Development and pre-operational validation of upgraded GMES Marine Core Services and capabilities

Reporting

Project Information

MYOCEAN

Grant agreement ID: 218812

Project website ↗

Status
Closed project

Start date
1 January 2009

End date
31 March 2012

Funded under
FP7-SPACE

Overall budget
€ 55 008 475,71

EU contribution
€ 33 800 000

Coordinated by
MERCATOR OCEAN
🇫🇷 France

This project is featured in...

RESEARCH*EU MAGAZINE
Components, systems and engineering

NO. 8, DECEMBER 2011

Final Report Summary - MYOCEAN (Development and pre-operational validation of upgraded GMES Marine Core

Services and capabilities)

Executive Summary:

The MyOcean FP7 project has been set up in the context of the GMES Marine Service, development selected by the European Commission to transition GMES to the provision of integrated and coordinated pan-European core operational oceanographic products and services. The objective of this service is to be utilised by intermediate service providers to meet information needs of the European Union, Member States, European industry and European Citizens. Four areas of benefit have been defined: (1) marine safety, (2) marine resources, (3) marine and coastal environment and (4) climate and seasonal forecasting.

The MyOcean Service provides core ocean information at global and European regional scales, from satellite and in-situ observations and from assimilative models in real time and over long time series. Essential ocean variables such as Currents, Temperature, Salinity, Sea Level, Sea Ice, Surface winds and Biogeochemistry are made available in a common catalogue presented in a single easy-access interface allowing users to discover, visualise and download about 240 core products.

The MyOcean "System of systems" relies on existing European operational oceanography infrastructures and is composed of 12 main Production Centres – 5 Thematic Assembly Centres (TAC) providing observation products and 7 Monitoring and Forecasting Centres (MFC) dealing with modelling and assimilation. Each Production Centre is responsible for its domain of activity or geographical area, therefore reducing unnecessary duplication. Production centres integrate into the overall MyOcean system through a Central Information System managing data flows and providing a unique and standard web interface to users (www.myocean.eu). The MyOcean integrated system shows efficient behaviour in operations thanks to well-defined roles among the hierarchy of systems. This has been made possible by rigorous project management and engineering methodologies for both system and organisation, including common planning, milestones and reviews according to standard guidelines and assessed by external experts. These common methodologies have also been applied to R&D activities which are centrally coordinated and managed to be directly relevant to service evolution. R&D activities have been reinforced by selecting specific actions through R&D open calls and by the organisation of MyOcean Science Days.

Strong standardisation efforts in terms of data product quality and performance have also been done in all Production Centres and managed at project level in order to provide users with reliable and unified product quality information.

MyOcean has moved towards a user-driven system by giving high priority to user interactions at each level of development and operational phases. User requirements are collected and particular attention is paid to user uptake. A Core User Group provides main drivers from the user point of view. Other users are engaged as Beta-testers in the Service validation and in the continuous service improvement process. In operations, user interactions are continuously monitored and feedback is collected through user surveys and specific user forums. Finally a unique MyOcean Service Desk is in continuous interaction with users, providing all necessary information and collecting any user requests.

MyOcean has set up a pan-European organisation among the 61 partners in 28 countries. This builds a model of governance based on a Board for strategic and programmatic issues, an Executive Committee gathering 18 Work Package leaders, chaired by a project manager and supported by a specific project management office. The top-level project management is assisted by two advisory bodies: the Scientific Advisory Committee and the Core User Group. Thereby, this pan-European organisation, with well-defined roles and responsibilities, manages the service delivery, the operational production, the quality

assessment and any evolutions or changes.

At the end of the project, MyOcean has reached its main objectives: provision of a core service as a main component of the GMES Marine Service, offering open and free access to a unified catalogue of products and services, based on an integrated System of Systems and acting as a single organisation. As a proof of usefulness of the MyOcean Service, 1000 Service Level Agreements have been signed by European operational agencies, intermediate users, users from the downstream sector or from the research and education domain. MyOcean paves the way for further development in a next sustained operational service.

Project Context and Objectives:
Readiness of European operational oceanography

During the 1990s the GODAE international project started to organise an oceanographic community, among academic research and national institutions, with the aim of improving knowledge of the marine environment. GODAE first organised global and large scale physical oceanography using modelling, observation and assimilation approaches.

The European MERSEA Strand1 FP5 project witnessed the first mature ocean hindcast experiments: the basin scale ocean "eddy permitting" model started to assimilate available satellite and in-situ data. These first "ocean estimation systems" offered a representation of the North Atlantic Ocean and the Mediterranean Sea, and were ready to be operated in real time. The European MERSEA and ECOOP FP6 projects provided more robust ocean modelling tools and observations representing the "eddy ocean", but also the development of regional operational demonstrators in European Seas, based on the same strategy.

The Marine Core Service (MCS) is a 'fast-track' development selected by the European Commission to transition GMES to the provision of integrated and coordinated pan-European core operational oceanographic products and services. The objective of the MCS fast track is to deliver a range of fully validated core operational oceanographic products and services which can be utilised by intermediate

service providers to meet information needs of the European Union, Member States, European industry and European Citizens.

The MCS fast-track was to be built on already existing and well-coordinated pan-European research and operational oceanography capabilities to deliver the service infrastructure described in the GMES Marine Core Services Implementation Plan.

Through participation in earlier Framework (e.g. MERSEA) and national projects, the European operational oceanographic community had been prepared to deliver an operational service according to the requirements of the Implementation Plan, and had already started its federation to achieve this objective. The MyOcean consortium, fully representative of this experienced, ready and motivated community has been structured around a core team of 12 core service operators, connected to key research and development players, ready to commit to operational service.

General concept of MyOcean

MyOcean addresses the topic SPA.2007.1.1.01 – development of upgraded capabilities for existing GMES fast-track services and related (pre)operational services. The MyOcean concept is compliant with the "Marine Core Service" concept defined by the Implementation Group, and detailed in the "GMES Fast Track Marine Core Service Strategic Implementation Plan" (Ryder, 24/04/2007). It can be summarised as follows:

• Thanks to a pan-European approach involving a network of key players of European operational oceanography, The MyOcean service aims at providing "core" information on the ocean in all areas of benefit identified by the MCS Implementation Group.

• Four areas of benefit are defined: (1) marine safety, (2) marine resources, (3) marine and coastal environment and (4) climate and seasonal forecasting, from which requirements have to be collected in order to define the MyOcean Service.

• MyOcean builds an open and free Service, as a single product portfolio presenting a clear offer on the core information related to ocean monitoring and forecasting, in a single access point to the whole set of information

• A production distributed through 12 production units interconnected as a system of systems, certified for operations and organized for innovation: 5 TACs dealing with observations (Thematic Assembly Centres) and 7 MFCs dealing with modelling and assimilation (Monitoring and Forecasting Centres).

• An organization to run the project and the service, but also to serve as a precursor of the future MCS management organization. MyOcean sets up an organization composed of a Board (chaired by the coordinator, dealing with strategic issues), an Executive committee (chaired by the project manager, and composed of the 17 other WP leaders), and two advisory bodies – the Scientific Advisory Committee and the Core User Group.

MyOcean Objectives

The MyOcean objectives have been defined as follows.

Objective 1: MyOcean proposes the MCS product and service portfolio for ocean monitoring and forecasting

MyOcean delivers a pan-European MCS product and service portfolio, which precisely characterises for the users the ocean monitoring and forecasting European "core service".

The MyOcean Marine Core Service is provided through a single entry point to access the product and service portfolio. The service delivery is based on secured web services and users are assisted by a Service Desk for understanding and ordering products and services.

MyOcean proposes a public service for the downstream sector, with a special attention to 3 key public user categories that have been targeted as a first step: Member States, EU agencies and Intergovernmental bodies

The MyOcean service provision is governed by Service Level Agreements (SLAs) with the MyOcean users.

Objective 2: MyOcean MCS infrastructures are made robust and optimised, and benefit from economies

of scale

MyOcean delivers a European ocean monitoring and forecasting core infrastructure, which is robust and optimized and benefits from pan-European economies of scale.

The MyOcean "System of Systems" is composed of 12 Production Centres - 5 Thematic Assembly Centres, handling space and in situ observations, and 7 Monitoring and Forecasting Centres, handling assimilative 3D modelling capacities - spread throughout Europe, but interconnected to form an integrated system thanks to an Information Management System and global workflow operations.

Each TAC and MFC centre considered individually is the reference centre in its area of competence for the rest of the consortium. They are organised to ensure (i) R&D activities which can be partly internal and external to the centre; (ii) a production and quality control, (iii) service operations including bulk delivery and expertise.

Each component of the system is based – when available and relevant – on pre-existing infrastructure; and follows a development validation and deployment plan to become robust, reliable, available and able to propose services with quality and continuity. Each sub-system should be in a position to demonstrate (i) scientific and technical progresses contributing to increase system robustness and/or the quality of products and (ii) visible economies of scale by reducing unnecessary redundancies. Economies of scale should be achieved through: the rationalisation into 12 Production Centres clearly committed in areas of competence minimising overlaps; the wide sharing generic tools such as the NEMO modelling code; the rationalisation of information management and user interface at pan-European level.

Objective 3: The MyOcean MCS service is validated and commissioned by the users

MyOcean delivers a MCS service validated by users, the feedback on this validation, and an organisation for a user-driven service.

MyOcean addresses the validation of its Marine Core Service in pre-operational conditions at two levels:

internally and externally
• Internally. The consortium organises – independently from the core service providers– the "service quality monitoring", checks the service compliance with Service Level Agreements, and identifies anomalies at each level along the production and service chain in terms of service availability and quality. Internal validation of the service quality is reported to users and service providers.
• Externally. The service is commissioned and validated by external users, based on representative service operations and service validation scenarios. A network of partners, independent from the core production, ensures the links with key users or organises the collection of requirements and assessment. Member States service providers, as users of the MyOcean MCS, are engaged in using the service to play the role of 'beta-testers'. Links with Inter-governmental bodies and European Agencies are organised to ensure requirements and feedbacks. Special partnerships are developed with EEA and EMSA to ensure the required level of specification and assessment of the MyOcean core service. External validation of the service quality is annually reported in Commissioning Forums involving service providers and users, and reported at the management level. A "core user group" is formed, acting as an advisory body for MyOcean in any strategic or steering issue.

Objective 4: MyOcean proposes a first model of governance for a MCS organization, and a contribution to the long-term roadmap

MyOcean delivers a MCS service organized for the pre-operational phase, its validation through a 3 year experience, and propositions dedicated to the MCS long-term roadmap.

MyOcean proposes and implements governance mechanisms to manage its pan-European marine core service in the pre-operational phase, and to support the European Commission and GMES stakeholders in implementing a full MCS service within the GMES programme.

MyOcean distinguishes the coordination, the governing, the executive and the advisory responsibilities, and forms different management bodies for these different roles.

The coordinator is assisted by a project office (directed by a project manager) duly manned to provide a real added-value in the cross-cutting coordination of the overall activity. A governing Board is set up to be the focal point for strategic issues related to the long term GMES MCS roadmap, and to ensure the project steering responsibility. GMES stakeholders are involved in this MyOcean strategic and steering level.

The executive responsibility is ensured by the group of work-packages leaders, chaired by the project manager.

Two permanent advisory bodies are organized: the Science Advisory Committee related to the scientific issues, and the Core User Group.

The reference intermediate users are committed to collect users' requirements for the whole application sector and to provide feedbacks on the service assessment by users.

A Marine Core Service (MCS) implementation roadmap, addressing long term schedule, governance, strategy, business models and data policy issues is prepared.

Objective 5: MyOcean proposes a first methodological approach for the full-scale implementation of a pan-European MCS capacity

MyOcean delivered a rigorous methodology to manage the implementation of the pan-European MCS, a

community educated to it, and a first feedback on it.

MyOcean proposes a rigorous methodology to ensure the deployment, qualification, upgrades and maintenance of the overall pan-European MCS system of systems, with a full validation process and compliance with sustainable operations.

This methodology considers a system – sub-system approach. A development plan is considered at each level committing to EC guidelines and based on project management and engineering standards including schedule, reviews, deliverables, documentation and configuration management, traceability, development guidelines.

Incremental development logic is considered, allowing the system and the services to be improved separately.

A quality management system is designed to remain sustainable; it addresses the system preoperational qualification, the service validation set up for the project, and the long term product quality assurance process for the MCS.

A Risk management process is set up.

Project Results:
(See figures or illustrations in attachement "Main S&T Results – illustrations v1.1")

1. WP 2 - CENTRAL ENGINEERING
MyOcean 1 - WP2 was composed as illustrated (see Figure 1)

WP2.1 and WP2.2 represent cross-cutting technical activities for the overall project. Their main objectives and outcomes were:
– Technical coordination
– Establish and adapt an overall methodology
– Support and help for implementation in other WPs
– Collective work coordinated by WP2 to carry out:
o Top-Level Definition, Design & Development (Definition, Requirements Analysis, Architecture & Design & Integration)
o Top-Level Verification (testing and other verifications)
o Top-Level Initial Operations (Transition, Validation, Support to operations)
– Definition of Quality Assurance and Management: Project, processes, services, system components and data products
– Configuration Management
– Change Management
– Release Management
– Definition of long term product quality management system
– Central role in the MyOcean Project review process for main releases (V1S1, V1S2, V2, V2.1)

WP2.3 and WP2.4 gathered all tasks related to MyOcean central sub-systems: MyOcean Information System (MIS, WP2.3) and MyOcean Web Data Access Portal (WP2.4). These central sub-systems are illustrated (circled in red) in the figure below (see Figure 2: The MyOcean Central sub-systems (MIS and Web Portal) within the overall MyOcean system), as linked to other sub-systems (Production Centres).

Their main objectives are:
– Provide the web services allowing the user to discover and download the product
– Provide an interface allowing the producers to describe the products in the catalogue
– Monitor the products, the user requests, the sub-systems
– MyOcean Showcase for Users, Partners, …
– Provide access to products and associated services (info, view, download)
– Manage Users Data Base
See Figure 3 "WP2.3 (MIS and WP2.4 (Web Portal) in the MyOcean System.

Major outcomes of WP2 during MyOcean 1:
• MyOcean 1 Service release (V1S1, V1S2, V2) delivered in due time and operational
• All Production Centres connected to central sub-systems delivering standard and common services to users
• Standardization (common tools, use of OGC Standard, INSPIRE compliant)
• A Single point of contact for Users
– One single interactive catalogue with all MyOcean products and services, Discovery, Access and

Viewing
– One single user contact point : The MyOcean main Service Desk
• Integration of Networks
– All Production Units sub systems connected to central sub systems
– All Organizations connected into a common Organization
– Hierarchic Network of Service Desks
• MIS and Web Portal central sub-systems carry out a large part of the MyOcean system integration. They represent the framework within which future capabilities will be embedded and to which Production Centres are connected: this is the MyOcean System (see MyOcean Web-Portal : www.myocean.eu)
• MIS and Web-portal successful operations totally compliant with Service Level Agreement (SLA) with Users

Main difficulties or deviations:
The main challenge (and difficulty) was to set up a common standard engineering method for the overall project, and make all partners follow this methodology to keep under control the major objectives of the project
Delivering a consistent and integrated system and service at mid-project time (December 2010) was the greatest constraint impacting efforts, resource allocation, versioning strategy, etc.
Adapt and apply processes to organize the MyOcean Service based on ITIL good practices.

2. WP3 – RESEARCH AND DEVELOPMENT
The Research and Development effort in MyOcean was distributed between a central work package (WP3) dedicated to generic and cross-cutting scientific developments, and R&D activities directly undertaken by the Production Centre work packages (WP4 – WP15).

Consistently with this project organization, the key objectives of WP3 were: (i) to provide MFCs with state-of-the-art modeling and assimilation tools, related expertise and scientific support ; (ii) to articulate the

generic & cross-cutting WP3 R&D with the more specific R&D in other WPs, and (iii) to build, with the help of a Scientific Advisory Committee, the scientific strategy of the project by organizing Open Calls to address R&D needs not specified in the initial work plan, and by linking the MyOcean R&D with external research and opportunities.

The R&D plan in WP3 included two components. In WP3.1 the R&D aimed at improving the generic tools to be shared by several production units, such as assimilation algorithms, ocean circulation codes, forcing functions, biogeochemical and ecosystem models. In WP3.2 Open Calls for R&D proposals were set up to address cross-cutting issues not covered by the initial work plan. The Open Call process was very helpful in providing a flexible mechanism to address novel R&D needs appearing along the project development, taking into account the scientific strengths and limitations of the MFCs and TACs components. The first MyOcean call for R&D proposals was implemented during the first year of the project, while the second call was published in 2010. A total of 12 projects were selected and implemented in MyOcean to consolidate the core scientific activity.

A Scientific Advisory Committee (SAC) was set up from the project start, involving 12 high-level

oceanographic experts from Europe and the international community involved in Operational Oceanography (e.g. the GODAE OceanView international program). Several meetings of the SAC were organized under the leadership of WP3 with the objective to (i) review R&D activities carried out as part of the TAC, MFC and cross-cutting work packages, (ii) assess and select projects submitted to the Open Calls, and (iii) formulate recommendations about scientific issues and perspectives to be developed in MyOcean and beyond.

In terms of scientific achievements, very significant progress has been accomplished in the fields of modelling the physical ocean circulation from global scale to regional seas, coupling the physics to biogeochemistry and marine ecosystem modelling, assimilation of satellite and in situ observations into models, data analysis and validation methodologies.

The reference code adopted for modeling the circulation in the MyOcean global system, as well as in several regional systems (Mediterranean, Black Sea, Western European shelf seas) is NEMO (Nucleus for European Modeling of the Ocean). The work done has been directed toward assessments of new physical parameterizations, improvements of the global ORCA025 (1/4°) model configurations common to the research and operational communities, and development of the new global 1/12° model configuration (ORCA12) and regional configurations in Western European shelf seas. Coupling to sea-ice has been significantly improved by implementing a new, physically-based "embedded" sea-ice scheme. In addition, NEMO was adapted to tackle the particular challenges in modelling the ocean margins, shelf and coastal seas. This required accurate representation of the propagation of coastal trapped waves (e.g. tides and surges), the accurately representation of vertical mixing at multi-boundary layers, the juxtaposition of steep topography and stratification, and modelling the flow around complex coastlines and regions of restricted exchange. At the end of MyOcean, NEMO is the common modeling platform adopted by almost all groups, from research to operations.

In terms of data assimilation, four-dimensional extensions of Kalman filters, called smoothers, have been developed for a better processing of satellite and in situ observations into models. These methods are

required particularly to solve the initialisation problem (finding an accurate ocean state to initialise a model forecast), and to improve future reanalyses of the ocean circulation. Part of this work included new developments of the SEEK and EnKF filter and smoother, complemented by new approaches to treat the analysis of non-Gaussian variables. Research activities focused on the application of Gaussian anamorphosis extension of ensemble-based Kalman filters to both problems of state and combined state-parameter estimation. A successful demonstration of these methods was made to assimilate ocean colour products into coupled physical-biogeochemical models. By combining state-of-the-art hydrodynamic-biogeochemical models with fisheries data and biological knowledge, it was further demonstrated that the generation of spatially resolved prognoses of fishing potential for small pelagics are within reach.

Internal communication and coordination of the scientific activities between WP3 and other WPs was essential for the scientific progress of MyOcean. An important event organized by WP3 to strengthen the scientific coordination was the 2010 MyOcean Science Days meeting, which was the first European Colloquium on scientific challenges of the GMES Marine Core Service. This meeting took place in Toulouse (France) at the Météo France International Conference Centre, December 1st – 3rd 2010. This event was organized at the MyOcean project mid-term with the aim of providing a forum for discussion of

all scientific matters related to the development of monitoring and forecasting systems, quality control and processing of observations feeding into the assimilative systems, and usage of MyOcean products for scientific applications. The plenary meeting of the first two days was attended by 130+ participants from 18 different countries, representing 45 institutions. The scientific issues addressed in the presentations were related to recent advances in physical ocean modelling and operational implementations, data assimilation developments, reanalyses and applications to marine biogeochemistry. The oral sessions were complemented by a remarkable poster session in which about 40 high-quality posters were presented.

In addition, a number of more specific workshops and meetings were organized to enable cross-fertilization of scientific advances within and outside the MyOcean sphere, such as the DRAKKAR/WP3 meetings which take place every year in Grenoble, providing an opportunity to review the progress made in ocean modelling using NEMO across MyOcean and external research projects of the international Drakkar consortium.

A special issue of the Ocean Science journal has been set up in 2012 to collect the most mature scientific achievements from MyOcean. A total of 33 manuscripts have been submitted, providing high visibility to the scientific progress made by MyOcean. In addition to the OS special issue, the whole R&D effort undertaken in MyOcean is documented in a series of R&D reference reports available upon request. All this documentation represents the scientific legacy of the project and provides a comprehensive background to help define the R&D roadmap of Operational Oceanography for the next years.

3. WP4 - THE GLOBAL MYOCEAN MONITORING AND FORECASTING CENTER (GLO MFC)

The MyOcean service is based on production centers that elaborate products that are delivered to the users through the MyOcean central service portal. The products are elaborated in production units and served on servers that are not centralized but located at the dissemination units, generally close to the production units.

The MyOcean global Monitoring and Forecasting center (the Global MFC) is one of these production centers. Its goals are (i) to develop systems based on assimilative models that are operated in real-time to

provide ocean products on the global ocean, (ii) to develop and implement a monitoring system that produces in real-time level-4 (gridded) products based on the real-time observations (without prognostic model), and (iii) to produce global reanalysis products, for a period covering the modern altimetry years (starting with the launch of ERS-1 and TOPEX POSEIDON at the end of 1992).

The real-time forecasting system

Before the start of the MyOcean project, Mercator Océan had developed and was operating forecasting systems, based on NEMO OGCM on ORCA grid (e.g. global at ¼°, with a 1/12° zoom over the north Atlantic and the Mediterranean), assimilating in situ profiles (provided by CORIOLIS), altimeter data (provided by SSALTO/DUACS) and Sea Surface Temperature products (RTG SST, retrieved with the forcing fields). In addition, it had developed a demonstration eddy resolving system (based on a global 1/12° NEMO configuration). All these systems were using ECMWF NWP products to force the ocean. The Met Office had implemented and was operating a suite of ocean forecasting systems (FOAM) which had recently been adapted to incorporate the same global ¼° NEMO configuration as the one used by Mercator Océan, corresponding also to the one used by the research community within the DRAKKAR project, but using different assimilation system, different sources for the observations, and using the Met Office NWP system output to force the ocean.

We have then implemented within MyOcean the operational ocean forecasting component of the Global MFC based on these assets, the Mercator Océan system being the nominal ocean forecasting system (e.g. delivering nominal services), while the Met Office system was implemented as a backup to be used in the case of Mercator Océan system failure.

We have then consolidated the systems operated at Mercator Océan and at the Met Office connecting them to MyOcean through the gateway of the MyOcean Information system (MIS-GW), and consequently delivering operational products and services based on these automated product generation. This was achieved for V1.

We have also extended this nominal production capacity, setting a R&D activity whose goal was to develop the science needed to implement these extensions:

• Towards the global at 1/12°
• implement a 1° global biogeochemical system coupled with the assimilative physics at ¼°
• implement daily services

These new capacities were implemented at V2.

We have also conducted some R&D tasks to prepare the future evolutions of FOAM at the Met Office: e.g. tasks (done by NOC-S) to evaluate the performances of the CICE sea ice model (which is the Met Office choice for the future in comparison to the LIM system which is a NEMO standard, and which is used by Mercator Océan), to evaluate HadOCC and MEDUSA two biogeochemical models used in the UK (as compared to PISCES which is a NEMO standard and is used at Mercator Océan), and also tasks (done by the Met Office) to prepare the future coupled system working on the air sea interface, and on NEMOVAR, the variational assimilation system to be used in the future by the Met Office.

The real-time monitoring system

CLS had in the past developed together with Mercator Océan a system based on the interpolation of observations who provide level-4 multivariate estimates of ocean variables (temperature and salinity) using the global ocean observing system (remote sensing with SST and altimetry) and in situ profiles of T and S (including ARGO).

The operation of this system is part of the Global MFC; the monitoring products are produced and delivered to the users. They are reference products based on observations only (e.g. without a prognostic

model and without data assimilation).

The reanalysis

In addition to this real-time capacity, we have defined a concerted project to gather existing forces and initiatives in Europe to produce global reanalysis at ¼° (namely the GLORYS project in France whose main partners are Mercator Océan and LEGI, a reanalysis project in the UK, led by the University of Reading who had already produced a reanalysis at ¼°, and CMCC who already produced low resolution reanalysis, and who volunteered to enter this coordinated European ¼° global reanalysis project), based as much as possible on the same model configuration (e.g. the ORCA025 model used by the DRAKKAR project, Mercator Océan and the Met Office),based on an agreed protocol (for the production and the assessment of the reanalysis), based on reprocessed input data (by the TACS), and using different assimilation systems (based on the experience of each of the corresponding groups).

This work gathering forces from 3 European reanalysis groups has been extended to incorporate the Canadian Department for Fisheries and Ocean (DFO) efforts because they had plans to contribute to global reanalysis. It has been extended also to include the reprocessing by CLS of the observations using the monitoring system operated in real-time and described above.

Finally, based on the assets of the GLORYS and DRAKKAR project, LEGI has been identified as a

leading organization to implement and share the reference ORCA025 model configuration. This configuration has been used to produce a reference forced simulation that complements the reanalysis ensemble.

Doing so, it was foreseen that joining these forces would create economies of scale and would foster the development of global reanalysis at eddy permitting (the model being developed and validated only once, the reanalysis production and assessment protocols being defined together and only once…).

All these products have been produced at V1: the reference forced simulation (by LEGI) the reference monitoring product by CLS, a set of 3 reanalysis products (produced by Mercator Océan, CMCC and the University of Reading), all of this covering a 17-year period (from 1993 to 2009). These products have been updated at V2 to incorporate new reanalysis products for which were demonstrated product improvements, and to extend the time series to incorporate the year 2010 (for some of the datasets).

The future

The global MFC has successfully fulfilled its mission; it is based on state-of-the-art assimilative models operated continuously, the service being seamlessly delivered while the system is upgraded, the products are served through MyOcean dissemination system, according to operational level agreed between the global MFC and MyOcean (availability, timeliness, …), its products have been extended to include daily service, biogeochemical services and eddy resolving global services based on R&D accomplishments.

The future consists of the continuation of this global MFC within the MyOcean 2 project. Some major changes compared to MyOcean have been already defined: the operational robustness of the nominal forecasting system operated by Mercator Océan (availability measured in 2011 better than required) pushed the consortium to abandon the concept of having a full system ready to back up the nominal one, which do not deliver products (only the products of the nominal being disseminated), because it was judged more efficient to concentrate the efforts on (i) developing a single system, fighting against the single points of failure within one system rather than maintaining two different system s in two places, and (ii) preparing the future services by developing and demonstrating a new capacity based on eddy permitting (1/4°) coupled ocean, ice, wave and atmosphere system.

The global MFC reanalysis initiative, unprecedented worldwide, is a success (the products are delivered, and are useful). It will continue within MyOcean 2 within a specific work package (e.g. outside the global

MFC).

Extension of the system capacity to improve the service delivered will include (i) adaptation to the changing environment and (ii) improvement of the quality of the products based on R&D efforts (improvement of the BGC resolution, implementation of a worldwide daily service at 1/12°…)

4. WP5 – ARTIC MFC

The Arctic MFC started with a V0 system (called TOPAZ3) inherited from the MERSEA project. Two identical versions of the TOPAZ3 system were then running real-time forecasts in parallel at NERSC and in met.no's pre-operational suite. The conceptually flexible system, allowed already the assimilation of 6 different data types of ocean observations (SLA, SST and Argo T/S profiles) and sea ice observations (concentrations and drift), but suffered from too little visibility and insufficient validation. The Arctic MFC also needed to tackle additional challenges: the inclusion of a specific ecosystem model for the Arctic, the production of a long reanalysis and the adaptation of the system and service to the MyOcean standards. Three years of collective efforts and two complete upgrades have since then made the Arctic MFC V2 an improved, quality-controlled system, thus more attractive to users.

The R&D for the Arctic MFC had tangible effects already in the first transition from the V0 to the V1 system. The EnKF needed an upgrade in order to ingest higher resolution SST data OSTIA from the SST-TAC as well as along-track altimeter data. The analysis was therefore carried out in ensemble space with a deterministic version of the EnKF (Sakov et al. 2010). A number of practical settings were also tested in the same time and implemented on the V0 system, improving spectacularly the assimilation efficiency (for example the errors on the ice edge location reduced from about 200 km to 50 km). The EnKF upgrade also streamlined the analysis step and reduced its execution time by a factor of 6. Improvements of the physical ocean model were taken up too, many of them being provided freely by the HYCOM community: a new hybrid vertical grid remapping reduced the temperature and salinity biases below the mixed layer, and the numerical development from Morel et al. (2009) allowed a near-halving of the model CPU costs. The model vertical resolution was then increased from 22 to 28 hybrid layers so that the vertical distribution of water masses was improved from V0 to V1. A new sea ice rheology was proposed for the Marginal Ice Zone and became a unique feature of the real-time system. It will evolve into an advanced coupled wave-ice model in MyOcean2. The sea ice thermodynamics (snow and albedo) were also improved as part of V1 as well as the river input data, channelled from the ECMWF ERA-interim to estuaries via the TRIP hydrological model. The latter was necessary for estimating freshwater fluxes from the otherwise unmonitored rivers around the Arctic. Ice type variables were also appended to the V1 model products using a rudimentary ice age tracer. The above upgrades (defining the TOPAZ4 system) were ported to the HPC Njord in Trondheim and the real-time system then entered met.no's operational chain, monitored by duty operators, in time for the release of the V1 system. This ended also the period of redundant V0 runs at NERSC and met.no which had proven useful during initial troubleshooting of V0. The quality of the V1 system was then monitored routinely following the specifications of the PCQV and accessible publicly through the portal, including an innovative measure of distance to the ice edge.

A Pilot reanalysis was also integrated with the same V1 system for the period 2003-2008, assimilating 6 data types including T/S profiles from the DAMOCLES IPY ice-tethered profilers. An extensive validation of the V1 Pilot reanalysis used data was from MyOcean TACs as well as external sources (AARI, NABOS)

of sea ice and ocean data (Sakov et al. 2012, Volkov et al. in prep.), involving the partners NERSC, IMR and NIERSC. Meanwhile, developments of the NORWECOM ecosystem model were carried out at IMR and NERSC with the adaptation of the meso/micro zooplankton module from ECOHAM4, the inclusion of river nutrient fluxes from the GLOBALNEWS project. The NORWECOM parameters were then calibrated using IS TAC data in the Norwegian and Barents Seas. Extra biological samples were taken in the Fram Strait, taking advantage of a WIFAR cruise, in an area void of data. Those will be used for validation during MyOcean2. NORWECOM was the main addition from the V1 to the V2 system, providing two new biological products in real-time and reanalysis modes: The real-time forecast product being NORWECOM coupled online to the TOPAZ4 system at the same horizontal resolution (12-15 km) assimilating physical observations only (see Figure 1), and the reanalysis product at coarser resolution (50 km) assimilated jointly physical and biological data (surface chlorophyll from ocean colour), using the EnKF developments from WP3. The V1 TOPAZ4 physical reanalysis was also integrated on the period 1991-2001, which, although shorter than planned, constitutes the longest stable run of a dynamic ensemble assimilation system and used about 1.5 million CPU hours on the HPC Hexagon in Bergen. Further adjustments of the EnKF were introduced while performing the Pilot reanalysis - bias estimation, model errors, moderation of observation errors - which reduced again the residual errors by 30% from the Pilot to the full reanalysis.

Since the model codes are shared between met.no and NERSC, these improvements benefited the real-time assimilation system, which was ported a second time to a new computer in Trondheim. The transition to the MyOcean input streams was painless (SIW, IS, SL and SST TACs), in particular the new CryoSAT2 altimeter data from the SL TAC was assimilated in February 2012, which may have mitigated the impact of the loss of ENVISAT.

From WP2, the advanced visualization service presenting consistently reanalysis and real-time products became a success among experts and semi-experts: Arctic bloggers, film-makers onboard ice-going vessels were able to consult short-term forecasts and assess the normality of the situation with respect to the reanalysis. Also using the MyOcean Information Services, internal comparisons of the operational V2 forecasts to those of the Global MFC are conducted routinely by met.no anticipating on the work planned in MyOcean2.

The Arctic MFC has a tight link with the offshore oil and gas industry, in particular with TOTAL E&P and various Joint Industry Projects (KarBiac, LoVeCur), another strong link has been constituted with the climate community through the projects MONARCH-A, SIDARUS and GREENSEAS and the Norwegian national users of BarentsWatch. The communication between the partners used web-based tools (Subversion for code management, a wiki page and a mailing list). The Arctic MFC partners were successful in submitting small R&D projects in WP3.2 (ProbaCast, Harmony-on-Ice). 9 scientific articles were published or submitted between all parters.
See Figure 1 "Dynamic view of the spring bloom onset in the Arctic biological forecast".

5. WP6 - BALTIC MFC
The Baltic Model Forecasting Centre BAL MFC consists of five Baltic partners. The partners BSH, Germany DMI, Denmark, FMI, Finland and SMHI, Sweden has performed model simulations as Production Units (PU). The last partner MSI, Estonia has taken the lead in the calibration and validation of the Baltic model products. DMI has been the Production Centre (PC) for the BAL MFC.
The physical ocean model used in the BAL MFC, the HIROMB-BOOS Model (HBM) has been developed

within the MyOcean project. The objective was to integrate the already existing Baltic Sea models into one common operational forecasting system, and combine the independent model development going on at the Baltic institutes into one operational system developed commonly via code sharing tools.
A model evaluation of the existing models took place within the BAL MFC and the DMI version of the Cmod 3D ocean model original developed at BSH was selected as the baseline Baltic ocean model code. Already existing model features from the other Baltic partners were then integrated into this system. Implementation plans for inclusion of new model features and upgrades improvements of already existing features have been thoroughly discussed and prioritized within the BAL MFC group and formed the baseline for the model development work and the MyOcean version upgrades for V1.1 in June 2011and V2 in January 2012.
Code stability and code portability (IBM, Linux, Solaris, etc.) of the HBM code have been a high priority, as the HBM model system is used in several institutes around the Baltic Sea to provide operational forecasts for the physical condition in the Baltic Sea. The model development has focused on a generic implementation with high portability, usable for (almost) all regions and with a free choice of horizontal, vertical and temporal resolution in every area. Two-way nesting of any numbers of sub-areas is possible. A high technical standard has been introduced in the code with respect to correctness and performance. The

code is completely written in ANSI-fortran90 and parallelized for both openMPI and MPI. An interface for coupling for external model components has been introduced and used for the bio-geo-chemical module production run.

Production achievements

A multi-model ensemble approach has been introduced in the Baltic group with respect to the physical ocean model products. The same HBM code has been run at all 4 PUs but with different model set ups as preferred optional features; different forcing; different model grids; nesting areas and resolutions.

One PU (DMI) was nominated to produce the nominal MyOcean Baltic daily operational forecasting product for the physical conditions in the Baltic Sea, and the 3 other PUs products were used as additional products for back-up systems and for inter-comparisons studies.

The bio-geo-chemical module ERGOM (developed original at IOW, Germany), has been used coupled to the HBM code to produce the daily operational Baltic bio-geo-chemical product available from V1.1 June 2011.

Two different data assimilation methods have been coupled to the HBM code and used for two 20 years Reanalysis simulations.

The work in the Baltic MFC group focused in the first year of the MyOcean project on the evaluation of the existing model systems in the Baltic Sea, and the establishment of common implementation plans for the further integration and development of the common HBM model system for the model upgrades for V1 and V2. During the 2nd year and 3rd year the model development has continued with focus on the improvements from V0 to V1, and from V1 to V2, respectively. Furthermore focus has been on designing the Baltic MFC calibration and validation framework, following the recommendation from the MyOcean PQCV group. The Baltic calibration and validation framework was successfully implemented for the V1 and V2 product upgrades, and will continue to be used in the future.

The Baltic MFC products evolvement in the MyOcean Catalogue:
The V0 Catalogue:
• One product (BAL PHYS) with forecast for the physical parameters in the Baltic Sea. Horizontal

resolution: 5 km. Vertical resolution: 5 vertical layers. Product update: twice daily.
The V1.1 Catalogue updated in June 2011:
• The BAL PHYS products were updated: the HBM ocean code was upgraded and improved; the product was extended to include 15 vertical layers as a request from the users.
• A new BAL BIO product was introduced with forecast for the bio-geo-chemical parameters in the Baltic Sea. Horizontal resolution: 5 km. Vertical resolution: 15 vertical layers. Product update: twice daily.
The V2 Catalogue updated in January 2012:
• The BAL PHYS products were updated: the HBM code was upgraded; the product was extended to include 25 vertical layers as a request from the users.
• The BAL BIO product was upgraded: the ERGOM code was upgraded and improved; the product was extended to include 25 vertical layers.
The V2.1 Catalogue upgrade in March 2012:
• Two new Reanalysis products were introduced with 20 years monthly fields for the physical parameters in the Baltic Sea for the period 1990-2009. The two products are based on model simulations with the HBM V1 code coupled to the two different data assimilation schemes: 3DVAR and Uni-variate Optimal Interpolation with elliptical shaped correlation functions implemented at DMI and SMHI, respectively. The

purpose of having two different Baltic reanalysis products was to estimate the accuracy on the reanalysis from using different data assimilation methods. More information on the Baltic Reanalysis products can be found in the validation report "MYO-WP06-ScVR-RAN_PHYS".

The Baltic MFC calibration and validation framework
The BAL MFC has during the 3 year defined a detailed calibration and validation framework we have used for the model and products upgrades for V1 and V2. The core variables included in this framework are temperature, salinity, sea level, sea ice and transports from the PHYS product, and nutrients, Chl-a and dissolved oxygen from the BIO product. The MERSEA metrics system is used and all the classes, ie class 1-4, are addressed within this Baltic calibration and validation framework.

The framework consists of:
• a calibration of the model for a 2 year model hindcast period decided to be the years 2007-2008 with a well-defined set of observations and calculations procedures to address the quality of the model simulations before operationalization.
• a validation to estimate the quality of the provided products just after operationalization, with the use of the observations available for this 2-3 months period in the statistical calculations.

For V1 all three operational HBM simulations run at BSH, DMI and SMHI, and the one ERGOM simulation run at DMI, went through a thoroughly calibration and validation procedures, for more details see the reports: MYO-WP6-ScCR and MYO-WP6-ScVR.
For V2 all four operational HBM simulations run at BSH, DMI, FMI and SMHI, and the one ERGOM simulation run at DMI, went through a thoroughly calibration and validation procedures, for more details see the reports: MYP-WP6-ScCR-V2 & MYO-WP6-ScVR-V2.
Examples from this report are included in Figures showing:
• observed and modelled ice coverage area for 2007 with a time series plot and a Taylor diagram (from the V2 calibration report)

• map of sea level statistics; the colour indicate the PU with the lowest root mean square difference (from the V2 validation report)
• plots of mean deviation of SST for 15/1 -15/2 2012 from the 4 PU simulations (from the V2 validation report).
The above mentioned calibration and validation reports show that Baltic MFC products have improved in quality from V0 to V1 and again from V1 to V2.

Integration into the MyOcean system
The Baltic products have been fully integrated into the MyOcean Information System from V1 June 2011, with respect to discover the Baltic model products within the Catalogue; to view the products in the dynamic viewing, and for downloading via ftp, opendap and the subsetter via the MIS-gateway software.

6. WP 7 – ATLANTIC NWS MFC
The NWS MFC have successfully completed the transition from the pre-MyOcean state to a position of delivering a service following common MyOcean standards and tools, and following the ECSS and ITIL

methodologies prescribed by MyOcean. The validation phase at V1 has been passed, and the sub-WP is providing an operational service both in terms of the full end-to-end documentation that is required to ensure the service meets its requirements and in terms of the ability to deliver to the FTSS following the obligations set out in the NWS MFC OLA.

The difficulties in the technical implementation of the MyOcean Information System and the initial effort required to embed processes for maintaining and supporting the service have been overcome. The work to implement the technology, and the significant amounts of documentation required meant there was more effort needed to "operationalise" the service than was at first envisaged. Despite that, the NWS MFC became operational to schedule following MyOcean specifications with two production units providing a forecast service (met.no and the Met Office) and two production units providing hindcast simulations (NOC and IMR), delivered through the two NWS MFC dissemination units at met.no and Met Office.

As well as having achieved the implementation of the production and service infrastructure, the NWS MFC has also made significant progress in the scientific and cal/val aspects of the work. The collaboration with teams from around the NWS region has proved invaluable in making progress in these areas.

Coordination

A number of project meetings have been organised and have contributed to the successful progress of the WP7 NWS MFC activities. The NWS MFC project meetings are increasingly leading to a strong team across the WP that is contributing to successful outcomes in, particularly, the R&D and Cal/Val sub-WPs. There has been participation in a wide range of MyOcean coordination tasks and meetings, as well as coordinating for example with the NEMO community, the IBI MFC and the BAL MFC.

Research and Technology

The work was divided into sub-tasks. The first, and largest, task was to develop the NEMO system and couple it to a suitable biogeochemistry model to allow it to simulate shallow, tidal waters. NEMO was originally designed as an open-ocean model, and was less mature as a coastal/shelf model at the beginning of the project than had been expected. This task was, however, completed successfully and in time to allow a NWS configuration to be developed that was suitable for the NWS region with the required

forcing, data assimilation and parameterisations for the region. This system was made operational for the MyOcean V1 release. The use of data assimilation in the system is a major step forward for the NWS MFC.

Smaller sub-tasks to deal with specific aspects of the system were also included, although were of lower priority than the tasks mentioned in the paragraph above. These include improving boundary conditions from the Baltic, the Atlantic and from rivers which have led to improvements in the system presently operational, and will lead to further improvements. Work was also done to understand options for physical and biogeochemistry data assimilation schemes for shelf environments.

The majority of the research budget was for targeted development of the nominal forecast system, but additionally a small budget was available to develop the hindcast systems. Two model systems have been used to provide the hindcast products, both of which have been developed on the basis of evaluation of the simulations available at the beginning of the project.

Implementation and Maintenance

This work package can broadly be split into two major strands of work, the implementation and the maintenance. Implementation includes pull-through of the research to provide the appropriate products in

an operational way (products), the implementation of the IT infrastructure to deliver the products (system), and the documentation and human infrastructure to support the production and delivery (service). The implementation was largely completed on the products and system side for V1. For V2 the changes to the system and products also required effort, although less so. The service design for human processes was also fully implemented at V1 and as a result of our experiences updated at V2. The full NWS service has been tested in operations and the implementation shown to work effectively for the system and service. Maintenance of the system has been on-going, and given the complexity and recent implementation of the system/service significant effort has been required on the maintenance side whilst the (pre-) operational service beds in. The documentation demanded for MyOcean required significantly more effort than was initially anticipated. However, the NWS MFC provided all documents to support the products, system and service as required. The service infrastructure has been designed and is described in detail in the SIOPM. A service manager for the NWS is in place and has been involved in designing the NWS service. The processes by which incidents and changes are managed have been documented. This includes product management processes and having dedicated staff for product management in the Met Office and met.no Dissemination Units. A robust backup system is in place with the required MyOcean standard delivery interfaces, production monitoring and service infrastructure.

Production
Products as described in the FTSS have been produced and delivered since the beginning of the project as expected. The robustness of the service meets the OLA requirements. The NWS nominal and backup forecast production systems are part of Numerical Weather Prediction operational system with full 24/7 operator supervision and operational monitoring. The transitioning of the versions has been completed successfully following MyOcean criteria. Physical and biogeochemical hindcast data from POL (now NOC) and IMR have been produced and are available from the NWS MFC dissemination units. Observational inputs to the NWS nominal system have been monitored. The data ingestion chain is monitored at various stages including at the point the data is transferred into the production chain. A final check, after the operational system has run, is also routinely carried out to ensure no problems have occurred in the use of the input data. The operational system has been monitored on a daily basis using a

web-based tool which has been developed to display plots and metrics.

Cal/Val and product quality control
Comprehensive evaluation of the product quality has been performed for the real-time and hindcast systems. These assessments were summarised in Quality Information Documents (QuIDs) for each product. Upgrades to the system have been evaluated and approved on the basis of the Scientific Calibration Reports (ScCR). The real-time systems have also had routine calculation of KPIs implemented based on forecast-observation differences. These are reported on a daily basis using a web-based system. The improvement in understanding of product quality has been a significant success of the MyOcean NWS MFC.

7. WP8 – IBI MFC
WP8 was in charge of developing, maintaining and operating an ocean Monitoring and Forecasting system over the Western European Atlantic shelves, the so-called "IBI Monitoring and Forecasting Centre (MFC)" . Essentially built around two core partners that provide operational services, Mercator Océan

(MO, France) and Puertos del Estado (PdE, Spain), WP8 got support from two research agencies, CNRS (France) and NERC (UK). A fifth partner, CLS (France), finally joined the group in the course of the second year of the project to provide support in the development of dissemination interfaces.

The idea for the IBI system as it is today, can certainly be tracked back to the early 2000s and in particular after the concern raised by the Prestige oil spill disaster offshore Galicia (13th November 2002). In January 2004, the 3-year long ESEOO project, funded by Spanish science and education ministry was launched to fill gaps in Spanish maritime security operational systems. This led to an improved coordination between operational oceanography teams over the region, better integration of Spanish observing systems and to the ESEOO numerical system that served as the initial system (V0) in MyOcean project. Soon after, from the growing needs of improved large scale products over this region for downstream users (such as the ESEOO community and the French Navy), Mercator Océan tackled the development of a high resolution (2 km), tide resolving system over the whole North East Atlantic (see Figure 1). Partially funded by European projects such as ECOOP and EASY , it sat the ground for the IBI V1 system, officially released to users thanks to MyOcean project in July 2011.

On a physical point of view, the IBI region has the unique property to span almost all the range of oceanographic processes. Of particular importance is obviously the remote impact of large scale North Atlantic and Azores currents and their intense meso-scale activity, but also large upwellings offshore Iberian Peninsula, intense freshwater inflows in the Bay of Biscay, significant (internal) tides, slope currents bordering the continental shelf and a dense gravity current carrying Mediterranean water into the domain. While scientifically exciting, this property added to the unprecedented sub-mesoscale permitting resolution used here appeared relatively challenging in terms of numerical modelling. This implied allocation of a significant part of the budget to research activities, at least to improve the chosen numerical code (NEMO) for shelf seas dynamics. These NEMO developments, partially coordinated with NWS MFC which shared the same concern, will certainly foster in the near future its use outside deep-ocean and climate related studies.

While the bulk of first project year has essentially been devoted to NEMO upgrades by MO, PdE undertook the complete reengineering of its production scripts initially adapted to the completely different V0 system. Meanwhile, PdE moved to a different computing environment (CESGA) and implemented

MOTU interfaces to connect with MyOcean delivery services. To ultimately offer full backup capacity, implementation of a duplicated operational chain on MeteoFrance computers has been performed by MO at the same time, implying strong coordination between French and Spanish engineering teams. Naturally moving from this initial design phase, the second year of the project has seen the progressive transition to real-time operations. Of particular scientific importance in that process were the results of V1 calibration phase. It revealed that in spite of the numerous initial issues to solve in order to make NEMO able to simulate coastal processes, the resulting code was as efficient as the V0, POLCOMS based, system. For real time monitoring of production quality, PdE developed a flexible graphical interface (See Figure 2), taking advantage of the various datasets provided by MyOcean TACs. After the required reviewing process, operational transition was successfully accomplished in early April 2011 when IBI MFC officially started daily automatic delivery to the MIS. This is all the more remarkable that the production is based on two fully redundant and independent production chains maintained by different teams on separate computing facilities. As such, IBI is one of the few MFCs within MyOcean providing such a level of robustness in a completely transparent way for users.

Last year of the project has essentially been devoted to the consolidation of the operational production procedures and link with central service desk. Limited time between V1 and V2 releases (approx. 6

months) did not offer the possibility to have significant changes in order to comply with MyOcean procedures. Nevertheless, short term R&D work has been pursued, leading to some new capacities such has real time river flow rates and minor bug fixes. Improvements to external interfaces were implemented with a new version of the MIS gateway that offers additional downloading options ("Direct Get File") and online viewing capability. Version transitioning has been done following MyOcean requirements, by providing extensive documentation of interface testing and scientific quality of the products. Finally, some research work has been done by CNRS and MO, targeted to more mid-term evolution of the system. This concerned in particular the implementation of data assimilation (which is not activated in the present system) and already provided some promising results. Noteworthy is an eight years long reanalysis assimilating in-situ and satellite data (sea surface temperature and altimetry) but still at an intermediate resolution (6 km).

Today, central service desk has already recorded 43 different users of IBI products over the last 5 months. Even if V2 products are relatively new, it is encouraging to note that in May 2012 around 5 users have downloaded IBI products on a regular basis (at least once a week).

8. WP 9 – MED MFC

The main objective of Med-MFC is to develop and operate the Mediterranean Monitoring and Forecasting Centre, one of the regional production centres of the MyOcean system. The Med-MFC is therefore the operational centre for the provision of modelling data sets that are at the basis of the continuous monitoring and forecasting of the marine environment for this region. This system is composed by two key element off line coupled: Med-currents, for the physical system, and Med-biogeochemistry, for the biogeochemical component. Three PU/DU's constitute the Mediterranean Production Centre: INGV for the nominal Med-currents system, OGS for the nominal Med-biogeochemistry system and HCMR for the back-up system.

Production achievements:

The main objective was to ensure the production following the MyOcean requirements. The products are Med-currents and biogeochemistry forecast, reanalysis and CalVal products. The forecast and operational

analysis products have been available since the beginning of the project (V0) and have been continuously improved in term of number of product and in their quality. Med-currents has added the Stoked drift products while Med-biogeochemistry has added to the chlorophyll the nutrients in V1 and the dissolved oxygen concentration, primary production and phytoplankton biomass in V2. The reanalysis products have been available only in V2 for both the components even if Med-currents has disseminated a long time series (seven years) since V1. During V1 and V2 all the products have been disseminated via MyOcean MIS-GW with an increase in functionalities and robustness going from V1 to V2. The three DU/PUs of the Med MFC has continuously increased the level of integration and synchronisation among them going from V0 to V2. Since V1 HCMR has fully operated a backup system for Med-currents PU/DU.

Engineering achievements:

The med-MFC has been fully integrated into the MyOcean system of systems in term of service, product delivery and organization. The level of organization of the service with the definition and implementation of the Sub-system service desk has continuously increased from V0 to V2. The relationship and hierarchy of partners institution in terms of a service delivery has been increased in terms of complexity and organisation of all the interactions (see Figure 1 "Med-MFC sub-system service desk evolution from V1 to

V2").

R&D achievements:
The main objectives of the R&D activities were to specify, design and develop the Mediterranean MFC system. The main achievements are the implementation of the wave-current interaction in Med-currents and the addition of the data assimilation component in Med-biogeochemistry.

The numerical model component of Med-currents is composed now by two elements: an Ocean General Circulation Model (OGCM) and a Wave Model. The OGCM code is NEMO-OPA (Nucleus for European Modelling of the Ocean-Ocean Parallelise) version 3.2 (Madec et al 2008). The code is developed and maintained by the NEMO-consortium. The model is primitive equation in spherical coordinates. The Wave Model is based on the WAM (Wave Analysis Model)-cycle 4 code (Kommen et al. 1994). NEMO-OPA has been implemented in the Mediterranean at 1/16? x 1/16? horizontal resolution and 71 unevenly spaced vertical levels (Oddo et al., 2009). The off-line coupling between NEMO and WAM is done as follow. The NEMO model provides a first guess of SST and surface currents, which are used by the WAM model. The neutral drag coefficient computed by WAM is used by the NEMO model and modified in order to take into account the stability conditions at the air-sea interface. The two models cover the entire Mediterranean Sea and also extend into the Atlantic in order to better resolve the exchanges with the Atlantic Ocean at the Strait of Gibraltar. The wave model takes into consideration the surface currents for wave refraction but assumes no interactions with the ocean bottom. The model uses 24 directional bins (15° directional resolution) and 30 frequency bins (ranging between 0.05Hz and 0.7931 Hz) to represent the wave spectra distribution.

The hydrodynamic model is nested, in the Atlantic, within the monthly mean climatological fields computed from ten years of daily output of the 1/4° x 1/4° degrees global model (Drevillon et al., 2008). Details on the nesting technique and major impacts on the model results are in Oddo et al., 2009. The model uses vertical partial cells to fit the bottom depth shape.

Med-biogeochemistry is off-line coupled to Med-currents, which provides the physical forcing in terms of velocity, temperature, salinity, irradiance, eddy diffusivity and wind speed fields (Teruzzi et al. 2011, Lazzari et al. 2010). The OPATM-BFM model of Med-biogeochemistry is a transport-reaction model that

deals with the time evolution of chemical and biological state variables in the marine environment. It is based on the OPA Tracer Model version 8.1 (Madec et al. 1998) coupled with the Biogeochemical Flux Model (BFM; Vichi et al. 2007a,b), an evolution of ERSEM (European Regional Sea Ecosystem Model). BFM is based on fluxes of elements (carbon, phosphorous, nitrogen and others) among chemical functional families and living functional groups. BFM is targeted on the phytoplankton/nutrients and microbial loop trophic level. Key aspects of the BFM are its potential for limitation by macronutrients (nitrogen, phosphate and silicate), the use of adjustable C:N:P:Si ratios in zooplankton and phytoplankton compartments, and the chlorophyll to carbon variable dependency.

The Med-biogeochemistry provides 10 days of forecast preceded by 7 days of simulation driven by a) physical forcings extracted by the analyses produced by the INGV Med-MFC_Current system, and b) assimilation of available surface chlorophyll field derived by satellite observations at the first day of such simulation.

The assimilation is made by means of a 3DVAR scheme which uses the method of the error covariance matrix decomposition described in Dobricic and Pinardi (2008). In particular, the approach provides that the error covariance matrix is decomposed in a series of different operators (Vi), and that the assimilation solution is found in a reduced dimension space (control space). Then the solution for the state vector

(biogeochemical variables) is obtained by the sequential application of the Vi operators.

The DEMO with the high resolution atmospheric forcing has provided an evaluation of the impact of a high resolution forcing on the products of the system. The DEMO of a super–ensemble method has been developed. Uncertainties and model errors can be investigated by applying the ensemble techniques designed to sample the error under investigation, but as far as they are concerned and interrelated, no one of the most used approach, multi-model or multi-physics super-ensemble, is clearly better than another, so we built ensemble datasets derived from both. We used the combination method proposed by Krishnamurti at al. (1999) that first shows the superior forecast skill of super-ensemble prediction determined with an optimal regression algorithm. In order to collect the analyses datasets, defined over the entire Mediterranean Sea, three Institutions have been involved in this activity INGV, HCMR and MERCATOR. The systems providing the dataset differ for horizontal and vertical resolution, atmospheric forcing, physics implemented, discretization techniques, sub-grid-scale parameterizations and data-assimilation schemes. This extensive dataset has been merged with four multi-physics member appositely created for this experiment. As a first attempt, this approach was applied using satellite derived surface temperature measures collected in MyOcean catalogue as true state. See Figure 2 which shows the results from one experiment.

CalVal activities:

In order to allow Near Real-Time (NRT) quality and consistency controls of the Mediterranean Monitoring and Forecasting Centre (Med-MFC) products, a web-based validation system was developed at the National Institute of Geophysics and Volcanology (INGV) within the framework of the European MyOcean project in collaboration with the Mediterranean Operational Oceanography Network (MOON) partners. A network of 15 centres from 9 different countries was established for NRT data exchange purposes, which yielded the possibility to undertake on-line evaluations of the Med-MFC products using independent observational data along with the output from the nested sub systems in the Mediterranean Sea.

The first step was to create a network for the NRT collection at INGV of in-situ and remote-sensing observational data, as well as sub-regional ocean forecast fields. All the data are downloaded and processed on a daily basis by the operational centre at INGV. The post-processing procedures involve a reorganization of the data sets according to their observational or model origin, and a subsequent storage in a common MySQL database.

Due to this database, it has been possible to create a dedicated validation web page, http://gnoo.bo.ingv.it/myocean/calval which offers daily updated 'on-fly' (qualitative and quantitative) quality checks of both forecasted and analysed model fields by direct model-to-model or model-to-observation comparisons. Upon user request, this web site communicates dynamically with database and provides diagnostics of the temperature, salinity, sea level, and velocity fields using the available observations and visualizes the results on-line.

The database allows also delay time (DT) products evaluation based upon ad-hoc defined statistics. The validation of the biogeochemical products is limited by the scarce access to real-time high –quality observations. At present, this validation activity is performing NRT quality checks using satellite-deduced chlorophyll estimates for the Mediterranean Sea, as well as for eight sub-regions: Alboran Sea, North-West Mediterranean, South-West Mediterranean, Tyrrhenian Sea, Southern Adriatic Sea, Ionian Sea, Aegean Sea and Levantine Basin. MyOcean OC-TAC (Ocean Colour Thematic Assembly Centre) provides the satellite data used for the validation of the chlorophyll fields. This evaluation is available on the web (http://gnoo.bo.ingv.it/calval/bgc). See Figure 3.

9. WP10 - Black Sea MFC

Overall objective of the WP10 activity was to build the Black Sea Monitoring and Forecasting Center (BS MFC) according to common standards of the My Ocean project, and to deliver regular and systematic reference information on the state of the Black Sea at the resolution required by intermediate users and downstream service providers, of known quality and accuracy, via the project Central Desk facilities. Development of the Black Sea operational forecasting system was started within the framework of the FP5 ARENA project. The pilot system was experimentally run manually in the summer of 2005. The complementary efforts within the framework of FP6 ASCABOS and ECOOP projects improved the skill of the basin-scale Black Sea nowcasting and forecasting system and made it partially automated. In spite of the improvement the system was still badly structured and used public network for the transition of input data and output products. Nevertheless it served as version V0 in the MyOcean project. Another important step was done before the start of the My Ocean project within the framework of FP6 SESAME project which provided processed observations on the Black Sea dynamics and ecosystem for the last 50 years and advanced numerical simulation techniques for reanalysis and hindcast of the Black Sea circulation and biochemistry.

It was necessary to realize a new design of the system software and hardware to be consistent to common MyOcean project requirements. Special local network for supporting functioning of the BS MFC nowcasting and forecasting system was constructed during three years of the project. The architecture of the system was redesigned according to the requirements of versions V1 and V2. A set of new tools governing simulation processes, nowcast and forecast data archiving and data access provision was developed. Automatic interfaces for downloading of all input data required for nowcast and forecast of the Black Sea state, and for validation of the BS MFC products were developed. The system now is fully integrated to the central MyO environment. The input interfaces are integrated in the External data downloading component ensuring access to data of SL, SST and OC TACs. The atmospheric forcing data were downloaded initially from the National Meteorological Administration site and then from SKIRON site

to extend the forecast up to five days at versions V1 and V2. The External Upstream data are adapted to the operational use. The production chain subsystems for analysis/ forecast/ reanalysis were integrated into the system. FTP and MOTU interfaces, delivering and viewing interfaces, File server, THREDDS, OpENDAP were implemented, FTP-servers and MIS Production Gateway were installed and configured, WMS-service is tuned for the WEB-Portal requirements. All output interfaces of the MIS Gateway Portal were installed to deliver BS MFC products to users and to carry out centralized control of the BS MFC Dissemination Unit operation.

Significant efforts were taken to provide users with a set of products similar to those produced by other MFCs. The version V0 of the BS MFC nowcasting and forecasting system included only circulation model. The V1 system was based on a new version of the circulation model which included the Mellor-Yamada turbulence closure for more accurate description of the exchange processes especially within the upper mixed layer. Reanalysis of the Black Sea stratification and circulation covering 1971 – 2002 was carried out within the framework of the V1 system. It was done by means of assimilation of temperature and salinity profiles (1971-1993) and space altimetry data. The models for simulating bio-optical and ecological parameters of marine environment were developed and incorporated into the operational system within the

framework of version V2.

The Black Sea MFC service operated efficiently during the project time. The BS MFC products are simulated and delivered to the users according to the working plan adopted by BS MFC. V0 products were delivered until September 23, 2011. V1 products are being delivered from July 5, 2011 up to now. V2 products are being delivered from January 12, 2012 up to now. The backup of the target production line is developed. Nowcasting and forecasting results are available to users in the digital and graphic formats via Central Desk of the project.

Scientific validation of V1 and V2 products produced from July 1, 2011 to May 2, 2012 was carried out in DT and NRT modes. Software of statistical estimation of the model simulation quality using in situ and satellite data is developed and used for verification and validation of BS MFC products. Software for graphic presentation of the validation results on the BS MFC http-site in Delay Time (DT) and Near Real Time (NRT) modes was developed and used. The results of validation are documented in ScVR, QUID and PUM. They were comprehensively examined according to the procedures of documentation reviewing included in the MyOcean working plan. All the BS MFC interfaces, servers and net means are technically validated. The results of technical validation are presented in the Test Reports, versions V1 and V2, which were examined according to the procedures of documentation reviewing included in the MyOcean working plan.

Full set of the requested project documentation is developed. The documentation is examined and approved according to the procedures of documentation reviewing included in the MyOcean working plan.

The R&D activity was carried out to ensure improvement of the product quality, implementation of new products and to build a base for the system future evolution. Successful fulfillment of the open call project won by WP10 consortium on a competitive ground will permit to apply in the near future the NEMO Primitive Equation module and 3D and4D-var data assimilation to provide operational forecasts.

The Black Sea MFC was developed in close collaboration of MHI NASU (Ukraine) with IOBAS (Bulgaria), NIMRD (Romania), IMS METU (Turkey) and UoP (UK). Efficient coordination of the WP10 partners' activity has contributed to successful development and operation of the Black Sea.

10. WP11 - The Sea Level Thematic Assembly Center (SL TAC)
The main objective of the Sea Level TAC is to provide in an operational context sea level based products for MyOcean internal (MFCs) and external users. This center is based on the existing SALP/DUACS center developed by CNES agencies for a large part, and complement by European and ESA projects like MERSEA, MFSTEP. The Myocean version 0 of the SL TAC is consequently a heritage of all the work performed thanks to these projects. Starting from global and Mediterranean products, the specific objectives of MyOcean was thus to complete the offer in term of European regions with the development of Black sea, Arctic and European (NWS + IBI) regions. In parallel the SALP/DUACS centers was integrated to the Myocean System&Service. The SL TAC organization is based on the central role of CLS that is the operator of the operational system. Then, DTU, IMEDEA and LEGOS are involved in R&D and Calval activities.
Integration into the MyOcean System&Service

In parallel to the development of new sea level products, one important objective for us has consisted in the implementation and in the integration of the existing DUACS system into the MyOcean central system in order to deliver successively the MyOcean version 1(December 2011) and version 2 (December 2012). The main developments are the following ones:

• Implementation of the MIS-Gateway for the interfacing with the central system (MIS and web portal).
• Configure and set up new processing chains that delivers the new regional products: black sea, Arctic and European (NWS+IBI) products
• Manage and adapt processing chain for the different events occurring on the altimeter missions: frequent anomalies of Jason-1 at the end of the period, ENVISAT orbit change and finally loss of ENVISAT, integration of Cryosat2 into the system to mitigate the difficulties associated to the old missions. This illustrates that the altimeter constellation is very frail and particular attention need to be paid on that at the MyOcean top level (board)
• Definition and provision of a new format for the SLTAC product that is Netcdf-CF compliant
• Various notable upgrades associated to the normal evolution and maintenance of the such system
• Set up new chain that generates Key Performances Indicators (KPI) that are now accessible at the following address http://www.aviso.oceanobs.com/en/data/product-information/duacs/key-performance-indicators/index.html

All these developments have been released in the different versions of the system (from V9.3 installed the July 2010 to the latest delivered in January 2012 (V12.0.1). In parallel to the system developments, the organisation of the service for MyOcean version 1 was set up with the definition and allocation of the different roles: Service Manager, Service Desk, Support Operator, Products manager, Incident and change Manager.

All the developments in term of System and Service have been also documented in the MyOcean documentation: PMP, SRD, ADD, SIOPM,... and are used to successfully pass all the different reviews needed to set up the Version 1 and Version 2 of MyOcean. At the production centre level, we participated to the Production Centre Design Workshop and the Acceptance Review

Description of the SL TAC System and Service

The production and delivery of the SLTAC products (external and internal) has been performed during the 3 years of the project on a nominal basis. No major problem has been encountered. However, when incidents appear, they are monitored and notified to the MyOcean central service desk. This production is composed by the NRT and the Reprocessing products, plus Key Performance Indicators (KPI) that are computed at a daily basis and are available at the following address:

http://www.aviso.oceanobs.com/en/data/product-information/duacs/key-performance-indicators/index.html. They allow having an overview of the observing system state.

The reprocessed products (covering the Global, Med and black sea regions) have been delivered in September 2010. The time series starts in October 1992 and ends at September 2010. Finally a total of 55 years of data (Topex/Poseidon, Jason 1 and 2, ERS-1/2, ENVISAT, GFO) has been processed. The reprocessed time series has been computed using the most recent reprocessed GDR (Geophysical Data Record) that ensure a maximum of consistency between the missions used for the whole period

Lastly, Specific Core Products (maps and curve of Mean Sea Level Trends for the Europe) have been also produced on request from ESA. They are used for the SOER reports.

R&D Main Achievements

The main R&D achievements obtained by the Sea Level TAC during the three years of the project are related to 3 topics:

1. Improvement of existing products and development of new regional products
2. Development of a new generation of along-track products dedicated to assimilation purpose with a specific link with the MFC team
3. Development and improve methods to validate the SL TAC products, and in particular develop methodology of comparison and combination with in-situ data

The strategy to develop the new regional products (Black sea, Arctic, Europe) was more or less similar for all new products. It consists to refine and tune several parameters of the level 2 and level 3 data and to implement specific corrections (essentially geophysical corrections) that are more adapted and performed better the global ones. Taking into account of the skill of each partner, development of Arctic has been performed by CLS and DTU, Europe by LEGOS and CLS whereas Black sea has been tuned by CLS only.

The new regional products developed in the frame of MyOcean aim to complete the standard offer to the users. In addition to the developments we have also set up the Tailored Altimeter Product for Assimilation Systems (TAPAS) initiative in April 2010 which aims to share a common definition of a new generation of altimeter products better dedicated to data assimilation in modeling systems (MFCs). Objectives were to share the state of the art of altimeter processing and the needs for assimilation in order to understand the possibilities and the constraints on the usage of altimetry in assimilation scheme and to define new products to be developed and tested. This initiative was conclusive (some MFCs has already tested some new products see paper Dobricic et al.) but need to continue during Moycean2.

More innovative work has been also performed and was dedicated to investigate the synergy between in-situ measurements and altimetry. This was done for gliders by IMEDEA/CSIC and for tide gauges by DTU. Then, specific investigation has been performed to improve the mapping procedure to retrieve higher resolution signals. Attempt has been done in the Bay of Biscay by LEGOS and in the Mediterranean Sea by IMEDEA/CSIC. Lastly, lagrangian advection technique has been assessed by LEGOS whereas some

new ocean indicators (Kurushio and the Ionian circulation in the Mediterranean sea) have been developed to improve the Climate service provided to EEA (CLS) .

Future Steps & Perspectives
Main objective for us will be to continue to operate the SL TAC System&Service in the context of the Myocean system of systems. Despite we probably enter into a phase where the integration work is less important (development of Baltic products), evolution of the system to increase its performance, improvements of the existing products (both standard, new generation as TAPAS and SPC) and adaptation to the events of the altimeter constellation will probably represent main part of the activities. Specific effort needs also to be done to manage SL TAC users taking into account the ones that already exist through AVISO.

11. WP 12 – OCEAN COLOUR TAC
The main mission of OCTAC is to operate a European Ocean Colour Service for GMES marine applications providing global, pan-European and regional (NW Shelves, Arctic, Baltic, Mediterranean,

Iberian-Biscay-Ireland (IBI) and Black Seas) high quality ocean colour products, accompanied by a suite of quality assurance items including accuracy.

OCTAC was designed and built as a distributed system integrating the existing activities and services developed previously within the EC supported projects. The OC Production Center is composed by five Production Units (CNR, ACRI, Ifremer, JRC, and PML) and three Dissemination Units (CNR, ACRI and Ifremer) organized in a single TAC (See figure 1 "Overview of the OCTAC System"). The production of OC global, Pan-European and regional products is distributed within the PUs. To improve the quality of the OC data, the regional OC processing chains use region-specific algorithms for satellite product retrieval. Apart from the regional algorithms, all PUs' processing chains have the same structure. Each PU is responsible of its own processing chain and QC of its products. The integration of the pre-existing PU system into the OCTAC was realized by defining common methodologies and developing interfaces. The harmonization and coordination of the distributed centre operations of the Cal/Val activities and service has made OCTAC an integrated and centralized sub-system providing a single ocean colour service to MyOcean users.

The entire OCTAC relies on three different OC sensors: MERIS, from ESA, and MODIS and SeaWiFS, both from NASA. It generates not only products for MyOcean data assimilation but also directly useable by intermediate/end users (intergovernmental bodies, National Environmental Agencies, etc.) to monitor the marine state. OCTAC provides a series of products that satisfy these stakeholders' requirements. Table 1 shows an overall list of OC products/parameters available from OCTAC. Since 2011 all the 138 OC products are produced and distributed with the same format. Also nomenclature of the products and files is the same independently of the PUs. Three different versions of ocean colour products are available to the users: the Near Real Time (NRT) products (within few hours), the Delayed Time (DT) products (within 5 days), and the Reanalysis (RAN) products (consistent time series). NRT, DT or RAN products are generated by global and/or regional processing chains using different input data. As a consequence NRT, DT and RAN products are characterized by different scientific qualities.

One of the challenges that the OCTAC has faced was to establish reliable error bars for each product and to improve the quality of ocean colour products for the European Seas. The first issues was achieved by on setting up a method for an off-line and on-line validation activity of multi-platform satellite OC products

for all processing modes (NRT, DT and RAN). This required defining and implementing agreed common methods/principles/metrics for validation and quality control of OC products of each OCTAC PU.

The off-line validation aimed at qualifying the errors associated with ocean colour products by comparing them with in situ observations. The off-line validation results allowed to characterize the core products (Rrs and Chl) OC data uncertainties at both the global and the regional scale, demonstrating that the OCTAC products fulfill the accuracy goal and showing a slight improvement of V1 products available from MyOcean as of 2011 with respect to the previous version.

The online validation is applied to all the OCTAC operational products and consists of three parts: analysis of number of input data and their quality; quality of processing data; consistency of physical signal. These checks are made by the PU processing chains and validation metrics/statistics are automatically generated during the operational processing. Since only few in situ NRT observation are available, a new methodology was developed by OCTAC partners to monitor the consistency of physical signal. This method was transferred to the operational OCTAC chains providing a method for continuous monitoring of the quality of NRT and DT products distributed to users. Online data validation results demonstrated the new system is able to identify of sensors drifts or shifts, in near-real time, as was clearly demonstrated by the results obtained by OCTAC, where the system was able to detect the degradation, started in mid-

2010, of the MODIS Aqua channel at 443 nm and able to catch the timing in which such degradation has severely impacted the Mediterranean products (See figures 2 & 3).

12. WP 13 – SEA SURFACE TEMPERATURE TAC

The main achievements of the SST TAC from the three years of the MyOcean project are:
- the operational acceptance of SST TAC near real-time production, as part of MyOcean V1 system, which was opened to external users in December 2010, and, with some products upgrades, as part of MyOcean V2 system, which was opened to external users in January 2012
- the production, validation and delivery of a 23 year (1985-2007) global SST re-analysis, based on the OSTIA analysis system
- the implementation of a routine quality monitoring of input L2P satellite SST sources. The results are displayed on the SST TAC cal/val home page : http://projets.ifremer.fr/cersat/Data/Quality-control/MyOcean-SST-QC/Control-Validation-MyOcean
- the implementation of common metrics for the quality monitoring and validation of all SST TAC near real-time L3/L4 products. The results are displayed on the SST TAC cal/val home page :
http://projets.ifremer.fr/cersat/Data/Quality-control/MyOcean-SST-QC/Control-Validation-MyOcean
- Research and Development activities, aiming at improving the inter-satellite SST bias correction and merging schemes. Two main studies have been conducted, with results which have led to a significant improvement of the operational High and Ultra High Resolution regional SST products covering the Mediterranean Sea and the Black Sea on one hand, and which will be soon implemented in the operational processing chain for High Resolution regional SST analyses over the Baltic Sea and the Arctic Ocean on the other hand.
- A large number of registered external users for the SST TAC products through the MyOcean web portal (more than 180 at the end of April 2011)
(See figures 1).

13. WP14 – SEA ICE and WIND TAC

The SIW TAC has been responsible for satellite based sea ice and wind observations in MyOcean1. It has been coordinated by met.no with support from KNMI on the wind part. A main priority has been on preparation and launch of the V1 (2010) and V2 (2011) products. The production and distribution of all sea ice and wind products has now been consolidated. New R&D based sea ice products (ice surface temperature, iceberg and ice class) and wind products have been introduced. All products are accessible via MyOcean catalogue, and new functionalities (as web-based sub-setting and user-authentication) have been implemented. SIW TAC sea ice data is used by MFC's for validation and assimilation, however external use is still limited. A main focus in MyOcean2, both centrally in MyOcean as well as for all subsystems must therefore be on promoting and ease the user access to the products.

R&D :
Sea Ice: An Ice Surface Temperature (IST) and Ice berg density product was developed and implemented. The IST product is an integrated IST, SST and MIZT (Marginal Ice Zone) temperature product based on METOP AVHRR IR swath data. The iceberg number density product is based on target

detection in satellite borne Synthetic Aperture Radar (SAR) at 100 m spatial resolution. All targets (iceberg pixel-clusters) are counted in 10 km grid cells in sea-ice-free areas to produce an iceberg number density grid for each available SAR scene.

A neural-network algorithm for classification of ice types and open water has been tested and implemented for use in discrimination between various ice types and open water in single polarisation SAR images. The algorithm has been used during the winter season 2011 and 2012, and the ice edge maps have been compared with ice charts from met.no.

Wind: A shallow water type global dynamical model was set up to propagate scatterometer winds in time and space in the last period. Work has been done to apply data assimilation techniques to include scatterometer 10 meter winds to initialize the dynamical model at every desired time period. A NetCDF template for the L3 product and scientific calibration and validation for the product has been performed. The production of a surface wind climatology has been implemented, tested, and validated. The resulting products are calculated from daily analysis estimated from METOP-A/ASCAT L2b retrievals, with a spatial resolution of 0.25° in longitude and latitude. The products are global. Data and made available at the end of each month.

Implementation and maintenance

SIW TAC Production, Assembly and Distribution system is organized in two main lines, Sea Ice and Wind. The assembly and dissemination system at met.no was entering V2 operational status from January 2012. The general documentation and review process for MyOcean has been followed. The SIW TAC Sea Ice Dissemination Unit is integrated as a part of the met.no's operational system. All MyOcean compliant interfaces was developed according to the requirements for the operational environment. Compliance with MyOcean specifications for web-based (HHTP) sub-setting and user-authentication was obtained after being delayed due to delayed specifications from MyOcean WP 2 on the interfaces. Wind products are distributed through the MyOcean unit at IFREMER.

SIW TAC Sea Ice Wind Production

By end of MyOcean the SIWTAC provides eleven product lines with in all nineteen data products. All SIW

TAC V1 and V2 products can be accessed through the MyOcean catalogue. The products are available as direct files, via FTP and as OpenDAP data streams. The co-operation with ESA on access to SAR data is working well and large amounts of SAR data (mainly ENVISAT and Radarsat) has been made available. See the table which gives an overview of product portfolio.

Sea Ice and Wind Cal/Val and quality

The SIW TAC CalVal plan was updated in connection to V2 in December 2011, and calibration reports for the new products were delivered. A new set of validation reports for all the products were produced in connection to the VRR review March 2012. The validation methods are described in the CalVal plan and briefly for each product in last annual report (April 2011). The various sea ice products are very different in terms of resolution, parameters and data input compared to other TAC products like SST and OC. For this reason standardization of validation methods is not straight forward and often not possible or wanted. However standardization of validation procedures for some of the products, e.g. the regional ice charts, will be developed in MyOcean2.

The L4 wind calibration and validation plan is described in details in previous MyOcean reports and documents. New results have been reported within VRR review of March 2012. In connection to the V2 review in December 2011 the calibration report for the new L3 Wind product was delivered. Also a

validation report was produced for the VRR review in March 2012. The validation methods are described in the latest version of the CalVal plan.

14. WP15 – IN SITU TAC

The role of the in-situ TAC for MCS is threefold

• to assemble high quality data sets

• to provide the "best" in situ products for data assimilation and model validation both in real-time and delayed mode to the MyOcean Monitoring and Forecasting Centres (MFC)

• to provide the MyOcean users with the actual status of the ocean seen by the established observing system for use in assimilation, validation and information

This implies a clear definition of quality control procedures, validation processes with error characterization as well as processing capabilities for reanalysis purposes.

The in-situ Thematic Assembly Centre of MyOcean is a distributed service integrating data from different sources for operational oceanography needs. The MyOcean in-situ TAC is collecting and carrying out quality control in a homogeneous manner on data from outside MyOcean data providers (national and international networks), to fit the needs of internal and external users. It provides access to integrated datasets of core parameters for initialization, forcing, assimilation and validation of ocean numerical models which are used for forecasting, analyses (nowcast) and re-analysis (hindcast) of ocean conditions. Since the primary objective of MyOcean is to forecast ocean state, the initial focus is on observations from automatic observatories at sea (e.g. floats, buoys, gliders, ferrybox, drifters, SOOP) which are transmitted in real-time to the shore at global (V0 2009) and regional (V1 mid 2011) scales both for physical and biogeochemical parameters The second objective is to set up a system for re-analysis purposes that requires products integrated over the past 25 years for temperature and salinity parameters. This will be the main challenge of MyOcean II for the European seas.

Since the elaboration of the proposal, the MyOcean in-situ TAC has been designed to rely on the EuroGOOS ROOSes with regional coordination endorsed by partners from the ROOSes and on a global component based on Coriolis data centre that acts as a GDAC (Global Data Centre) for some of the

JCOMM networks.

The MyOcean in-situ TAC is focused on a limited number of parameters:

– Temperature and salinity: global and regional, produced in real time (all components) and delayed mode (global, as prototype in other regions)

– Currents: global and regional, produced in real time (global, North West Shelves, Mediterranean Sea, Baltic)

– Sea level: regional, produced in real time (South West Shelves, North West Shelves, Baltic)

– Biogeochemical (chlorophyll, oxygen and nutrients): global and regional, produced in real time (all components)

See Figure 1 "The INS TAC components and institute responsibilities".

The In-Situ TAC architecture is decentralized. However, quality of the products delivered to users must be equivalent wherever the data are processed [Pouliquen et al., 2010]. The global and regional components of the in-situ TAC are performing the same functions:

• Gather data available on international networks or though collaboration with regional partners.

• Apply automatic quality controls that have been agreed at the in- situ TAC level. These procedures are defined by parameter, elaborated in coherence with international agreement, in particular SeaDataNet,

and documented in MyOcean catalogue.

• Assess the consistency of the data over a period of time and an area to detect data not coherent with their neighbours but could not be detected by automatic quality control (QC). This function has a level of complexity on its implementation which is clearly different from the other three as it highly relies on scientist expertise.

• Distribute the products within MyOcean and to the external users mainly through global and regional portals.

As the structure of the FTP portal is based on platforms, it has been feasible to integrate other parameters measured by a platform and also to include platforms that measure parameters not processed by MyOcean in-situ TAC such as wind and waves. This activity has been endorsed by the EuroGOOS ROOSes in collaboration with the regional INS-TAC partners and no additional near real time QC is performed on the new parameters. In collaboration with SeaDataNet, the appropriate vocabularies have been used to integrate the new parameters and SeaDataNet extends these vocabularies if needed.

The monitoring tools developed for MyOcean benefit to the ROOSes as the service is operated jointly. These tools monitor the availability of the portals, the continuity of the data integration to detect when one data provider server is down and retrieve the data when back on line, the delays in order to reach a 24h-48h delivery from observation date. The permanent service improving loop that drives MyOcean activities will therefore benefit to the ROOSes with lower additional activity performed at ROOS level.

A new data provider, who wants to provide access to its observing system data, simply has to contact the ROOS portal manager and provide access to his data via an FTP server without changing his in house format as long as it contains enough metadata information. The conversion to common NetCDF format is taken on board by the MyOcean in-situ TAC partners as well as data integration on the portal. Presently about 2500 platforms are transmitting observations at global scale each day among a total of 8500 different platforms within a month. The numbers are different because some platforms do not transmit data everyday (e.g. Argo floats transmit every 10 days, Vessels do not acquire data when they are in harbour…)

See Figure 2 " In Situ platforms integrated in March 2012 by the INS TAC global and regional

components".

This infrastructure developed jointly by MyOcean and EuroGOOS ROOSes has set up a useful service both for operational oceanography in Europe but also for the research community and the development of downstream services. It relies on open and free data policy. In the coming years it will be strengthened within MyOceanII to enhance the assessment of the products and develop temperature and salinity time series for re-analysis activities. It will also be extended to coastal data within the JERICO project (www.jerico-fp7.eu/) as well as in Mediterranean Sea within Perseus (http://www.perseus-fp7.eu/). At global scale a better integration of the European glider data will be developed within the GROOM project. This infrastructure will be used by the EMODNET-PP project (http://www.emodnet-physics.eu/) to provide discovery and viewing service for fixed point stations and ferrybox data managed by MyOcean/EuroGOOS for real time and SeaDataNet for historical data. It is important that this infrastructure is sustained on the long term jointly by the regions and the European Commission and not only through national funds complemented by FP project as presently.

15. WP 16 – SERVICE DESK

WP16 was responsible for the introduction and management of a Service Desk and Service Management processes. During the three years a Service Desk was in operation, and processes were introduced and matured. Organisational structures were introduced early in the project and were reviewed at key points in the project. The graph below shows the improvement in maturity throughout the project.

See Figure 1 - Maturity of Service Management

All partners within MyOcean have had input to or been impacted by the work undertaken in WP16, however this report contains input from just a few of those partners, others would have similar input. During the course of the project a Service Desk Infrastructure was developed based on the Production centre Structure. Each Production Centre established their own structure depending on the number of partners and the capability of the organisations involved.

See Figure 2 - My Ocean Service Desk Structure

The Service Management Structure took on a similar structure with a MyOcean Service Manager providing the co-ordination role.

There were two training workshops for Service Managers to provide training and a forum for discussion on how to develop and implement the processes.

The Service Management Process Working Group was established and used to provide input and co-ordination of the processes as well as then continuing to provide a forum for WP1, 2, 16, 17 and 18 to co-ordinate activities.

On 22 March 2011 Clare Hubbard and Bruce Hackett attended the Norwegian IT Service Management Forum at Gardermoen, Norway, to present "MyOceans - introducing IT Service Management for a pan-European service"

On 8th November 2011 Clare Hubbard attended the UK itSMF to Present "Service Management across My Oceans" as the winner of the 2010 UK itSMF, Service Management Champion of the Year 2010.

WP.16.2.T Service Design, Implementation and Evolution

During the project the Service Management Processes were developed according to the Service Management Plan and in line with the Service Level Requirements.

The processes were documented in the OPM, which was updated for each major release. The OPM described the processes used centrally as well as providing guidance for the implementation at Local level. SIOPMs were produced to describe the local implementation of the Service Management Processes.

After each release evidence was collected from partners to check that the requirements were being met in line with the Service Level Requirements Validation Document (SLRVD).

The processes developed and implemented as part of WP16.2 were Request Fulfilment, Access Management, Incident Management, Event Management, Problem Management, Change Management, Configuration Management, Service Level Management, Continual Service Improvement, Release Management.

The core processes were incident and change management processes these went through several iterations in line with internal and external feedback. For example making incident notification messages 'OPT IN' for Users.

Processes which were developed but have not yet been implemented in full include Service Continuity and Information Security.

Met Office & PMO developed a process for securing the access to the private details of users. PMO holds user details in a secure area of Alfresco. Access to this secure area is granted only on completion of a Non-Disclosure Agreement.

As part of the Continual Service Improvement Process we developed a User Feedback log which was used to manage user feedback from both adhoc comments through Service Desk and formal user surveys.

Maturity of the processes evolved from Maturity Level 1 at the start of the Service Operations to Maturity Level 4 after V2 release (based on assessment against requirements).

Clare Hubbard (Met Office) won the UK itSMF award for "Service Manager of the year" November 2010, for her work done on MyOcean.

WP.16.3.T My Ocean Service - Service Operation

Met Office operated the Central Service Desk from April 2009 until March 2012 led by Kirsten Wilmer-Becker. This was transferred to Mercator in readiness for MyOcean 2 during the last quarter of FY 11/12. The Service Desk operated the Request Fulfilment, Access Management and Incident Management processes as well as recording user information to support the processes.

Met Office Service Manager co-ordinated production of the Service Monitoring Reports for distribution to Partners, Exec, Board and EC Reviewers. These were initial produced monthly and then changed to quarterly as the Service operation stabilised.

The Service and System Change Approval Management Group (SCAMG) was established, this group approved the development and release of changes between major releases (V1, V1.1 and V2).

For the Major releases the SMPWG members co-ordinated the gathering of information to be communicated to users on the changes to products and access mechanisms. Central Service Desk organised the messages to users in line with the Transition Communication plan.

During the Operation of the Service the numbers increased month on month, with a large increase occurring with the introduction of on-line registration.

See Figure 3 - Number of users by month

See Figure 4 - Timeliness of service request resolution against number of service requests received over time.

Even with the continuing increase in users we were still able to improve the Service being offered to users.

16. WP 17 – SERVICE DEFINITION AND MONITORING

The objectives of the workpackage 17 were to:

- define MyOcean Service and the evolution of the service
- provide analysis of the service rendered (monitoring of the products downloaded)

Right at the beginning of MyOcean project, there were about 30 production units which delivered products directly to users via their own website, independently, and using their own format.

These production units merged into 12 production centers which were grouped together according to the type of data they were dealing with.

The MyOcean service opened in November 2009. At this stage of the service, all the products were listed and described in one catalogue. However the users had to have one login/password for each production

center to be able to download their products.

A common access to the catalogue of products first proposed to users in December 2010. The MIS Gateway was built and then put in production in December 2010 in order to simplify the access to the products. A large part of the products have been since that time downloadable by the web portal and the catalogue, using a same login/password.

Since July 2011 or January 2012, all the products are accessible via one unique web portal with one login/password per user for all the products (with some exception), registration is done online via the web portal and is mandatory to download products, product information is standardized and available via the web portal (creation of PUM (Product User Manual) and QUID (Quality Information Document)), the presentation of the products is homogenized and improved with a viewing functionality for each product, and finally, transaction accounting functionality starts to be implemented to monitor products download and evaluate user's behavior.

At the end of MyOcean in March 2012, MyOcean service gives access to more than 200 oceanographic products available through a single interactive catalogue, with a unique access via the web portal (main delivery point).

From November 2009 to March 2012 the number of registered users has reached one thousand. Products download analysis (Transaction Accounting) done during the last 3 months of MyOcean (January-February- March 2012) shows that 20% of these registered users download products every month. This is an average calculated for these 3 months.

The MyOcean service is free and open to everybody. However, a user is not allowed to redistribute the products MyOcean as is (when a user registers and signs a "Service Level Agreement", the user agrees to respect the terms of the MyOcean license). A user is also kindly requested to answer to surveys and provide feedback.

MyOcean catalogue contains observation products from satellite or in-situ measurements, analysis (hindcast, real time, short term forecasts) from model output (6 European basins and the global ocean) and re-analysis or long time-series products.

MyOcean Service provides oceanographic products and information such as temperature, salinity, currents, sea ice, sea level, wind and biogeochemical parameters.

Observations and model-based data products are covering the Global Ocean, the Arctic area, the Baltic Sea, the Atlantic North-West shelves area, the Atlantic Iberian-Biscay-Ireland area, the Mediterranean Sea and the Black Sea.

17. WP18 – User's Assessment and Requirements

The aim is to address the following strategic objective of the project: "the MyOcean MCS is validated and commissioned by the users", the overall goal of WP18 in the 3-year course of the project has been to establish a mechanism of structured interaction with targeted users of the service. Four categories of MyOcean users have been identified: a) National Institutions (from EU Member States) who are service providers at national level delivering products and downstream services to end users; b) European and International Organizations who have responsibility for marine and maritime affairs (EEA, EMSA, HELCOM, OSPAR, ICES etc.); c) the private sector that delivers specialized services based on MCS products; and d) International – global initiatives such as GODAE and GEOSS. Each of these user categories requires a different approach and during MyOcean it has been decided to focus on the first two of them, while activities aiming at approaching the other two categories are planned for the follow-up of the

project. Thus, WP18 has organized the following two major activities:

a. the collection of user requirements and their updates from the first 2 user categories i.e.: i. national institutes who operate existing mature systems at national level (Reference Intermediate Users – RIU) and ii. major EU and intergovernmental institutional users; and

b. the structured assessment of MyOcean products and services by these users

in order to provide feedback to the relevant production units and contribute to service evolution.

The work of the 35 partners/users of WP18 has been structured into the four areas of benefit of MyOcean namely Coastal and Marine Environment; Marine Safety; Marine Resources; and Weather, Seasonal forecasting and Climate.

Being both experienced users of monitoring and forecasting products, they have successfully delivered their feedback to the user requirements on a systematic basis as well as feedback on MyOcean service, based on the integration of core products into their systems. Collection of this input was performed mainly by e-mail and during WP meetings or other MyOcean meetings. Demonstrations from users showing integration of MyOcean products into their own systems were particularly valuable. All the received feedback has been transformed into recommendations for improvement and has been communicated to higher levels, especially to WPs relevant with service definition (WP17) and management (WP16). It has been also used for the planning of MyOcean2. Example of recommendations received by WP18 users is listed below:

• Need for higher temporal and spatial resolution products for most applications (ice, oil drift forecasts, coastal applications, fisheries)

• Request for longer hindcasts & reanalysis

• New products for catalogue: atmospheric forcing fields; waves; eddy viscosity

• Inclusion of value added products (e.g. fronts detection) should be explored

• Better documentation on products (data source, quality etc) and service (e.g. download instructions)

• Explore alternative delivery mechanisms and techniques to deal with large data files

• Good response by service desk; slower response by PU / service definition

• Registration process has improved but can be even better

• Web portal needs to be redesigned; become simpler; user friendly; also for catalogue

• Positive impact on performance of national systems; added value for EU agencies

A key part of the work of WP18 has been the management of the Core Users Group (CUG), with a clear aim to collect feedback and recommendations from key users of MCS products such as European institutes, international organizations, meteorological services, and organizations providing downstream services. Two meetings were organized during MyOcean and the relevant recommendations have been transformed into requests for change (RFCs) assigned to and handled by relevant MyOcean components (esp. service). A main difficulty encountered was the organization of a third meeting with the close-out of MyOcean. Since the CUG did not manage to meet, work has been conducted via e-mail. The next CUG meeting will be organized by the end of 2012, preferably back to back with a major MyOcean 2 event. Example of recommendations provided by the CUG is given below:

• Quality of products to be more visible; need to open the scientific assessment reports (e.g. of MFC – TAC) to users

• Accessibility to service to be improved (Web interface, registration) – more user friendly; more visualization products

- Sustainability of service of major concern; GMES to seek for commitments the soonest possible
- Reliability – robustness of service is recognized
- Work closer with downstream service providers; common outreach & training activities; more clear boundaries between services
- Need for higher temporal and spatial resolution products to initialize & force national systems (downscaling, ice & oil drift applications). Solve the wind & waves products issue. Need for long timescale products (re-analysis)
- Response to emergencies; possibly not a MCS issue but needs to be addressed

The role of WP18 also included the collection of user feedback from various MyOcean events, especially the User Workshop of Stockholm in April 2011. This event gave the opportunity to users to interact with one another as well as with MyOcean components (MFCs, TACs, technical, engineering, communication, etc). Clear recommendations for improvements have been collected and analyzed by relevant MyOcean components. A strong request from users has been to have more technical guidance from MyOcean.

As part of the cooperation of WP18 with WPs 16 and 17, tasks included providing internal feedback during user satisfaction surveys, validation tests etc. and active participation in weekly teleconferences. Key deliverable was a validation test report and feedback, delivered by most WP18 users (on a voluntary basis). This involved validation testing of the new functionality delivered following a release in early 2012. Validation testing is important to ensure that the release is performing as intended and to inform future improvements and evolutions. User assessment on this stage is very important.

Another task of WP18 was the organization and management of Continual Service Improvement (CSI) in cooperation with WPs 16 and 17. This process is about using information about past successes and failures in order to continually improve the effectiveness and efficiency of service. Work involves collection of user feedback coming from different sources (external/internal), its logging and assessment in a feedback tracker and finally its feeding into service definition. Plans for improvement of service and products will be delivered under CSI in the course of MyOcean 2.

Overall, the main achievements and difficulties of WP18 throughout the course of MyOcean can be summarized as follows:

- a structured interaction with national users has helped to received valuable input through requirements and assessment of the MyOcean service
- strategic advice on service has been received from Core Users; this was a key contribution to service evolution
- the tasks performed have helped in various aspects of service definition and evolution
- the wide range of users addressed makes it difficult to homogenize requirements
- user participation and uptake need to be encouraged
- recommendations have not always been specific; user forms need to be more simplified and direct

In conclusion, the interaction between MyOcean and key users that has been organized through WP18 is of strategic importance for the evolution and long-term sustainability of the GMES Marine Service. Based on the three years' experience, this interaction is further enhanced in the next phase of MyOcean through different mechanisms: a) stronger links are established between the user related activities and the service definition / evolution as well as the training and outreach tasks, b) more effort is put on analysis of user requirements and assessment and their translation into service improvement actions, c) a wider range of users (including the private sector as well as international organizations) is addressed through the training and outreach activities, d) the coordination of national users is given to EuroGOOS and its regional

approach (through the ROOSs) is followed in the respective WP.

Potential Impact:
A. POTENTIAL IMPACT

1. Pre-operational oceanography capacities in the GMES research framework context

A progressive implementation strategy
MyOcean has inherited from the MERSEA FP6 project, and will be followed by the FP7 MyOcean-2 project in the long-term goal for implementing a European operational oceanography capacity. This capacity is based on existing assets at national level, which have been brought together through MERSEA with an emphasis on Research and Development. The MyOcean project performed the transition from research to operations, as a first step in the preparation of the GMES operational implementation.

Starting the implementation of a "core service"
MyOcean has been implemented in the strict definition of the "core service" as "information on the state of physical ocean and marine ecosystems for the global ocean and the European regional areas". The MyOcean generic ("core service") information is limited to this European scope and does not address application areas at national levels, such as e.g. marine safety or coastal zone management. This defines the boundaries between (i) the Ocean Monitoring and Forecasting component of the GMES Marine Service, and (ii) other GMES Marine Service components available or in preparation at European level, as well as (iii) institutional and private services targeting specific user needs and benefiting from the MyOcean information and services. Thus, MyOcean entirely focuses on "EU capacities for monitoring and predicting the marine environment with a comprehensive capacity to provide data and information required by a range of downstream service providers relating to the global oceans and the European regional seas". Firstly discussed in Mersea, MyOcean has experienced the definition of the "core service" as a

strong driver for service continuity over the years.

Emergence of a technically robust and sustainable infrastructure in Europe in the context of GMES
MyOcean has contributed to "the emergence of a technically robust and sustainable infrastructure in Europe in the form of core services, able to supply both source data and higher level interpreted data". The MyOcean "system of systems" is directly derived from the Marine Core Service Strategic Implementation Plan guidelines. Its infrastructure has been designed to form a single pan-European integrated multi-component system, based on a limited number of core "Production Centres" – 5 Thematic Assembly Centres (TAC) handling space and in situ observations and 7 Monitoring and Forecasting Centres (MFC) running assimilative models. These Production Centres are located in different places in Europe to maximize integration with existing assets infrastructure and resources, R&D and user networks, thus facilitating their long-term sustainability and performance. Each of these Production Centres is built on existing systems whose performance and robustness has been thoroughly assessed through a multi-year experience. The operators-in-charge are clearly identified and committed to ensure full performance of these core components. Modularity comes naturally from this system-of-systems approach, which will be re-used in the next phase (MyOcean2) in particular to manage evolutions.

Significant European added-value could be found in the integrated approach adopted for delivering the service, including the sharing of activities at European level (no unnecessary duplications of capacities and resources). Economies of scale have already been achieved during the MyOcean project:

• the share on responsibilities in terms of production and dissemination of ocean products,

• the emergence of central components implementing information management and user interfaces as a single entry point and avoiding duplication of technical development effort in each distributed centre

• the development of the European NEMO modelling platform (physics, ice and ecosystem) now used for the global ocean and the Mediterranean Sea, as well as by the Atlantic sub-regions IBI and North-West-Shelves

2. A continuous, stable and reliable Service concept

A continuous service available to users
MyOcean has experienced the implementation of a continuous service with the systematic delivery of products and information through dedicated tools (e.g. web portal), organisation (e.g. service desk), user agreements (e.g. SLAs between MyOcean and users), data management (e.g. formats), and eventually the product information (e.g. catalogue). Service evolution is planned with guaranteed service continuity for users. Through the MyOcean portfolio continuity, to be continued by the MyOcean2 portfolio, the user communities will benefit from about several years of development and provision of GMES Marine Service information.

A stable service concept and data policy, assessed by service agreements
MyOcean has managed its relationships with its users through Service Level Agreements (SLAs). These SLAs have defined the MyOcean commitments and responsibilities regarding: (i) product and information delivery (content, constraints) and (ii) the use of information and conditions of use. The MyOcean data policy for accessing to MyOcean products and information is open and free-of-charge.
The MyOcean Service Level Agreement and data policy approach form a stable base to foster the use and

sharing of GMES information and data, and contribute to strengthening the Earth system monitoring markets in Europe.

Towards a long-term service provision scheme with appropriate governance
MyOcean has initiated the concept of long-term service provision scheme for the GMES Marine Service, to be continued by the following MyOcean2 project in the preparation of the implementation of the European Centre for Ocean Monitoring and Forecasting (ECOMF) before the end of 2014. Based on the MCS Implementation Group recommendations, MyOcean has paved the way to its successor MyOcean2 in the perspective of ECOMF by experimenting a European governance for the whole project (Board and Executive Committees), with roles clearly assigned to all parties during the project period.

A service qualified for the operational phase
MyOcean has established the basis for an operational qualification of the GMES Marine Service component. In particular, the technical integration of the distributed service component has been achieved through the MyOcean Information System (MIS) which enables monitoring the flows between the different sub-systems and control the availability of data to be delivered to the users.

Technical reviews (both internal and external) have been established the standard base for the qualification of the MyOcean System and Service. This qualification addresses different aspects of the quality of service:
• qualification from a system point of view, with all the standard steps of the testing activity (integration, verification and validation with specific reviews)
• qualification of the operational processes that have been designed during MyOcean to operate the MyOcean system as a single organization
• qualification of data products in terms of performance and scientific content. This has been managed at project top-level with the definition and operation of specific qualification procedures according to common standards.

The different phases of the service evolutions (versions) of MyOcean have been rigorously qualified through the above process. In routine operations and outside the major versions, changes are managed through a specific change management process, with specific change commission review groups acting at project level: the System and Service Acceptance Management Group (SCAMG) acts specifically to review the acceptance of changes and the readiness to operations. It activates a specific Quality Review Group (QuaRG) for addressing all topics related to the scientific and performance quality of ocean products.

3. Integrating state-of-the-art technical and scientific capacities

The MyOcean consortium gathers world-leading specialists in ocean monitoring and forecasting activities, based on space and in-situ observation, assimilation and modeling techniques. This community of skilled researchers and engineers has based its operational oceanography developments on strong scientific foundations. Thanks to this approach, the development of the MyOcean service has been based on state-of-the-art algorithms and methods in "observation data (satellite, in-situ) collection and delivery, data validation and fusion from multiple sources, techniques for assimilation into models, and validation of space derived products by means of in-situ data". Ensemble-based assimilation methods, eddy-resolving

modeling codes including for sea ice and marine ecosystems were all developed in leading research laboratories. With its Scientific Advisory Committee, its links with other S&T projects and a marine community, its specific R&D activity organized by open calls during the project, the MyOcean project has been organized to ensure regular service evolution based on S&T achievements.

4. A service designed to interface with national or regional centres and European stakeholders

MyOcean has established a network of RIUs (Reference Intermediate Users) (national systems) that have delivered their requirements through User Requirements Documents, signed Service Level Agreements to use MyOcean products and have provided regular assessment (User Assessment Reports) regarding both quality and impact of the provided service. This network will continue its activities in the next phases with more emphasis on the regional coordination of these activities capturing the needs and the perspectives of the EuroGOOS regional networks and recognising their strategic importance for future developments.

Interfaces with the main building blocks of the GMES infrastructure have been identified, addressed and secured. These encompass:

• "Downstream" interfaces with the intermediate users, including national service providers, EU agencies, inter-governmental bodies involved in European environmental policies, and any intermediate user of the downstream sector. Dedicated links with EU EEA and EMSA through specific Service Level agreements have been established.

• Upstream interfaces with the observation infrastructure and service operators have been put in place:

o For space observation infrastructure through the ESA "Data Access" and links with EUMETSAT facilities

o For the in-situ observation infrastructure, e.g. international Argo floats centres, through the In-Situ TAC Formal agreements addressing MyOcean external dependencies, especially with observation infrastructure operators, contribute to the reliability and performance of the service.

5. The MyOcean contribution to the European information-base for a wide variety of applications and users

A European information service devoted to global monitoring for the marine environment: MyOcean already provides Europe with a worldwide capacity to monitor the ocean environment through space observations, in-situ observations, models and their combination. With a high-resolution capacity over the global ocean and region enhancements, MyOcean places Europe at the first rank of operational oceanography in the world. This EU GMES Marine Service provided by MyOcean is unique and provides Europe with a significant advantage. Complementary to the ESA Earth observation capacity, this world-class GMES ocean monitoring and forecasting service delivers in real-time a 3D description of the ocean state, assessed by European ocean experts, and fully recognized at the international level.

A European assessment on the state of global ocean and regional seas – The MyOcean service is designed to contribute to assessments of the marine environment, resources and climate change. MyOcean 3D information on the physical state of the global and regional oceans and marine ecosystem characteristics provided in near real time and also on a multi-year basis allows the identification of anomalies and changes. Moreover, MyOcean provides highly useful information for interpretation of the time series trends, variability and anomalies that could contribute to a European independent assessment and evaluation capacity. MyOcean already contributes to the assessments of the marine environment, resources and climate change, through the provision of consistent time series information.

A Service targeting a wide range of downstream services – The availability of the Ocean Monitoring and Forecasting of the GMES Marine Service already fosters the development and improvement of application services in areas such as (i) marine safety, (ii) marine resources, (iii) the marine and coastal environment and (iv) weather forecasting and climate.

The MyOcean contribution is expressed through the easiest possible access to the core information (reduce existing technical and data policy barriers) and the best linkages between information producers and users to benefit from their expertise. The MyOcean open data policy is a key factor for fostering uptake on the downstream side. Indeed the whole MyOcean project, system and service organisation has been designed to meet this objective of a multiple-use market led by a wide community of intermediate users.

Competitiveness in the global economy and meeting the sustainable development objectives are strongly

linked to the availability and use of reliable and well-assessed information, which MyOcean has demonstrated the feasibility in an operational context.

At the end of the MyOcean project, the MyOcean Service provides about 240 ocean observation, analysis or forecast products, addressing the 4 areas of benefit: (i) marine safety, (ii) marine resources, (iii) the marine and coastal environment and (iv) weather forecasting and climate. These products are proposed to users with common and standard services: product interactive and operational downloading, product viewing, product descriptions, user manual and information on product quality.
From the beginning of the project the number of users has been continuously increased as the service was improved in terms of products and capabilities, reaching now up to 1000 Service Level Agreements signed, as a demonstration of the link between MyOcean and its applications and users.

B. MAIN DISSEMINATION ACTIVITIES and EXPLOITATION OF RESULTS

1. MAIN DISSEMINATION ACTIVITIES

The 3-years project objectives were:
-To promote MyOcean (products and services) in the European community
-To strengthen the link with GMES program
-To involve the project partners and provide them with common communication tools
-To contribute to enlarging the user's community (in Europe and beyond)

1.1. MyOcean HOUSESTYLE and LOGO

This was a pre-requisite for this long-term communication action plan. A communication's agency created the logo, the graphic rules, and the web templates so as any documentation's templates.
The "MyOcean" look guarantees the MyOcean's image consistency all over the project period and provide

MyOcean partners with a common corporate identity for any kind of documents (internal, external).

1.2. ACTIONS ACCORDING TO AUDIENCE TARGET & PLANNING

1.2.1. Actions towards GMES stakeholders
External communication has been managed by WP1.3 in close cooperation with GMES bureau and SWIFT project.
From April 2010 until March 2012, WP1.3 has actively supported GMES communication actions:
- Input for GMES info website (News, Events, Catalogue)
- Contribution to GMES posters and Roll-ups production (May 2010):
- Contribution to the GMES booth on the Toulouse Space Show (8/11 June 2010)
- Contribution to the GMES booth on ESA Living planet in Bergen on 28 June/2 July.
- Inputs for Commissioners' breakfast organized by VP Tajani / Oct 2010 (Illustration per area of Benefit)
- Input for an exhibition related to GMES at the Berlaymont building in Jan 2011 (Illustration)
- Inputs for the GMES Video (MyOcean Animations) Jan/Feb 2011
- Inputs for the FP7 Partner Board meeting planned in Dec 2010 (2-3 pages summary of the internal

review process +catalogue)

- Participation to 4 SWIFT meetings in Brussels (March 2010/Sept2010/March2011/December 2011)

1.2.2. Actions towards the European Union presidencies

Two MyOcean partners have been deeply involved: CSIC IMEDEA and MUMM.

• EU Spanish Presidency/ CSIC Imedea

European Maritime Day, Gijon- 18/21 May 2010

MyOcean was present on EuroGOOS booth. Nadia PINARDI and Pierre BAHUREL were speakers to the conference.

• EU Belgian Presidency/ MUMM

EurOceandays, Ostend 12/13 Oct. 2010 « Grand Challenges for Marine Research in the Next Decade ». Kostas NITTIS (WP18/HCMR) presented an Introduction to the Ostend declaration).

As a « Pre-event », a conference has been organized in the EUROPEAN PARLIAMENT: « Monitoring the Oceans, Essential Knowledge for a Sustainable Maritime Economy », where Pierre BAHUREL (CO01) made a presentation with the contribution from Sébastien LEGRAND, (P46-MUMM Belgium).

1.2.3. MyOcean Web site

As from Day One (April 1st 2009), MyOcean website (V0) was open: http://www.myocean.eu

At this time, the website was merely providing a query-able catalogue with a few products. A limited editorial content was updated on a best effort basis. The outstanding service level upgrade occurred in December 2010 (V1) by transforming MyOcean "website" into a "web portal". The editorial content evolved accordingly with:

a. An editorial policy

b. A living media

c. Frequent and regular updates

d. Tracking data to measure audience

a. An editorial policy

As any kind of media, a website needs an editorial policy, giving the "tone" and the "look and feel" according to the MyOcean positioning.

The following MyOcean positioning has been define (see table in Annex "Main dissemination activities")

As a Data Provider pooling a unique experts' team in Operational Oceanography, MyOcean had to move from a PROJECT-DRIVEN website to a USER-DRIVEN web portal by inspiring trust and credibility. As a consequence following items have been introduced:

• To demonstrate the benefits of Use (of MyOcean products & Services)

• To explain the MyOcean User Approach

• To detail the catalogue of services beside the catalogue of products

• To highlight Project members and stakeholders (with hyperlink to their website)

• To provide an information platform (News, Showcase, Newsflash, Products improvements…)

• To give a direct access to Products and Services from the home-page

• To regularly update the Editorial content

Actually, the targets of MyOcean are obviously larger than Users and Stakeholders and can be extended to the general public, to the Press, to students and to any European citizen in general. So far, they are

considered as secondary targets. Secondly, "Users" have been addressed as an homogeneous population, whilst they cover many sub-targets such as Public End-Users, Private End-Users, Downstream users… This segmentation will be taken into account during MyOcean2 as far as downstream users are concerned.

b. A living media (content/functionality/update)

A large range of new contents has been implemented as from V1 (December 2010): on the project, on the service, on the products, on areas of benefits and on Operational Oceanography in general.
The MyOcean User Workshop was a good opportunity to get users feedback and improvements ideas to improve the Editorial Website and match our targets. As a consequence, the website was also improved for the V2 step (December 2011).
Here below are detailed the new web sections and sub-sections implemented for V1 (December 2010):
A. VERTICAL MENU BAR :
"ABOUT US" :
The project (description)
. Objective (description + diagrams)
. Schedule (description + diagrams)
. Organisation (description + diagrams)
. Intranet (ALFRESCO access)
Our Partners (Map)
List per country (with hyperlinks with partners' website)
List per partner (with hyperlinks with partners' website)
A user-driven approach (description + maps)
NEWS & EVENTS (latest article + archive)
FOCUS ON
. Latest article (aiming at illustrating a specific feature of MyOcean)
. Archive

PRODUCT SHOWCASE (Promoting a MyOcean's product)
. Latest Image
. Archive
EDUCATION (tutorial section)
. Observations
. Modelling
. Ocean parameters
PRESS/EDITION CORNER
GMES/FP7 (description and hyperlinks)
FAQ (related to the project in general, not to the products)
Site Map and ALL RIGHTS RESERVED

B. HORIZONTAL MENU BAR
PRODUCTS & SERVICES
. For the 4 areas of benefits:
Domain of application

Frequently requested parameters
Products families frequently in use
Users involved (URD)

. Catalogue of services (description)
. Access to Products (WP2)
. News Flash (Service Desk's E-warnings on products & Services to users)
. Products improvements (Section oriented CALVAL)
. Technical FAQ (linked to registration/downloads/Scripts…)
CONTACT US (enlarged to Service Desk and Communication team)
VO HOME PAGE / V1 HOME PAGE

- Some new functionalities (not as many as expected due to technical constraints):
• RSS Field on 3 sections (News & Events, Product Showcase, and Focus On)
• Technical FAQ for guiding users step by step
• A direct link to the catalogue of products from the Home page

- Frequent and regular updates: Thanks to the new CMS, each member of the WP1.3 team is in a position to update the editorial part of the web portal. However, the content production and validation steps are essentially ensured by 2 persons only (Communication Manager and Web Design Manager). Following sections are regularly updated:
• NEWS&EVENTS (monthly update in average)
• PRODUCT SHOW CASE (monthly update)
• FOCUS ON (update according to News related to Ocean)
• EDUCATION (update according to text improvements/precisions/new illustrations)
• NEWS FLASH! (daily or weekly, synchronised with Service Desk's E-mail to users)
• TECHNICAL FAQ (according to Service version)

According to users demand, WP1.3 have been striving to bring improvements for an easier navigation and an easier access to data:
- A "User Corner" has been created so Users can directly access to Service functionalities from the Home page: Catalogue, Registration, Service desk, News Flash (on-line messages from the Service Desk), Products improvements and Technical FAQ.
- A "search area" has been implemented for any query.
- The Areas of benefits are still detailed though not as an entry to the catalogue to avoid any misunderstanding: MyOcean proposes a sole catalogue.
- A "Scientific publications" web section has been created to allow MyOcean Users, Consortium members or Stakeholders to submit and promote their work related to MyOcean activities to a large scientific community. The documents can be issued from: MyOcean Science Days, Published papers, Conference/Colloquium, Doctoral Thesis, User Forums or else.
As a result, the MyOcean V2 Home page has become (see picture in Annex "Main dissemination activities").

c. Tracking data

MyOcean website is monitored by analytic logs (statistics) since March 2010. The website has recorded important audience improvement. In February 2010, the monthly visits did not reach 2 500 while 2 years later they increased almost fourfold, up to 9 182. The order of magnitude is even bigger for the number of pages displayed (less than 20 000 in Feb2010 versus 186 000 in Feb.2012)

The table here below shows the audience increase from V1 to V2: (see picture in Annex "Main dissemination activities").

The countries of origin of the MyOcean Website are more or less the same since March 2011 (see illustration in Annex "Main dissemination activities"). However in February 2012, Turkey appears in the Top 10, while Germany disappears.

1.2.4. Other dissemination activities

• Hand out
• Events
• Publications
• Internal Newsletter
• IPhone App
• Success stories
• Users interviews and MyOcean closure videoclip

1.2.4.1. HANDOUT

MyOcean partners can be all considered as potential ambassadors by spreading MyOcean words in their own community or by sustaining MyOcean messages in conferences for instance.

WP1.3 therefore decided to provide MyOcean partners with relevant documentation and materials; depending on the topic of an event, they can be all or partially stored in a dedicate MyOcean folder
• General leaflet (Front and back page)
• Leaflet Maritime Safety (Front and back page)
• Leaflet Marine & Coastal Environment (Front and back page)

• Leaflet Marine Resources (Front and back page)
• Leaflet Weather, Seasonal Forecasting &Climate (Front and back page)
(see illustration in Annex "Main dissemination activities"
• Generalist poster on MyOcean
• USB sticks dedicated to Events attendees (including copy of catalogue or of reference MyOcean documents) (see illustration in Annex "Main dissemination activities")

All communication materials are posted on ALFRESCO and a complete list of materials has been provided to MyOcean partners during the latest Annual Review in Roma.

1.2.4.2. EVENTS

Two major events organized by MyOcean have been dedicated to SCIENCE and USERS, the two MyOcean key-drivers:
• The first MyOcean Science Days (WP3) on 1-2 December 2010 in Toulouse, targeting MyOcean Scientists and Researchers.

• The first MyOcean User Workshop on April 7-8 2011, targeting users, prospective users and MyOcean stakeholders.

MSD 2010: WP1.3 merely gave a logistic support.
MUW 2011: WP1.3 partners (Mercator Ocean and CLS) were deeply involved (before March 31st 2011) in the preparation and the organization of the first User Workshop which gathered more than 100 people in Stockholm.

• First EC Innovation Convention: The very first Innovation Convention organised by the European Commission took place in Brussels on 5/6 December 2011. The MyOcean project was honored to have been selected by the Directorate-General for Research & Innovation to be part of this outstanding event. For this occasion, WP1.3 had developed and exhibited a brand new IPhone app:""Your Ocean online". The Convention has brought together the world's leading experts in research and innovation. More than 1200 visitors have attended the convention to listen to high level conferences, to attend workshops and to discover about 50 research and innovation results being developed under European funding programmes (out of which MyOcean - FP7 Space). The Convention was opened by President Barroso and Commissioner Geoghegan-Quinn (Research, innovation and Science).

The Events also became "Communication materials":
• These 3 events were systematically announced and reported on the section "News & Events" gathering documents produced at that time (with authorization of authors).
• Interviews have been conducted with 4 users during the User Workshop, enabling to have User testimonies posted on the Web portal and on next-to-come Success Stories.

To be noticed: A survey realized by the WP1.3 team (with 35% coverage) during the MyOcean user Workshop pointed out the trust level of users in MyOcean:
-> 60% did recommend MyOcean to a third person
-> 80% would recommend MyOcean to a third person

MyOcean was also present (booth or oral presentations) in external events such as (not exhaustive):
• 4th GEO European Projects Workshop, Athens, 29-30 April 2010
• International Polar Year, Oslo, 8-12 June 2010
• 3rd Euro-Argo User Meeting, Paris 17-18 June 2010
• The Harmony-on-Ice workshop in Louvain la Neuve, Belgium, 13-14 Sept. 2010,
• Eumetsat meteorological satellite conference, Cordoba, 20-24 Sept. 2010
• GEO Ministerial Summit, Beijing, 3-5 Nov. 2010
• The Arctic Frontiers Conference, Tromsø (inside the Arctic circle) 28th Jan. 2011

1.2.4.3. PUBLICATIONS
(see illustration in Annex "Main dissemination activities")
• WP1.3 produced or contributed to following publications, posted on the MyOcean Web portal
• Public Service Review: *Science & Technology 6* (March 2010):
• Public Service Review: *Science & Technology 7* (May 2010) / Editorial
• GEOSS Brochure 2010: GEOSS for Climate - The GEO Climate Societal Benefit Area

- GEOSS Brochure 2011: GEOSS for Water- The GEO Water Societal Benefit Area
- ALMANACCO DELLA SCIENZA (4th may 2011) : MyOcean at its second annual review

1.2.4.4. INTERNAL NEWSLETTER

An internal newsletter has been created in April 2010 to enable any member to follow the project development. 4 Newsletters have been issued since and sent by E-mail to MyOcean members. They are also stored on Alfresco, the project Intranet. The format is a front/back page, easy to ready, with following sections: From the Board/About Production/About Service/Consortium life/GMES corner/Seen on the Website.

This newsletter was initially sent to about 200 persons and further new subscriptions, is sent to close to 300 persons. An internal survey made among MyOcean members during the 2011 Annual Review in Roma clearly fosters this media.

1.2.4.5. SUCCESS STORIES

(see illustration in Annex "Main dissemination activities")

In order to illustrate MyOcean benefits to national and European decision makers, REA did encourage WP1.3 to issue regularly success stories. The format is a one-page document with images and non-scientific language. Started mid-2011, this initiative has been leading to 3 success stories: 4 users' feedback, MyOcean contribution during Fukushima event, MyOcean contribution to Black Sea Pollution combat.

1.2.4.6. SMARTPHONE APP

(see illustration in Annex "Main dissemination activities")

Smartphone apps are a new powerful communication tool.

MyOcean IPhone app, called " Your Ocean on-line" does obviously not provide the same Web portal service, but is an easy way to spread MyOcean capabilities and benefits around the World. The 2 first versions (V1 in December 2011 and V2 in March 2012) have been developed to be easily understood by a large (and not necessarily scientist) audience and shows 3 entries: Ocean forecasts from the bottom to the

surface of the ocean (Day /Day +2/Day+4), "Multimedia" and "About Us". Since the application launch in December 2011, the logs show 60 to 70 visits per week on average with an unexplainable peak at 112 visits early February 2012. To be noticed: Numerous visits from the USA and Australia. (see illustration in Annex "Main dissemination activities")

1.2.4.7. USERS INTERVIEWS and MyOcean CLOSURE VIDEOCLIP

A first Video Clip was produced before the project launch and was obviously "intentions" oriented.

A final Video clip was necessary to show, 3 years after, the MyOcean benefits and results, to hear users' feedback and to introduce the next steps.

WP1.3 therefore interviewed 5 users related to 5 regions: IBI (MeteoGalicia), MED (Moon members), BLACK SEA (Black Sea Commission), ARCTIC (Total) and GLOBAL (Starlab).

As a result:
- each region will have a dedicated video clip (interview of their user) which they will be able to use for their own communication purposes
- a small part of these interviews has been used for the MyOcean closure video clip (3'40)

The video clip scenario prepared with WP1.3 reminds the origin and the aim of the project, the Areas of benefits, the current number of users (1000 in March 2012), shows a user working on the MyOcean catalogue on-line, illustrates key-features of MyOcean through Users' words (open & free access, scientific excellence, reliability, one point of entry, sustainability) and introduce the roadmap to MyOcean2 and ECOMF.

2. EXPLOITATION OF RESULTS

The added value and the benefits of MyOcean services are largely demonstrated through different media channels:
1. The free MyOcean smartphone application (Your Ocean online: http://itunes.apple.com/fr/app/myocean-online/id481028824?mt=8&uo=4) has been developed for a not-scientist audience who can easily and playfully understand (tactile search and touch video) what types of data and services MyOcean provides and the FP7/GMES frame. The data, issued from the MyOcean's7 regions are daily updated.
2. A closure video realized at the end of MyOcean (March 2012) is meant to show results and users satisfaction (while the Kick-off video issued early 2009 was merely describing intentions). It is used for Communication at European level and at Regional level (through partners).
3. User interviews, posted on the website, enable potential users and decision makers to understand how far MyOcean gives value to different usages in our 4 Areas of benefits :
a. Maritime Safety: Offshore Oil Exploration in extreme climate conditions; Coastal models for pollution combat; Transports in Arctic Area.
b. Marine Resources: Protection of biodiversity, Aquaculture.
c. Coastal and marine environment: service to Fishermen and tourism, to water quality, oil spill combat.
d. Weather, Climate & SF: weather forecast, Climate change.
4. Success stories edited in paper and posted on the website (contribution to monitoring of radioactive

contamination from Fukushima, Oils spill combat in the Black Sea…).
5. Exhibition organized by GMES (GEO Summit Beijing Nov.2010 / Toulouse Space Show June 2010/ GEO Summit Istanbul Nov.2011/ FP7 Let's embrace Space conference in Budapest June 2011 / Breakfast with EC commissioners Oct. 2011 + exhibition at Berlaymont/Brussels.
6. On the editorial web portal: 3 web sections are contributing to the exploitation on results : FOCUS ON which highlights specific topics directly linked to MyOcean services, SCIENTIFIC PUBLICATIONS on which MyOcean Users, Consortium members or Stakeholders can submit and promote their work related to MyOcean to a large scientific community and PRODUCT SHOWCASE illustrating MyOcean products through animations and Oceanic events.

List of Websites:
Website: http://www.myocean.eu

Website contact: MERCATOR OCEAN, Mr Pierre Bahurel, 8-10 rue Hermès, Parc Technologique du canal, 31520 Ramonville Saint Agne

Related documents

📄 final1-218812-1122103-main-dissemination-activities-with-illustrations-v1-1.pdf

Last update: 29 March 2017
Record number: 196595