MeDir-OP, A Mediterranean directory for operational oceanography developed within the MAMA project

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Abstract

The Mediterranean network to Assess and upgrade the Monitoring and forecasting Activity (MAMA), a 3-year thematic network project shared by leading marine research institutions from all the Mediterranean countries, has contributed to strengthening the institutional and scientific platform for the establishment of operational oceanography in the region.

A key task in the MAMA project consisted in the stocktaking of activities and identification of current capabilities in operational oceanography on a country basis with a focus on availability of technological infrastructures, human resources and funding, applications and product needs. The information was collected by:

1. Country Profiles on the operations of institutes/agencies/organisations dealing with marine monitoring; national structures supporting such activities and marine affairs in general; relevance of marine sectors in the economic activities of each country
2. a structured questionnaire targeting a comprehensive inventory on the routine marine monitoring activities in the Mediterranean.

The Mediterranean Directory on Operational Oceanography (MeDir-OP) presents this information through the use of a user-friendly internet-based graphical interface allowing easy viewing of the metadata according to a number of categories. Specific information sets are collated into searchable mini-databases.

MeDir-OP provides the basis for assessing the needs and potentials for operational oceanography in the region. It serves as an essential step to identifying gaps in infrastructures, to underpin further research and technological developments specific to the region, and to designing an observing system that meets the needs of end-users.

Keywords Metadatabase, operational oceanography, directory, web interface

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1. Introduction

In 2002, the World Summit on Sustainable Development in Johannesburg (UN, 2002) recognised the very large role that the sea plays in supporting economies and society at large, and reached agreement on the urgent need to take further actions to achieve the sustainable development of oceans and coasts. The principles of the United Nations Conference on Environment and Development in Rio 1992, that established the Global Ocean Observing System (GOOS), were reaffirmed. In many parts of the world marine resources bear a key element to prospering economies, and a multitude of economic activities and consequent pressures on natural resources occur primarily in the coastal zone. This has brought coastal states to an incumbent situation where further development needs to be strictly rationalised to curb potential negative impacts on such resources, and to secure the various derived coastal and marine uses in the future.

This has led to more stringent regional commitments that coastal states have gradually come to face in fulfilling obligations to policies (such as in fisheries, bathing water quality, etc.), improving the management of marine resources, and in seeking a sustained development of the coastal zone.

Operational ocean monitoring and forecasting networks at global, regional and national scales, as defined in the GOOS (IOC, 1998), are needed to assist coastal states in meeting the requisites for the sound management of the marine resources. The challenge is to shape the marine forecasting systems in the regions upon state-of-the-art 21st century science and technology, adapted to the specificity of the regions, taking into account the more demanding needs of an evolving knowledge-driven society, the greater reliance of future regional economic growth on the marine sector, and targeting the benefit of different users in all the riparian countries. It is moreover necessary to build frameworks for partnerships between nations, to combine and integrate resources and infrastructures, and to promote a harmonious implementation based on the principles of co-development, co-ownership and sharing of benefits (Drago *et al.*, 2004).

GOOS Regional Alliances (GRAs) have been set up worldwide to co-ordinate the efforts of states towards the implementation of GOOS. They have different capacities, resources and levels of activity, but all seek to establish a global sustained system of observations to predict the state of the marine environment, to fulfil commitments to international agreements and to seek practical benefits for a variety of end-users and for the public good in general.

One of the key roles that GRAs are called to exercise consists in the pooling of information on operational marine monitoring activities in the regions. This role is reiterated in the Implementation Strategy for the Coastal Module of GOOS (UNESCO, 2005), and is pursued as a main goal in GRAND (GOOS Regional Alliance Networking Development) which is an EU-funded Specific Support Action that plans to carry out a significant inventory task in the GOOS regions (Vallerga *et al.*, 2005). Such inventories of existing operational observation programmes constitute a pre-requisite to the harmonious planning and optimal design of regional ocean observing, modelling and forecasting systems composed of integrated national components, and targeting the exploitation of results by a wide range of end-users.

In the Mediterranean, the thematic network project Mediterranean network to Assess and upgrade Monitoring and forecasting Activity in the region (MAMA) was conducted from 2002 to 2005 by MedGOOS, the GOOS Regional Alliance in the region. This project brought together a consortium made up of major marine institutions from all the Mediterranean countries, and staged a joint effort between countries to strengthen scientific links and build momentum towards ocean forecasting in the region. The aims of MAMA were centred on the trans-national pooling of scientific and technological resources through the sharing of experiences and the transfer of expertise, to bring capacities relevant to operational oceanography in the region to comparable levels, and to provide an integrated effort towards the planning and design of the initial ocean observing and forecasting system in the Mediterranean (Vallerga *et al.*, 2002; Drago *et al.*, 2003). This project has enabled MedGOOS to prove its role in providing guidance to the Mediterranean states and stimulate the necessary awareness, capacity building and pre-operational R&D to support operational oceanography in the region.

One of the specific objectives of MAMA was to identify the gaps in the monitoring systems in the region and in the capability to measure, model and forecast the ecosystem; and to integrate the knowledge base derived from relevant national and international RTD projects and programmes. To this end a major effort was conducted to gather information at country level on the present assets in the Mediterranean to monitor, assess and forecast the state of the coastal waters. The main focus was on existing initiatives in relation to ocean forecasting, current activities of marine research institutions involved in operational oceanography, availability of technological infrastructures, equipment, human resources and funding.

This activity culminated in the development of a Mediterranean Directory for Operational oceanography (MeDir-OP) as a main deliverable of MAMA. MeDir-OP resides on the MAMA website (www.mama-net.org). The underlying metadatabase can be accessed from http://capemalta.net/mama/wp1interface/dbase/.

2. Survey on the current status of ocean monitoring activities

The effort conducted in the MAMA project for the identification and stocktaking of the present capability in the Mediterranean for operational oceanography was run in parallel with an awareness campaign staged in each country, and a process of consultation with key stakeholders including public authorities responsible for marine affairs, marine research institutions, marine service providers and end-users in general. Information on marine agencies, institutes and centres that make marine observations and acquire ocean and coastal data in operational mode, and details on their monitoring activities were collected by a dedicated survey.

The collection of information was mainly done by two separate activities:

1. Country Profiles on the current capabilities in pre-operational ocean observations and forecasting
2. an inventory on the ongoing marine monitoring activities compiled by major marine-related institutes/centres on a country basis.

The Country Profiles are structured in three main sections:

Section A — Profile of relevant institutions

Section B — Profile of the national organisational structure in marine affairs and research

Section C — Relevance of the marine sector to the economy.

The profiles provide an overview on:

- the operations of institutes/agencies/organisations dealing with the monitoring, assessment and forecasting of the state of the ocean and coastal areas
- the national structure for the support and conduct of marine monitoring and research activities
- the key public administration/authorities responsible for marine affairs, environmental policy formulation and implementation
- the relevance of the maritime sector in the economic activities of each country. More specifically this activity has provided detailed information on:
  - key institutions dealing with the monitoring of the marine environment or underpinning research for operational oceanography
  - providers and potential users of marine services.

The Survey on Marine Monitoring Activities in the Mediterranean has enabled a comprehensive inventory on the existing marine monitoring activities in the Mediterranean, and the current related applications, serving as a first step towards identifying gaps in infrastructures, to underpin further research and technological developments specific to the region, and to design the initial observing system that meets the needs of end-users.

The metadata was collected by means of an on-line entry sheet in the form of a questionnaire structured in two parts:

- The first part aiming to identify in each country the current demand, requirements and practice for applications that make use of routine marine observations. The requested information enabled an assessment on the type and extent of current operational activities in ocean/coastal monitoring that address the needs of existing or candidate customers, including research. It also furnished a picture of the extended potential benefits that can be derived and developed from existing activities. The information included details on:
  - the main recipients
  - the key customer-based deliverables including descriptions of products and services provided
  - the monitoring activities including the main parameters measured, type of analysis, processing and assessments made to apply measurements to user needs.
- A second part focusing on the technical details of marine monitoring and observing sites, platforms and devices. It identifies the current practices in the observation and monitoring of the marine environment, including details on platforms, instruments, sensors, maintenance, telecom systems, data storage, exchange codes and formats, etc.

3. MeDir-OP, a regional directory for operational oceanography

The metadata derived from the surveys described above provided a large variety of information with many cross-linkages between categories. The synthesis and analysis was made by compiling information on specific themes and mainly by developing a metadatabase focusing on two broad fields, namely:

- institutes engaged in operational oceanography or undertaking related research
- routine marine monitoring activities.

This metadatabase forms the backbone of MeDir-OP.

The directory can be viewed by means of an internet-based, user-friendly graphical interface that was developed to furnish visual classified representations of the underlying metadata in the form of clickable layered maps. The maps group locations and descriptions of the main ocean/coastal monitoring programmes, location of key institutes underpinning operational oceanography, positions of buoys and country descriptions of related resources.

The institutions covered in MeDir-OP are key centres and agencies in the Mediterranean that deal with the monitoring of the marine environment or underpin research for operational oceanography, oceanographic data management centres, and providers of operational marine services.

Information is also provided on end-users of marine data, on the key public administrative units responsible for conducting marine affairs, and managers of environmental issues on a national and regional scale as well as general descriptions of national maritime economies with highlights on the relevance of the sea as an economic resource through the ranking of key classes of maritime activities.

At an equally prominent level MeDir-OP gives information on routine marine monitoring activities including the type of observing platforms, instrumentation, measured parameters, method of measurement, data processing and analysis, dissemination of related products, and other relevant details.

Furthermore MeDir-OP complements the Mediterranean directory (MeDir) with individual experts and scientists involved in marine research initiatives in the region. The MeDir database is a joint initiative of the MedGOOS Secretariat in Malta and the IOC/IODE Secretariat in Paris.

4. Structure of MeDir-OP

The information in the directory is presented by means of a web interface composed of a Control Panel, a Map Area and a Summary Box (Figure 1). The Control Panel provides a handle to the first level selection of metadata categories and sub-maps. It also gives access pointers to two metadata mini-databases and to MAMA-Net for on-line access to selected operational data services.

The Map Area is an interactive window consisting of a series of maps with pointers to spatial information and several pull-down menus for easy selection of metadata requests.

The Summary Box is the area where the results from a request are presented in a concise form. Detailed metadata descriptions appear in pop-up windows.

Figure 1 Main components of the MeDir-OP web interface window.

The directory map structure consists of three main sets.

4.1 MAP 1: Country profiles

This first map gives information on a country basis of:

1. **Institutes/Entities** — listing institute/entity names in each country with marine-related activities, each classified according to one of five types: marine centres related to ocean observations/forecasting, oceanographic data centres, general marine research centres, national marine environmental agencies, and other marine-related entities.
2. **Research and monitoring programmes** — listing research programmes/projects conducted in the country, shown in the form of a table indicating name of research programme and responsible institute. This section lists also the ocean modelling archives in a country.
3. **Marine affairs** — giving a choice between: Ministries/Authorities/Agencies and Coordinating Bodies. In both cases the information is given in the form of a table with name of entity and brief description of the entity.
4. **Marine sector economy** — giving a choice between a general description and the economic relevance of marine resources/activities in each country.

4.2 MAP 2: Marine Institutes/entities related to operational oceanography

This section consists of a set of four maps, one map for each of four categories of institutes/entities according to the following classification:

1. Marine Institutes/Entities targeting ocean observations/forecasts
2. Oceanographic Data Centres
3. National Environmental Agencies
4. Other marine-related entities.

The user is allowed to choose between these four categories and work on the relevant map according to the chosen category. For each category, map entries are indicated by points positioned on the geographic location of the institute/entity. Once a map is chosen, clicking on a point gives the name of the entity and other information: contacts; mission; institute type; activity type; sectors/field of activity; human resources; and a list of research and monitoring activities.

4.3 MAP 3: Research and monitoring programmes

This consists of a map showing geographic locations of research and monitoring activities. For each activity the name of the programme appears by moving the pointer over the location of the particular programme, and the corresponding information is given upon choosing from a list menu: name of programme, responsible entity and contacts; objectives; geographical area; key variables measured; platforms used; period of operation; source of funding.

Figure 2 Map showing locations of main monitoring stations in the Mediterranean Sea.

The activities are categorised into several subsections as follows:

1. Trend monitoring dealing with observations for detecting trends, identifying and assessing environmental changes, and including traditional monitoring activities
2. Ships of Opportunity for observations made from voluntary ships
3. Sea Level Observations covering measurements made mainly by coastal systems and sea level gauge networks
4. Marine Buoys, Wave Observations and Moorings which include real time monitoring with measurements made by automated systems and long term observations by other moored instruments

5. Hydrographic surveys and other programmes referring mainly to observations from regular marine surveys.

In addition, a searchable database was prepared and forms an integral part of the MeDir-OP. This on-line database serves to search, track, and categorise:

- marine institutions with activities related to operational oceanography
- projects and platforms for routine ocean/coastal observations.

Search sessions can be conducted at first level through the entry of a keyword, or more specifically at a higher level by choosing map category, country, institute type or geographical area.

5. Concluding remarks

The survey conducted within the MAMA project has provided a first comprehensive picture of the existing institutional set-ups, infra-structural assets and the human and funding resources deployed in operational oceanography in the Mediterranean region. Besides compiling a detailed inventory with descriptions of more than 120 routine ocean and coastal monitoring activities, this effort has in addition started to map the frame-works within which marine affairs are conducted in the riparian countries, and has prepared a first reference to the major marine-related economic activities that can benefit from operational observations and forecasting.

The exercise has served to put into practice a methodology for this kind of inventorying, and established a basis for acquiring, compiling, analysing and synthesising metadata relevant to operational oceanography. Partners have been empowered to repeat and update similar assessments at national scale.

The benefits of such inventorying efforts are multiple. This kind of mapping allows quasi-quantitative comparisons between countries and between regions; it prepares the way to the identification of additional resources in operational oceanography that are needed in countries to fully benefit from the basin-wide ocean observing system planned for GOOS; it is moreover the precursor to the effective design of an initial observation and forecasting system, based on combined and complementary national contributions and a co-ordinated upgrading of capabilities in all partner countries.

The Mediterranean Directory for Operational Oceanography embraces the bulk of the collected metadata and provides a web-based resource for the use of this information in planning and management. The MedGOOS Secretariat at the IOI-Malta Operational Centre within the University of Malta, in collaboration with the MedGOOS partners, aims to maintain and regularly update this metadatabase.

Some enhancements and further developments are planned mainly to better represent the socio-economic dimensions on top of the scientific and technology-related components. In a comprehensive approach to marine resource management and sustainability the inter-dependence between ecological considerations and socio-economic impacts/ forcings needs to be addressed (Kullenberg, 2004). To this end it is necessary to merge observational parameters with socio-economic variables that represent the multi-purpose interests of the various stakeholders, and enable an integrated ecological-economic approach that quantifies the socio-economic impacts of changes in the coastal systems.

In the specific case of operational oceanography, integrated assessments can provide a handle to adapt ocean observation and forecasting systems for maximal social and economic benefits; to enable monitoring and prognoses of the impacts of operational oceanographic activities on national and regional economies, on security and on public services in general; and furthermore to elaborate adequate levels of investment in such systems commensurate to returns and to social priorities and needs. This can only be achieved by destricating the complex interactions between the social, ecological and technological counterparts. It surely cannot be done without the backbone of relevant data and information.

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