Chapter 19

MERSEA: DEVELOPMENT OF A EUROPEAN OCEAN MONITORING AND FORECASTING SYSTEM

Ocean and Marine Applications for GMES

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Abstract: The strategic objective of the MERSEA Integrated Project is to provide an integrated service of global and regional ocean monitoring and forecasting to intermediate users and policy makers in support of safe and efficient offshore activities, environmental management, security, and sustainable use of marine resources. Thus MERSEA objectives are very close to those of GODAE, to which the project federates the European contribution. As it is still in its initial phase, this chapter does not present results yet, but aims to outline the scope and work plan of the project.

Keywords: Mersea, GMES, global monitoring, operational oceanography

1. Introduction

The MERSEA Integrated Project is funded by the EU Commission to develop the ocean and marine applications component of the future GMES system[1]. The GMES system is being developed to fulfill the requirements of the EU for independent global information services in support of policy making and sustainable economic development. GMES addresses also such issues as risk and conflict prevention, or the negotiation and monitoring of treaties and conventions.

The concept of GMES is to provide monitoring and operational services for the global environment. The best established and developed systems are the National Weather Services (NWS) for the atmosphere, which are truly

[1] GMES: Global Monitoring for the Environment and Security, a joint initiative of the EU and the European Space Agency

operational and global in their coverage, and issue weather forecasts regularly. NWS are also responsible for observations, analysis and forecasts in marine meteorology (wave forecasts, sea-ice conditions, storm surges), and marine safety (oil spills and drifting objects, search and rescue). Global ocean analyses and forecasts are also produced by some NWS for seasonal or climate applications, or in support of naval operations.

However, improvements in the ocean components of those systems are necessary and feasible. Progresses in high resolution numerical ocean modeling and data assimilation techniques, together with the availability of global data sets, allow more accurate representation of the three dimensional currents distribution –in contrast to many models that consider only the wind-driven component, for instance. Such advances have been implemented in several global systems, described in this volume. In particular, the FOAM, MERCATOR, and Mediterranean Forecasting systems are key components of MERSEA, complemented by major regional alliances around the North-West European shelves, the Baltic and North seas, and the Arctic and northern basins.

Specific ocean analysis and forecasting systems are needed to extend the range of services presently provided by NWS –and to improve them –as well as to respond to increased demand in several sectors, most notably ocean research, global ocean climate monitoring, ecosystem modelling, support for commercial applications in the offshore industry and maritime transport, or coastal management. These fields of application are the motivation for several international programmes, e.g. GODAE, or the Global Ocean Observing System (GOOS) and its regional alliances.

The four year MERSEA project started in April 2004, with the goal to deliver a working pan-European ocean system by early 2008. Some thirty eight agencies, institutes or universities in sixteen countries collaborate on the research and development effort.

Development of operational oceanography in Europe has been conducted under national programmes or research projects funded by the EU or the ESA. Consequently, there is a wide range of practices, formats, technical development, or institutional implementation. Some systems are fully operational, others are research projects, while some regions are not covered. It is one of the objectives of MERSEA to pool resources for the development of a high resolution system, to integrate regional systems by implementing standards and promoting best practices, and to fully validate the systems.

A preliminary project, MERSEA Strand 1, was conducted from January 2003 to June 2004, with participation of most of the partners of the present project. The objective was to assess the strengths and weaknesses of present systems, to conduct selected demonstrations (ecosystem modelling, and oil spill drift predictions), and to report on the lessons learned and make recommendations for future progress. The chapter by L. Crosnier and C. Le Provost in this volume describes one aspect of the project. It has proven

quite effective in building the MERSEA consortium, and in providing a baseline and starting point for the Integrated Project.

2. The MERSEA work plan

At the core of the system under development is the collection, validation and assimilation of remote sensed and in situ data into ocean circulation models that allow for the self consistent merging of the data types, interpolation in time and space for uniform coverage, nowcasting (i.e., data synthesis in real-time), forecasting, and hind-casting, and delivery of information products. Those products are aimed at intermediate users, such as NWS, or marine institutes and agencies in charge of ocean monitoring, or private service providers, who will use them in turn to improve their services or develop customized applications.

Accordingly, the work plan is structured in a number of work packages, that can be grouped in three main modules: one concerned with input data (remote sensed, in situ, and atmospheric forcing); the second with system design and development, production, research and validation, information management; the third with the development of specific applications. Other issues of overall assessment, outreach and training, and communication are addressed in the management and coordination work packages.

The various tasks and topics addressed in the project are summarized in a set of key specific objectives:

- Develop the systems needed, and use them, to provide real-time, high quality, validated, merged products from satellite data for surface height, surface temperature, ocean color, sea-ice and surface velocity.
- Implement and assess the value of moorings and gliders for bio-geochemical data. Initiate routine provision of real-time data from specific research vessels. Make cost-effective contributions to the in situ system for the Mediterranean and the global Argo system. Collect in situ data and make them available in real-time through a unique server.
- Implement and test a high resolution global ocean model with assimilation of remote sensed and in situ data; develop a deep ocean model for use in shelf seas and evaluate its performance on NW European shelf; evaluate methods for nesting of models ; develop and assess bio-geochemical models ;
- Progressively implement a coordinated ocean and sea-ice monitoring and forecasting system for the global ocean and European seas, assimilating in situ and satellite data and providing high-resolution forecasts on a daily or weekly basis for physical and bio-geochemical variables.

- Make systematic assessments of the performance of the analyses and forecasts of the physical and bio-geochemical variables.
- Assess the value of boundary data for regional forecasts and implement data assimilation methodologies for regional seas and test their impact.
- Develop an information management system that will deliver both real-time and delayed mode information to users, allowing them to exploit multiple data sets from many different sources with user-friendly internet-based interfaces. Provide full documentation and meta-data.
- Develop and demonstrate applications in support of the safety of marine operations including improved wave-forecasting, and forecasts for ship routing, the offshore oil and gas industry, oil spill drift.
- Implement research results and perform specific experiments to improve now-casting (analysis) and forecasting for ecosystems and seasonal weather forecasting.
- Help to organize appropriate teams and agencies to establish the proper framework for the ocean component of GMES by 2008.
- Develop a communication, promotion, education, and outreach program towards the general public, policy makers, end-users, and specialists to increase awareness and knowledge on the global ocean environment.

3. The MERSEA system

At the end of the project, in mid 2008, a working prototype system will be delivered. Its exact architecture is not defined at this early time, since the design is an essential task of the project. The present concept is that of a set of thematic centres: satellite products, in situ data, forcing fields, and the main ocean forecasting systems: global and regional. Those centres must be integrated by the adoption of common formats, practices, and quality standards. The institutional framework under which the system will be operated is an open question; the participating institutions (Met agencies and marine institutes) will continue to play a major role. The possibility of establishing a European Centre for Ocean Monitoring and Forecasting, is considered. Such a Centre would provide a focal point of excellence to conduct research and development, for training, to pool resources and operate the global system, and to distribute basic products to participating members. The major regional systems would be out-centres, with identified operators, and close ties to the global system. Considerations of funding, administrative status and international agreements are complex, and go beyond the scope of the project.

4. Conclusions

Several initiatives, such as the Group on Earth Observations and its System of Systems concept, and the GMES, provide a strong impetus towards the establishment of operational oceanography services in Europe. MERSEA intends to play a major role towards that end. There is certainly a strong public and political demand and interest in monitoring and understanding our global environment. There is perhaps also a somewhat utopian view in some quarters that everything can be observed and forecast, for the benefit of economic growth, sustainable development, public safety, and risk prevention. The recent devastating Indian Ocean tsunami must humble us: the terrible toll is due not only to the rare physical event and the difficulty to predict it; it is compounded by socio-economic factors (e.g. patterns of land use, settlement, and population growth), inadequate public education on the phenomenon, and improper communications for warnings.

Our models are imperfect, but significant progress is being made, and their realism and forecasting skill are constantly improving. These improvements result from advances in ocean modelling and assimilation, and from the availability of global data sets from satellites and in situ observing systems. One of the challenges is to sustain them in the long term and to transition them from research projects to operational systems.

MERSEA intends not only to develop the backbone of a future European ocean monitoring and forecasting system, but also to demonstrate its value for practical applications of interest to society.

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