United Nations
Educational, Scientific and
Cultural Organization

Intergovernmental
Oceanographic
Commission

ANNUAL REPORT 08

Intergovernmental Oceanographic Commission

of UNESCO

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1.0 Statement from the Chair

Javier **VALLADARES**
Chair
Intergovernmental
Oceanographic
Commission
of UNESCO

Our oceanographic portfolio at the Intergovernmental Oceanographic Commission is compiled of a variety of topics. Our dynamic approach to encouraging governments to coordinate and cooperate in all areas of research, services, and training in regards to the seas and coastal areas is our strongest quality. We carry the oceanographic torch and its environmental message within our governments, but we cannot carry it alone. We are reliant on other organizations, both private and nongovernmental, for guidance and support. And like coral reefs around the world we are also struggling for survival.

With limited resources, we are trying to support a multiplicity of topics that are linked in a myriad of ways. As a result, it is almost impossible to satisfy all the topics equally. Indubitably, we are leaving behind the idealistic perception of the Intergovernmental Oceanographic Commission as an almighty and self-sufficient organization that can participate in every ocean forum and embrace each new challenge confronting our seas. These first 49 years of life have taken us along a far more complicated journey. This year, some voices were raised outlining the need to develop more binding mechanisms, both diplomatic and scientific, which would translate into concrete actions, and thereby demand increased commitment by each of our Member States. We have come to realize that our future is inherently dependent on moving forward together—with each Member State taking on robust responsibilities, not only from an economic point of view, but also in cooperation and mutual assistance. We must also remember that our goals must reach beyond the simple quest for knowledge, as knowledge alone will not help resolve the challenges we leave pending to future generations.

In my capacity as chairman I have worked to help strengthen our regional alliances. During 2008 I had the pleasure of visiting China's State Oceanic Administration, which is increasing its regional and global leadership as well as its support to IOC related initiatives. There I contributed to establishing 18 July as China's National Ocean Awareness Day. On 20-21 October the Scientific Committee on Oceanic Research held its 50th anniversary symposium and I presented our greetings and respect, which we feel deeply for our non-governmental partner. I also took part in the most recent meeting of IOCARIBE, one of our first regional bodies, and felt the thrill of their professional enthusiasm. In November, I attended a very interesting series of three meetings that the South Pacific Permanent Commission (CPPS) convened in Guayaquil, Ecuador: A High Level Meeting on Climate Change and its Impact on Marine and Coastal Ecosystems in the Southeast Pacific; the 10th Global Meeting of UNEP Regional Seas Conventions and Action Plans; and the 4th Forum of the Global Ocean Observing System (GOOS) Regional Alliances. The South Pacific Permanent Commission is exemplary in its efforts to support IOC regional initiatives as well as in integrating UNEP and UNESCO initiatives in the region. The forum agreed unanimously on the need for participation from governmental and non-governmental organizations, as well as from the private sector at global and regional levels, to provide a multidisciplinary approach toward adapting to climate change and mitigating its impact on marine and coastal ecosystems. Although the GOOS Regional Alliances did not fully agree on a common governance procedure, in their diversity of opinions the strength of regional cooperation could still be seen.

Finally, together with the regional IOC Vice-chairpersons and the support of the Secretariat, we are preparing for the celebration of our 50th anniversary in 2010. This anniversary corresponds with a change in leadership for both UNESCO's Director-General and our own Executive Secretary. As the current "skipper on duty," I look forward to continuing our sailing adventure of coordinating the needs of governments around the world in our global effort to monitor the seas and develop research capabilities.

1.1 Statement of the Executive Secretary

MUCH MORE THAN "FISH AND SHIPS"

When the ocean makes the headlines, the news usually concerns a threat to biodiversity, a crisis in the fishing industry or an oil-spill accident. These are important issues, but are only part of the much bigger story that needs telling. As our understanding of the climate system improves, we realize the complex yet essential role of the ocean plays in its regulation. Because of its capacity to store heat, the ocean is not only the engine of weather but also the memory of climate. Life on earth originated in the margins of the primordial ocean and for millions of years evolved in this aquatic milieu. The ocean is the ultimate global commons providing essential ecological services that make life possible on our planet. Humankind has strong fundamental reasons to revere the ocean, as ancient civilizations intuitively did.

But our everyday behavior falls far short from this serene ideal. As the current piracy crisis has revealed - and despite the 1982 United Nations Convention of the Law of the Sea (UNCLOS) - there are many gaps in the governance in this unique international space. UNCLOS provides an integrated legal framework on which to build sound and effective regulations on the different uses of the ocean, which have been implemented by the UN specialized agencies and programs over the last 30 years. Nevertheless, severe limitations exist for monitoring and enforcing these regulations. National and international institutions are fundamentally weak. They are usually compartmentalized on a sector-by-sector division of duties and responsibilities, leaving little room for integrated policy-making addressing issues that cut across several domains.

Thus, despite progress, many major challenges remain to be addressed. Regulation of High Seas or trans-zonal fisheries is one of them. There is also increasing concern that many fisheries practices are unsustainable and that global fisheries generally are facing a major crisis.

Unsustainable uses are posing a danger to many special habitats as well, especially in the coastal environment, including mangroves, estuaries, coral-reefs, and underwater mountains – all of which are hot-spots for marine biodiversity. The illegal traffic of people, arms and drugs via the High Seas is increasing.

Absorbing over 2300 million tons of carbon from CO_2 - roughly one third of total annual emissions - the ocean has already spared us from catastrophic climate change. But in doing so, its own intrinsic balances are being altered: it is becoming more acidic and has taken the largest fraction of the additional heat generated by climate change, something that might eventually alter the normal patterns of ocean circulation that are so essential for keeping CO_2 out of contact from the atmosphere.

Because of these alarming trends, the World Summit on Sustainable Development in 2002 decided to keep the oceans under permanent review via global and integrated assessments of the state of the seas. This is the most comprehensive initiative undertaken by the UN system yet to improve Ocean Governance. In 2005 the UN General Assembly through resolution 60/30, requested UNESCO's Intergovernmental Oceanographic Commission and the United Nations Environment Programme (UNEP) to take the lead in getting this process started. The report of three years of work is ready and has been distributed to the United Nations Member States and the general public. Later this year, in the emblematic UN Headquarters building in New York, a Working Group of the whole composed by all members of the UN will consider this report and propose a course of action to the 64th Session of the General Assembly. A positive endorsement will open the way for the first Global Integrated Assessment of the Ocean to be conducted by the UN system for 2014-15, the two years when the Commission on Sustainable Development will conduct a review of oceans and coastal issues. Given the high stakes, failure to do so is not an

Patricio **BERNAL**
Assistant Director-General,
UNESCO
Executive Secretary
Intergovernmental Oceanographic
Commission
of UNESCO

1.2 IOC Highlights in 2008

Assessing the strategic positions the Commission gained, as well the important events in which we participated, in the context of political, environmental and economic events provide a backdrop to this past year in the IOC.

As a specialized mechanism of the UN system that coordinates Ocean Scientific research and Ocean services worldwide, we have strategically positioned ourselves in the lead role of four major inter-agency initiatives:

- The UN Secretary-General called on UNESCO and the World Meteorological Organisation to act as conveners in developing the UN Portal on climate knowledge. Additionally, UNESCO has entrusted us with the leadership of the inter-sectoral platform on Climate Change and to bring together the diversity of UNESCO's expertise to address this complex problem.
- Co-leadership with the United Nations Environment Program in preparing the Regular Process for the Global Marine Assessment of the State of the Ocean.
- The UN mandate for the global coordination of the four regional Intergovernmental Coordination Groups for Tsunami Early Warning and Mitigation Systems. The Working Group on Tsunamis and Other Hazards Related to Sea-level Warning and Mitigation Systems (TOWS-WG) has been instrumental to ensure close collaboration of both the Intergovernmental Coordination Groups and other agencies in and outside of the UN system.
- The coordination and participation, on behalf of UNESCO, of the UN Oceans and Coastal Areas Network (UN-OCEANS) towards providing relevant scientific and governance mechanisms for sustainable development of oceans and coasts.

This year was marked by IOC participation in a number of important events that particularly demonstrate the growing public understanding and political support for climate change science.

- We co-sponsored two international Symposia, 'Effects of Climate Change on the World's Oceans' held in Gijón, Spain and the 'Ocean in a High CO_2 World' Symposium held in Monaco. These two symposia involving more than five hundred marine experts from over fifty countries resulted in numerous publications and the development of the Monaco Declaration signed by 150 leading marine scientists.
- Our intensive participation in the International Polar Year has led to major scientific advances in the understanding and knowledge of Polar Regions and leaves a legacy that includes sustained observations and strengthened international research collaboration in these fragile areas.
- This year, two major regional initiatives have been launched under the Integrated Coastal Area Management programme: 'Adaptation to Climate Change in Coastal Zones (ACCC)' will assist five countries in West Africa to develop and implement adaptation measures consistent with national coastal management priorities over four years and the Southeast Pacific Data and Information Network in Support to ICAM (SPINCAM) project on South American Pacific coasts.

The IOC has also spent some efforts in reconnecting with global ocean science and observations communities, with individual scientists and with marine science institutes.

- The 'completion' of the Global Ocean Observing System was an important goal, but we are now leaning to the more pragmatic position of obtaining government support to maintain the system at its 60 percent level, which would free research budgets from this burden and allow us to better serve our stakeholders.

Funatufi atoll is part of Tuvalu, the fourth smallest country in the world and one under immediate threat from climate change.
© Shuuichi Endou / NGO Tuvalu Overview

- The World Climate Research Program's (WCRP) recent revamping of its programs opens another window of opportunity to interact more directly with scientists, by focusing our sponsorship to specific WCRP research projects that are relevant to our member states.
- We are reengaging with specialised groups of scientists such as the Global Ocean Data Assimilation Experiment (GODAE) group, to solve the problem of down-scaling open-ocean models to regional models of coastal processes.
- Our work on self-driven Capacity-development has addressed marine science institutes and been implemented in over 100 marine institutes in 5 developing regions. An indicator that the workshops have been responding to a real need is seen in the commitment shown by a large percentage of participants to attend these workshops.

CONCLUSION

As the recognized United Nations mechanism for global cooperation in the study of the oceans, we will continue to use the convening power this confers on us in strengthening the ties within our own collective body of 136 member states speaking for the ocean.

Capacity-development

OVERVIEW 2

The Capacity-Development Section works with scientists, institutes and ministries in developing countries. Activities are driven by national needs, focusing on the science and technology necessary to improve the sustainable use and management of marine and coastal resources and environments. The first phase of the Capacity Development programme, funded by Sweden and Italy, now nears completion. Over 100 institutes globally have participated, with an emphasis on Africa. This year's implementation has seen increased in-house and regional cooperation through workshops strengthening institutes with skills in leadership, raising funds, and decision support tools for environmental management.

ADVANCED LEADERSHIP

The third and final Leadership Workshop of the Western Indian Ocean region, held at Maputo in April 2008, brought directors from the region together with those from West Africa and outside the continent. During discussions of their experiences they found they shared similar problems. Positive post-workshop feedback followed, with accounts of improved national funding and innovative regional collaborations brokered by workshop participants.

Collaboration with the Indian Ocean GOOS (IOGOOS) linked directors and senior executives of 19 institutes in 10 countries, who attended a joint leadership workshop in the region. This was co-funded by IO-GOOS at Indian National Centre for Ocean Information Services (INCOIS), Hyderabad in May 2008. Participants learned and used leadership skills, defining and prioritising the implementation of a regional observation network.

RAISING FUNDS

The Republic of Congo and Colombia initiated the development of projects on understanding, preventing, and rehabilitating eroded coasts, requesting IOC to coordinate workshops to kick-start the process of raising awareness and funds. The Congo workshop (Pointe Noire, October 2008) had buy-in from neighbouring Gabon and Cameroon, and interest of the African Development Bank. Similarly, the Colombia workshop (Cartagena, November 2008) evoked the interest of national authorities to fund identified projects.

Supporting the IO-GOOS proposal writing initiative, the Borneo Marine Research Institute (BMRI) hosted a workshop of IO-GOOS institutes in the Indian Ocean and Western Pacific Ocean regions at Sabah, Malaysia in December 2008.

Ehrlich **DESA**

DEVELOPING DECISION SUPPORT TOOLS (DST) FOR COASTAL MANAGEMENT

Kenya Marine and Fisheries Research Institute (KMFRI) and Kenya Meteorological Department (KMD) jointly co-hosted the regional Applied National Hydrodynamic Modelling Workshop at KMD, Nairobi in November-December 2008. Scientists who previously studied with fellowships from the Norwegian sea-level fellowship programme (managed by the IOC Tsunami Unit), and from POGO, trained the workshop participants – a "train-the-trainer" approach. Nationally important pilot sites were identified, and preliminary models gave the first overviews of coastal processes at work. Subsequent models will provide management information important to stakeholders.

Synergies in developing DST were expanded between the Capacity Development programme, the Italian-funded COAST-MAP-IO, and other IOC programmes. INCOIS hosted 16 participants from 12 IOCINDIO region countries that are part of the IOC Tsunami Warning and IO-GOOS programmes in a workshop at Hyderabad, 27 October-7 November. Participants were trained to model processes in their areas of interest, that of inundation modelling and remote sensing for coastal management and Tsunami Warning.

RESEARCH AND EDUCATION

Three training programmes in research at-sea were conducted. The Training-Through-Research (TTR) Cruise 17 to the Eastern Atlantic Ocean (June-August) studied ecological hotspots at ocean margins; the Baltic Floating University (BFU) Cruise 15 to the Baltic Sea (July) conducted hydro-meteorological observations; and three University of the Sea (UoS) cruises to the Eastern Indian Ocean (October 2008 to January 2009) assessed petroleum prospects. About 60 young researchers in marine sciences from over 25 countries of Africa, Europe, North and South America, and Asia-Pacific Regions participated.

A grab sampling during the Training-Through-Research (TTR) Cruise 17 to the Eastern Atlantic Ocean (June-August).

Approximately 250 students participated in the activities of the UNESCO/IOC Chairs in Concepción, Maputo, Moscow and St. Petersburg. Activities ranged from specific ship-board and land-based courses in physical oceanographic surveys, marine geosciences, oceanographic modelling, remote sensing, as well as workshops and conferences.

OUTREACH SUPPORTING EXTENSION OF THE CONTINENTAL SHELF

With the deadline for extension of the continental shelf approaching for many countries, the Section intensified its support to Member States and collaboration with UNEP's GRID-Arendal Shelf Programme, and Geozentrum Hannover's BGR (Federal Institute for Geosciences and Natural Resources). IOC served its networks in Africa, linking them to these specialist organisations that provided coastal states the necessary technical assistance. IOC held information meetings, published material on the process to be followed, raised awareness at different fora, and assisted Member States in identifying consultants to conduct necessary desktop studies.

Students and staff onboard the sailing catamaran Centaurus-II *during the Baltic Floating University Cruise 15 to the Baltic Sea.*

IMPACT

Self-driven capacity development has proved an effective approach. We work in-step with state funded institutes' expertise and development plans, and are thereby improving the chances of sustaining programme benefits. The high proportion of participating institutions that paid their way to attend workshops (about 30 percent in the case of Africa) is a good indicator of the traction the programme has gained. Another good indicator is the number of countries that co-funded workshops and independently undertook follow-up training.

Leadership of a marine institute to deliver on its national mandate is a challenge in any country. Many are struggling to allocate limited resources toward policy and outreach programs, let alone curiosity-driven science. A chronic insufficiency of resources increases the challenges of leadership and management. The first phase of the self-driven Capacity Development Programme addressed these challenges. Two examples are the advanced leadership programme, which struck a chord especially with African directors to the point of being replicated in some of their organisations; and modelling workshops, which had enthusiastic participants as well as clearly recognizable consultancy services and products marketable to the public.

THE WAY FORWARD

Overall, the feedback received indicated that developing local institutional capacities to respond to national issues is preferred to the traditional method of facilitating individual participation in global programmes, that are often largely conceived outside developing regions. This preference is strongly voiced in Africa. This said, it is widely agreed that state-funded institutes working alone would not have the resources to deal with the increasing demands that sustainable management of marine and coastal resources will bring, and a wider approach to include the private sector, policy makers, and the media must be sought. These aspects need consideration in the next phase of the Capacity Development programme.

The need to participate in regional and global programmes will arise naturally and in time, and capacity development can then progress to facilitating international scientific collaboration, a task that IOC, as the recognized United Nations mechanism for global cooperation in the study of the oceans, is uniquely positioned to fulfill.

ACKNOWLEDGEMENTS

The IOC Capacity Development programme gratefully acknowledges the support of the: Borneo Marine Research Institute, Sabah, Malaysia; Colombian Ocean Commission; Indian National Centre for Ocean Information Services, Hyderabad, India; Kenyan Marine Fisheries Research Institute, Mombassa, Kenya; Ministry of Transport and Maritime Affairs, Republic of Congo; Western Indian Ocean Marine Science Association, Zanzibar, Tanzania; and the UNESCO Institute of Water Education, Delft, Netherlands.

2.1 Empowering Developing Countries to Sustainably Use their Coastal Resources: Self-driven Capacity Building

Working with institutes is an essential complement to the training of individual scientists, and enhances ownership and coherence of IOC's cooperation with institutes' long-term plans.

Under this project, the Capacity Development Section completed its series of workshops targeted at directors, project leaders, and scientists in Africa. The focus was on motivating institutional change, equipping the institutions with skills to enable them to expand their funding base, and encouraging regional teamwork. The Instituto Nacional do Meteorologia, Mozambique hosted the third and final Leadership workshop for Heads of marine related institutions from the Western Indian Ocean region from 10-14 April 2008 in Maputo, Mozambique. The workshop provided the participants an opportunity to: (i) renew, update and extend leadership competences, (ii) review leadership proficiency and plan for future development, (iii) interact with and learn from peers, (iv) strengthen institutional and regional networks, and (v) renew personal energy, drive and commitment. Fellowships funded by the IOC Tsunami Unit and the Partnership for

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Joannès **BERQUE**

Third Leadership workshop for the Western Indian Ocean Region (Maputo, Mozambique, April 2008)

Observing the Global Oceans (POGO) were provided to enable experts from the region to undertake internships on hydrodynamic modelling at the National Institute of Oceanography in Goa, India, and the Centre for Water Research in Perth, Australia. These experts then provided training during a regional hydrodynamic workshop that the Kenya Meteorological Department hosted from 24 November to 5 December 2008 in Nairobi, Kenya. The models employed during the workshops will be further developed to provide important management information to stakeholders addressing issues of: shoreline change, inundation, storm surge and sea level rise, sedimentation and dredging, and water quality. The Western Indian Ocean Marine Science Association (WIOMSA) continued to be a key partner in these activities.

In Western Africa, the Republic of Congo addressed a request to UNESCO's Intergovernmental Oceanographic Commission for technical assistance in the development of a sub-regional project aimed at enhancing capacities for coastal planning to better manage erosion. Congo sponsored a regional workshop that brought together the foremost experts on erosion in Western Africa to Pointe Noire on 6-10 October 2008. The Minister of Maritime Transport and the Minister of Higher Education actively participated in the workshop, which was also attended by community representatives from Loango, an area that has suffered from severe coastal erosion engulfing villages and historic sites, as well as artisanal fisheries organizations.

Regional activities

OVERVIEW 3.

In this year's annual report, capacity building and regions have been moved to the front, in recognition of their importance for the Commission and their role as the vanguard of many of our programs. The regions are where global intergovernmental discussions in Paris are transformed into real actions with clear benefit to individual member states. IOC's member states have demonstrated again and again an increasing preference for the efficiency of bilateral and regional cooperation in support of multilateral, global activities in many of our programs, be they in science, observations, services, or capacity building.

Our annual report is an opportunity to celebrate the many successes and advancements that have been made in the regions, thereby providing an essential opportunity to highlight how regional activities have contributed to the High Level Objectives of IOC. The first article, by Mika Odido, highlights one of IOC's largest and most successful extra-budgetary projects, the Ocean Data and Information Network for Africa. Continuing with Africa, two articles by Justin Ahanhanzo provide overviews of the year's highlighted contributions to the Global Ocean Observing System from Africa and the development of strategic alliances for the African Ocean Partnership based on a grassroots approach that has successfully empowered regional capacities in operational oceanography. Finally, Mika Odido provides an update from the Seventh Session of the Committee for the Western Indian Ocean held in Mombasa, Kenya in July. Moving to the Pacific, Wenxi Zhu rightfully trumpets the efforts made in the revitalization of our Sub-Commission for the Western Pacific, underscored by the creation of a permanent UNESCO post for the WESTPAC secretariat based in Bangkok and

King tide at Tuvalu. Damages caused by rising sea levels and global warming have become increasingly serious over the past 10 years. Life for the Tuvualuans has become deeply affected by these calamities.

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Fig. 1: *Schematic cartoon showing the location of IOC's regional offices (dots) and the approximate geographical domains covered by its Sub-commissions, Committees, GOOS regional alliances, Ocean Data and Information Networks and Intergovernmental Coordination Groups for regional tsunami warning systems.*

numerous activities including the adoption of a regional strategy for 2008-2013. Nick D'Adamo then reports on the successful renewal and new 5-year sponsorship deal for the Perth Office, and reviews the activities coordinated out of Perth for the Southeast Asia, Pacific Islands and Indian Ocean regions, highlighting existing and proposed initiatives relevant to the IOC's four High Level Objectives (HLO). From the America's region Cesar Toro, on behalf of our Sub-Commission for the Caribbean, provides an overview of its 10th session in Puerto La Cruz, Venezuela, in October and describes the creation of a permanent UNESCO post for the IOCARIBE secretariat based in Kingston. And finally, Janice Trotte provides an overview of the work coordinated out of the IOC Regional office for GOOS in Rio de Janeiro, focusing on support for the GOOS regional alliance for the Upper Southwest and Tropical Atlantic as well as southern hemisphere cooperative efforts carried out through the India-Brazil-South Africa Ocean Alliance.

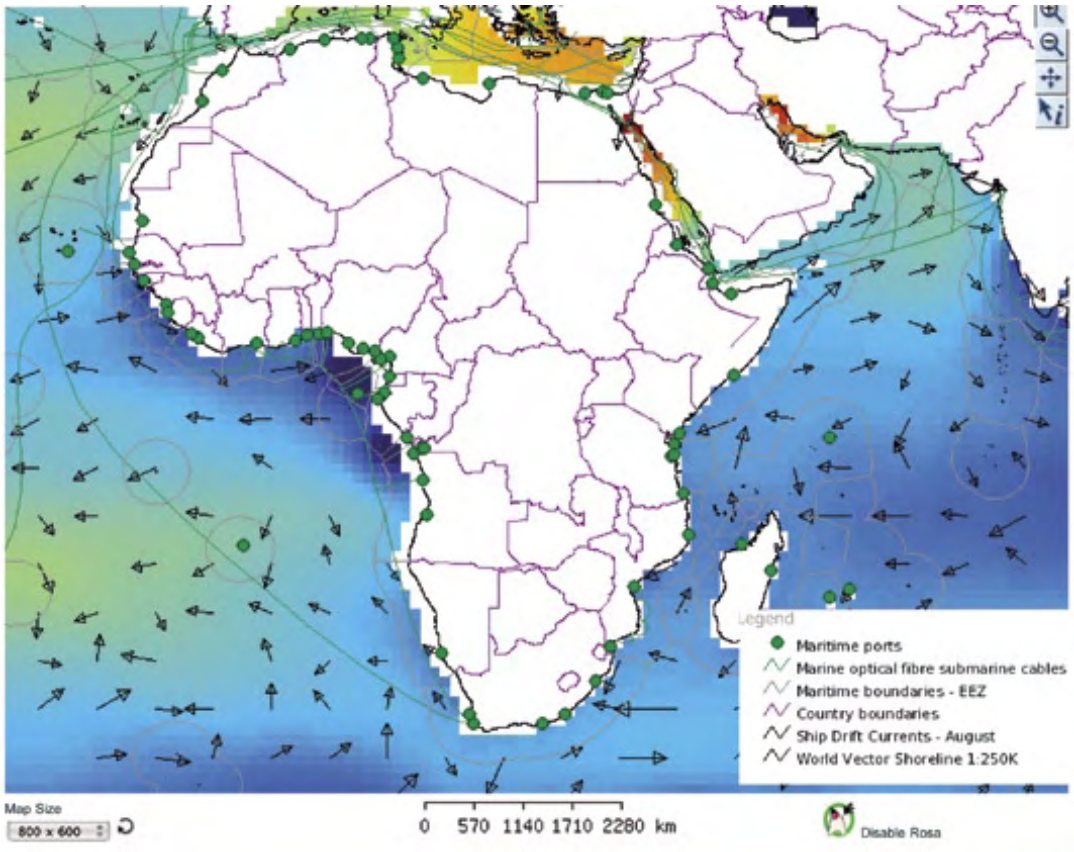
In this report, we focus on the importance of individual regional activities. Still, it may be timely to undertake a critical assessment of the global sum of the IOC's regional activities. Such a review should examine potential organizational improvements, efficiencies through better integration, and potential consolidation of the regional resources that currently exist through the IOC's framework of Sub-Commissions, committees, coordinating groups, program offices, project offices, information centers, regional alliances and data networks in regions all around the globe. Figure 1 provides an attempt to show these offices and domains on a map. Given the obvious overlap in some regions, and gaps in others, it is quite possible that the total impact of this network of individual efforts may add up to less than the sum of the parts. Each regional office or group is carrying out excellent work to service the global IOC objectives, however there may well be a case for better overall coordination and streamlining of IOC regional activities through a review and assessment of the potential benefits that might be gained through rationalization of the framework of offices and capacities around the globe to a more coherent and smaller set of consolidated entities. Regional consolidation is certainly a challenge, but also a seed that may germinate throughout the coming Assembly meeting and next inter-sessional period, hopefully to bear fruit in another annual report in the not too distant future.

3.1 Ocean Data and Information Network for Africa

Across Africa, over 25 countries are following the flow of information from the rivers to the sea. Data are easily accessible via online catalogs and directories.

The Kenya Marine and Fisheries Research Institute in Mombasa hosted the seventh planning and review workshop for the Ocean Data and Information Network for Africa (ODINAFRICA) from 14-16 July 2008. The participants reviewed the progress and identified the following achievements since the current phases started in 2004:

Forty institutions from 25 countries are involved in the activities of the network. The participating institutions developed a suite of data and information products, including: library catalogues, catalogues of national data sets and data sources (meta databases), directories of marine and freshwater professionals, directories of marine related institutions and their profiles,



The African Marine Atlas (www.africanmarineatlas.net) offers ocean data for coastal communities.

Mika **ODIDO**

Installation of tide gauge at Nouakchott, Mauritania.

marine data archives and marine biodiversity databases. These are available from National Oceanographic Data Center websites (www.nodc-countryname.org and www.nodc-senegal.org), as well as through the project website (www.odinafrica.org). Training was provided on a wide range of topics such as data and information management, development of electronic repositories and websites, application of remote sensing and GIS to coastal management, marine biodiversity data management, modelling, end to end data management, and sea level data analysis and interpretation.

ODINAFRICA installed tide gauges in Cameroon, Congo, Djibouti, Egypt, Ghana, and Mauritania. This brings the total number of tide gauges installed along the African coastline by national agencies and regional and international programmes and projects to more than 40. Information on the network is available on the African Sea Level Network website (www.iode.org/glossafrica), while the data from 22 of the stations can be accessed near-real time at www.sealevelstation.net.

The African Marine Atlas (www.africanmarineatlas.net) developed in collaboration with the African Coelacanth Project (ACEP), and the United Nations Environment Programme (UNEP) provides access to maps, images, data and information to a wide range of users. The African Marine Atlas website (http://omap.africanmarineatlas.net) contains over 800 downloadable data products derived from the fields of marine geo-sphere, hydrosphere, atmosphere, biosphere, geopolitical and the human socio-economic dimensions.

The participating institutions developed a proposal for the next phase (ODINAFRICA-IV) focusing on the application of data and information products to the sustainable management of marine and coastal resources, as well as reducing the risks of ocean related hazards. The Government of Flanders (Belgium) has approved funding of US$ 3.5 million for the implementation of ODINAFRICA-IV from 2009-2012. This marks another chapter in the activities that IODE has sustained in the region since 1989.

3.2 The Global Ocean Observing Systems in Africa

GOOS-AFRICA focused on reinforcing strategic partnerships with key regional and international stakeholders.

Regionally, these included the Department of Human Resources, Science and Technology of the African Union, the Large Marine Ecosystems Commission and Programmes, the African Centre of Meteorological Application for Development, Ocean Data and Information Network in Africa (ODINAFRICA), and the African Association of Remote Sensing of the Environment (AARSE). Internationally, links were strengthened with the Group on Earth Observations (GEO) and the associated Global Earth Observing System of Systems (GEOSS), leading to joint ventures including the Synthetic Aperture Radar for Africa (SAR-Africa), the Altimetry for Coastal Regions in Africa (ALTICORE-Africa), African Ocean and Meteo Network, the GMES-AFRICA, the FerryBox-Africa, the Europe-Africa Marine Network (EAMNet), GEONETCast/DevCoCast, and the Plan for the implementation of the Coastal Zone Community of Practice (CZCP) in Africa. These initiatives aim to empower African capacity related to ocean observing systems.

The Antea *off the coast of Cotonou in September 2008 conducted physical oceanographic studies in West Africa as part of the Programme Régional d'Océanographie Physique en Afrique de l'Ouest (PROPAO).*

IOC Member States and GOOS Regional Alliances (GRAs) have placed high priority on implementing GOOS in the Coastal Seas. GEO/GEOSS endorsed the Concept of a CZCP as a meaningful way of implementing Coastal GOOS. In collaboration with the International Scientific Steering Committee charged with the development of regional plans for the implementation of CZCP, GOOS-AFRICA stakeholders developed a plan titled: "Supporting Decision Making in the Coastal zone: Strengthening Observing Systems Capacity for Managing and Mitigating the Impacts of Human Activities and Coastal Inundation in the African Region". A Pan-African workshop is scheduled for 2-7 August 2009 in Accra for an in-depth review of this plan.

Justin **AHANHANZO**

3.3 Strategic Alliances for the African Ocean Partnership: towards Reinforcing Operational Oceanography in Africa

The vibrant demonstration of GOOS-AFRICA in 2008 embraced numerous strategic alliances, laying foundations for institutional building of operational oceanography in synergy with meteorological and climate related initiatives. A detailed list of these partnerships and programmes are highlighted in the article in this Annual Report on Regional IOC Activities.

Because the institutional building through research and education is the key for capacity building, we will put emphasis here only on four major actions linking operational oceanography, climate change, and earth observations:

1- **Africa Centre for Climate and Earth System Science**: A pan-African Facility for Operational Oceanography and Climate Change: The Government of South Africa built a high-performance computing centre in Cape Town that supports the activities of the Africa Centre for Climate and Earth System Science (ACCESS) including research, education and technology development in operational oceanography.

2- **Regional Reference Centre in Computing and Climate modelling in West Africa**: Following the related decisions of the African heads of state and governments: (i) Decision on the Extension of African Continental Shelf and the Climate Change and (ii) Decision on the Tunis Declaration related to international solidarity and climate change in Africa and the Mediterranean, the Government of Benin organised a regional dialogue on climate change in the area of the Economic Commission of West African States with a strong recommendation for the reinforcement of oceanographic and meteorological platforms along the African coasts. A Regional Centre on Computing and Climate Modelling to support research and studies on climate change processes and impacts in Africa is being established in Benin.

3- **Synthetic Aperture Radar for Africa (SAR-Africa):** In November 2008, the SAR-Africa project was initiated to develop a sustainable research and operational capacity for marine Synthetic Aperture Radar applications in Southern Africa.)

4- **Master and Ph.D programme in Physical Oceanography associated with the UNESCO Chair at the University of Abomey-Calavi in Benin**: In the framework of the regional programme for promoting physical oceanography in West Africa involving Benin, Côte d'Ivoire, Ghana, Nigeria and Togo, the UNITWIN/UNESCO Chair in Mathematical Physics and Applications based at the University of Abomey-Calavi (Benin) established the first ever international Multi-University Diploma on Regional African Oceanography with focus on African oceanographic issues: "A Multi-University Master Degree and Doctoral Training Programme in Physical Oceanography and Applications".

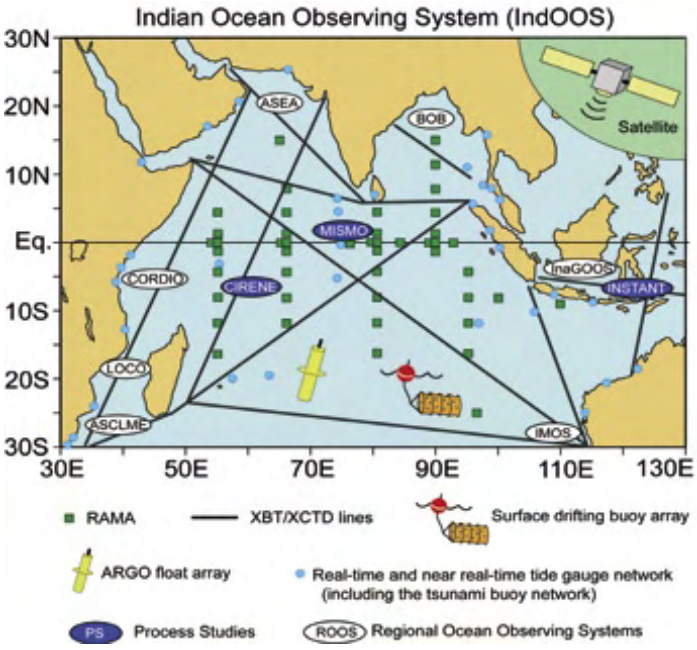

INTERNATIONAL CHAIR IN MATHEMATICAL PHYSICS AND APPLICATIONS (ICMPA)
UNESCO CHAIR IN MATHEMATICAL PHYSICS AND APPLICATIONS
UNITWIN/UNESCO Chairs - Twinning networks and university networks
MULTI-UNIVERSITY MASTER'S DEGREE AND DOCTORAL TRAINING PROGRAMME IN PHYSICAL OCEANOGRAPHY AND APPLICATIONS

3.4 IOC Regional Committee for the Western Indian Ocean (IOCWIO)

Countries bordering the Western Indian Ocean are coordinating their approach in developing a strong future for ocean research.

The Seventh Session of IOCWIO was held in Mombasa, Kenya, 18-21 July 2008, and attended by delegates representing Comoros, Kenya, Mauritius, Madagascar, Mozambique, Seychelles and Tanzania as well as representatives of other regional programmes and organisations. The session reviewed a report on activities implemented since the previous session, and endorsed a work plan for the period 2008-2010, focusing on: oceans and climate research; links between oceanography and fisheries; strengthening of the regional sea level network; and training on the use of decision support tools (modelling, GIS and remote sensing). The delegates endorsed the proposal for the next phase of the Ocean Data and Information Network for Africa and established a Regional Group of Experts on Ocean Dynamics and Climate. Mohamudally Beebeejaun (Mauritius) was elected Chairman and Alfonse Dubi (Tanzania) Vice-Chairman.

The session was preceded by the planning and review workshop for the Ocean Data and Information Network for Africa. During this workshop a proposal was endorsed for the next phase focusing on application of data, information and products to integrated coastal management. The proposal is to be implemented during 2009-2012. Other activities in the region included a tidal analysis workshop, (3-5 April 2008, Mombasa, Kenya), an advanced leadership workshop for heads of marine related institutions (9 -15 April 2008, Maputo, Mozambique), and a numerical modelling workshop (24 November to 5 December 2008, Nairobi, Kenya). These were organized in collaboration with the Western Indian Ocean Marine Science Association.



The Indian Ocean Observing System (IndOOS) of the Indian Ocean Panel (IOP) of GOOS/CLIVAR. The IOP has taken IndOOS from a concept to almost full reality in just a few years. Most components of the system are largely completed now, and the stations for the deep moorings component of IndOOS (RAMA: Research Moored Array for the African-Asian-Australian Monsoon Analysis and Prediction) are almost 50% occupied. Many IOP member countries provide substantial vessel support and infrastructure for regular maintenance of the system.

3.5 IOC Sub-Commission for the Western Pacific (IOC/WESTPAC)

New navigators lead the way for the Western Pacific region.

Wenxi **ZHU**

The revitalisation of WESTPAC continued throughout 2008, as underscored by the creation of the permanent post of Head of IOC/WESTPAC Secretariat. IOC/WESTPAC held its Seventh Intergovernmental Session, in Sabah, Malaysia, 26-29 May 2008. The Session included the adoption of the IOC/WESTPAC Strategy and Programme Structure (2008-2013), which aligns strongly with the IOC's global objectives through focussed regional implementation. The Session also established an IOC/WESTPAC Advisory Group to provide scientific and technical advice on the development, planning and implementation of IOC/WESTPAC activities, and initiated seven new regional country-driven projects contributing to the IOC's High-Level Objectives in the context of regional needs. It also endorsed a new regional capacity-building initiative: IOC-UNESCO Regional Network of Training and Research Centres on Oceanography in the Western Pacific, aimed at improving regional capability in oceanography. New officers were elected at the Session: Chairman Zhang Zhanhai; and Vice-Chairpersons Yasuwo Fukuyo and Professor Nor Aieni Binti Hj Mokhtar.

The Seventh IOC/WESTPAC International Scientific Symposium (21-25 May 2008), was held in Sabah (Malaysia) in conjunction with the IOC/WESTPAC Session, and was made possible by the generous sponsorship of the Malaysian Government, through its National Oceanography Directorate. The themes of the Symposium focussed on regional issues relating to: effects of climate change; coastal and offshore processes; marine environmental forecasting; data management; and marine ecosystem health. This was IOC/WESTPAC's largest scientific symposium to date. It represented a strong endorsement by regional and international stakeholders of the role and relevance of IOC/WESTPAC as (i) a regional focal point for science relevant to IOC/WESTPAC Member States and (ii) as an effective regional platform for the sharing of marine scientific knowledge, the stimulation of new ideas and the imparting of experience and lessons gained through IOC/WESTPAC's framework of project implementation.


IOC/WESTPAC
7th INTERNATIONAL SCIENTIFIC SYMPOSIUM
WWF MALAYSIA
NEAR-GOOS
IOC/WESTPAC E-Bulletin

3.6 UNESCO IOC Perth Regional Programme Office

Coordinating intergovernmental oceanographic research from down under, Australia's IOC office is making waves.

Nick **D'ADAMO**

A review and renewal of the IOC Perth Regional Office was coordinated by officer in charge, Nick D'Adamo, leading to a 5-year 'Cooperation Agreement' (2008-13) between the Western Australian State Government, Australian Bureau of Meteorology (BoM) and UNESCO/IOC, continuing the strong collaboration established in 1998 between these organisations. The office services the balanced regional objectives of its three Parties as a regional node of the IOC, focusing on GOOS but increasingly addressing the full spectrum of IOC programmes. It facilitates and coordinates programmes mutually relevant to its sponsors, aligned with the IOC's High Level Objectives across climate change, ecosystem health, natural hazards and sustainable natural resource management, with cross-cutting capacity building a key priority. BoM continues to fully host and administer the office, in co-location with the Secretariat of the Intergovernmental Coordination Group/Indian Ocean Tsunami Warning System (ICG/IOTWS), which the office helped establish after the 2004 Boxing Day Tsunami.

The Office works principally through its support, sponsorship and collaboration of Indian Ocean GOOS, South East Asia GOOS, Western Australia GOOS and Pacific Islands GOOS (about 80 members in total) and is a key regional advocate for the IOC. It underpins GOOS Regional Allicance (GRA) meetings and engages in GRA forums. Project highlights in 2008 include: progressing the Indian Ocean Panel's (IOP) Climate Variability and Predictibility and facilitating/sponsoring the development of Sustained Indian Ocean Biogeochemical and Ecological Research as a bio-geochemical complement; facilitation of the development of proposals for Indian Ocean and Southeast Asia coastal monitoring projects across ecosystem health, remote sensing and shoreline changes; development of ocean forecasting system applications for regional alliances, using Australia's Bluelink, and linking to other global and regional forecasting systems; development of the South East Asian Strategic Plan; engaging in the Australian Integrated Marine Observing System; facilitation and coordination of Pacific Islands work plans and advisory committee meetings; progressing the Census of Marine Life in the North West Indian Ocean region; integrating Australian stakeholders with the global Large Marine Ecosystem programme; facilitation of funding support, with NOAA, BoM and New Zealand's NIWA, for scientific educational resources on ARGO floats in the Pacific Ocean: and as local host, underpinning the GSSC-XII and PICO-II meetings and the GSSC workshop for Perth, 23-27 February 2009.

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

As the first established regional Sub-Commission, based in Cartagena de Indias, Colombia, IOCARIBE has almost thirty years of experience promoting and tailoring the IOC's global programs to the special needs, interests, cultures and amazing diversity of the Caribbean and adjacent regions.

The 10th Session of the IOC Sub-Commission for the Caribbean and Adjacent Regions (IOCARIBE-X) was convened in Puerto La Cruz, Venezuela, 22-25 October 2008. The meeting was hosted by the Government of Venezuela and attended by delegations representing Member States from Barbados, Brazil, Colombia, Cuba, Dominican Republic, Jamaica, Mexico, Nicaragua, Panama, Trinidad & Tobago, USA, Venezuela, and also included UN and regional organization representatives.

The Sub-Commission approved four recommendations concerning, respectively: administrative arrangements for the IOCARIBE Secretariat; participation of the IOCARIBE Sub-Commission in the 50th Anniversary of the IOC; nutrient and sediment reduction in the wider Caribbean; and programme and budget for 2009-2011. During the Session, a MoU between IOCARIBE-GOOS and the GOOS Regional Alliance for South-East Pacific (GRASP) was signed.

Immediately prior to IOCARIBE-X, a complementary symposium on tsunamis was held in Puerto La Cruz, Venezuela, 20-21 October 2008, aiming to facilitate scientific support and development of national/local tsunami and other coastal warning and mitigation capacities.

To streamline administrative operations of the IOCARIBE Secretariat with those of UNESCO, the position of Head of IOCARIBE and UNESCO Science Programme Officer was established as a permanent position to be based at the UNESCO Regional Office in Kingston, Jamaica. The position was opened for recruitment in 2008 and Cesar Toro was appointed by the Director-General of UNESCO as Head of IOCARIBE Secretariat and responsible for UNESCO Science Programme for the Caribbean.

Parque Nacional Tayrona, Colombia.
© Andrew Fanning

Historic Cartagéna, Colombia.
© Andrew Fanning

We are glad to report that Andrew Fanning, one of three CIDA-interns posted in Cartagena for IOCARIBE in 2008, is now working at Headquaters for Capacity Development. Andrew has contributed substantially to various parts of this report.

Cesar **TORO**

Andrew **FANNING**

3.8 UNESCO-IOC Regional Office for GOOS in Rio de Janeiro

The Rio GOOS Office is an IOC regional antenna aimed at driving cross-cutting programmes to strengthen national capacities for observing the oceans, understanding their role in climate change, and better utilizing associated information for natural response planning and ocean forecasting.

Plans are in place to develop a new MoU to extend its current tenure beyond 2009. The Office is the Technical Secretariat for the GRA Regional Alliance in Oceanography for the Upper Southwest and Tropical Atlantic (OCEATLAN). The 4th Session of OCEATLAN was convened in Rio de Janeiro, Brazil, 26-28 May 2008, hosted by the Directorate of Hydrography and Navigation (DHN), and attended by Vincent Defourny (Director, UNESCO Brasilia Office) and Javier Valladares (IOC Chairman). Recommendations addressed the enhancement of existing observing activities in the region and the establishment of a new pilot project for CO_2 monitoring, complementing existing projects such as PIRATA. The 5th Session of OCEATLAN will be held in Uruguay, 12-14 May 2009.

Relevant to OCEATLAN was the 4th Workshop of the Science Aquarius/SAC-D Satellite Mission, held in Puerto Madryn, Argentina, 3-5 December 2008, sponsored by CONAE (National Space Agency of Argentina). It aimed to strengthen capacities for satellite based ocean observations of the South Atlantic. Space agencies from Argentina, Brazil, USA, Italy, Canada and France participated. OCEATLAN's www.oceatlan.org website facilitates data dissemination and education and supports Oceanography courses in Brazilian universities. The IOC/UNESCO Rio GOOS Office and OCEATLAN facilitated planning of vessel logistics for Oceanographic process studies and GOOS related surveys, such as the "Circulacion Meridional Sur" Project, to be conducted in the South Atlantic onboard the Brazilian Navy Vessel "Cruzeiro do Sul", in 2009.

The Rio Office works similarly with the India-Brazil-South Africa Ocean Alliance (IBSA-OCEAN) to facilitate and coordinate ocean research and observations. IBSA's regional objectives address, for example, seasonal to decadal climate prediction, ocean observation systems and ocean information dissemination networks. An IBSA-OCEAN workshop is planned for Goa, India, 4-8 May 2009.

Janice **TROTTE**

Tsunami unit

OVERVIEW 4

The three tsunami warning systems established after the 2004 Indian Ocean tsunami are now almost operational. Coordinated by Intergovernmental Groups this governance model has provided important insights into how to responsibly establish systems on nationally owned end-to-end systems. Based on the experience in the Pacific and in establishing these new Tsunami Warning Systems through Intergovernmental Coordination Groups individual activities, links with international partners and the supporting Working Groups under each ICG, all dealing with similar matters and often calling on the same capability for advice and input, are not fully efficient. This finding—the IOC's mandate to provide a global coverage for the tsunami hazard and the need to ensure close collaboration with other agencies, bodies and programmes in- and outside the UN system—lead to the establishment of the Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems (TOWS-WG) during the 24th IOC Assembly. In April 2008 this working group held its first meeting and prepared a comprehensive report with detailed recommendations on how best to proceed. The TOWS-WG recognized the power accorded to the regional ICGs as a strong mandate with much responsibility. In this context the role and mandate of TOWS WG has been strengthened by the decision of the 41st Executive Council while all ICGs acknowledged the work done and advice provided by TOWS-WG so far. We are on the right track, but continuous coordination among key actors is still needed to insure fully-fledged tsunami and other ocean-related hazards warning systems provide imminent protection from tsunamis and other sea-level related hazards.

IOC's Tsunami Unit has assisted Member States to coordinate their efforts through the ICG mechanism, in providing opportunities of training and supporting technical assistance. The Tsunami Unit's work was almost entirely made possible by extra-budgetary funds generously provided by Australia, Belgium, Czech Republic, Finland, France, Germany, Israel, Italy, Japan, Norway, Spain, the United States of America as well as the International Strategy for Disaster Reduction (ISDR), the Permanent Commission for South East Pacific (CPPS) and the UN Economic and Social Commission for Asia Pacific (ESCAP).

SUMMARY OF 2008 INTERNATIONAL TSUNAMI WARNING ADVISORIES

From the International Tsunami Information Center (ITIC)

The Pacific Tsunami Warning Center (USA), Japan Meteorological Agency (Japan), and the West Coast / Alaska Tsunami Warning Center (USA), provide international tsunami advisory services for the Pacific Ocean, Indian Ocean, Caribbean Sea and adjacent region, and western Atlantic

Peter **KOLTERMANN**

SUMMARY OF INTERNATIONAL TSUNAMI WARNING ADVISORIES

DATE	TIME (UTC)	LOCATION	EPICENTER	DEPTH (km)	Mw	PTWC (P), JMA (J), or WC/ATWC (A) ACTION	ACTION TIME (UTC)	TSUNAMI? DAMAGING?	MAXIMUM MEASUREMENT AND LOCATION (information source)
20-Feb.	8:09	Off West Coast of Sumatra, Indonesia	2.768° N	15	7.4 (G)	LTW 01 (P)	8:22	NO	
			95.964° E		7.2 (P, J)	TWI (J)	8:29		
						LTW 02 (P)	9:26		
						LTW 03 (P) - Cancellation	9:47		
25-Feb.	8:37	Southern Sumatra, Indonesia	2.486° S	23	6.9 (G)	LTW 01 (P)	8:50	YES	0.12 m (ampl), 22 min (period), Padang, Indonesia (P)
			99.972° E		7.1 (P, A, J)	TIS (A)	8:52	NO	
						TWI (J)	8:59		
						LTW 02 (P) - Cancellation	10:09		
16-Nov.	17:03	Minahasa Peninsula, Sulawesi, Indonesia	1.271° N	32	7.3 (G)	TIB (P)	17:13	YES	0.255 m (peak to trough), 24 min (half-period), Toli-Toli, Indonesia (Indonesia)
			122.091° E		7.6 (P, A, J)	TIS (A)	17:16	NO	
						NWPTA (J)	17:17		

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

Ocean. Each centre independently and continuously monitors the earth's seismicity to evaluate the tsunamigenic potential of large earthquakes, and then work together to coordinate their advisories to ensure consistency in the results they report. In 2008, the USGS reported 179 earthquakes of magnitude 6 or greater.

In 2008, internationally, PTWC, covering the Pacific Ocean, including the South China Sea, Indian Ocean, and wider Caribbean regions:

- responded to over 600 earthquake alarms;
- issued earthquake observatory messages for 593 earthquakes;
- issued official products for 53 earthquakes (of magnitude 6.5 or greater in the Pacific and Indian Oceans, and of magnitude 6.0 or greater in the Caribbean region);
- issued two local watch bulletins for two earthquakes in the Indian Ocean, one warning/watch bulletin for the Pacific Ocean (Sulawesi, Indonesia), and no warning/watch bulletins for the Caribbean.

In 2008, internationally, JMA, covering the Northwest Pacific Ocean, including the South China Sea, and Indian Ocean region:

- issued official products for a total of 20 earthquakes;
- issued a Northwest Pacific Tsunami Advisory for 13 earthquakes (of magnitude 6.5 or greater);
- issued a Tsunami Watch Information bulletin for seven earthquakes in the Indian Ocean (of magnitude 6.5 or greater).

In 2008, internationally, WC/ATWC, covering the Pacific and Atlantic Oceans, and Gulf of Mexico (Canada, US states except for Hawaii), and Caribbean (Puerto Rico, US and British Virgin Islands):

- responded to over 550 earthquake alarms;
- issued earthquake observatory messages for 564 earthquakes;
- issued official products for 125 earthquakes (of magnitude 4.0 or greater);
- issued no warning or watches for the US/Canada or Puerto Rico/Virgin Islands.

4.1 Indian Ocean Tsunami Warning and Mitigation System

The Fifth Session of the Intergovernmental Coordination Group for the Indian Ocean Tsunami Warning and Mitigation System (ICG/IOTWS) was held in Putrajaya, Malaysia, in April 2008 and was attended by 134 participants from 18 IOTWS Member States, 5 Observer States and 8 UN agencies and other institutions. The ICG adopted the Regional Tsunami Watch Provider (RTWP) Implementation Plan (available as IOC Technical Series No. 81) and decided to create an RTWP Coordination Group (RCG).

Tony **ELLIOTT**

By the end of 2008, three Indian Ocean Member States had commenced operating as RTWPs at Service Level 1 and several others are expected to commence later in 2009. These RTWPs are progressing towards the provision of Service Level 2 and will be "shadowing" the Interim Advisory Service provided by the Japan Meteorological Agency (JMA) and the Pacific Tsunami Warning Center (PTWC) during the transitional period, before assuming full responsibility for regional tsunami advisories in the Indian Ocean. The ICG established a Task Team to plan the Indian Ocean Wave 09 Exercise, in October 2009.

Workshop participants at Sur Lagoon conducting a geological assessment of tsunami hazards in Makran, Oman, in May 2008.
Photo: © Marco Cisternas

A series of workshops designed to enhance regional and national capacity in the development of standard operating procedures in tsunami warning and emergency response for Indian Ocean and Southeast Asian Countries was organised in 2008 and will continue throughout 2009.

At a UNESCO/IOC-organised field workshop on the "Geologic Assessment of Makran Tsunami Hazards" in Oman in May 2008, 16 earth scientists from 11 Indian Ocean countries, plus several international experts, met for field work and intensive discussions on using coastal geology to assess earthquake and tsunami hazards of the north-western Indian Ocean.

The assessment missions on the needs and capabilities in bathymetric surveying, mapping, and modelling in 10 countries involved in the COASTMAP-IO project were completed in 2008 and six training courses have been successfully conducted with the assistance of India, Germany and Indonesia. Modern hardware and software for modelling have been supplied to all twelve participating countries and 75 specialists were trained.

In collaboration with GLOSS a fellowship programme on sea level science and applications was developed for the region. Funded by Norway, the programme aimed to improve the sustainability of the sea level network through training visits to selected sea level institutions.

4.2 Pacific Tsunami Warning and Mitigation System

The PTWS moved towards a stronger regional structure to accommodate threats from near-field seismic sources and enhance regional stakeholder commitments. The 1st meeting of the newly formed PTWS Steering Group in Guayaquil, Ecuador 8-10 October 2008 decided to submit to the 23rd Session in 2009 documents that reflect these changes, namely a Medium Term Strategy, a new organizational structure of its Working Groups to meet recommendations by the TOWS Working Group, and to update the PTWS Implementation Plan. The PTWS Users Guide was finalized for publication.

Bernardo **ALIAGA**

UNESCO/IOC's International Tsunami Information Center (ITIC) in Hawaii, USA provided important outreach material to the other TWSs, and was involved in numerous training, assessment and capacity building activities. Strengthening national tsunami standard operating procedures for achieving an end-to-end tsunami warning and emergency response has been the focus of the ITIC's recent trainings. ITIC serves as a depository of tsunami related information and material.

To test the efficiency and performance of the PTWS the second Pacific Ocean wide tsunami exercise, "Pacific Wave 08" took place from 0000 UTC to 2340 UTC on 29 October 2008. The fictional tsunami was generated by a magnitude 9.2 earthquake off the northeast coast of Japan at 40ºN, 143ºE. Bulletins were issued by the Northwest Pacific Tsunami Advisory Center in Tokyo (Japan), the Pacific Tsunami Warning Center in Hawaii (USA), and the West Coast and Alaska Tsunami Warning Center in Alaska (USA) and sent to focal points responsible for tsunami response in the countries concerned. Altogether, a total of 40 countries and sub-national entities independently participated in PacWave08, which included 28 of 33 countries with official ICG/PTWS Tsunami Warning Focal Points and/or National Contacts. The evaluation questionnaire responses showed that the PacWave08 objectives were successfully met. Future tsunami exercises should emphasize both, actual exercise activities (warning receipt, notification, and response) and the post-exercise evaluation components. Because exercises are testing the feasibility and applicability of established standard operating procedures, it is essential that post-exercise assessments be carried out to identify problems and where possible, to establish immediate corrective actions. As a result of PacWave08, certain shortcomings have been identified and are being addressed. The first Pacific-wide exercise, "Pacific Wave 06", was carried out in 2006, and the third exercise is planned for 2010.

Tsunami warning signs in New Caledonia.
Photo: Courtesy of Marguerite Wattez

4.3 Tsunami and other Coastal Hazards Warning System for the Caribbean and Adjacent Seas

The Third Session of the Intergovernmental Coordination Group for the Tsunami and Other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (ICG/CARIBE EWS-III) was held in Panama City, Panama, 12-14 March 2008. The ICG reviewed and upgraded the CARIBE-EWS Implementation Plan and received progress reports on training activities as well as on the process of nominations of Tsunami Warning Focal Points (TWFP) and Tsunami National Contact (TNC): to date 23 out of 29 countries. The ICG also endorsed core networks of seismic and sea level stations. Based on the experience and work of Tsunami Warning Systems in other regions, CARIBE-EWS will identify the technical, logistical and administrative requirements for an operational Regional Tsunami Warning Centre, which is planned to be operational by 2010. The Group elected Lorna Inniss (Barbados) as Chairman and confirmed Israel Matos (USA) and Gustavo Malave (Venezuela) as Vice-Chairmen for 2008-2009. The ICG decided to hold its Fourth session in March 2009 and recommended to accept the offer from France to host it in Martinique. It further agreed to target March 2010 for its Fifth Session.

4.4 Tsunami Early Warning and Mitigation System in the North Eastern Atlantic, the Mediterranean and Connected Seas

Uli **WOLF**

For the Intergovernmental Coordination Group for the Tsunami Early Warning and Mitigation System in the North Eastern Atlantic, the Mediterranean and Connected Seas (ICG/NEAMTWS) the year 2008 was dominated by the work of the Task Team on the RTWC Architecture and updates to the instrumentation networks including the major improvement in real time access to sea-level stations and seismometers in the region. Consequently ICG/NEAMTWS-V, held in Athens, Greece, on 3-5 November 2008, concentrated on the findings of the Task Team and adopted the TOWS recommendations for a sea-level related hazards framework. The ICG reviewed the progress made during the intersessional period and adopted recommendations and updates to the NEAMTWS Implementation Plan. Most Member States have not nominated Tsunami Warning Focal Points (TWFP) and Tsunami National Contacts (TNC), designated to receive and disseminate official tsunami relevant information. In Athens the Meeting encouraged Member States to share and exchange tsunami-relevant real time observational data, complying with the UNESCO/IOC Oceanographic Data Exchange Policy and especially to strengthen the cooperation with and involvement of North African Member States in the NEAMTWS coordination process. The ICG also decided to use the terms "watch" and "advisory" for the two classes of alerts issued by Regional Centres (RTWC), whereas "warning" should only be used by the National Centres. The mandate of the Task Team was extended until the next ICG meeting, which will take place in Istanbul, Turkey, in November 2009.

Ocean sciences

OVERVIEW 5

Annual activities of the Ocean Sciences Section during 2008 clustered around the high-level objectives adopted for 2008-2013 and the priority areas of research in climate change, ocean health, coastal research, assessment, and management. OSS actively contributed in 2008 to make all science efforts as extensive and global as possible, but also tried to contribute to building scientific capabilities in the developing world, especially in Africa, in line with UNESCO's priorities. Activities included promotion and coordination of externally funded programmes (science innovation and management), stimulating co-operation between researchers and organisations to explore new directions (science synergy) and providing scientific criteria for ecosystem management (scientific services). OSS is also the forefront of many important international developments and events, such as guidelines, publications, and symposia. All these take place in a wide range of scientific areas.

Within the context of the Integrated Coastal Area Management (ICAM) programme, efforts towards the implementation of regional initiatives have continued particularly through the launch of two major regional projects. Firstly, in West Africa, the Adaptation to Climate Change in Coastal Zones (ACCC) project, funded by United Nations Development Program and Global Environment Fund over a four year period, will assist five countries in developing and implementing adaptation measures in designated pilot sites, in the context of national coastal management plans and policies. In South America, the SPINCAM (Southeast Pacific data and Information Network in support to ICAM) project, funded by the Government of Flanders (Belgium) for three years and implemented in collaboration with CPPS, will apply the *ICAM indicator methodology Handbook* (IOC Manuals and Guides 46) in the five countries of the CPPS region.

The Harmful Algae Bloom (HAB) Programme launched a Project Plan for a GEOHAB Core Research Project on HABs in Stratified Systems, a special GEOHAB issue of the Elsevier Journal `Harmful Algae` on HABs and Eutrophication. A Task Team under the IOC Intergovernmental Panel on HABs developed a master plan for an integrated and comprehensive 'Harmful Algae Information System' to be developed in cooperation with OBIS, WoRMS, ICES, PICES, and ISSHA. The HAB Programme continues its strong focus on capacity building and conducted three international training workshops, two capacity enhancing expert workshops and one meeting of a regional HAB network (FANSA South America). UNESCO Publishing released the monograph in the 'Oceanographic methodology' series 'Real-time Coastal Observing Systems for Marine Ecosystem Dynamics and Harmful Algal Blooms: Theory, Instrumentation and Modelling'.

The Global Coral Reef Monitoring Network (GCRMN) conducted ecological and socio-economic training in association with Reef Check and World Fish Center in more than 38 countries. Two outstanding reports were published in

Luis **VALDÉS**

2008: the `Status of Caribbean Coral Reefs after Bleaching and Hurricanes in 2005` and the 'Status of Coral Reefs of the World'. The first report was launched at the World Bank in Washington DC and the second report at UNESCO's Intergovernmental Oceanographic Commission in Paris. The distribution included 4,000 copies of each.

The International Ocean Carbon Coordination Project (IOCCP) established the Global Ocean Ship-based Hydrographic Investigations Panel (GO-SHIP) to revise the 1994 World Ocean Circulation Experiment (WOCE) Hydrographic Program Manual and develop a strategy for the next global hydrography survey to follow after CLIVAR. The IOCCP also initiated the Surface Ocean CO_2 Atlas Project (SOCAT) to develop a global common-format database of surface CO_2. The first SOCAT dataset includes data from over 14 countries, producing an initial database composed of more than 7 million measurements of various carbon parameters from approximately 2,100 cruises from 1968 to 2007. The IOCCP provided scientific and technical advice to the International Maritime Organization (IMO) London Convention's Scientific Group on Ocean Fertilization in their deliberations to determine how to regulate ocean fertilization experiments to protect the marine environment.

The Intergovernmental Oceanographic Commission sponsored two important symposia that involved OSS leadership. In May IOC, ICES, and PICES co-sponsored the International Symposium Effects of Climate Change on the World's Oceans, which was held in Gijón, Spain, and gathered 400 participants from 48 countries from around the world. This was the largest and most important symposium on the effects of climate change on the oceans in 2008 and will repeat again in 2012 in connection with Yeosu International Expo in Korea. The conclusions and a selection of the best contributions will be published in a peer-review volume of the ICES Journal of Marine Science in August 2009.

In October the second Ocean in a High CO_2 World symposium was held at the Oceanography Museum of Monaco under the High Patronage of Prince Albert of Monaco. The symposium was sponsored by SCOR, UNESCO/IOC, the IAEA Marine Environmental Laboratory and IGBP. Based on results presented at the symposium, 150 leading marine scientist from 26 countries developed "The Monaco Declaration", which called for immediate action by policymakers to reduce CO_2 emissions sharply to avoid possible widespread and severe damage to marine ecosystems from ocean acidification.

Harmful Algal Bloom in the central Baltic 2008.
© Swedish Coast Guard

5.1 The Ocean in a High CO_2 World

More than 150 leading marine scientist from 26 countries called for immediate action by policymakers to reduce CO_2 emissions sharply to avoid possible widespread and severe damage to marine ecosystems from ocean acidification. This warning was issued in the Monaco Declaration, released on 30 January 2009, and developed by the participants of the 2nd international symposium on The Ocean in a High CO_2 World.

The ocean absorbs at least 1/4th of the CO_2 emitted to the atmosphere from human activities every year, reducing the CO_2 concentration in the atmosphere and its impact on climate. However, this valuable ecosystem service comes at a steep ecological cost: the acidification of the ocean.

When CO_2 dissolves in seawater, carbonic acid is formed. This phenomenon, called "ocean acidification", decreases the availability of carbonate, making it more difficult for many marine organisms and corals to construct their shell or skeletal material out of calcium carbonate minerals. Since the beginning of the industrial revolution, ocean acidity has increased by 30 percent. Such large changes in ocean acidity have probably not been experienced on the planet for the past 21 million years. How marine ecosystems, coral reefs, and fisheries will respond to this rapid acidification is unknown.

In 2004, the IOC and SCOR developed an international symposium, "The Ocean in a High CO_2 World", which brought together 120 scientists from 18 countries to discuss how increases in atmospheric CO_2 were affecting ocean chemistry and biology, to evaluate potential strategies to artificially enhance ocean carbon uptake, and to discuss directions for future research. The term ocean acidification was not in wide use, and only a small group of specialists had been studying how increasing marine concentrations of CO_2 and corresponding reductions in pH and carbonate ion concentrations were affecting marine organisms, mostly corals. At that time, ocean scientist were primarily studying the beneficial effects of the ocean's great capacity to take up CO_2, thereby moderating the increase in atmospheric CO_2 from fossil-fuel burning. But as the meeting progressed, there was a growing awareness of many problems associated with corresponding changes in ocean chemistry and associated biological impacts.

The first symposium marked a turning point for many scientists, who suddenly understood that the impacts of ocean uptake of CO_2 were as important as its benefits. The media also picked up on these growing concerns and interest increased rapidly as national ocean acidification reviews were released and several papers from the symposium were published in high-profile science journals.

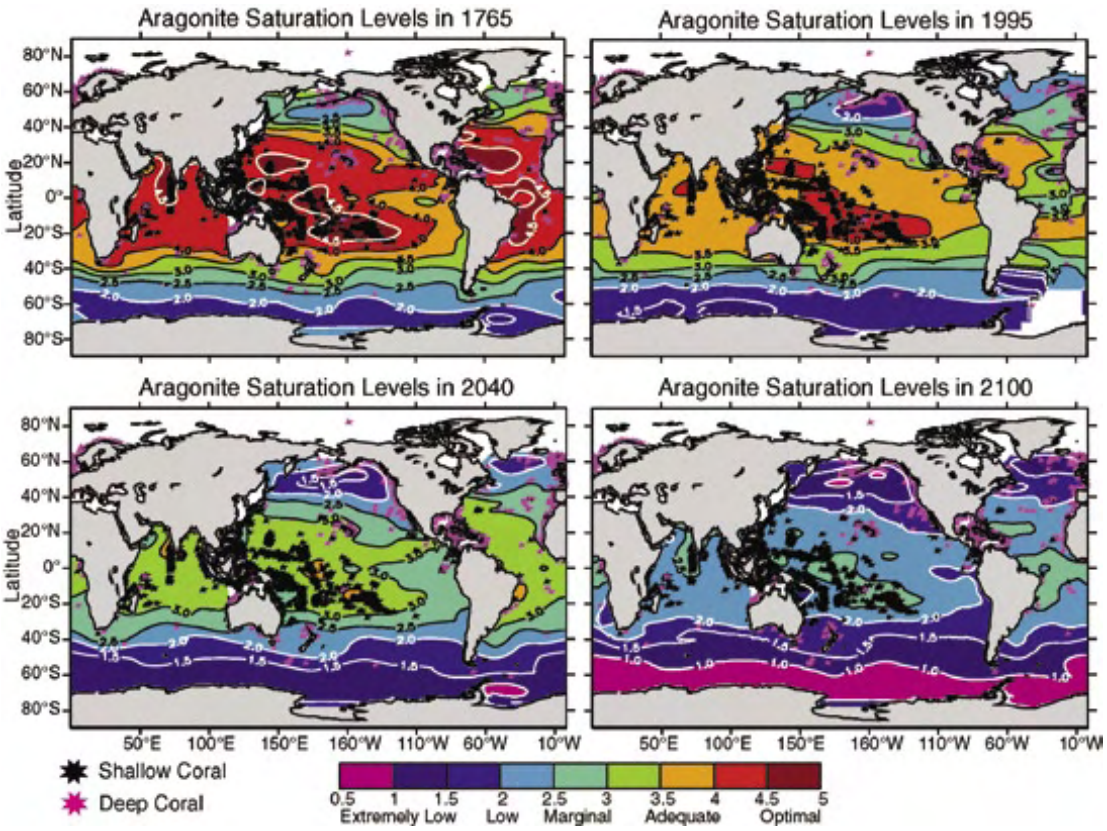
Four years later, under heightened concern, 220 scientists from 32 countries united for a second Ocean in a High CO_2 World symposium. The 2nd symposium was held on 6-9 October 2008 at the Oceanography Museum of Monaco under the High Patronage of Prince Albert of Monaco. The symposium was sponsored by SCOR, IOC-UNESCO, the International Atomic Energy Agency's Marine Environmental Laboratory and the International Geosphere-Biosphere Program, and supported by the Prince Albert II Foundation, the Centre Scientifique de Monaco, the U.S. National Science Foundation, the International Council for the Exploration of the Sea, and the North Pacific Marine Science Organization.

Maria **HOOD**

At the symposium, scientists reviewed the latest research results and summarized findings:

- ocean acidification is already detectable and is accelerating;
- biological impacts will include reduced calcification rates; reduced growth, production and life span of adults, juveniles and larvae; reduced tolerance to changes in other environmental factors; changes in species biogeography; changes to biodiversity; and changes to food-webs;
- severe biological impacts may occur within decades;
- marine organisms exhibit a range of responses to ocean acidification depending on the life stage of the organism;
- selective breeding experiments demonstrate the some level of adaptation to acidification impacts may be possible for some organisms; and
- naturally low pH environments provide a glimpse of ecosystems in a high-CO_2 world, which show low biodiversity, eroding and pitting of shells of gastropods, and structurally fragile coral reefs.

The closing remarks from Prince Albert of Monaco inspired participants to call for the development of a declaration to highlight the dangers of ocean acidification. They also called



Projected area of optimal growth for coral reefs. The figure shows model projections of the saturation levels of aragonite (a form of calcium carbonate used by corals) from the pre-industrial era to 2100. Before the industrial revolution, large bands of the tropical ocean were optimal for coral growth. By 2040, these areas are only adequate for growth, and by 2100, most areas are only marginal. Image courtesy of Feely RA, Orr JC, Fabry VJ, Kleypas JA, Sabine CL, and Langdon C (in press) Present and future changes in seawater chemistry due to ocean acidification.
In AGU Monograph, The Science and Technology of CO_2 Sequestration, B. J. McPherson and E. Sundquist, eds.

Prince Albert of Monaco, high patron of the 2008 Ocean in a High CO_2 World Symposium.
© Palais Princier de Monaco

for immediate action to limit widespread and severe damage to marine ecosystems. The Monaco Declaration, with a foreword from Prince Albert II, describes the current state of understanding of potential impacts of ocean acidification and suggests policy initiatives.

"*The chemistry is so fundamental and changes so rapid and severe that impacts on organisms appear unavoidable*," said James Orr of the Marine Environment Laboratories (MEL-IAEA) and chairman of the symposium. "The questions are now how bad will it be and how soon will it happen. The report from the symposium summarizes the state of the science and priorities for future research, while the Monaco Declaration implores political leaders to launch urgent actions to limit the source of the problem."

"*In order to advance the science of ocean acidification, we need to bring together the best scientists to share their latest research results and to set priorities for research to improve our knowledge of the processes and of the impacts of acidification on marine ecosystems*," explained Patricio Bernal, Executive Secretary of UNESCO's IOC. "*The Ocean in a High-CO_2 World Symposia Series provides this forum to scientists every four years, and the Research Priorities Report it produces represents an authoritative assessment of what we know about acidification impacts*."

Prince Albert II of Monaco has urged political leaders to heed the Monaco Declaration as they prepare for climate negotiations at the United Nations Climate Change Conference in Copenhagen this year. "*I strongly support this declaration, which is in full accord with my efforts and those of my Foundation to alleviate climate change*," he said.

The Monaco Declaration and the Research Priorities Report of the Ocean in a High CO_2 World symposium are available at: www.ocean-acidification.net. A summary for policymakers will be published in early 2009 and a special issue of the journal *Biogeosciences* will highlight significant research results from the symposium.

5.2 The International Ocean Carbon Coordination Project

The IOC-SCOR International Ocean Carbon Coordination Project (IOCCP) promotes the development of a global network of ocean carbon observations for research through technical coordination and communications services, international agreements on standards and methods, and advocacy and links to the global observing systems. The IOCCP was started as a pilot-project of the IOC-SCOR CO_2 Panel in 2003, and became a standing project to replace the CO_2 Panel in 2005 with terms of reference adopted by the 23rd Session of the IOC Assembly. In 2008, the IOCCP undertook three major activities: the Global Ocean Ship-based Hydrographic Investigations Panel (GO-SHIP), the Surface Ocean CO_2 Atlas Project (SOCAT), and the Changing Times workshop.

THE GLOBAL OCEAN SHIP-BASED HYDROGRAPHIC INVESTIGATIONS PANEL (GO-SHIP)

IOCCP and CLIVAR, with input from SOLAS and IMBER, established GO-SHIP to bring together interests from physical hydrography, carbon, biogeochemistry, Argo, OceanSITES, and other users and collectors of hydrographic data, to develop guidelines and advice for the development of a globally coordinated network of sustained ship-based hydrographic sections that will become an integral component of the ocean observing system. Panel Members include Masao Fukasawa (JAMSTEC, Japan), Chris Sabine (NOAA, USA), Bernadette Sloyan (CSIRO, Australia), Toste Tanhua and Arne Koertzinger (IfM-GeoMar, Germany), Gregory Johnson (NOAA, USA), and Nicolas Gruber (ETH, Switzerland).

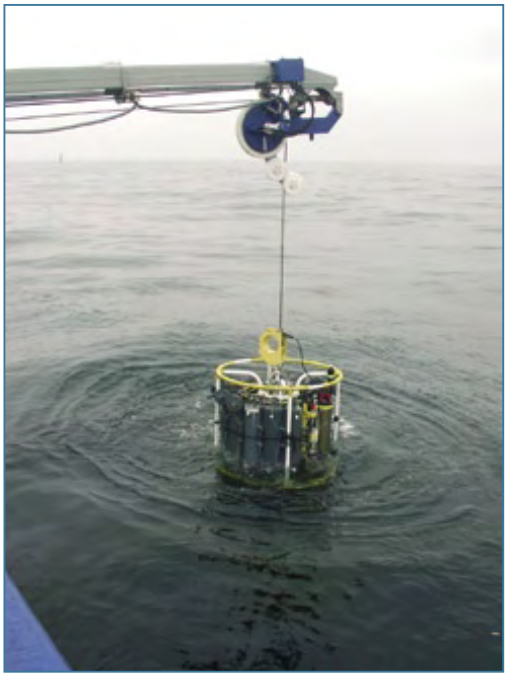
Current activities include the revision of the 1994 WOCE Hydrographic Manual and development of a white paper for OceanObs09 for a sustained global programme of ship-based hydrography building on the foundations of WOCE/JGOFS, and CLIVAR. A website for integrated hydrography is under development, and an email list has been developed to facilitate communication in the hydrography community. To join this list, send an email to sympa@lists.unesco.org with "subscribe go-ship" in the subject line. For more information visit www.ioccp.org and follow the link from Hydrography to GO-SHIP.

THE SURFACE OCEAN CO_2 ATLAS (SOCAT) PROJECT

At the "Surface Ocean CO_2 Variability and Vulnerability" (SOCOVV) workshop in April 2007, co-sponsored by IOCCP, SOLAS, IMBER, and the Global Carbon Project, participants agreed to establish a global surface CO_2 data set that would bring together, in a common format, all publicly available surface fCO_2 data for the surface oceans. The data set builds on the work started in 2001 and now contains data from over 2000 cruises from 1968 to 2007 with more than 5 million measurements. This data set will be published as a 2nd-level quality controlled, global surface ocean fCO_2 data set following agreed procedures and regional review, and will serve as a foundation upon which the community will continue to build in the future. The data set will be made available via Live-Access Server in late 2009.

SOCAT has held two technical workshops to discuss 1st and 2nd level QC procedures, and a coastal workshop was held in January in Kiel under the leadership of Alberto Borges to discuss special needs for coastal zone data in the SOCAT

R/V Penck *in stormy weather off Gotland (CTD fixed on deck)*



CTD with sampling bottles heaved up

data set. A regional workshop for the Pacific Ocean will be held from 18-20 March in Tsukuba with Yukihiro Nojiri (NIES, Japan) and Steve Hankin (NOAA PMEL, USA) as co-chairs. A regional workshop for the Atlantic, Indian, and Southern Ocean regions will be held sometime this summer. For more information visit www.ioccp.org and follow the link from Synthesis Groups to SOCAT.

CHANGING TIMES: AN INTERNATIONAL OCEAN BIOGEOCHEMICAL TIME-SERIES WORKSHOP

This workshop, co-sponsored by IOCCP, OceanSITES, the US Ocean Carbon and Biogeochemistry Project, and POGO brought together 40 participants from 17 countries to review the scientific rationale for sustained time series observations of carbon and biogeochemistry, the value of networking observations, existing global, regional, and national programmes, needs, interests and emerging issues, technology and development issues and collaboration and networking needs, interests and possibilities. While many of the carbon and biogeochemistry time-series stations were appropriate for coordination within the OceanSITES framework (e.g., open-ocean, Eulerian, and open data policy), other stations and biogeochemical observation programmes were not, particularly those in the coastal zone. The workshop participants agreed to work in collaboration with OceanSITES where appropriate, but also to develop an inventory of all carbon and biogeochemistry observing programmes to facilitate coordination and communication among them. This inventory would be restricted to observation programmes that are meant to be long-term, and would not include process studies or one-off experiments.

Ocean observations and services

OVERVIEW 6

Keith **ALVERSON**

The Ocean Observations and Services section of the Intergovernmental Oceanographic Commission can point to a number of major accomplishments in 2008. We were extremely satisfied to see the regional alliances of the Global Ocean Observing System (GOOS) emerge in November at the forum meeting in Guayaquil, Ecuador, as self-powered, bottom-up workhorses for coastal implementation of observing systems. The forum was particularly successful in catalyzing enthusiastic engagement for observing systems in the South and Central American regions. Another highlight was the agreement with the Government of Flanders (Belgium) to extend the Ocean Data and Information Network in Africa through 2012. The project will focus on the application of data and information products toward sustainable management of marine and coastal resources as well as toward reducing Africa's risk to ocean related hazards. On the global scale, the WMO-IOC Joint Technical Commission for Oceanography and Marine Meteorology (JCOMM) played a key role in ensuring continued progress in development of the in-situ ocean observing system for climate (Fig. 1) and in advocating for continuity in altimetry through Jason-3 and Sentinel 3b missions and beyond. Finally, all the programmes through the Ocean Observations and Services section worked intensively in 2007-2008 to contribute to the International Polar Year of scientific research in the Arctic and the Antarctic that the ICSU and WMO organized. In this year's annual report we highlight some of the outcomes of this intense, interdisciplinary, high-latitude campaign most relevant to the Intergovernmental Oceanographic Commission.[1]

THE INTERNATIONAL POLAR YEAR 2007-2008

Over the last polar year, researchers observed exciting new phenomena, made fundamental scientific discoveries, developed new methods and tools. They advanced interdisciplinary and international links in polar science and most importantly gained new understanding of the Polar Regions' rapid response to a warming Earth. The year took place during a time when our planet has been changing faster than at any other time in human-recorded history. That change is particularly evident at high latitudes. The urgencies of polar research and observations have never been greater.

1. Allison, I. Beland, M. and the ICSU/WMO Joint Committee for IPY, 2009. *The State of Polar Research*, World Meteorological Organization, Geneva , 12 pp.

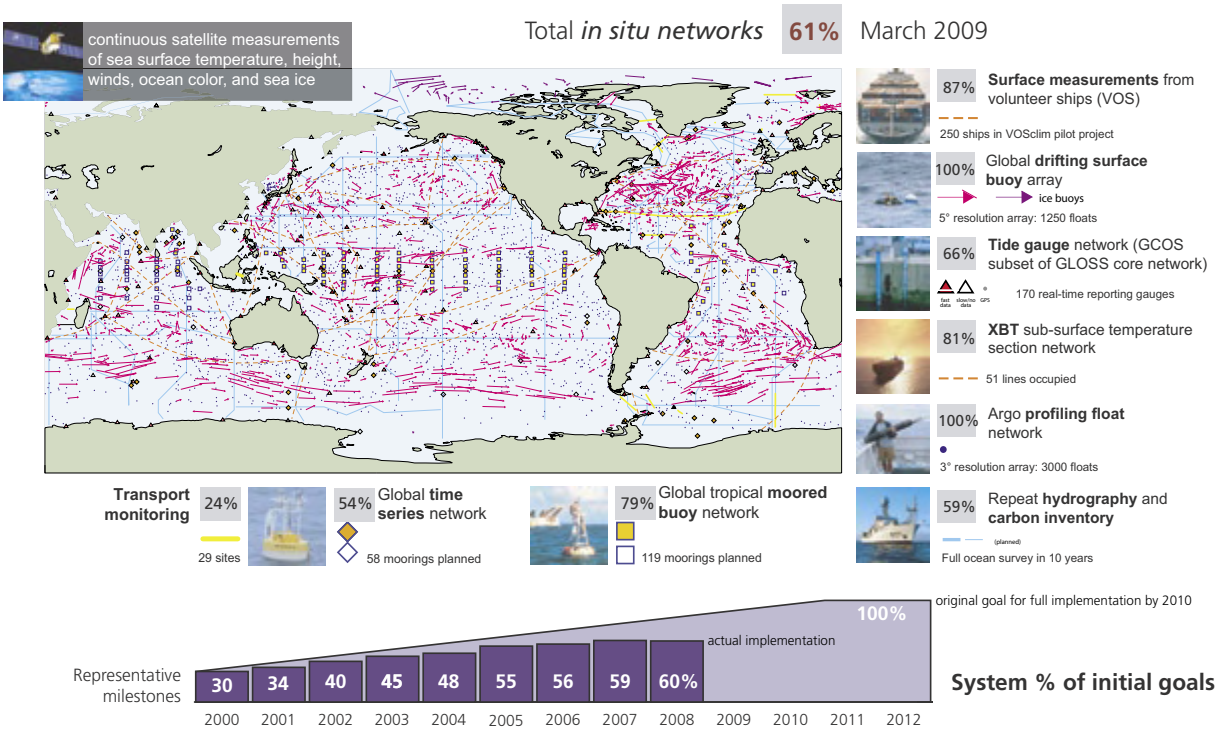


Fig.1 *Status of the in-situ ocean observing system for climate. In 2008 the in-situ ocean observing system achieved 60 percent of its initial design specification. However, implementation has slowed and has now fallen substantially behind the planned build-up. Without completing the system, Member States will be unable to adequately monitor global climate change.*

MARINE SCIENTIFIC ADVANCES DURING THE INTERNATIONAL POLAR YEAR

The International Polar Year laid the foundation for major scientific advances in knowledge and understanding of the polar oceans and their role in the functioning of our planet. The full scientific legacy of IPY will evolve in the years and decades after the completion of the observational programme described in the IPY Science Plan[2]. Already however, significant advances in scientific knowledge and understanding have begun to emerge and some specific to the polar oceans are reported here.

New assessments of the state of the Greenland and Antarctic ice sheets have been made using from satellite measurements of changes to the elevation and to the gravitational fields of the ice sheets, and estimates of the difference between snow input (from high resolution meteorological models) and ice discharge (from satellite measurements of ice sheet velocities and thickness at the coast). Polar scientists are continuing to refine these assessments, but it now appears certain that both the Greenland and the Antarctic ice sheets are losing mass and thus raising sea level, and that the rate of ice loss from Greenland is increasing. In both Greenland and Antarctica part of the loss is due to increased ice outflow. The potential for these ice sheets to undergo further rapid increase in ice discharge remains the largest unknown factor in projections on the rate of sea level rise

2. Allison, I., Béland, M. and the ICSU/WMO Joint Committee for IPY. 2007. *The Scope of Science for the International Polar Year 2007-2008.* WMO/TD-No. 1364, World Meteorological Organization, Geneva, 79 pp.

within the Intergovernmental Panel on Climate Change (IPCC). New data also show that warming in the Antarctic is much more widespread than was thought prior to 2007.

During IPY, the summer minimum extent of Arctic perennial sea ice decreased by about a million square kilometres to its minimum extent since satellite records began. In addition, the North Pole region was covered only in relatively thin first-year ice in mid-winter for the first time in the observational record. IPY expeditions recorded an unprecedented rate of ice drift across the Arctic basin, providing compelling evidence of changes in the Arctic ice-ocean-atmosphere system.

Intensive multi-ship surveys of the Southern Ocean have uncovered a remarkably rich, colourful, and complex range of life, greatly extending our knowledge of polar biodiversity. As a result of these surveys, two areas, each around 400 square kilometres, have been recognized as Vulnerable Marine Ecosystems under the Convention for the Conservation of Antarctic Marine Living Resources, and placed on an international register for protection. Interdisciplinary studies of Antarctic sea ice have revealed that the physical characteristics of the ice and the adjacent ocean play an important role in controlling primary productivity in marine ecosystems.

Marine ecologists have continued to unravel the fascinating and complex patterns of geographical distribution of polar organisms and their environmental interaction. Some microbial species occur in nearly identical form in both Arctic and Antarctic ecosystems, while other species have developed very differently in these two environments. Yet other organisms have evolved and expanded their ranges to lower latitudes. For example, new evidence from IPY shows that several living species of deep-sea octopuses in the northern latitudes originated from a common ancestral species that still survives in the Southern Ocean. IPY studies of modern ecosystems have also documented recent poleward migrations of terrestrial and marine species in response to climatic warming.

Data from marine mammals equipped with instrument tags, research vessels, and the Argo floats confirm that the Southern Ocean, and particularly the southern flank of the Antarctic Circumpolar Current, has warmed more rapidly than the average global ocean (Fig. 2). In addition, the dense bottom water formed near Antarctica has freshened in some locations and warmed in others. The freshening is consistent with increased melt from the Antarctic ice shelves and ice sheet. These changes are signs that global warming is affecting the Antarctic in ways not previously suspected.

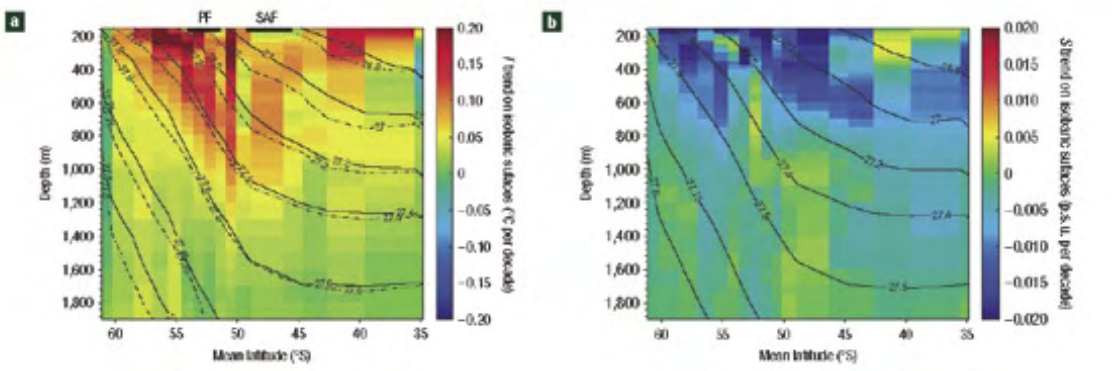


Fig.2 *Mean decadal trends in the southern ocean since the 1960s of (a) potential temperature and (b) salinity averaged on isobaric surfaces.*
(From Bönning et al., Nature Geoscience*, 2008) reprinted with permission.*

TOWARD A LEGACY OF THE IPY

The rapid pace of scientific advancement and our increasing awareness of mankind's impact on the Earth system as a whole suggest that research and data from this IPY will leave a lasting legacy in many fields of science, and provide a clearer picture of what future changes may occur and what effects they may have on the ocean. In addition to catalyzing major scientific advances in knowledge and understanding of the Polar Regions, IPY will also leave a vital legacy that will include sustained observing systems and strengthened international research coordination and collaboration.

Observing systems for monitoring change are essential for validating and improving predictions, especially of future global warming and its impacts. An unprecedented expansion of ice, ocean, atmosphere, coastal, and land observations was made in the Polar Regions during 2007 and 2008. In this context, the Global Ocean Observing System (GOOS) and the Joint Commission for Oceanography and Marine Meteorology (JCOMM) are planning observational systems for both poles: the Sustaining Arctic Observing Networks and a Southern Ocean Observing System. At the same time the International Oceanographic Data and Information Exchange (IODE) is facilitating increased data sharing, access, and preservation as more data come online.

Increasing operational costs and global economic pressures on national budgets will add to the challenge for politicians and science funding organizations of maintaining and expanding these global observing systems to fill the polar gaps. Nevertheless, as itemized above, the urgency for understanding the global impact of polar changes will remain, not least because global warming is affecting the Polar Regions faster and to a greater extent than the rest of the globe. The Polar Regions are an integral and rapidly changing part of the Earth System. Humankind's future environment, well being, and sustainable development require that we comprehensively understand and observe polar systems and processes in the context of the changes that are already upon us.

Deployment of a surface drifter.
Photo: Courtesy of Isabelle Ansorge, University of Cape Town, South Africa.

LINKS WITH PARTNER PROGRAMMES

The Ocean Observations and Services section continues to participate in joint activities with a number of partner organizations.

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.

On behalf of the Executive Secretary of IOC, the OOS section head represented IOC interests in WMO Executive Council working group on WMO Integrated Global Observing System and WMO Information System (WIGOS/WIS). At the same time IODE and JCOMM worked together in developing WIGOS pilot projects on marine meteorology and oceanography.

GOOS remained actively engaged as the oceanic component of the Global Earth Observing System of Systems (GEOSS) and helped in organizing the Group on Earth Observations (GEO).

IODE worked with the Census of Marine Life (CoML) Ocean Biodiversity Information System (OBIS) toward developing long-term management, archival and accessibility to ocean biographic data.

6.1 Global Sea Level Observing System

The Intergovernmental Oceanographic Commission in 1985 established the Global Sea Level Observing System (GLOSS) to provide oversight and coordination for global and regional sea level networks in support of international climate, oceanographic, and coastal sea level research. The Intergovernmental Oceanographic Commission coordinates GLOSS activities, which are now part of the observing components of the WMO-IOC Joint Technical Commission for Oceanography and Marine Meteorology (JCOMM).

Thorkild **AARUP**

Mark **MERRIFIELD**

Belén **MARTÍN MÍGUEZ**

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

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

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

A measure of the current status of GLOSS is the number of operational stations in the GCN. Of the 290 stations, 220 (76%) have provided data recently to one of the GLOSS Data Centres, which represents the participation of 69 nations. Approximately 57% of the GCN stations are providing data in near real time via the Global Telecommunication System (GTS) or the Internet. Data are received in "Fast Delivery" mode (that means within ~1 month) from 193 stations (67%). 131 stations have continuous GPS or Doris at or near the tide gauge. The status of the GLOSS GCN has improved substantially since 1999, primarily in the considerable increase in near real time stations (166 compared to 72).

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

The bulk of the planned tide gauge upgrades in the Indian Ocean have been carried out and more than 50 sea level stations are now reporting sea level data in real time (see Fig. 2). Several countries also have plans for further densification of their national networks. For the other tsunami system regions some progress are now emerging with respect to making sea level station data available in real time. Overall there is steady but somewhat slower progress than seen in the Indian Ocean due to funding limitations and designation of warning centers.

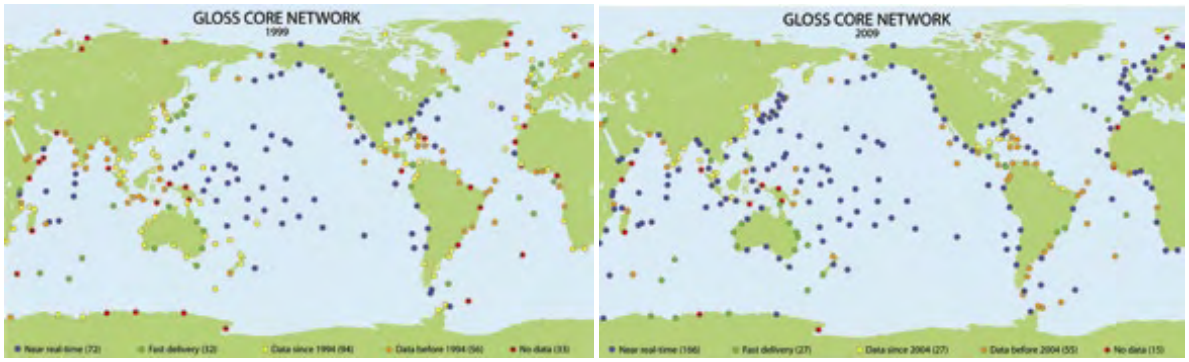


Fig.1 *Status of reporting of the sea level gauges in the GLOSS Core Network in 2009 (right) and 1999 (left). «Near real time» and «Fast Delivery» stations provide high frequency sea level reports (hourly or better), which are necessary for understanding sea level variability in addition to mean sea level rise. Near real time stations (blue) provide data typically within 1 hour of collection; Fast delivery (green) within one month. Delayed mode low frequency data within 5 years (yellow) or greater (orange) include monthly averages provided to the Permanent Service for Mean Sea Level (PSMSL). White dots are placed on tide gauges that are geo-referenced, measuring local land movements, in order to measure absolute sea level change.*

IOC has in collaboration with the Flanders Marine Institute (VLIZ, Belgium) developed a web-based global sea level station monitoring service for viewing sea level data received in real time from different network operators through a number of different communications channels.

The particular aims of this service are: (i) to provide information about the operational status of global and regional networks of real time sea level stations; and (ii) to provide a display service for quick inspection of the raw data stream from individual stations.

The service provides a global station monitoring service for real time sea level measuring stations in (i) the GLOSS Core Network; and (ii) the networks under the regional tsunami warning systems in the Indian Ocean, North East Atlantic & Mediterranean, Pacific and the Caribbean.

The web service provides the following capabilities:

- Global sea level network map, showing color-coded operational status (working/not working)
- Station listing, showing metadata (4-letter code, GLOSS ID number, Location, Collection method, Last Data Transmission date/time, Delay, and Transmit Interval)
- Plotting and download of data received.

The number of stations being tracked by the web-service has grown from about 25 stations at the end of 2007 to presently 293 stations. The tracking will help to more rapid identification malfunctioning of stations and thereby lead to more complete data sets.

More information about the sea level station monitoring service is available at : www.ioc-sealevelmonitoring.org.

An important element of the GLOSS Programme is its training activities carried out with national tide gauge agencies and partner programs including the regional tsunami warning systems. A GLOSS type sea level training course was carried out in collaboration with the CARIBE-EWS and the University of Puerto Rico (23–27 June 2008, Mayagüez, Puerto Rico). Short term practical training in advance of tide gauge installations was also provided by the Proudman Oceanographic Laboratory (Liverpool, UK) for participants from Nigeria and Congo.

Fig.2 *Sea level network of the Indian Ocean Tsunami Warning System (IOTWS)*

Fig.3 *Website of the IOC Seal Level Station Monitoring Facility (www.ioc-selevelmonitoring.org)*

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

The fellowships enabled 1-3 months visits at selected sea level institutions in the GLOSS network. 96 applications from 18 countries bordering the Indian Ocean were received. A total of 30 fellowships have been awarded. All trainees have provided a final report giving account of their work and the main outcome of their training, and the reports point to measurable progress in terms of technical/scientific skills acquired and highlight the collaborative links that were formed with institutions in the GLOSS network.

In 2006 UNESCO/IOC hosted the WCRP workshop "Understanding Sea Level Rise and Variability". Work on the proceedings from the workshop has been nearly completed and a peer reviewed book titled "Sea Level Rise and Variability" will be published in 2009. The book covers all aspects of modern sea-level rise, with a focus on the present rate of change and the variable rates of change over the past century and millennia. The book also provides Member States with policy guidance and advice on priorities for research and observations. (For more information on the Workshop please see http://wcrp.wmo.int/AP_SeaLevel.html).

6.2 International Oceanographic Data and Information Exchange

For IODE the year 2008 was another year of growth. As a follow up to the adoption of the "IOC Strategic Plan for Oceanographic Data and Information Management" by the 24th Session of the IOC Assembly in 2007, IODE and Harmful Algae Bloom (HAB Programmes) decided to cooperate on the development of the Harmful Algal Information System (HAIS). Working together in close collaboration with the Intergovernmental Oceanographic Commission and Integrated Coastal Area Management (ICAM), IODE contributed to the Southeast Pacific data and Information Network in support to Integrated Coastal Area Management.

A second new area of cooperation is the implementation, with SCOR, of a pilot activity to promote the ability to publish data sets as unique objects and their citation by other researchers as a missing incentive to improve data flow to National Oceanographic Data Centers.

The International Oceanographic Data and Information Exchange (IODE) decided to refocus its attention to agreement on international standards by establishing the Ocean Data Standards pilot project, as a joint IODE-JCOMM activity (www.oceandatastandards.org).

Another major development for IODE in the area of cooperation was the discussion to integrate OBIS into the IOC. The Intergovernmental Oceanographic Commission's Executive Council, during its 41st Session in 2008 found the idea of partnering OBIS and IODE hugely beneficial for both, and welcomed the wish of the OBIS Governing Board to investigate different scenarios for a close affiliation between the two programmes. The Intergovernmental Oceanographic Commission's Project Office for IODE co-sponsored a workshop with the Sloan Foundation in November 2008 to investigate the long-term management and the archival and accessibility of ocean biogeographic data that a collaboration between IOC and OBIS would entail. The 25th Session of the IOC Assembly in June 2009 will provide a final decision on this matter.

At the regional level IODE continued the development and support of regional Ocean Data and Information Networks (ODIN). In the Caribbean region a pilot project for the development of a Caribbean Marine Atlas was implemented. This led to the approval of a proposal for a two-year project for the full development of the Caribbean Marine Atlas. ODINAFRICA-III formally ended in December 2008 but a new phase (ODINAFRICA-IV) was successfully submitted for funding to the Government of Flanders (Belgium) and is expected to start in April 2009. Similarly the OceanTeacher ended in December 2008 but a new proposal for the development of the "OceanTeacher Training Academy" was approved for funding by the Government of Flanders, Belgium.

Peter **PISSIERSSENS**

Annexes

7

Funding for IOC programmes

This Annual Report describes a wide spectrum of activities that highlight the relevance of the Intergovernmental Oceanographic Commission of UNESCO's programmes in 2008. Together with national and non-governmental initiatives implementation and related staff costs during 2008 were financed through income from UNESCO as parts of its regular programme allocation, as approved by the UNESCO General Conference, and from extrabudgetary resources, notable those provided by IOC Member States and partner organizations through their contributions to the Intergovernmental Oceanographic Commission of UNESCO Special Account and contributions for specific projects through the creation of UNESCO Funds-in-Trust. This financial report does not consider other contributions (either direct or in-kind) provided by Member States which do not enter the budgetary flow of IOC - with the exception of the very substantial contributions to the IOC Programme Offices in Ostend, Perth and Vigo, for which official information was provided to the Executive Secretary and is available online www.ioc-unesco.org/annualreport2008

The full version of this section of the report containing detailed information on income and expenditure under different types of funding is available online www.ioc-unesco.org/annualreport2008.

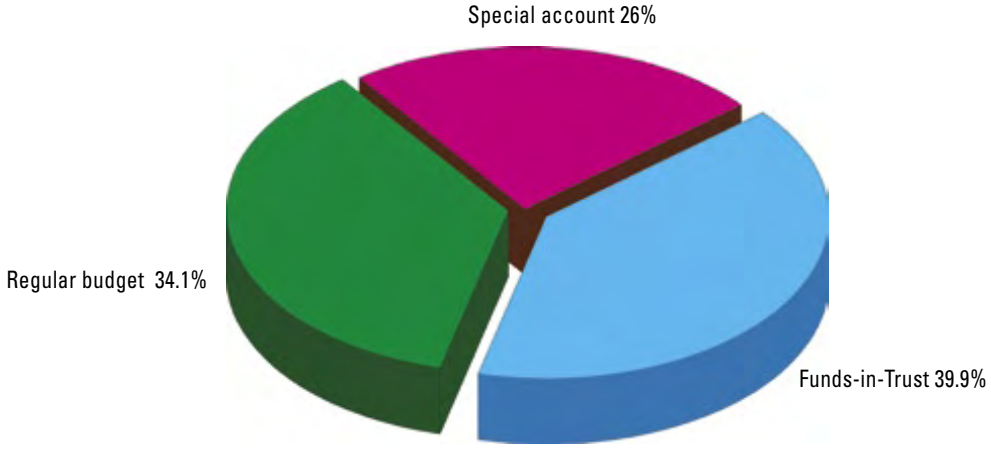


Chart 1. *2008 Expenditure (disbursements) by source (Regular Budget vs Extrabudgetary) -Total: USD 11,670,328 .*

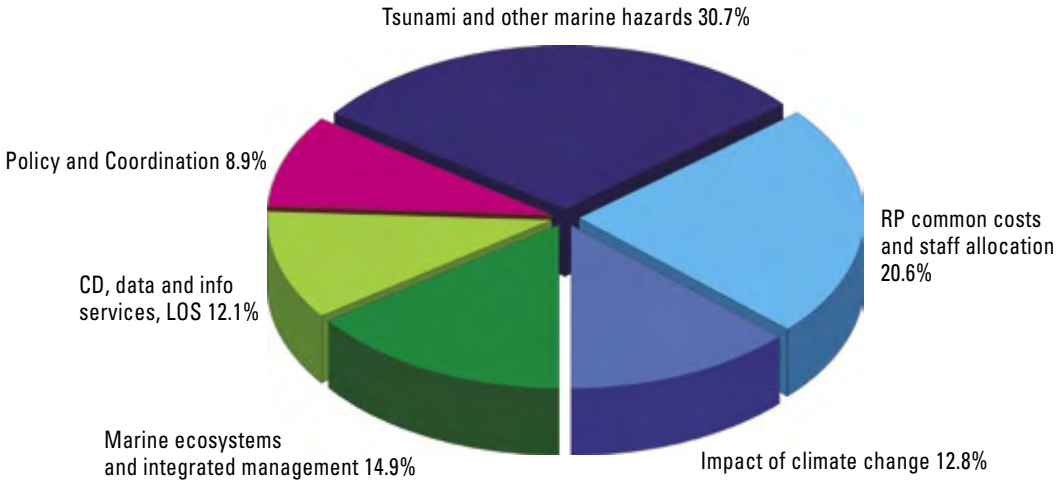


Chart 2. *2008 Expenditure (disbursements) by Main Programme Areas -Total USD 11,670,328.*

1. REGULAR PROGRAMME

The IOC Assembly at its 24th session (19-28 June 2007) considered the Draft Programme and Budget for the biennium 2008-2009 as presented by the Executive Secretary in document IOC-XXIV/2 Annex 11. The Executive Secretary explained that while the 176th Executive Board converged towards the Zero Real Grown scenario for the UNESCO's Programme and Budget for 2008-2009, some key Member States still supported a Zero Nominal Growth Scenario, which in real terms represented a diminution of the budget. Given the uncertainty in the approval of UNESCO's 34 C/5, the IOC Programme and Budget for 2008-2009 had been conceived around three scenarios.

The Financial Committee considered the implications of the different scenarios at the level of IOC. Following the recommendations of the Committee, the Assembly adopted Resolution XXIV-15 'IOC Programme and Budget 2008-2009', in which it stressed 'the importance of the regular funds provided by UNESCO, as an efficient and effective intergovernmental means to generate additional actions and support from Member States', and urged Member States 'to support the IOC programme proposals when the Draft 34 C/5 is being considered by the UNESCO Executive Board and the General Conference'.

The Committee agreed that, in the event that the budget agreed at the General Conference of UNESCO would partly or totally cover real growth, the additional resources to IOC should be allocated as follows:

- Additional investment in the area of climate change and impacts and adaptation strategies for coastal regions, specifically for the benefit of Africa, Small Island Developing States and Least-Developed Countries
- Additional support for the response to the risks posed by tsunami
- New support to provide additional actions in the prevention and mitigation of natural hazards and, in particular, to extend the level of activity, across all lines of IOC
- The global reporting process for assessment of the marine environment/

The 34th General Conference of UNESCO (Paris, 16 October-3 November 2007) endorsed the $ 631M budget for the Organization for 2008-2009. During the discussions on the budget there was unanimously strong support for the Commission, allowing the Commission to maintain approximately the same budget allocation for the activities specified in the previous biennium, as requested by the Assembly at its 24th Session through Resolution XXIV-15. The adopted appropriation for activities for 2008-2009, inclusive of indirect programme costs, was $ 4,052,100, of about 5% more than for the biennium 2006-2007. The General Conference also encouraged the Director-General to look for ways to reinforce the IOC budget through an additional allocation.

Detailed reporting on expenditure under regular programme is available online www.ioc-unesco.org/annualreport2008.

2. EXTRABUDGETARY FUNDING

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

In 2008 the IOC Special Account has undergone a profound restructuring. This new structures allows transparent and detailed reporting that follows the same format as the regular programme work plans within the framework of the 34 C/5 and is in accordance with the programme priorities as defined in the Medium-Term Strategy (34 C/4).

Contributions to and expenditures from the IOC Special Account and Funds-in-Trust are available online www.ioc-unesco.org/annual-report2008.

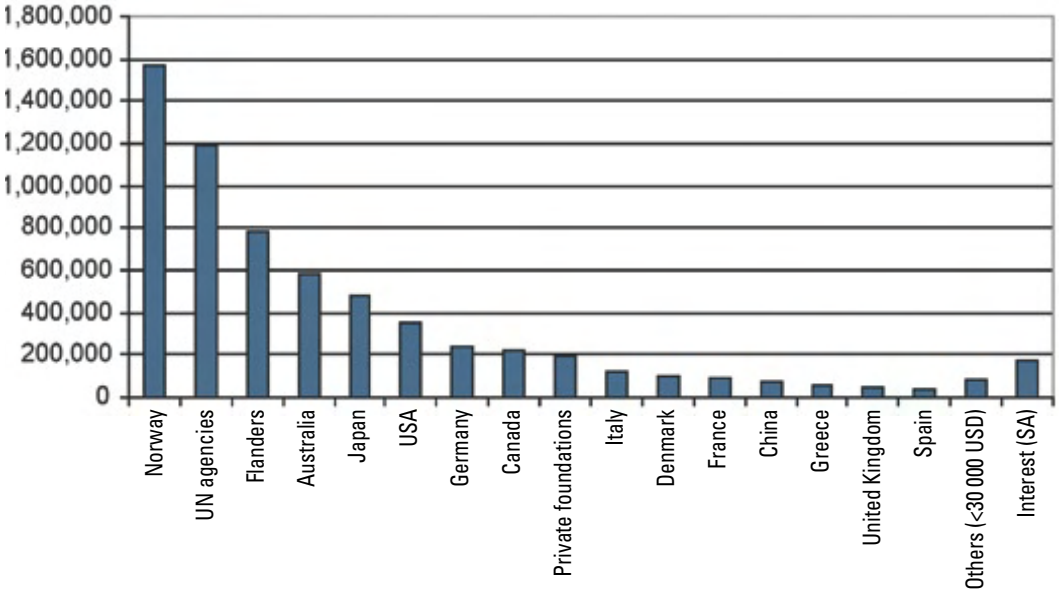


Chart 3. *Main extrabudgetary donors - based on 2008 revenue/contributions to the IOC Special Account and to the Funds-in-Trust (Total of US$ 6,390,045).*

3. OVERVIEW OF THE IOC STAFFING SITUATION

The most relevant fraction of the fixed cost of the IOC's operation is personnel, with core staff funded by UNESCO's regular budget allocation for staff representing 21% per cent of total 2008 expenditure. In addition, another 33% of expenditure covers all types of temporary assistance, including short-term consultancies and fee contractors. During 2008, the IOC counted approximately 55 employees (50.8 person/year) of which 38 were at Headquarters and 17 in the Field (respectively 43 and 15 in 2006-2007). Of these, 39 were professional staff and 16 provided administrative and secretarial assistance. Two (2) professionals (C. Clark and W. Zhu) were seconded to the IOC Secretariat by the United States of America and China, respectively. 22 established posts are funded by UNESCO staff allocation (34 C/5 Approved): 10 professional staff and 12 administrative and secretarial assistants. Two (2) professional posts: Head of the Ocean Science Section and Head of the WESTPAC Secretariat were under recruitment in 2008. The rest of the IOC personnel are funded by other sources, mainly extrabudgetary.

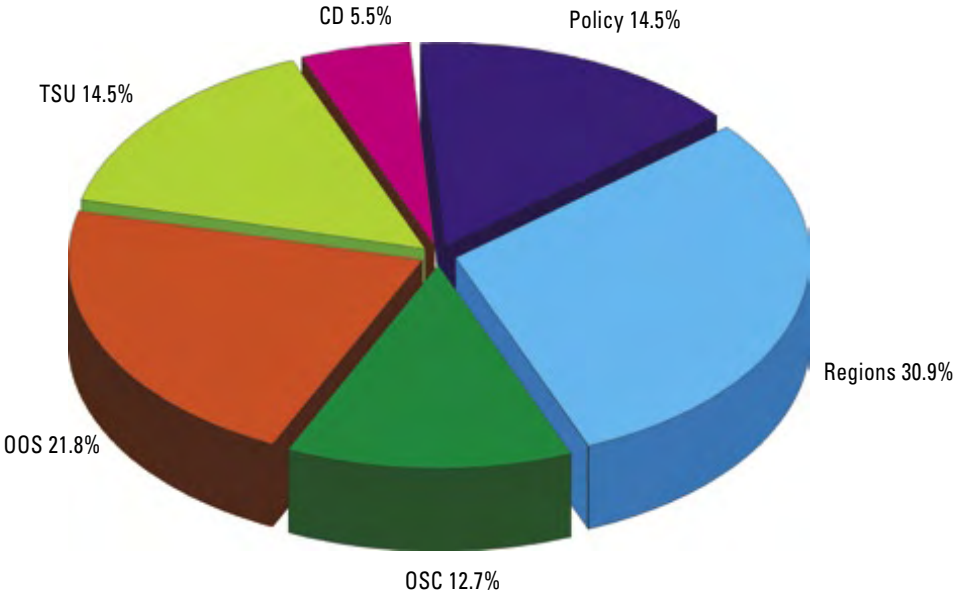
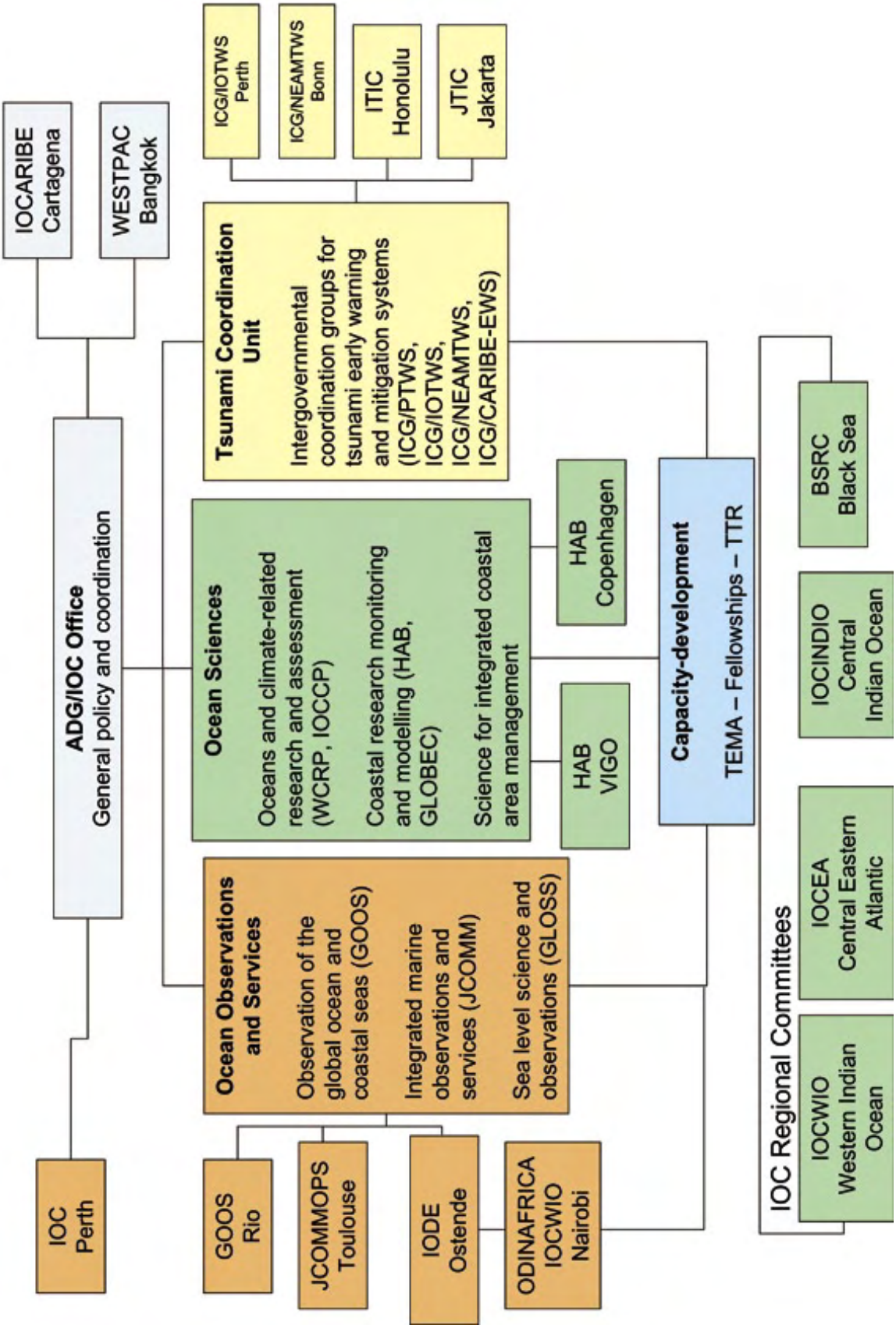
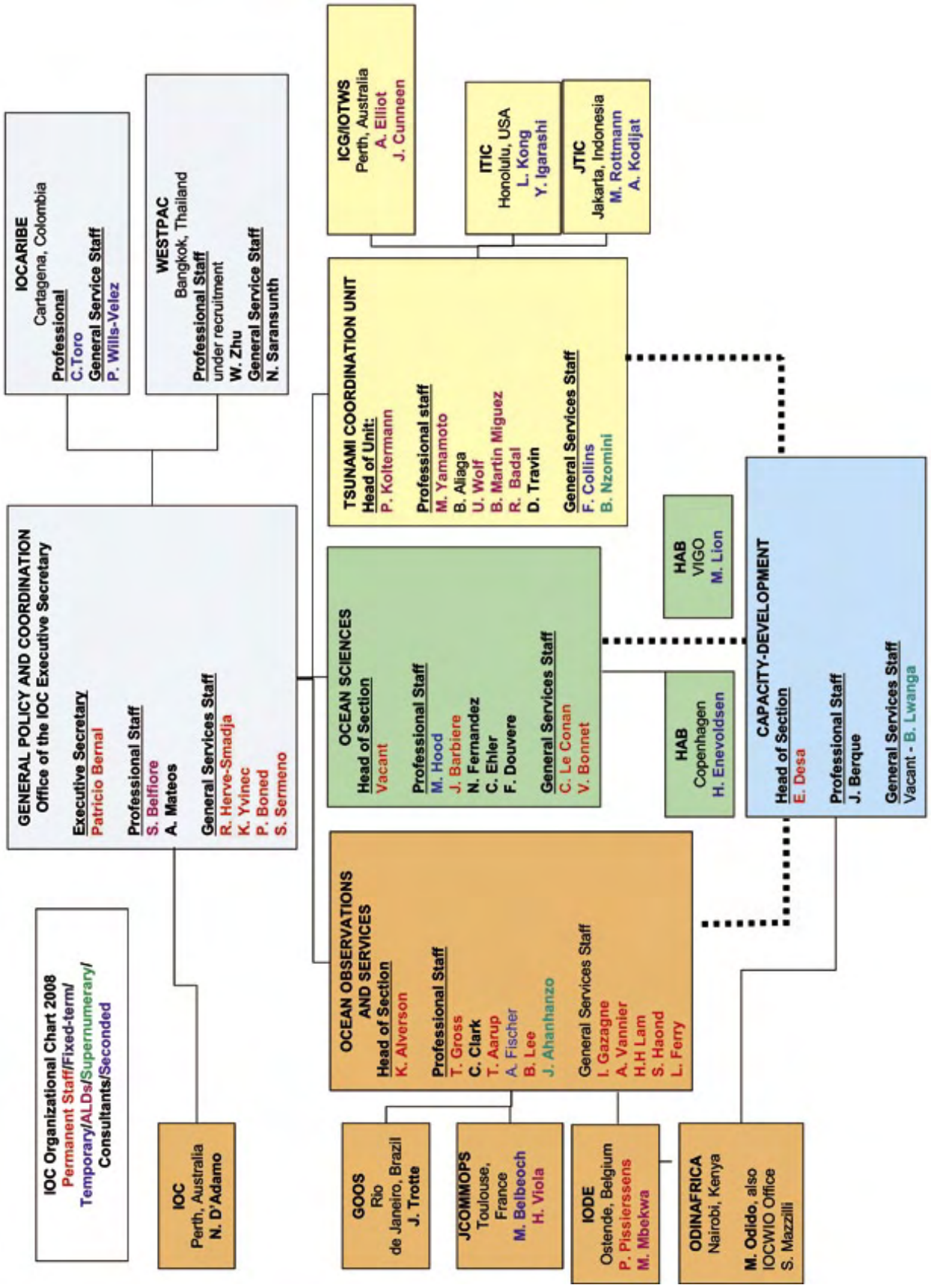


Chart 4. *IOC Staff by Main Structural Groupings.*

Structure of the IOC Secretariat



IOC Staff


IOC Organizational Chart 2008
Permanent Staff/Fixed-term/
Temporary/ALDs/Supernumerary/
Consultants/Seconded
GENERAL POLICY AND COORDINATION
Office of the IOC Executive Secretary
Executive Secretary
Patricio Bernal
Professional Staff
S. Beffiore
A. Mateos
General Services Staff
R. Herve-Smadja
K. Yvinec
P. Boned
S. Sermeno
IOC
Perth, Australia
N. D'Adamo
IOCARIBE
Cartagena, Colombia
Professional
C.Toro
General Service Staff
P. Wills-Velez
WESTPAC
Bangkok, Thailand
Professional Staff
under recruitment
W. Zhu
General Service Staff
N. Saransunth
ICG/IOTWS
Perth, Australia
A. Elliot
J. Cunneen
ITIC
Honolulu, USA
L. Kong
Y. Igarashi
JTIC
Jakarta, Indonesia
M. Rottmann
A. Kodijat
TSUNAMI COORDINATION UNIT
Head of Unit:
P. Koltermann
Professional staff
M. Yamamoto
B. Aliaga
U. Wolf
B. Martin Miguez
R. Badal
D. Travin
General Services Staff
F. Collins
B. Nzomini
OCEAN SCIENCES
Head of Section
Vacant
Professional Staff
M. Hood
J. Barbiere
N. Fernandez
C. Ehler
F. Douvere
General Services Staff
C. Le Conan
V. Bonnet
HAB
VIGO
M. Lion
HAB
Copenhagen
H. Enevoldsen
CAPACITY-DEVELOPMENT
Head of Section
E. Desa
Professional Staff
J. Berque
General Services Staff
Vacant - B. Lwanga
OCEAN OBSERVATIONS
AND SERVICES
Head of Section
K. Alverson
Professional Staff
T. Gross
C. Clark
T. Aarup
A. Fischer
B. Lee
J. Ahanhanzo
General Services Staff
I. Gazagne
A. Vannier
H.H Lam
S. Haond
L. Ferry
GOOS
Rio
de Janeiro, Brazil
J. Trotte
JCOMMOPS
Toulouse,
France
M. Belbeoch
H. Viola
IODE
Ostende, Belgium
P. Pissierssens
M. Mbekwa
ODINAFRICA
Nairobi, Kenya
M. Odido, also
IOCWIO Office
S. Mazzilli

IOC Manuals and Guides

No.	Title
1 rev. 2	Guide to IGOSS Data Archives and Exchange (BATHY and TESAC). 1993. 27 pp. (English, French, Spanish, Russian)
2	International Catalogue of Ocean Data Station. 1976. (Out of stock)
3 rev. 3	Guide to Operational Procedures for the Collection and Exchange of JCOMM Oceanographic Data. Third Revised Edition, 1999. 38 pp. (English, French, Spanish, Russian)
4	Guide to Oceanographic and Marine Meteorological Instruments and Observing Practices. 1975. 54 pp. (English)
5 rev. 2	Guide for Establishing a National Oceanographic Data Centre. Second Revised Edition, 2008. 27 pp. (English) (Electronic only)
6 rev.	Wave Reporting Procedures for Tide Observers in the Tsunami Warning System. 1968. 30 pp. (English)
7	Guide to Operational Procedures for the IGOSS Pilot Project on Marine Pollution (Petroleum) Monitoring. 1976. 50 pp. (French, Spanish)
8	(Superseded by IOC Manuals and Guides No. 16)
9 rev.	Manual on International Oceanographic Data Exchange. (Fifth Edition). 1991. 82 pp. (French, Spanish, Russian)
9 Annex I	(Superseded by IOC Manuals and Guides No. 17)
9 Annex II	Guide for Responsible National Oceanographic Data Centres. 1982. 29 pp. (English, French, Spanish, Russian)
10	(Superseded by IOC Manuals and Guides No. 16)
11	The Determination of Petroleum Hydrocarbons in Sediments. 1982. 38 pp. (French, Spanish, Russian)
12	Chemical Methods for Use in Marine Environment Monitoring. 1983. 53 pp. (English)
13	Manual for Monitoring Oil and Dissolved/Dispersed Petroleum Hydrocarbons in Marine Waters and on Beaches. 1984. 35 pp. (English, French, Spanish, Russian)
14	Manual on Sea-Level Measurements and Interpretation. (English, French, Spanish, Russian)
	Vol. I: Basic Procedure. 1985. 83 pp. (English)
	Vol. II: Emerging Technologies. 1994. 72 pp. (English)
	Vol. III: Reappraisals and Recommendations as of the year 2000. 2002. 55 pp. (English)
	Vol. IV: An Update to 2006. 2006. 78 pp. (English)
15	Operational Procedures for Sampling the Sea-Surface Microlayer. 1985. 15 pp. (English)
16	Marine Environmental Data Information Referral Catalogue. Third Edition. 1993. 157 pp. (Composite English/French/ Spanish/Russian)
17	GF3: A General Formatting System for Geo-referenced Data
	Vol. 1: Introductory Guide to the GF3 Formatting System. 1993. 35 pp. (English, French, Spanish, Russian)
	Vol. 2: Technical Description of the GF3 Format and Code Tables. 1987. 111 pp. (English, French, Spanish, Russian)
	Vol. 3: Standard Subsets of GF3. 1996. 67 pp. (English)
	Vol. 4: User Guide to the GF3-Proc Software. 1989. 23 pp. (English, French, Spanish, Russian)
	Vol. 5: Reference Manual for the GF3-Proc Software. 1992. 67 pp. (English, French, Spanish, Russian)
	Vol. 6: Quick Reference Sheets for GF3 and GF3-Proc. 1989. 22 pp. (English, French, Spanish, Russian)
18	User Guide for the Exchange of Measured Wave Data. 1987. 81 pp. (English, French, Spanish, Russian)
19	Guide to IGOSS Specialized Oceanographic Centres (SOCs). 1988. 17 pp. (English, French, Spanish, Russian)
20	Guide to Drifting Data Buoys. 1988. 71 pp. (English, French, Spanish, Russian)
21	(Superseded by IOC Manuals and Guides No. 25)
22	GTSPP Real-time Quality Control Manual. 1990. 122 pp. (English)
23	Marine Information Centre Development: An Introductory Manual. 1991. 32 pp. (English, French, Spanish, Russian)
24	Guide to Satellite Remote Sensing of the Marine Environment. 1992. 178 pp. (English)
25	Standard and Reference Materials for Marine Science. Revised Edition. 1993. 577 pp. (English)
26	Manual of Quality Control Procedures for Validation of Oceanographic Data. 1993. 436 pp. (English)
27	Chlorinated Biphenyls in Open Ocean Waters: Sampling, Extraction, Clean-up and Instrumental Determination. 1993. 36 pp. (English)
28	Nutrient Analysis in Tropical Marine Waters. 1993. 24 pp. (English)
29	Protocols for the Joint Global Ocean Flux Study (JGOFS) Core Measurements. 1994. 178 pp . (English)

No.	Title
30	MIM Publication Series:
	Vol. 1: Report on Diagnostic Procedures and a Definition of Minimum Requirements for Providing Information Services on a National and/or Regional Level. 1994. 6 pp. (English)
	Vol. 2: Information Networking: The Development of National or Regional Scientific Information Exchange. 1994. 22 pp. (English)
	Vol. 3: Standard Directory Record Structure for Organizations, Individuals and their Research Interests. 1994. 33 pp. (English)
31	HAB Publication Series:
	Vol. 1: Amnesic Shellfish Poisoning. 1995. 18 pp. (English)
32	Oceanographic Survey Techniques and Living Resources Assessment Methods. 1996. 34 pp. (English)
33	Manual on Harmful Marine Microalgae. 1995. (English) [superseded by a sale publication in 2003, 92-3-103871-0. UNESCO Publishing]
34	Environmental Design and Analysis in Marine Environmental Sampling. 1996. 86 pp. (English)
35	IUGG/IOC Time Project. Numerical Method of Tsunami Simulation with the Leap-Frog Scheme. 1997. 122 pp. (English)
36	Methodological Guide to Integrated Coastal Zone Management. 1997. 47 pp. (French, English)
37	Post-Tsunami Survey Field Guide. First Edition. 1998. 61 pp. (English, French, Spanish, Russian)
38	Guidelines for Vulnerability Mapping of Coastal Zones in the Indian Ocean. 2000. 40 pp. (French, English)
39	Manual on Aquatic Cyanobacteria – A photo guide and a synopsis of their toxicology. 2006. 106 pp. (English)
40	Guidelines for the Study of Shoreline Change in the Western Indian Ocean Region. 2000. 73 pp. (English)
41	Potentially Harmful Marine Microalgae of the Western Indian Ocean Microalgues potentiellement nuisibles de l'océan Indien occidental. 2001. 104 pp. (English/French)
42	Des outils et des hommes pour une gestion intégrée des zones côtières - Guide méthodologique, vol.II/ Steps and Tools Towards Integrated Coastal Area Management – Methodological Guide, Vol. II. 2001. 64 pp. (French, English; Spanish)
43	Black Sea Data Management Guide (Under preparation)
44	Submarine Groundwater Discharge in Coastal Areas – Management implications, measurements and effects. 2004. 35 pp. (English)
45	A Reference Guide on the Use of Indicators for Integrated Coastal Management. 2003. 127 pp. (English). ICAM Dossier No. 1
46	A Handbook for Measuring the Progress and Outcomes of Integrated Coastal and Ocean Management. 2006. iv + 215 pp. (English). ICAM Dossier No. 2
47	TsunamiTeacher – An information and resource toolkit building capacity to respond to tsunamis and mitigate their effects. 2006. DVD (English, Bahasa Indonesia, Bangladesh Bangla, French, Spanish, and Thai)
48	Visions for a Sea Change. Report of the first international workshop on marine spatial planning. 2007. 83 pp. (English). ICAM Dossier No. 4
49	Tsunami preparedness. Information guide for disaster planners. 2008. (English, French, Spanish)
50	Hazard Awareness and Risk Mitigation in Integrated Coastal Area Management. 2009. 141 pp. (English). ICAM Dossier No. 5
51	IOC Strategic Plan for Oceanographic Data and Information Management (2008–2011). 2008. 46 pp. (English)
52	Tsunami risk assessment and mitigation for the Indian Ocean; knowing your tsunami risk – and what to do about it (English) (In preparation)
53	Marine Spatial Planning. A Step-by-step Approach. 2009. 99 pp. (English). ICAM Dossier No. 6. (In preparation)

IOC Governing and Major Subsidiary Bodies

In this Series		Languages
Reports of Governing and Major Subsidiary Bodies, which was initiated at the beginning of 1984, the reports of the following meetings have been issued in 2008:		
129.	Fourth Session of the Intergovernmental Coordination Group for the Tsunami Early Warning and Mitigation System in the North Eastern Atlantic, the Mediterranean and Connected Seas, Lisbon, Portugal, 21–23 November 2007 (* Executive Summary available separately in E, F, S & R)	E*
130.	Twenty-second Session of the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System, Guayaquil, Ecuador, 17–21 September 2007 (* Executive Summary available in E, F, S & R included)	E*
131.	Forty-first Session of the Executive Council, Paris, 24 June–1 July 2008	E, F, R, S
132.	Third Session of the Intergovernmental Coordination Group for the Tsunami and other Coastal Hazards Warning System for the Caribbean Sea and Adjacent Regions, Panama City, Panama, 12–14 March 2008 (* Executive Summary available separately in E, F, S & R)	E*
133.	Eighth Session of the IOC Intergovernmental Panel on Harmful Algal Blooms, Paris, France, 17–20 April 2007 (* Executive Summary available separately in E, F, S & R)	E*

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