MarinERA Publication N°7

FUTURE LOOKS

Strategic analyses for new activities

Prepared by Marine Board - ESF Secretariat

November 2008

MarinERA: Facilitating the Coordination of National and Regional Marine Research Programmes in Europe (2004 – 2008)

MarinERA, a EU 6th Framework Programme ERA-NET, is a partnership of leading Marine Research Funding Organisations from 13 European countries, supported by the Marine Board – European Science Foundation. Together these organisations invest over €80 million per annum in competitive marine research.

The specific objectives of the MarinERA Project are to:

1. Map European Marine Research Programmes and Specialised Infrastructures to contribute towards the development of the marine component of the European Research Area, facilitating the creation of an internal market and quantifying the existing European marine research capacity.
2. Facilitate the networking of Marine Research Funding Agencies in the European Union, leading to a more cost effective and efficient use of EU Member State and Associate Member State resources including scientific personnel, specialist infrastructures and planned investments;
3. Contribute to the development of a European Marine Research Policy, identifying future challenges and opportunities and the priority research programmes that need to be put in place to address / benefit from them;
4. Provide a basis for sharing available resources to address priority issues that are beyond the capacities of individual EU Member State and Associate Member States;
5. Progress the reciprocal (mutual) opening of EU Member State and Associate Member State Marine Research Programmes - a key objective of the European Research Area.

The MarinERA Project Partners are:

- French Institute for Exploitation of the Sea (Ifremer) - France
- Marine Board - European Science Foundation
- Marine Institute - Ireland
- Research Council of Norway (RCN) - Norway
- Jülich Research Centre GmbH - Project Management Organisation JŸlich (FZJ-PTJ) - Germany
- Ministerio de Ciencia e Innovación (MICINN) - Spain
- Academy of Finland (AKA) - Finland
- Netherlands Organisation for Scientifi c Research (NWO) - The Netherlands
- Natural Environment Research Council (NERC) - UK
- General Secretariat for Research and Technology, Ministry of Development (GSRT) - Greece
- Foundation for Science and Technology (FCT) - Portugal
- Belgian Federal Public Planning Service Science Policy (BELSPO) - Belgium
- Science and Innovation Administration, Ministry of the Flemish Community (AWI) - Belgium
- Malta Council for Science and Technology (MCST) - Malta
- Ministry of Science and Higher Education (MSHE) - Poland
- Institute of Oceanology Polish Academy of Science (IOPAS) - Poland

MarinERA: building the confidence to create a favourable climate in which to pursue the enhanced co-operation and reciprocal opening of EU Member State and Associate Member State Marine Research Funding Programmes.

For further information on the MarinERA project see: www.marinera.net

This publication was produced by Aurélien Carbonnière and Niamh Connolly (Marine Board - ESF Secretariat)

Strategic Activities

The European marine research landscape
Marine Board-ESF perspectives

A European vision
"Vision is the art of seeing what's invisible to others"
(Jonathan Swift, 1686, Trinity College Dublin)

The increasing interdependence of marine research policies and programmes at both national and European levels, in tandem with the rapidly changing management and governance structures within which European marine sciences operate, result in the need for the development of new approaches to support the establishment of European research priorities and strategies. The Marine Board-ESF responds to this need by facilitating enhanced bilateral and multilateral partnerships and supporting the development of pan-European strategies for marine science, through its provision of a forum for directors representing European marine science organisations (research funding and research performing organisations). Addressing strategic issues, the Marine Board-ESF develops policy advice to national and European agencies, with the objective of providing both complementary and compatible marine research strategies at the research-policy interface.

At present, the Marine Board-ESF represents 30 marine research organisations from 20 European countries, who are motivated to come together to share information, identify and respond to common challenges and key developments, and initiate common activities. Since its creation in 1995, the Marine Board has been dedicated to identifying and prioritising emergent disciplinary and interdisciplinary marine scientific issues of strategic European importance, initiating analysis and studies in support of the development and evolution of a European strategy for marine research.

In its role as a science policy think-tank, the Marine Board-ESF:

- synthesises the outputs of advanced marine research;
- provides insights necessary to transform research into knowledge for leadership and decision making;
- places marine research within the context of European socio-political and economic issues that profoundly affect Europe;
- develops foresight initiatives to secure future research capability and to support informed policy making.

One of the principal foresight mechanisms of the Marine Board-ESF are the Marine Board Working Groups. Such Working Groups are established on subjects of European dimension which are considered of strategic importance for marine sciences, though yet to be addressed properly or lacking visibility. In 2007 and 2008, topical foresight activities have resulted in publications which address, *inter alia*, options for optimal use of research vessels, impacts of climate change on the marine environment, remote sensing of shelf sea ecosystems, effects of anthropogenic sound on marine mammals, and a vision for a future European Marine Observation and Monitoring Network – EMODNET (see list of publications Annex 1).

Aside from thematic foresight initiatives, the Marine Board regularly publishes a synthesis of priorities for future marine research in its Navigating the Future series. The latest in the series, *Navigating the Future III*, was published in November 2006. It outlines the most important thematic research priorities for Europe, building on pan-European developments such as the European Marine Environment Strategy and the Galway Declaration 2004. The research priorities documented in *Navigating the Future III* were subsequently taken into account as funding priorities not only for the EC 7th Framework Programme, but also in the objectives of national research programmes. As such, *Navigating the Future III* is an important source of information in the context of MarinERA Task 2.1 *Future Looks: strategic analyses for new activities.* The publication is often referred to as

the main contribution of the Marine Board-ESF to the marine component of the European Research Area.

Another important task of the Marine Board-ESF is to serve as an interface between the marine science community and policy, by monitoring policy developments at the European and national levels. When deemed necessary, the Marine-ESF responds to these developments with the aim of furthering marine sciences in Europe and protecting the marine environment while promoting sustainable development.

In 2007, the Marine Board-ESF responded to two major policy consultation processes launched by the European Commission: (1) the Green Paper[1] "Towards a future Maritime Policy for the Union: A European vision for the oceans and seas" (June 2006)[2]; and (2) the Green Paper "The European Research Area (ERA): New Perspectives" (May 2007)[3]. In its responses to both Green Papers, the Marine Board-ESF addressed the questions of relevance to its mandate and activities, focusing on marine research matters. In its response to the Maritime Policy Green Paper[4], the Marine Board-ESF recognised the European Maritime Policy as a very powerful mechanism for promoting and sustaining marine science and technology in support of European economic development. The Marine Board-ESF emphasised the need for collective action from the marine research community and the need for a new impetus for EU marine and maritime research. The Marine Board-ESF response also recognised the need for a European Marine and Maritime Research Strategy to support an integrated European Maritime Policy. This was further reinforced by the Bremen Conference organised by the German EU Presidency in April 2007 and by the declaration issued by the marine and maritime scientific communities at the EurOCEAN 2007 conference in Aberdeen (organised by the Marine Board-ESF). The Aberdeen Declaration is a cornerstone of the future European Marine and Maritime Research Strategy which the Commission presented in a communication on 3 September 2008[5].

On 10 October 2007, the European Commission adopted its Blue Book on the future European Maritime Policy (together with the Conclusions from the Consultation on a European Maritime Policy). The Blue Book includes a plan of action to improve cross-sectoral collaboration between marine and maritime players and echoes the research priorities stated in the Aberdeen Declaration and in the Marine Board-ESF response to the Green Paper. The Marine Board particularly welcomed the European Commission's intentions to present a comprehensive European Strategy for Marine and Maritime Research in 2008: to support research to predict, mitigate and adapt to the effects of climate change on maritime activities, the marine environment, coastal zones and islands; and to support the creation of a European marine science partnership for a concerted dialogue between the scientific community, industry and policy makers. The Integrated Maritime Policy thus recognizes that such policy will only succeed with the continued engagement and support of all the actors and stakeholders concerned, including the programme developers and managers at the national level. To this end, the European Commission continues to work with stakeholders and authorities at European, national and regional levels in order to translate its vision into reality. Well organized and coordinated marine and maritime research communities are key in providing the necessary support.

The European Commission's Green Paper "The European Research Area (ERA): New Perspectives" (June 2006), launched a broad institutional and public debate on what should be done to create a unified and effective European Research Area, which would fulfil the needs and expectations of the scientific community, business and citizens. In the Green Paper on ERA, the European Commission highlights that... "the European Research Area has become a key reference for research policy in Europe".

[1] Green Papers are documents published by the European Commission to stimulate discussion on given topics at European level. They invite the relevant parties (bodies or individuals) to participate in a consultation process and debate on the basis of the proposals they put forward. Green Papers may give rise to legislative developments that are then outlined in White Papers – Europa Glossary.

[2] Available at: http://ec.europa.eu/maritimeaffairs/pdf/com_2006_0275_en_part2.pdf

[3] Available at: http://ec.europa.eu/research/era/pdf/era_gp_final_en.pdf

[4] Marine Board – ESF Summary Statement in response to the European Commission's Green Paper "Towards a future Maritime Policy for the Union: A European vision for the oceans and seas".

[5] Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions – A European Strategy for Marine and Maritime Research A coherent European Research Area framework in support of a sustainable use of oceans and seas.

In its response to the Green Paper on ERA, the Marine Board-ESF recommended that "In recognition of the needs and expectations of the European Research Area, and working towards coherence between national and regional programmes and research priorities of European relevance, it is increasingly important to develop a partnership approach to programmes funded by FP7 and those funded nationally. To this end, the optimal use of instruments such as ERA-NETs (including ERA-NET+), Technology Platforms and Article 169 is essential." This view is acknowledged by the European Commission Working Document "Results of the Public Consultation on the Green Paper The European Research Area: New Perspectives". However, at the time of the ERA Green Paper Consultation, it was clear that building the ERA would require much more work, particularly to overcome fragmentation of research activities, programmes and policies across Europe. The Marine Board-ESF response addressed the best way to strengthen and broaden the European Research Area in the frame of marine science. The Marine and Maritime Research Strategy launched by the European Commission Communication in September 2008 should play an important role in this regard.

The Marine and Maritime Research Strategy aims to mobilise Europe's considerable capacity in marine and maritime research and technology development. The Research Strategy refers to the identification and implementation of new methods of governance for more efficient use of existing and new financial resources at European, national and regional level. It outlines a number of challenges for science and technology, addressing for example climate change and the impact of human activities on coastal and marine ecosystems. It supports the provision of evidence based policy making in areas such as the implementation of an ecosystem approach to marine resource management, maritime and spatial planning, ocean governance and maritime economics and transport. It highlights new technology and knowledge-based commercial opportunities, for example in renewable ocean energy, value added bio-products from the sea (blue biotechnology), the deep-sea frontier, and new innovations in ocean observation.

The Marine and Maritime Research Strategy is fully aligned with, and supportive of, other EU policies including: the development of the knowledge economy (Lisbon, 2000), the principles of sustainable development (Gothenburg 2001); enhanced partnership (Ljubljana, 2008), the EU Marine Strategy Directive (DG Environment: 2008) and the establishment of a European Research Area (2007). Indeed, Commissioner Janez Potočnik (DG RTD) has pointed out that, the Strategy should be seen as one of the pioneer actions for the implementation of the ERA within a specific research sector.

The Marine Board-ESF welcomes the European Commission's Communication on the Marine and Maritime Research Strategy and is committed to participating in the consultation process necessary for the evolution of the Research Strategy, and the implementation of activities towards achieving its objectives. However, the Marine Board-ESF recognises that the Research Strategy cannot be served in isolation; neither can it maximise its full impact by operating in isolation. It is widely reported that there is currently insufficient collaboration between national research programmes, which represent 85% of public research funds in Europe. The EC FP6 & FP7 ERA-NET instrument has gone some way towards nurturing and supporting such collaboration. In the context of broadening and strengthening the European Research Area, the European Union's Joint Programming Scheme, as defined by the European Commission's Communication[6] of 15 July 2008, is a further structural component to be considered in the design of future work programmes, whether nationally, bilaterally or multilaterally, or at the European level.

[6] Communication from the Commission to the European parliament, the Council, the European economic and social committee and the committee of the regions - Towards joint programming in research : working together to tackle common challenges more effectively Brussels, 15.7.2008, COM(2008) 468 final {sec(2008) 2281}{sec(2008) 2282}

The Joint Programming Scheme is designed to ensure that public research funds are used as efficiently as possible, with expectation that the first Joint Programming initiatives should be launched in 2010. It involves Member State engagement in the definition, development and implementation of common research agendas, as a possible outcome of the pro-active approach in the Sustainable Development Strategy and the Marine and Maritime Research Strategy. Research areas on marine ecosystems and biodiversity have been identified as priorities to be addressed by future Joint Programmes across Member State borders. As EU Member States struggle to increase research investment targets to achieve the Lisbon Agenda target of 3% of GDP, Commissioner Potočnik has stated that …"we should increase the impact of our national investments by acting jointly." This will increase the efficiency and leverage effect of funding research at the European level, enhance training and mobility of researchers, in line with the EU's Growth and Jobs Agenda.

This MarinERA publication profiles a synthesis of the research priorities of several initiatives and is intended to support the identification of research priorities for future programmes, whether national, jointly between clusters of funding agencies, or pan-European. It is based on a strategic assessment of European, regional, and national priorities, and those elaborated by thematic specific groups. The publication does not intend to detail specific topics which might be included in specific Work Programmes; rather, it profiles priorities which may support the definition of future Work Programmes. It may also inform the future development of Strategic Research Agendas, as required by the Joint Programming Initiative.

The MarinERA consortium partners have a mutual interest in funding environmental research with a strong societal impact that is often expected to support future policy developments. The authors hope that this publication will support MarinERA partners and other funding organisation in planning research funding programmes in line with policy developments. The ultimate challenge of integrating marine research across disciplines and across nations remains, and generates an opportunity for exciting new collaborations. Such collaborations may result in important scientific discovery that will provide insight for future policy developments, in keeping with a sustainable European maritime economy.

Specific Approach within MarinERA

Task 2.1 - Future Looks: strategic analyses for new activities (Task Leader: Partner 2, Marine Board-ESF)

MarinERA WP 2 objective: *to analyse the existing national Marine RTD Programmes within participating Member States, to identify areas of common interest (regional / thematic), and promote adoption of procedures to make existing programmes more transparent and accessible.*

To enable Europe's marine research community to develop medium to long-term plans, and analyse future research development in multidisciplinary topics, MarinERA Task 2.1 identified and prioritised emergent disciplinary and interdisciplinary scientific issues of strategic importance for marine research within the European Research Area (ERA), with particular reference to those of the MarinERA consortium partners.

In seeking to develop and enhance the understanding and management of marine research, this task involved reviewing topic specific position papers from several organisations and research initiatives.

Recognising that the challenges associated with the development of a multifaceted vision for marine science throughout Europe requires extensive colaboration, the assessment presented in this publication is based on a synthesis of position papers reflecting national priorities and pan-European research challenges and opportunities. It also takes into account the identification of research priorities recently established by some international and EU FP funded initiatives, including:

- **ERA-NETs and foresight initiatives:** AMPERA, BiodivERsA, BONUS, CIRCLE, ECORD-Net, EUROPOLAR, IRWN-Net, MariFish, MarinERA, Martec, SKEP; FEUFAR;
- **ESF-EUROCORES:** EuroCLIMATE, EuroDEEP, EuroDIVERSITY, EuroMARC, EuroMARGINS;
- **FP6 marine NoEs (Networks of Excellence), and I3 (Integrated Infrastructure Initiative):** ESO-NET, EUR-OCEANS, MarBEF, Marine Genomics Europe; SeaDataNet (I3);
- **International organisations:** CIESM; Marine Board-ESF.

It should be noted that **not all priorities of the above European initiatives have been listed** in this document, as to do so is beyond the scope of this work. Other initiatives, such as HERMES (EC FP6 IP) have also been consulted for background information. Priorities identified within the European Commission's Marine and Maritime Research Strategy (September 2008) and the Joint Programming Scheme (July 2008) have also been included.

The following tables list priorities as identified in *Navigating the Future III* (Marine Board Position Paper 8, November 2006) which was endorsed by the MarinERA consortium in 2007 as providing a very effective synthesis of key priorities. For purposes of clarity and ease of comparison, within each sub-thematic category (e.g. "Fish & Aquaculture" in the first category "Marine Research and Maritime Transport"), **priorities** have been differentiated into two components:

research and **policy and management.**

In the column headed **national priorities**, note that the insertion of a **country code** denotes the commitment and/or expresses the interest of the named country – involved in the **MarinERA** consortium - in relation to the corresponding marine research priorities. An important feature to consider is that two countries, **Portugal** (represented in MarinERA by Fundação para a Ciência e a Tecnologia (FCT), Ministry of Science and Technology) and **Finland** (represented by Academy Of Finland (AKA), Research Council), do not identify specific marine lines in their programmes: they

both cover all scientific disciplines and promote high-quality basic research.

Potential trans-national interdisciplinary research themes have been investigated. By identifying such opportunities for synergies and complementarities for co-operation, strategic activities can be established to progress towards providing complementary research strategies at the European level and the development of the marine component of the ERA.

This foresight initiative allowed the MarinERA consortium to enhance their identification of thematic areas suitable for elaboration of programmes for joint calls for proposals. It also identified the gaps to be addressed in future collaborative programmes and the research areas which may currently lack potential for funding, or indicate duplication. The deliverable provides some basic material towards supporting the development of a collective vision of the future for European marine science in relation to developments in Europe and world-wide, promoting synergy and cohesion amongst national programmes and organisations.

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List of codes, projects and acronyms

MarinERA partners' country codes	
BE (BE1: BELSPO, BE2:AWI)	Belgium
DE	Germany
FR	France
GR	Greece
IE	Ireland
NL	The Netherlands
NO	Norway
PL	Poland
ES	Spain
UK	United Kingdom

Projects	
AMPERA	ERA-NET on Accidental Marine Pollution
BiodivERsA	ERA-NET on Biodiversity
CIESM	Conseil International pour l'Exploitation Scientifique de la Méditerranée
CIRCLE	ERA-NET on Climate Change
ECORD-Net	ERA-NET on scientific drilling in the oceans and continents and marine geophysical surveys
ESO-NET	European Seas Observatories Network (NoE)
EuroCLIMATE	Climate Variability and the (past, present and future) Carbon Cycle (EUROCORES)
EUROCORES	EUROpean COllaborative RESearch scheme
EURODEEP	Ecosystem Functioning and Biodiversity in the Deep-Sea
EuroDIVERSITY	Challenges of Biodiversity science (EUROCORES)
EuroMARC	Challenges of Marine Coring Research (EUROCORES)
EUROMARGINS	Slope Stability on Europe's Passive Continental Margins (EUROCORES)
EUROPOLAR	ERA-NET on polar research
EUR-OCEANS	EURopean network of excellence for OCean Ecosystems ANalysiS
FEUFAR	Specific Support Action on the future of fisheries and aquaculture research
IWRM-Net	ERA-Net on water resource management
I3	Integrated Infrastructure Initiative
MarBEF	Network of Excellence on Marine Biodiversity and Ecosystem Functioning
MariFish	ERA-NET on fisheries
MarinERA	ERA-NET on marine sciences
Martec	ERA-NET on marine engineering
MGE	Marine Genomics Europe (NoE)
NoE	Network of Excellence (EUR-OCEANS, MarBEF, Marine Genomics Europe, ESO-NET)
SEADATANET	Pan-European infrastructure for Ocean and Marine Data management for online integrated data access (I3)
SKEP	ERA-NET on environmental protection

Acronyms	
ARGO	Global Array of Profiling Floats
AUV	Autonomous Underwater Vehicle
CC	Climate Change
CLIVAR	Climate Variability and Predictability (international research programme)
CFP	Common Fisheries Policy
CZ	Coastal Zone
DST	Data Storage Tag
EAF	Ecosystem Approach to Fisheries
EMODNET	European Marine Observation and Data NETwork
ENSO	El Niño Southern Oscillation
EURO-ARGO	European contribution to the ARGO global array of profiling floats
EUROCORES	EUROpean COllaborative RESearch scheme
GLOBEC	Global Ocean Ecosystem Dynamics
GMES	Global Monitoring for Environment and Security
HAB	Harmful Algal Bloom
ICZM	Integrated Coastal Zone Management
IMBER	Integrated Marine Biochemistry and Ecosystem Research
INSPIRE	EC Directive establishing an Infrastructure for Spatial Information in the European Community
MPAs	Marine Protected Areas
NAO	North Atlantic Oscillation
OFEG	Ocean Fleet Exchange Group
ROV	Remotely Operated Vehicle
RTD	Research and Technical Development
UPR	Ultra-Peripheral Region
VMS	Vessel Monitoring System

Part I
National and European priorities

Marine research and maritime transport

		ESF-EURO CORES	FP6 ERA-NETs & Foresight	FP6 marine NoEs, I3	CIESM	National Priorities
Fish - Aquaculture	**Research priorities**					
	Develop integrated assessments (socio-economics, models, indicators) and facilitate the progressive adoption of the EAF concept (including MPAs roles and impacts in the dynamics of fish stocks)		BONUS FEUFAR MariFish	NoEs		ES, FR, GR, IE, NL, NO, PL, UK
	Evaluate the economic impacts (policies, ecosystem changes on resources, drivers of fisheries/aquaculture activities)		BONUS FEUFAR MariFish	NoEs		ES, FR, IE, NO
	Involve the research community into participative management plans		MariFish	NoEs		ES, FR, IE, NO, NL
	Make gears more efficient and able to mitigate by-catch and discards, limit ecosystem impacts and improve selectivity		BONUS FEUFAR	NoEs		Beyond the scope of this exercise
	Improve fuel efficiency by, for example, the development of new technologies and more use of passive gears		BONUS FEUFAR			Beyond the scope of this exercise
	Valorise currently underused components of the catch		FEUFAR			Beyond the scope of this exercise
	Encourage basic research on populations of lower trophic level resources		FEUFAR	NoEs		Beyond the scope of this exercise
	Aquaculture: • research on news species, • research on the development of offshore cage technologies • alternative food for the farmed resources • species enhancement (selective breeding,hybrid, triploid) • research on the environmental impact of aquaculture activities • aquaculture for other purposes than food production • improvement of technologies for inshore aquaculture		BONUS FEUFAR			Beyond the scope of this exercise
	Policy and management priorities					
	Improve the fisheries governance; maritime policy to address the Science & Technology to underpin/ support challenges of the CFP		BONUS FEUFAR MariFish			ES, FR, IE, NO, NL
	Develop further research into the socio-economics of the fishing communities, including issues such as ownership of resources and management		BONUS FEUFAR	NoEs		Beyond the scope of this exercise
	Facilitate the development of multi-annual and multi-species management models and approaches, taking cognizance of trophic relationships and ecosystem health		BONUS FEUFAR	NoEs		Beyond the scope of this exercise
	Develop monitoring and enforcement technology beyond the current VMS		BONUS FEUFAR			Beyond the scope of this exercise
	Encourage artificial habitat creation and better understand fish behaviour (including further tag-recapture and DST studies)		FEUFAR			Beyond the scope of this exercise
	Develop a new common policy in aquaculture and support the innovation sector and food processing. Raise awareness to political and policy making communities would result in identifying priorities for future investments		BONUS FEUFAR MariFish			BE (1&2), ES,FR,IE, NO
	Turn scientific data, findings and conclusions into information for stakeholders		BONUS FEUFAR MariFish	NoEs		ES, FR, IE, NO, NL, UK

		ESF-EUROCORES	FP6 ERA-NETs & Foresight	FP6 marine NoEs, I3	CIESM	National Priorities
Marine Biotechnology	**Research priorities**					
	Screen and preserve deep ecosystems		BiodivERsA	NoEs		DE, ES, FR, IE, NO, UK
	Develop bio-prospecting, genetics and bio-informatics' techniques		FEUFAR	NoEs	CIESM	BE1, ES, FR, GR, IE, NO, PL, UK
	Develop an efficient procedure/structure for the discovery of novel biomolecules		FEUFAR	NoEs	CIESM	FR, GR, IE, NO, UK
	Obtain basic knowledge about marine ecosystem functions necessary to allow intelligent management of industries (aquaculture)		BONUS FEUFAR MariFish	NoEs		BE (1&2), ES, FR, GR, IE, NO, UK
	Policy and management priorities					
	Support the development of networks and partnerships (RTD/Industry)			NoEs	CIESM	DE, ES, FR, GR, IE, NO, UK
Energy & wealth	**Research priorities**					
	Study acoustics-oil disturbance on ecosystems		AMPERA			FR, NO, UK
	Support research on gas hydrates		ECORD-Net BONUS	NoEs		DE, ES, FR, IE, NO, UK
	Encourage research on requirements for effective location, operation and harnessing of renewal energy sites		ECORD-Net			BE1, FR, IE, NO, UK
	Policy and management priorities					
	Foster cooperation/interaction between marine groups/petroleum companies		ECORD-Net			FR, IE, NO, UK
	Assess whether sustainable ocean energy should be promoted or not based on science-environmental and financial criteria		ECORD-Net			DE, FR, IE, NO, UK
	Consolidate partnerships towards enhanced understanding of the origin, locations and characteristics of ocean energy resources		ECORD-Net			FR, IE, NO, PL, UK
Aggregate ore deposits	**Research priorities**					
	Develop research on dredging and dumping		ECORD-Net			BE2, DE, FR, IE, NO
	Improve our understanding of the geochemical mechanisms of ore deposits			NoEs		
Socio-economics of marine resources	**Research priorities**					
	Accurate and update financial data on the value and importance of European maritime economy; collect and analyse on a regular basis		BONUS FEUFAR			BE1, ES, FR, IE, NO
	Highlight consumer preference and market development: • product development from fish • consumer health • traceability • labelling		BONUS FEUFAR			Beyond the scope of this exercise
	Estimate the non-market value of marine goods and services		FEUFAR SKEP BONUS		CIESM	BE1, FR, IE, NO,PL,UK
	Secure intellectual property rights and international laws				CIESM	Beyond the scope of this exercise

		ESF-EUROCORES	FP6 ERA-NETs & Foresight	FP6 marine NoEs, I3	CIESM	National Priorities
Maritime transport	**Research priorities**					
	Develop technologies to monitor and regulate vessels; forecast/monitor oil spills		AMPERA			BE1, ES, FR, GR, IE, NO
	Strengthen research on invasive species		BiodivERsA BONUS FEUFAR	NoEs		BE1&2, ES, FR, GR, IE, NO
	Study effects of harbours development on environment (best practices; monitoring tools)		Martec			BE1, DE, ES, FR, GR, IE, NO
	Manage/understand transport pathways and effects of pollutants from ocean exploitation (multi-sensor systems and modelling are still required)		AMPERA BONUS	NoEs		BE1, ES, FR, GR, IE, NO
	Policy and management priorities					
	Initiate Technology Platform on ship building		Martec			NO
	Encourage funding programmes to support an increased implementation of measuring devices on regular shipping routes					IE, NO

Commission's Communication "A European Strategy for marine and Maritime Research. A coherent European Research Area framework in support of a sustainable use of oceans and seas" (September 2008)

Marine research and maritime transport

Maritime Facts and figures (extracted from the Green Paper – Towards a future Maritime Policy for the Union)

- 90% of external trade and 40% of internal trade in the EU is seaborne. The 1200-plus European ports host 3.5 billion tons and 350 million passengers per year
- Shipbuilding (shipyards and marine equipment suppliers provide 0,8 million direct and indirect highly skilled jobs and account for a turnover of € 90 billion; Europe is the world leader in the production of highly sophisticated vessels such as ferries and cruise ships).
- Energy (seas and oceans offer underexploited resource for the use of alternative energies such as tidal and wave power and offshore wind farms and account for 121 € millions in 2005).
- Fisheries and aquaculture (0,5 million jobs; 0,3% of EU GDP equating to about € 20 billion/year; aquaculture accounts for 19% of the Union's total fishery production).
- New resources and blue biotechnology (emerging sector with predicted growth of 10% per year and a global market of € 2,4 billion).

Recommendations

- Promote cross-sectoral integration and improving knowledge transfert, existing and emerging markets in areas such as blue technology
- Synergies with and between Member States, regions and industry sectors.
- Develop new models for higher education in the marine/maritime field (e.g. via dedicated Knowledge and Innovation Communities at the European Institute of Innovation and Technology, EIT);
- Developing adequate new and interdisciplinary skills, education and innovation capacities in order to respond to the current socio-economic and cultural trends and requirements;
- Looking at a more efficient use of existing and new human and financial resources.
- In addressing these cross-cutting research issues, particular attention will be paid to the integration of social-economic research and the impact of management options.
- At regional level, building on existing maritime clusters supported in the framework of the "Regions of Knowledge" initiative, mapping existing opportunities in 2009 and stimulating long-lasting clustering under Community Regional Policy.
- In close partnership with Commission services, using the initiative Regions for Economic Change13 of Cohesion Policy, to further develop regional activities in this field.
- Promote regional maritime clusters as well as synergy between regional marine research and innovation strategies
- A particular attention will also be given to Community Innovation Programme (CIP) with a view to boost eco-innovation and to transfer marine and maritime technology expertise at EU level.
- FP7 instruments contribute to research and innovation capability in local industries

Research topics requiring a cross-thematic approach

- **Impact of human activities on coastal and marine ecosystems and their management**

Coastal and marine ecosystems are affected by land-based as well as maritime activities. A better understanding and mitigation of the cumulative effects of these activities through more eco-efficient technologies is crucial.

- **Ecosystem approach to resource management and spatial planning**

Integrated ecosystem approach to marine resources management, as well as knowledge to develop coastal and marine spatial planning options to help optimise the management of marine and maritime activities and their sustainable development.

- **Marine biodiversity and biotechnology**

The marine environment hosts a considerable part of biodiversity on earth. We need more knowledge on the functional role, evolution, protection and exploitation of marine biodiversity, the latter including biotechnology and bio-prospecting.

- **Exploitation of marine renewable energy resources**

The ocean is a huge reservoir of energy and the marine processes that can be used to produce energy are numerous. We need more knowledge on how to exploit the potential of offshore wind, ocean currents, wave and tidal movements.

Europe's coastal zones, shelf seas, continental margins and biodiversity

		ESF-EURO CORES	FP6 ERA-NETs & Foresight	FP6 marine NoEs, I3	CIESM	National Priorities
Coastal Zones and Marine Spatial Planning	**Research priorities**					
	Favour interdisciplinary research (humanities, economy) to address the challenge of implementing ICZM and marine spatial planning; develop holistic models and integrated tools		CIRCLE BONUS FEUFAR	NoEs		BE1, DE, ES, FR, GR, IE, NL, NO, PL, UK
	Investigate the environmental, social and economic impacts of anthropogenic activities		BONUS CIRCLE FEUFAR	NoEs		BE1&2, DE, ES, FR, GR, IE, NL, NO, PL, UK
	Understand sea-level rise and variability: assessments of coastal territories vulnerability, economical consequences, mitigation and adaptation strategies with regard to CC; distinguish CC to anthropogenic impacts on the coastal zones		BONUS CIRCLE FEUFAR	NoEs	CIESM	BE1, DE, ES, FR, IE, NL, NO, UK
	Develop integrated numerical models of estuarine processes to support improved management of rivers and estuaries		BONUS	NoEs	CIESM	BE1, DE, ES, FR, IE, NL, NO, UK
	Investigate coastal erosion linked to watershed mis-management		BONUS		CIESM	Beyond the scope of this exercise
	Develop research on sand grains transport in the coastal environment		BONUS			BE1, DE, ES, FR, NL, NO, PL, UK
	Understand the impacts of turbulence on marine ecosystems		BONUS	NoEs		BE1, ES, FR, IE, NL, NO, UK
	Adapt biotechnological chips to provide non-invasive and affordable systems for ecotoxicological screening of water quality					BE1, FR, IE, NO
	Ensure a targeted monitoring of coastal risks (tracers of human activities)		AMPERA BONUS FEUFAR	NoEs	CIESM	BE1, DE, FR, GR, IE, NL, NO, PL, UK
	Favour integrated (regional-UPR) and multidisciplinary studies directed to answer societal needs		divERsA BONUS FEUFAR	NoEs	CIESM	BE1, ES, FR, GR, IE, NO, UK
	Improve observing and modelling methods and technologies particularly in the CZ		AMPERA BONUS FEUFAR	I3	CIESM	BE1, DE, ES, FR, GR, IE, NL, NO, UK
	Investigate HAB: initiation and the development of toxicity – research at the ecosystem level		BONUS FEUFAR	NoEs	CIESM	BE1, ES, FR, GR, IE, NL, NO, UK
	Study spatial interactions between fisheries and aquaculture		FEUFAR			Beyond the scope of this exercise
	Policy and management priorities					
	Harmonise national management plans to favour coherence and implementation of ICZM: vertical integration between terrestrial and maritime plans is essential and they should start at a national level		BONUS IWRM-net	NoEs		BE1, DE, ES, FR, IE, NL, NO, UK
	Develop an EU wide mechanism for comparative analysis and exchange of best practise (indicators, databases)		CIRCLE BONUS IWRM-net	NoEs		BE(1&2), DE, FR, IE, NL, NO, UK
	Elaborate the Atlas of the Seas in the whole CZ: status of data, data compatibility and quality (INSPIRE) and collection capacity; design an implementation plan			I3		BE1, DE, FR, IE, NL, NO

		ESF-EUROCORES	FP6 ERA-NETs & Foresight	FP6 marine NoEs, I3	CIESM	National Priorities
Observing, predicting and monitoring systems	**Research priorities**					
	Study impacts of CC on coastal areas		BONUS	NoEs	CIESM	BE1, DE, ES, FR, GR, IE, NL, NO, PL, UK
	Predict climate, ocean currents and meteorology at different time scales		BONUS ECORD-NET	NoEs	CIESM	BE1, DE, ES, FR, IE, NL, NO, PL, UK
	Prepare bathymetric and seabed habitat maps; implementation of high-end computing facilities		BONUS	NoEs	CIESM	DE, FR, IE, NO, UK
	Establish long-term, high-quality observations of climatic drivers of oceanographic, biogeochemical and biodiversity variability, and associated anthropogenic parameters		BONUS ECORD-NET	NoEs	CIESM	BE1, ES, DE, FR, GR, IE, NL, NO, PL, UK
	Policy and management priorities					
	Establish a European Marine Observation and Data NETwork (EMODNET) for improving systematic observation, interoperability, access, standardisation of data format and long-term funding of vital database		BONUS MarinERA	I3	CIESM	BE1, DE, ES, FR, GR, IE, NL, NO, UK
Ocean margin geologic processes and geohazards	**Research priorities**					
	Implement telecommunication and fibre-optic cabled networks adapted to ecosystem observations and monitoring			NoEs		ES, FR, GR, IE, NO, UK
	Improve multi-risk monitoring and warning systems; risk management of geohazards		ECORD-Net	NoEs		FR, NO, UK
	Develop research on gas hydrates dynamics and mechanisms		ECORD-Net	NoEs		FR, NO, UK
	Develop research on the Mediterranean seabed: geo-hazard vs. economic opportunities			NoEs	CIESM	Beyond the scope of this exercise
Marine Biodiversity	**Research priorities**					
	Explore and describe ocean biodiversity		BONUS MarinERA	NoEs	CIESM	BE(1&2), DE, ES, FR, GR, IE, NL, NO, PL, UK
	Set key indicator species, niches and roles; develop tools (MPAs) for policy makers		BONUS FEUFAR	NoEs	CIESM	BE1, DE, ES,FR, IE, NL, NO, UK
	Investigate impacts of invasive species, fisheries practice, gravel extraction, dredging, oil industry etc. on biodiversity		BONUS FEUFAR	NoEs		BE1, ES, FR, GR, IE, NL, NO, PL, UK
	Develop research on the escapement of aquaculture fish (genetic implications for wild stocks)		BONUS FEUFAR	NoEs		Beyond the scope of this exercise
	Develop research on biomagnification of new contaminants in marine foodwebs		BiodivERsA BONUS	NoEs	CIESM	Beyond the scope of this exercise
	Develop research on the tropicalization of Mediterranean biodiversity (invasive species, endemic extinctions)		BiodivERsA MarinERA	NoEs	CIESM	Beyond the scope of this exercise
	Policy and management priorities					
	Maintain large-scale European initiatives		Bio-divERsA BONUS MarinERA	NoEs		BE2, DE, ES, FR, GR, IE, NL, NO, PL, UK
	Coordinate archives, collections and genetic databases		Bio-divERsA BONUS	NoEs		BE1, DE, ES, FR, IE, NL, NO, UK

		ESF-EURO CORES	FP6 ERA-NETs & Foresight	FP6 marine NoEs, I3	CIESM	National Priorities
Functional role of biodiversity	**Research priorities**					
	Source and compile long-term biodiversity data sets as a vital European resource		Bio-divERsA	NoEs		BE (1&2), DE, FR, IE, NL, NO, PL,UK
	Understand the relative importance of top-down regulation of marine food webs versus the traditional approach in which bottom-up control		BONUS FEUFAR	NoEs		BE1, ES, FR, IE, NL, NO, UK
	Develop research in functional genomics and systems biology			NoEs		BE1, ES, FR, IE, NL, NO, UK
	Develop meta-genomic (environmental sequencing) and use of micro-array technology			NoEs		BE1, FR, IE, NL, NO, UK
	Investigate relationship biodiversity/ecosystem function: management and development of sustainable strategies for marine exploitation. Assess biodiversity at varying functional levels (genomic, species, functional group, and ecosystem)		Bio-divERsA BONUS	NoEs	CIESM	BE1, ES, FR, GR, IE, NL, NO, UK
	Develop evolutionary process studies			NoEs		FR, IE, NO, UK
	Provide a better coverage of eukaryotic diversity		Bio-divERsA	NoEs		FR, NO, UK
Microbial diversity	**Research priorities**					
	Promote research on microbial biodiversity			NoEs	CIESM	BE1, DE, ES, FR, IE, NO, PL, UK
	Investigate the role of micro-niches and micro-scale dynamics in sustaining symbiotic consortia of micro-organisms in the ocean, in marine sediments and in extreme environments			NoEs	CIESM	ES, NO,UK
	Develop molecular biology and genomic techniques for in situ detection and monitoring of the biodiversity, abundance and activity of micro-organisms			NoEs	CIESM	FR, IE, NO, PL, UK
	Classify and detect viral particles			NoEs	CIESM	ES, FR, NO, UK
	Research on the impacts of climate change on micro-organisms			NoEs	CIESM	DE, ES, FR, NO, UK
	Obtain a more complete picture of the genetic diversity inherent in populations of marine viruses			NoEs	CIESM	ES, FR, NO, UK

Commission's Communication

Europe's coastal zones, shelf seas, continental margins and biodiversity

Facts and figures (extracted from the Green Paper – Towards a future Maritime Policy for the Union)

- Tourism and coastal zones (maritime tourism accounts for about 3 million jobs with a turnover of € 72 billions in 2005).

Recommendations

- Building new research and observation infrastructure;
- closer integration and more efficient use of marine data bases;
- Finding mechanisms for the sustainable support and management of data on the seas, including mapping of European waters and the integration of maritime surveillance systems.

Research topics requiring a cross-thematic approach

- **Impact of human activities on coastal and marine ecosystems and their management**

Coastal and marine ecosystems are affected by land-based as well as maritime activities. A better understanding and mitigation of the cumulative effects of these activities through more eco-efficient technologies is crucial.

- **Ecosystem approach to resource management and spatial planning**

Integrated ecosystem approach to marine resources management, as well as knowledge to develop coastal and marine spatial planning options to help optimise the management of marine and maritime activities and their sustainable development.

- **Marine biodiversity and biotechnology**

The marine environment hosts a considerable part of biodiversity on earth. We need more knowledge on the functional role, evolution, protection and exploitation of marine biodiversity, the latter including biotechnology and bio-prospecting.

- **Continental margins and deep sea**

Enhanced understanding of sediments in continental margins and deep seas, gas hydrate behavior, deep-sea ecosystems and technologies needed to enhance deep-sea observation.

Ocean climate interactions and feedback

		ESF-EURO CORES	FP6 ERA-NETs & Foresight	FP6 marine NoEs, I3	CIESM	National Priorities
Climate Change	**Research priorities**					
	Improve the temporal resolution in the reconstruction of climate history of the ocean in scales from tens to hundreds of years; develop models for climate evolution on global and regional scales	■	BONUS CIRCLE ECORD-Net	NoEs		BE1, DE, ES, FR, IE, NL, NO, PL, UK
	Improve the definition of extreme events; observing networks		BONUS CIRCLE ECORD-Net	NoEs		BE1, ES, FR, GR, IE, NL, NO, UK
	Detect the actual phenomena (ENSO, NAO); new observational and measurement sensors and systems need to be designed		CIRCLE ECORD-Net	NoEs		FR, GR, IE, NL, NO, UK
	Detect/assess CC impacts on oceans and mechanisms leading to these impacts	■	BONUS CIRCLE ECORD-Net MarinERA	NoEs	CIESM	BE1,DE, ES, FR, GR, IE, NL, NO, UK
	Develop appropriate adaptive strategies: downscale global models to regional/local scales and improve regional/local scenario modelling	■	BONUS CIRCLE ECORD-Net MarinERA	NoEs		BE1, DE, ES, FR, GR, IE, NL, NO, UK
	Study ecosystem variation and functionality resulting from CC	■	BONUS CIRCLE ECORD-Net FEUFAR MarinERA	NoEs	CIESM	BE1, ES, FR, GR, IE, NL, NO, UK
	Assess dynamics of change: towards a major ecosystem shift? (oscillations vs. trends)	■	BONUS MarinERA	NoEs	CIESM	Beyond the scope of this exercise
	Support fisheries and aquaculture studies in response to CC impacts	■	BONUS FEUFAR	NoEs		Beyond the scope of this exercise
	Climate-simulating mesocosms are required to unravel the basic biogeochemical links and responses of climate-critical plankton species to physical and chemical drivers of climate change (e.g. temperature, pH, CO_2, solar radiation) and the associated biogeographic consequences		CIRCLE	NoEs		DE, NO, PL
	Policy and management priorities					
	Provide decision makers with scenarios detailed enough		BONUS CIRCLE ECORD-Net MarinERA	NoEs		BE1, DE, FR, IE, NL, NO, UK
	Predict scenarios at the regional and local scales		BONUS CIRCLE ECORD-Net MarinERA	NoEs		BE1, DE, FR, GR, IE, NL, NO, UK
	Initiate a data policy to facilitate timely and improved access to data		BONUS CIRCLE ECORD-Net MarinERA	I3 NoEs		BE1&2, DE, FR, IE, NL, NO, UK
	Promote the coordination and the integration of European research programmes with the climate component of international research programmes, including CLIVAR, GLOBEC and IMBER	■	BONUS CIRCLE ECORD-Net MarinERA	NoEs		BE1, DE, ES, FR, IE, NL, NO, PL, UK

		ESF-EURO CORES	FP6 ERA-NETs & Foresight	FP6 marine NoEs, I3	CIESM	National Priorities
	Research priorities					
Ocean-atmosphere coupling and the ocean thermohaline circulation	Transform prototype observational experiments into multidisciplinary long-term observational networks to monitor the evolving dynamics of the system. Research effort is required to focus on key Arctic and sub-Arctic deep water formations, gateways and pathways for the out-flows of cold dense water, and return flows of warm surface currents in the world ocean			NoEs		DE, FR, IE, GR, NL, NO, PL, UK
	Encourage research on impacts of climate change on regional seas (e.g. the Arctic, Nordic, Baltic and the Mediterranean Seas)		BONUS CIRCLE MarinERA	NoEs	CIESM	BE1, DE, ES, FR, GR, IE, NL, NO, PL, UK
	Contribute to the global ARGO experiment by providing hydrographic observations in the long term, both for operational oceanography and for monitoring climate change		MarinERA	I3 NoEs		DE, ES, FR, GR, IE, NL, NO, PL, UK
Ocean biogeochemical impacts and feedbacks in a greenhouse ocean	Predict future CO_2 levels and estimate absorption limits and oceanic budgets for anthropogenic CO_2 under greenhouse scenarios		BONUS	NoEs		DE, ES, FR, IE, NL, NO, PL, UK
	Conduct independent studies and evaluations so that there can be an objective debate on the environmental feasibility, usefulness, ethics and impacts of ocean carbon sequestration			NoEs		DE, ES, FR, IE, NO
Ventilation of marine biogases and fertilisation feedbacks	Develop research on current air-sea fluxes of climatically critical biogases			NoEs		DE, ES, FR, IE, NO, UK
	Develop coupled physical biogeochemical ocean climate models that incorporate carbon speciation and nutrient dynamics		BONUS	NoEs		ES, FR, IE, NL, NO, UK
	Support should be directed towards adapting biogeochemical gene probes, coupled with phylogenetic probes, to enable the application of high-throughput bio-analytic technologies for exploration of microbial biodiversity, and assessment of food web dynamics and biogeochemical feedbacks			NoEs		ES, FR, IE, NO, UK

Commission's Communication

Recommendations

- Identifying cross-thematic research objectives across traditionally self-contained fields of investigation: e.g. climate change,
- In addressing these cross-cutting research issues, particular attention will be paid to the integration of social-economic research and the impact of management options.

Research topics requiring a cross-thematic approach

- **Climate change and the oceans**

We need enhanced detection and better assessment of the impacts of climate change on oceans and on coastal areas. Options to mitigate or make the best use of the impact of climate change are also important, as well as risks and opportunities in relation to the Arctic Ocean.

New frontiers in marine sciences

		ESF-EURO CORES	FP6 ERA-NETs & Foresight	FP6 marine NoEs, I3	CIESM	National Priorities
Life in extreme environments	**Research priorities**					
	Support research on microbial, invertebrate, vertebrate and other populations supported by these extreme habitats. It should be carried out in an interdisciplinary manner, concurrent with geological and oceanographic surveys		ECORD-Net	NoEs	CIESM	DE, ES, FR, IE, NO, UK
	Establish in situ observatories to elaborate baseline studies		ECORD-Net	NoEs		DE, FR, GR, NO, IE
	Develop and deploy deep ocean vehicles and observatories with new sensors		ECORD-Net	NoEs		DE, FR, GR, IE, NO, UK
Deep-sea frontier	Investigate (micro) biological processes in the oceans and sediment/water interface: develop and implement new suites of instruments.		ECORD-Net	NoEs		DE, ES, FR, IE, NO, PL, UK
	Understand hydrothermal phenomena		ECORD-Net	NoEs		DE, FR, NO, UK
	Quantify the contribution of cold vents to the geochemical balance of various elements with fluids		ECORD-Net	NoEs		DE, FR, IE, NO, UK
	Support integrated multidisciplinary studies		ECORD-Net	NoEs		DE, ES, FR, GR, IE, NO, UK
Arctic seas - IPY	Adapt and transfer for use in the Arctic those technologies devised for deployment elsewhere		EURO-POLAR	NoEs		DE, FR, NO, UK
	Policy and management priorities					
	Develop research in Arctic seas in partnership with many other countries		EURO-POLAR	NoEs		DE, ES, NO, PL, UK

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Recommendations

- Strengthen cooperation with third countries in order to enhance participation in large-scale international research programmes. Particular attention should be paid to research into the "blue ocean" beyond national jurisdictions and deep-sea research.

Research topics requiring a cross-thematic approach

- **Continental margins and deep sea**

Enhanced understanding of sediments in continental margins and deep seas, gas hydrate behaviour, deep-sea ecosystems and technologies needed to enhance deep-sea observation.

		ESF-EURO CORES	FP6 ERA-NETs & Foresight	FP6 marine NoEs, I3	CIESM	National Priorities
	Research priorities					
	Further assess, convert and apply novel miniature sensors; develop long-lived, easy to use and cost-effective in situ instruments		MarinERA	I3 NoEs		FR, IE, NL, NO, UK
	Facilitate novel and high-throughput techniques for the development and assessment of new drugs, therapies and biomaterials			NoEs		FR, IE, NO
	Develop, deploy and demonstrate renewable ocean energy schemes (offshore wind, wave, tidal)					ES, FR, IE, NO, UK
	Develop and operate multi-parametric ocean observatories and monitoring systems		BONUS MarinERA	I3 NoEs	CIESM	DE, FR, GR, IE, NL, NO, UK
	Develop ROVs & AUVs technologies; industrial partnerships			I3 NoEs		DE, ES, FR, IE, NL, NO, UK
	Network calibration facilities		MarinERA	I3 NoEs		FR, IE, NL, NO, UK
	Adapt software technologies		MarinERA	I3 NoEs		DE, FR, IE, NO, UK
	Standardise interfaces of system components			I3 NoEs		FR, IE, NL NO, UK
	Enhance long-term monitoring capability via sensors		MarinERA	I3 NoEs		FR, GR, IE, NO, UK
	Policy and management priorities					
	Raise awareness to political and policy making communities and identify priorities for future investments		BONUS MarinERA	I3 NoEs		FR, IE, NO, UK
	Favour the transfer of new developments			I3 NoEs		ES, FR, IE, NO, UK

Commission's Communication

Recommendations

- Fostering knowledge and technology transfer in partnership with marine and maritime stakeholders, providing support measures to enable screening of marine and maritime technology expertise to promote rapid transfer at EU level. A particular attention will also be given to Community Innovation Programme (CIP) with a view to boost eco-innovation and to transfer marine and maritime technology expertise at EU level.

Research infrastructures

		ESF-EURO CORES	FP6 ERA-NETs & Foresight	FP6 marine NoEs, I3	CIESM	National Priorities
	Research priorities					
	Implement operational satellites for observing the ocean in the framework of GMES			I3 NoEs		BE1, FR, GR, NL, NO, PL, UK
	Implement high-end computing facilities in Europe for ocean and climate numerical modelling		BONUS MarinERA	I3 NoEs		DE, FR, GR, IE, NL, NO, PL, UK
	Policy and management priorities					
	Better use and share of existing facilities		BONUS MarinERA	I3 NoEs	CIESM	BE1&2, DE, ES, FR, GR, IE, NL, NO, PL, UK
	Support the establishment of a European Marine Observation and data NETwork (EMODNET)		All ERA-NETs	I3 NoEs		BE2, DE, FR, GR, IE, NO, NL
	Include a detailed, long-term and comprehensive data management plan in all marine research and observation programmes; coordinate data acquisition, management and quality insurance; establish a European policy for data dissemination		All ERA-NETs	I3 NoEs		BE1&2, FR, GR, IE, NL, NO, PL, UK
	Maximise vessel use on a regional and pan-European scale, to improve interoperability, reciprocal-transnational access; extend and develop the OFEG partnership concept; launch a forum of specialised operators of experimental facilities		BONUS MarinERA	I3 Noes	CIESM	BE1&2, DE, ES, FR, GR, IE, NL, NO, UK
	Reinforce European marine biology facilities (sequencing centres, bioinformatics tools, institutes)		MarinERA	I3 NoEs		BE2, DE, FR, IE, NL, NO, UK
	Develop biotechnological Mediterranean platforms			NoEs	CIESM	Beyond the scope of this exercise

Commission's Communication

Recommendations

- Building new research and observation infrastructure;
- Developing sustainable support for the specialised pan-European research infrastructures12 required to meet identified challenges and opportunities, including those proposed under the current ESFRI Roadmap and Integrated Infrastructures Initiatives (I3) of FP7;
- Defining at European level investment requirements (including their running costs) for new infrastructures needed to support pan-European and international marine and maritime research (for example using Cohesion Policy funds to co-finance them).
- Optimising the use of existing research infrastructures;
- To optimise their use it will be essential to build lasting and complementary relationships between infrastructure holders based on joint plans for future investments and standardisation in measurement, observation and reporting methodologies.
- Finding mechanisms for the sustainable support and management of data on the seas,
- The Commission will coordinate the launching of a European marine observation and data network (EMODNet)14 in 2009 integrated with GEOSS and GMES.

Multidisciplinary studies & the European research strategy

	ESF-EUROCORES	FP6 ERA-NETs & Forestight	FP6 marine NoEs, I3	CIESM	National Priorities
Research priorities					
Support integrated assessment of key species (combination of moleculars/functional and biogeochemical approaches)			NoEs		FR, NO, UK
Support integrated assessment of key regions with key ecosystems (ultra-oligotrophic waters, anoxic zones of the world ocean, coastal upwelling zones)		FEUFAR	NoEs	CIESM	ES, FR, NO, PL, UK
Policy and management priorities					
Initiate a comprehensive and integrated European Marine and Maritime Science, Research, Technology and Innovation Strategy		All ERA-NETs	NoEs		BE1, DE, ES, FR, GR, IE, NO, NL, PL
Establish an adequately resourced and sustained process to oversee the implementation and delivery of this Strategy within an holistic European Maritime Policy		All ERA-NETs	NoEs		BE1, DE, FR, GR, IE, NL, NO
Initiate and support the necessary funding mechanisms, specialised infrastructures, data collection and information management, and capacity building essential to manage our on-going relationship with the oceans and seas		All ERA-NETs	NoEs		BE1, DE, FR, GR, IE, NL, NO, PL, UK
Develop a framework that enables inclusion of risk and uncertainty in policy development and assessment throughout fisheries, aquaculture and the ecosystem		AMPERA BONUS FEUFAR	NoEs		Beyond the scope of this exercise
Implement outreach activities		All ERA-NETs FEUFAR	NoEs		Beyond the scope of this exercise
Set-up new instruments for multi-national cooperation across the Whole Mediterranean Basin				CIESM	Beyond the scope of this exercise

Part II
Regional priorities

In this part, we have clustered the same national research priorities on a sea-basin approach, in keeping with the frame given by the European maritime policy.

A- North Atlantic Area (including North Sea, English Channel, Celtic Sea, Norwegian Sea)
B- Baltic Sea
C- Mediterranean Sea (including Black Sea)

A - Marine Science priorities in the North Atlantic Area (including North Sea, the English Channel, the Celtic Sea, the Norwegian Sea)

Topic	Research initiatives Policy and Management initiatives	Participating Countries							
		BE		ES	FR	IE	NL	NO	UK
		BE1	BE2						

Marine research and maritime transport

		Participating Countries							
		BE		ES	FR	IE	NL	NO	UK
		BE1	BE2						
Fisheries - Aquaculture	Involve the research community into participative management plans								
	Improve the fisheries governance; maritime policy to address the Science & Technology to underpin/support challenges of the CFP								
	Develop a new common policy in aquaculture and support the innovation sector and food processing. Raise awareness to political and policy making communities would result in identifying priorities for future investments								
	Turn scientific data, findings and conclusions into information for stakeholders								
Marine Biotechnology	Screen and preserve deep ecosystems								
	Develop bio-prospecting, genetics and bio-informatics' techniques								
	Develop an efficient procedure/structure for the discovery of novel biomolecules								
	Obtain basic knowledge about marine ecosystem functions necessary to allow intelligent management of industries (aquaculture)								
	Support the development of networks and partnerships (RTD/Industry)								
Energy & wealth	Study acoustics-oil disturbance on ecosystems								
	Support research on gas hydrates								
	Encourage research on requirements for effective location, operation and harnessing of renewal energy sites								
	Foster cooperation/interaction between marine groups and petroleum companies								
	Assess whether sustainable ocean energy should be promoted or not based on science-environmental and financial criteria								
	Consolidate partnerships towards enhanced understanding of the origin, locations and characteristics of Ocean energy resources								
Aggregate ore deposits	Develop research on dredging and dumping								

		Participating Countries							
		BE		ES	FR	IE	NL	NO	UK
		BE1	BE2						
Socio-economics of marine resources	Accurate and update financial data on the value and importance of European maritime economy; collect and analyse on a regular basis								
	Estimate the non-market value of marine goods and services								
Maritime transport	Develop technologies to monitor and regulate vessels; forecast/monitor oil spills								
	Strengthen research on invasive species								
	Study effects of harbours development on environment (best practices; monitoring tools)								
	Manage/understand transport pathways and effects of pollutants from ocean exploitation (multi-stressor systems and modelling are still required)								
	Initiate Technology Platform on ship building								
	Encourage funding programmes to support an increased implementation of measuring devices on regular shipping routes								

Europe's coastal zones, shelf seas, continental margins and biodiversity

		Participating Countries							
		BE		ES	FR	IE	NL	NO	UK
		BE1	BE2						
Coastal Zones and Marine Spatial Planning	Favour interdisciplinary research (humanities, economy) to address the challenge of implementing ICZM and marine spatial planning; development of holistic models and integration tools directed to stakeholders	■		■	■	■	■	■	■
	Investigate the environmental, social and economic impacts of anthropogenic activities	■	■	■	■	■	■	■	■
	Understand sea-level rise and variability: assessments of coastal territories vulnerability, economical consequences, mitigation and adaptation strategies with regard to CC; distinguish CC to anthropogenic impacts on the coastal zones	■		■	■	■	■	■	■
	Develop integrated numerical models of estuarine processes to support improved management of rivers and estuaries	■		■	■	■	■	■	■
	Develop research on sand grains transport in the coastal environment	■		■	■		■	■	■
	Understand the impacts of turbulence on marine ecosystems	■		■	■	■	■	■	■
	Adapt biotechnological chips to provide non-invasive and affordable systems for ecotoxicological screening of water quality	■			■	■		■	
	Ensure a targeted monitoring of coastal risks (tracers of human activities)	■			■	■	■	■	■
	Favour integrated (regional-UPR) and multidisciplinary studies directed to answer societal needs	■		■	■	■		■	■
	Improve observing and modelling methods and technologies particularly in the CZ	■		■	■	■	■	■	■
	Investigate HAB: initiation and the development of toxicity – research at the ecosystem level	■		■	■	■	■	■	■
	Harmonise national management plans to favour coherence and implementation of ICZM: vertical integration between terrestrial and maritime plans is essential and they should start at a national level	■		■	■	■	■	■	■
	Develop an EU wide mechanism for comparative analysis and exchange of best practise (indicators, databases)	■	■		■	■	■	■	■
	Elaborate the Atlas of the Seas in the whole CZ: status of data, data compatibility and quality (INSPIRE) and collection capacity; design an implementation plan	■			■	■	■	■	
Observing, predicting and monitoring systems	Study impacts of CC on coastal areas	■		■	■	■	■	■	■
	Predict climate, ocean currents and meteorology at different time scales	■		■	■	■	■	■	■
	Prepare bathymetric and seabed habitat maps Implementation of high-end computing facilities				■	■		■	■
	Long-term, high-quality observations of climatic drivers of oceanographic, biogeochemical and biodiversity variability, and associated anthropogenic parameters	■		■	■	■	■	■	■
	Establish a European Marine Observation and data NETwork (EMODNET) for improving systematic observation, interoperability, access, standardisation of data format and long-term funding of vital database	■		■	■	■	■	■	■

		Participating Countries							
		BE		ES	FR	IE	NL	NO	UK
		BE1	BE2						
Ocean margin geologic processes and geohazards	Implement telecommunication and fibre-optic cabled networks adapted to ecosystem observations and monitoring								
	Improve multi-risk monitoring and warning systems; risk management of geohazards								
	Develop research on gas hydrates dynamics and mechanisms								
Marine Biodiversity	Explore and describe ocean biodiversity								
	Set key indicator species, niches and roles; develop tools (MPAs) for policy makers								
	Investigate impacts of invasive species, fisheries practice, gravel extraction, dredging, oil industry etc. on biodiversity								
	Maintain large-scale European initiatives								
	Coordinate archives, collections and genetic databases								
Functional role of biodiversity	Source and compile long-term biodiversity data sets should be as a vital European resource.								
	Understand the relative importance of top-down regulation of marine food webs versus the traditional approach in which bottom-up control								
	Develop research in functional genomics and systems biology								
	Develop meta-genomic (environmental sequencing) and use of micro-array technology								
	Investigate the relationship between biodiversity and ecosystem function: management and development of sustainable strategies for marine exploitation. Assess biodiversity at varying functional levels (genomic, species, functional group and ecosystem)								
	Develop evolutionary process studies								
	Provide a better coverage of eukaryotic diversity								
Microbial diversity	Promote research on microbial biodiversity								
	investigate the role of micro-niches and micro-scale dynamics in sustaining symbiotic consortia of micro-organisms in the ocean, in marine sediments and in extreme environments								
	Develop molecular biology and genomic techniques for in situ detection and monitoring of the biodiversity, abundance and activity of micro-organisms								
	Classify and detect viral particles								
	Develop research on the impacts of climate change on micro-organisms								
	Obtain a more complete picture of the genetic diversity inherent in populations of marine viruses								

Ocean climate interactions and feedback

		Participating Countries							
		BE		ES	FR	IE	NL	NO	UK
		BE1	BE2						
	Improve the temporal resolution in the reconstruction of climate history of the ocean in scales from tens to hundreds of years; develop models for climate evolution on global and regional scales	■		■	■	■	■	■	■
	Improve the definition of extreme events; observing networks	■		■	■	■	■	■	■
	Detect the actual phenomena (ENSO, NAO); new observational and measurement sensors and systems need to be designed	■			■	■	■	■	■
	Detect/assess CC impacts on oceans: assessment of mechanisms leading to these impacts	■		■	■	■	■	■	■
	Develop appropriate adaptive strategies: downscale global models to regional/local scales and improve regional/local scenario modelling	■		■	■	■	■	■	■
	Study ecosystem variation and functionality resulting from CC	■		■	■	■	■	■	■
	Implement climate-simulating mesocosms to unravel the basic biogeochemical links and responses of climate-critical plankton species to physical and chemical drivers of climate change (e.g. temperature, pH, CO_2, solar radiation) and the associated biogeographic consequences							■	
	Provide decision makers with scenarios detailed enough	■			■	■	■	■	■
	Predict scenario planning at the regional and local scales	■			■	■	■	■	■
	Initiate a open data policy to facilitate timely and improved access to data	■	■		■	■	■	■	■
	Promote the coordination and the integration of European research programmes with the climate component of international research programmes, including CLIVAR, GLOBEC and IMBER	■		■	■	■	■	■	■
Ocean-atmosphere coupling and the ocean thermohaline circulation	Transform prototype observational experiments into multidisciplinary long-term observational networks to monitor the evolving dynamics of the system. Research effort is required to focus on key Arctic and sub-Arctic deep water formations, gateways and pathways for the out-flows of cold dense water, and return flows of warm surface currents in the world ocean				■	■	■	■	■
	Encourage research on impacts of climate change on regional seas (e.g. the Arctic, Nordic, Baltic and the Mediterranean Seas)	■		■	■	■	■	■	■
	Contribute to the global ARGO experiment by providing hydrographic observations in the long term, both for operational oceanography and for monitoring climate change			■	■	■	■	■	■

		Participating Countries							
		BE		ES	FR	IE	NL	NO	UK
		BE1	BE2						
Ocean biogeochemical impacts and feedbacks in a greenhouse ocean	Predict future CO_2 levels and estimate absorption limits and oceanic budgets for anthropogenic CO_2 under greenhouse scenarios								
	Conduct independent studies and evaluations, so that there can be an objective debate on the environmental feasibility, usefulness, ethics and impacts of ocean carbon sequestration								
Ventilation of marine biogases and fertilisation feedbacks	Develop research on current air-sea fluxes of climatically critical biogases								
	Develop coupled physical biogeochemical ocean climate models that incorporate carbon speciation and nutrient dynamics								
	Support should be directed towards adapting biogeochemical gene probes, coupled with phylogenetic probes, to enable the application of high-throughput bioanalytic technologies for exploration of microbial biodiversity, and assessment of food web dynamics and biogeochemical feedbacks in diverse oceanic environments								

New frontiers in marine sciences

		Participating Countries							
		BE		ES	FR	IE	NL	NO	UK
		BE1	BE2						
Life in extreme environments	Develop research on microbial, invertebrate, vertebrate and other populations supported by these extreme habitats should be supported, and should be carried out in an interdisciplinary manner, concurrent with geological and oceanographic surveys								
	Establish of in situ observatories is required to elaborate baseline studies								
	Develop and deploy deep ocean vehicles and observatories with new sensors								
Deep-sea frontier	Investigate (micro)biological processes in the oceans and sediment/water interface requires the development and implementation of new suites of instruments								
	Understand hydrothermal phenomena								
	Quantify the contribution of cold vents to the geochemical balance of various elements with fluids								
	Initiate integrated multidisciplinary studies (Deep-Sea Floor Frontier)								
Arctic seas - IPY	Adapt and transfer for use in the Arctic those technologies devised for deployment elsewhere								
	Develop research in Arctic seas in partnership with many other countries								

Critical technologies

		Participating Countries							
		BE		ES	FR	IE	NL	NO	UK
		BE1	BE2						
	Further assess, convert and apply novel miniature sensors; develop long-lived, easy to use and cost-effective in situ instruments; standardise interfaces of system components; network national calibration facilities								
	Facilitate novel and high-throughput techniques for the development and assessment of new drugs, therapies and biomaterials								
	Develop, deploy and demonstrate renewal ocean energy schemes (offshore, wind, wave, tidal)								
	Develop and operate multi-parametric ocean observatories and monitoring systems								
	Develop ROVs & AUVs; industrial partnerships								
	Network calibration facilities								
	Adapt software technologies								
	Standardise interfaces of system components								
	Implement long-lived, easy—to-use and cost effective in situ instruments								
	Enhance long-term monitoring capability via sensors								
	Raise awareness to political and policy making communities and identify priorities for future investments								
	Favour the transfer of new developments								

Research infrastructures

		Participating Countries							
		BE		ES	FR	IE	NL	NO	UK
		BE1	BE2						
	Implement operational satellites for observing the ocean in the framework of GMES	■			■		■	■	■
	Implement high-end computing facilities in Europe for ocean and climate numerical modelling				■	■	■	■	■
	Better use and share of existing facilities	■	■	■	■	■	■	■	■
	Support the establishment of a European Marine Observation and data NETwork (EMODNET)		■		■	■	■	■	
	Include a detailed, long-term and comprehensive data management plan in all marine research and observation programmes; coordinate data acquisition, management and quality insurance; establish a European policy for data dissemination	■	■		■	■	■	■	■
	Maximise vessel use on a pan-European scale, to improve interoperability, reciprocal-transnational access; extend and develop the OFEG partnership concept; launch of a forum of specialised operators of experimental facilities	■	■	■	■	■	■	■	■
	Reinforce European marine biology facilities (sequencing centres, bioinformatics tools, institutes)		■		■	■	■	■	■

Multidisciplinary studies & the future European Research Strategy

		Participating Countries							
		BE		ES	FR	IE	NL	NO	UK
		BE1	BE2						
	Initiate integrated assessment of key species (combination of moleculars/functional and biogeochemical approaches)				■			■	■
	Initiate integrated assessment of key regions, key ecosystems (ultra-oligotrophic waters, anoxic zones of the world ocean, coastal upwelling zones)			■	■			■	■
	Initiate a comprehensive and integrated European Marine and Maritime Science, Research, Technology and Innovation Strategy	■		■	■	■	■	■	
	Establish an adequately resourced and sustained process to oversee the implementation and delivery of this Strategy within an holistic European Maritime Policy	■			■	■	■	■	
	Initiate and support the necessary funding mechanisms, specialised infrastructures, data collection and information management, and capacity building essential to manage our on-going relationship with the oceans and seas	■			■	■	■	■	■

B - Marine Science priorities in the Baltic Sea

In this table, Baltic national priorities have been listed and compiled first; therefore, not all BONUS priorities are mentioned here.
BONUS science plan and implementation strategy cover many of the priorities listed in the general table Part I.

Topic	Research initiatives Policy and Management initiatives	Participating Countries		European Initiative
		DE	PL	BONUS

Marine research and maritime transport

		Participating Countries		European Initiative
		DE	PL	BONUS
Fish - Aquaculture	Develop integrated assessments (socio-economics, models, indicators) and progressive adoption of the EAF concept (including MPAs roles and impacts in the dynamics of fish stocks)		■	■
Marine Biotechnology	Screen and preserve deep ecosystems	■		■
	Develop bio-prospecting, genetics and bio-informatics' techniques	■	■	
	Support the development of networks and partnerships (RTD/Industry)	■		
Energy & wealth	Support research on gas hydrates	■		
	Assess whether sustainable ocean energy should be promoted or not based on science-environmental and financial criteria	■		■
	Consolidate partnerships towards enhanced understanding of the origin, locations and characteristics of ocean energy resources		■	
Aggregate ore deposits	Develop research on dredging and dumping	■		
Socio-economics of marine resources	Estimate the non-market value of marine goods and services		■	■
Maritime transport	Study effects of harbours development on environment (best practices; monitoring tools)	■		

Europe's coastal zones, shelf seas, continental margins and biodiversity

		Interested Countries		European Initiative
		DE	PL	BONUS
Coastal Zones and Marine Spatial Planning	Favour interdisciplinary research (humanities, economy) to address the challenge of implementing ICZM and marine spatial planning; develop holistic models and integrated tools	■	■	■
	Investigate the environmental, social and economic impacts of anthropogenic activities	■	■	■
	Understand sea-level rise and variability: assessments of coastal territories vulnerability, economical consequences, mitigation and adaptation strategies with regard to CC; distinguish CC to anthropogenic impacts on the coastal zones	■		■
	Develop integrated numerical models of estuarine processes to support improved management of rivers and estuaries	■		■
	Develop research on sand grains transport in the coastal environment	■	■	
	Ensure a targeted monitoring of coastal risks (tracers of human activities)	■	■	■
	Improve observing and modelling methods and technologies particularly in the CZ	■		■
	Harmonise national management plans to favour coherence and implementation of ICZM: vertical integration between terrestrial and maritime plans is essential and they should start at a national level	■		■
	Develop an EU wide mechanism for comparative analysis and exchange of best practise (indicators, databases)	■		■
	Elaborate the Atlas of the Seas in the whole CZ: status of data, data compatibility and quality (INSPIRE) and collection capacity; design an implementation plan	■		
Observing, predicting and monitoring systems	Study impacts of CC on coastal areas	■	■	■
	Predict climate, ocean currents and meteorology at different time scales	■	■	■
	Prepare bathymetric and seabed habitat maps; Implementation of high-end computing facilities	■		■
	Establish long-term, high-quality observations of climatic drivers of oceanographic, biogeochemical and biodiversity variability, and associated anthropogenic parameters	■	■	■
	Establish a European Marine Observation and data NETwork (EMODNET) for improving systematic observation, interoperability, access, standardisation of data format and long-term funding of vital database	■		■
Ocean margin geologic processes and geohazards	Improve multi-risk monitoring and warning systems; risk management of geohazards	■		
	Develop research on gas hydrates dynamics and mechanisms	■		
Marine Biodiversity	Explore and describe ocean biodiversity	■	■	■
	Set key indicator species, niches and roles; develop tools (MPAs) for policy makers	■		■
	Investigate impacts of invasive species, fisheries practice, gravel extraction, dredging, oil industry etc. on biodiversity		■	■
	Maintain large-scale European initiatives	■	■	
	Coordinate archives, collections and genetic databases	■		
Functional role of biodiversity	Source and compile long-term biodiversity data sets as a vital European resource.	■	■	■
	Develop research in functional genomics and systems biology	■	■	
Microbial diversity	Promote research on microbial biodiversity	■	■	
	Research on microbial biodiversity is a fertile and very necessary area for prioritising future marine research commitments	■	■	
	Develop molecular biology and genomic techniques for in situ detection and monitoring of the biodiversity, abundance and activity of micro-organisms		■	
	Research on the impacts of climate change on micro-organisms	■		

Ocean climate interactions and feedback

		Interested Countries		European Initiative
		DE	PL	BONUS
Climate Change	Improve the temporal resolution in the reconstruction of climate history of the ocean in scales from tens to hundreds of years; develop models for climate evolution on global and regional scales			
	Detect the actual phenomena (ENSO, NAO); new observational and measurement sensors and systems need to be designed			
	Detect and assess CC impacts on oceans and the mechanisms leading to these impacts			
	Develop appropriate adaptive strategies: develop skills to downscale global models to regional/local scales and improve regional/local scenario modelling			
	Climate-simulating mesocosms are required to unravel the basic biogeochemical links and responses of climate-critical plankton species to physical and chemical drivers of climate change (e.g. temperature, pH, CO_2, solar radiation) and the associated biogeographic consequences			
	Provide decision makers with scenarios detailed enough			
	Predict scenario planning at the regional and local scales			
	Initiate a data policy to facilitate timely and improved access to data			
	European research programmes to coordinate and integrate with the climate component of international research programmes, including CLIVAR, GLOBEC and IMBER			
Ocean-atmosphere coupling and the ocean thermohaline circulation	Transform prototype observational experiments into multidisciplinary long-term observational networks to monitor the evolving dynamics of the system. Research effort is required to focus on key Arctic and sub-Arctic deep water formations, gateways and pathways for the out-flows of cold dense water, and return flows of warm surface currents in the world ocean			
	Encourage research on impacts of climate change on regional seas (e.g. the Arctic, Nordic, Baltic and the Mediterranean Seas)			
	Contribute to the global ARGO experiment by providing hydrographic observations in the long term, both for operational oceanography and for monitoring climate change			
Ocean biogeochemical impacts and feedbacks in a greenhouse ocean	Predict future CO_2 levels and estimate absorption limits and oceanic budgets for anthropogenic CO_2 under greenhouse scenarios			
	Conduct independent studies and evaluations, so that there can be an objective debate on the environmental feasibility, usefulness, ethics and impacts of ocean carbon sequestration			
Ventilation of marine biogases and fertilisation feedbacks	Develop research on current air-sea fluxes of climatically critical biogases			

New frontiers in marine sciences

		Interested Countries		European Initiative
		DE	PL	BONUS
Life in extreme environments	Support research on microbial, invertebrate, vertebrate and other populations supported by these extreme habitats. It should be carried out in an interdisciplinary manner, concurrent with geological and oceanographic surveys	■		
	Establish in situ observatories is required to elaborate baseline studies	■		
	Develop and deploy deep ocean vehicles and observatories with new sensors	■		
Deep-sea frontier	Investigate (micro)biological processes in the oceans and sediment/water interface requires the development and implementation of new suites of instruments	■	■	
	Understand hydrothermal phenomena	■		
	Quantif the contribution of cold vents to the geochemical balance of various elements with fluids	■		
	Launch integrated multidisciplinary studies (Deep-Sea Floor Frontier)	■		
	Adapt and transfer for use in the Arctic those technologies devised for deployment elsewhere	■		
	Develop research in Arctic seas in partnership with many other countries	■	■	

Critical technologies

		Interested Countries		European Initiative
		DE	PL	BONUS
	Develop and operate multi-parametric ocean observatories and monitoring systems	■		
	ROVs & AUVs; industrial partnerships	■		
	Adapt software technologies	■		

		Interested Countries		European Initiative
		DE	PL	BONUS
	Implement operational satellites for observing the ocean in the framework of GMES			
	Implement high-end computing facilities in Europe for ocean and climate numerical modelling			
	Better use and share of existing facilities			
	Support the establishment of a European Marine Observation and data NETwork (EMODNET)			
	Include a detailed, long-term and comprehensive data management plan in all marine research and observation programmes; coordinate data acquisition, management and quality insurance; establish a European policy for data dissemination;			
	Maximise vessel use on a pan-European scale, to improve interoperability, reciprocal-transnational access; extend and develop the OFEG partnership concept; launch of a forum of specialised operators of experimental facilities			
	Reinforce European marine biology facilities (sequencing centres, bioinformatics tools, institutes)			

Multidisciplinary studies & the future European research strategy

		Interested Countries		European Initiative
		DE	PL	BONUS
	Support integrated assessment of key regions with key ecosystems (ultra-oligotrophic waters, anoxic zones of the world ocean, coastal upwelling zones)			
	Initiate a comprehensive and integrated European Marine and Maritime Science, Research, Technology and Innovation Strategy			
	Establish an adequately resourced and sustained process to oversee the implementation and delivery of this Strategy within an holistic European Maritime Policy			
	Initiate and support the necessary funding mechanisms, specialised infrastructures, data collection and information management, and capacity building essential to manage our on-going relationship with the oceans and seas			

C - Marine science priorities in the Mediterranean Area (including the Black sea)

In this table, Baltic national priorities have been listed and compiled first; therefore, not all BONUS priorities are mentioned here.
BONUS science plan and implementation strategy cover many of the priorities listed in the general table Part I.

Topic	Research initiatives Policy and Management initiatives	Countries			International
		ES	FR	GR	CIESM

Marine research and maritime transport

		Countries			International
		ES	FR	GR	CIESM
Fisheries Aquaculture	Develop integrated assessments (socio-economics, models, indicators) and progressive adoption of the EAF concept (including MPAs roles and impacts in the dynamics of fish stocks)				
	Evaluate the economic impacts (policies, ecosystem changes on resources, drivers of fisheries/aquaculture activities)				
	Involve the research community into participative management plans				
	Improve the fisheries governance; maritime policy to address the Science & Technology to underpin/support challenges of the CFP				
	Develop a new common policy in aquaculture and support the innovation sector and food processing. Raise awareness to political and policy making communities would result in identifying priorities for future investments				
	Turn scientific data, findings and conclusions into information for stakeholders				
Marine Biotechnology	Screen and preserve deep ecosystems				
	Develop bio-prospecting, genetics and bio-informatics' techniques				
	Develop an efficient procedure/structure for the discovery of novel biomolecules				
	Obtain basic knowledge about marine ecosystem functions necessary to allow intelligent management of industries (aquaculture)				
	Support the development of networks and partnerships (RTD/ Industry)				
Energy & wealth	Study acoustics-oil disturbance on ecosystems				
	Support research on gas hydrates				
	Encourage research on requirements for effective location, operation and harnessing of renewal energy sites				
	Foster cooperation/interaction marine groups/petroleum companies				
	Assess whether sustainable ocean energy should be promoted or not based on science-environmental and financial criteria				
	Consolidate partnerships towards enhanced understanding of the origin, locations and characteristics of ocean energy resources				

		Countries			International
		ES	FR	GR	CIESM
Aggregate ore deposits	Develop research on dredging and dumping				
Socio-economics of marine resources	Accurate and update financial data on the value and importance of European maritime economy; collect and analyse on a regular basis				
	Estimate the non-market value of marine goods and services				
	Secure intellectual property rights and international laws	*	*	*	
Maritime transport	Develop technologies to monitor and regulate vessels; forecast/ monitor oil spills				
	Strengthen research on invasive species				
	Effects of harbours development on environment (best practices; monitoring tools)				
	Manage/understand transport pathways and effects of pollutants from ocean exploitation (multi-stressor systems and modelling are still required)				

*** : Beyond the scope of this exercise**

Europe's coastal zones, shelf seas, continental margins and biodiversity

		Countries			International
		ES	FR	GR	CIESM
Coastal Zones and Marine Spatial Planning	Favour interdisciplinary research (humanities, economy) to address the challenge of implementing ICZM and marine spatial planning; develop holistic models and integration tools directed to stakeholders				
	Investigate the environmental, social and economic impacts of anthropogenic activities				
	Understand sea-level rise and variability: assessments of coastal territories vulnerability, economical consequences, mitigation and adaptation strategies with regard to CC; distinguish CC to anthropogenic impacts on the coastal zones				
	Develop integrated numerical models of estuarine processes to support improved management of rivers and estuaries				
	Investigate coastal erosion linked to watershed mis-management	*	*	*	
	Develop research on sand grains transport in the coastal environment				
	Understand the impacts of turbulence on marine ecosystems				
	Ensure a targeted monitoring of coastal risks (tracers of human activities)				
	Favour integrated (regional-UPR) and multidisciplinary studies directed to answer societal needs				
	Adapt biotechnological chips to provide non-invasive and affordable systems for ecotoxicological screening of water quality				
	Improve observing and modelling methods and technologies particularly in the CZ				
	Investigate HAB: initiation and the development of toxicity – research at the ecosystem level				
	Harmonise national management plans to favour coherence and implementation of ICZM: vertical integration between terrestrial and maritime plans is essential and they should start at a national level				
	Develop an EU wide mechanism for comparative analysis and exchange of best practise (indicators, databases)				
	Elaborate the Atlas of the Seas in the whole CZ: status of data, data compatibility and quality (INSPIRE) and collection capacity; design an implementation plan				
Observing, predicting and monitoring systems	Study impacts of CC on coastal areas				
	Predict climate, ocean currents and meteorology at different time scales				
	Prepare bathymetric and seabed habitat maps implementation of high-end computing facilities				
	Establish long-term, high-quality observations of climatic drivers of oceanographic, biogeochemical and biodiversity variability, and associated anthropogenic parameters				
	Establish a European Marine Observation and Data NETwork (EMODNET) for improving systematic observation, interoperability, access, standardisation of data format and long-term funding of vital database				

		Countries			International
		ES	FR	GR	CIESM
Ocean margin geologic processes and geohazards	Implement telecommunication and fibre-optic cabled networks adapted to ecosystem observations and monitoring				
	Improve multi-risk monitoring and warning systems; risk management of geohazards				
	Develop research on gas hydrates dynamics and mechanisms				
	Develop research on the Mediterranean seabed: geo-hazard vs. economic opportunities	*	*	*	
Marine Biodiversity	Explore and describe ocean biodiversity				
	Set key indicator species, niches and roles; develop tools (MPAs) for policy makers				
	Investigate impacts of invasive species, fisheries practice, gravel extraction, dredging, oil industry etc. on biodiversity				
	Develop research on biomagnification of new contaminants in marine foodwebs	*	*	*	
	Develop research on the tropicalization of Mediterranean biodiversity (invasive species, endemic extinctions)	*	*	*	
	Maintain large-scale European initiatives				
	Coordinate archives, collections and genetic databases				
Functional role of biodiversity	Source and compile long-term biodiversity data sets as a vital European resource				
	Understand the relative importance of top-down regulation of marine food webs versus the traditional approach in which bottom-up control				
	Develop research in functional genomics and systems biology				
	Develop meta-genomic (environmental sequencing) and use of micro-array technology				
	Investigate the relationship between biodiversity and ecosystem function: management and development of sustainable strategies for marine exploitation. Assess biodiversity at varying functional levels (genomic, species, functional group and ecosystem)				
	Develop evolutionary process studies				
	Provide a better coverage of eukaryotic diversity				
Microbial diversity	Develop research on microbial biodiversity				
	Investigate the role of micro-niches and micro-scale dynamics in sustaining symbiotic consortia of micro-organisms in the ocean, in marine sediments and in extreme environments				
	Develop molecular biology and genomic techniques for in situ detection and monitoring of the biodiversity, abundance and activity of micro-organisms				
	Classify and detect viral particles				
	Research the impacts of climate change on micro-organisms				
	Obtain a more complete picture of the genetic diversity inherent in populations of marine viruses				

Ocean climate interactions and feedback

		Countries			International
		ES	FR	GR	CIESM
Climate Change	Improve the temporal resolution in the reconstruction of climate history of the ocean in scales from tens to hundreds of years; develop models for climate evolution on global and regional scales				
	Improve the definition of extreme events; observing networks				
	Detect the actual phenomena (ENSO, NAO) new observational and measurement sensors and systems need to be designed				
	Detect and assess CC impacts on oceans and the mechanisms leading to these impacts				
	Develop appropriate adaptive strategies: downscale global models to regional/local scales and improve regional/local scenario modelling				
	Study ecosystem variation and functionality resulting from CC				
	Assess the dynamics of change: towards a major ecosystem shift? (oscillations vs. trends)	*	*	*	
	Provide decision makers with scenarios detailed enough				
	Predict scenario planning at the regional and local scales				
	Initiate a data policy to facilitate timely and improved access to data				
	Coordinate and integrate European research programmes with the climate component of international research programmes, including CLIVAR, GLOBEC and IMBER				
Ocean-atmosphere coupling and the ocean thermohaline circulation	Transform prototype observational experiments into multidisciplinary long-term observational networks to monitor the evolving dynamics of the system. Research effort is required to focus on key Arctic and sub-Arctic deep water formations, gateways and pathways for the out-flows of cold dense water, and return flows of warm surface currents in the world ocean				
	Encourage research on impacts of climate change on regional seas (e.g. the Arctic, Nordic, Baltic and the Mediterranean Seas)				
	Contribute to the global ARGO experiment to provide hydrographic observations in the long term, both for operational oceanography and for monitoring climate change				
Ocean biogeochemical impacts and feedbacks in a greenhouse ocean	Predict future CO_2 levels and estimate absorption limits and oceanic budgets for anthropogenic CO_2 under greenhouse scenarios				
	Conduct independent studies and evaluations, so that there can be an objective debate on the environmental feasibility, usefulness, ethics and impacts of ocean carbon sequestration				
Ventilation of marine biogases and fertilisation feedbacks	Develop research on current air-sea fluxes of climatically critical biogases				
	Develop coupled physical biogeochemical ocean climate models that incorporate carbon speciation and nutrient dynamics				
	Support should be directed towards adapting biogeochemical gene probes, coupled with phylogenetic probes, to enable the application of high-throughput bioanalytic technologies for exploration of microbial biodiversity, and assessment of food web dynamics and biogeochemical feedbacks in diverse oceanic environments				

New frontiers in marine sciences

		Countries			International
		ES	FR	GR	CIESM
Life in extreme environments	Develop research on microbial, invertebrate, vertebrate and other populations supported by these extreme habitats should be supported, and should be carried out in an interdisciplinary manner, concurrent with geological and oceanographic surveys				
	Establish in situ observatories is required to elaborate baseline studies				
	Develop and deploy deep ocean vehicles and observatories with new sensors				
Deep-sea frontier	Investigate (micro)biological processes in the oceans and sediment/ water interface: development and implement new suites of instruments				
	Understand hydrothermal phenomena				
	Quantify the contribution of cold vents to the geochemical balance of various elements with fluids				
	Support integrated multidisciplinary studies (Deep-Sea Floor Frontier)				
Arctic seas - IPY	Adapt and transfer for use in the Arctic those technologies devised for deployment elsewhere				
	Develop research in Arctic seas in partnership with many other countries				

Critical technologies

		Countries			International
		ES	FR	GR	CIESM
	Further assess, convert and apply novel miniature sensors; develop long-lived, easy to use and cost-effective in situ instruments; standardise interfaces of system components; network national calibration facilities				
	Develop, deploy and demonstrate renewal ocean energy schemes (offshore wind, wave, tidal)				
	Develop and operate multi-parametric ocean observatories and monitoring systems				
	ROVs & AUVs; industrial partnerships				
	Network calibration facilities				
	Adapt software technologies				
	Standardise interfaces of system components				
	Enhance long-term monitoring capability via sensors				
	Raise awareness to political and policy making communities and identify priorities for future investments				
	Favour the transfer of new developments				

Research infrastructures

		Countries			International
		ES	FR	GR	CIESM
	Implement operational satellites for observing the ocean in the framework of GMES				
	Implement high-end computing facilities in Europe for ocean and climate numerical modelling				
	Better use and share of existing facilities				
	Support the establishment of a European Marine Observation and data NETwork (EMODNET)				
	Include a detailed, long-term and comprehensive data management plan in all marine research and observation programmes; coordinate data acquisition, management and quality insurance; establish a European policy for data dissemination				
	Maximise vessel use on a regional and pan-European scale, to improve interoperability, reciprocal-transnational access; extend and develop the OFEG partnership concept; launch a forum of specialised operators of experimental facilities				
	Reinforce European marine biology facilities (sequencing centres, bioinformatics tools, institutes)				
	Develop biotechnological Mediterranean platforms	*	*	*	

Multidisciplinary studies & the future European research strategy

		Countries			International
		ES	FR	GR	CIESM
	Support integrated assessment of key species (combination of moleculars/functional and biogeochemical approaches)				
	Support Integrated assessment of key regions with key ecosystems (ultra-oligotrophic waters, anoxic zones of the world ocean, coastal upwelling zones)				
	Initiate a comprehensive and integrated European Marine and Maritime Science, Research, Technology and Innovation Strategy				
	Establish an adequately resourced and sustained process to oversee the implementation and delivery of this Strategy within an holistic European Maritime Policy				
	Initiate and support the necessary funding mechanisms, specialised infrastructures, data collection and information management, and capacity building essential to manage our on-going relationship with the oceans and seas				
	Set-up new instruments for multi-national cooperation across the whole Mediterranean Basin	*	*	*	

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Marine Board Publications (2002 – 2008)

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- Marine Board Position Paper 5 **Integrating Marine Science in Europe** (November 2002)

- Marine Board Position Paper 6 **Navigating the Future II. Summary of Integrating Marine Science in Europe*** (March 2003)
  *1st publication of the series **Navigating the Future appeared in March 2001, entitled Navigating the Future – Towards a European Marine Research Area**

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