

# TOWARDS AN ALLIANCE OF EUROPEAN RESEARCH FLEETS

## Reporting

### Project Information

EUROFLEETS

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## Final Report Summary - EUROFLEETS (TOWARDS AN ALLIANCE OF EUROPEAN RESEARCH FLEETS)

### Executive Summary:

The quality of the infrastructures available for marine research contributes to Europe research performance. Marine research infrastructures are so considered as key elements of the European Strategy for Marine Research. A coherent pan-European approach with enhanced partnership in investment, development and usage of research fleets is necessary to better meet the diverse needs of European marine research.

From its launching in September 2009, the EUROFLEETS (full name: "Towards an alliance of European research fleets") process aims at bringing together the European research fleets owners and operators to enhance their coordination and to promote the cost-effective use of their facilities. It supported research services for the sustainable management and the monitoring of the regional seas and the oceans, and organized a common access to modern and well equipped research vessels to European and international

scientists and industrialists on sole condition of scientific excellence, thereby contributing to the EU ambitious goals for maintaining the ocean biodiversity or understanding climate change.

Funded by FP7 (GA n°228344), the EUROFLEETS project included 24 diverse beneficiaries from 16 countries: 14 EU member states including 4 “recent” ones, and 2 countries associated to EU. The EC contributed to the Project by 7.2 M€ on a final budget close to 10 M€.

For its 4 years duration, the EUROFLEETS project succeeded at:

- participating to the European efforts to stay at first rank in the international scientific competition;
- using more cost efficiently the existing European fleets and associated equipment under the umbrella of the European Research Area;
- promoting greener and more sustainable research vessel and underwater vehicle operations and design;
- providing 221 European researchers and their partners with access to 18 cruises on board 15 highly performing research vessels wearing 11 flags, on basis of scientific excellence;
- updating a consolidated view of the European research fleets, taking into account existing national

roadmaps; thus building, in coordination with existing groups such as OFEG and ERVO, a European shared strategic vision of the foreseeable evolution of this infrastructure;

- fostering coordinated and joint development of European fleets, thanks to new inter operable software and innovative underwater vehicle payloads;
- developing training and education at sea with nearly 60 young scientists or technicians trained during 5 ship-based courses on board 4 research vessels owned by EUROFLEETS beneficiaries, and with 126 pupils and students (from 9 to 18 years) taught on the importance of marine sciences and research fleets, during on-board education activities;
- structuring and durably coordinating, through the e-platform EVIOR, the way that the research vessels are operated, and their interoperability real capabilities;
- working upon common procurement strategy, and build corresponding roadmap on prospective shared basis;
- Promoting innovative e-access to research vessels during scientific cruises.

The overall situation of the European research fleets appears still vulnerable. A limited number of large countries succeeds to renew and maintain their large research vessels (of the Global and Ocean classes) and modernize the associated embarked equipment. In the contrary the majority of the European member states is not in a position to renew their research fleets (mainly of the Regional class) due to the financial crisis that developed after the preparation of the EUROFLEETS project in 2008. Europe as a whole still need an effort to renew its national Regional research vessels and develop an inter-operable set of modern and innovative scientific equipment to complete them.

It is still too early to properly and fully measure the EUROFLEETS impacts, even if three examples are still significant:

- some scientific publications have already been published or accepted, especially on basis of data acquired during EUROFLEETS funded cruises. More will come as normal lead time for publication is 4 to 5 years after cruise;

3 years after cruise,

- the integrated EUROFLEETS evaluation process initiated by AWI has shown its sustainability and robustness qualities. It was furthermore excellently evaluated by its scientific clients as fully transparent;
- the leverage effect of the European funding has been once again demonstrated through several additional/preparation cruises run on board nationally funded vessels, through training courses run on board research vessels put at Project's disposal free of charge by Project's beneficiaries, or through numerous tests run for developed software or underwater payloads with only marginal costs charged to the Project.

The EUROFLEETS2 project has now taken the lead and will capitalize on EUROFLEETS successes:

- through an enlarged beneficiary fan (31 beneficiaries from 24 countries including 2 SMEs) and an extended scope of work (including polar sciences), its European and international audience is and will be much wider;
- it already launched its first ship time and equipment calls that were awaited by the scientific community. A lot of proposals was received and some are still under evaluation. A pilot "super integration" project is under scheduling as its flag ship initiative;
- efforts to facilitate Regional research vessels renewal will be made through preparation of design guidelines. Owners and operators will so be ready for order as soon as crisis effect will decrease;
- innovative technological developments will be amplified.

These results and perspectives show that the European research fleets infrastructure has already achieved a deep mutation to a more coordinated and efficient scientific tool, and will prove during EUROFLEETS2 life (until 2017) through new progress that European funding has been essential to complete this essential evolution.

Project Context and Objectives:

The marine environment represents a vast universe of natural resources that has yet to be explored. This universe holds a myriad of opportunities to support the European economic competitiveness. The marine environment is still costly to access, highly variable and very unpredictable. This, together with increasing societal demands and present financial crisis, means that European marine research should open a new integration phase with a long-term approach.

The FP7-funded EUROFLEETS project has contributed to this challenge by building up an alliance of marine research centres, universities and industrialists from European Union (EU) and associated countries to it, that work together and share resources, to improve the quality of marine research and valorise Marine Board past initiatives and know-how accumulated through other European projects like BONUS 185, ERICON-AB or SeaDataNet.

The marine infrastructures necessitate a variety of dedicated and complementary expensive facilities. They include research vessels, observation networks, data centres, computing and experimental facilities, etc. Of particular importance are the research vessels and their highly specialised equipment which are both necessary to maintain observation systems, monitor oceanographic parameters, implement sophisticated equipment and collect rare and sensitive biological samples.

Many maritime countries own and operate these scientific infrastructures with variable coordination level

many maritime countries own and operate these scientific infrastructures with variable coordination level on European and international scales. Thus EUROFLEETS has opened perspectives for a new coherent pan-European approach to infrastructure policy. Through enhanced partnership, development and use, optimised and innovative ways to meet the present and future needs of European marine research have been explored and evaluated.

By bringing together marine research fleet owners and operators, EUROFLEETS has contributed to enhance operational coordination between research vessels and associated equipment, and to promote their cost-effective use for sustainable management of regional seas and oceans. The Project gave support to environmental and biodiversity protection and climate change research. EUROFLEETS also benefited to the sustainable exploitation of marine resources and provided more formation and training of European emerging scientists.

The Project has grouped twenty four beneficiaries from fourteen member states of the European Union and two associated countries to it, namely AWI (Germany), CNR (Italy), CSIC (Spain), EurOcean (Portugal), FCT (Portugal), GeoEcoMar (Romania), HCMR (Greece), IEO (Spain), Ifremer (France), SDLO (Netherlands), IMR (Norway), IMS-METU (Turkey), IO-BAS (Bulgaria), IOPAS (Poland), IPEV (France), Maris (Netherlands), Marum (Germany), MI (Ireland), MPIMM (Germany), NERC (UK), OGS (Italy), RBINS-MUMM (Belgium), TUT (Estonia) and VLIZ (Belgium). All constitute together a rich and balanced partnership: four recent EU member states were involved aside historical European operators; all European eco-regions were represented from the Baltic Sea to the Black Sea; well equipped beneficiaries operating important and modern fleets are sharing their experience and know-how with less equipped operators.

The ambitious objectives of the Project covered three activities: Trans National Access (TNA), Networking Activity (NA) and Joint Research Activity (JRA).

EC funding was valorised under TNA umbrella to open free of charge access to 15 European research vessels: five large ones, of Global and Ocean classes, and ten others of Regional class. Equipment like underwater vehicles were also made available under this scheme. The scientific excellence of cruise proposals was evaluated by an independent European review panel led by a European scientific leader.

NA was very diverse with a lot of complementary objectives. Based on Marine Board position paper 10 proposals, the Strategic vision was still a motivating one: it has constituted a new attempt to integrate the various European renewal schemes. Training and formation of scientists and technicians was another NA priority. Greening of research vessels was also very promising, opening the way to environment friendly research vessel building and operation. Interoperability was a key long lasting exercise. Additional objectives were dedicated to the development of the European Virtual Infrastructure in Ocean Research platform, a new portal fully interoperable with SeaDataNet one, together with the Project's portal allowing the organisation of ship time calls and the Project's communication.

JRA included two technological R&D projects, concerning developments of embarked software and innovative interoperable payloads for European underwater vehicles.

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#### Project Results:

Transnational Access has been the core activity of the EUROFLEETS project since its central aim was to provide access for the first time to European Research Vessels –RVs- for all European scientists and their partners, in particular for scientists from nations with limited, or no, access to research vessels and other marine infrastructure, on basis of scientific excellence.

EUROFLEETS was successful in accomplishing a pan-European call and evaluation process for ship-time proposal. During the four years of the project, access to 5 Ocean/Global and 13 Regional RVs from 11 countries was offered through three ship-time calls: the two first calls “Ocean” and “Regional1” were launched the 4th March 2010 and the 3rd call “Regional2” the 10th February 2011. Only 15 of the proposed RVs got funded cruises.

Ship-time funding was the result of a competitive evaluation coordinated by AWI (Alfred Wegener Institut, Germany). The individual assessment of proposals by experts in the respective field of research formed an integrative and essential part of the access modalities.

Scientists got access to RVs on basis of scientific excellence, and the EUROFLEETS evaluation system has proven to be objective, transparent and fair and can be fully recommended as a procedure for future European calls for ship-time. This is a major step towards an intensified cooperation of European RVs.

Essential pre-requisites to the success of this process were a number of points which should be observed in future calls:

1 - The evaluation procedure and evaluation criteria are based upon the best experiences from different European ship-time application and evaluation procedures, further considering European evaluation procedures (EC and ESF). The defined criteria and weighting of scores were regarded as very appropriate to allow a thorough and comprehensive scientific assessment of proposals. Those criteria should be applied in future pan-European calls and efforts should be directed towards the application of these criteria on a national level to progress towards a more unified European or international standard in the evaluation of proposals for ship-time.

2 - Interlinked to the evaluation criteria is the proposal structure, which was regarded as well defined and which covered all relevant points to gain a complete project description. The quality of proposals submitted to the “Ocean” call differed considerably from those of the “Regional 1” call primarily reflecting a different clientele and experience in the writing of proposals. A successful involvement of proponents with less experience benefited from a more detailed proposal structure description and several templates to be completed for the “Regional 2” call. This led to more uniform and higher standards for proposals across all of Europe.

3 - As part of their review, the Scientific Review Panel (SRP) prepared a detailed Evaluation Summary Report to provide applicants with a comprehensive feedback on their proposal indicating strengths and weaknesses for each section of the proposal. For some of the proposals on Regional RVs the SRP recommended a resubmission of an improved version of the proposals to the “Regional 2” call. This

recommended a resubmission of an improved version of the proposals to the "Regional 2" call. This should foster proponents to improve the quality of proposals for ship-time. These measures of guidance and support in proposal writing would profit most from a continued process of calls on a pan-European level, thereby raising the international competitiveness of European marine scientists.

4 - The separation into two steps, to have a detailed scientific evaluation of the proposals before taking into account any logistical considerations, guaranteed a high quality, reliable process. The pan-European view reduced national considerations and fostered impartiality of the bodies involved. This proved to be very beneficial for the overall quality of the proposals. Furthermore, the Logistic Review Panel (LRP) meeting was very successful and efficient in placing high-ranked proposals of high scientific quality, taking advantage of the inherent flexibility of a dispersed but coherently managed RV infrastructure. Thus, this procedure in two independent steps is strongly recommendable for future calls.

5 - The exact definition of the whole call and evaluation process well in advance of the whole procedure is necessary to guarantee smooth cooperation of all stakeholders involved (project beneficiaries, RV operators, both review panels, and applicants). The use of an alert was helpful in this respect and should be employed in future calls.

6 - At present funding of ship-time is granted as a stand-alone provision detached from subsequent funding of data analysis, thus it cannot be assured that funding of subsequent data analysis will be available. To secure post cruise data analysis, a combined funding of cruise and post cruise work would be desirable.

Altogether, 54 proposals for ship-time on Global/Ocean and Regional RVs were submitted in the three calls, indicating the demand for marine research cruises in Europe and showing how successful could be the idea to provide ship-time on a big suite of European RVs. 17 cruises have been successfully carried out amounting in a total of 190,5 days of ship-time, with a clear focus on the North Atlantic and the European regional seas, especially the Mediterranean Sea. The scientific disciplines carried out on the cruises covered all fields of marine research with a focus on geoscientific research. Only marginal troubles or delays in the cruises have taken place and all cruise reports have been delivered on time.

RVs were available from 2011 to 2013 in all oceans except the Pacific Ocean and the Polar Seas depending on the national schedule of the RVs. The areas of operation for the Global/Ocean RVs span from one of the longest oceanographic transect ever made through the whole Atlantic Ocean on-board of RV Polarstern (Atlantic CDOM cruise) to distinct areas and very detailed mapping and sampling in the western Mediterranean Sea by the SALTFLU project on-board of RV OGS Explora. For Regional RVs, the operational areas showed a clear focus on the Mediterranean and its marginal seas (e.g Black Sea). Usually, these cruises took place as one single expedition but EUROFLEETS also provided the Estonian RV Salme to a Latvian group of scientists for 4 cruises in the Baltic Sea to study the seasonal variability of the pelagic – benthic system.

221 scientists and students participated in the EUROFLEETS cruises. The Principal Investigators (PIs) of the cruises came from all over Europe and international collaborators from US, Canada, New Zealand etc. have been involved in the cruises as well. Most of the cruise participants came from Italy, followed by Spain and Germany. Additionally, the applications for the "Regional2" call contained more proposals from

Spain and Germany. Additionally, the applications for the Regional2 call contained more proposals from new European member states or other countries than the proposals for the “Regional1” call, showing that the call for proposals reached a larger audience and the guidance given for the applications helped also scientists from new member states to successfully apply for ship-time.

The high number of students (65, representing 30 % of the on-board scientific parties) who participated to the EUROFLEETS funded cruises, reflects one key priority set by the Project to contribute to the training of young scientists. The students had 17 different nationalities. A majority of them (10) came from Italy, followed by Latvia (8) and Ireland (7).

Despite the necessary time from cruise completion and data collection to data analysis, EUROFLEETS funded cruise are already producing their first peer reviewed publications with i) two papers published in the journal Ocean Science (2013) and in the journal Remote Sensing of Environment (2014) by the scientific party of the BIO-OPT cruises jointly run on board the Bulgarian RV Akademik and the Romanian RV Mare Nigrum, ii) and one paper published in 2013 in the Journal of maps by the scientific party of the FAIVI cruise run on board the French RV L’Atalante and the oceanographic launch Haliotis. A news article published in Nature during the completion of the Caldera 2012 cruise also allowed to widely disseminate the targeted scientific objectives towards the scientific community and to raise interest for such a collaborative cruise involving a multi-national team and also multi-national infrastructures as the cruise was run on board the Greek RV Aegaeo and required combined deployment of the Greek submersible Thetis and the Autonomous Underwater Vehicle (AUV) under validation by the University of Girona, Spain. These first publications, together with the numerous presentations made by the EUROFLEETS scientific parties in scientific conferences, show that more scientific publications based on funded cruises results are expected and should be produced in a near future.

Joint Research implemented within the Project focused on two relevant and operation-oriented themes aiming to serve the need for larger interoperability and resource sharing expressed by the EUROFLEETS consortium and to facilitate future transnational access through common tools and procedures.

As a first area of work, the Joint Research Activity focused on the development of four software prototypes: EARS (EUROFLEETS Automatic Reporting System) for recording events occurring during a cruise, GLOBE Software (Global Oceanographic Bathymetry Explorer) mainly dedicated to MBES (MultiBeam Echo Sounder) data processing, CDInfusion for the integration of molecular data with oceanographic data from various cruises, and the Deep Sea Video Platform for the visualization and annotation of video from ROV surveys. Special attention was also paid to the calibration of multi-parametric probes as this is an essential issue for both the data logging and the delivery of high quality raw data to the scientific community.

From the first specification stages, standardization was considered as a key cross-cutting issue. To promote data transmission to marine data centers, the Project made special efforts to produce guidelines to developers and to highlight that standards do not only deal with common data formats and structures but also with nomenclatures, data dictionaries and communication protocols as part of the strategy of interoperability and data sharing. The standardization effort created synergies and allowed to establish links with other European initiatives such as SeaDataNet (for common vocabularies, Cruise Summary Report - CSR, and Common Data Index - CDI formats), GeoSeas (for 3D bathymetric data visualization)

report -CSN- and Common Data Index -CDI- formats), GeosEas (for 3D bathymetric data visualization) and EmodNet (for bathymetric data processing), and also with international programmes such as the Ocean Data Interoperability Platform (ODIP) and the Rolling Deck to Repository (R2R) program (for common vocabularies and metadata).

The EARS software is an on-board tool which aims to record any possible event, ranging from a sample taken or an observation done to any malfunction occurring during a survey. Events could then be used in data quality control processes, or in a more general approach, they provide contextual information useful to scientists during data processing. Three subsets have been identified: the Automatic event entry (automatic acquisition of data from selected sensors), the Manual event entry (for additional information, comments or actions set by an operator) and the Reporting component. EARS was developed using the existing software CASINO+ developed and made available by Ifremer.

- The Automatic event entry aims to acquire data coming from selected sensors of the ship (such as weather parameters, salinity, ship attitudes ...). In the perspective of having EARS operational on-board many RVs in EUROFLEETS2, one priority was to develop a flexible tool so that it can accommodate different practices, technologies or traditions among the RVs operators. Physically, the proposed open architecture is thus based on serial links to Ethernet switches and connected to the ship network. A dedicated Graphical User Interface has been developed: it allows having EARS listening and recording sensor data referring to an archive of instrumentation set-ups which could be easily retrieved by non-expert users.

- The development of the Manual Events entry module required the prior description of the Manual event concept based on common controlled vocabularies with the semantic equivalence to others used in frameworks like SeaDataNet. The need to reach a common understanding of the concept "event" and of its fundamental pieces of information has led to the production of a consented "Event entity model". This model has naturally evolved to a formal ontology. Commonality of the used lists/terms were discussed with the American R2R project in the context of the ODIP international project (Australia, USA and Europe). A dedicated multilingual Graphical User Interface has been developed to enter manual events. Geo-referencing is ensured through a connection to the automatic acquisition module.

- Two new reporting approaches have been introduced: the Full Reporting that exports from the database all occurred events and the 24-hour Ship Summary Report (SSR). This latter provides the snap-shot of the RV situation (ship ID, cruise ID, position, heading ...) extended with a set of 24-hour latest events from EARS and also with the last 24-hour navigation track. It is implemented upon a set of WebServices that independently modifies the different parts of the SSR. Hence, different updating rates can be adopted to refresh each element of the SSR or to work with different sources of information facilitating its deployment in different RVs.

This daily report is intended to be transmitted from vessel to shore to the data center of the ship operator, or to information portals such as the European Virtual Infrastructure in Ocean Research (EVIOR) developed within EUROFLEETS and available at <http://www.eurofleets.eu>.

On top of the two reporting approaches introduced here above, EARS is able to create automatically the Cruise Summary Report (CSR) required by data centers at the end of the cruise. To this purpose, the SeaDataNet MIKADO software has been plugged to EARS



SeaDataNet with ADC software has been plugged to EARS.

The EARS software was successfully tested on-board two EUROFLEETS RVs: the RV Belgica (RBINS-MUMM, Belgium) in January 2013 during a 3-day cruise and the RV Oceania (IOPAS, Poland) from January to March 2013 during 4 scientific cruises.

The GLOBE Software developed within EUROFLEETS is a demonstration software for multi-sensors post-processing. Mainly dedicated to MBES data, it is also designed to accept further functionalities such as images and video. It can be used on-board or on-shore, and offers the ability to get a quick view of acquired data and, in a later stage, to implement data processing with accurate environment data. The software delivers “cleaned” multi-beam data files and Digital Terrain Model (DTM). The toolset focuses on bathymetry data cleaning and provides efficient tools covering the navigation processing, invalidation of erroneous data, correction of bias affecting bathymetry and imagery (roll, pitch, heading, heave, time ...) and tide correction. Moreover, illustrating its multi-sensors capabilities, the software includes a plugging for photo rendering. This option enables to load and display OTUS photo (12-bit Black&White images) on bathymetry seafloor.

The central module dedicated to data visualization has been developed using the existing 3D-Viewer software developed by Ifremer. This 3D-Viewer co-developed within EUROFLEETS initiated promising synergies with the European project GeoSeas through the proposal made by both projects to use a common and unique tool for 3D data visualization. This common 3D-Viewer is so available for download on the Data products and Services webpage of the GeoSeas portal ([www.geoseas.eu](http://www.geoseas.eu)).

The processing flow was also adapted to be compliant with the EmodNET methodology. Common Data Indexes are accessible from the DTM allowing to download datasets. Further collaboration is expected in a near future with the EmodNET2 community as GLOBE software could be used as a reference tool to provide DTM products.

The GLOBE Software was also successfully tested on-board the RV Belgica during the January 2013 sea trials. Test reports have been produced and are available to the whole consortium.

The CDinFusion software is a web based tool which aims to integrate and combine molecular sequence data with oceanographic, physico-chemical and biological data obtained from various cruises and prepare them for submission in public sequence archives, allowing so to overcome the obstacle related to the fact that sequence data generation and ex-situ measurements of environmental parameters are inherently asynchronous and often only readily available years after an expedition/cruise.

This tool allows users to upload molecular sequence data in the common FASTA-format. The user can then either submit additional metadata via web forms or upload pre-defined Excel-sheets. The system maps all sequence data to the corresponding metadata and produces Genomic Standards Consortium compliant data files ready for submission to one of the International Nucleotide Sequence Database Collaboration (INSDC) public sequence archives ([www.insdc.org](http://www.insdc.org)).

The CDinFusion webtool is available to the research community, it is part of the Marine Ecological Genomics portal allowing access to integrated environmental and (meta)genomic data intended for use in marine microbial ecology and is available for use and evaluation at the weblink [www.megx.net/CDinFusion](http://www.megx.net/CDinFusion).

The Deep Sea Video Platform is a web based system for watching, processing, annotating and searching

The Deep Sea Video Platform is a web based system for watching, processing, annotating and searching ROV videos. It also utilizes social web technologies to allow for a distributed world-wide scientific community to collaboratively annotate videos anywhere at any time. The developed prototype includes the following features: video watching, video search using keywords, geographic position, depth and time range and any combination thereof and video annotation organized in themes.

Studies undertaken on the calibration of multi-parametric probes resulted in a twofold progress. Firstly, recommendations for calibration methods, best practices and high data quality were proposed for each parameter/sensor, selecting the most used inside the community. A Reference handbook "Protocols and Recommendations on Calibration Procedures" was produced, with each section of the Reference handbook structured according to three general issues: equipment, sampling procedures and measurement procedures. This could serve as a reference guideline among the European marine research community.

Secondly, a substantial work has been done on how to record in a standardized way all the information included in the calibration process. The innovative and promising approach based on the description of sensor calibration information in SensorML format proposed by the Project should constitute the basis for future development on e-access within EUROFLEETS2. This approach is also of particular interest for marine database projects such as SeaDataNet and should stimulate new synergies between these two European initiatives.

The second area of work of the Joint Research Activity aimed to develop a set of three interoperable payloads for underwater systems: the BioGeoChemical (BGC) module, the 3D HDTV camera and the In Situ Chemical Analysis and Sampling Payload (ICASP) module. A fourth objective also aimed to develop two prototype software: the mission management software CMPT (Common Mission Programming Tool) as running underwater vehicles in scientific missions has to be planned carefully in order to use ship time most effective but as well as to operate underwater vehicles in a safe manner with respect to secure huge vehicle investments, and the DUNE (Detector for UNDERwater Events) prototype to make a first step forward towards the automatic annotation of underwater videos with metadata of scientific interest.

The BGC module was designed as a construction kit, in order to combine autonomous sensor modules with 4 basic components: the switch, the actuator, the logger and the sensor module.

With a construction kit like this, scientific operators are capable to build their own modular microprofiler, allowing interconnection of several sensor packages, data logger, underwater switches and motor controller to one operational unit. This unit could be operated either autonomous or remotely controlled. In addition, integration on different underwater platforms, e.g. ROV, AUV, Crawler, Lander, towed instruments (video sensor system MEDUSA, corer TV-MUC, deep water camera OFOS) is easy and was tested successfully on a variety of national and international cruises and field campaigns, as standalone version within long-term observatories (shallow water investigations of CO<sub>2</sub> seeps in the Mediterranean Sea for the European project ECO<sub>2</sub>) as well as AUV payload during the HE-377 cruise on RV Heincke in North Sea and the ARK XXVII/2 cruise on RV Polarstern in the Arctic ocean. The BGC module could be easily adapted to other scientific needs – remotely operated or autonomous/short-term deployed. All modules have been used to perform measurements in the water column and sediments with a variety of different sensors (O<sub>2</sub>, pH, pCO<sub>2</sub>, T, H<sub>2</sub>S) in order to study the physico-chemical environment of marine ecosystems, e.g. seeps and anoxia (EU projects HYPOX, ECO<sub>2</sub>).

ecosystems, e.g. seeps and anoxia (EU-projects HIFOX, EOC2).

The 3D HDTV module developed within EUROFLEETS is an innovative small scale scientific underwater stereo camera system (3D) with high definition quality (HDTV); the development was conducted in close cooperation between MARUM, Ifremer and the FRAUNHOFER IIS Institute of Erlangen (Germany). The high-end camera system is designed for the use onboard remotely operated or autonomous vehicles (ROVs or AUVs) and it allows to viewing, recording and mapping of live visual video information from the seafloor or from underwater objects in true stereoscopic or super-stereoscopic modes. The most innovative part of this development lies in the signal transcoding; it provides 3D information even on limited bandwidth channels, because it offers scalable data transfer down 10 Mbit/sec @25 frames/sec or even less. The EUROFLEETS 3D HDTV camera incorporates an innovative technical approach to allow the installation/interfaces on a huge variety of platforms, because in most scenarios even one fiber is available on ROV tether systems. Signal transfer can either be routed to the sea surface with a single standard Ethernet connection, or via a dedicated HDTV telemetry based on the HD-SDI data format at high data rates of 1.5 Gbit/sec. The visualization could be achieved either via a high-end 3D capable large scale monitor and shutter glasses or via standard laptops and open-source 3D Bino-Player ([www.bino3d.org](http://www.bino3d.org)).

Since many existing ROV or AUV platforms do have the necessary space, power and ethernet connection interface already available, the use of the 3D HDTV camera system allows a wider scientific use of very high quality underwater images with 3D information - not available before. Providing the 3D HDTV camera system to the scientific community will foster the investigation of deepwater corals, hydrothermal vents, coastal and shelf marine fauna, gas hydrate and methane seeps, immediately – all of them demanding better visual documentation and higher quality acquisition of visual three-dimensional datasets. The 3D-HDTV camera has been successfully tested at the MARUM test basin with the ROV Quest under realistic field conditions, the system has been proved as very stable and ready to use on by science.

The ICASP module was designed as a versatile, integrated sensor package, consisting of a revolver-type water sampler, various geo-chemical sensors and the electronic core unit (payload control computer or PCC). The PCC represents an entire downscaled computer (i.e. not just a data logger), which could act a configurable interface between ICASPs sensors and the control computer of any underwater vehicle. The advantage of the ICASP lies in the vehicle-independent operation scheme; no vehicle interface is mandatory (e.g. INS input, time, synchronized signal, etc.) to operate the ICASP on a given underwater vehicle. Instead, it could be operated completely autonomous; no adjustment to electronic or logical settings hampers the easiest usage on different carrier systems. In the period between 2012 and 2013, ICASP was deployed during several expeditions along with the AWI Bluefin AUV. The cruise HE-377 (RV Heincke, April 2012) and the two arctic expeditions ARK 27/2 (RV Polarstern, July 2012) and MSM-29 (RV Maria S. Merian, June-July 2013) are to be mentioned specifically. At the end of the project, the ICASP module has been considered as operational and new developments are already planned to further enhance its capabilities.

A Common Mission Programming Tool (CMPT) was developed in order to minimize the risk to lose the underwater vehicle due to user-induced faults as well as to monitor the operation of the vehicle during its mission but also to visualize gained scientific data – in one tool only. It was developed using the existing software Mimesa made available by Ifremer. The CMPT was designed as a client/server Microsoft

software mimosa made available by Ifremer. The CIVIL T was designed as a client/server Microsoft Windows based planning tool, with an ArcGis Runtime module as base, well reflecting that most scientists actually merging their scientific data inside ArcGis projects. Doing so, scientific user could easily plan their underwater missions on “their own” ArcGis project incorporated into the CMPT, well anticipating to plan on a geo-referenced base. During the project lifetime, several vehicle specific “parser-modules” have been implemented into the CMPT in order to export “mission files” into vehicle specific syntax (AUVs, Glider, Floats) and to use it for ROV operations as well. The use of CMPT for ROV operations displays best the capacity of such integrated mission planning tool as scientific users can pre-plan their ROV mission in their lab, transfer their mission to the ROV control unit, allowing afterwards the ROV mission operators and scientists to more effectively operate the ROV in real-time mode. The CMPT is used in operational mode for scientific cruises on the MARUM AUV B-Seal and ROV Quest 4000, and on the Ifremer AUVs AsterX and IdefX and ROV Victor 6000.

The DUNE software was developed as a prototype platform offering several algorithms for the automatic detection of events such as appearance (and disappearance) of fixed or mobile fauna (gorgonian corals, fishes ...) on underwater videos, with the objective in the near future to automatically annotate videos with metadata of scientific interest, thereby allowing scientists to replay their data and videos more efficiently.

The state of the art of the image analysis techniques conducted before the design phase allowed to focus on advanced image analysis techniques, such as classification techniques (supervised learning) or neuromorphic selective attention algorithms. Three different techniques were identified: i) the cascade classifier (Haar or LBP trainer, AdaBoost detector) enabling automatic detection of a well-known set of objects, ii) the multi-scale saliency model (originally introduced by MBARI) as a detection system inspired by the behavior and the neuronal architecture of the early primate visual system, and iii) a custom detection method based on SIFT/SURF and Delaunay triangulation. These three techniques have been implemented in the DUNE software using OpenCV open source library, and tests have been conducted on ROV underwater videos. Promising results have been obtained, for example for the classification of gorgonian corals in Mediterranean canyons and the detection of big fishes (fixed or mobile) on sedimentary seafloor, allowing to further specify a complete image processing scheme (in particular including image enhancement pre-processing, extraction of environment information, and advanced tracking methods), with more robust performances in different types of underwater environment.

As a necessary complement to TransNational Access and Joint Research, Networking Activity contributed to an impressive sharing of knowledge, best practices and expertise. The wide range of actions carried out represents a major step forward towards an enhanced coordination of European research fleets owners and cost-effective use of their facilities. They can be summarized as follows.

As a first action, the “Strategic Coordination vision” work package created the Fleet Evolution Group (FEG) gathering all research fleet operators involved in the project (but National Oceanographic Centre in the United Kingdom) and volunteering non-beneficiaries of the EUROFLEETS projects as well. Efforts to enlarge the participation to the EUROFLEETS FEG group were reinforced when OFEG (Ocean Facilities Exchange Group) and ERVO (European Research Vessel Operators) groups joined the Project as permanent invitees. The second and third FEG meetings were so organized during the 2012 and 2013 ERVO annual meetings.

The EUROFLEETS FEG is the appropriate forum for information sharing on strategic views of European fleets operators, and will be maintained and extended thanks to the EUROFLEETS2 project.

As a starting point for the launching of a European strategic view on research fleets and their associated equipment, the FEG worked on the assessment of the current status of European research fleets for three classes of research vessels (Global, Ocean and Regional using the US classification), and for major underwater equipment -UWE-. Through the FEG meetings and information from national contacts, 24 countries were surveyed (Belgium, Bulgaria, Croatia, Denmark, Estonia, Faroe Islands, Finland, France, Germany, Greece, Greenland, Iceland, Ireland, Italy, Lithuania, Netherlands, Norway, Poland, Portugal, Romania, Spain, Sweden, Turkey and United Kingdom). The assessment made constitutes an update of the Marine Board-ESF Position Paper 10 “European Ocean Research Fleets: Towards a Common Strategy and Enhanced Use” dated March 2007, with the extension of the survey scope to cover all RVs accessible for academic research, i.e. multipurpose RVs plus polar and fisheries RVs used for academic research on top of their public service missions (such as support to polar stations, stock assessment ...).

A total of 78 RVs currently in operation has been identified:

- 36 from the Global/Ocean classes,
- 42 with Regional capacities.

Regarding their distribution in age, more than half (46 RVs, 59%) is 20 years or older, and almost one third (24 RVs, 30%) is 30 years or more. Though the extended surveyed range of RVs, these figures are coherent with the pessimistic perspective highlighted in 2007, and even worse since almost all RVs identified in the MB-ESF position paper (except two RVs which have been decommissioned without replacement, and two other ones which have been replaced) are still in operation.

Since 2007, only three Global/Ocean RVs (<10% making less than 1% per year) were built and put into service (RVs Sarmiento de Gamboa and Miguel Oliver for Spain, and RV Discovery for United Kingdom). More, among the RVs presently aged more than 30 years, 11 ships are Ocean/Global RVs. With 5 Global/Ocean RVs under construction, ordered or funded, Germany (for RVs Sonne, Polarstern and Poseidon) and Norway (RV Lance replaced by R/V Konprins Haakon, and RV Fridtjof Nansen) are the only two European countries currently showing their ability to renew their Global/Ocean classes research fleets.

The situation is different for Regional RVs (RRVs) since the survey highlighted more new Regional RVs since 2007 (8 ships from 6 countries: Belgium, Croatia, Germany, Greenland, Spain and Turkey): 6 new built RVs and two refitted ones (one for Germany, the RV Elisabeth Mann Borgese, ex-Schwedeneck from the German Navy, and one for Turkey, the RV Alemdar-2 refitted from a tugboat). Special attention has to be drawn to the length of these new RVs since many of them are “small” RRVs. Among the 6 new Regional RVs built since 2007, only three ships are longer than 40m (RVs Angeles Alvarino and Ramon Margalef for Spain, and RV Marmara for Turkey). Three other RRVs, currently under construction or ordered, are also expected to come into service in the next years, and only one RRV (to replace RV Skagerak for Sweden) will be longer than 40m. This observation clearly highlights that the capability of future RRVs is still a key challenge and that the number of RRVs is not the key parameter, but has to be

future RRVs is still a key challenge and that the number of RRVs is not the key parameter, but has to be completed by the ability to meet increasingly complex scientific demands. With the future marine research agenda driven by interdisciplinary research across a broad range of spatial and temporal observation scales, RRVs remain key instruments, and new RRVs will have to be more flexible and more capable in terms of onboard scientific instrumentation, number of scientist cabins, laboratories, and also in terms of vessel endurance, leading to optimized scientific productivity.

In addition to the five Global/Ocean RVs and four Regional RVs under construction, ordered or funded, the survey points out that 11 projects of new RVs (renewal or new building) from 10 countries are currently waiting for funding. This shows that the current economic crisis makes funding more and more difficult to secure for many countries, and that research fleets need to gain visibility at national level to ensure their future development. This finding is confirmed by the answers received from 19 countries regarding the status of their national roadmap for research infrastructures:

- 7 countries (Bulgaria, Denmark, Estonia, France, Germany, Italy and Norway) representing 36% have national roadmaps, including RVs and associated equipment or reference documents describing their renewal plans at national level,
- two countries (Spain and Turkey) have announced that national roadmaps including RVs are under construction,
- the other 10 countries, representing more than 50%, confirm that no roadmap referring to RVs exists in their country.

Moreover, most of the 11 renewal projects cited above are planned to be nationally funded. Only two of them envisage public-private partnership and only one is based on cooperation with foreign countries or marine institutes; this can be interpreted as another consequence of the current crisis, which makes the nations inclined to work at national level, and tends to slow or even stop integration efforts at European level.

In all cases, collected data show that the risk of a severe reduction of the number of RVs accessible for academic research within the next 10 years is becoming higher and higher. Such a declining European situation increases the need for prioritizing coordination of national investment plans in order to ensure optimal use of the limited available resources. Efforts in this direction will continue through the EUROFLEETS2 project, in particular through the establishment of procedures and recommendations, based on a flexible and multidisciplinary design for Regional RVs aiming to facilitate the exchange of equipment and their interoperability, in order to progress towards more coordinated and even integrated European Regional research fleets.

To improve the efficiency and flexibility in the management of European research fleets and to promote the coordinated development of operating procedures and standardized protocols for vessels operators, the work package (WP) "Operational issues – Contribution to operational fluidity within European Research fleets" focused in three complementary areas in order to:

- achieve a useful database on technical requirements and mobilization of European LEXI's (Large Exchangeable Instrumentation) and to establish criteria for a common interface ensuring future interoperability between new platforms and between sensors and payloads;

interoperability between new platforms and between sensors and payloads,

- describe the variety of national methods to access Regional Research Vessels (RRVs), as an essential pre-requisite for the development of a common cruise scheduling system within EUROFLEETS2;
- set up procedures for RVs to provide assistance in a rapid response capability.

From the perspective of RVs, interoperability refers to the ability of transnational cooperation for the exchange of equipment and operational issues, allowing transfer of knowledge and information to national operators to increase efficiency in the use of costly marine platforms and sophisticated equipment.

EUROFLEETS has made a step forward towards an enhanced interoperability within the RVs through the completion of nearly 900 individual interoperability assessments of LEXIs that require significant effort to deploy from both a technical and logistical perspective: in total, 23 LEXIs of European research fleet operators -including 10 ROVs, 6 AUVs, 4 seismic equipment, 2 HOVs and 1 Drill Rig- have been evaluated across 39 European Global and Ocean classes RVs.

A new LEXI Infobase developed in collaboration with EurOcean has been made operational through the EUROFLEETS website (<http://www.eurofleets.eu/lexi/>) with up-to-date information for the considered LEXIs covering technical specifications, technical support required, insurance, transport, costs and logistical arrangements, together with payloads capabilities.

To ensure that European RV owners can make provision for available LEXIs when designing and building new vessels or refitting vessels, full system interface specifications have been produced in a common format. Data compiled for each equipment include a wide range of system parameters (frequency, voltage, kVA, weight, winches, deck arrangements, etc ...) and a full inter-comparison has been undertaken for each equipment type to RV operators to ensure their vessel specifications will meet requirements for the widest possible range of equipment or, in a more realistic approach, for the number of equipment that the vessel is likely to have access to or be required to accommodate.

Similar specifications have been reviewed for future underwater payloads (tools and sensors) to help to build common interface specifications for use with future systems and to facilitate the exchange of sensors and equipment on existing systems.

The common approach in RVs promoted through EUROFLEETS implies the development of appropriate common mechanisms to facilitate vessel access and equipment sharing, together with the definition of common standards and harmonized procedures for the management and planning of the cruises themselves.

With this in view, the Project firstly reviewed the procedures implemented in 15 European countries in order to determine the existing procedures for RV management cruise planning. Though the various management regimes are focused around the same principles, this survey at national level highlighted that significant differences remain in timing, procedures, evaluation practices, etc. This strengthens the need to foster common standard and harmonized procedures in RV management and, as a first step towards this perspective, the Project established a set of guidelines built on collected information and addressing various aspects of the management procedures such as 1) Ownership, 2) Management, 3) Applications, 4) Evaluations, 5) Funding, 6) Scientific equipment, 7) Ship schedule, 8) Permits and cruise preparation and 9) Cruise report.

Moreover, the survey showed that not all institutions have developed an on-line based cruise application



moreover, the survey showed that not all institutions have developed an on-line based cruise application and planning systems such that cruise applications, barter and/or rental opportunities, and completed cruise programs can be made available to scientists and operators. To demonstrate how a RV cruise planning tool could improve the flow of programme information from operators to Cruise Programme databases, the Project made an inventory of systems existing at European level. Five systems were identified and owners/operators approached to provide more technical and functional details and also possible license details. This was followed by an analysis of which system would best fit the EUROFLEETS requirements, and the cruise planning system from IMR (Norway) was chosen as most suitable to become a demonstrator for a generic cruise planning system. It has been tentatively integrated in the EUROFLEETS EVIOR portal and configured only for demonstration and not for operational use. Only the results after the planning processes of EUROFLEETS funded cruises can be so consulted (cruises details, calendar of each cruise and timeline of all TNA funded cruises).

Produced guidelines, together with the demonstrator, will be essential inputs for the development of a European shared scheduling tool planned to be co funded by EUROFLEETS2 which will contribute to improve the European research fleets efficiency by facilitating end user information about RVs activity and eventual availability.

In strong connection with the EVIOR portal, the Project also established a step by step procedure to initiate a rapid response to the aid of a RV to retrieve a scientific instrument lost at sea. This procedure comprises a) the descriptions of the incident, the lost instrument and the proposed intervention, b) the RV localization and c) the determination of the Point Of Contact (POC) of the considered RV.

An accurate description of the equipment lost (type, size, weight, condition of equipment, anchor points, risks, hazards, etc.), and a precise location (coordinates, time, depth, method) are crucial to decide on specific vessel (RVs) and necessary actions (type of intervention and re-localization) for searching and recovering the lost tool. So, the procedure includes a dedicated form to be completed by the POC of the equipment lost to allow a correct transfer of information between the involved parties.

For the RV localization, the current procedure recommends to use existing websites on maritime traffic (e.g. sailwx) which provide real-time updated maps of ship locations via AIS (Automatic Identification System) allowing information of ships name and type as well as speed and ship tracking. The RV closest to the last location of the lost instrument and likely to intervene can be so identified.

Then the procedure proposes to use the Research Vessel Infobase available on the EVIOR portal (<http://www.eurofleets.eu/rvs/>) and the vessel's information page to determine the POC of the RV and get in contact with the person in charge.

However, considerations of a rapid response intervention, based on the experience discussed during ERVO meetings, show that the initiation of a rapid response intervention should be thought over very carefully and should be an exceptional event. The value of the lost instrument should be in relation to the value of the ship time, man power, risk taken at recovery, etc. related to the requested rapid response intervention.

To conclude the rapid response capabilities of RVs can be very useful but there is a need for an organization to coordinate the rapid response interventions, mainly in relation to the financial aftermath of such actions. ERVO and/or OFEG groups seem to be logical candidates to coordinate such aspects.

Besides this, rapid response interventions of RV will stay an ad hoc operation which depends on the actual



Besides this, rapid response interventions of RV will stay an ad hoc operation which depends on the actual situation related to the lost scientific equipment and the nearby RVs. EurOcean and EUROFLEETS2 could help with limited adjustments of the Research Vessel Infobase by adding a direct link to the RV programs/schedules and with an integration of the AIS and VOS RV location data within the database.

In supplement to the efforts made during the EUROFLEETS funded cruises to involve students as active members of the on-board scientific parties, the Project made special efforts towards the training of European emerging scientists and technicians in its “Advanced training and education” WP.

To provide effective practical (hands on) advanced training related to marine infrastructures, EUROFLEETS firstly focused on the provision of advanced offshore training activities as an excellent way to experience the use of instrumentation, data collection and processing. In total, nearly 60 young scientists or technicians from 19 European and third countries were trained during 5 ship-based training courses developed on board 4 RVs owned by EUROFLEETS beneficiaries which accepted to make them available without financial support (MI, Ireland, for RV Celtic Voyager; IMR, Norway, for RV G.O. Sars;

IOPAS, Poland, for RV Oceania; TUT, Estonia, for RV Salme):

1 - The PhD course in “Sea-truthing for calibration and validation of satellite ocean colour imagery of coastal zone and lakes” was supported by IOPAS in the EUROFLEETS frame and organized from 16th to 23rd of May 2010 in Asko (Sweden) by the Nordic Network for Aquatic Remote Sensing (NordAquaRemS). This clearly highlights the “capitalization” of pre-existing experiences or initiatives as a possibility to find additional resources. The course consisted in lectures, seminars, field work and laboratory exercises. Within EUROFLEETS, IOPAS supported two days of field work and practical training (in water sampling, optical measurements for inherent and apparent optical properties, and wet lab work for water sample processing) on board RV Oceania. In total, the whole course accommodated a group of 19 international students from 9 countries (Estonia, Finland, Germany, Iceland, Lithuania, Norway, Poland, Russia and Sweden).

2 - Two “Multidisciplinary ship-based training courses for postgraduate students of marine-related sciences” held in 2010 consisted of two days of ship-based training and one shore-based day. The courses took place in the waters off Cork onboard the RV Celtic Voyager and ran from 14th to 16th and from 17th to 19th of August. The processing and analysis of data were carried out in the laboratories of the University College Cork (UCC). The training was carried out by scientists from OGS, UA/FCT, TUT, MI and Galway Mayo Institute of Technology in Ireland. Geophysical and technical support was provided by the MI. 20 students were drawn from 6 countries and 14 institutions throughout Europe. In addition to the core disciplines of the courses, additional areas of research covered by students included naval architecture, marine environmental monitoring, climate change and marine toxicology. Courses were designed to provide a multidisciplinary approach to studying the marine environment using the core marine science disciplines of oceanography, fisheries biology, benthic ecology and geosciences. Training focused on the practical, cross-disciplinary skills involved in sampling and data acquisition including the deployment and operation of equipment and instrumentation followed by the processing, analysis and integration of the acquired data and samples. In addition to discipline specific skills and techniques other training elements were also incorporated, including vessel familiarization and orientation, survey design,

training elements were also incorporated, including vessel familiarization and orientation, survey design and planning, EUROFLEETS RV activities and capabilities, and safety at sea.

3 - The “EUROFLEETS ship-based training course, for scientists and technicians, in multibeam echo sounder technology” was held on board the RV G.O. Sars from 25th to 27th January 2011. IMR offered to make available its RV, which is equipped with two Kongsberg multi beam echo sounders permanently installed. In addition, the course was kindly supported by Kongsberg Maritime by providing a senior instructor to run this three-day course in multi beam technology. 12 course positions were available and the number of applicants was relatively high (36 in total, from 12 different countries). Candidates were selected on basis of their nationality (in order to have an optimal geographical distribution), and their professional background. The course was orientated towards technicians and scientists involved in seabed mapping on European RVs. Among others, the topics covered were multi beam theory, Seabed Information System (SIS) and data handling. All participants were accommodated on board the G.O. Sars, and the course was organized with day trips and alternated lectures and “hands-on” training.

4 - The EUROFLEETS Ship-based Training course for PhD Students “Practical skills in oceanography: equipment and data processing” was organized on board RV Salme in Tallinn (Estonia) from 6th and 10th July 2011. The course, aimed at acquiring the advanced practical skills in oceanography necessary to design and conduct multidisciplinary marine research, included survey design and measurements using autonomous systems and adaptive sampling onboard RV Salme in a stratified brackish water estuary (Gulf of Finland). The equipment included an autonomous buoy profiler, a Ferrybox system, profiling and towed devices, a water sampling array and laboratory equipment for treatment and analyses of samples. The course contained i) introductory lectures, ii) exercises to design and plan the field measurements, iii) two days of surveys onboard the RV, iv) post-cruise sample analyses in an onshore laboratory, v) processing, analysis and integration of data, and vi) preparation of a study report. 12 course positions were advertised and 28 applications from 12 European countries were received. 11 students (most phytoplankton-related, only 2 with previous sea-going experience) from 9 countries and 11 different institutions throughout Europe attended this course. The training was carried out by scientists from three main countries (Estonia, Ireland, USA), including two EUROFLEETS beneficiaries.

These 5 pilot training courses were widely advertised on the Project and European websites and all of them received more applicants than available course positions. Participants cited the experience as an indispensable training, hence carrying the message that the EUROFLEETS training programme offered offshore training opportunities not otherwise available, and highlighting the existing and extremely valuable capacity within the European RV fleets. The very positive feedback from the trainees, together with the award of 2 ECTS (European Credit Transfer System) credits at NFQ (National Framework of Qualifications) level 10 for the course made on board RV Salme, demonstrate how offshore training programmes could be incorporated into national and international postgraduate schools and programmes.

Aware that education is a necessary preamble to stimulate vocations in marine science and technology, EUROFLEETS also prepared guidelines for the implementation of education activities, based on the previous assessment of the existing best practices in education activities for RVs among the project’s beneficiaries. Having noticed that the majority of education activities are dedicated to the tertiary school level and that the primary school is by far the least tackled, the Project proposed to implement an

level and that the primary schools by far the least tackled, the Project proposed to implement an education activity orientated towards secondary school but capable to be adapted for primary school children.

This on-board education activity was developed by EurOcean, in collaboration with the University of Aveiro and FCT (Portugal). The implemented activity addressed not only the scientific component but also the social and cultural heritage aspects, aiming to expose the students to different marine related vocations and further raise awareness of the importance of the ocean and of marine studies and their wider implications in the daily-life. A small ship (the caravel “Vera Cruz”, an exact replica of the ancient caravels used in the Portuguese Age of Discovery) was chartered on May 13th to 15th 2013, allowing a total of 126 students (with ages between 9-18 years old) to be taught on the importance of oceanographic RVs, positioning systems and sciences dedicated to oceanographic research, with particular attention to the Marine Geology and Geophysics and Physical Oceanography. Guidelines for the implementation of education activities and materials developed for the “Vera Cruz” education activity are available on the EUROFLEETS public website.

Closely related with inter-operability aspects addressed by the WP “Operational issues – Contribution to operational fluidity within European Research fleets”, the training tasks established a first register of

Technical exchangeable personnel among the Project’s beneficiaries with a view to determining the availability of suitable qualified and skilled personnel that could form part of future transnational deployment teams. In total, 72 technicians from 18 institutions belonging to 15 European countries were indicated as being available for exchange.

The review of technician skills showed that Oceanographic disciplines are the most represented (followed by Biologic/Benthic, Geosciences, Generic and Electronics, and Fisheries scientific areas) and that technician exchanges in the operation and maintenance of CTD and underway Oceanographic sensors could readily take place. Operation and set up of Multibeam or fisheries echosounders would be two other areas or skill sets suitable for technicians exchange if demands exist.

Conversely, the review identified the issue that not all technicians are specialized in areas which are relevant to LEXIs (Large Exchangeable Instruments) with only 12 respondents (out of 72) identifying experience with ROVs (Remotely Operated Vehicules) and HOVs (Human Operated Vehicles). Assistance for operation of ROVs is determined by the level of complexity and customization of the systems, and also by the technical experience of the personnel combined with language barriers which are often important considerations governing the success of the mission. So, this rather low number of exchangeable technicians can be explained by the fact that many of the ROVs in the LEXI database are rather specialized and offer limited opportunity for use of technicians not familiar with the systems in question. To make progress towards future transnational deployment teams, the Project thus recommends as a first step to consult the LEXI’s operators to establish their needs in exchangeable personnel and, in a second step, to match up their requirements, to expand and update annually or bi-annually the database of exchangeable technicians with curriculum vitae of technical experience. Policies and procedures at institute level would be then required to ensure the overall success and buy-in of future transnational deployment teams.

Providing support to European RV operators in managing the environmental footprint arising from their RVs, equipment and research operations, together with the definition of minimum and high-end functional operational demands of future Regional RV use design, were two other overarching objectives in

operational demands of future regional RV eco-design, were two other overarching objectives in EUROFLEETS. The objectives of the WP “Eco-responsibility and eco-design for existing and new RVs” were thus twofold; firstly it was to develop an environmental process that reflected the bespoke nature of the Marine Scientific Research (MSR) undertaken by the RVs communities. Secondly it was to develop a set of eco design criteria that reflected the special nature of the RVs that delivered this bespoke MSR capability. In particular the development of eco design standards and criteria that were suitable for the Regional class RVs that were being or about to be built by the EUROFLEETS beneficiaries. Progress made on both areas was actively promoted towards broader RVs community through participation to workshops such as Safer Seas, UNOLS or IRSO and ERVO meetings. The very positive feedback from these workshops and meetings showed that EUROFLEETS was leading in this area.

The environmental processes developed and delivered in the form of several reports covered RV Life Cycle Analysis (RVLCA) considering all phases in the life cycle (from design, over production and usage to decommissioning), the production of an Environmental Management Plan (RVEMP) and concluding with the establishment of an environmental management system (RVEMS) based where possible on the ISO14001 standard suitable for adoption by the EUROFLEETS community. The early research which involved an extensive dialogue within EUROFLEETS RVs operators highlighted the distinct nature of the delivery of MSR. It was noted that environmental issues being highlighted during the RVLCA research were not just limited to RVs as seen by the application of the IMO (International Maritime Organization) suite of conventions but were inclusive of the less intuitive environmental aspects of research operations (RO) and research equipment (RE). Through the high level guidance principles provided to allow RV operators to establish their RV Environmental Management Plan (RVEMP) on the basis of these three inventory elements, the study highlighted the requirement to also deal with the greening of Marine Autonomous Systems (MAS) which are increasingly used in support to MSR.

The RVLCA study produced a series of inventory tables covering RV, RO and RE areas which were based on the ISO 14001 standards. Their use will establish a harmonized approach to the capture of environmental issues within the EUROFLEETS community. The study also proposed the adoption of two definitions for “scope” and “goal” for the RVLCA process. It is assessed that their adoption will also influence the way in which the international RV operator community will manage these issues. The RVLCA study also identified the need for the establishment of a common environmental training programme.

The research in support of the production of a RVEMS capability identified that trying to achieve one common EMS based on one standard such as ISO 14001 would not be straight forward. The current status of RVEMS within the community shows the following mix of capability : i) RVEMS capability based on ISO14001 standard, ii) RVEMS capability on the ISM Code standard, iii) RVEMS capability based on a mix of ISO14001 and the ISM Code standards, and iv) No RVEMS capability. The impact of this RVEMS research will be to recognize that no one standard would become common across the research fleets but more importantly that those operators with no RVEMS need to be encouraged further to put in place an EMS capability that is based on one or a mix of the two standards already in use.

The work on the production of guidelines for RV eco-design has impacted highly not just on the EUROFLEETS consortium but also on the wider community with the work being exposed to classification societies, ship builders and other non-European RV operators. This work was undertaken with fruitful collaboration with ship designers and an executive summary of these final guidelines was published in the

collaboration with ship designers, and an executive summary of these initial guidelines was published in the open literature in June 2013 (Eco-Design of Research Vessels by Andre Cattrijsse and al., The Journal of Ocean Technology, Vol. 8, No. 2, 2013). Green ship technologies and green ship operational measures that exist or that are in development today have been addressed, as well as the potential or applicability of each technologies to Regional RVs, making these guidelines as a relevant input to the EUROFLEETS2 project.

In order to improve information sharing and provide up-to-date information about European RVs, cruise programmes, completed cruises and specialized marine equipment, EUROFLEETS through its WP package "Virtual Research fleet platform" developed the European Virtual Infrastructure in Ocean Research (EVIOR) by way of an Integrated Information Portal. Provided information aims to enhance awareness of opportunities among users and to improve cost-effectiveness of cruises.

This portal is operational since March 2010 and is provided as one of the navigation options in the public EUROFLEETS website (<http://www.eurofleets.eu>). It was not built from scratch but by using and elaborating basis components from the SeaDataNet pan-European marine and ocean data management

infrastructure, POGO (Partnership for Observation of the Global Oceans) and EurOcean. Thus, the present portal comprises the four following information retrieval and maintenance modules:

- RV Cruise Programme database page, with the EUROFLEETS Quick Search interface containing planned cruises per research vessel and owner/operator. From this interface users and vessel managers have access to additional applications for extended search and for updating the RV Cruise Programme database itself via a file procedure to the British Oceanographic Data Centre (BODC) as content coordinator and via an online Content Management System (CMS) as operated by MARIS as system manager;
- Cruise Summary Reports (CSR) page, giving access to: i) the EUROFLEETS User interface of the CSRs database containing details of completed cruises and providing a first level inventory of oceanographic measurements made and samples taken during cruises since 2005, ii) the Online Content Management System of the of the SeaDataNet Cruise Summary Reports database, managed by BSH (Bundesamt fuer Seeschifffahrt und Hydrographie, Germany) for submitting CSR's, and iii) Instructions on how to update CSR's and to contact the National Oceanographic Data Centres (NODCs) that are overseeing the CSR collation per country;
- Research Vessel database page, giving access to: i) the EUROFLEETS User interface of the RV database containing main characteristics of each RV, owner/operator contact details and, if available, a link to the ship's webpage, ii) Instructions on how to update vessel entries, and iii) the Online Content System of the RV database, managed by EurOcean;
- Large Exchangeable Instruments (LEXI) database containing details of underwater vehicles and of large exchangeable instruments from European operators and also managed by EurOcean.

The portal and its components have been and will in the future be maintained by RV managers and RV operators. Therefore instructions and user manuals have been compiled and are provided for EUROFLEETS beneficiaries and other RV operators on how to contribute and update information entries in the databases of the EUROFLEETS Integrated Information Portal. Moreover, RV and equipment operators are regularly contacted and encouraged to submit new entries and to maintain their existing entries. For the Cruise Programme information, BODC is contacting operators and gathering input, while

entries. For the Cruise Programme information, BODC is contacting operators and gathering input, while MARIS takes care that the new input is well imported. The CSRs are maintained in cooperation with the SeaDataNet network while the information on RVs and LEXIs are maintained via EurOcean.

The gathering of entries for the Cruise Programmes database proceeds rather well and nowadays per year ca 300 cruise plans are gathered for RVs from 14 countries. For the CSRs database per year ca 700 - 800 CSRs are gathered from more than 20 countries around European seas. The RVs infobase contains at present details of 267 operating RVs of Global, Ocean, Regional and Coastal classes. The European LEXIs database contains information on 124 embarked equipment.

In May 2013, a prototype functionality for Dynamic Vessel Tracking & Events was added to EVIOR, as a first step towards a common system for giving e-access to underway and operational information and data from sailing RVs. The prototype has been set up for the RVs Sarmiento de Gamboa and Hesperides (CSIC, Spain). Based on an on-line reporting of the geographic position, speed, bearing and logged events for the on-board fixed instruments from the RVs to the CSIC data centre, the prototype allows to retrieve through the EVIOR portal dynamic charts of the momentary position of the RVs with position, speed, and bearing, and also track-charts of the RVs sailing from start of the prototype service till present with overview of the sailed tracks, details of positions, speeds and bearings, and option to re-run the tracks as animation. Examples of 24-hour Ship Summary Reports (SSR) can be also captured by clicking on any position of the vessel track and the SSR includes options to retrieve the event logs for the fixed instruments. Further development of this activity towards an operational mode are planned within EUROFLEETS2.

Potential Impact:

EUROFLEETS potential impacts:

EUROFLEETS is aiming at bringing together the existing European research fleet owners, to enhance their coordination and promote the cost effective use of their facilities to enhance the scientific knowledge of world seas and oceans in a cost efficient and effective way. The impacts of EUROFLEETS results are and will remain consequently diverse and cover various fields involving research fleets owners and operators, as the scientific user community.

EUROFLEETS impact on European competitiveness is still limited but could be significant, especially on a long-term scale as a typical infrastructure projects.

The maritime regions account for more than 40% of EU GDP (Gross Domestic Product) and population. Europe's welfare is therefore linked with the sea and socio economic activities at sea are strategic to European development with about 4% of the GDP generated by marine industries. Thereby EUROFLEETS has served the economic challenges linked to the maritime and marine sectors by providing sustainable access to cost efficient Research Vessels (RVs) and equipment able to accelerate the access to new knowledge and innovation.

EUROFLEETS has significantly consolidated the links between European RV operators and owners.

EUROFLEETS integration impact is sensible but still limited. The EUROFLEETS project has been

EUROFLEETS integration impact is sensible but still limited. The EUROFLEETS project has been designed in 2007 and the financial crisis hit it very strongly. Further progress is still promoted and awaited thanks to the EUROFLEETS2 project:

- Through an intensified collaboration and sharing of information, and thanks to the participation of OFEG and ERVO in the EUROFLEETS Fleet Evolution Group, EUROFLEETS has made a new step towards a coordinated strategic vision of European Research Vessels (RVs). The Project developed a comprehensive picture of the European research fleets and given a “forecast” of their future capabilities and capacities in Europe regarding Global, Ocean and Regional class RVs and associated equipment and instruments that can give useful insight and perspectives to RV owners and operators across Europe in their internal planning and deliberations regarding their plans for acquiring new RVs and equipment;

- The work achieved shows that the European research fleets are ageing and that their renewal plans are not sufficient to keep up or even expand the capabilities for marine research in Europe without a more offensive strategy regarding RVs and equipment, and a higher degree of utilization of the smaller RVs scattered around Europe. It also shows that the EUROFLEETS and EUROFLEETS2 projects are timely initiatives in order to obtain a better understanding by decision makers of the current situation and its

prognosis if no changes are made. It also shows that many of the EUROFLEETS activities contribute to reduce the fragmentation within the European research fleets and are so vital for the future development and utilization of the European research fleets and equipment on both national and European levels;

- To foster joint ownership and use of both existing and new RVs and equipment, EUROFLEETS has mapped the interoperability of equipment and vessel across Europe and given a useful oversight over which equipment could be deployed from which vessel and thereby give the RV operators a tool to optimize the usage of their own RVs and equipment;

- EUROFLEETS has furthermore played a key role in the creation of a new European Research Grouping between German and French underwater technologies leaders –also EUROFLEETS beneficiaries- in December 2012 for an initial duration of 5 years, for a common design and procurement process for two sister underwater vehicles.

EUROFLEETS has contributed to strengthen the scientific excellence of marine research in Europe by facilitating access to top-level European RVs and has fostered scientific exchange at European and International levels:

- By establishing one of the first pan-European evaluation systems for ship-time proposals and by providing access to 15 European RVs to European scientists and their partners on the basis of scientific excellence. Through a real and fair competition, EUROFLEETS has attracted European and International scientists and made some significant steps for the creation of an efficient infrastructure by implemented an integrated access to the funded infrastructures;

- The trans-national access organized within the Project convened joint scientific cruises and contributed to the scientific exchange in Europe by fostering multi-disciplinary and multi-national groups to apply for the cruises and by allowing funded access to scientists on RVs they have no or limited access to. A

the cruises and by allowing funded access to scientists on RVs they have no or limited access to. A collaborative cruise was also organized on board the French RV L'Atalante with two scientific parties from two different disciplines namely of geology and biology using a two-step process involving two successive calls for ship time. A multi-team and multi-disciplinary cruise in this form has an innovative character providing a number of challenges to the ship-operator but at the same time opening up new avenues for the future. It should be a recommendation for future pan-European calls for ship-time on board large RVs to include this aspect.

- By promoting the sharing of available infrastructure and equipment, EUROFLEETS created synergies between member states to enhance experience and capabilities and especially supported scientists from less or no-equipped countries to get access to RVs and to improve their experience in marine research. Moreover, by communicating their proposal evaluation to non-selected Principal Investigators (PIs), EUROFLEETS allowed applicants to progress towards excellence and to get a better evaluation for the next ship-time calls, and access to funded cruises. Such a learning process contributed to increase the overall scientific level as European distribution during the Project's duration.

EUROFLEETS was also an excellent demonstrator of the EC funding leverage effect, particularly in the trans-national access, as some PIs received significant national funding to complete the EUROFLEETS funding. Three fruitful examples can be cited:

- for the cruise ECO2@North Sea run on board the Irish RV Celtic Explorer, the scientific party led by a German PI got funding of GEOMAR Kiel 6000 ROV on German funding;
- the underwater instruments installed for one year during the Caldera 2012 run on board the Greek RV Aegaeo have been retrieved one year later on Greek national funding;
- to prepare the Gateway cruise carried out on board the French RV Marion Dufresne, a pre-site survey was carried out by the Belgian RV Belgica on Belgian national funding.

EUROFLEETS has contributed to streamline and enhance the data flow to data centers in standardized data formats, seeking synergy with existing International and European initiatives and thereby participating in the implementation of the integrated European Maritime Policy:

- The European Virtual Infrastructure in Ocean Research (EVIOR) portal providing up-to-date information about European RVs, cruise programmes, completed cruises and specialized marine equipment, will enhance awareness of opportunities among users and improve cost-effectiveness of cruises. Created in cooperation with existing initiatives such with SeaDataNet and POGO, EVIOR includes the Cruise Summary Report (CSR) service component and provides users and data centres with detailed information about the data acquisition activities engaged during the scientific cruises. This information is crucial for data centres for following up the processing of the data sets and the long term storage and accessibility towards users;
- The EARS (EUROFLEETS Automatic Reporting System) for recording events occurring during cruises will highly contribute to standardize the events acquisition and description by common vocabularies, and will increase the accurate data flow on cruises activities to data centers;



- The demonstration software for multi-sensors post-processing GLOBE Software (Global Oceanographic Bathymetry Explorer) developed within EUROFLEETS produces Digital Terrain Models (DTM) compliant with the EmodNET methodology, allowing to propose GLOBE Software as a reference tool for the provision of DTM products to the EmodNET2 community.

EUROFLEETS developed several innovative and interoperable payloads for European underwater vehicles in a collaborative approach for sharing R&D risks and costs. Working together on innovation knowledge and integration has facilitated the choice of innovative solutions or equipment (such as underwater 3D cameras developed by the Erlangen Fraunhofer Institute), thus limiting the failure risk by mutualizing it. Payloads offering high-level performances in their respective fields have been successfully developed and tested: they are ready for operational use during scientific cruises, what has allowed to propose some of them –the 3D high resolution cameras- under the innovative Embarked Equipment Calls organized within EUROFLEETS2 and to make them accessible to all European scientists. The common work achieved during the Project to specify, design, integrate and run the final tests will allow the involved technical and scientific teams to pool the developed payloads and further collaborate in the future.

Additional impacts of EUROFLEETS results are expected in terms of standardisation and labelling:

- The EUROFLEETS “label” could be helpful for a national project to be integrated within its national roadmap as demonstrating a real cooperation mood. The new Baltic Sea Regional RV aiming to replace the RV Salme in 2020 is a first example of this, since this renewal project is described in the 2010 Estonian Research Infrastructures Roadmap by making reference to EUROFLEETS as regards the availability of this new RV for access by international research groups;

- Numerous EUROFLEETS guidelines have been completed: they cover greening, inter-operability standards, cruise management, European evaluation or training schemes, common data formats and structures, common communication protocols and will be widely circulated within beneficiaries and more generally within European and world RV operators through dedicated media. In particular, the work undertaken with fruitful collaboration with ship designers on green ship technologies and green ship operational measures has been published in the open literature in June 2013 (Eco-Design of Research Vessels by Andre Catrijsse and al., The Journal of Ocean Technology, Vol. 8, No. 2, 2013).

Societal impacts of EUROFLEETS results are diverse and still cover various fields:

- An important one would be to reinforce the position and visibility of European marine sciences which as a whole are really competitive with the US and Japan ones. EUROFLEETS funded cruises have thus succeeded to attract international collaborators from US, Canada, New Zealand etc. to join scientific cruises led by European scientists on board top level European RVs;

Through a successful trans-national access, EUROFLEETS helped to collect crucial information on our oceans and enhanced the scientific knowledge of the oceans by giving the European and International marine scientists access to world-class RVs. In doing so, EUROFLEETS contributed to reinforce the EU international leadership in marine, environmental and climate research. The huge scientific pressure on RV Marion Dufresne and its giant corer (7 of the 8 received proposals were evaluated as Excellent by the

marion Dufresne and its grant core) (7 of the 8 received proposals were evaluated as Excellent by the EUROFLEETS Scientific Review Panel) demonstrates this reality;

- EUROFLEETS has contributed to a better understanding of potential environmental impacts of RV operations, both for the vessel operators, the vessel crews and the scientific parties on board, and what could be done to minimize or even eliminate such potential negative consequences. The guidelines which have been developed show to the RV owners and operators several ways they could use to reduce the environmental impact of the operation of their existing RVs and also in regards to design new RVs as “green” as possible. European RVs built as per the EUROFLEETS guidelines will so positively contribute to Environment protection and Climate preservation;

- EUROFLEETS made a significant effort to improve access to resources and skills by training the new generation of marine researchers. During funded cruises, young students were incorporated in the scientific party, representing in total 30% of involved scientists. Students, technicians and scientists were also given training opportunities covering a lot of scientific disciplines on different levels, and giving the attendees many opportunities to establish contact with fellow students, technicians and/or scientists from different parts of Europe. Some EUROFLEETS member institutions (MI from Ireland, IMR from Norway, IOPAS from Poland, and TUT from Estonia) have donated ship and/or staff time to prepare and run these courses, and in some cases even industry like Kongsberg Simrad have donated personnel time to contribute to the training courses.

The heavy commitment to support training across borders shown within the Project and the very positive feedback from the trainees has demonstrated that offshore training programmes could be highly relevant when they are incorporated into national international postgraduate schools and programmes, allowing to both raise interest in scientific careers and promote their development.

Such large and diverse impacts explain why the EUROFLEETS2 proposal was prepared in 2011. Positively evaluated by the experts of the European Commission, it started in March 2013. The 6-month overlap between the two projects has allowed to ensure a continuous transnational-access and to cover the needs of the scientific user community. More of 70% of the EUROFLEETS beneficiaries decided to join EUROFLEETS2 and attracted new beneficiaries operating modern RVs or specialist in polar sciences, and so enlarging the original EUROFLEETS scope of work.

EUROFLEETS2 main objectives are to consolidate and amplify EUROFLEETS achievements, and to prepare a new management scheme for European marine infrastructures, more open, more cost-efficient and really connected with innovation and industry, to fully contribute to European competitiveness.

EUROFLEETS main dissemination activities:

EUROFLEETS has carried out generic dissemination activities but also specific dissemination actions in order to promote the Project's overall and specific objectives, to raise awareness and understanding of Project's objectives and contribute to the exploitation of results.

The Plan for dissemination and promotion activities developed early in the Project life allowed to consider different levels of dissemination and to identify which media would be appropriate to disseminate the different Project objectives to audiences targeted by the Project. Dissemination activities were so

different Project objectives to audiences targeted by the Project. Dissemination activities were so implemented through combined and complementary actions involving the usage of electronics media - in particular the Project Internet Hub and e-newsletters -, the participation to European and international conferences, the organization of relevant events or workshops, and the development of appropriate dissemination materials.

Dissemination activities implemented within the Project were also the result of a collective effort as many EUROFLEETS beneficiaries conducted opportunity dissemination actions through articles published on their own websites or press releases on Project's results, and promoted the Project's objectives in European and national events of scientific, political and general nature.

The EUROFLEETS Internet Hub was launched on January 29th 2010 and is accessible through three easy identifiable domains (URLs) - the main domain: <http://www.eurofleets.eu> <http://www.eurofleets.org> and <http://www.eurofleets.net> both redirecting to this main domain) has been developed as the focal tool for communicating and disseminating information generated by the Project among its beneficiaries and towards the target audiences. Designed at being a "one stop shop" for European research vessel

information to provide easily accessible information taking into consideration all the different plug-in modes, the Internet Hub was developed with two components: an administration/editing area and a public access website with different plug-in modes, such as the intranet for the repository of the Project information or the European Virtual Infrastructure in Ocean Research (EVIOR) Integrated Information Portal developed within the Project.

Since its launch, the EUROFLEETS Internet Hub was regularly updated with articles, news, events, press releases, Deliverables, products, etc. which were also disseminated through e-newsletters. A further layout of the EUROFLEETS Internet Hub homepage was also developed on February 2012, as to reflect the transition of the Project's opportunities phase - ship-time calls and training courses - to the product oriented phase by visually displaying relevant Deliverables and other Project's products.

In accordance with the guidelines stated in the Plan for dissemination and promotion activities, a dedicated Identity Set (logotype and website banner) and several institutional printed materials were developed to assist the Project's dissemination: such as the EUROFLEETS Institutional and Research Vessels Posters, the Institutional Brochure, the Institutional Roll-Up, the EUROFLEETS Pens, the EUROFLEETS Bags and the EUROFLEETS Banners. Apart from these printed materials aiming to disseminate on the Project as a whole, specific additional printed materials were also developed such as: the EUROFLEETS 2nd Call Flyer, the EUROFLEETS multidisciplinary marine science ship/based training course for postgraduate students of marine/related sciences Flyer, the EUROFLEETS New developments of facilitating transnational access and interoperability software Flyer, the Infrastructures Poster, the EUROFLEETS "navios de investigação; ... sabias que?" Educational Brochure, the EUROFLEETS Funded Cruises Scientific Posters, and the EUROFLEETS in Numbers Brochure.

The promotion of EUROFLEETS objectives together with the dissemination of EUROFLEETS results were also ensured through the participation of the Project to relevant European events and thanks to the active participation of the Project's beneficiaries to European and international conferences:

- The EUROFLEETS Project has participated in the 3rd European Maritime Day, held in Gijon, Spain from May 19th to the 21st 2010, with a permanent stand displaying promotional materials to policy-makers as the marine scientific community and public-at-large. The Project also participated to the EurOCEAN 2010 Conference, held in Ostend, Belgium from the 12th to the 13th of October 2010 with a permanent stand displaying promotional materials reaching a vast audience ranging from the marine scientific community to policy-makers;

- EUROFLEETS beneficiaries were also active in participating in several European and International conferences to promote the Project's results and perspectives, such as the ESFRI 2011 Symposium (Brest, France), the ICRI 2012 conference (Copenhagen, Denmark) and the MSI Symposium 2012 (Toulon, France). By implementing the EUROFLEETS Fleet Evolution Group in conjunction with the ERVO annual meetings, European RVs operators were regularly informed on Project's results, in particular regarding the eco-responsibility and inter-operability aspects addressed by the Project. On the other hand, the work undertaken on eco-responsibility and green ship technologies was also widely disseminated to a wide audience with the publication of a paper in the open literature (The Journal of Ocean Technology, 2013) and through the participation to the SaferSeas 2011 conference (Brest, France) and to the

"Greening the Research Fleets" workshop organized by the UNOLS in 2012 (Durham NC, USA). Finally, the effort made by the Project under the Joint Research Activities to develop common software tools was actively disseminated through the participation to numerous conferences such as EGU 2011 and 2013 (Vienna, Austria), the International conference on Advances in geographic Information Systems 2012 (California, USA), the GEBCO Science Day 2012 (Monaco) and IMDIS 2013 (Lucca, Italy). Targeted dissemination was made towards the SeaDataNet and EmodNET European initiatives through participation to their General Assemblies and meeting and presentations of EUROFLEETS progress in their fields of interest.

- EUROFLEETS funded cruises were disseminated by involved scientific parties through dedicated blogs and videos posted on YouTube. Though data analysis can require a long time period, many results have already been presented to several scientific events such as EGU 2013 (Vienna, Austria), the ASLO 2013 Aquatic Sciences meeting (New Orleans, USA), the HERMIONE Annual meeting 2012 (Faro, Portugal), the Marine and River Dune Dynamics 2012 (Brugge, Belgium) etc., and articles have been published, such as in Nature News for the EUROFLEETS funded "Caldera 2012" cruise run on board the Greek RV Aegaeo. First papers are starting to be published in peer reviewed publications, with two papers already published in the journal Ocean Science (2013) and in the journal Remote Sensing of Environment (2014) by the scientific party of the EUROFLEETS funded BIO-OPT cruises jointly run on board the Bulgarian RV Akademik and the Romanian RV Mare Nigrum, and one paper published in the Journal of maps (2013) by the scientific party of the EUROFLEETS funded FAIVI cruise run on board the French RV L'Atalante and the oceanographic launch Haliotis). The EUROFLEETS funded cruise run on board the Portuguese RV Dom Carlos I allowed also to develop three Master theses.

Finally, the Project organized the EUROFLEETS Final Conference, held on June 13th 2013 at the Auditorium of the Royal Belgian Institute of Natural Sciences, Brussels (Belgium). This conference was dedicated to disseminate the main EUROFLEETS results and to introduce future perspectives in the frame of the European project EUROFLEETS2 towards the European policy-makers and the scientific community. For this EUROFLEETS Final Conference, a dedicated brochure entitled "EUROFLEETS in

community. For this EUROFLEETS final conference, a dedicated brochure entitled "EUROFLEETS in numbers" was also produced to disseminate the Project's main results.

Exploitation of EUROFLEETS results:

Despite the Project's effort, no commercial exploitation of EUROFLEETS results is planned.

List of Websites:

The EUROFLEETS public website is accessible through three easy identifiable domains: [the main domain](#), and <http://www.eurofleets.org> and [both redirecting to the main domain](#).

## Related documents



[final1-eurofleets-finalreport-attacheddocuments-v2.pdf](#)

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