
Contribution to a national research
strategy for marine sciences for 2020
Exploring the sea
to understand the earth
Ifremer

THE SEA, MANKIND'S FUTURE

FOREWORD

Although the first decade of the 21st century has not quite elapsed, the outlines of two trends which will confront humanity can already be seen. The first is somewhat pessimistic, as shadows undeniably loom over the prosperity of current and future generations alike: climate change, programmed depletion of energy resources, threats to some food sources for humans, and so on. These realities are the challenges that the people of the 21st century will have to overcome if they want to foster the second, optimistic trend, which is the pathway of progress. The promises it holds and its outcomes are generally tied to the « quality of life ».

Now, the oceans could help to cope with some of these concerns. As we now know, the sea holds the key to climate change. A significant part of food resources for humans will depend on restoring and preserving fisheries stocks and developing aquaculture. The oceans contain mineral resources whose scope and potential are still debated, as well as being a living reservoir for new energy sources which could take over from fossil fuels. There also seems to be an incredibly vast realm of possibilities opened up by «blue biotechnologies «, uses for marine molecules, with an ever-growing list of potential fields of applications, like industry, health, cosmetics, agri-food and others. Finally, in terms of well-being, our fellow citizens are no longer content to simply breathe the brisk sea air, admire marine wildlife or enjoy a sail while on holiday. Indeed, more and more people are coming to the seaside both to live and to earn their livelihood there.

Ifremer in a changing world

Ifremer, the French research institute for exploitation of the sea, has designed its strategic plan with precisely these challenges in mind. It is one of the research institutes with the broadest range of skills and expertise worldwide. Underwater technologies, biodiversity, fisheries science and aquaculture, coastal environment, mineral resources, biotechnologies and operational oceanography are all part of its research missions and fields of skill and excellence. The strategic plan, while closely linked to preparing the contract that will bind Ifremer and the French State from 2009 to 2012, must also convey the much broader ambition of contributing to a nationwide marine research strategy. Four years is a very short time indeed, both for the stakes involving the sea and for the pace of numerous research programmes. So the strategic plan can shed light on stakes and challenge for the coming 10 to 15 years and measure their implications in terms of scientific priorities, cooperation strategies, as well as managing the Institute's resources, and first and foremost, its human resources.

Drafting this document has called on the collective intelligence of Ifremer and its partners. It reflects the discussions about the place that Ifremer should give in future programmes and projects to marine renewable energies, biodiversity, observing the consequences of climate change and the linkage between fisheries and aquaculture, to name a few. This work has drawn on outlook studies conducted jointly in France and Europe with many organisations over the past few years, as well as bilateral contacts established throughout 2008. The final selection presented is based on the integrated approach to marine sciences and technologies that has provided the Institute's structure for nearly a quarter of a century now. Indeed, while research is increasingly conducted through calls for

cross-disciplinary projects, both nationally and in Europe, the integrated approach is more relevant than ever.

In this document, some special Ifremer ambitions are stated. They are: to become a resource agency for the entire French ocean research fleet; further reinforce its strong points in the fields of coastal and high seas operational oceanography, exploring deep sea mineral resources; marine renewable energies, marine biodiversity, blue biotechnologies, sustainable fisheries and aquaculture, while seeking partnerships for excellence, particularly with Universities and clarifying its interventions with other establishments which are grouped within programme 187 of the LOLF finance law, as well as developing its European and international partnerships.

In order to rise to these ambitious challenges, Ifremer has also undertaken sweeping efforts in-house, including in managerial aspects. The entire institution will be certified ISO 9001 between now and 2012; accounts certified as of 2009; the number of scientific programmes and projects simplified and clarified; an identity charter established; and forecast-based management of jobs and skills broadened and professionalised. Those are a few of the powerful ideas shaping Ifremer's course. Thus strengthened, the Institute will provide its contribution to knowledge, protection, exploration and utilisation of the marine world. These are fields where France holds both excellence and high expectations, with the perspective of sustainable development now essential for everyone. By calling its plan the « Contribution to a national research strategy for marine sciences », Ifremer clearly displays its conviction that networking of the French marine science community is the only way to find responses on a par with the stakes.

THE SEA IN THE 21 ST CENTURY

The ocean, an environment with numerous specificities

Although the great navigators and conquerors provided a precise idea of the oceans' range, their conquest of the seas is far from complete today. From knowing the extent of the seas must follow knowledge about how they function and the life forms they hold. Exploring the marine environment, from surface to sea floor, in order to utilise it in compliance with the rules of sustainable development is the crux of the challenge for marine science. And yet, access to the sea remains a difficult proposition at times, requiring appropriate facilities to explore, discover and monitor the oceans. Special physics and strong hydrodynamics control the chemical, biogeochemical and biological cycles of the sea. Its dynamics have proved to be complex, heterogeneous, deep and stratified, while perpetually moving, to such an extent that well-adapted sampling strategies are needed to present an unbiased view of reality. This remains a unique geological environment whose active ridges are behind the geological formation of continents. Its deep-sea ecosystems are where life in the sea and on land originated. The countless species sheltered by the sea are quite difficult to study, due to their dynamics and migratory behaviours over both time and space. Thus, the marine environment must be studied at every scale, from local to global, in the frame of a comprehensive multidisciplinary approach to fill the gaps - so much greater than for environments on land - in knowledge about it.

Global strategic priorities

Both internationally and on the European scale, the ocean will be the focus of great attention in numerous research fields. Amongst these are: predictions for climate change and its impacts, operational oceanography, observation and operational monitoring of ecosystems, invasive species, combined anthropogenic impacts in the coastal zone, spatial planning tools for management, especially for the continental shelf and protected marine areas, and developing indicators, methods and models to ensure high quality, integrated advice.

A new research system and new societal expectations

Setting up these work study programmes will take place within a new context, firstly due to the various reforms which have been engaged for scientific research. In France, laws on research and that governing the independence of universities; generalisation of funding through calls for projects on regional, national or European levels; the creation of AERES and strengthening competitiveness clusters are all new givens that Ifremer must take on board. In addition, a new stakeholder in the form of the general public is now playing a preponderant role. People are increasingly aware of the importance of a healthy environment and the need to protect both biodiversity of and services rendered by marine ecosystems. They intend, more and more, to weigh in on the issues. Their worry on this score is also shared by the other stakeholders, seeing the almost unanimous scientific consensus on some subjects, like the speeding up of global change and its impacts (climate, sea level and acidification), or overfishing and over-harvesting of marine resources and the shortcomings of classic management methods for fisheries stocks.

THE IFREMER OF TOMORROW

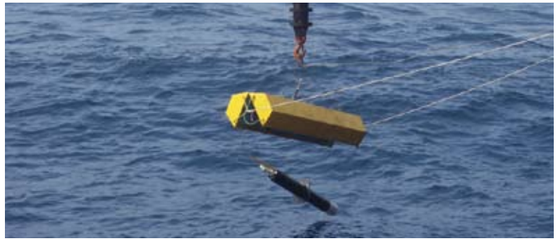
Ten structuring orientations for Ifremer for 2020

Thanks to its multidisciplinary nature and integrated approach to sustainable development, Ifremer has identified 10 structuring directions of action related to international strategic priorities. To develop these orientations which combine continuity and renewal, it must aim for excellence and develop the ability to work in partnerships on cross-cutting research themes. What these ten orientations have in common is that they require both research studies linked to the Institute's skills and and surveillance missions and the deployment of its technological resources. The ten orientations are to:

- learn about ocean circulation to supplement the diagnosis of global change,
- learn about and characterise marine biodiversity to better protect it,
- develop enhanced value and use of biological resources through biotechnologies and bio-prospection,
- contribute to sustainable fisheries and aquaculture,
- promote sustainable use of mineral and energy resources,
- supplement monitoring networks to meet global and European challenges,
- design a nationwide environmental forecast system for coastal environments
- optimise the oceanographic fleet as a major resource facility,
- implement a national and European strategy for marine databases,
- and promote shared capacity for technological innovation.

I / LEARN ABOUT OCEAN CIRCULATION TO SUPPLEMENT THE DIAGNOSIS OF GLOBAL CHANGE

Determine feedback between ocean circulation and climate change on different scales of time and space, including study of inshore-offshore exchanges.



Context and stakes

By demonstrating that current global warming is almost certainly related to human activity, the IPCC has ensured that the issue of climate change is on the agenda of the public's and decision-maker's concerns. In this frame, climate change underway in the physical, geochemical and biological compartments of the ocean must be observed and measured and the ocean's role in the terrestrial climate must be specified.

In addition, the coastal ocean is the site of numerous activities from fisheries and aquaculture to shipping and tourism. Some of these activities, like using renewable energy sources, will be developed, thus creating new needs for knowledge.

Others are related to risks that sometimes lead to accidents. Coastal regions are also those most vulnerable to global change, raising questions ranging from water management to the fate of contaminants. French organisations involved, and especially Ifremer, are behind the development of tools (PREVIMER, REDEO) based on observing and modelling the ocean.

Finally, satellite observation of oceans and ocean modelling at very high resolutions have opened up an entire realm of research by revealing the often systematic presence on the ocean surface of fronts and very small eddies, proving that variability is organised on small scales. And yet, these high-energy, small-scale phenomena have a significant influence on global matter and heat budgets in the ocean.

3 stakes have been identified:

- **participation in the international effort to diagnose climate change and understand the underlying mechanisms**
- **high resolution of the ocean, a theme for which Ifremer has developed novel expertise**
- **the coastal ocean and exchanges with the high sea, for which greater knowledge is needed, seeing the pressure exerted by uses**

Objectives and strategy

Maintain and secure lasting global observation networks

- **Extend measurement-taking capacity beyond depths of 2,000 metres, a zone for which documentation of ocean circulation is lacking.**

Since studying the climate requires acquiring long-term series, Ifremer will maintain its strategy of observing and understanding the variability of the ocean climate on a global scale, on the regional study sites already identified, in order to define indicators of climate change and contribute to the development of networks to monitor climate changes for the ocean. Research will focus on understanding the processes of ocean variability needed to determine trends related to anthropogenic forcing or unforeseen developments that can lead to sharp changes.

Coupling of biogeochemical cycles and the physical ocean, along with the retroactive effects on the climate system have become major research themes. Therefore, the Institute will contribute to setting up routine measurements of relevant biogeochemical parameters on Argo profiling floats to quantify climate change in these ocean compartments.

- **Contribute to the marine strand of studies to diagnose, attribute and determine the regional aspects of the effects of climate change.**
- **Improve understanding of exchanges between the coastal ocean and the high seas**

Analysing the long-term impact of climate change in the coastal zone, i.e. on small spatial scales, is a hardly-explored field in France and slated to grow significantly in coming years. Ifremer has already developed a strategy for the Mediterranean seafront and holds numerous assets to position itself as a knowledge integrator in this field.

- **Mastering ocean dynamics at very high resolutions**
- **Transferring knowledge acquired to operational oceanography systems**

Over the past few years, Ifremer has taken the lead role in observation and quantitative analysis of small spatial scales through partnerships with space agencies (CNES, ESA) in the field of observation and with JAMSTEC in the field of modelling. The Institute will strengthen the synergy between theoretical and numerical work, interpreting very high resolution satellite observations, developing instruments, deployments and analysing in situ measurements. By linking observations and the 3D properties of the ocean, Ifremer can address questions related to observation capacities for these phenomena, conditions for application and the observability of them, developing interpretation methods and numerical models and finally managing and sharing information. The main applications cover various fields, from local to climate levels, and will notably enable small- and medium-scale eddies to be studied. Inshore-offshore exchanges along with better knowledge about physical processes along the slope will provide realistic modelling and the needed coast to offshore continuity.

2/ LEARN ABOUT AND CHARACTERISE MARINE BIODIVERSITY TO BETTER PROTECT IT

Analyse and understand how marine and coastal ecosystems function, particularly in France

Context and stakes

The Millennium Ecosystem Assessment (MEA) describes biodiversity as the foundation for services rendered by nature, whether cultural, economic of environmental. And yet, today over 60% of ecological services are considered as degraded. Preserving ecosystems and sustainably managing resources, reducing the vectors of impacts and developing ecological engineering are the major issues on which the future well-being of humans will depend. The top-priority aims here for marine research are to contribute to understanding the role and functions provided by biodiversity, analyse the resiliency of ecosystems, develop capabilities to forecast its changes and better assess the services rendered.

The issue of maintaining all biodiversity and its sustainable use is a world priority set out in several international agreements (CBD), European policies (PCP, MES) and national strategies in France (SNB, Grenelle environmental summit). It is based on four orientations which can be applied to the marine environment:

- **characterising and assessing biological diversity through all its components (genetic, species and ecosystem-related)**
- **understanding its dynamics on different scales and forecasting its evolution, especially in the context of global change**
- **evaluating the ecological, economic and social impacts of the changes**
- **developing sustainable management practices for species and their habitats**

For Ifremer, the challenge also involves taking part in building a strategic vision for biodiversity to support public sector decision-making. French scientific expertise is under-represented in international organisations and this should be improved, notably in the framework of the International Mechanism of Scientific Expertise on Biodiversity (IMOSEB).

Objectives and strategy

- **Study how marine species adapt to global changes and the resiliency of marine ecosystems affected by human activities.**

Developing knowledge about functional biodiversity requires inter alia relying on species inventories using molecular biology techniques.

- **Develop research which focuses, depending on the approach, on « study sites » or « processes », through a multidisciplinary approach linked to a multi-institute coordination.**

The ecosystem-based approach, which consists in studying a given population on the basis of its interactions with other organisms, populations and species, is now recognised by both the scientific community and those responsible for managing these areas.

- **Model marine biodiversity in complex systems, including uses.**

Consistent, quality-controlled numerical models that are able to evolve should be developed. Within a cycle which is generally multidisciplinary in nature, they gather:

- computational codes and their numerical resolution,
- quantification and qualification of processes
- a series of terrain data which can calibrate and validate the results

- **Build a vital partnership with the MNHN, universities and OSU to draw up population inventories**

- **Contribute to setting up an inter-governmental mechanism of scientific expertise to protect deep sea biodiversity (in international waters), called IMOSEB**

- **Take part in facilitating the IPBES platform**

Setting up work based on marine and coastal biodiversity indicators to take knowledge and expertise forward on these themes will be essential. This could be done in several ways:

- **Draw up an inventory of existing indicators of biodiversity (task planned within the SINP portal context) and examine how indicators for non-exploited biodiversity could be developed**

- **Lead work on functional biodiversity indicators in order to link them to the MEA list of ecosystem-based services, i.e. 23 services grouped into 4 categories**

- **Participate in developing indicators from landscape ecology, in order to enable information about landscape structure and the functioning of marine and coastal ecosystems to be linked**

- **Seek the best use of the marine food web index as an indicator of functional biodiversity offering a dynamic image of interactions between society and nature**

- **Create linkages between indicators of biological diversity and simulation models which can test scenarios, make indicators dynamic and perform prospective analyses**

- **Contribute to developing biodiversity monitoring networks based on partnerships with users of this biodiversity**

3/ DEVELOP ENHANCED USE OF BIOLOGICAL RESOURCES

Collect, isolate and characterise marine microorganisms. Improve enhancement of the entire exploited marine biomass, particularly by-products. Develop innovative research to meet the requirements of various industrial sectors

Context and stakes

The marine environment represents 70% of the biosphere but only 300,000 species out of the 1.8 million inventoried on Earth, with their total number being estimated at 10 to 100 million. This unexplored and unexploited resource could be the main source of new molecules in coming decades. Already, more than 5,000 molecules used in pharmacology come from the marine environment. In particular, the need to find new drugs and high performance production systems provides real opportunities for R&D. This is all the more true in that solutions from biotechnologies meet several major challenges for the future:

- Raw materials and fossil fuels are becoming increasingly rare and costly: marine plant biomasses produced by photosynthesis could be a solution to produce energy of raw materials for industry (fine chemistry, pharmaceuticals).
- **the requirement to reduce energy consumption and greenhouse gas emissions from industrial processes: microalgae could help in CO2 sequestration and some enzymes could supply catalytic biosynthesis solutions to replace current chemical processes used.**
- **environmental compliance by treating pollution from land, sea or industry.**
- **legislative trends for chemical products (European REACH directive), setting the target of 20 to 30% of natural products to be used in industry by 2030. The proportion of biodegradable polymers from biotechnologies could thus reach from 15 to 20% of the world market currently using petrochemical polymers in the next few decades.**
- **increasingly rare marine resources, in general, and food resources in particular, justifying the need for more enhanced use of all caught and harvested biomass.**

Ultimately, less than 50% of commercially used marine species are directly used by humans, the rest often wrongly considered as waste or by-products and should be turned into valuable, usable forms.

This makes sustainable using and managing marine resources, while respecting biodiversity, a true global challenge.

Objectives and strategy

Ifremer has a relatively unique specificity, giving it access to and availability of marine strains. It possesses the means for exploration and conservation of microorganisms, and has developed matchless controlled culture know-how. This expertise positions it ideally to deal with species not yet cultivated, in terms of process and genomics alike. The Institute is thus well situated to explore non-culturable fractions using metagenomics. Specific skills and know-how are mainly focused on biopolymers, enzymes, peptides (especially antimicrobial) and on bioconversion of marine resources. The Institute has also succeeded in attracting a number of partners involved in converting biomass into products of interest using biotechnologies. The next task is to reach a level of consistent coherency through active facilitation of the biotechnology orientation.

The following objectives for each field have been set:

Bioprospecting

- support existing microorganism collections and extend them to other non-hydrothermal marine microorganisms
- isolate and cultivate species considered as impossible to cultivate until now, based on outputs from metagenomics
- set up a systematic harvesting procedure for ocean research cruises

Molecular biodiversity

Set up ways and means to contribute and respond to new requirements and challenges for new molecules targeting human and animal health applications in particular, by creating or adding to chemical compound libraries

Environment

Focus special attention on microorganisms and their related biomolecules, in the frame of environmental biotechnology applications (bioremediation, bioproducts, bioprocesses, REACH directive, etc.)

Bioconversion

Perfect, develop and transfer biotechnological conversion solutions (called bioprocesses) in order to maximise resource exploitation in the context of sustainability

Biotechnology for microalgae

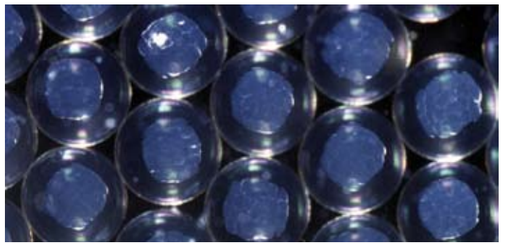
Pursue and extend the research engaged which targets the use of broad biotechnological potential. There are several pathways for energy recovery applicable for plant biomass from microalgae which could, like terrestrial plants, produce hydrogen, be converted into biogas by methanisation processes or supply oils which could be transformed into biodiesel fuel. The very large investments recently made by industry should help a mass energy production supply chain to emerge

International expertise

Develop scientific expertise and joint R&D work to participate in international exchanges on future regulations related to protection and sustainable use of the sea and its resources

4/ CONTRIBUTE TO SUSTAINABLE FISHERIES AND AQUACULTURE

Enable ×sheries and aquaculture to sustainably provide a healthy food supply while meeting new challenges for the state of resources, rising energy prices, pro×tability for companies and protection of habitats



Context and stakes

According to FAO outlooks for 2020-2030, aquaculture and fisheries could provide an almost equal share of the 130 to 150 million tonnes of products yearly intended for human consumption, compared to 108 in 2005. However, maintaining or even increasing the availability of bioaquatic products for human food requires both a sustainable management system for fishery resources and sustainable growth of aquaculture production: this is a major stake for marine research applications. Fisheries and aquaculture must cope with the same constraints, such as impacts on ecosystems and biodiversity, effects of climate change, along with growing globalisation of trade in products from the sea, but also specific difficulties, especially overfishing in European waters and conflicts of use between aquaculture developments and other activities already concentrated along the coast. In other words, the actual viability of marine fisheries and mariculture, whose futures are intrinsically linked, is at stake.

Objectives and strategy

Apply the ecosystem-based approach to fisheries and aquaculture enterprises

This central principle is based on 4 general trends:

- subject the operational short-term to long-term strategic planning
- combine risk analysis with a precautionary approach
- associate representation of citizens with traditional stakeholders in fisheries and aquaculture (administration, profession, research)
- consider sustainable production of foods from the sea as a contribution to sustainable development in general

Closer and improved relations between scientists and professionals also remain a constant objective: this is why Ifremer has signed a number of charters, amongst them one with CNPMEM and DPMA in 2004 and one with CNC in 2006. The RECOPESCA and OPTIPECHE-Competitiveness cluster projects are another illustration of this.

To meet these aims, maintaining some priorities in research and expertise will be needed, along with implementing new strategies.

Orientations for research and expertise to be maintained

In research, Ifremer will pursue its strategy to improve collection, observation methods using research vessels, data management and tools to model fished stock dynamics by combining them with an economic approach. It will keep up its long-term observation series for fished populations, ecosystems and their uses, including a few « benchmark series ». In particular, studies on individual tagging will receive investment support.

The Institute will develop new methods for data processing, experimentation, analysis, modelling and diagnosis of ecosystems' health. It will also improve its ability to anticipate crises affecting the shellfish farming sector and pursue research efforts on how to get out of crisis situations. Research on farmed species pathology will be pursued, especially for molluscs and shrimp, focusing efforts on knowledge about pathogenic organisms and their interactions with the host and the environment, as well as on genetic selection. This will be done working closely with professionals. The same approach will be applied to improving quality of seafood and developing sustainability indicators, as already seen in the European ECASA contract. Ifremer will also continue its provision of expert appraisals for regional, national and European public authorities.

New strategies

Ifremer will devote itself to growing the knowledge about the biology and ecology of populations targeted by fisheries and/or domesticated by aquaculture, through innovative methods like molecular biology. This will essentially involve determining the ecological footprint of fisheries and aquaculture, by identifying the « driving » processes of their dynamics and turning fish-farming research towards concepts of ecological intensification which combine criteria of both quantity and quality of yields. It will also seek better understanding of how they function and assess the performances and capacity for change of governance systems for fisheries and aquaculture.

In a strategic approach, the Institute will develop its expertise potential in new fields:

- MPAs and artificial reefs
- energy saving
- spatial planning for aquaculture (accessibility to public maritime domain)
- new technologies (ISO standards for aquaculture infrastructures, offshore, etc.)
- integrated bio-economic advice.

5/ PROMOTE SUSTAINABLE USE OF MINERAL AND ENERGY RESOURCES

Explore the deep sea to establish conditions for better raw material supplies from deep marine resources, as well as exploiting new resources (hydrogen, methane, oil and gas, gas hydrate and metals). Determine the impact on marine ecosystems. Contribute to developing marine renewable energy sources

Context and stakes

In the next 20 years, energy supplies will have to meet growing demand and cope with the long term drop in fossil fuel productions and the need to reduce environmental impacts for effects on the climate. The wealth of resources in the ocean deep, covering 60% of the planet (at depths greater than 2000 m), could become a crucial source for future world requirements for energy and raw materials.

Marine energy resources are being explored and some greatly exploited, such as oil, while other resources like hydrates and hydrogen are still being estimated and processes to exploit them and make them part of an energy supply chain still being developed. Different time frames to start up production must be considered, to authorise short-term or long-term research studies. In addition, scientific exploration of the deep seafloor over the past thirty years has identified several geological and geochemical processes leading to concentrations of metals, particularly those giving rise to polymetallic nodules, cobalt crusts and hydrothermal sulphides, as well as the beginning of novel potential energy resources, in this case, methane hydrates and hydrogen. These discoveries open new frontiers for finding and identifying mineral and energy resources in the oceans.

There are four types of stakes:

Scientific

Raw material supplies require taking an inventory of potential sources for a start. Making progress in scientific knowledge about the type and way these resources are formed is fundamental for any industrial exploitation and to confirm their viability. This particularly concerns hydrogen, methane, hard-to-access oil and gas, and metals.

Technological

Progress is expected in developing technologies for efficient exploration, production, extraction and transport that are adapted to the specific deep sea situations, without neglecting their environmental impact.

Geopolitical and economic

Access to mineral raw materials is creating growing international competition. Following the lead of Russia, Japan, the United States and China, France and Europe will have to define a strategy in this field and secure their supplies.

Legal

Faced with the rapid development of demand for mineral raw materials, as well as growing interest from industry, the ISA is currently examining how to legislate in international waters.

Objectives and strategy

Develop knowledge / deep sea exploration

Multidisciplinary cruises in marine geosciences and deep sea biology should be organised on targeted study sites. Ifremer must endeavour to develop knowledge on specific geological objects related to various types of mineral and energy resources, with the accent on rock or sediment fluid interactions. It must help discover new resources and establish their interest for industry while taking account of the importance of the ecosystem-based approach for their sustainable use. Knowledge about reservoir equivalents must be improved through sedimentology. Finally, the need to develop strategic partnerships is obvious, both with academia (UMR, GDR) and with industry, particularly by setting up a GDR research grouping in marine sedimentology.

Select geographical study sites with respect to the stakes;

develop tools for exploration and observation; deploy seabed observatories (ESONET, EMSO); improve production systems, in collaboration with industrial firms; assess the impact of exploiting resources (oil and mining)

Develop marine renewable energy sources:
offshore wind, tidal and wave power, thermal energy and its derivatives (air conditioning), salinity gradient and biomass (microalgae, see orientation 3).

There are significant offshore wind, wave and current energy resources along European coasts.

The marine renewable energy potential in overseas France should also be taken into account, particularly in view of the specificities for power supplies on islands. From March 2007 to March 2008, Ifremer conducted a prospective study on marine renewable energy sources for the year 2030, carried out with industrial firms. Research

issues were identified with regard to the various technological supply chains. They recommend:

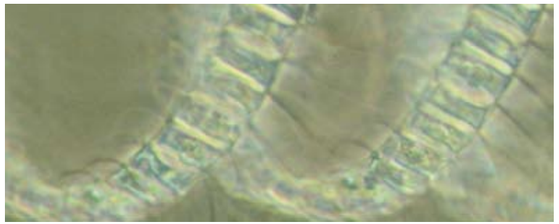
- supporting technological development by industrial designers, depending on partnerships

- contributing to better knowledge about exploitable energy resources

- developing studies to assess environmental and socio-economic impacts.

6/ SUPPLEMENT MONITORING NETWORKS TO MEET GLOBAL AND EUROPEAN CHALLENGES

Run high-performance national monitoring networks at sea and in coastal or inshore waters to best comply with environmental, ×sheries and animal health regulations, to support public policies and apply European directives. Develop innovative research to support monitoring so that regulatory changes can be foreseen and acted on



Context and stakes

France must set up increasingly complex surveillance networks, both within the frame of international agreements signed and implementation of its European directives commitments. The objectives pursued are those of European policies for water (WFD), coastal and offshore ecosystems (MES), fisheries (CFP), the environment, health safety and aquaculture and agreements for regional seas (OSPAR, Barcelona Convention). These actions are highly operational in nature and give rise to yearly summaries and advice to back up public policies. Their aim is to characterise ecosystems' status and resources in order to make the way they are exploited more viable and restore their condition and uses.

Monitoring networks are considered as « public interest services » and today they count the ROCCH (national observation network for chemical contaminants, REBENT (benthic biocenoses monitoring network), REPHY (monitoring network for phytoplankton and phycotoxins), REMI (microbiological inspection network for shellfish farming areas), REPAMO (mollusc pathology network) and the SIH (monitoring network for fisheries resources and their uses).

However, all these networks also have research issues which are sometimes directly raised by their implementation. Thus, the following parameters must be taken into account:

- quality requirements at every step of monitoring and expert assessment, which will require accreditation of Ifremer's laboratories, as well as those of outsourced subcontractors and partners

- change in the geographical range and scope of networks, since the zones they cover have generally been extended

- increased number of principals, making coordination more difficult

Also, in the frame of research-monitoring-expertise continuity, maintaining high research potential associated with a partnership for excellence will be needed. This will provide support both in metropolitan and overseas France for the quality and performance of monitoring networks and the related expert appraisals, to improve research and surveillance methods (chemical detection of phytoplankton toxins, forecasting phytoplankton blooms, ecotoxicology, impacts, developing titration methods, recourse to molecular biology, and so on). It will lead to new high-throughput automated systems to monitor environmental quality and resources. Finally, it should enable new regulations to be anticipated, by taking part in European expert committees and contributing new know-how acquired through research.

Objectives and strategy

As regards natural hazards and anthropogenic risks, the multidisciplinary approach developed at Ifremer, enabling the Institute to provide help in analyses and sometimes assessments, is a guiding principle to be strengthened with respect to the targets for risks that are:

- microbiological
- chemical
- phytoplankton-related (toxic)
- geological (quakes, underwater landslides, tsunamis)

To maintain the standardised monitoring arrays and adapt them to new regulatory stakes and quality requirements, Ifremer, whose calling is to run and take part in monitoring systems for marine and coastal waters and ecosystems, must implement the following actions:

- **outsource routine tasks more systematically and redeploy efforts on tasks with higher added value (databasing, long-term series and research)**

- **develop a a general monitoring strategy which includes offshore and coastal areas**

- **invest in developing new sensors and in automating data to obtain new productivity gains**

- **develop research in viral microbiology and phytoplankton toxins to find new diagnostic methods**

- **use operational oceanography data supplied by satellite and airborne observations, high frequency automated measurement buoys and numerical models**

- **optimise and better valorise fleet use by conducting more integrated scientific cruises in the fisheries and MES ecosystem-based approach**

- **efficiently pursue work on information systems, which is one of Ifremer's solid skill sets recognised in both France and Europe.**

7/ DESIGN A NATIONWIDE ENVIRONMENTAL FORECASTING SYSTEM FOR COASTAL ENVIRONMENTS

Develop diagnostic and forecasting systems for anthropogenic impacts to foresee changes in ecosystems and the way they are exploited, to promote monitoring and help manage crises affecting different users of the maritime environment

Context and stakes

Over the past ten years, the feasibility of operational oceanography to describe the physical state of the ocean has been demonstrated, whether on global, regional or coastal scales. Its applications can be on institutional or private-sector levels, like:

- accidental pollution (monitoring and predicting drift of slicks)
- maritime safety and transport (search and rescue and predicting the drift of objects)
- weather forecasts and predicting extreme events (cyclones, etc.)
- seasonal and climate forecasts
- coupling to biogeochemical modelling and fisheries resource management
- naval oceanography (acoustic propagation and underwater visibility)
- offshore applications (oil, routing and laying underwater cables)
- research (studies on processes, the ocean climate and on optimising ocean research cruises)

As regards coastal operational oceanography more specifically the stakes are the same, with the addition of environmental monitoring in both biological and health terms, as well as managing the impacts of climate change and responding to the general public's need for information. Economic activities along shore areas also potentially use services from operational oceanography. This is the case for aquaculture, fisheries, shipping, offshore installations, marine renewable energies, water sports and leisure activities and active management of waters used for bathing, recreation and aquaculture. The forecasting aspect which should enable authorities to foresee crises, particularly those involving microbiological health issues and toxic algal blooms should also be added.

The main stakes for coastal operational oceanography are:

- setting up a nationwide operational system for coastal areas on the three seafronts of metropolitan France, which should extend to the shore and take catchment basins into account

- supporting MES and public policies

- linkage with monitoring activities

The ideal system, which should rely on a high seas system set up in an EU framework (KOPERNIKUS), must be able to supply accurate, qualified and consistent data, - i.e. on the past, present and future status, over periods from a few days to a few weeks - for physical, biogeochemical and ecosystem states.

Objectives and strategy

Setting up this type of coastal environmental forecasting systems will rely on the following implementations:

- **Continuing to define the economic model for operational oceanography and the organisation of basic services for coastal and high seas operational oceanography, in national (REDEO, Mercator-Ocean, marine competitiveness cluster) and European (KOPERNIKUS) frames.**

- **Set up in situ measurement systems required for operational coastal oceanography and take part in defining new means for observation (satellite and on-site)**

Partnerships should be set up to intensify and streamline coastal zone measurements for operational and research purposes.

- **Continue to demonstrate the complementarity between monitoring, alerts and operational oceanography**

- **Work with the ministries concerned to define a strategy where operational coastal oceanography supports MES**

The « mission-based » approach for pre-operational environmental forecasting should be complemented by a value enhancement approach in keeping with Ifremer's role to support development of the economic sector.

- **Develop research on identified topics:**

  - models, in order to realistically reproduce physical and above all biological processes
  - ability to simulate forcings and then true couplings
  - developing data assimilation methods to improve predictions, supply each type of prediction or analysis with error estimations

A few permanent pilot sites will be needed, particularly where crucial needs arising from satellite, numerical and coastal fields merge. They could have extensive instrumentation (especially ocean-meteorology) since they meet a joint demand and could be more efficiently valorised. Finally, the coastal observation system must be capable of deploying remote measurement systems that can be relocated and easily deployed in crisis situations.

8/ OPTIMISE THE OCEANOGRAPHIC FLEET AS A MAJOR RESEARCH INFRASTRUCTURE

Manage and deploy the French ocean research fleet, underwater vehicles and the associated instruments, and develop technological research to keep these facilities competitive with those in the world class

Context and stakes

The decree that led to Ifremer's creation made it responsible for « creating and managing major facilities of general interest ». Ifremer currently owns 4 blue water vessels, 4 inshore vessels, 2 deep sea underwater systems and numerous other facilities including seismic equipment and two AUVs (see p. 5). Taken together, their replacement cost exceeds 370 million euros and annual running costs surpass 30 million euros. In addition, Ifremer has access to the French Navy's hydrographic vessel Beautemps-Beaupré through a partnership agreement signed with the Ministry of Defence. Ifremer is not alone in carrying out this mission as a resource agency; other French stakeholders include the SHOM (for the ministry of Defence), IPEV and IRD for high seas vessels, INSU and CEMAGREF for coastal vessels.

A high quality fleet and facilities are vital for research that attains excellence. This means maintaining fleet performance and capabilities along with the means to adapt to future requirements, particularly as concerns those described above. They are: studying retroactions between ocean circulation: and climate change (orientation 1); developing the ecosystem-based approach to fisheries (orientation 4); deep sea exploration (orientation 5); surveillance of slope-related, seismic, volcanic and tsunamis hazards (orientation 5, amongst others); establishing habitat mapping and an atlas of continental seas (orientations 1 and 4); monitoring inshore and coastal zones with the perspective of implementing the EU strategy for the marine environment (orientation 7).

To meet these research objectives, Ifremer will have to cope with a number of needs and difficulties, beginning with financing fleet operation, due in particular to high fuel costs and the fact that scientific cruises are not covered by either the EU or the ANR, meaning that carrying out remote cruises will remain difficult to schedule. Moreover, the need is clear to renew its capabilities, particularly in upgrading ageing coastal and regional fleets within the context of an ecosystem-based approach to the coast and to continental shelves, as well as the need to adapt to new requirements generated by the Marine environmental strategy. This must take the need for technological innovation into account, especially so that new generations of autonomous vehicles, including deep sea AUVs and new multi-vector deployment modes, based on the CETSM structure can be perfected. Finally, the Institute will have to define new and more relevant indicators for the fleet, in terms of both measuring its scientific performance and its economics. These will be suggested to foreign partners in a comprehensive approach enabling the inter-comparison of the scientific services rendered, which is useful for carrying out scientific cooperation projects.

Objectives and strategy

Therefore, to maintain and adjust the national ocean research fleet to the demand and to the French scientific community's requirements, Ifremer proposes:

- **Setting up a new economic model for the fleet**

It should be defined in keeping with the new project-based funding for research, especially through seeking co-financing from public- or private-sector sources.

- **Pursuing the technological research effort for fleet and vehicles**

Here the objective is to maintain this national infrastructure's recognised world-class standing for excellence, as a European leader in the field.

- **Forming groupings with other coastal fleet managers**

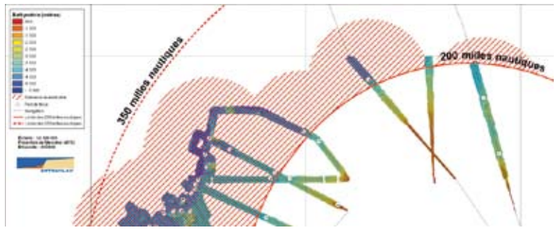
Ifremer's calling is to manage the entire French ocean-going fleet. Therefore, creating such a grouping should be examined whenever it can provide economies of scale.

- **Building partnerships and synergy with European fleet managers, in an approach to be defined, to be able to intervene in every ocean**

The infrastructures required to carry out research programmes are particularly costly and sophisticated for marine sciences. That explains why many initiatives have appeared in recent years to create infrastructures which are managed on a European level. Amongst them is the four-year Eurofleets programme, coordinated notably by Ifremer and slated to begin in January 2009. It will enable some complementary fleets to work closely, on the basis of interoperability criteria, as well as promote an EEIG type European organisation.

9/ IMPLEMENT A NATIONAL AND EUROPEAN STRATEGY FOR MARINE DATABASES

Save, manage and ensure the permanence of marine and coastal data in databases made available to all users in order to support public decision-making, research and EEZ management and comply with European directives



Context and stakes

Ifremer, working with its supervisory ministries and main partners (SHOM, INSU, BRGM, CNES, IRD) has developed databases in the fields of hydrology, geosciences, marine environment, fisheries and biology. Some data are used by the French, European and international scientific communities and by the ministries that Ifremer reports to, to draw up three national information systems on water, fisheries and natural environments. They are also used for purposes of international agreements where France has commitments, as well as by an increasingly broad number of users and public-sector operators like regional services or agencies and by private-sector operators, including the general public.

Its role is to back up and catalogue the data with significant heritage value, reference them and management them to ensure availability and dissemination, through dedicated portals, while complying with national and international directives and standards for formatting and quality in the field.

These databases have steadily evolved towards this heritage-based vision, to support public decisions and serve public and private sector users. They must also cope with a triple evolution:

- a standard-setting evolution imposed by European directives (DCR, WFD, MES) and national requirements (Geoportal and national information systems: SIEau, SINP and SIPA)

- a technological evolution given impetus by the INSPIRE directive, quality standards(ITIL, ISO 19115 and ISO 20000 standards) and development of management tools and communications networks. The developments for standardisation, as well as evolving State services, whether they are centralised (DGME) or decentralised (MIMEL) and creation of agencies (ANR) provide strong impetus for moving towards an increased range of services

- an IT evolution related to the size and scope of the large amounts of satellite data to be processed

Objectives and strategy

Today, databases are truly strategic resources, like other major facilities and high-performance computers. The main objective is their integration in systems that will provide global and ranked access to all data for the marine environment, along with ensuring full interoperability between all databases thanks to a single « ocean portal » and building services based on availability, continuity, quality and service commitment. Further development of the quality indicators will improve assessment of database and information system performances.

With facilities located along all French coasts, offshore means of intervention and experience in managing similar projects like EXTRAPLAC, SEXTANT, Quadrige2 and BIOCEAN, Ifremer is a legitimate actor in meeting these objectives, providing that financial means are set up to achieve them. Indeed, the Institute ensured both scientific and technical management of the EXTRAPLAC in association with SHOM, IFP and IPEV. In addition, it developed an integrated strategy for biodiversity and habitat mapping, from technological development to databasing of information and producing global reference cartography. The EMODNET initiative proposed by the MES directive aims to build the future European marine data network and eventually have it recognised as the European « World Data Center » of the UNESCO Intergovernmental Oceanographic Commission. This gives Ifremer, as the SeaDataNet project coordinator, and all its partners, de facto, a special position and responsibility in developing it.

The ambitions for coordination and interoperability of marine databases will be built on the following grounds:

- **Inter-organisational cartography with a shared vision, where the respective responsibilities of each body are specified, leading to development of a national data management policy**

- **Creating « networks of national information systems », like SeaDataNet, and developing joint outputs with high added value**

- **Developing service tool kits to satisfy database users' needs, and their products derived from them, in particular for compliance with European directive requirements**

- **Building a partnership for the national programme on the continental shelf, in the form of a multi-annual initiative (SHOM, BRGM, IRD, INSU, Universities-Ifremer) under the aegis of the relevant ministries**

- **Databasing of biodiversity inventories, which will have to deal with constraints of interoperability with global initiatives.**

This will be the foundation for cooperation with the AAMP agency for marine protected areas, in order to develop operational tools to exploit these data in scorecards for managers

- **The joint objective of strengthening France's position in the European and international alliance**

10/ PROMOTE SHARED CAPABILITY FOR INNOVATION

Integrate leading edge technologies in measurement systems serving oceanographic research and use of resources. Use our testing and quali×cation facilities as tools for inter-organisational cooperation and enhancing their economic value-building

Context and stakes

Although underwater technologies were initially developed in great part for military applications, as was the case for sonar, then for oil exploration (revolutionising 3D seismics), scientific discoveries from public-sector research have always been linked to technological progress and this is especially true in oceanography. Requirements for observations, measurements and monitored are ever-increasingly in need of greater accuracy, reliability, durability and quality. At sea, defective design or lack of reliability often entails an outright loss, if not of the equipment, at least of the cruise. Whence the importance of testing and qualification facilities that are adapted to the specificities of the marine environment. In France, most of them are managed by Ifremer and their developments must keep up with technological research needs.

In the modern context of knowledge about the deep sea, France has been one of the forerunners, first with CNEXO and then Ifremer, along with the United States, the USSR and Japan. The technological advance this afforded France led to world firsts in realm of science, like the submersibles Nautile and Épaulard (the first AUV) and to global recognition in oceanographic technologies. Ifremer plays a special role, thanks in particular to true synergy between research and technology, along with strong, cross-cutting participation in technology to support scientific and monitoring programmes, as well as close relations with socio-economic sectors. In addition, acting as a resource operator has made it a driver for technological progress, to meet the needs of the national scientific community.

Issues of engineering sciences play a key role in applying these advances to the marine environment. Ifremer is a leader in some disciplines, such as resistance to external pressure, resistance of materials to corrosion and biofouling, seismics and underwater acoustics. In terms of naval technology, Ifremer has developed prime contracting capabilities, particularly for vessel and vehicle system architecture and technological capabilities in the fields of materials, hydrodynamics, acoustics, optics, electrical engineering and electronics) to support both its own projects and industrial requirements.

All national and international forward studies have emphasised the need to develop means of observation and measurement that increasingly rely on multidisciplinary skills, ranging from sensors to data, including database storage and techniques. Concurrently, quality assurance demands have extended to the research sector, making it necessary to implement formalised systems of certification or accreditation to make qualification and testing activity secure. Finally, metrological activities will grow, particularly with respect to the WFD, and will have to be better taken into account at Ifremer. This means fitting out laboratories and reviewing how tasks involving several organisations are structured.

Objectives and strategy

The challenges for Ifremer concern the following:

▸ Sensors

New leads, to be developed in partnership with University laboratories, engineering schools and research institutes like CNRS, CEA or SHOM centre on:

- the crucial need to develop sensors to detect biological material, even at trace levels (microalgae, pathogenic organisms)

- developing appropriate, self-calibrating methods and technologies (optics, acoustics, etc.) to measure in situ physical-chemical parameters in seawater, to supplement and, if possible, replace sampling techniques

- pooling of multidisciplinary expertise (biology, physics, chemistry, nanotechnologies, etc.) to design sensors that can interpret on the interfaces between biology and inert environments

▸ Data transmission and management systems

These systems must make it possible to access data in the shortest possible time following measurements, including those acquired by vessels and sent to scientific teams on shore.

▸ Measurement chains or instrument systems

The generic challenges and breakthroughs for instrument systems lie in:

- making them more compact and reducing energy consumption and complete recovery costs

- deploying new communications systems and developing « local intelligence » of sensors to facilitate their integration on a range of media

- improving autonomy and resistance to biofouling

▸ Trial bases at sea

Bases for sea trials managed in the framework of regional cooperation are being considered or studied, so that instruments like drones and large scale or full size subsea observatories can be developed over long periods.

▸ Exclusive fine-tuning tools to be upgraded

Some « conventional » qualification means for hydrodynamic and pressure testing, for instance, have performances that are unique in Europe, like the pressure chambers and the circulation tunnel in Boulogne. They remain essential facilities to qualify and secure shipborne equipment. Maintaining these sets of facilities will require renewal of their oldest components, particularly the 1000-bar pressure chamber in Brest, and upgrade their measurement environment with respect to the complexity of systems and devices tested.

FOR NETWORKING OF MARINE SCIENCES

To meet the objectives set, in the frame of these 10 structuring orientations, Ifremer will have to act on two fronts, one of them external, in the framework of better adjusted partnerships and the other in-house, on its own premises and within its own human resources.

Building a strategic partnership with universities and research institutions

The Institute intends to implement local, metropolitan France, European and international partnerships on the regional level and beyond. Some orientations will be given priority, like strengthening links between Ifremer and French universities, whether local or world-class metropolitan; using structuring and visible tools like UMR and GDR research units and groups, building the capacity to host French, European and non-EU students, and working in collaboration B2C3I members, mainly on fisheries and environmental issues. They have all undertaken, through an agreement signed in January 2005, to promote a drive for cooperation in each Overseas French region, enabling joint projects to emerge within clusters of excellence which have been developed on the basis of complementarity of member organisations. This also means making research in overseas entities a core focus of the ERA, through involvement in European programmes.

Cooperating with major stakeholders in developed countries and strengthening our action in the Mediterranean

Some research activities can only be conducted on a global scale, and that is especially true in the fields of oceanography and climate, geosciences and fisheries. Thus, they are carried out in frame of international programmes, of which Ifremer co-supports some of the international secretariats (WCRP, GLOBEC, IMBER, KOPERNIKUS, ICES, etc.). Seeing the global scale of some questions, the similarity of types of problems to solve and the scientific and technological complexity of the issues, Ifremer must extend its range of cooperation both towards countries with technical and scientific capacities which are equal to or better than those of France and towards countries which could be customers for our expertise, like the United States, Canada, Japan, China and Russia.

Ifremer's international actions fall under 3 main categories today:

- **participation in major international programmes**
- **scientific partnerships with major stakeholders in developed countries**
- **work done to support development, but selectively and focusing particularly on the Mediterranean**

Take part in building the European marine research area

Progressively setting up an Integrated Maritime Policy will produce direct and indirect effects on Ifremer's work and studies, respectively with the proposal of a European marine and maritime research strategy and with the implementation of new obligations, as well as controlling economic development. The same will be true for the ERA, which will progressively establish the orientation of national research in the frame of joint programming, with a greater role for excellence clusters. In this context of the European area now being constructed, the main challenge for Ifremer will reside in its commitment to structuring marine research in Europe, aiming for greater complementarity and less overlap and duplication in research efforts undertaken by the Member States. Therefore, the Institute must aim to ensure a directing role in targeted fields, broken down with respect to its three founding missions:

- **Scientific research**

A skilful combination of national and European priorities will have to be set up in order to coordinate large-scale European projects or even multinational programmes or those of dedicated pan-European entities, with a strong national partnership.

- **Environmental monitoring and product quality**

In a context where public expertise to serve society is moving onto a European level and transcending national divisions, the issue will be to calibrate, compare, harmonise and then select our methodologies, to promote them to similar organisations in Europe with the aim of helping a unified monitoring system which includes a maximal amount of French know-how, come into being.

- **Major facilities**

To keep world-class, operational infrastructures in the general context of rising costs, it will be up to Ifremer to take part in structuring shared infrastructures on a European scale, support streamlining and specialisation of some major facilities and dedicated infrastructures and ensure their running and coordination in Europe.

In-house organisation serving the strategy

Internal evolutions will also take place in the Institute. Efforts will be made to modernise financial management. Its ambitions and values must be more clearly displayed. For these purposes, a culture of valorisation, i.e. enhancing the value, utility and re-utilisation of what we produce, will be developed and made more professional. A proactive valorisation strategy organised like a true industrial process will be implemented, so that Ifremer will be a partner of reference for industrial firms. In terms of human resources, the Institute is already working to develop mobility between institutions and better acknowledge individual and collective performance, to promote and improve professional development, forecast-based job and skill management, hosting and mobility of researchers in Europe and worldwide. Another aim will be to improve recognition of both individual and collective performance, including non-monetary performance and expertise. Finally, the quality of social dialogue at Ifremer will provide the basis to foster cohesion and accompany changes at the Institute. Ifremer will also have to appropriate the best practices of scientific assessment, and lastly, pursue the approach to broader bases of communications which has begun. This will focus on 4 fields of priority action: raising awareness about marine science stakes; raising the Institute's visibility; better explaining what Ifremer is and does and finally, making the Institute's identity a shared one.

GLOSSAIRE

AAMP: Agence des aires marines protégées
AAMP: Agency for marine protected areas
AERES: Agency for evaluation of research and higher education
ANR: French national research agency
AUV: Autonomous Underwater Vehicle
B2C3I: Inter-organisation committee for French tropical overseas entities (grouping the organisations concerned by the LOLF)
BIOCEAN: Deep sea environment benthic ecology database
BRGM: geological and mining survey office
CBD: Convention on Biological Diversity
CEA: French atomic energy commission
CEMAGREF: National agricultural and environmental engineering research institution
CETSM: European centre for underwater technology
CFP: Common fisheries policy
CIRAD: centre for international cooperation in agricultural research for development
CNC: National shellfish-farming committee
CNES: National space research centre
CNEXO: National centre for ocean exploitation
CNPMEM: National committee of maritime fisheries and mariculture
CNRS: National centre for scientific research
DGME: General directorate for modernisation of the French State
DPM: Maritime public domain (state-owned)
DPMA: maritime fisheries and aquaculture directorate
ECASA: Ecosystem Approach for Sustainable Aquaculture
EEIG: European Economic Interest Group
EEZ: Exclusive economic zone
EMODNET: European Marine Observation and Data Network
EMSO: European Multidisciplinary Seas Observation
EPIC: State-funded industrial and commercial establishment
ERA: European Research Area
ESA: European Space Agency
ESONET: European Seas Observation Network
EU: European Union
EXTRAPLAC: French Continental shelf extension program
FAO: Food and Agriculture Organization of the United Nations
FIS: Fisheries information system
GDR: Research group
GEOSTAR: Geophysical and Oceanographic Station for Abyssal Research
GLOBEC: Global Ocean Ecosystem Dynamics
ICES: International Council for the Exploration of the Sea
IFP: French petroleum institute
Ifremer: French research institute for exploitation of the sea
IMBER: Integrated Marine Biogeochemistry and Ecosystem Research
IMOSEB: International Mechanism Of Scientific Expertise on Biodiversity
INSU: National institute for sciences of the universe
IOC: UNESCO Intergovernmental Oceanographic Commission
IPBES: Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
IPCC: Intergovernmental Panel on Climate Change
IPEV: Paul-Emile-Victor polar institute
IRD: French research institute for development
ISA: International Seabed Authority
ISO: International Organization for Standardization
ITIL: Information Technology Infrastructure Library
JAMSTEC: Japan Agency for Marine-Earth Science and Technology
LOLF: Institutional law on public finances, whose programme 187 is implemented by INRA, IRD, CEMAGREF, BRGM, CIRAD and Ifremer
MAP: French ministry of agriculture and fisheries
MEA: Millennium Ecosystem Assessment
MEEDDAT: French ministry of ecology, energy, sustainable development and spatial planning

Mercator-Ocean: Public Interest Group on operational oceanography, formed by CNES, Ifremer, CNRS, IRD, SHOM and Météo-France.
MES: Marine Environment Strategy
MESR: French ministry of higher education and research
MIMEL: Inter-ministerial mission for sea and coasts
MNHN: National museum of natural history
MPA: Marine Protected Area
OPTIPECHE: System to sustainably and responsibly optimise trawl fisheries
OSPAR: Oslo Paris convention for North East Atlantic marine environmental protection
OSU: Observatory for sciences of the universe
PREVIMER: Routinely produces analyses and forecasts of coastal marine environmental status
QUADRIGE2: Coastal database managed by Ifremer
REACH: EU regulation on Registration, Evaluation, Authorisation & restriction of CHemicals
REBENT: French national monitoring network for benthic biocenoses
RECOPESCA: Network of fishing effort and environment parameters measurement
REDEO: Network for development and use of coastal operational oceanography
REMI: microbiological inspection network in shellfish-farming areas
REPAMO: Mollusc pathology network
Réphy: phytoplankton and phycotoxin monitoring network
ROCCH: National chemical contaminant observation network
SeaDataNet: European project aiming to create and operate a pan-European, marine and oceanographic data management infrastructure
SEXTANT: Ifremer's geographic reference data server
SHOM: French navy hydrographic and oceanographic service
SIEau: National water information system
SINP: Nature and landscapes information system
SIPA: Fisheries and aquaculture information system
SNB: National biodiversity strategy
UMR: Joint research unit
WCRP: World Climate Research Programme
WFD: Water Framework Directive

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