Fields	15-26 May	Tokyo, Japan	Ocean Observations and Services
Eleventh Ocean Observations Panel for Climate	16-20 May	Tokyo, Japan	Ocean Observations and Services
Second Intergovernmental Coordination Group for the Tsunami Early Warning and Mitigation System in the North Eastern Atlantic, the Mediterranean and Connected Seas (ICG/NEAMTWS)	22-24 May	Nice, France	Tsunami Coordination Unit
First Cross-cutting Working Group on the African Strategy for the Applications of Remote Sensing for Integrated Management of Natural Resources	22-25 May	Paris, France	Ocean Observations and Services
Ninth Editorial Board for the International Bathymetric Chart of the Caribbean Sea and Gulf of Mexico	23-26 May	Cartagena de Indias, Colombia	Tsunami Coordination Unit
Thirteenth Integrated Global Observing Strategy Partnership (IGOS-P) Plenary	24 May	Geneva, Switzerland	Ocean Observations and Services
ODINAFRICA Marine Atlas Project - Data Mining and Coordination Workshop	6-23 June	Ostend, Belgium	Ocean Observations and Services
Second Version of the IOC Tsunami Numerical Modelling Training Course	6-16 June	Ostend, Belgium	Ocean Observations and Services
Understanding Sea Level Rise and Variability	6-9 June	Paris, France	Ocean Observations and Services
Meeting for Directors and Managers for Marine Science in the Caribbean	12-14 June	Port of Spain. Trinidad and Tobago	IOCARIBE Sub-Commission
ADRICOSM-EXT Data Mapping and Numerical Modelling Training Course	12-15 June	Trieste, Italy	Capacity-Development
General Bathymetric Chart of the Oceans (GEBCO) Guiding Committee	14-23 June	Bremerhaven, Germany	Tsunami Coordination Unit
Tenth Consultative Group on Ocean Mapping (CGOM)	16-19 June	Bremerhaven, Germany	Tsunami Coordination Unit
Capacity-Building Team Building Workshop	19 June	Paris, France	Capacity-Development
Seventh IOC Regional Science Planning Workshop on Harmful Algal Blooms in South America	21-23 June	Lima, Peru	Ocean Sciences
Thirty-ninth Executive Council	21-28 June	Paris, France	Secretariat
North Atlantic Synthesis Meeting and Friends of Oxygen on Argo Side Meeting	28-30 June	Laugarvatn, Iceland	Ocean Sciences
First Workshop on North-East Asian Regional GOOS (NEAR-GOOS) Data Management	29-30 June	Tokyo, Japan	WESTPAC Sub-Commission
Meeting of ICG/IOTWS Working Group III	30 June-1 July	Sri Lanka, Colombo	ICG/IOTWS, Perth
Large Marine Ecosystems Meeting	3-5 July	Paris, France	Ocean Sciences
Third Intergovernmental Coordination Group for the Tsunami Early Warning and Mitigation System in the Indian Ocean (ICG/IOTWS)	31 July-2 August	Bali, Indonesia	ICG/IOTWS, Perth

IOC-WESTPAC Planning and Technical Standardization Meeting for Training-Through-Research Project 'Application of ELISA as a Monitoring Tool for Paralytic Shellfish Poisons'	16-21 August	Nha Trang, Viet Nam	WESTPAC Sub-Commission
Twelfth International Conference on Harmful Algae	4-8 September	Copenhagen, Denmark	Ocean Sciences
IOC Qualifications in Identification and Enumeration of Harmful Microalgae Training Course	10-19 September	Copenhagen, Denmark	Ocean Sciences
IOC Capacity-Development Leadership Workshop for Directors of Marine Institutes in the Caribbean	12-15 September	Kingston, Jamaica	Capacity-Development
GEF Global NEWS Workshop	18-22 September	Paris, France	Ocean Sciences
Joint IODE-IOI Training Course on the GIS and Remote Sensing Data	18-23 September	Ostend, Belgium	Ocean Observations and Services
ODINAFRICA Advanced Data Management Training Course	25-29 September	Ostend, Belgium	Ocean Observations and Services
ODINAFRICA Marine Atlas Project Progress Workshop	2-4 October	Ostend, Belgium	Ocean Observations and Services
Second ODINAFRICA Websites Improvement Workshop	2-6 October	Ostend, Belgium	Ocean Observations and Services
Sustained Indian Ocean Biogeochemical and Ecological Research (SIBER) Workshop	3-6 October	Goa, India	Ocean Sciences
JCOMM Management Committee	5-7 October	Geneva, Switzerland	Ocean Observations and Services
Second Joint IODE/JCOMM Combined Modelling and Data Management Training Workshop	6-14 October	Ostend, Belgium	Ocean Observations and Services
Twenty-second Data Buoy Cooperation Panel	16-20 October	La Jolla, CA, USA	Ocean Observations and Services
Twenty-sixth Meeting on the Argos Joint Tariff Agreement	23-25 October	La Jolla, CA, USA	Ocean Observations and Services
ESA/KARI/PORSEC/IOC Training Course in Earth Observation	25-27 October	Daejeon, Republic of Korea	Capacity-Development
Second IOC-WIOMSA Capacity-Development Leadership Workshop for Directors of Marine Institutes in the East Africa	25-28 October	Zanzibar, United Republic of Tanzania	Capacity-Development
Second ODINAFRICA Marine Biodiversity (Sponges) Data Mobilization Workshop	6-16 November	Ostend, Belgium	Ocean Observations and Services
First Joint GOOS-AFRICA/LME Leadership Workshop on Remote Sensing and Operational Oceanography and Parallel Meeting of the International Bilko Steering Committee	6-10 November	Cape Town, South Africa	Ocean Observations and Services
GLOSS/ODINAFRICA Training Course on Sea Level Measurement and Interpretation	13-23 November	Ostend, Belgium	Ocean Observations and Services
Second Forum of the Pan-African Large Marine Ecosystems	13 November	Cape Town, South Africa	Ocean Observations and Services
Third Forum of GOOS Regional Alliances	14-17 November	Cape Town, South Africa	Ocean Observations and Services
Second Board of Intergovernmental Committee for the Global Ocean Observing System (I-GOOS Board)	18 November	Cape Town, South Africa	Ocean Observations and Services
Meeting of the Training-Through-Research Executive Committee	19 November	Paris, France	Capacity-Development
ADRICOSM-EXT Final Meeting	20–21 November	Rome, Italy	Capacity-Development
First NEAR-GOOS Working Group on New Generation Sea Surface Temperature	22 November	Sendai, Japan	WESTPAC Sub-Commission
Third Group of Experts on Biological and Chemical Data Management and Exchange Practices (GEBICH)	27-28 November	Cape Town, South Africa	Ocean Observations and Services
Group of Experts on Scientific Aspect of Marine Pollution (GESAMP)	27 November-1 December	Paris, France	Ocean Sciences
ODINAFRICA Marine Atlas Project - Data Assembly Workshop	28 November-1 December	Ostend, Belgium	Ocean Observations and Services
Second IOC Capacity-Development Leadership Workshop for Directors of Marine Institutes in the Caribbean	29 November-3 December	Havana, Cuba	Capacity-Development
Training-Through-Research Flanders Project Capacity-Development Field Trip	1-5 December	Errachidia, Morocco	Capacity-Development
Third International Workshop for Global Oceanographic Data Archaeology and Rescue Project in the Western Pacific Region (GODAR-WESTPAC)	4-5 December	Tokyo, Japan	WESTPAC Sub-Commission
First GlobColour User Consultation Workshop	4-6 December	Villefranche-sur-Mer, France	Ocean Sciences
Preparatory Meeting toward the Establishment of ODINWESTPAC	6 December	Tokyo, Japan	WESTPAC Sub-Commission

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 2006. Together with national and non-governmental initiatives, the implementation and related staff costs during 2005 were financed through income from UNESCO as part of its regular programme allocation, as approved by the UNESCO General conference, and from extra-budgetary resources, notably those provided by IOC Member States and partner organizations through their contributions to the Intergovernmental Oceanographic Commission of UNESCO Special Account and contributions for specific projects through creation of UNESCO Funds-in-Trust. This Financial Report does not consider other contributions (either direct or in-kind) provided by Member States in support of the Commission's programme execution, which are rather substantial but do not enter the budgetary flow of IOC[1].

Table 1. Consolidated Report on Funding Available for 2006 Activities

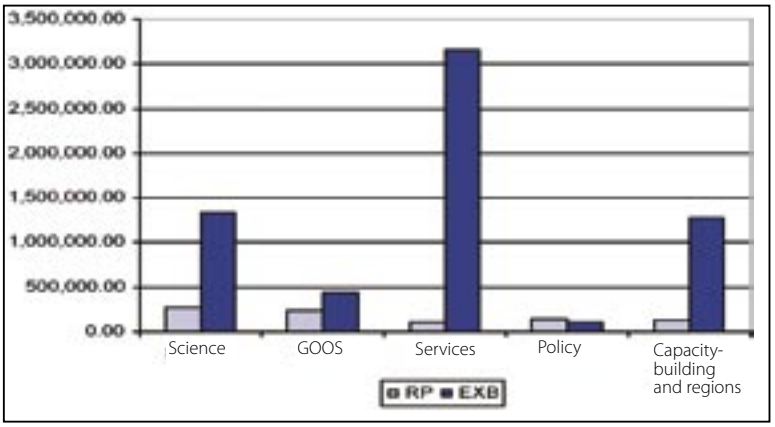
Programme/ Activity title	A. Regular Programme		B. IOC Special Account			C. Funds-in-Trust	TOTAL
	Allotment 2006		B.1 Programme Activities		B.2 Earmarked	Planned 2006	
					Allotment 2006		
	Programme	*Staff*	*Programme*	*Staff*	*Programme and Staff*	*Programme and Staff*	
IOCCP	14,400.00	0.00	0.00	115,000.00	0.00	0.00	129,400.00
OOPC	40,000.00	0.00	0.00	85,000.00	0.00	0.00	125,000.00
WCRP	125,000.00	0.00	0.00	0.00	0.00	0.00	125,000.00
HAB	25,650.00	50,000.00	111,244.13	0.00	0.00	0.00	186,894.13
ICAM	150,460.00	0.00	74,607.68	0.00	0.00	1,249,451.08	1,474,518.76
Environment and Ecosystems	49,800.00	0.00	0.00	0.00	543,253.48	36,308.65	629,362.13
GMA	0.00	0.00	49,985.00	0.00	0.00	15,000.00	64,985.00
GOOS	248,500.00	138,000.00	331,176.95	148,906.02	178,478.79	0.00	1,045,061.76
JCOMM	82,000.00	0.00	0.00	0.00	0.00	0.00	82,000.00
IODE	89,095.30	80,000.00	62,346.11	0.00	0.00	1,144,960.72	1,376,402.13
Tsunami	40,000.00	0.00	68,585.26	0.00	2,705,761.15	3,363,621.28	6,177,967.69
Ocean Mapping	24,800.00	0.00	1,798.48	0.00	0.00	0.00	26,598.48
Capacity-Building	145,000.00	0.00	33,422.08	0.00	0.00	1,212,921.83	1,391,343.91
UNCLOS/ABE-LOS	51,000.00	33,000.00	36,818.89	0.00	0.00	0.00	120,818.89
Governing Bodies	77,600.00	0.00	0.00	0.00	0.00	0.00	77,600.00
ADG Office	0.00	85,000.00	96,875.65	0.00	0.00	0.00	181,875.65
Regions - Global	12,850.00	0.00	0.00	0.00	0.00	0.00	12,850.00
Regions - WESTPAC		62,500.00	121,915.00	0.00	0.00	0.00	184,415.00
Regions - IOCARIBE		121,135.24	20,000.00	0.00	0.00	484,524.00	625,659.24
Sub-total		***569,635.24***	***1,008,775.23***	***348,906.02***	***3,427,493.42***	***7,506,787.56***	
Regular Programme Common Charges	***290,550.00***						
		2,036,340.54			***4,785,174.67***		
Regular Programme Staff Allocation		***2,254,289.00***					
Interest on Special Account*					***222,871.00***	***7,506,787.56***	
Sub-total by category		4,290,629.54			5,008,045.67	7,506,787.56	
TOTAL FUNDING IOC 2006 **							**16,805,462.77**

*Danish contribution towards HAB (both Programme and Staff) only received in January 2007, not shown here.

** Used to cover shortfalls (mainly Staff and Governing Bodies meetings)

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

PROGRAMME



Expenditure under regular programme and extrabudgetary by main activity axes (not taking into account common charges, support costs and global IOC Regular Programme Staff Allocation).

Table 2. Consolidated Report on Expenditure (Disbursements) 2006 – All Sources of Funding

	Regular Programme			Special Account		Funds-in-Trust			TOTAL
	Programme	Staff	Common Charges	Programme	Staff	Programme	Staff	Project Support Costs	
MLA 1 Science	275,378.41	26,382.13	29,659.22	518,566.12	394,763.78	819,624.65	79,591.33	10,099.34	2,154,064.98
MLA 2 GOOS	235,519.89	151,984.52	53,910.08	447,655.01	352,712.90	0.00	0.00	0.00	1,241,782.40
MLA 2 Services (incl. Tsunami)	109,630.06	85,953.36		348,242.92	10,006.00	2,811,289.34	571,667.40	311,513.54	4,248,302.62
MLA 3 Policy	145,732.41	91,282.78	92,432.39	107,565.79	458,896.91	0.00	0.00	0.00	895,910.28
MLA 3 Capacity-Building and Regions	136,355.19	177,832.95		77,878.27	29,593.63	1,198,523.42	61,482.87	96,014.50	1,777,680.83
TOTAL	902,615.96	533,435.74	176,001.69	1,499,908.11	1,245,973.22	4,829,437.41	712,741.60	417,627.38	10,317,741.11
Regular Programme Staff Allocation		2,116,520.60							
GRAND TOTAL			**3,728,573.99**		**2,745,881.33**			**5,959,806.39**	**12,434,261.71**

1. Regular programme implementation

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

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

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

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

Table 3. Resolution XVIII-16 – Budget Breakdown for 2006-2007

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

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

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

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

The IOC Executive Council at its Thirty-ninth Session, 21-28 June 2006, in its Resolution EC-XXXIX.10 'IOC Programme and Budget' provided further guidelines as to how the regular programme funding should be allocated.

Table 4. Regular Programme Expenditure: Disbursements as at 31 December 2006: Programme *versus* Personnel (Based on SAP Post-Closure Reports)

Budget Code	Title (short)	Allocation	Expenditure 2006			Exec. Rate
			Programme (incl. missions) (incl. missions)	Personnel (CI 11 and 13)	TOTAL	
MLA 1						
32131101 IOC	IOCCP	27,937.00	9,027.22	4,776.00	13,803.22	49%
32131102 IOC	OOPC	75,871.00	30,222.49	7,310.06	37,532.55	49%
32131103 IOC	WCRP	250,000.00	120,812.72	4,187.00	124,999.72	50%
32131201 IOC	Harmful Algal Blooms	49,112.00	5,008.26	0.00	5,008.26	10%
32131202 IOC	Environmental Variability and Eco-systems	88,613.00	35,542.39	2,141.68	37,684.07	43%
32131301 IOC	Project on Indicators for ICAM	60,920.00	26,026.02	1,616.69	27,642.71	45%
32131302 IOC	Guidance for ICAM Implementation	60,930.00	13,784.43	4,621.04	18,405.47	30%
32131401 IOC	ICAM Implementation in Africa	55,327.00	10,730.40	0.00	10,730.40	19%
32131402 IOC	Regional Implementation of ICAM in Other Regions	57,930.00	24,224.48	1,729.66	25,954.14	45%
Sub-total	**Programme**	**726,640.00**	**275,378.41**	**26,382.13**	**301,760.54**	**42%**
32131501 EVA	SC Programme Evaluation	8,900.00	0.00	0.00	0.00	0%
32131502 SEO	SC Global Thematic Reports	6,300.00	2,761.80	0.00	2,761.80	44%
32131503 SEO	New Initiatives and Cooperation	4,200.00	0.00	0.00	0.00	0%
32131504 SEO	SC Programme Development	5,200.00	0.00	0.00	0.00	0%
32131505 POC	SC Programme Operating Costs	53,900.00	17,485.88	0.00	17,485.88	32%
32131506 POC	SC Informatics Costs	6,300.00	86.54	0.00	86.54	1%
32131601 HQC	HQ Contribution to Common Charges	11,600.00	5,800.00	0.00	5,800.00	50%
32131602 SIT	UNESCO SITA Link (ADM/DIT)	12,200.00	3,525.00	0.00	3,525.00	29%
Sub-total	*Common Charges*	*108,600.00*	*29,659.22*	*0.00*	*29,659.22*	*27%*
TOTAL MLA 1		835,240.00	305,037.63	26,382.13	331,419.76	40%
MLA 2						
32132101 IOC	Global Ocean Observing System (GOOS)	748,873.00	187,089.10	150,327.78	337,416.88	45%
32132201 IOC	JCOMM Coordination	159,022.00	48,430.79	1,656.74	50,087.53	31%
32132301 IOC	IODE - 1	61,782.00	24,730.83	0.00	24,730.83	40%
32132302 IOC	IODE - 2	21,861.00	7,997.01	0.00	7,997.01	37%
32132303 IOC	IODE - 3	12,071.00	0.00	0.00		0%
32132304 IOC	IODE - 4	184,001.00	26,251.49	77,808.36	104,059.85	57%
32132305 QUI	Implementation Local Activities ODINCARSA	7,000.00	6,990.00	0.00	6,990.00	100%
32132401 IOC	Development of Operational Tsunami Warning	54,200.00	23,838.59	3,226.00	27,064.59	50%
32132402 IOC	Ocean Mapping	47,260.00	19,822.14	4,919.00	24,741.14	52%
Sub-total	**Programme**	**1,296,070.00**	**345,149.95**	**237,937.88**	**583,087.83**	**45%**
32132501 EVA	SC Programme Evaluation	16,600.00	0.00	0.00	0.00	0%
32132502 SEO	SC Global Thematic Reports	11,700.00	1,866.13	3,822.49	5,688.62	49%
32132503 SEO	New Initiatives and Cooperation	7,800.00	5,700.00	0.00	5,700.00	73%
32132504 SEO	SC Programme Development	9,800.00	9,800.00	0.00	9,800.00	100%
32132505 POC	SC Programme Operating Costs	67,800.00	1,896.43	0.00	1,896.43	3%
32132506 POC	SC Informatics Costs	11,900.00	5,910.66	0.00	5,910.66	50%
32132507 TEL	SC Telephone	13,100.00	5,189.50	0.00	5,189.50	40%
32132601 HQC	HQ Contribution to Common Charges	21,900.00	10,950.00	0.00	10,950.00	50%
32132602 SIT	UNESCO SITA Link (ADM/DIT)	23,000.00	8,774.87	0.00	8,774.87	38%
Sub-total	*Common charges*	*183,600.00*	*50,087.59*	*3,822.49*	*53,910.08*	*29%*
TOTAL MLA 2		1,479,670.00	395,237.54	241,760.37	636,997.91	43%

MLA 3						
32133101 IOC	Training Through Research Programme	61,945.00	19,018.99	0.00	19,018.99	31%
32133102 IOC	Mobility and Linkages	44,290.00	28,275.00	0.00	28,275.00	64%
32133201 IOC	UNESCO Chairs, Visiting Researchers	20,000.00	5,000.00	0.00	5,000.00	25%
32133202 IOC	Remote Sensing and Modelling	10,000.00	10,000.00	0.00	10,000.00	100%
32133301 IOC	Integrated TEMA Website	20,000.00	2,071.35	0.00	2,071.35	10%
32133302 IOC	Statements on Capacities of Member States	120,000.00	47,132.14	1,371.82	48,503.96	40%
32133401 IOC	Promoting UNCLOS Implementation	87,000.00	42,584.64	4,999.01	47,583.65	55%
32133402 IOC	UNCLOS/ABE-LOS Consultant	83,000.00	14,068.15	18,519.26	32,587.41	39%
32133501 IOC	Governing Bodies and Public Awareness	177,600.00	56,805.85	19,188.59	75,994.44	43%
32133502 IOC	ADG/IOC Office Staff	195,000.00	32,273.77	48,575.92	80,849.69	41%
32133503 IOC	Coordination of IOC Regional Activities	38,700.00	9,660.78	2,586.88	12,247.66	32%
32133504 IOC	IOCARIBE Office Staff	230,000.00	0.00	121,135.24	121,135.24	53%
32133505 IOC	HAB Office Staff	100,000.00	10,827.68	0.00	10,827.68	11%
32133506 IOC	WESTPAC Office Staff	109,055.00	4,369.25	52,739.01	57,108.26	52%
Sub-total	**Programme**	**1,296,590.00**	**282,087.60**	**269,115.73**	**551,203.33**	**43%**
32133601 EVA	SC Programme Evaluation	14,800.00	0.00	0.00	0.00	0%
32133602 SEO	SC Global Thematic Reports	10,500.00	5,249.71	0.00	5,249.71	50%
32133603 SEO	New Initiatives and Cooperation	7,000.00	0.00	0.00	0.00	0%
32133604 SEO	SC Programme Development	8,700.00	8,700.00	0.00	8,700.00	100%
32133605 POC	SC Programme Operating Costs	88,500.00	15,898.53	0.00	15,898.53	18%
32133606 POC	SC Informatics Costs	15,500.00	6,234.18	0.00	6,234.18	40%
32133607 TEL	SC Telephone	6,400.00	3,475.77	0.00	3,475.77	54%
32133608 AGI	SC Headquarters Indirect Costs	54,800.00	21,000.83	5,519.77	26,520.60	48%
32133701 HQC	HQ Contribution to Common Charges	28,600.00	14,300.00	0.00	14,300.00	50%
32133702 SIT	UNESCO SITA Link (ADM/DIT)	30,100.00	12,053.60	0.00	12,053.60	40%
Sub-total	*Common charges*	*264,900.00*	*86,912.62*	*5,519.77*	*92,432.39*	*35%*
TOTAL MLA 3		1,561,490.00	369,000.22	274,635.50	643,635.72	41%
TOTAL IOC	**PROGRAMME**	**3,319,300.00**	**902,615.96**	**533,435.74**	**1,436,051.70**	**43%**
TOTAL IOC	**COMMON CHARGES**	**557,100.00**	**166,659.43**	**9,342.26**	**176,001.69**	**32%**
TOTAL IOC	**32130000 HEQ - Staff Costs IOC-HQ**	**4,390,039.00**			**2,116,520.60**	**48%**
GRAND TOTAL		8,266,439.00			**3,728,573.99**	**45%**

(*theoretical execution rate for 31 December 2006 is 50%)

2. IOC SPECIAL ACCOUNT

2 - Account – 194IOC9090 – Programme Activities: Income

Table 5. 2006 Contributions to the IOC Special Account – 194IOC9090 – Programme Activities

Donor	Amount	Purpose
MLA 1 – SCIENCE (191SCI2020)		
USA NOAA	10,000.00	Marine Spatial Planning
USA NOAA	10,000.00	Marine Spatial Planning
The Nature Conservancy, USA	10,000.00	Marine Spatial Planning
Gordon and Betty Moore Foundation, USA	15,000.00	Marine Spatial Planning
English Nature, UK	9,300.00	Marine Spatial Planning
WWF	12,807.68	Marine Spatial Planning
Conservation International Foundation	7,500.00	Marine Spatial Planning
USA NOAA	35,000.00	GEOHAB
USA NOAA	10,000.00	HAB Training, incl. U.S. participation
USA NOAA	15,000.00	HAEDAT
Université Pierre et Marie Curie	2,005.02	HAB (contribution towards publication expenses)
Université Pierre et Marie Curie	10,000.00	HAB (contribution towards publication expenses)
Transfer from 193DEN2020 (closed project)	28.11	HAB
Transfer from 193UKM2041 (closed project)	832.00	Coral Reefs project
Spain	38,379.00	HAB/Vigo
USA NOAA	30,000.00	Global Marine Assessment
Republic of Korea	19,985.00	Global Marine Assessment
Sub-total	**235,836.81**	
MLA 2 – GOOS (191GOS2040)		
UNEP	18,000.00	GOOS activities
UNEP	2,000.00	GOOS activities
USA NOAA	20,000.00	Technical Services of Dr J.Baker (GOOS/JCOMM)
USA NOAA	20,000.00	Technical Services of Dr J.Baker (GOOS)
Italy (IMC)	7,384.61	MAMA project
United Kingdom (NERC)	28,000.00	GOOS and GLOSS
USA NOAA	20,000.00	Rio GOOS
USA (State Department)	20,000.00	GOOS Regional Forum
USA NOAA	20,000.00	JCOMM/GLOSS
USA NOAA	30,000.00	Rio-GOOS (Argo Floats Deployment)
Germany (Institute for Coastal Research/GKKS)	2,405.84	GLOSS/Understanding Sea Level Rise meeting, June 2006
IAPSO	2,100.00	GLOSS/Understanding Sea Level Rise meeting, June 2006
France IRD	2,570.70	GLOSS/Understanding Sea Level Rise meeting, June 2006
France CNRS	9,640.13	GLOSS/Understanding Sea Level Rise meeting, June 2006
France IGN	6,377.55	GLOSS/Understanding Sea Level Rise meeting, June 2006
UK Meteorological Office	9,251.00	GLOSS/Understanding Sea Level Rise meeting, June 2006
Asia Pacific Network for Global Change Research	5,000.00	GLOSS/Understanding Sea Level Rise meeting, June 2006
USA	58,041.00	GLOSS/Understanding Sea Level Rise meeting, June 2006
European Environment Agency (EAS)	11,556.12	GLOSS/Understanding Sea Level Rise meeting, June 2006
Sub-total	**292,326.95**	
MLA 2 – IODE (191SER2030)		
IFREMER France	8,464.33	IODE - EurOcean
Wallingford	13,881.78	IODE - Motive Project
USA NOAA	20,000.00	IODE XIX
USA (State Department)	20,000.00	IODE Data ATM Programme
Sub-total	**62,346.11**	
MLA 2 – Ocean Mapping (191SER2030)		
International Landkartenhaus (Germany)	745.34	Ocean Mapping
RMIB Geoscience, The Netherlands	271.68	Ocean Mapping
Republic of Korea (Permanent Delegation)	254.45	Ocean Mapping
Republic of Korea (Permanent Delegation)	527.01	Ocean Mapping
Sub-total	**1,798.48**	

MLA 2 – Tsunami Warning System (191SER2030)		
Vassar College	505.00	TWS
WMO	18,751.46	ICG/TWS/Caribbean, January 2006, Barbados
Israel	5,000.00	TWS/Mediterranean
Canada	22,328.80	TWS
USA (State Department)	20,000.00	ICG-II meeting TWS-Caribbean
Republic of Korea	1,000.00	TWS
Geohazards International	1,000.00	TWS
Sub-total	**68,585.26**	
MLA 3 – CAPACITY-BUILDING (191CAP2050)		
University of Southampton, UK	20,699.48	HERMES Project
ESA	12,722.60	ESA/KARI/PORSEC/IOC Training Course, Daejon, Republic of Korea
Sub-total	**33,422.08**	
MLA 3 – REGIONS (191CAP2050)		
China (People's Republic of)	20,000.00	Regional Cooperation WESTPAC
China (People's Republic of)	20,000.00	Regional Cooperation WESTPAC
WAPMERR	76,915.00	Conference on Post-Disaster Assessment and Monitoring in the Indian Ocean and Asian Waters
UNU	5,000.00	Conference on Post-Disaster Assessment and Monitoring in the Indian Ocean and Asian Waters
USA NOAA	10,000.00	IOCARIBE
USA NOAA	10,000.00	IOCARIBE-GOOS Integration into TWS
Sub-total	**141,915.00**	
MLA 3 – POLICY (191POL2050)		
Consortium for Oceanographic Research and Education	935.48	ADG/IOC Travel Costs (Reimbursement)
Spain (IEO)	7,108.98	ABE-LOS
Spain (MFA)	19,505.83	ABE-LOS
Greece	10,204.08	ABE-LOS
Australia (BOM)	2,250.91	Travel Expenses IOC Officers meeting Buenos Aires
Deusches Komitee Katastrophenvorsorge (Germany)	844.59	ADG/IOC Travel Costs (Reimbursement)
USA (State Department)	50,000.00	Revision of the IOC Website
USA (State Department)	30,000.00	Performance Metrics
Sub-total	**120,849.87**	
STAFF		
Australia (CSIRO)	7,470.00	Argo Coordinator
Canada	8,582.52	Argo Coordinator
IFREMER	12,853.50	Argo Coordinator
USA NOAA	120,000.00	Argo Coordinator
UK Meteorolofical Office	13,850.00	Argo Coordinator
USA NOAA	85,000.00	Albert Fischer
USA NOAA	25,000.00	JCOMM/GOOS Albert Fischer
USA NOAA	115,000.00	Maria Hood
Sub-total	**387,756.02**	
NON-EARMARKED		
Canada	12,844.67	Programme Activities Support
Sub-total	**12,844.67**	
INTEREST		
First quarter	54,176.00	
Second quarter	54,136.00	
Third quarter	55,230.00	
Fourth quarter	59,329.00	
Sub-total	**222,871.00**	
TOTAL 2006	**1,580,552.25**	

2.1 - Account – 194IOC9090 – Programme Activities: Expenditure

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

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

Table 6. Programme Activities: Expenditure on Operation Codes

	2006 Disbursements	Unliquidated Obligations	Total
MLA 1 – Ocean Science			
11 - Experts and Consultants	394,161.40	2,188.52	396,349.92
13 – Administrative Support Personnel	602.38	0.00	602.38
16 - Mission Costs	17,494.01	264.90	17,758.91
10 - Other Personnel Costs	0.00	0.00	0.00
20 - Sub-Contracts	187,795.26	36,073.21	223,868.47
32 - Training and Seminars	28,881.20	4,319.67	33,200.87
40 - Equipment and Maintenance	3,589.62	0.00	3,589.62
50 - Sundry Expenditure	422.09	0.00	422.09
Sub-total	**632,945.96**	**42,846.30**	**675,792.26**
MLA 2 – Global Ocean/Coastal Observing Systems			
11 - Experts and Consultants	289,717.39	4,049.02	293,766.41
13 - Administrative Support Personnel	7,843.60	0.00	7,843.60
16 - Mission Costs	55,646.50	12,667.86	68,314.36
10' - Other Personnel Costs	0.00	0.00	0.00
20 - Sub-Contracts	174,756.83	5,400.00	180,156.83
32 - Training and Seminars	146,002.57	7,929.72	153,932.29
40 - Equipment and Maintenance	26,305.68	2,900.94	29,206.62
50 - Sundry Expenditure	39,909.20	0.00	39,909.20
Sub-total	**740,181.77**	**32,947.54**	**773,129.31**
MLA 2 – Ocean Services			
11 - Experts and Consultants	10,006.00	55.01	10,061.01
13 - Administrative Support Personnel	0.00	0.00	0.00
16 - Mission Costs	28,571.66	2,964.04	31,535.70
10' - Other Personnel Costs	0.00	0.00	0.00
20 - Sub-Contracts	27,502.53	414.98	27,917.51
32 - Training and Seminars	17,728.36	0.00	17,728.36
40 - Equipment and Maintenance	22,233.51	5,355.71	27,589.22
50 - Sundry Expenditure	18,946.46	2,015.00	20,961.46
Sub-total	**124,988.52**	**10,804.74**	**135,793.26**
MLA 3 – General Policy			
11 - Experts and Consultants	24,010.80	0.00	24,010.80
13 - Adminstrative Support Personnel	61,953.60	0.00	61,953.60
16 - Mission Costs	20,878.23	280.00	21,158.23
10' - Other Personnel Costs	0.00	0.00	0.00
20 - Sub-Contracts	28,861.30	1,800.00	30,661.30
32 - Training and Seminars	55,423.04	0.00	55,423.04
40 - Equipment and Maintenance	2,393.22	130.00	2,523.22
50 - Sundry Expenditure	10.00	0.00	10.00
Sub-total	**193,530.19**	**2,210.00**	**195,740.19**
MLA 3 – Capacity-Building/Regional Cooperation			
11 - Experts and Consultants	1,445.53	2,024.01	3,469.54
13 - Adminstrative Support Personnel	28,148.10	0.00	28,148.10
16 - Mission Costs	10,673.90	0.00	10,673.90
10' - Other Personnel Costs	0.00	0.00	0.00
20 - Sub-Contracts	56,376.00	0.00	56,376.00
32 - Training and Seminars	10,781.92	456.00	11,237.92
40 - Equipment and Maintenance	0.00	0.00	0.00
50 - Sundry Expenditure	46.45	0.00	46.45
Sub-total	**107,471.90**	**2,480.01**	**109,951.91**
TOTAL	**1,799,118.34**	**91,288.59**	**1,890,406.93**

2.2 Earmarked Activities – Income and Funds Availability

Table 7. Income and Expenditure under Earmarked Activities (193-Series)

Budget Code	Project Title (short)	Donor	Allotment	Income	Disbursements 2006		Unliquidated	TOTAL
			2006	2006	Programme (Incl.Missions)	Personnel	Obligations (Programme)	EXPENSES
MLA 1 – Ocean Science								
193INT2000	Ecosystems and Fisheries	UNEP	544,113.59	0.00	280,383.94	0.00	62,597.76	342,981.70
193DEN2020	IOC HAB Centre	Denmark	-28.11	-28.11	*			
	GCRMN	UK	-832.00	-832.00	*			
Sub-total			**543,253.48**	**-860.11**	**280,383.94**	**0.00**	**62,597.76**	**342,981.70**
MLA 2 – GOOS								
193GLO2001	DBCP Coordinator	DBCP MS	178,478.79	0.00	5,034.23	55,151.91	11847.07	72,033.21
Sub-total			**178,478.79**	**0.00**	**5,034.23**	**55,151.91**	**11,847.07**	**72,033.21**
MLA 2 – Tsunami								
193INT2001	Indian Ocean TWS (contribution from Finland and Germany received in 2005)	Israel		5,000.00				
		ISDR		250,000.00				
		Sub-total	2218109.58	255,000.00	119,203.02	223,961.25	174168.96	517,333.23
193INT2002	ICG Secretariat	Australia	487,651.57	427,541.50	114057.38	148,971.26	53681.58	316,710.22
Sub-total			**2,705,761.15**	**682,541.50**	**233,260.40**	**372,932.51**	**227,850.54**	**834,043.45**
TOTAL			**3,427,493.42**	**681,681.39**	**518,678.57**	**428,084.42**	**302,295.37**	**1,249,058.36**

2. 3. UNESCO Funds-in-Trust for specific projects

Table 8. Expenditure under 'Active' Funds-in-Trust

Budget Code	Project Title (short)	Donor	Valid From	Valid To	Total Allocation	Planned 2006*	Disbursements 2006			TOTAL
							Programme	Personnel	PSC	
MLA 1 – Ecosystem and Marine Environment Protection										
213INT2002	Coastal Marine Ecosystems	UNEP	15/7/04	31/7/06	10,577.23	10,577.23	10,577.23	0.00	N/A	10,577.23
513RAS2000	Biodiversity and Megafauna	Flanders	1/1/04	31/12/07	66,000.00	25,731.42	25,463.83	0.00	2,546.38	28,010.21
Sub-total					76,577.23	36,308.65	36,041.06	0.00	2,546.38	38,587.44
MLA 1 – ICAM										
213GLO2003	Global Dialogue on Oceans	UNEP	1/9/05	31/8/07	994,600.00	499,302.35	427,053.56	18,667.42	N/A	445,720.98
RAF0047695	Climate Change (W. Africa)	UNDP	1/10/05	31/3/07	700,000.00	601,336.00	270,222.63	55,035.01	N/A	325,257.64
RAS0050713	Groundwater in Caspian Sea	UNDP	1/9/06	28/2/07	50,000.00	50,000.00	14,934.74	1,731.90	N/A	16,666.64
513GLO2007	Integrated Service and Spatial Tools	Flanders	1/6/06	31/3/07	92,194.00	83,812.73	66,291.38	4,157.00	7,044.83	77,493.21
513RLA2001	Integrated Service Platforms	Flanders	1/7/06	30/4/07	16,500.00	15,000.00	5,081.28	0.00	508.13	5,589.41
Sub-total					1,853,294.00	1,249,451.08	783,583.59	79,591.33	7,552.96	870,727.88
MLA 1 – GMA										
513GLO2008	UN Global Reporting	Flanders		31/12/07	16,500.00	15,000.00	0.00	0.00	0.00	0.00
Sub-total					16,500.00	15,000.00	0.00	0.00	0.00	0.00
TOTAL MLA 1					**1,946,371.23**	**1,300,759.73**	**819,624.65**	**79,591.33**	**10,099.34**	**909,315.32**
MLA 2 – IODE										
513GLO2002	ODIMEX	Flanders	1/1/04	31/12/07	382,800.00	135,546.69	108,488.50	0.00	10,848.85	119,337.35
513GLO2005	IOC Ocean Forum Series	Flanders	1/9/05	15/12/06	10,000.00	9,091.00	7,893.08	0.00	789.31	8,682.39
513GLO2006	METADATA	Flanders		7/3/07	15,000.00	13,636.00	9,444.19	0.00	944.42	10,388.61

513RAF2003	ODINAFRICA III	Flanders	1/1/04	31/12/07	2,530,000.00	956,687.53	694,643.06	100,545.56	79,518.86	874,707.48
513RAF2004	Development of an African Depository	Flanders	1/1/04	31/12/07	111,100.00	29,999.50	10,911.22	0.00	1,091.12	12,002.34
Sub-total					3,048,900.00	1,144,960.72	831,380.05	100,545.56	93,192.56	1,025,118.17
MLA 2 – Tsunami										
216RAS2000	Implementation of Tsunami Warning Centre	UNDP		28/2/07	81,400.00	27,272.00	0.00	0.00	0.00	0.00
248INT2000	Indian Ocean TWS	UN-ISDR	1/2/05	28/2/07	3,193,399.77	1,989,512.60	1,765,033.72	223,109.83	159,051.49	2,147,195.04
248RAS2000	Indian Ocean TWS	UN-ISDR	20/9/06	22/12/06	15,120.00	14,000.00	14,000.00	0.00	1,120.00	15,120.00
504INT2000	Indian Ocean TWS	Norway	1/9/05	21/5/08	1,842,465.00	1,003,750.00	160,913.30	163,984.47	42,236.69	367,134.46
534INT2002	NEAMTWS	Italy		31/12/07	121,065.00	81,156.57	18,872.36	0.00	2,453.41	21,325.77
561INT2000	Indian Ocean TWS	Ireland	1/11/05	31/12/08	600,960.00	209,664.81	19,506.25	84,027.54	13,459.39	116,993.18
490GLO2200	*UNESCO Special. Account TWS***	*Vol. Con..*	*1/1/06*	*31/12/07*	*1,000,000.00*	*38,265.30*	*1,583.66*	*0.00*	*N/A*	*1,583.66*
Sub-total					6,854,409.77	3,363,621.28	1,979,909.29	471,121.84	218,320.98	2,669,352.11
TOTAL MLA 2					**9,903,309.77**	**4,508,582.00**	**2,811,289.34**	**571,667.40**	**311,513.54**	**3,694,470.28**
MLA 3 – Capacity-Building										
503GLO2000	Self-Driven Capacity-Building	Sweden		31/12/08	853,015.00	271,170.00	135,809.16	4,246.42	18,207.23	158,262.81
534RER2002	ADRICSCOM	Italy	15/4/05	10/2/07	1,184,830.00	874,037.78	823,024.49	49,354.65	56,704.64	929,083.78
513RAF2005	Geo-Biosphere Processes	Flanders	1/1/04	31/12/07	285,000.00	67,714.05	57,712.87	7,131.80	6,484.47	71,329.14
Sub-total					2,322,845.00	1,212,921.83	1,016,546.52	60,732.87	81,396.34	1,158,675.73
MLA 3 – Regions										
RLA0047861	Caribbean LMEs	UNDP	17/1/06	30/4/07	700,000.00	484,524.00	181,976.90	750.00	14,618.16	197,345.06
Sub-total					700,000.00	484,524.00	181,976.90	750.00	14,618.16	197,345.06
TOTAL MLA 3					**3,022,845.00**	**1,697,445.83**	**1,198,523.42**	**61,482.87**	**96,014.50**	**1,356,020.79**
TOTAL IOC					14,872,526.00	7,506,787.56	4,829,437.41	712,741.60	417,627.38	5,959,806.39

* IOC workplans and initial 2006 allotments before accounts closure and subsequent adjustments

** Part of the UNESCO Special Account (Additional 25M to Regular Budget) - IOC Ceiling/Allocation = 1M, but Funds Available = Income Received

Allotment 2006 represents the contribution from France ($38,265.30), contribution from the Czech Republic ($36,378.52) allotted in 2007, thus not shown here.

Funding Provided to IOC Projects through Funds-in-Trusts Managed by UNESCO Regional Offices (Bangkok and Jakarta)

506RAS2016	IOC/WESTPAC HAB	Japan	8/5/06	10/2/07	19,210.00		14,876.22	0.00	1,933.91	16,810.13
506GLO2000	TTR Project: ELISA	Japan	13/7/06	10/2/07	21,357.00		17,000.00	0.00	2,210.00	19,210.00
525RAS2000	Tsunami Info Centre	Canada	21/7/06	30/9/08	438,596.00		537.55	4,903.37	707.32	6,148.24

OVERVIEW OF THE IOC STAFFING SITUATION

The most relevant fraction of the fixed cost of the operation of the IOC is personnel, representing 37 per cent of 2006 expenditure. In 2006 the IOC counted approximately 51 employees (47.1 persons/month, compared to 43.74 persons/month in the biennium 2004-2005): 38 at Headquarters and 13 in the Field. Of these, 33 are professional staff and 18 provide administrative and secretarial assistance. Two professionals – C. Clark and W. Zhu – were seconded to the IOC Secretariat by the USA and China respectively. Only 20 out of 51 employees are core UNESCO staff (posts funded by the UNESCO staff allocation): 8 professionals and 12 administrative and secretarial assistants. The person/month ratio improved compared to the biennium 2004-2005 due to the creation of the Tsunami Unit with extra-budgetary funded posts.

Table 9. IOC Staff Classified by Type of Funding

Core Staff on UNESCO Posts	20.00
Seconded Staff (Directly Paid by Governments)	2.00
Associate Experts	0.00
Staff Paid by Earmarked Extrabudgetary Funds	18.25
Staff Paid from Staff Savings	1.00
Staff Paid from Non-Earmarked Extrabudgetary Funds	1.00
Staff Paid from UNESCO Regular Programme Allocation for Programme	8.75
TOTAL	**51.00**

Table 10. IOC Staff by Main Programme Axes

	Permanent Staff (UNESCO Core Posts)		Temporary Staff (All Types of Contracts)		TOTAL
	(P)	(G)	(P)	(G)	
Ocean Science	2	2	4	0	8
GOOS (and JCOMM)	3	3	6	1	13
Ocean Services (without Tsunami)	1	1	2	0	4
Tsunami	0	1	7	2	10
Capacity-Building	1	1	1	0	3
Policy	1	4	2	1	8
Regions – Field	0	0	3	2	5
TOTAL	**8**	**12**	**25**	**6**	**51**

UNESCO

INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION (IOC)

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

(EXPRESSED IN US DOLLARS)

	Programme Activities	Earmarked Activities	Total Year 2006	Total Year 2004
INCOME				
Voluntary Contributions - Schedule 1.3	1,356,821.14		1,356,821.14	3,235,371.30
Other income:				
Interest	222,871.00		222,871.00	43,490.00
Earmarked - Schedule 1.3		682,541.50	682,541.50	604,000.00
Transfers	860.11	(860.11)	-	-
TOTAL INCOME	1,580,552.25	681,681.39	2,262,233.64	3,882,861.30
Cash Disbursements Schedule 1.2	1,799,118.34	946,762.99	2,745,881.33	2,018,828.01
Increase (Decrease) in balance of unliquidated obligations	(87,216.84)	(15,103.41)	(102,320.25)	(34,332.32)
TOTAL EXPENDITURE	1,711,901.50	931,659.58	2,643,561.08	1,984,495.69
EXCESS (SHORTFALL) OF INCOME OVER EXPENDITURE	(131,349.25)	(249,978.19)	(381,327.44)	1,898,365.61
Reserves and fund balances, beginning of the period	1,681,487.58	2,557,614.90	4,239,102.48	1,141,472.13
Reserves and fund balances, end of the period	1,550,138.33	2,307,636.71	3,857,775.04	3,039,837.74

Approved _____
John Haigh
Chief Accountant

UNESCO

INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION (IOC)

SCHEDULE OF DISBURSEMENTS AND UNLIQUIDATED OBLIGATIONS
FOR THE PERIOD 1 JANUARY 2006 TO 31 DECEMBER 2006

(EXPRESSED IN US DOLLARS)

	2006 Disbursements	Unliquidated Obligations	Total
A. Programme Activities			
Capacity Building/ Regional Cooperation			
11 - Experts & Consultants	1,445.53	2,024.01	3,469.54
13 - Adm. Support Personnel	28,148.10	-	28,148.10
16 - Mission Costs	10,673.90	-	10,673.90
10' - Other Personnel Cost	-	-	-
20 - Sub-Contracts	56,376.00	-	56,376.00
32 - Training & Seminars	10,781.92	456.00	11,237.92
40 - Equipment & Maintenance	-	-	-
50 - Sundry Expenditure	46.45	-	46.45
Sub-Total	107,471.90	2,480.01	109,951.91
Global Ocean/Coastal Observing Systems			
11 - Experts & Consultants	289,717.39	4,049.02	293,766.41
13 - Adm. Support Personnel	7,843.60	-	7,843.60
16 - Mission Costs	55,646.50	12,667.86	68,314.36
10' - Other Personnel Cost	-	-	-
20 - Sub-Contracts	174,756.83	5,400.00	180,156.83
32 - Training & Seminars	146,002.57	7,929.72	153,932.29
40 - Equipment & Maintenance	26,305.68	2,900.94	29,206.62
50 - Sundry Expenditure	39,909.20	-	39,909.20
Sub-Total	740,181.77	32,947.54	773,129.31
General Policy			
11 - Experts & Consultants	24,010.80	-	24,010.80
13 - Adm. Support Personnel	61,953.60	-	61,953.60
16 - Mission Costs	20,878.23	280.00	21,158.23
10' - Other Personnel Cost	-	-	-
20 - Sub-Contracts	28,861.30	1,800.00	30,661.30
32 - Training & Seminars	55,423.04	-	55,423.04
40 - Equipment & Maintenance	2,393.22	130.00	2,523.22
50 - Sundry Expenditure	10.00	-	10.00
Sub-Total	193,530.19	2,210.00	195,740.19
Ocean Science			
11 - Experts & Consultants	394,161.40	2,188.52	396,349.92
13 - Adm. Support Personnel	602.38	-	602.38
16 - Mission Costs	17,494.01	264.90	17,758.91
10' - Other Personnel Cost	-	-	-
20 - Sub-Contracts	187,795.26	36,073.21	223,868.47
32 - Training & Seminars	28,881.20	4,319.67	33,200.87
40 - Equipment & Maintenance	3,589.62	-	3,589.62
50 - Sundry Expenditure	422.09	-	422.09
Sub-Total	632,945.96	42,846.30	675,792.26
Ocean Services			
11 - Experts & Consultants	10,006.00	55.01	10,061.01
13 - Adm. Support Personnel	-	-	-
16 - Mission Costs	28,571.66	2,964.04	31,535.70
10' - Other Personnel Cost	-	-	-
20 - Sub-Contracts	27,502.53	414.98	27,917.51
32 - Training & Seminars	17,728.36	-	17,728.36
40 - Equipment & Maintenance	22,233.51	5,355.71	27,589.22
50 - Sundry Expenditure	18,946.46	2,015.00	20,961.46
Sub-Total	124,988.52	10,804.74	135,793.26
Total A.	**1,799,118.34**	**91,288.59**	**1,890,406.93**
B. Earmarked activities			
Charpentier Salary, Mission and Other Costs	60,186.14	11,847.07	72,033.21
Promoting Ecosystem-based Approaches to Fisheries Conservation and LMEs between UNEP and IOC	280,383.94	62,597.76	342,981.70
Indian Ocean Tsunami Monitoring and Warning System	343,164.27	174,168.96	517,333.23
Secretariat for the Indian Ocean Tsunami Monitoring and Warning System	263,028.64	53,681.58	316,710.22
Total B.	**946,762.99**	**302,295.37**	**1,249,058.36**
TOTAL (A + B)	**2,745,881.33**	**393,583.96**	**3,139,465.29**

Schedule 1.3

UNESCO

INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION (IOC)

SCHEDULE OF INCOME
FOR THE PERIOD 1 JANUARY 2006 TO 31 DECEMBER 2006

(EXPRESSED IN US DOLLARS)

A. Programme Activities (194IOC9090)

Funds received		
Canada	43,755.99	
China	40,000.00	
Greece	10,204.08	
Israel	5,000.00	
Korea Rep. of	21,766.46	
Spain	19,505.83	
United Kingdom	51,101.00	
U.S.A.	803,041.00	
UNU	5,000.00	
UNEP	20,000.00	
W.M.O	18,751.46	
World Bank		
Asia Pacific Network (APN)	5,000.00	
Australian Bureau of Meteorology	2,250.91	
CNRS	9,640.13	
Conservation International Foundation	7,500.00	
Consortium for Oceanograhy research	935.48	
CSIRO	7,470.00	
Deutsches Komitee Katastrophenvorsorge	844.59	
English Nature	9,300.00	
European Environment Agency	11,556.12	
European Space Agency	12,722.60	
Geohazards International	1,000.00	
GKSS Forschungszentrum	2,405.84	
Gordon & Betty Moore Foundation	15,000.00	
HR Wallingford Ltd	13,881.78	
IFREMER	21,317.83	
Institut de recherche et Developement	2,570.70	
Institut Géographique National, France	6,377.55	
Instituto Espanol de Oceanografia	45,487.96	
International Assoc. for the Physical Sciences of Oceans of Vicksburg	2,100.00	
International Landkartenhaus	745.34	
International Marine Centre	7,384.61	
RMIB Geoscience	271.68	
Southampton Oceanography Centre	20,699.48	
The Nature Conservancy	10,000.00	
Universite Pierre et Marie Curie	12,005.02	
VASSAR College	505.00	
WWF International	12,807.68	
World Agency of Planetary Monitoring and Earhquake Risk Reduction	76,915.00	1,356,821.14

			4
			Schedule 1.3
Interest			222,871.00
Transfer from budget codes:			
193DEN2020		28.11	
193UKM2041		832.00	860.11
Total A.			**1,580,552.25**
B. Earmarked activities			
Indian Ocean Tsunami Monitoring and Warning System (193INT2001)			
Israel		5,000.00	
Transfer from UNISDR project - 248INT2000		250,000.00	255,000.00
Seceretariat for the Indian Ocean Tsunami Monitoring and Warning System (193INT2002)			
Australia			427,541.50
I.O.C. Science and Communication Centre on Harmful Agal Blooms (193DEN2020)			
Transfer to 194IOC9090			(28.11)
Global Coral Reef Monitoring Network (193UKM2041)			
Transfer to 194IOC9090			(832.00)
Total B.			**681,681.39**
TOTAL (A + B)			**2,262,233.64**

UNESCO

INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION (IOC)

STATEMENT OF ASSETS, LIABILITIES, RESERVES AND FUND BALANCES AS AT 31 DECEMBER 2006

(EXPRESSED IN US DOLLARS)

	31.12.2006	31.12.2004
Assets:		
Cash and term deposits	4,251,359.00	3,227,147.17
Total Assets	**4,251,359.00**	**3,227,147.17**
Liabilities:		
Accrued Payables unliquidated obligations (see schedule 1.2)	393,583.96	187,309.43
Total liabilities	**393,583.96**	**187,309.43**
Reserves and fund balances:		
Earmarked activities	2,307,636.71	353,560.16
Operating reserves	1,550,138.33	2,686,277.58
Total reserves and fund balances	**3,857,775.04**	**3,039,837.74**
Total liabilities, reserves and fund balances	**4,251,359.00**	**3,227,147.17**

Acronyms

ABE-LOS	Advisory Body of Experts on the Law of the Sea (IOC)
ACEP	African Coelecanth Ecosystem Programme
ADRICOSM-EXT	ADRIatic sea integrated COastal areaS and river basin Management system EXTension
ANCA	Harmful Algae in the Caribbean
ASFA	Aquatic Sciences and Fisheries Abstracts
ASI	Austral Summer Institute
BFU	Baltic Floating University
BMB	Baltic Marine Biologists
BOM	Australia's Bureau of Meteorology
BUFR	Binary Universal Form for the Representation of meteorological data
CAS	Commission for Atmospheric Science
CBS	WMO Commission for Basic Systems
CCI	WMO Commission for Climatology
CCMP	Chesapeake Community Model Programme
CFU	Caspian Floating University
CGOOS	Coastal Module of the Global Ocean Observing System
CIESM	Mediterranean Science Commission
CLCS	Commission on the Limits of the Continental Shelf
CLIMAR	JCOMM Workshop on Advances in Marine Climatology
CLIVAR	Climate Variability and Predictability Programme (WCRP)
CNES	Centre National d'Etudes Spatiale (France)
CNRS	Centre National de la Recherche Scientifique (France)
COASTS	Coastal Ocean Advanced Scientific and Technical Studies
COOP	Coastal Ocean Observations Panel (GOOS)
CORE	Coral Reef Ecology Working Group
CRP	Core Research Project
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DBCP	Data Buoy Cooperation Panel (WMO-IOC)
E2EDM	'End-to-End' Data Management
EEZ	Exclusive Economic Zone
ESA	European Space Agency
EU	European Union
FANSA	Working Group on Harmful Algal Blooms in South America
FAO	Food and Agriculture Organization (UN)
GAPA	Geological-Geophysical Atlases of the Atlantic and Pacific Oceans
GCOS	Global Climate Observing System (WMO-ICSU-IOC-UNEP)
GCRMN	Global Coral Reef Monitoring Network
GEBCDMEP	Group of Experts on Biological and Chemical Data Management and Exchange Practices
GEBCO	General Bathymetric Chart of the Oceans (IOC-IHO)
GEF	Global Environment Facility (World Bank-UNEP-UNDP)
GEO	The *Ad Hoc* Group on Earth Observations
GEOHAB	Global Ecology and Oceanography of HABs (IOC-SCOR)
GEMIM	Group of Experts on Marine Information Management (IOC-IODE)
GEOSS	Global Earth Observation System of Systems
GESAMP	Joint Group of Experts on the Scientific Aspects of Marine Environmental Protection (IMO-FAO-UNESCO-WMO-WHO-IAEA-UN-UNEP)
GETADE	Group of Experts on Technical Aspects of Data Exchange (IOC-IODE)
GIS	Geographic Information Systems
GLOSS	Global Sea Level Observing System (IOC)

GODAE	Global Ocean Data Assimilation Experiment
GODAR	Global Oceanographic Data Archaeology and Rescue Project (IOC/IODE)
GOHWMS	Global Ocean-related Hazards Early Warning and Mitigation System (IOC)
GOOS	Global Ocean Observing System (IOC-WMO-UNEP-ICSU)
GRA	GOOS Regional Alliance
GSSC	GOOS Scientific and Technical Committee
GTS	Global Telecommunications System
GTSPP	Global Temperature-Salinity Profile Programme
HAB	Harmful Algal Bloom (IOC)
HAE-DAT	Metadata database on Harmful Algal Events
IAPSO	International Association for the Physical Sciences of the Oceans
IASPEI	International Association of Seismology and Physics of the Earth's Interior
IBCM	International Bathymetric Chart of the Mediterranean
ICAM	Integrated Coastal Area Management (also name of IOC programme)
ICES	International Council for the Exploration of the Sea
ICG	Intergovernmental Coordination Group (IOC)
ICG/CARIBE-EWS	Intergovernmental Coordination Group for tsunami and other coastal hazards warning system for the Caribbean and adjacent regions (IOC)
ICG/IOTWS	Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (IOC)
ICG/ITSU	International Coordination Group for the Tsunami Warning System in the Pacific (IOC)
ICG/NEAMTWS	Intergovernmental Coordination Group for the Tsunami Early Warning and Mitigation System in the North Eastern Atlantic, the Mediterranean, and Connected Seas (IOC)
ICG/PTWS	Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (IOC)
ICPC	United Nations Interagency Coordination and Planning Committee for Earth Observations
ICSU	International Council for Science
IDNDR	International Decade for Natural Disaster Reduction
IGBP	International Geosphere-Biosphere Programme
IGOS	Integrated Global Observing Strategy
IHO	International Hydrographic Organization
IOC	Intergovernmental Oceanographic Commission (UNESCO)
IOCARIBE	IOC Sub-Commission for the Caribbean and Adjacent Regions
IOCCP	International Ocean Carbon Coordination Project (SCOR-IOC)
IODE	International Oceanographic Data and Information Exchange (IOC)
IMO	International Maritime Organization
IOI	International Ocean Institute
IPCC	Intergovernmental Panel on Climate Change
IPY	International Polar Year
ISDT	Integrated Systems Development Tool
ISSHA	International Society for the Study of Harmful Algae
ITIC	International Tsunami Information Center
ITSU	International Coordination Group for the Tsunami Warning System in the Pacific (IOC)
JCOMM	Joint Technical Commission for Oceanography and Marine Meteorology (WMO-IOC)
JCOMMOPS	JCOMM *in situ* Observing Platform Support Centre
JGOFS	Joint Global Ocean Flux Study
JMA	Japan Meteorological Agency
LME	Large Marine Ecosystem
LOICZ	Land-Ocean Interaction in the Coastal Zone (IGBP)
MAMA	Mediterranean network to Assess and upgrade Monitoring and forecasting Activity in the region
MarBEF	Marine Biodiversity and Ecosystem Functioning
MEDAR/MEDATLAS	Mediterranean Data Archaeology and Rescue/Mediterranean (and Black Sea) Atlas
MEDI	Marine Environmental Data Information Referral Catalogue
MIM	Marine Information Management

MLA	Main Line of Action
MOC	Meridional Overturning Circulation
MOON	Mediterranean Operational Oceanography Network
MSP	Marine Spatial Planning
NASA	National Aeronautics and Space Administration (USA)
NEARGOOS	North East Asia GOOS
NEPAD	New Partnership for Africa's Development
NEPAD-COSMAR	Coastal and Marine Sub-theme of NEPAD Environment Programme
NGO	Non-Governmental Organization
NOAA	National Oceanic and Atmospheric Administration (USA)
NODC	National Oceanographic Data Centre
ODIMeX	Oceanographic Data and Information Management
ODIN	Ocean Data and Information Network (IOC)
ODINAFRICA	Ocean Data and Information Network for Africa (IOC and Flanders)
ODINCARSA	Ocean Data and Information Network for the IOCARIBE and South America regions
ODINCINDIO	Ocean Data and Information Network for the Central Indian Ocean region
OOPC	Ocean Observations Panel for Climate (GCOS-GOOS-WCRP)
PICES	North Pacific Marine Science Organization
PORSEC	Pacific Ocean Remote Sensing Conference
PTWC	Pacific Tsunami Warning Center
ROPME	Regional Organization for the Protection of the Marine Environment
RSHU	Russian State Hydrometeorological University
SCUFN	IOC/IHO (International Hydrographic Organization) Sub-Committee for Undersea Features Names
SOOP	Ship-of-Opportunity Programme (JCOMM)
SSG	Scientific Steering Group
TEMA	Training, Education and Mutual Assistance in the Marine Sciences (IOC cross-cutting provision/programme)
THC	Thermohaline Circulation
TIP	Tropical Atmosphere Ocean (TAO) project Implementation Panel
TTR	Training-through-Research (IOC)
TWS	Tsunami Warning System
UNCED	United Nations Conference on Environment and Development
UNCLOS	United Nations Convention on the Law of the Sea
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNEP-GRID	United Nations Environment Programme Global Resource Information Database
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UN-ISDR/PPEW	United Nations International Strategy for Disaster Reduction/Platform for the Promotion of Early Warning
UNU	United Nations University
UoS	University of the Sea
VLIZ	Flanders Marine Institute (Belgium)
WAGOOS	Western Australia GOOS
WAPMERR	World Agency of Planetary Monitoring and Earthquake Risk Reduction
WCRP	World Climate Research Programme (WMO-ICSU-IOC)
WESTPAC	IOC Subcommission for the Western Pacific
WGBOSV	Working Group on Ballast of Ship and Other Vectors
WIOMSA	Western Indian Ocean Marine Sciences Organization
WIS	World Meteorological Organization Information Systems
WMO	World Meteorological Organization (UN)
WSSD	World Summit on Sustainable Development
XML	Extensible Markup Language

Intergovernmental Oceanographic Commission (IOC)

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