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Commission

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# IODE/ICAM WORKSHOP ON THE DEVELOPMENT OF THE CARIBBEAN MARINE ATLAS (CMA)

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## 1. OPENING OF THE WORKSHOP

The workshop was opened on Monday 8 October 2007 by Mr Peter Pissierssens. He started by introducing the invited experts, welcoming Dr Sherry Heileman, ICAM expert, Mr Greg Reed, IODE expert, and Dr Cesar Toro, Head of the IOCARIBE Office, Cartagena, Colombia.

He then invited the participants to introduce themselves. The list of participants is included as [Annex III](#). He expressed his regret that Dominica and Guyana had not been able to respond to the invitation to participate in the workshop.

Mr Pissierssens then gave a presentation on IOC (<http://ioc.unesco.org>) and IODE (<http://www.iode.org>). He explained that the IOC, created in 1960, is a body with functional autonomy within UNESCO. IOC currently has 136 Member States. The Headquarters are based in Paris, France but IOC also has field offices in Colombia, Brazil, Thailand, Kenya, Denmark, Belgium and Australia. IOC's activities can be subdivided in addressing ocean scientific uncertainties for the management of the marine environment and climate change, developing operational capabilities for the management and sustainable development of the open ocean and coastal areas, and building capacity of Member States in marine science for the coastal ocean. He then informed the workshop that IODE (International Oceanographic Data and Information Exchange) has been established in 1961 "*to enhance marine research, exploitation and development by facilitating the exchange of oceanographic data and information between participating Member States and by meeting the needs of users for data and information products*". Since its establishment the IODE programme has developed a network of 66 National Oceanographic Data Centres (NODCs) and is developing a similar network of marine libraries. Mr Pissierssens then recalled that the 24<sup>th</sup> Session of the IOC Assembly (2007) adopted the **IOC Strategic Plan for Oceanographic Data and Information Management**, which will lead to the development of a comprehensive and integrated ocean data and information system, serving the broad and diverse needs of IOC Member States, for both routine and scientific use. A core element of the strategy implementation will be the development of a distributed data system called Ocean Data Portal (previously called the Data-ATM). He then stressed that the **timely, free and unrestricted international exchange of oceanographic data** is essential for the efficient acquisition, integration and use of ocean observations gathered by the countries of the world for a wide variety of purposes including the prediction of weather and climate, the operational forecasting of the marine environment, the preservation of life, the mitigation of human-induced changes in the marine and coastal environment, as well as for the advancement of scientific understanding that makes this possible. He recalled that IOC had adopted its "IOC Oceanographic Data Exchange Policy" in 2003 (at the 22<sup>nd</sup> Session of the IOC Assembly).

With regard to data and ICAM, Mr Pissierssens highlighted that data are required in each step of the ICAM policy cycle (planning, implementation, outcome, monitoring, evaluation). Monitoring, as an essential component of the assessment/evaluation also requires substantial data and information management. He then summarized the challenges that would need to be addressed as: (i) identify national institutions that monitor the variable; (ii) establish national data directory (metadata system); (iii) establish national integrated data infrastructure; (iv) agree on standards for data description and data access; (v) build national human and infrastructural capacity; and (vi) maintain the system and ensure services.

He explained that IODE can contribute in several ways: (i) capacity building for ocean/coastal data management; (ii) assisting with standards for data descriptions, data quality control;

(iii) assisting with establishing national data infrastructure (distributed database technology) (NODC establishment); (iv) assisting with developing products/services such as marine atlas, database development, online data retrieval services,... Mr Pissierssens then explained that the IODE's capacity building activities at the regional level as based upon the ODIN strategy (Ocean Data and Information Network). These programmes link training, equipment and operational support in a regional context, with a strong focus on product and service development and involving multiple stakeholders. He then referred to ODINCARSA (Ocean Data and Information Network for the Caribbean and South America regions – <http://www.odincarsa.org>) but explained that so far this project had been active mostly in Latin America. He further explained that all IODE training courses now use the training tool OceanTeacher (<http://www.oceanteacher.org>).

Mr Pissierssens recalled that the idea of developing a Caribbean Marine Atlas had been the result of discussions between Ms Lorna Inniss, Mr Clement Lewsey (IOCARIBE Vice-Chair), Mr Reed and Mr Pissierssens during the 2007 IOC Assembly on the development of the African Marine Atlas. It had been concluded there that a similar product for the Caribbean could contribute to national and regional ICAM activities. It had been agreed at that time, to prepare a project brief on the Caribbean Marine Atlas concept. This had subsequently been circulated by Ms Inniss to IOCARIBE member states (island states) to invite expressions of interest. Based upon the responses a funding request for the organization of the "Stakeholder Meeting towards the Development of the Caribbean Marine Atlas" was prepared by the IODE Secretariat, for submission to the 13<sup>th</sup> Session of the Steering Committee of the Flanders-UNESCO Trust Fund for Science (FUST) as a small-scale activity (SSA). The request for US\$ 20,000 was approved enabling the organization of the workshop.

Mr Pissierssens recalled that the objectives of the workshop were:

- (i) To inform the participating countries of the potential benefits of a Caribbean Marine Atlas;
- (ii) To identify current national coastal zone management arrangements, data availability and data and information management needs;
- (iii) To identify national and regional coastal and marine issues that could be the focus of the Caribbean Marine Atlas;
- (iv) To identify the national resource requirements of the participating countries to enable full participation in a Caribbean Marine Atlas Pilot Project;
- (v) To prepare a draft work plan of a Caribbean Marine Atlas Pilot Project, for submission to, and approval by the respective national governments.

## **2. NATIONAL PRESENTATIONS**

It was recalled that all regional participants had been invited, in preparation for the meeting, to prepare a powerpoint presentation on the marine and coastal priority issues of their country, the associated data needs, and how these are currently addressed. The full presentations will be made available online through the IODE/CMA web site.

## 2.1 Barbados

The presentation was given by Mr Ramon Roach. Mr Roach started by explaining that Barbados has a population of 267,900 (2003) and that 62% of the population lives within 2 km of the coastline. Barbados' economy is based on tourism, agriculture and financial services. Mr Roach talked about the local perspective, touching on demographics, agriculture and environment of Barbados, priority issues at the local and regional level, ICM in Barbados and the potential benefits of the Caribbean Marine Atlas.

In terms of local coastal zone management issues, Mr Roach referred to habitat degradation (beaches, marine waters, coral reefs, seagrass beds and mangroves), natural hazard mitigation (tropical storms, winter storms and tsunamis), and sustainable development (resource extraction and natural heritage). Regarding regional coastal zone management issues Mr. Roach mentioned international shipping (invasive exotic organisms, oil spills, hazardous materials), Atmospheric deposition (Sahara dust, ocean acidification), and climate change (sea level rise, storm frequency/severity, global warming),

Mr Roach explained that coastal zone management had been started in Barbados as early as the 1970s to address coastal erosion. The Coastal Zone Management Unit (CZMU) now had the following role: (i) monitor coastal resources for long-term trends; (ii) advise to public on coastal matters; (iii) advise the Town and Country Planning department on coastal development and the marine environment. The CZMU uses a holistic approach through an Integrated Coastal Management Plan. It addresses several pollution related issues such as nearshore water quality, health and viability of coral reefs, sediment loading from overland runoff, polluted groundwater seepage, and management of coastal development. The structure of the CZMU includes three technical sections namely coastal planning, coastal engineering and marine research. CZMU is also responsible for marine pollution control. It has close working relations with the Environmental Protection Department (EPD) which is responsible for monitoring and control of conditions that could affect environmental quality, as well as with the Fisheries Division.

Mr Roach reported that CMZU runs several monitoring programmes: habitat health, marine water quality, beach trends, nearshore currents. Others are implemented by EPD or the Fisheries Division (bathing beach water quality, loading, catch effort). A range of indicators are produced (Live coral cover, Species abundance (coral and fish), disease prevalence, water quality standard exceedance, beach recreational potential, beach erosion rates and potentials, sediment transport indices, current and wave transport trends).

Mr Roach then that the data used by CZMU are mainly those available in-house from libraries, reports, and online sources (e.g. UN). The CZMU aims towards providing its services on-line, as well as to improved data sharing between government departments, improved distribution of data to the public, streamlining of data analysis and reporting, and designing of databases. However it was noted that many of these objectives would depend on availability of time and improved expertise through training.

Mr Roach identified the following desired outcomes of the Caribbean Marine Atlas for Barbados:

**(i) Improved data management**

- a. Collection and manipulation of marine data
- b. Databases
- c. Data sources
- d. Automation of processes
- e. Development of new indices

**(ii) Improved understanding of non-local events through data access**

- a. Ocean currents
- b. Atmospheric processes
- c. Seawater temperature
- d. HABs
- e. Vulnerability to invasive species

**(iii) Improved data availability**

- a. Regional partnerships for the retrieval of relevant data

**(iv) Improved resource allocation**

- a. Direction of future research
- b. Simplification of monitoring

It was further concluded that Barbados has a need for assistance with building its data management system to underpin the mapping and GIS applications.

## 2.2 Cuba

The presentation was given by Dr Adan Zuñiga Ríos. He started his presentation by explaining that the Cuban archipelago has a coastline of 3725 km. There are 4 sub-archipelagos with thousand keys and small islands. Cuba has 14 provinces and a population of over 11 million. The Cuban economy relies on natural resources such as nickel, oil, beaches, fishing, and agriculture.

In terms of environmental priorities Dr Zuñiga Ríos noted that coastal erosion is a significant problem, especially in areas where tourism is developing. However he noted that erosion is also a regional programme affecting many of the Caribbean islands. Another serious problem is sea level rise, caused by hurricanes and global change.

In terms of environmental protection several actions have been taken by the government, including a legal framework (environmental, coastal zone management, forestry, fisheries, etc.). There exists also a national system for protecting areas, an educational system with an increasing focus on the environment, and there are many research and management institutions that have experience with coastal problems. These institutions have highly educated and trained staff. They include the Institute of Oceanology, the Institute of Meteorology, the Institute of Ecology and Systematics, the Institute of Tropical Geographic, the Coastal Ecosystems Research Center, the National Aquarium of Cuba, the Marine Research Center, the Bays Studies Center, the Fisheries Research Center, the GeoCuba Marine

Studies, the Centre of Environmental Studies of Cienfuegos. There are also ICZM capacity building centers and there is a monitoring station system in place.

Dr Zuñiga Ríos explained that most of these national institutions collect data that are applicable to coastal and marine management. A considerable number of research papers is produced by the national centres and digital maps are produced. All institutions have their own database systems and they share data with each other as well as with international centres.

Dr Zuñiga Ríos concluded by proposing the following way forward towards the development of the Cuban component of the Caribbean Marine Atlas:

**(i) Organize a workshop of directors of coastal/marine institutions with the objectives to:**

- Create the Cuban Marine Atlas Commission;
- Prepare a work plan to collect data for the Caribbean Marine Atlas;
- Detail the contributions of Cuba;
- Establish the foundations to establish a multi-institutional project.

**(ii) Organize a workshop for technicians in order to:**

- Compile existing information (data base, cartographical information, scientific reports);
- Discuss standard methods of collecting data;
- Identify ways to incorporate existing biological collections into a common database;
- Attempt to create a digital network for the Cuban Marine Atlas Commission;
- Create a schedule of work for the Cuban Marine Atlas Commission.
- Discuss how to create a common metadata system for the digital network;
- Design a multi-institutional project and explore funding sources;.
- Prepare a report on both workshops and send it to IOC.

## 2.3 Grenada

The presentation was given by Mr Jerry Mitchell. He explained that, in terms of priority environmental issues for Grenada the following could be identified: (i) south-eastern coast of Grenada which includes considerable mangrove areas, sea grass beds and coral reefs that are major nursery areas or the east coast fisheries of Grenada. Problems include development, fishing pressure, marine pollution, and illegal dumping; (ii) Grand Anse Bay Area, which has coral reefs, beaches, and sea grass beds. This is the single most important recreational diving site in Grenada with over 20,000 dives/year. It is also an area of subsistence fishing; (iii) Mollinere Marine Protected Area, which has sea grass beds, beaches, coral reefs, underwater sculpture park. Problems include uncontrolled fishing, scuba diving and pollution.

A number of measures have been taken to address the issues:

- Designation of two Marine Protected Areas
- Draft Coastal Zone Management legislation
- Identification of areas that needs urgent attention/actions
- Watershed management plans
- Identify coastal resources

The following national institutions and agencies are involved:

- Ministries of
  - Health
  - Planning
  - Fisheries
  - Environment
  - Economic affairs
  - Land use Department
  - Physical planning unit
  - Forestry
- St Georges University
- Nature Conservancy

In terms of data needs, Mr Mitchell noted the need for partial data compilation in electronic format and hard copy, data analysis, expansion of data collection and of parameters measured, hardware for data collection and storage.

Mr Mitchell informed the meeting that some equipment is available for data collection/sampling. GIS capability is also available. For database management MS Excel and MS Access are used. There is currently no web site as no staff time is available to develop the service.

Mr Mitchell concluded by expressing the urgent need for the Caribbean Marine Atlas. He expected that the workshop will lead to the expansion of near shore data, further identification of resources, help in the decision making process of marine protected areas design and policy guidance, and development of better coastal zone policies. Mr Mitchell further called for support in data collection (methodology and equipment), data management, data dissemination and online data/information services.

## 2.4 Jamaica

The presentation was given by Mr Sean Green. He explained that for Jamaica the following priorities could be identified:

- (i) Degradation of natural resources
  - Beach Erosion
  - Sand Mining
  - Conversion of mangrove areas into other uses
  - Landfill or reclamation of foreshore areas
  - Coral reef deterioration
  - Loss of sea grass beds
- (ii) Over-exploitation of fisheries resources
  - Over fishing
  - Dynamite fishing
  - Inappropriate fishing methods
- (iii) Declining water quality and pollution
  - Industrial sources (industrial liquid and solid waste)

- Domestic sources (household liquid and solid waste)
  - Upland deforestation
  - Other sources (dredging activities, shipping)
  - Increased surface run-off from paved areas
  - Agricultural sources (pesticide and fertilizer run-off)
- (iv) Land use conflicts
- Absence of access to foreshore lands, due to human settlements encroachment
  - Poor positioning of structures within the coastal areas, e.g. jetties, groynes, buildings
  - Unplanned developments e.g. squatting
- (v) Water use conflicts
- User conflicts among different groups (swimmers, boaters, divers, fishermen, offshore oil exploration)
- (vi) Destruction of life and property by natural hazards
- Flooding due to tropical storms
  - Loss of property due to hurricanes and natural disasters

Mr Green explained that in order to deal with ICAM, Jamaica has established a “National Oceans Council” which involves several sectors. Several projects related to ICAM have been implemented such as CWIP, Ridge to Reef and the GEF IWCAM project. The National Environment & Planning Agency (NEPA) has adapted an ecosystem approach by the establishing a Integrated Watershed and Coastal Zone Management Branch. Agencies involved in ICAM include the Ministry of Health and Environment, NEPA, the University of the West Indies as well as other agencies such as The Nature Conservancy (TNC).

In terms of data requirements and availability Mr Green identified the need for data related to: land use and cover, coastal sensitivity, water quality, hydrological, climate, **oceanographic conditions, near shore bathymetry**, coastal ecosystems, existing and proposed plans and projects, and updated **Satellite images with complete coastal area coverage** (most important in bold).

It was noted that there is currently no systematic monitoring. Data are obtained from other institutions. There is a lack of data management expertise and no web-based products are developed.

In conclusion Mr Green identified the following expectations related to the Caribbean Marine Atlas:

- maps of coastal resources,
- shoreline classification and zoning of the coast
- coastal terrestrial mapping
- coastal erosion indexing
- foreshore and benthic mapping
- coastal erosion and sediment dynamics study
- ecological sensitivity mapping

- the production of a Coastal Zone Management Zoning maps at the macro and micro levels
- the training of individuals in coastal zone management, remote sensing and GIS
- A computerized database and GIS responsive to the needs of the programme.

## 2.5 Saint Lucia

The presentation was given by Ms Sarita Williams. She explained that St Lucia has a population of 166,312 on an area of 640 sq km. St Lucia has a coast line of 158 km. The country's rugged interior has led to a high demand for the comparatively low lying coastal lands for commercial, housing and infrastructural developments. The economy depends on coastal resources especially for human settlements, fisheries and more recently for tourism.

Ms Williams summarized the marine and coastal issues as follows:

- (i) Natural resources: Biodiversity
  - Loss of key species (Loss of higher carnivorous reef fish)
  - Declining habitat diversity (declining wetlands)
  - Loss of ingenious species
  - Introduction of exotic species (e.g. Tilapia fish)
- (ii) Natural resources: Water Resources
  - Degradation of watersheds
  - Heavy sedimentation and contamination
- (iii) Productive Sector: Fisheries Sector
  - Over fishing of some fish species (e.g. sea urchins)
  - Destructive fishing practices
  - Loss of fishing grounds due to conflicting uses (e.g. Tourism development)
  - Degradation and loss of fishing, nursery and spawning grounds due to:
    - Storms
    - Land based pollution
    - Poorly monitored development
- (iv) Productive Sector: Industry
  - Waste water discharge (534,500 cm<sup>3</sup> annually)
- (v) Productive Sector: Tourism
  - Cruise ships and yachts generated waste (ill-equipped adequately to deal with collection and disposal of cruise ship and yachts generated waste)
  - Reduced focus on natural carrying capacities or limits of acceptable change
  - Conflicts among coastal resource users and pressure on the resource. (SMMA ; diving and snorkelling)
- (vi) Productive Sector: Agriculture
  - Introduction of agrochemicals into waterways and coastal water
  - Loss of soil leading to high levels of sediment in rivers and coastal water
  - Contribution to solid waste (e.g. pesticide bottles)

- (vii) Productive Sector: Sand Mining
  - Permit system
  - Easy access to this resource has led to illegal sand mining
  - Degradation to the shoreline
  - Loss of nesting grounds for iguana and sea turtles
  - Degradation to river and nearshore systems due to sedimentation
  
- (viii) Physical development: Built environment
  - Unplanned and poorly controlled development
    - Lack of appropriate facilities to cater adequately to sewage (including greywater) treatment
    - Vulnerability increased to landslides, floods and storm surge impacts
    - Shoreline erosion (inappropriate setbacks, inappropriate sited structures along coast line and degradation of natural wave breakers.
  - E.g. North of island highly built - >50% of population inhabit; inadequate utilities to service the region resulted severe degradation of supporting coastal systems. (coral reefs, seagrass beds, mangroves, beaches, wetlands, rivers, watershed areas)
  
- (ix) Physical development: Ports and Marinas
  - Excavation and dredging of wetland (e.g. Rodney Bay Marina)
  - Lack of facilities for collection or pump out of sewage from yachts
  - High levels of faecal coliform concentrations (Min. of Health, 1989 – 1992)

Ms Williams then proceeded to inform the workshop that 26 Marine Protected Areas were established mainly to conserve and protect areas such as turtle nesting sites and fish nursery and breeding grounds. Unfortunately they have a low enforcement capacity due to the remoteness of the areas, privately owned land, and no legal demarcation of reserves. In terms of data collection and management she noted that insufficient priority is given to collection and management of relevant data. This results in a lack of information regarding coastal processes in the environment to make informed planning and management decisions.

In order to address these issues Ms Williams identified the need for awareness, education and sensitization and for data collection and data management systems. There is also an urgent need for a coastal zone management policy and institutional framework.

She listed the following data needs:

- Coral reefs
- Nutrient levels at all major bays, ports and harbours (currently only 5 are monitored)
- Sedimentation rates, water clarity and salinity (currently only done at SMMA)
- Temperature
- Trends in water quality (sea level rise impact on water quality, ballast water studies)
- GIS maps of fishing grounds
- Fish stock assessment with reference to temperature changes

Ms Williams concluded by identifying the following expectations regarding the Caribbean Marine Atlas:

- Easy Access to information that will filter into the decision making process
- Ability to make informed decisions
- Improve management strategies
- Promote easy sharing of information (national, regional and international scale)
- Aid gap assessment
- Determine management effectiveness

## 2.6 Trinidad and Tobago

The presentation was given by Ms Sandra Timothy. She started by stating that Trinidad and Tobago is considered to be the most prosperous of the Caribbean Islands, mainly due to its oil and natural gas exploration. The country has a coastline of 705 km (546 for Trinidad and 159 for Tobago). The coastal areas support life systems, contribute to the economy, provide recreational and aesthetic value. Sixty per cent of small scale economic activities significant for the support of human lives are located within coastal areas. The West Coast is heavily developed due to port needs. Approximately 50% of the country's national transportation arteries (roads, bridges etc) are also located there.

Ms Timothy then listed the following environmental/development issues that were sited at the Environmental Compendium held in Trinidad in September 2007:

- Modification of Hydrological Regime
  - Paving of waterways, channel realignment, diversion of watercourses, location of residential (housing) settlements and over-pumping of aquifers.
- Discharge of Chemicals (not in Tobago)
  - Contamination from petroleum hydrocarbon and heavy metals – East Coast less contaminated than the West Coast
- Degradation watersheds
  - Increase in watershed infiltration - indiscriminate cutting of trees, forest fires, inappropriate farming on hillsides, planned and unplanned housing development
  - 50% of wetlands in Trinidad and Tobago have been lost (National Wetland Policy, 2002)
  - Increase in loss of coral reef and coastal areas
- Impact from surrounding Channel
  - High sediment discharge from the rivers on the South American mainland into the south coast causing siltation

Sector activities include Tourism (approx. 90% of the tourist facilities and hotel rooms are located in the coastal areas), Fisheries (Coastal areas account for about 90% of annual fish production), and Forestry, Town and Country planning (there is a national physical development plan).

Ms Timothy further reported that there is an Institute of Marine Affairs which deals with the management and conservation of marine resources. It further deals with Coastal zones, inland waterways and rivers, near-shore waters, Exclusive Economic Zone (EEZ): Fisheries and Aquaculture; Environmental Research; Legal Research; Marine Chemistry; Technical Advisory. It carries out chemical/biological studies (no monitoring) as well as physical studies (including client oriented projects); large component of this is monitoring. In addition, there is an Environment Management Agency which deals with international protocols/conventions for the environment falls under the EMA (e.g. Montreal Protocol, Basel Convention, Convention on Biodiversity, Convention on Biosafety, UN Convention on Climate Change, Kyoto Protocol, Vienna Convention for Ozone). It also deals with Research, Education, Emergency response and it is the major monitoring agency of the environment (Noise, Air Water, Waste, Climate change etc). There is also the Tobago House of Assembly which provides parallel services for Tobago. Finally there are a number of NGOs involved in environmental management issues.

Ms Timothy informed the workshop that some level of assessment and monitoring is done among agencies within government, along with some NGOs and CBOs. In the past assessment was done based on impact- response. At present, proactive assessment and monitoring is being done. Each Ministry/Division use assessment and monitoring tools suitable to their needs: no standardized assessment tool is used across ministries. Some level of sectoral integration exists. She identified the following constraints related to assessment and monitoring:

- Shortage of technical staff to build data source
- Commitment of technical staff
- Limited data sharing among agencies
- Vending of information within government
- Data format sometimes not compatible for immediate use
- Lack of a central pool for information sharing among Ministries
- Slow process to using an integrated approach to decision making
- “Raw” data exist but these need to be GIS compatible

Ms Timothy noted that a number of measures have been taken to address the issues relating to the environment: legislation and laws have been developed to protect the Environment to include: Water Pollution Rules, Land-Use Plan EIAs, Integrating Watershed and Coastal Areas Management, Compendium of Environmental Statistics, Public Health, Air Pollution, Plant and Wild Life Protection; along with several others.

## **2.7 Turks and Caicos**

The presentation was given by Mr Luc Clerveaux. He started by informing the workshop that the Turks and Caicos Islands are an archipelago composed of 40 islands with a total area of 986 km<sup>2</sup>. There are 33 protected areas covering 793 km<sup>2</sup>. The human population numbers 33,202 (2006 estimate). The economy is based on tourism, offshore banking, transport and storage, communication, real estate, construction and fishing. 100% of the population lives in the coastal area. Ecosystems include coral reefs, mangroves and wetlands, beach/dune systems. There are no rivers or streams but fragile fresh water lenses. There are dry tropical forests, poor soils and karstic limestone features.

The country is characterized by limited manpower resources. Data cannot be collected effectively: there are only 3 scientific officers, 1 environmental engineer and 1 environmental officers

to collect data in the 33 protected areas. Therefore large areas remain unstudied and there is limited monitoring. The human population expands rapidly and moves into areas that are prone to flooding. Often foreign contractors are hired who are not familiar with the laws of the country.

Mr Clerveaux reported that a number of measures have been taken to address issues:

- A 10 year development plan implemented;
- Laws are currently being updated to deal with development issues;
- TCInvest (Turks and Caicos Investment agency);
- EIA's for developments (often affected by politics);
- Pollution task force in place to monitor Coastal Pollution;
- Development monitoring- each development has a set TOR developed in conjunction by the Department Of Planning (DOP) and the Department of Environment and Coastal Resources (DECR) which details the way the development should proceed;
- Coral reef monitoring- wide scale rapid assessments, intensive long term monitoring occurring. Utilizing a variety of methods and parameters. Draft Coral Reef monitoring strategy in legislation.
- Coastal Water Quality Monitoring
- Mangrove monitoring- CARICOMP methodology.
- Seagrass monitoring – CARICOMP methodology .
- On other less developed islands – habitat mapping in response to development pressures.
- Individual Marinas – water quality monitoring for Blue Flag Certification.
- Fisheries stock assessments
- Monitoring of harvested marine products
- Development of National Environmental standards- EIA requirements (draft).
- Wildlife Protection Ordinance (draft)

The following agency departments are involved from the Ministry of Natural Resources:

- Department of Environment and Coastal Resources
- Protected Areas
- Fisheries
- Department of Economic Planning and Statistics
- Turks and Caicos National Trust
- Department of Planning
- Environmental Health Department

Mr Clerveaux concluded by identifying the following expected outcome regarding the Caribbean Marine Atlas:

- Support the Caribbean Atlas
- Hope to obtain Better Data collection Methods
- Better Data Management
- Better Planning Techniques for future
- Better monitoring capabilities

### **3. SMALL ISLAND DEVELOPING STATES: CHARACTERISTICS, COASTAL/MARINE ISSUES AND APPROACHES TO ADDRESSING THEM**

This item was introduced by Dr Sherry Heilaman. She explained that Small Island Developing States (SIDS) possess a number of geophysical, ecological, and socio-economic characteristics that make them highly vulnerable to external shocks, and which have important implications for their sustainable development. This is recognized in a number of international frameworks (e.g. Barbados Programme of Action for Sustainable Development of SIDS, WSSD JPOI).

- Geophysical features include: small land masses, high ratio of coastline and EEZ to land area (therefore the entire island could be considered the coastal zone); inland influences being very strong in coastal areas; and high exposure to natural hazards.
- Ecological features include: Include fragile ecosystems; high degree of endemism; small populations of living resources.
- Socio-economic features include: Include narrow natural resource base; limited opportunities for land-based development; high dependence on coastal and marine areas and resources for economic development, food security, employment; population, economic activities and infrastructure concentration in the coastal zones; relatively high poverty levels; and limited human resources.

The Environmental Vulnerability Index (developed by the South Pacific Applied Geoscience Commission - SOPAC, UNEP and partners) showed the most environmentally vulnerable countries are SIDS. Coastal areas are particularly vulnerable to external perturbations.

#### Major environmental issues in SIDS coastal and marine areas

Major environmental problems in coastal areas include: Degradation of coastal habitats; overexploitation of living resources; pollution (land-based and marine-based); natural hazards (sea level rise, extreme climatic events). This was confirmed in the country presentations given earlier in the workshop. While these problems are also experienced in other countries, they are particularly acute in SIDS, which have limited resistance and resilience to recover from these perturbations. Further, these problems could be experienced throughout the island, since the entire island could be considered a coastal zone because of the small land masses.

#### Approaches to addressing problems in coastal and marine areas

These include sectoral approaches (traditionally used); Ecosystem-based approaches, which have been used in a number of projects in the region (e.g. LME 5-module approach, adopted by the CLME project; FAO/Lesser Antilles Pelagic Ecosystem project; Global International Waters Assessment; ICAM).

Because of the convergence in the coastal zone of a multitude of human pressures from both sea and land based origins, as well as from natural phenomena, an integrated, multisectoral

approach is required for effective management and sustainable development of these areas. Among these are Integrated Coastal Area Management (ICAM) and its variants (ICOM, IWCAM), which are increasingly being adopted.

### Integrated Coastal Area Management

(Partly based on IOC handbook on ICOM indicators):

- ICAM definition, concepts, goals, objectives and functions.
- Steps in the ICAM/ICOM process.
- Conceptual frameworks for evaluation of ICAM programme (e.g. Driving force –Pressure – State – Impact – Response (DPSIR)), and associated indicators.

### Data and information needs

Underpinning an effective ICAM programme is credible and timely data and information, which are needed for informed decision-making. Specifically, data and information are needed for:

- Environmental assessment and diagnosis of problems in coastal and marine areas.
- Development of ICAM strategies and plans.
- Monitoring and evaluation of ICAM progress.
- Adaptive management.

Requirements include spatio-temporal multivariate data series, and an efficient information infrastructure that capitalizes on appropriate technologies for data acquisition, integration, dissemination and analysis. A system of indicators and supporting data and information to compile the indicators are an important feature of an efficient information system.

### Conceptual framework for monitoring and evaluation

The DPSIR framework and its variants were described, and are convenient approaches to analyze linkages among socioeconomic trends, ecological phenomena and institutional responses. The use of indicators within such a framework is a useful tool for assessment, monitoring and evaluation of the state of the coastal environment and of ICAM programmes. The use of indicators in ICAM was discussed, and the three types of indicators (Governance, Ecological, Socio-economic) presented.

### Data and information situation in Caribbean SIDS

As described in the country presentations, a number of constraints regarding data and information in the region are a major impediment to effective ICAM. These include:

- Limited work on indicators.
- No standard protocols and format for data collection and storage.
- Limited time series; spatial and temporal gaps.
- Data scattered among a number of agencies.
- Data not easily accessible.
- Limited use of data and information tools.

A marine atlas for the Caribbean could help to address some of these constraints and is urgently required for the region.

## 4. THE MARINE ATLAS

### 4.1 Demonstration of the African Marine Atlas

Mr Reed introduced this agenda item. He explained that the African Marine Atlas (AMA) is a web-based atlas that contains a collection of maps, supplementary tables, illustrations and information describing the African marine environment. AMA provides interactive map capabilities including (as shown in Figure 1):

- variable map size (small, medium, large)
- GIS-type tools such as zoom in/out, pan, attribute data.
- selectable background layers including bathymetry, topography, land cover, sediment thickness, ocean temperature, ocean salinity, chlorophyll, air temperature, clouds.
- selectable raster and vector layers including coastlines, geohazards, ocean currents, country and maritime boundaries, fishing areas and catches, coral reefs, ports, sea level stations.

He explained that a web atlas contains a collection of: Maps, Supplementary tables, Illustrations and Information. The AMA web atlas provides interactive map capabilities.



Figure 1: Interactive Map Features AMA

He then proceeded with an online demonstration of the African Marine Atlas (<http://www.africanmarineatlas.net>). The African Marine Atlas initial view display the map of Africa without any data layers. The African Marine Atlas project prepared over 800 data layers but of these currently only about 90 layers are available. They are available as vector or raster images as “layers” or “background”.



Figure 2: African Marine Atlas initial view

These images show AVHRR land cover raster layer, a combination of seasonal chlorophyll and EEZ boundaries. It is also possible to zoom in (lower image):

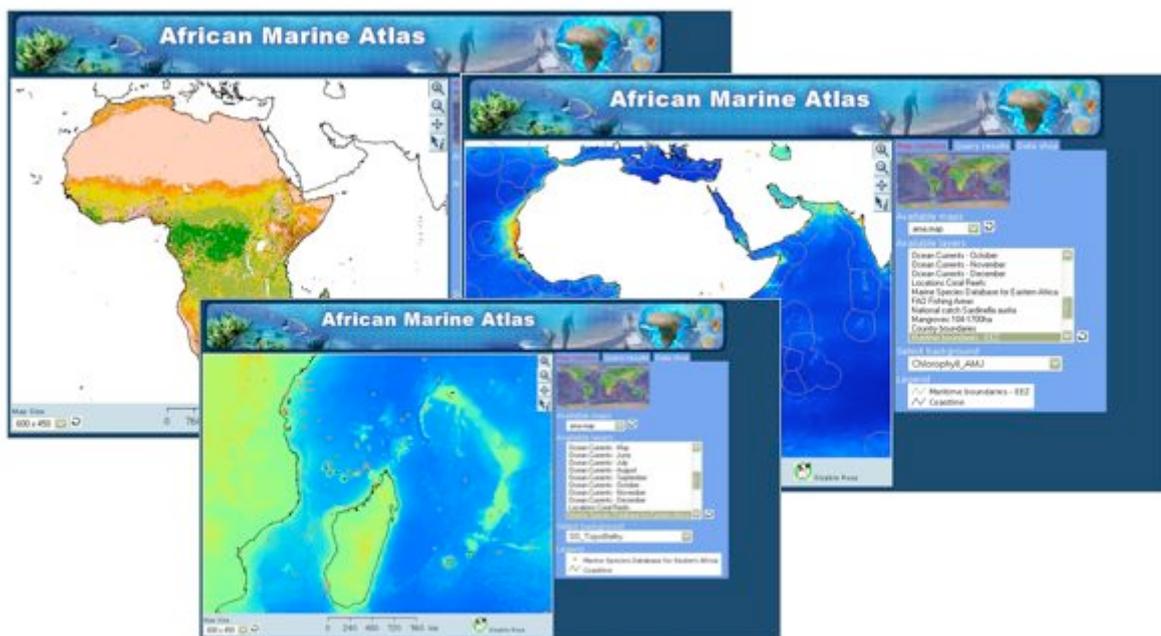


Fig 3: AMA displays

Another interesting feature is the possibility to display the specific values (query result) for a feature of the layer. Below you can see an example for a data sample from MASDEA (Marine Species Database for Eastern Africa) showing an occurrence of a species in that particular geographic location.



Figure 4: query result display

Mr Reed further explained that the AMA is based on the open source MapServer (<http://mapserver.gis.umn.edu/>) application, an open source web mapping application. It can be installed on web servers or stand-alone systems running Linux, Mac or Windows operating systems.

He noted further that MapServer based mapping applications do not offer a full range of features provided with GIS software. However the AMA offers the possibility to download the data layers that can then be imported into a GIS application. He also pointed out that the AMA data layers can be served from a local host or from a remote server. The AMA application includes layers that are served from the AMA host server (based in Oostende, Belgium) as well as layers available remotely through Web Mapping Services (WMS).

## 4.2 Atlas Development

### 4.2.1 The conceptual model

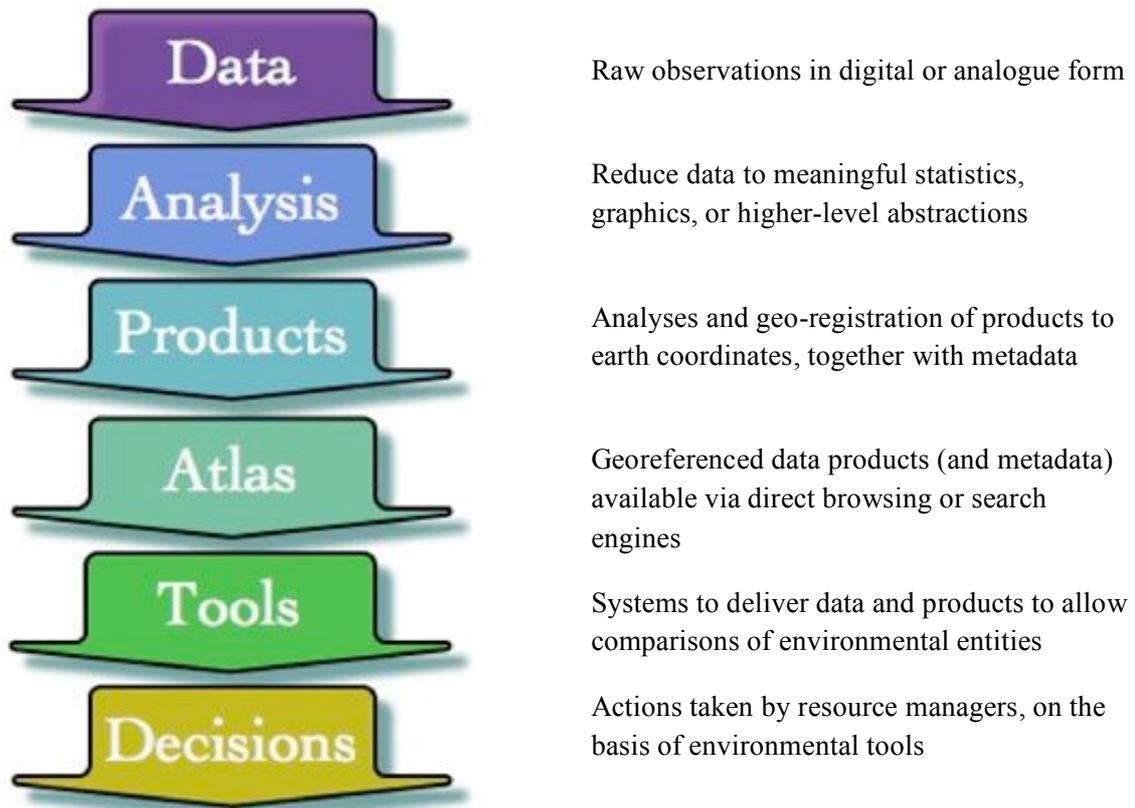


Figure 5: Atlas conceptual model

### 4.2.2 Defining the purpose and needs

This item was introduced by Mr Greg Reed. He explained that a coastal web atlas is a collection of digital maps, datasets, illustrations and information. It is a decision support tool accessible via the internet. Before commencing the development of a marine atlas it is important to identify clear goals and to identify how these goals can be achieved.

He identified the following questions that need to be asked during the Atlas development process (*Reference: Report on Coastal Mapping & Informatics Trans-Atlantic Workshop, 2006*) :

1. **What is the purpose of the atlas?**
  - e.g. educational resource or a tool for coastal managers?
2. **Who is the atlas audience?**
  - e.g. general public or professionals?
3. **What are their skills?**
  - e.g. basic web experience or GIS expertise?
4. **What spatial data will it contain?**

- e.g 20 static layers or 200+ changing layers and expanding list?
- 5. **Are there opportunities for data sharing?**
  - e.g sharing data via a distributed system, all data stored locally or a combination?
- 6. **What functionality is necessary?**
  - e.g simple identify feature tool or more complex spatial analysis?
- 7. **What additional information will be included?**
  - e.g searchable metadata, topical descriptions, images, charts?
- 8. **Which software should be used?**
  - e.g off the shelf or Open Source software?
- 9. **What operating system should be used?**
  - e.g Microsoft or Linux server?
- 10. **What technical and data standards should be met?**
  - e.g Open Geospatial Consortium, metadata standards?
- 11. **What resources are available for development?**
  - e.g programmer, GIS specialist or science writer?
- 12. **How should the web site and navigation be organised?**
  - e.g focus on the interactive map or the text topics?
- 13. **How will the content be managed?**
  - e.g manual updates or a database management system?
- 14. **How should data be searched?**
  - e.g search metadata by parameters, search data attribute tables?
- 15. **How will the atlas be backed up?**
  - e.g manual or automatic backup system?
- 16. **Is the design scalable and flexible?**
  - e.g ability to handle more layers and changing technology?
- 17. **What institutional / financial support is available?**
  - e.g single/multiple development grants or committed institutional funding?

### 4.2.3 Atlas Features

Mr Reed explained that the standard features of the Atlas should include:

- Map display
  - Interactive (zoom, query features)
  - Overview map
  - Scale bar, Geographic coordinates
- Data display
  - Vector and raster data
  - User control (turn on/off layers)
  - One or multiple layers can viewed
- Atlas tools
  - Zoom to defined area of interest
  - Search for specific datasets
  - Advanced queries
- Layer list
  - User control of layers
- Attribute data

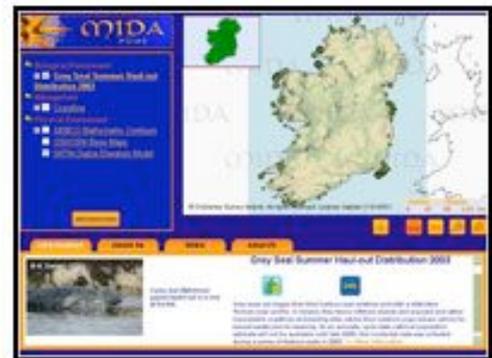
- Identify tool
- Table results (pop-up?)
- Metadata
  - Crucial component
  - Use metadata standard
  - Display basic or advanced metadata
- Information
  - Descriptions of topics and issues
  - Links to key web sites, organizations, documents
  - Resources (coastal management, education, tourism, etc)

#### 4.2.4 Atlas examples

##### **The Marine Irish Digital Atlas** (Fig 6, right)

- Resource for coastal and inshore marine areas of Ireland
- Makes available maps, data and information on coastal themes
- Searchable metadata and web GIS

URL: <http://mida.ucc.ie/>



##### **De Kustatlas** (Fig 7, right)

- Facilitates communication and awareness-raising
- Provides a contact point for coastal information
- Integrates planning and coastal policy

URL: <http://www.kustatlas.be>



##### **Oregon Coastal Atlas** (Fig 8, right)

- Information on different coastal systems
- Interactive mapping, direct search and download, spatial analysis tools
- Provide a decision-making resource

URL: <http://www.coastalatlus.net/>



##### **African Marine Atlas** (Fig 9, right)

- Provides easily downloadable data on various key themes relevant to the marine and coastal environment of Africa
- Maps, images, data
- Data search and download + dynamic web mapping

URL: <http://www.africanmarineatlas.net>



Regarding the African Marine Atlas Mr Reed explained that the Atlas includes geospatial data (vector and raster geographically referenced data and imagery), non-geospatial data (non-geographically references data sets such as photos and text) and metadata (metadata descriptions for all geospatial data including source URLs for data downloaded from the Internet).

#### 4.2.5 Atlas Development Steps

Mr Reed identified the following steps leading to the Atlas:

- Identify geographic Area of Interest (AOI) for the Atlas
- Agree the topic outline
- Gather available data according to the scope of topics, geographic limits and temporal considerations
- Describe metadata and source location URLs
- Review gridded datasets for data value ranges to set standard image legend parameters
- Convert all data to appropriate GIS formats
  - Shapefiles for vector data
  - ASCII ArcGrids for gridded data and satellite imagery
  - Geo-referenced images to accompany most arrays
- Clip all GIS files to the AOI
- Convert data to required products (e.g. seasonal climatological grids/contours)
- Convert these products to the correct GIS formats
- Create a browser interface to the GIS files, with links to the metadata files and source location URLs
- Publish the atlas on the Internet with a browser interface using static HTML pages
- Publish the atlas as an interactive Map Service
- Publish the browser-based atlas on DVD for dissemination to marine and coastal scientists
- Produce a hardcopy publication

#### 4.2.6 Atlas data themes

The following data themes can be identified:

- Geosphere. Including geohazards, minerals, sediments, soils and land cover
- Hydrosphere. Including physical oceanography, chemical oceanography, optical oceanography, limnology
- Biosphere. Including biological oceanography, marine and terrestrial botany, fisheries, zoology, protected areas
- Atmosphere. Including climate, weather, air quality
- Human Environment. Including geopolitical aspects, population, infrastructure, industry and commerce, tourism
- Base Maps. A comprehensive set of base maps and geo-referenced images

Design and usability are keys to the success of the Atlas. and a SWOT (strengths, weaknesses, opportunities and threats) analysis is a useful step in developing a marine atlas. (See Fig 10)

STRENGTHS	WEAKNESSES
1. <b>Standards and specifications</b> are maturing and gaining wide acceptance.	1. <b>Metadata is often inadequate</b> , inaccurate, out of date or non-existent.
2. International and national <b>regulations are driving the need</b> for data and encouraging their availability.	2. <b>Data management is difficult</b> due to the large quantities of data, difficult-to-support formats and multiple copies.
3. Academic institutions and research organizations can take advantage of <b>emerging technologies</b> to design innovative products.	3. <b>Data access limitations</b> , licensing and desire to recoup costs are restrictive.
4. Development of a <b>coastal atlas can aid in collaboration</b> between institutions and sharing of methods.	4. There are <b>limitations in the ability to display</b> certain data types and to perform <b>data analysis</b> .
THREATS	OPPORTUNITIES
1. The <b>Google Earth paradigm</b> challenges atlas developers to meet design expectations of users.	1. <b>Community building and collaboration</b> can leverage the expertise of atlas developers.
2. <b>Data policies and IPR</b> impair accessibility and re-use of data.	2. <b>e-Gov and SDI initiatives</b> are helping to increase interest in Coastal Atlases among policy makers and regulators.
3. <b>Erratic funding</b> affects the ability to develop and maintain atlases and leads to staff turnover issues.	3. Atlases enable <b>identification of data gaps</b> and provide the ability to <b>pull resources together</b> to fill gaps and improve data.
4. <b>Credibility</b> : Atlases may not meet actual user needs and expectations; data quality may be poor; changing technologies may be disruptive.	4. Use of <b>emerging technologies</b> , including Open Source and OGC standards, enhance data sharing, presentation and online analysis.

Fig 10 : SWOT analysis of marine atlas

(Adapted from: *Report on Coastal Mapping & Informatics Trans-Atlantic Workshop, 2006*)

Finally, Mr Reed stated that the African Marine Atlas will continue to be augmented with new datasets and this will require discovery of new datasets and conversion to GIS formats. A new interface will be designed to incorporate the current static and dynamic mapping sites. Maintenance is essential to ensure the Atlas remains current and is accepted by the community as a valuable planning tool.

## 5. ENVIRONMENTAL PRIORITY ISSUES IN THE CARIBBEAN REGION

### 5.1 Analysis of issues and availability of data by country

The regional participants were invited to fill a questionnaire that would assist in identifying priority issues, related indicators and data availability, in order to determine focus for data mining. It is noted that the data for the surveys were provided by the participating national experts and should be considered as a first and rough assessment. They should not be considered as final.

#### **Guiding questions:**

- What are the priority environmental issues and/or the statistical topics in your country?
- What are some of the statistical variables/indicators that reflect each of these issues/topics?
- Which indicators exist in your country?
- Are the data readily available for the selected indicators?
- Who are the main data owners for the selected indicators?

- Does the proposed list of environmental indicators fully reflect these priority issues?
- Are there priority indicators for your country, which are not included in the list?

**EXERCISE 1: Identity priority issues by country**

Highest priority



Medium priority



Low priority



Priority concerns	Specific issues	Countries							weight
		Barbados	Cuba	Grenada	Jamaica	St. Lucia	Trinidad & Tobago	Turks & Caicos	
Habitat degradation/loss	Coral reefs	R	R	N	N	N	R	R	21
	Mangroves	R	N	N	N	N	N	N	16
	Seagrass	1N	2N	1L	1N	1N	1L	3L	18
	Beaches	1R	1R	1N	1N	1N	2N	2R	19
	Forests	2N	2L	1N	1N	2N	2N	2R	16
Unsustainable exploitation of natural resources	Overfishing	1R	2N	1N	1N	1N,R	1R	1R	20
	Sandmining	2N		1N	2N	1N	2L	2N	14
	Destructive fishing				2N,L	2L		1N	7
Pollution	Sediments (turbidity)	1R	3L	1L	1N	1N	2L	2N	17
	Sewage pollution (coliform)	1R	3L	1L	1N	1N	1N	1R	19
	Agrochemicals	1R	3L	2N	1N	1N	3L	2R	15
	Oil	2N	3L	3L	2N	3R	2L	2N	11
	Heavy metals	2L	3L	3L	3L	3R	2N	2R	10
	Nitrates/nitrites	1R	2L	1L	1N	1N	1L	2N	19
	Solid waste	1R	3L	2L	1N	1N	1N	1R	18
	BOD/COD	1L	3L	1L	1N	1N	2N	2R	17
Runoff (storm, grey water)			1N	1N	1N	1N	2N	14	
Natural hazards	Hurricanes	1R	1R	1R	1R	1N	2R	1R	20
	Tsunamis	2R	3N	1R	1R	3R	3R	1R	14
	Sea level rise	1R	1L	1R	1R	1N	2R	1R	20
	Volcano			1R					3
	Flooding	2N	1N		1L	1L	2L	2N	15
	Earthquakes					1L	3N		5

Table 1: Order of priority of issues Scale of concern is local (L), national (N), regional (R).

**Ranked list of priorities for the entire region: (number indicates weight)**

1. Coral Reefs (21)
2. Overfishing, Hurricanes, Sea Level Rise (20)
3. Beaches, Sewage pollution, Nitrates/Nitrites (19)
4. Seagrass, Solid waste (18)
5. Sediments, COD/BOD (17)
6. Mangroves, Forests (16)
7. Agrochemicals, Flooding (15)

8. Sandmining, Runoff, Tsunamis (14)
9. Destructive fishing, oil, heavy metals, volcano, earthquakes (<12)

**Priority concerns by country:**

- **Barbados:** coral reefs, seagrass, beaches, overfishing, sewage pollution, nitrates/nitrites, solid waste, hurricanes, sea level rise
- **Cuba:** coral reefs, beaches, hurricanes, sea level rise
- **Grenada:** coral reefs, seagrass, beaches, overfishing, sewage pollution, nitrates/nitrites, hurricanes, sea level rise
- **Jamaica:** coral reefs, seagrass, beaches, overfishing, sewage pollution, nitrates/nitrites, solid waste, hurricanes, sea level rise
- **St. Lucia:** coral reefs, seagrass, beaches, overfishing, sewage pollution, nitrates/nitrites, solid waste, hurricanes, sea level rise
- **Trinidad & Tobago:** coral reefs, seagrass, overfishing, sewage pollution, nitrates/nitrites, solid waste
- **Turks and Caicos:** coral reefs, overfishing, sewage pollution, sold waste, hurricanes, sea level rise

The participants concluded that the top priorities in the region are degradation of coral reefs, seagrass beds and beaches, overfishing, hurricanes, sea level rise, sewage pollution, nitrates/nitrites, and sold waste. However the participants stated that the atlas, at the national level, could equally focus on national priorities.

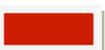
**EXERCISE 2: Issue and Indicator analysis by country**

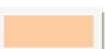
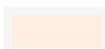
<p><b>Codes :</b></p> <p><b>Column : 3</b>  <b>Q. 2. : Unit of measurement</b>          1 - percentage          2 - tonnes          3 - unit catch by fuel consump.          4 - litre          5 - m<sup>3</sup>          6 - ha          7 - m          8 - No. of persons/km<sup>2</sup>          9 - mg O<sub>2</sub> per liter          10 - No. of parts per unit          11 - No. of people infected          12 - kW/Hour          13 - m<sup>3</sup> per person          14 - frequency          15 - kg per capita          16 - mg/m<sup>3</sup></p>	<p><b>Column : 4</b>  <b>Q. 3 : Data availability</b>          1 - Available          2 - Partially available          3 - Not available</p> <p><b>Column : 5</b>  <b>Q. 4 : Source of data</b>          1 - Fisheries Dept.          2 - Coastal Zone Dept.          3 - Lands &amp; Surveys          4 - Forestry Dept.          5 - CARICOMP          6 - UWICED          7 - CFRAMP          8 - Min. of Agriculture          9 - Planning Dept.          10 - National Disaster office          11 - Statistical office          12 - Appropriate Min./Agency          13 - Research Institute          14 - Monitoring stations          15 - Private          16 - N.G.O.</p>	<p><b>Column : 6</b>  <b>Q. 5 : Method of data collection</b>          1 - Surveys/census          2 - GIS          3 - Monitoring          4 - Remote sensing          5 - Admin. Records          6 - Ad-hoc surveys          7 - Research papers</p> <p><b>Column : 7</b>  <b>Q. 6 : Data Coverage</b>          1 - National          2 - Sub-national          3 - Urban          4 - Rural          5 - Regional          6 - Other</p>	<p><b>Column : 8</b>  <b>Q. 7 : Periodicity</b>          1 - Annual          2 - Biannual          3 - Monthly          4 - Weekly          5 - Daily          6 - Ad-hoc/one time          7 - Seasonally          8 - (5-10) year period          9 - varies          10 - Quarterly          11 - Periodically          12 - Hourly</p> <p><b>Column : 9</b>  <b>Q. 8 : Quality</b>          1 - Good          2 - Poor          3 - Varies</p>	<p><b>Column : 10</b>  <b>Q. 9. : Relevancy</b>          1 - Crucial          2 - Important          3 - Potentially important          4 - Marginally important</p> <p><b>Column : 11</b>  <b>Q.10 If data not available.</b>          1- Feasible and cost-effective          2 - Feasible and not cost effective          3 - Varies          4-Feasible</p>
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CARICOMP: Caribbean Coastal Marine Productivity Program  
 UWICED: University of West Indies Centre for Environment and Development  
 CFRAMP: CARICOM Fisheries Resource Assessment and Management

Figure 11: Codelist for indicator analysis by country (based upon a similar exercise conducted at the UNSD/CARICOM workshop on environmental statistics, Belize, 2000)

Col. 4: Availability of data:  available  partially available  not available

Col. 9: Quality:  good  poor  varies

Col.10: Relevance  crucial  important  potentially important

**BARBADOS**

1	2	3	4	5	6	7	8	9	10	11
Issue	Indicator	Unit of measurement	Availability of data	Source of data	Method of collection	Data coverage	Periodicity of data collection	Quality of data	Relevance of indicator	Data not available
Habitat	Protected marine areas	6, 1	1	2	2	1	9	1	3	
	Loss of coral reefs	6, 1	1	2	2, 1	1	8	1	1	
	Loss of mangroves	6	1	2	2, 1	1	9	1	3	
	Loss of seagrass beds	6, 1	2	2	2, 1	1	9	1	2	
	Beach erosion	7	1	2	1, 2	1	10	1	1	
	Beach encroachment		1	2, 3, 9	2, 1	1	9	3	1	
	Biodiversity	14	2	2, 12, 13	1, 3	1	Marine 6, 8, 9 Other 9	3	1	
	Forest cover	6	2	2, 3, 12	2	1	9	1	3	
Unsustainable exploitation of natural resources	Fish landings	2	1	1	3, 6	1	5	1	1	
	Fishing effort	3	1	1	3	1	3	1	1	
Natural hazards	Frequency	14	1	12	5	1	9	1	2	
	Sea level rise	7	2	2, 12, 13	3	1	5	3	1	
	Human losses		1	10, 11, 12	5	1	1	1	2	
	Economic losses		1	10, 11, 12	5	1	1	1	2	
Human environment	Population in coastal zone	8	1	2, 9, 11	1, 2	1	8	3	2	
	Hotels	14	1	11, 12	1	1	1	1	2	
	Coastal urbanization	1	1	2, 3, 9, 11	1, 2	1	9	1	2	

Table 2: Issue and Indicator analysis for Barbados

**Conclusions:**

- Out of the 17 indicators, data are fully available for 13 (76%), and the quality of the data is considered as good;
- Sea level: 1 gauge available
- For 4 indicators, data are available partially and their quality is between good and variable;

- Out of the 7 crucial indicators, for 5 of these, data are fully available, and for 4 out of these, data are of good quality;
- For none of the indicators, for which data are available, is the data quality poor

## CUBA

1	2	3	4	5	6	7	8	9	10	11
Issue	Indicator	Unit of measurement	Availability of data	Source of data	Method of collection	Data coverage	Periodicity of data collection	Quality of data	Relevance of indicator	Data not available
Habitat	Protected marine areas	10	1	SNAP National System for Protecting Areas	2	1	6	1	2	4
	Loss of coral reefs	6	2	13 & 14	3	2	1	1	2	1
	Loss of mangroves	6	2	13 & 14	3	2	1	1	2	1
	Loss of seagrass beds	6	2	13 & 14	3	2	1	1	2	1
	Beach erosion	7	2	13 & 14	3	2	2	1	1	1
	Beach encroachment	1	2	13 & 14	7	2	6	1	2	1
	Biodiversity		2	12, 13 & 14	7	2	6	1	2	1
	Forest cover	6	2	12	1	2	6	1	2	1
Unsustainable exploitation of natural resources	Fish landings	2	2	11 & 12	1	2	1	1	1	1
	Fishing effort	2	2	11 & 12	1	2	1	1	1	1
Natural hazards	Frequency	14	1	12 & 13	1 & 7	1	1	1	1	1
	Sea level rise	7	1	13	3	2	1	1	1	1
	Human losses		1	12	5	1	1	1	1	1
	Economic losses		1	12	5	1	1	1	1	1
Human environment	Population in coastal zone		2	12	2 & 1	6	6	2	2	3
	Hotels		1	12	5	1	6	1	2	1
	Coastal urbanization		2	12	2 & 1	6	6	2	2	3

Table 3: Issue and Indicator analysis for Cuba

**Conclusions:**

- Out of the 17 indicators, data are fully available for 6 (35%), and the quality of the data is considered as good;
- Out of the 7 crucial indicators, for 4 of these, data are available and for 4 out of these, data are of good quality;
- For 2 out of 3 human environment indicators the data quality is considered poor;
- Sometimes no data are collected, sometimes data are available only in hard copies
- Indicators marked crucial are relevant rather than crucial
- Human environment data quality is poor because data are available only for some sites.

**GRENADA**

1	2	3	4	5	6	7	8	9	10	11
Issue	Indicator	Unit of measurement	Availability of data	Source of data	Method of collection	Data coverage	Periodicity of data collection	Quality of data	Relevance of indicator	Data not available
Habitat	Protected marine areas	1,5,14	1	1	2,1,3,6,7	1,5,6				
	Loss of coral reefs	1	2	1	7,1,3	2	3,	1	1	1
	Loss of mangroves	1	2	1,4			6	3	1	1
	Loss of seagrass beds		3						1	1
	Beach erosion	1	2	1	1,5	2	6	2	1	1
	Beach encroachment	1	3					2	1	1
	Biodiversity	1	1	8	1	1	1	3	1	1
	Forest cover	1,5,6	1	8	1,2	1		1	1	
Unsustainable exploitation of natural resources	Fish landings	1,2	1	1	5,1	1	5	1	1	1
	Fishing effort	2	1	1	5,1	1	5	1	1	
								1		
Natural hazards	Frequency		1		5	1				
	Sea level rise		3							
	Human losses		1					1		
	Economic losses		2			1				
Human environment	Population in coastal zone	8	1	11	5	1	1			
	Hotels		1	9	5	1		1		
	Coastal urbanization		1			1		3		

Table 4: Issue and Indicator analysis for Grenada

### Conclusions:

- Out of the 17 indicators, data are fully available for 10 (58%), and the quality of the data is generally considered as good;
- Out of the 9 crucial indicators, for 4 of these, data are fully available and for 3 out of these, data are of good quality;
- For 3 indicators no data are available;
- Additional comments:
  - no sea level data are available: there is no sea level station (it was recommended to check with the port authority if a station is present in the port)
  - beach encroachment: there are some agencies dealing with this, but the problem is to get recent data: data are available only up to 1999
  - seagrass beds: no survey has ever been done

### JAMAICA

1	2	3	4	5	6	7	8	9	10	11
Issue	Indicator	Unit of measurement	Availability of data	Source of data	Method of collection	Data coverage	Periodicity of data collection	Quality of data	Relevance of indicator	Data not available
Habitat	Protected marine areas	6	1	12	2	1	6	1	2	
	Loss of coral reefs	1	2	12, 5	6	2	9	3	1	
	Loss of mangroves	1	2	12, 5	2, 6, 7	2	9	3	2	
	Loss of seagrass beds	1	3	12, 2	4	2	6	2	2	4
	Beach erosion	7	2	12	3	2	10	1	2	
	Beach encroachment	14	3	12	6	1	6	3	3	
	Biodiversity	1	2	12	7, 5, 6	1	9	3	1	
	Forest cover	1	2	4	2	1	9	1	1	
Unsustainable exploitation of natural resources	Fish landings	15	2	1						
	Fishing effort	8	2	1						
Natural hazards	Frequency	11	2	12						
	Sea level rise									
	Human losses									
	Economic losses	11	2	12						
Human environment	Population in coastal zone			9, 12						
	Hotels			9, 12						
	Coastal urbanization Etc			9, 12						

Table 5: Issue and Indicator analysis for Jamaica

**Conclusions:**

- Out of the 17 indicators, data are fully available for 1 (6%), and the quality of the data is generally considered as good;
- Out of the 3 crucial indicators, for none of these, data are fully available;
- For 9 indicators data are availability is incomplete;
- For 2 indicators no data are available;
- For 5 indicators no information was obtained.
- Additional comments:
  - data are collected by many agencies.
  - habitat data: this is a starting programme; sometimes data are available on paper
  - sealevel rise: no sea level station available
  - natural hazards: this info can be obtained from CDERA.

**SAINT LUCIA**

1	2	3	4	5	6	7	8	9	10	11
Issue	Indicator	Unit of measurement	Availability of data	Source of data	Method of collection	Data coverage	Periodicity of data collection	Quality of data	Relevance of indicator	Data not available
Habitat	Protected marine areas	14, 1, 6	1	1, 9	3, 2	1	6	1, 3	2	
	Loss of coral reefs	1, 14;	1	1, 9	3	2	1	1, 3	1	
	Loss of mangroves	1, 14	1	1,9	1, 2,	2	8	3	1	
	Loss of seagrass beds		2	1, 9	3, 2	2	8	3	1	
	Beach erosion		1	1	3	2	10	1	1	
	Beach encroachment		1	1	3	2	10	1	1	
	Biodiversity		1	1, 8, 2,4,9,	1, 7	2	9	3	1	
	Forest cover	1, 6	1	4	1	1			1	
Unsustainable exploitation of natural resources	Fish landings	2	1	1	3	2	15 days per month ( 11)	1	1	
	Fishing effort	3, 14	1	1	3	2	15 days per month (11)	1	1	
Natural hazards	Frequency			10, Meteorological stations (MS)			5		1	
	Sea level rise		1	10, MS			5		1	
	Human losses			10 . MS			5		1	
	Economic losses			10						
Human environment	Population in coastal zone		1	9, 11	1	1	9		1	

	Hotels		1	9, 11	1	1	9		1	
	Coastal urbanization		1	9, 11	1	1	9		1	

Table 6: Issue and Indicator analysis for Saint Lucia

**Conclusions:**

- Out of the 17 indicators, data are fully available for 13 (76%), and the quality of the data is considered as good for 6 of these;
- Out of the 15 crucial indicators, for 12 of these, data are available and for 5 out of these, data are of good quality;
- For none of the indicators the data quality is considered poor;
- For 3 indicators no information is available.
- Additional comments:
  - seagrass beds, mangroves and coral reefs: data are available but inaccurate
  - sometimes data are collected locally, not nationally

**TRINIDAD & TOBAGO:**

1	2	3	4	5	6	7	8	9	10	11
Issue	Indicator	Unit of measurement	Availability of data	Source of data	Method of collection	Data coverage	Periodicity of data collection	Quality of data	Relevance of indicator	Data not available
Habitat	Protected marine areas	Cabinet Approval and No. of parks protected	1	12	1,7	1	3		1	
	Loss of coral reefs	No. of spp loss, % coral bleached	1	16, 12,6	1, 7, 4	2	10, 2		1	
	Loss of mangroves	% loss of spp, Acreage of mangroves removed	1	12, 16	1, 7	1	1		1	
	Loss of seagrass beds	% loss/years	2	16, 13,6	1, 7	2	10		1	
	Beach erosion		2	12, 16, 6	3, 6	1			1	
	Beach encroachment	No. of new hotels, guest houses & other development	2	12,	3, 6	1			1	
	Biodiversity	% cover of vegetation, % spp loss	2	12,16	3, 5	1	1		1	
	Forest cover	% forest loss, % reforested	2	12, 4, 16	5	1			1	
Unsustainable exploitation of natural resources	Fish landings	No. of landing sites, weekly, Mthly, yearly catch	1	1, 11	3,	4	4		2	
	Fishing effort	No. of registered boats	1	1, 11	5	4	1		3	
Natural hazards	Frequency	No. of	1	10, 11	1, 5	1	7		1	

		occurrence/year							
	Sea level rise	No. of meters /year	1	16, 12, 6	1, 3	1			1
	Human losses	% loss/ year	1	1, 11	1, 5	1	7		1
	Economic losses	% loss/ year	1	11	1, 5	1	7		1
Human environment	Population in coastal zone	8	2	12, 11	1, 5	1			2
	Hotels	No. of hotels	1	12, 11	1, 5	1	1		3
	Coastal urbanization	No. of settlement, No. of industrial activities	2	9, 12	1, 5	1			2

Table 7: Issue and Indicator analysis for Trinidad & Tobago

**Conclusions:**

- Out of the 17 indicators, data are fully available for 10 (59%)
- No information is available on the quality of the data;
- Out of the 12 crucial indicators, for 7 of these, data are fully available;
- Additional comments\;
  - seagrass beds: survey is now being done for Tobago
  - human environment: data should be available

**TURKS & CAICOS**

1	2	3	4	5	6	7	8	9	10	11
Issue	Indicator	Unit of measurement	Availability of data	Source of data	Method of collection	Data coverage	Periodicity of data collection	Quality of data	Relevance of indicator	Data not available
Habitat	Protected marine areas	6	2	2	3	1	11	1	2	
	Loss of coral reefs	6	2	2	3	1	11	1	1	
	Loss of mangroves	6	2	2	6	1	9	3	2	
	Loss of seagrass beds	6	2	2	6	1	6	2	2	
	Beach erosion	1								
	Beach encroachment									
	Biodiversity									
	Forest cover									
Unsustainable exploitation of natural resources	Fish landings	2	1	1	3	1	5	1	1	
	Fishing effort	3	1	1	3	1	5	1	1	
Natural hazards	Frequency									
	Sea level rise	7	2	2	3	1	11	2	2	
	Human losses			11						

	Economic losses	1	1	11						
Human environment	Population in coastal zone	1	1	11	1	1	8	1	1	
	Hotels									
	Coastal urbanization	8	1	11					1	

Table 8: Issue and Indicator analysis for Turks and Caico

**Conclusions:**

- Out of the 17 indicators, data are fully available for 5 (29%), and the quality of the data is considered as good;
- Out of the 5 crucial indicators, for 4 of these, data are fully available and for 3 out of these, data are of good quality;
- Additional comments:
  - islands are spread. there is currently no system for data collection, except for fisheries
  - sea level: there is a sea level station on one island
  - MPA: out of 33, only 3 or 4 are being monitored regularly because they are tourist areas.

**Summary conclusions for all countries:**

Ranking by data fully available for all 17 indicators:

1. Barbados 76%
2. Saint Lucia 76%
3. Trinidad and Tobago 59%
4. Grenada 58%
5. Cuba 35%
6. Turks and Caicos 29%
7. Jamaica 6%

Data availability (and of good quality) for crucial indicators:

- Barbados 4 out of 7  
 Cuba 4 out of 7  
 Grenada 3 out of 9  
 Jamaica 0 out of 3  
 Saint Lucia 5 out of 15  
 Trinidad and Tobago could not be analyzed at this time  
 Turks and Caicos 4 out of 5

**Analysis by Indicator**

(Availability 1=fully available; 2=partially available; 3=not available)

(Quality: 1=good 2=poor 3=varies )

Priority concerns	DATA	Indicator	Countries						
			Barbados	Cuba	Grenada	Jamaica	St. Lucia	Trinidad & Tobago	Turks & Caicos
Habitat	Availability/unit	*MPAs	1	1	1	1	1	1	2
	Quality		1	1	-	1	1,3	-	1
	Availability/unit	*Loss coral reefs	1	2	2	2	1	1	2
	Quality		1	1	1	3	1,3	-	1
	Availability/unit	Loss sea grass	2	2	3	3	2	2	2
	Quality		1	1	-	2	3	-	2
	Availability/unit	Beaches	1	2	2	2	1	2	-
	Quality		1	1	2	1	1	-	-
Unsustainable exploitation	Availability/unit	*Fish landings	1	2	1	2	1	1	1
	Quality		1	1	1	-	1	-	1
	Availability/unit	Effort	1	2	1	2	1	1	1
	Quality		1	1	1	-	1	-	1
Pollution	Availability/unit	Sediments (turbidity)							
	Quality								
	Availability/unit	Sewage (coliform)							
	Quality								
	Availability/unit	Nitrates/nitrites							
	Quality								
	Availability/unit	Solid waste							
	Quality								
Natural hazards	Availability/unit	*Hurricanes freq.	1	1	1	2	1	1	-
	Quality		1	1	-	-	-	-	-
	Availability/unit	*Human losses	1	1	1	-	-	1	-
	Quality		1	1	1	-	-	-	-
	Availability/unit	*Economic losses	1	1	2	2	-	1	1
	Quality		1	1	-	-	-	-	-
	Availability/unit	*Sea level rise	2	1	3	-	1	1	2
	Quality		3	1	-	-	-	2	
Human environment									

Table 9: Analysis by indicator

Note: pollution was not assessed

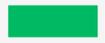
## 5.2 Data availability matrix for common priority issues

This analysis gives an overview of data availability (for use in the Atlas) and their quality, for all priority issues for each country.

Priority concerns	Specific issues	Countries						
		Barbados	Cuba	Grenada	Jamaica	St. Lucia	Trinidad & Tobago	Turks & Caicos
Habitat degradation/loss	Coral reefs	available	partially available	partially available	partially available	available	available	partially available
	Seagrass	partially available	not available	not available	not available	partially available	partially available	not a priority
	Beaches	available	partially available	not available	not available	available	not a priority	not a priority
Unsustainable exploitation of natural resources	Overfishing	available	not a priority	available	partially available	available	available	available
	Sewage pollution (coliform)	not available	not a priority	available	not available	not available	not available	not available
	Nitrates/nitrites	available	not a priority	partially available	partially available	partially available	available	partially available
	Solid waste	partially available	not a priority	not available	not available	partially available	partially available	not available
	Natural hazards	available	available	available	partially available	not available	partially available	not available
	Sea level rise	partially available	available	not available	not available	available	partially available	partially available

Table 10: data availability matrix for common priority issues

**Note: In some cases data may be collected but may not be available for public access**

	available		partially available		not available		not a priority
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The above matrix will assist countries in identifying issues for which Atlas layers can be prepared at this time. The matrix also shows issues for which data need to be collected or mined from other sources.

## 6. REQUIRED RESOURCES TO DEVELOP A MARINE ATLAS

This agenda item was introduced by Mr Reed. He explained that in order for all countries to effectively participate in the Caribbean Marine Atlas project **resources will be required for training, data mining & data formatting, computer systems and ongoing maintenance of the developed systems.**

### 6.1 Training

#### 6.1.1 OceanTeacher

Mr Reed further informed the workshop that all IODE training now uses the OceanTeacher education system. OceanTeacher is composed of several integrated components:

- Digital Library: contains a wide range of data management and information management materials, including software, quality control and analysis strategies, and reference documents.
- Training modules (using distance learning methodology): a collection of outlines, notes, examples, and miscellaneous documents used in conjunction with the Digital Library that are used during group training courses
- Video library (most courses taught at the IOC Project Office for IODE are now video recorded and made available on-line as streaming video.



Figure 12: OceanTeacher homepage

OceanTeacher is now used not only for IODE courses but also by GOOS and JCOMM.

The OceanTeacher training curriculum has two levels: basic and advanced data management:

### **BASIC DATA MANAGEMENT**

- ***DM 101 Introduction to Ocean Data.*** Oceanographic measurements (parameters, units, conventions); programmatic and technical aspects of data collection; data formats used for ocean data and their special characteristics
- ***DM 102 Ocean Data Collection.*** Development Building a national ocean data collection from the World Ocean Database 2005 and other local and published data sources; basic data analysis with popular software programs
- ***DM 103 Ocean Data Products & Synthesis.*** Developing a suite of standard and specialized ocean data analysis products from the national data collection, and the synthesis of these products with other available analyses in Geographic Information Systems.

### **ADVANCED DATA MANAGEMENT**

- ***DM 203P Geographic Information Systems for Coast & Ocean Management.*** An intensive, hands-on tutorial in the use of proprietary (ESRI) Geographic Information System software to assemble and analyse coastal and marine data for environmental management purposes.
- ***DM 203N Geographic Information Systems for Coast & Ocean Management.*** This course is the equivalent of DM 203P, with the major difference that the software used throughout is in the public domain.

Mr Reed explained that there are also Marine Atlas courses in OceanTeacher:

- ***DM 207 MapServer Application for a Marine Atlas.*** This course introduces the Data Manager to an open source software application to build spatially-enabled internet

applications to publish maps and to build an interactive map application demonstrator for a marine atlas. The African Marine Atlas is used here as the training model.

- **DM 210 Marine & Coastal Atlases.** (PROPOSED) Practical workshop intended to address the creation of a Marine & Coastal Atlas for a specific geographic area, including the construction of the static HTML interface to the GIS data products. The workshop builds upon the theoretical concepts presented in prior courses (DM 203P or DM 203N), but it includes the real-world considerations of exactly where the Atlas will cover, what themes will be included, and the construction of the actual products for this area.

Full details on the above course modules are provided in [Annex II](#).

### 6.1.2 Training provided to the region by IODE

In order to identify training requirements national assessments will need to be made of existing skills in data management and GIS. In this regard it was noted that a few experts from the region had received data management training in 2005 within the framework of the ODINCARSA project: Trinidad (Makeda Antoine-Malchan), St Lucia (Patricia Medar-Hubert), Cuba (Carlos Rafael Alonso), Dominica (Sebastian Riviere), Barbados (Ramon Roach). It was highly recommended that these trained individuals be included in the CMA project if they were still working in the same place. Based upon the assessment of existing skills and required skills, additional training can be planned in 2008. The workshop was informed that financial resources are available for this purpose at the IOC Project for IODE in Oostende, Belgium.

## 6.2 Scale of data layers

Mr Reed then described the data that will be required for a marine atlas:

- CONTINENT/REGIONALSCALE DATA LAYERS - These layers cover the complete the Atlas area of interest, defined by the AOI. These data may be sourced from global collections
- NATIONAL AND LOCAL SCALE DATA LAYERS - These layers cover specific States (or perhaps small groups of States). These data may be sourced from national collections. Some themes may be provided as "virtual" datasets
- VIRTUAL DATA LAYERS - These layers can be provided as links to online web services, such as Web Map Services (WMS), to provide dynamically produced map layers. These can be combined with datasets from the Atlas.

## 6.3 Data Mining

Mr Reed explained that data mining would be one of the core tasks within the Marine Atlas project and he provided the following definition of data mining: “*data mining is the process of finding new information from existing collections of data*”. Data mining draws on a variety of tools and techniques and can use data from different sources and in different formats.

## 6.4 Bringing it all together: Data Mining and Assembly Workshop

Mr Reed explained that one of the most important events towards the Atlas will be the Data Mining and Assembly workshop. This event will bring together the national experts from the region involved in the Atlas project. The specific objectives of this workshop will be:

- AOI - Identify geographic Area of Interest (AOI)
- TOPICS - Identify relevant environmental topics (as a subject taxonomy)
- DATA MINING – Begin gathering all available data from existing sources
- METADATA – Record all available metadata files and source location
- ASSIGNMENTS - Create regional or thematic teams, and assign the following distributed jobs:
  - Clip all GIS formats to the AOI
  - Convert other data to products (e.g. seasonal climatological grids/contours)
  - Convert these products to GIS formats
- COLLECTION - Assemble and quality control the final products, using FTP technology and a central server
- ACCESS - Create a browser interface to the GIS files, with parallel links to the available metadata files and source location.

## 6.5 Computer Systems

Effective participation in the Project assumes that all participants will have access to a PC with (broadband) Internet access as well as GIS software (either commercial or open source).

## 6.6 Ongoing maintenance

Resources will be required for ongoing maintenance. There will also be a need for a project coordination mechanism, and expertise for site management of the atlas, both in terms of the web mapping site and data updates.

During the discussions the participants clearly stated the need to ensure that the atlas can be used as a tool to improve or facilitate existing tasks serving national needs. The participants also recognized the need to provide different types of atlas products: (i) atlas products for general public use; (ii) atlas products for decision makers (restricted access); and (iii) local atlas products accessible to the data originators which can be used as a data repository and for which access restrictions are allowed and respected. It was further noted that public atlas site could be hosted by the IOC Project Office for IODE in Oostende, Belgium (if so desired), whereas the products of types (ii) and (iii) can be hosted locally.

## 7. TECHNICAL AND RESOURCE ISSUES RELATED TO PARTICIPATION IN THE CARIBBEAN MARINE ATLAS: THE CURRENT STATUS AND REQUIREMENTS

### 7.1 Assessment of existing data management resources and needs

Table 13. Technical and Resource Issues. The information in this table relates to the technical capabilities of national organizations to develop a coastal atlas.

Specific issues	Barbados	Cuba	Grenada	Jamaica	St. Lucia	Trinidad & Tobago	Turks & Caicos
Do you quality control your data If Yes, what standards are used	No	No	No	No	Yes	Yes	No
			Some QC is done		Standards defined by the agency collecting the data.	Follows some internat. standards	
Are your data made available to external users? (outside organization)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Yes: online without charge					X <a href="http://www.slumaffe.org">www.slumaffe.org</a>	X	X <a href="http://www.environment.jt">www.environment.jt</a>
Yes: offline upon request without charge			X	X	X	X	X
Yes: offline upon request, with charge (reproduction and shipping cost)	X	X					
Can you access (online or other) data from other institutions in your country?	Yes	Yes	Yes	Yes	Limited access to data of other agencies	Limited access to data of other agencies	Yes
Yes: online with charge							
Yes: offline upon request without charge	X	X		X	X	X	X
Yes: offline upon request, with charge	X	X		X		X	
Do you have a metadata system to describe your data?	Yes. Some metadata, not systematic	No	No	No	No	No To be implemented under IWCAM	No
If Yes, what standard/system do you use?	ISO						

Do you have internet access at your institution?	Yes	Yes	Yes	Yes	Yes	Yes	Yes
If Yes, state the type of connection (e.g. dial-up, broadband)?	DSL	Dial up	Broad-band T1,T3	Broad-band	Broadband	DSL	DSL
Do you have access to GIS software at your institution?	Yes	Yes	Yes	Yes	No	Yes	No
If Yes, which software (e.g. ArcGIS 9.2)?	ArcGIS 8, 9.2	ArcGIS	ArcGis 9.2	ArcGis 3.2		ArcGIS	
Do you have GIS expertise within your organization?	Yes	Yes	Yes	Yes	No	Yes	Yes
If Yes, provide details.	2 experts with working knowledge ; IODE DM courses, ESRI course	Basic GIS, data management	GIS experts available within Ministry and will be available to contribute	Limited training but able to manage existing shapefiles	One officer has previous training but is not currently using skill.	Worked on a consultancy basis (every other month at the organization) Ministries of government have some GIS capability but is limited.	Basic knowledge
Do you have sufficient hardware (computers and storage) for data processing? (for your institution)	Yes	No	No	No	No	Yes	No
If No, what additional hardware is required?		3 PC are required	Desktop PC's and additional storage.	Additional storage & web server needed for data handling.	Not enough hard drive space and memory. Used for other activities		Storage
Do you have personnel who can be used for data mining and assembly? (available)	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Provide details	CZMU, other agencies	People available	Fisheries Data collectors and data managers.	Staff within the Integrated watershed and coastal zone management branch in NEPA.			
Do you have personnel who will be responsible for	Yes	Yes	Yes	Yes	No	Yes	Yes

the ongoing maintenance and discovery of data for the atlas? (longer term)							
Provide details	CZMU, other agencies	One person	MPA office personnel	Staff within the IWCZM branch in NEPA; Centre for Marine Science, UWI	Not at present. Maybe CZMU (to be investigated)	Conditional. For government this will depend on contractual arrangement with relevant ministry	

The meeting, based upon the results of the above survey, concluded as follows:

- most of the participating institutions do not perform quality control on the data they hold;
- all institutions make data available to outside users, and most do so without charge;
- most institutions can obtain access to data held in other national institutions and mostly without cost;
- almost none of the institutions maintain a metadata system to describe the data they hold;
- all institutions have Internet access, and all except one have broadband Internet access;
- all institutions except one have GIS software in their institution and all except one have inhouse GIS expertise;
- most institutions report a need for equipment support which mostly consists of additional storage capacity;
- all institutions have personnel who can be used for data mining and assembly within the framework of marine atlas development;
- most institutions have personnel who will be responsible for the ongoing maintenance and discovery of data for the atlas.

The meeting recommended the following:

- 1. Institutions should establish institutional a meta-database system, based on international standards, and promote the development of such systems at the national level;**
- 2. The Caribbean Marine Atlas pilot project should provide some equipment (mostly storage capacity);**

## 7.2 Formal country participation in the IODE programme

It was further noted that none of the participating institutions has an IODE National Oceanographic Data Centre (NODC). IODE National Coordinators for oceanographic data management have been nominated only in Barbados (L. Inniss), Cuba (Julieta Gutierrez), and Trinidad & Tobago (Maria Lera-Andalcio). Only one IODE National Coordinator for marine information management has been nominated (Trinidad & Tobago: Maria Lera-Andalcio)

**Other countries planning to participate in the Caribbean Marine Atlas were urged to nominate national coordinators for both oceanographic data management and marine information management.**

**In order to benefit fully from the international network of oceanographic data centres countries in the region were further urged to establish IODE National Oceanographic Data**

**Centres, bearing in mind that capacity building assistance is available to guide and assist the newly developed centres.**

IOC will provide information on IOC action addresses for the participating countries.

To assist with the development of the Caribbean Marine Atlas, which requires inter-agency cooperation and inter-sectoral cooperation, **the Meeting recommended the development of national coordinating groups. It was noted that similar mechanisms may exist already, dealing with e.g. natural disasters. It was noted that this group should also address the issue of data sharing and data dissemination to various user audiences.**

It was noted that, beyond local/national data, it will also be important to identify data available from external sources (e.g. international agencies). Dr Heileman informed the meeting that she will be able to provide some information in this regard, including the WHO assessment report on health and sanitation. Useful data could be extracted from this.

### 7.3 National Training Requirements

In terms of training requirements the meeting agreed that the below table be taken home and should be filled after consultation with national experts. The meeting agreed that input for the table should be provided to the IODE Secretariat **by 1 November 2007**. Details on the listed course modules is available in [Annex II](#).

Based upon the assessment of needs the IODE trainers will then compose relevant training programmes to be implemented in 2008.

Course Course description	Barbados	Cuba	Grenada	Jamaica	St. Lucia	Trinidad & Tobago	Turks & Caicos
<b>BASIC DATA MANAGEMENT</b>							
DM 101 Introduction to Ocean Data. Oceanographic measurements (parameters, units, conventions); programmatic and technical aspects of data collection; data formats used for ocean data and their special characteristics							
DM 102 Ocean Data Collection Development Building a national ocean data collection from the World Ocean Database 2005 and other local and published data sources; basic data analysis with popular software programs							
DM 103 Ocean Data Products & Synthesis Developing a suite of standard and specialized ocean data analysis products from the national data collection, and the synthesis of these products with other available analyses in Geographic Information Systems							
<b>ADVANCED DATA MANAGEMENT</b>							
DM 203P Geographic Information Systems for Coast & Ocean Management. An intensive, hands-on tutorial in the use of proprietary (ESRI) Geographic Information System software to assemble and analyse coastal and marine data for environmental management purposes							

<p>DM 203N Geographic Information Systems for Coast &amp; Ocean Management. This course is the equivalent of DM 203P, with the major difference that the software used throughout is in the public domain.</p>							
<b>MARINE ATLAS COURSES</b>							
<p>DM 207 MapServer Application for a Marine Atlas. This course introduces the Data Manager to an open source software application to build spatially-enabled internet applications to publish maps and to build an interactive map application demonstrator for a marine atlas. The African Marine Atlas is used here as the training model.</p>							
<p>DM 210 Marine &amp; Coastal Atlases. (PROPOSED) Practical workshop intended to address the creation of a Marine &amp; Coastal Atlas for a specific geographic area, including the construction of the static HTML interface to the GIS data products. The workshop builds upon the theoretical concepts presented in prior courses (DM 203P or DM 203N), but it includes the real-world considerations of exactly where the Atlas will cover, what themes will be included, and the construction of the actual products for this area.</p>							

Table 14: Training Course requirement matrix

## 8. WORKPLAN FOR THE DEVELOPMENT OF THE CARIBBEAN MARINE ATLAS PILOT PROJECT

The meeting agreed on a detailed work plan for the period October 2007 - December 2008. This work plan will result in the online publication of the Caribbean Marine Atlas Pilot, focusing on an initial group of 6 or 8 countries (6 if only the countries that attended the current workshop participate, 8 if also Guyana and Dominica participate).

The detailed work plan is provided in Table 15. The table shows the tasks that need to be carried out, the planned starting and completion dates, the duration in days or weeks, the % completion at the time of publication of this report, the cost in € (Euro) and the person(s) the task is assigned to. We note that costings in the table refer to costs in addition to the contribution made by the cooperating countries (funds to be covered by IOC/IODE and/or donors). Note that Ramon Roach has been assigned the task of updating the CMA web site. This task may also be assigned to the regional coordinator.

The work plan is also shown in Gantt chart format in Table 16.

A breakdown of tasks by resource (contributor) is shown in Table 17. The purpose of this table is to allow all participants in the CMA pilot project to correctly assess their expected contribution in time and effort to the project, and to allow the national governments to assign relevant staff to the project.

Table 15: Detailed work plan for the Caribbean Marine Atlas (in € ) – note that the duration is a preliminary estimate based upon the Gantt chart in Table 16.

<b>Task</b>	<b>Start</b>	<b>End</b>	<b>Duration</b>	<b>Completed</b>	<b>Cost</b>	<b>Assigned to</b>
<b>CMA total</b>	8/10/07	12/12/08	62w	1,79%	<b>179,400</b>	
<b>Finalize preparatory stakeholder meeting</b>	8/10/07	1/11/07 8:00	3w 3d	100%	<b>20,000</b>	
Implement regional stakeholder workshop	8/10/07	10/10/07	3d	100%	20,000	
Prepare workshop report and send to participants for final corrections	11/10/07	23/10/07	1w 4d	100%		October 07 workshop participants; Peter Pissierssens
Finalize and publish report - send to participants	24/10/07	24/10/07	1d	100%		Peter Pissierssens
Report published	1/11/07	1/11/07				
<b>CMA website development and Promotion</b>	15/10/07	12/12/08	61w	0%	<b>3,400</b>	

Provide guidance to contractor on graphic elements website banner and logo	15/10/07	19/10/07	1w	0%		Ramon Roach
Develop CMA website banner and logo	15/10/07	19/10/07	1w	0%	600	Contractor; IODE Secretariat /Donor
Develop CMA web site (Joomla)	5/11/07 8:00	9/11/07	1w	0%	800	Contractor; IODE Secretariat /Donor
Populate website with basic documentation (report/PPTs)	19/11/07	20/11/07	2d	0%		Peter Pissierssens
Basic web site online	20/11/07	20/11/07				
Maintain/update web site	21/11/07	3/6/08	28w	0%		Regional Project leader; Ramon Roach
Prepare brochure	31/07/08	31/07/08			2,000	
Brochure published	29/08/08	29/08/08				
Participate in relevant national and regional decision maker event to promote the Atlas	1/9/08 8:00	12/12/08	15w	0%		
<b>establishment national atlas team and teamleader</b>	22/10/07	31/12/07	10w	0%	<b>0</b>	
Report at relevant level about the importance of the Atlas and the interest to your country of participation	22/10/07	2/11/07	2w	0%		October 07 workshop participants; Ramon Roach
Establish national coordination group for the atlas development	22/10/07	1/11/07	1w 4d	0%		National government
national coordination group defined	2/11/07 8:00	2/11/07 8:00				
Identify	22/10/07	2/11/07	2w	0%		National

national teamleader						Atlas Team
National teamleader defined	2/11/07 8:00	2/11/07 8:00				
Consider nomination of IODE national coordinators DM and IM	5/11/07 8:00	28/12/07	8w	0%		National government; National Atlas Team
Consider establishment of NODC	5/11/07 8:00	28/12/07	8w	0%		National government
OPTIONAL: NODC formally established	31/12/07	31/12/07				
<b>assess requirements to participate in CMA</b>	1/11/07 10:00	10/12/07 10:00	5w	0%	<b>5,000</b>	
Identify required training to participate in Atlas project	1/11/07 10:00	15/11/07 10:00	2w	0%		National Team Leader; National Atlas Team
Detail equipment requirements (and send to IODE secretariat)	12/11/07 8:30	19/11/07 08:30	1w	0%		National Team Leader; National Atlas Team
Procure required small equipment and deliver	19/11/07 10:00	10/12/07 10:00	3w	0%	5,000	IODE Secretariat /Donor; Peter Pissierssens
Assess training requirements for all participating countries	15/11/07 10:00	23/11/07 16:20	8d	0%		Regional Project leader; Greg Reed; Peter Pissierssens
Training course descriptions prepared	26/11/07	26/11/07				
<b>identify parameters to be mined for priority issues</b>	5/11/07 8:00	31/01/08 11:00	12w	0%	<b>0</b>	
identify data holders	5/11/07 8:00	16/11/07	2w	0%		National Team Leader; National Atlas Team
locate all historical records available nationally	19/11/07	11/1/08	8w	0%		National Team Leader; National Atlas Team
identify if data are available in electronic or	19/11/07	30/11/07	2w	0%		National Team Leader;

paper form						National Atlas Team; Regional Project leader
digitize paper data into electronic (xls) form	3/12/07 8:00	3/12/07 8:00				
data available in electronic form	31/01/08	31/01/08				
identify restrictions on use of data	19/11/07	31/01/08 11:00	10w 3d	0%		National Team Leader; National Atlas Team
<b>Training Courses and workshops</b>	4/2/08 10:00	6/6/08	17w 4d	0%	<b>90,000</b>	
Data Management + GIS Training Course	4/2/08 10:00	15/02/08 10:00	1w 4d	0%	40,000	National Team Leader; Regional Project leader; To be Decided; Greg Reed; Murray Brown
Data mining and assimilation workshop	21/04/08	25/04/08	1w	0%	25,000	To be Decided; National Team Leader; Regional Project leader
Mapserver training course	2/6/08 8:00	6/6/08	1w	0%	25,000	National Team Leader; Regional Project leader; Greg Reed; To be Decided
<b>Atlas development</b>	16/02/08	9/9/08 8:00	29w 1d	0%	<b>1,000</b>	
Perform data quality control on data	16/02/08	18/04/08 14:00	8w 4d	0%		National Atlas Team; National Team Leader; Regional Project leader
Conversion of data sets into shapefiles	28/04/08	30/05/08 16:00	4w 4d	0%		National Team Leader; National Atlas Team

Quality controlled data available in shapefiles	30/05/08 16:00	30/05/08 16:00				
Set up central mapserver system (Oostende)	2/6/08 8:00	9/6/08 8:30	1w	0%	1,000	IODE Secretariat /Donor; Contractor
central mapserver system established (Oostende)	16/06/08	16/06/08				
Import layers into regional mapserver system	17/06/08	8/9/08	12w	0%		
Set up national mapserver system	16/06/08	27/06/08	2w	0%		National Team Leader
national mapserver systems established	30/06/08 11:00	30/06/08 11:00				
Import layers into national mapserver system	30/06/08	9/9/08 0:00	10w 1d	0%		National Team Leader; National Atlas Team
CMA system operational and online	9/9/08 8:00	9/9/08 8:00				National Atlas Team
<b>Project Assessment and Planning</b>	22/09/08	10/10/08	3w	0%	<b>60,000</b>	
First project assessment and planning workshop	22/09/08 10:00	26/09/08 10:00	4d	0%	60,000	National Team Leader; Regional Project leader; Peter Pissierssens; Cesar Toro; Greg Reed; Murray Brown; Sherry Heileman; Ramon Roach
IOCARIBE-X	6/10/08 8:00	10/10/08	1w	0%		IOCARIBE members



Table 17: Resource report

<b>Name</b>	<b>Start Date</b>	<b>End Date</b>	<b>Duration</b>
<b>Ramon Roach</b>	15/10/07	26/09/08	<b>31w 4d</b>
Provide guidance to contractor on graphic elements website banner and logo	15/10/07	19/10/07	1w
Report at relevant level about the importance of the Atlas and the interest to your country of participation	22/10/07	2/11/07	2w
Maintain/update web site	21/11/07	3/6/08	28w
First project assessment and planning workshop	22/09/08 10:00	26/09/08	4d
<b>October 07 workshop participants</b>	11/10/07 8:00	2/11/07	<b>3w 4d</b>
Prepare workshop report and send to participants for final corrections	11/10/07 8:00	23/10/07	1w 4d
Report at relevant level about the importance of the Atlas and the interest to your country of participation	22/10/07	2/11/07	2w
<b>National government</b>	22/10/07	28/12/07	<b>17w 4d</b>
Establish national coordination group for the atlas development	22/10/07	1/11/07	1w 4d
Consider nomination of IODE national coordinators DM and IM	5/11/07 8:00	28/12/07	8w
Consider establishment of NODC	5/11/07 8:00	28/12/07	8w
<b>National Team Leader</b>	1/11/07 10:00	26/09/08	<b>46w 7h</b>
Identify required training to participate in Atlas project	1/11/07 10:00	15/11/07	2w
identify data holders	5/11/07 8:00	16/11/07	2w
Detail equipment requirements (and send to IODE secretariat)	12/11/07 8:30	19/11/07	1w
locate all historical records available nationally	19/11/07	11/1/08	8w
identify if data are available in electronic or paper form	19/11/07	30/11/07	2w
identify restrictions on use of data	19/11/07	31/01/08	10w 3d
Data Management + GIS Training Course	4/2/08 10:00	15/02/08	1w 4d
Perform data quality control on data	16/02/08	18/04/08	8w 4d
Data mining and assimilation workshop	21/04/08	25/04/08	1w
Conversion of data sets into shapefiles	28/04/08	30/05/08	4w 4d
Mapserver training course	2/6/08 8:00	6/6/08	1w
Set up national mapserver system	16/06/08	27/06/08	2w
Import layers into national mapserver system	30/06/08	9/9/08	
First project assessment and planning workshop	22/09/08 10:00	26/09/08	4d
<b>National Atlas Team</b>	22/10/07	9/9/08	<b>49w 3d</b>
Identify national teamleader	22/10/07	2/11/07	2w

Identify required training to participate in Atlas project	1/11/07 10:00	15/11/07	2w
identify data holders	5/11/07 8:00	16/11/07	2w
Consider nomination of IODE national coordinators DM and IM	5/11/07 8:00	28/12/07	8w
Detail equipment requirements (and send to IODE secretariat)	12/11/07 8:30	19/11/07	1w
identify if data are available in electronic or paper form	19/11/07	30/11/07	2w
identify restrictions on use of data	19/11/07	31/01/08	10w 3d
locate all historical records available nationally	19/11/07	11/1/08	8w
Perform data quality control on data	16/02/08	18/04/08	8w 4d
Conversion of data sets into shapefiles	28/04/08	30/05/08	4w 4d
Import layers into national mapserver system	30/06/08	9/9/08	
CMA system operational and online	9/9/08 8:00	9/9/08	1d
	15/11/07		
<b>Regional Project leader</b>	10:00	26/09/08	<b>44w</b>
Assess training requirements for all participating countries	15/11/07		
	10:00	23/11/07	1 week
identify if data are available in electronic or paper form	19/11/07	30/11/07	2w
Maintain/update web site	21/11/07	3/6/08	28w
Data Management + GIS Training Course	4/2/08 10:00	15/02/08	1w 4d
Perform data quality control on data	16/02/08	18/04/08	8w 4d 5h
Data mining and assimilation workshop	21/04/08	25/04/08	1w
Mapserver training course	2/6/08 8:00	6/6/08	1w
First project assessment and planning workshop	22/09/08	26/09/08	4d
<b>Peter Pissierssens</b>	11/10/07	26/09/08	7 w
Prepare workshop report and send to participants for final corrections	11/10/07	23/10/07	1w 4d
Finalize and publish report - send to participants	24/10/07	24/10/07	1d
Assess training requirements for all participating countries	15/11/07	23/11/07	1 w
Populate website with basic documentation (report/PPTs)	19/11/07	20/11/07	2d
Procure required small equipment and deliver	19/11/07	10/12/07	3w
First project assessment and planning workshop	22/09/08	26/09/08	4d
<b>Cesar Toro</b>	22/09/08	26/09/08	4d
First project assessment and planning workshop	22/09/08	26/09/08	4d
<b>Greg Reed</b>	15/11/07	26/09/08	4 w
Assess training requirements for all participating countries	15/11/07	23/11/07	1 w
Data Management + GIS Training Course	4/2/08	15/02/08	1w 4d
Mapserver training course	2/6/08	6/6/08	1w

First project assessment and planning workshop	22/09/08	26/09/08	4d
<b>Murray Brown</b>	4/2/08	26/09/08	2w 3d
Data Management + GIS Training Course	4/2/08	15/02/08	1w 4d
First project assessment and planning workshop	22/09/08	26/09/08	4d
<b>Sherry Heileman</b>	22/09/08	26/09/08	4d
First project assessment and planning workshop	22/09/08	26/09/08	4d
Contractor	15/10/07	9/6/08	3w
Develop CMA website banner and logo	15/10/07	19/10/07	1w
Develop CMA web site (Joomla)	5/11/07	9/11/07	1w
Set up central mapserver system (Oostende)	2/6/08	9/6/08	1w
<b>To be Decided</b>	4/2/08	6/6/08	3w 4d
Data Management + GIS Training Course	4/2/08	15/02/08	1w 4d
Data mining and assimilation workshop	21/04/08	25/04/08	1w
Mapserver training course	2/6/08	6/6/08	1w
<b>IOCARIBE members</b>	6/10/08	10/10/08	1w
IOCARIBE-X	6/10/08	17:00	1w
<b>IODE Secretariat /Donor</b>	15/10/07	9/6/08	6w
Develop CMA website banner and logo	15/10/07	19/10/07	1w
Develop CMA web site (Joomla)	5/11/07	9/11/07	1w
Procure required small equipment and deliver	19/11/07	17:00	1w
Set up central mapserver system (Oostende)	2/6/08	10/12/07	3w
		10:00	
		9/6/08	1w

## 9. CONCLUSIONS AND CLOSING REMARKS

The participants observed that not all IOCARIBE countries had been able to participate in the workshop: out of the 29 IOC Member States in the region (excluding USA, UK, NL, French Territories) currently only 8 had been identified initially. However it was noted that for a pilot project it would not be possible to involve all countries from the start. Depending upon the experiences with, and success of the 2007-2008 pilot project, a more extensive project could be considered at a later date, involving all IOCARIBE Member States. However it was recommended that all IOCARIBE Member States should be kept informed about the CMA initiative.

The workshop further recommended that the Atlas, when operational, be actively promoted at any relevant occasion. In this regard reference was made to CARICOM meetings as well as the next Session of IOCARIBE in Venezuela in October 2008. The results can then also be submitted to the June 2009 Session of the IOC Assembly.

It was further mentioned that this is an activity within a larger programme: it should be considered part of the information system for the Caribbean Large Marine Ecosystem (C-LME) project and also be tied to the development of the Caribbean programmes on Tsunami and Coastal Hazards and to IOCARIBE-GOOS. The Atlas will also reveal data gaps at the national and regional level which then need to be addressed by relevant ocean science or observation programmes. Reference was made also to the HAB programme which is implementing the HAIS (Harmful Algae Information System). It was recommended to link with this initiative as it has similar objectives to the Atlas. HAB is of relevance to all countries in the region so cooperation is essential.

The workshop further urged closer collaboration between sectors at the national level. As an example it was noted that coastal area managers do not traditionally interact much with disaster managers. It will be necessary to actively link with NMHSs and disaster managers. A similar approach needs to be followed at the regional level.

The workshop welcomed the interest expressed by the GEF IWCAM (Integrating Watershed and Coastal Areas Management in Caribbean SIDS) project in the CMA project and invited close collaboration between IWCAM and CMA. Reference is made also to the recommendations in chapters [7.1](#) and [7.2](#)

Mr Pissierssens provided a brief demonstration of the African Sealevel monitoring service (based at the IOC Project Office for IODE in Oostende, Belgium; URL: <http://www.sealevelstation.net>) as another example of a web-based mapping application developed by the IODE programme for the benefit of the IOC GLOSS programme as well as for the Indian Ocean tsunami warning and mitigation programme. The workshop expressed its appreciation for this valuable initiative and strongly recommended that a similar product be developed for the Caribbean region. In this regard Mr Toro pointed out that, although there are a considerable number of sea level stations in the region, many are currently not operational (in real time). Plans are underway to establish several new stations and a service like the Oostende system will provide useful services to the entire network.

Ms Sandra Timothy (Trinidad & Tobago) expressed great appreciation for the organization of the workshop as the Atlas will be a useful tool for many coastal management issues. She pledged to bring information out on the initiative and to get her country fully involved.

Mr Ramon Roach (Barbados) thanked the invited experts and secretariat for the meeting and said that the product would be very valuable as a public interface as well as at the institutional level. It will now be important to keep momentum. Mr Roach pledged to organize a national meeting of stakeholders, which initially would be mostly informal.

Mr Pissierssens thanked the participants for their hard work during the workshop and expressed his hope that the Atlas would become a success story for the region. He noted that the new IOC strategic plan for oceanographic data and information management is guiding the IODE programme to be fully transversal providing data and information services to all IOC programmes at the national, regional and global level. Cooperation with other programmes has already started and the current workshop and planned Atlas will be an example of close cooperation between IODE and ICAM to develop a tool that provides direct benefits to national coastal zone managers and decision makers.

Dr Heileman welcomed the enthusiasm demonstrated by the participants to develop this Atlas, the need for which has long been recognized. It is now the first time that this is being done, so she hoped that the relevant authorities in countries could be convinced of the need for this product, and to show commitment to develop and maintain it in the long term. It is important to get all relevant agencies and institutions involved. Much work has to be done in technical issues as well as in promoting the atlas at national and regional levels. When participants return home, you will find a number of other frameworks where data and information are needed, for example, reporting under conventions. Countries are something overburdened by these reporting requirements and often do not have the data and information to do so. These processes also need data and indicators, and this tool will also serve these and many other needs, as it will make data more easily available. She indicated that she is looking forward to continued involvement in the development of the atlas..

Mr Greg Reed thanked the participants and local organizers. He pointed out that everyone is enthused now but the work is only just starting. We have a one year deadline to get the atlas finished. Substantial efforts will need to be made to source the data. IODE will provide training but all data need to be mined and processed. Mr Reed expressed his commitment to assist in the process. He looked forward to seeing the prototype in 12 months. At that time we should also involve other countries in the region. He ended by stressing the need to see the Atlas not as a static product but as a dynamic product that will need regular updating so it can be a valuable tool for management and decision making..

Mr Cesar Toro thanked all for coming and for their enthusiasm. He thanked Ms Lorna Inniss and Mr Ramon Roach for the hard work in organizing this meeting. He stated that it is important that this product is not an isolated initiative but frames in large programmes and activities that IOC of UNESCO has in the region. He welcome the expertise of IODE and of the IOC project Office for IODE in Oostende which had developed into an excellent technology and training facility. Regarding the atlas he urged the countries not to consider this as an end product but as a tool that will require continuous updating so it can remain a valuable working tool. Mr Toro concluded by stating that IOC in its field offices in Cartagena or Oostende or IOC Headquarters in Paris are ready to contribute to this development.

The participants warmly thanked the local organizers Ms Lorna Inniss and Mr Ramon Roach for their tireless efforts in making the local arrangements for the meeting. Mr Pissierssens noted that thanks to their hard work it had been possible to organize the meeting at very short notice,

subsequent to the approval of the funding request by the Government of Flanders (Kingdom of Belgium).

ANNEX I

CARIBBEAN MARINE ATLAS INFORMATION SHEET

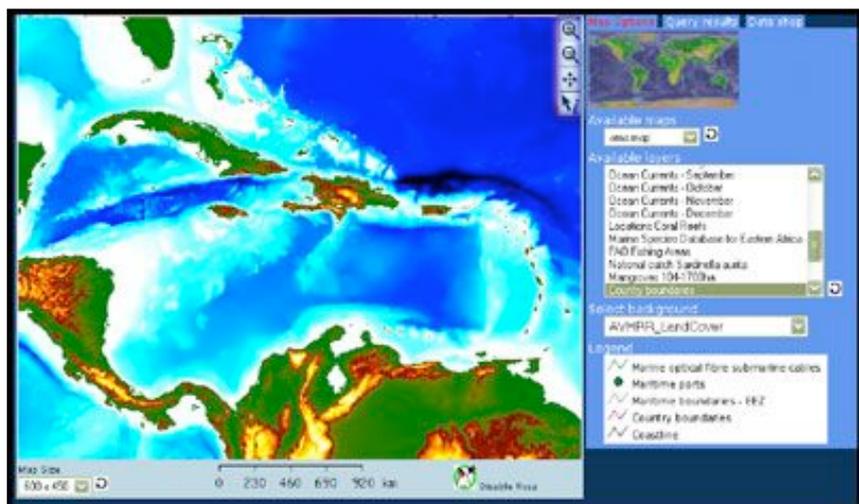


## Caribbean Marine Atlas

A number of Caribbean countries are embarking on an initiative to develop a Caribbean Marine Atlas (CMA). **The purpose of the CMA is to identify, collect and organize available geo-spatial datasets into an atlas of environmental themes for the Caribbean region**, under the sponsorship of the Intergovernmental Oceanographic Commission's (IOC) International Oceanographic Data and Information Exchange (IODE) and Integrated Coastal Area Management (ICAM) Programmes. The CMA will include geo-spatial data from national and regional projects and programmes, related to the sustainable development and integrated management of marine and coastal areas in the region.

While these areas and their associated living resources are of major importance for the sustainable development of the Caribbean, they are under increasing pressure from a combination of anthropogenic and natural threats. A major constraint to effective integrated management of these areas has been limited availability of data and information as well as of appropriate data and information tools.

A prototype version of the Caribbean Marine Atlas will be prepared by nine participating countries (Barbados, Cuba, Dominica, Grenada, Guyana, Jamaica, St Lucia, Trinidad & Tobago and Turks & Caicos). It is expected the prototype Atlas will be released in October 2008. It is planned to extend the Atlas to include other countries in the region. Environmental datasets from organizations in the contributing countries will be collected for presentation in the Atlas.



## Data Layers

The data layers for the Atlas will be:

- **Regional Scale Data Layers** - These layers cover the complete Atlas area of interest.
- **National/Local Scale Data Layers** - These layers cover specific countries in the Caribbean. It will be the responsibility of the participating countries to collect and organize data. Some of the data themes that will be included will be provided as "virtual" datasets.
- **Virtual Data Layers** - These layers will be provided as links to online web map servers (WMS) or web feature servers (WFS) that produce dynamic maps that can be integrated into the Atlas.

## Features of the Atlas

The CMA will be a digital atlas comprising easily downloadable data on various key themes relevant to the marine and coastal environment of the Caribbean. Among these themes are coastal habitats, fisheries, environmental quality, climate change and sea level rise, oceanography, as well as socio-economic aspects. The Atlas will also contain dataset descriptions (metadata) and links to the source data. It is intended both to provide necessary datasets directly to concerned scientists, coastal zone management practitioners, and natural resource managers, and will set the stage for the development of decision-makers' toolkits that rely on geo-spatial information.

**The CMA will play an important role in informing decision-makers on issues relating to the marine and coastal environment and it is envisaged the Atlas will become the main entry point for anyone interested in finding information on the coastal and marine environment of the Caribbean.**

The development of the CMA will also provide a tool to assist community building and collaboration in the region. It will draw on national human resources to identify issues of concern, define appropriate indicators and locate datasets that can be used in the atlas. In addition, data gaps that require additional resources will be identified. As part of the Atlas development, the IODE programme will provide the necessary training to the relevant persons from each country. The CMA will be built using open source technologies and will be based on international standards to enable the sharing of technological knowledge and resources. The Atlas will encourage the wide dissemination of key datasets by providing access and visualization of these data.

## Contact

Peter Pissierssens, IODE Project Office for IOC (of UNESCO)  
email: [p.pissierssens@unesco.org](mailto:p.pissierssens@unesco.org) ; [j.barbiere@unesco.org](mailto:j.barbiere@unesco.org)  
URL: <http://www.iode.org/cma>

## ANNEX II

### OceanTeacher Training Modules

#### **DM 101 Introduction to Ocean Data**

##### GOAL

- To introduce the student data manager to the nature of marine data: what it contains, how it is written, how to interpret it, and how to deal with new or difficult formats

##### LESSONS

1. Oceanographic Parameters
2. Oceanographic Measurement Units
3. Temperature & Salinity Scales
4. Standard Depths
5. Collecting Data
6. Data Format Types
7. Oceanographic Data Formats
  1. Code Tables
  2. Geography: Location
  3. Geography: Charts
  4. Date & Time
  5. Quality Flags

#### **DM 102 Ocean Data Collection Management**

##### GOALS

- To show students how to create a National Data Collection, using the World Ocean Database, other published or unpublished data sources, and near real-time operational data
- To demonstrate some basic data analysis functions in popular ocean software programs

##### LESSONS

1. Data Folder Structure
2. Area of Interest
3. Initial Collection from the World Ocean Database
4. Data Collection Metadata
5. Basic Data Analyses
6. Exporting ODV Products
7. Adding Bottle Data
8. Adding CTD Data - Under construction
9. Adding Operational Data
10. Quality Control with Special Purpose Collections

#### **DM 103 Ocean Data Products & Synthesis**

##### GOALS

- To demonstrate a broad suite of basic analysis methods for ocean data (including remote sensing data) using popular software systems
- To demonstrate basic methods for combining data products in Geographic Information Systems (GIS)

##### LESSONS

1. Gridding & Contouring with Surfer
2. Gridding with Saga
3. Global Relief Products
4. Surfer Vector Charts
5. GIS Synthesis: Local & Online Data

#### **DM 203: Geographic Information Systems for Coast & Ocean Management**

##### GOAL

- To introduce the Data Manager to some of the fundamental concepts and operational tasks in utilising Geographic Information Systems for ocean and coastal management

##### LESSONS

1. Fundamentals of Geographic Information Systems
2. GIS Data and Metadata
3. GIS Operations
4. Spatial Analysis and Modelling
5. Marine GIS Applications

### **DM 203P Geographic Information Systems for Coast & Ocean Management**

#### GOAL

- To introduce students to a wide range of basic Geographic Information System operations, using non-proprietary software

#### CONTENTS

1. GIS Overview
2. Base Maps
3. Gridded Data Overview
4. Gridded Data Methods
5. Grid & Image Manipulations
6. Vector Data Overview
7. Vector Data Methodes
8. Obtaining GIS Data

### **Data Mining and Assembly Workshop**

### **DM 207 MapServer Application for a Marine Atlas**

#### GOALS

- To introduce the Data Manager to an open source software application to build spatially-enabled internet applications and publish maps.
- To build an interactive map application demonstrator for the African Marine Atlas.

#### LESSONS

1. Introduction to MapServer
2. MapServer for Windows
3. Tutorial Exercises
4. Template Design for the African Marine Atlas
5. Develop African Marine Atlas Prototype Application

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**ANNEX III**

**LIST OF PARTICIPANTS**

**REGIONAL EXPERTS**

Mr. Sean GREEN  
National Environment & Planning Agency  
10-11, Caledonia Av., Kingston 5  
JAMAICA W.I.  
Tel: (876) 754-7540 ext 2247  
Fax: (876) 754-7594/5  
E-mail: [sgreen@nepa.gov.jm](mailto:sgreen@nepa.gov.jm)

Ms. Sarita WILLIAMS-PETER  
Fisheries Biologist  
Department of Fisheries  
Ministry of Agriculture, Land, Forestry and  
Fisheries  
Pointe Seraphine, Castries  
SAINT LUCIA  
Tel. + (758) 468 4139/4138/4145  
Fax. + (758) 452 3853  
Email: [deptfish@slumaffe.org](mailto:deptfish@slumaffe.org)

Ing. Adan Zuñiga RÍOS  
(Presently Acting Advisor to ICZM, Caracas,  
Venezuela)  
Geologist Engineer/Director  
Coastal Ecosystem Research Center,  
Centro de Investigaciones de Ecosistemas  
Costeros  
Cayo Coco, Morón, Ciego de Ávila.  
CUBA. CP 69400  
Tel: (053) 33-301161 & (053) 33-301421  
Fax: (053) 33-301151  
E-mail: [adanzrs@yahoo.com](mailto:adanzrs@yahoo.com) /  
[adan@ciec.fica.inf.cu](mailto:adan@ciec.fica.inf.cu)

Mr. Luc CLERVEAUX  
Environmental Officer, c/o Dept. of  
Environment & Coastal Resources, National  
Environmental Centre, Lower Bight Rd.,  
Providenciales  
TURKS & CAICOS ISLANDS, BWI.  
Tel: 1-649-941-5122  
Fax: 1-649-946-4793

E-mail: [cool\\_llc@hotmail.com](mailto:cool_llc@hotmail.com)

Mr. Jerry MITCHELL  
Marine Protected Areas Office,  
Fisheries Division, Ministry of Agriculture,  
Botanical Gardens, Ministerial Complex,  
Tanteen St. George's  
GRENADA  
Tel: 1473 440 3814, Etx: 2010  
Fax: 1473 440 4191  
E-mail: [mitchell.jerry@gmail.com](mailto:mitchell.jerry@gmail.com)

Ms. Sandra TIMOTHY  
Project Manager, GEF-IWCAM Project,  
Buccoo Reef Trust, Cowie's Building, Carnbee  
Junction, Auchenskeoch Road, Carnbee  
TRINIDAD & TOBAGO  
Tel: 1 868 635 2000  
Fax: 1 868 639 7333  
E-mail: [s.timothy@buccooreef.org](mailto:s.timothy@buccooreef.org)

Mr Ramon ROACH  
Water quality analyst  
Coastal Zone Management Unit  
Bay Street  
St. Michael  
BARBADOS BB11156  
E-mail: [rroach@coastal.gov.bb](mailto:rroach@coastal.gov.bb)

Ms Lorna INNIS  
Coastal Zone Management Unit  
Bay Street  
St. Michael  
BARBADOS BB11156  
E-mail: [linniss@coastal.gov.bb](mailto:linniss@coastal.gov.bb)

**INVITED EXPERTS**

Ms Sherry HEILEMAN  
Consultant  
60, rue Emeriau

Paris 75015  
FRANCE  
Tel: +33 1 40 59 08 34  
E-mail: [sh\\_heileman@yahoo.com](mailto:sh_heileman@yahoo.com)

Mr Greg REED  
Executive Officer  
Australian Ocean Data Centre Joint Facility  
Wylde Street  
AUSTRALIA  
Tel: +61 2 93593141  
Fax: +61 2 93593120  
Email: [greg@metoc.gov.au](mailto:greg@metoc.gov.au)

### **IOC SECRETARIAT**

Mr Cesar TORO  
IOC/UNESCO Secretary for IOCARIBE  
Casa del Marques de Valdehoyos  
Cartagena  
COLOMBIA

Tel: +57-5-664 63 99  
Fax: +57-5-660 0407  
E-mail: [c.toro@unesco.org](mailto:c.toro@unesco.org)

Mr Peter PISSIERSSENS  
IODE Programme Coordinator  
IOC Project Office for IODE  
Wandelaarkaai 7  
8400 Oostende  
BELGIUM  
Tel: +32-59-34 01 58  
Fax: + 32-59-34 01 52  
E-mail: [p.pissierssens@unesco.org](mailto:p.pissierssens@unesco.org)

**ANNEX IV**

**LIST OF ACRONYMS**

AMA	African Marine Atlas
AOI	Area of Interest
ASCII	American Standard Code for Information Interchange
ATM	Automated Teller Machine
AVHRR	Advanced Very High Resolution Radiometer
CARICOMP	Caribbean Coastal Marine Productivity Programme
CBO	Community-based Organizations
CLME	Caribbean Large Marine Ecosystems
CMA	Caribbean Marine Atlas (IOC/IODE)
COD/BOD	Chemical Oxygen Demand/Biological Oxygen Demand
CZMU	Coastal Zone Management Unit (Barbados)
CWIP	Coastal Water Improvement Project
DPSIR	Driver-Pressure-State-Impact-Response
DSL	Digital Subscriber Line
DVD	Digital Versatile Disc
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EMA	Environmental Management Authority (Trinidad & Tobago)
EPD	Environmental Protection Department (Barbados)
FAO	Food and Agriculture Organization of the United Nations
GIS	Geographic Information System
GOOS	Global Ocean Observing System
HAB	Harmful Algal Bloom
HTML	HyperText Mark-up Language
ICAM	Integrated Coastal Area Management

ICOM	Integrated Coastal and Ocean Management
ICZM	Integrated Coastal Zone Management
IOC	Intergovernmental Oceanographic Commission (of UNESCO)
IOCARIBE	IOC Regional Sub-commission for the Caribbean and Adjacent Regions
IODE	International Oceanographic Data and Information Exchange (IOC)
ISO	International Organization for Standardization
IWCAM	Integrating Watershed and Coastal Areas Management (GEF)
JCOMM	Joint WMO-IOC Technical Commission on Oceanography and Marine Meteorology
JPOI	Johannesburg Plan of Implementation (See WSSD)
LME	Large Marine Ecosystems
MASDEA	Marine Species Database for Eastern Africa
MPA	Marine Protected Area
MS	Microsoft
NEPA	National Environment & Planning Agency (Jamaica)
NGO	Non Governmental Organization
NODC	National Oceanographic Data Centre (IOC/IODE)
ODIN	Ocean Data and Information Network (IOC/IODE)
ODINCARSA	Ocean Data and Information Network for the Caribbean and South America
QC	Quality Control
SIDS	Small Island Developing States
SMMA	Soufriere Marine Management Area (St Lucia)
SOPAC	South Pacific Applied Geoscience Commission
TNC	The Nature Conservancy
SWOT	Strengths, Weaknesses, Opportunities and Threats
UN	United Nations
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
URL	Uniform Resource Locator





## **Intergovernmental Oceanographic Commission (IOC)**

United Nations Educational, Scientific and Cultural Organization (UNESCO)

1, rue Miollis, 75732 Paris Cedex 15, France

Tel: +33 1 45 68 39 83

Fax: +33 1 45 68 58 12

<http://ioc.unesco.org>

IOC Project Office for IODE

Wandelaarkaai 7

8400 Oostende, Belgium

Tel: +32 59 34 21 34

Fax: + 32 59 34 01 52

<http://www.iode.org>