
Annual report
2013
Ifremer

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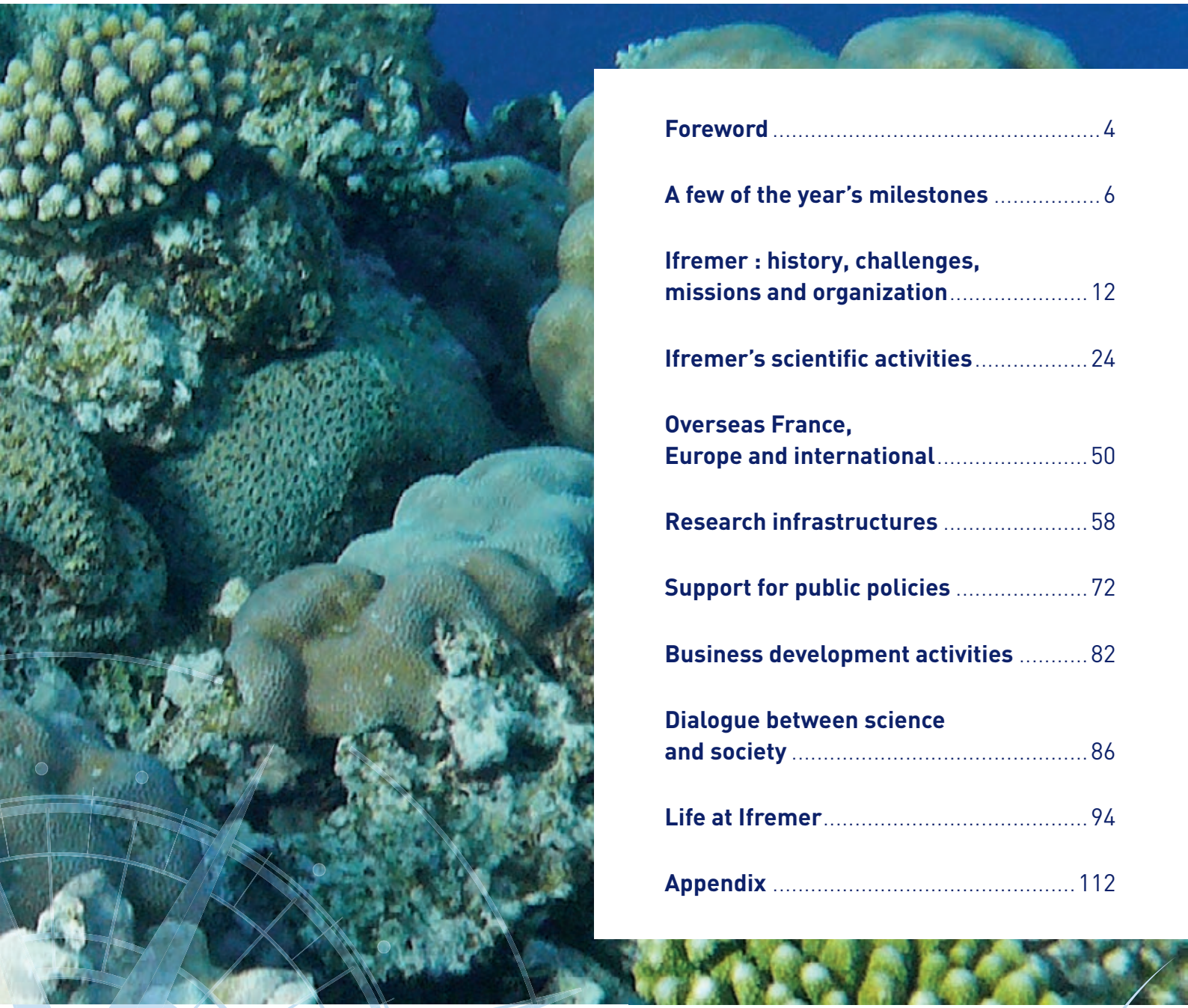
Summary



Foreword

For Ifremer, the keynote activity of the year 2013 was that of preparing the future. This led our Institute to review its strategic plan. The work accomplished was the outcome of broad in-house consultation and it has clarified the Institute's position. Presented to the board of directors in June, this new strategic plan was the basis for the work leading up to future contractual relations with the French State.

Ifremer is a research body. By definition, this means that the recurrent junctures when it undergoes external assessment or defines its strategic orientations are important events. Indeed, scientific excellence or relevance cannot be decreed, but on the contrary is objectively attested by our peers. In 2012 and 2013, a great majority of Ifremer's research units were reviewed and the overarching scientific policy of the entire institution was examined. The assessment of the Institute was conducted by the French evaluation agency for research and higher education, Aeres. It emphasised the quality of the studies carried out, international recognition of our teams, the ability to deliver integrated coverage of the field of marine sciences and to deploy our forces over a wide spectrum of activities, ranging from academic research to providing support for public policies. It also highlighted areas for improvement and progress: the need to be vigilant about possible dissipation in studies and research, which can arise directly from the fact that Ifremer is solicited from many sides, and the fact that the guidelines for transfer of technology and business developments have not been sufficiently formalised. These conclusions will inspire the Institute's changes to come, relying on the high level of motivation of our teams, a point also emphasised by Aeres. Another illustration of this dynamic drive: in 2013, over four hundred-fifty of the scientific publications indexed worldwide in the *Web of Science* come from Ifremer, compared to just two hundred-seventy-six in 2000.

During the year, the research units in the Languedoc-Roussillon region prepared their new projects, which will start in January 2015. This will ring significant changes for Ifremer. Three hitherto separate laboratories (the environmental resources laboratory in Sète, the fisheries research laboratory of the current UMR joint research unit for exploited marine ecosystems in Sète and the biology of exploited marine organisms team in the current UMR working on rational intensification for sustainable fishfarming in Montpellier) decided to join together within a future joint research unit associating CNRS, IRD and the university of Montpellier II, thus forming a major regional cluster in the field of marine sciences.

2013 also saw the assessment of the Carnot Edrome institute, set up within Ifremer. The expert appraisal underscores both the excellent level achieved by the Institute, in reaching the targets initially set, and its true capacity for scientific resourcing.

Ifremer's positioning at the interface between research and support for public policies leads it to act in providing public authorities with assistance in crisis management, as in the episode of excess mortalities of oysters which affected both juveniles and adult oysters this year. Our Institute was solicited both for data collection and for research purposes, with the characterisation of the effects of

the *Vibrio aestuarianus* bacteria related to mortality episodes of adult oysters. This aspect of our Institute's work is exemplary, in terms of the relevance of the approach taken, the associated difficulties dealt with and precautions to be taken: the sensitive nature of the topic subjects the teams to substantial debate. Confronted with these controversial discussions, it is the Institute's responsibility to share the knowledge available to it on a daily basis, while explaining how this knowledge base is established over the long term and what uncertainties it holds. This represents unrelenting, ongoing efforts, while professionals in the impacted sector, quite understandably, expect definitive and immediate answers, which are just not available.

In the realm of support to policy-makers, our Institute greatly contributed to establishing the monitoring programme called for by the Marine Strategy Framework Directive (MSFD). Underpinned by its research, the Institute has identified the parameters and processes for inspection and monitoring of the marine environment. This puts it in a position to best determine the most effective tool to meet the expectations of public authorities, whilst promoting its own responsibilities and scope of intervention. This process should set a precedent for others.

In 2013, Ifremer, as one of the four founding organisations of the French oceanographic fleet joint service unit, contributed to jointly drawing up a multi-annual plan for fleet developments, so that it can continue to support high quality research. This is the first time that the four fleet operators have finalised this sort of synopsis.

This year was also a period of transition for the management of our Institute. Jean-Yves PERROT left the presidency of Ifremer in August 2013 after directing the Institute for nearly eight years. We take this opportunity to thank him for his action.

Finally, the last quarter of the year 2013 marked the beginning of the preparation for the future contract setting out our objectives between the State and Ifremer. An assessment was drawn up of the situation for the entire Institute, identifying pathways for progress and priorities, which will serve in the text of the future contract to be submitted to the Ministries that Ifremer reports to in 2014. This contract is, first and foremost, a tool rather than a solution. It provides the opportunity to share views between the Ministries and the staff of the Institute. Likewise, it gives the chance to focus our Institute's efforts on our essential fields of work, to develop partnerships, clarify expectations and ensure that they are in balance with the available resources. It is up to us to set the course, collectively rise to meet the challenges ahead and thus build Ifremer for the next decade.

François JACQ
Chairman and Chief Executive Officer of Ifremer

A few of the year's milestones

The Aeres evaluation of the Institute: encouragement with respect to the teams' work and valuable input for the upcoming contract for objectives.

"Ifremer is a unique tool in European terms

Summary

Ifremer's research units are assessed by the Agency for evaluation of research and higher education (Aeres) on a regular basis. The assessments conducted in 2012-2013 underscored the scientific excellence of the units and the contributions made by our research units and their laboratories to meet societal challenges. This is cause for satisfaction for the Institute, taken as acknowledgement of the quality of our teams and the relevance of the research issues they are working on.

Above and beyond the evaluation of the units, in 2012 and 2013 the whole institution was also assessed, as regards its management. Its conclusions are consistent with those for the research units, concerning the overall high quality of studies and the international recognition enjoyed by the teams. The assessment drawn up of the new organisation implemented in 2011 was also considered to be positive. However, a number of points to be watched or areas of improvement were identified. The report also revealed the still uneven involvement in academic partnerships, the dispersion of activities which seems to be directly due to the numerous orders and solicitations which Ifremer receives and the absence of a sufficiently formalised policy for transferring results and business development.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Aeres thus suggested that better control of this dispersion be ensured. It was also recommended that efforts continue for better integration in the academic fabric, once approach being to devote greater resources to the doctoral policy and to create incentives for partnerships. The inspection committee also noted the complex nature of in-house governance, which is in part a legacy of a very wide range of activities, combined with a highly scattered geographical distribution.

The analysis by Aeres identified some guidelines for reflection about the orientation and conditions of academic partnerships for several units, in order to develop their scientific project. Ifremer has taken these conclusions on board, and engaged in-house thought and discussion on which the scientific committee will be consulted as to the action required.

Because of its continuum of activities and the wide range of expertise at Ifremer, it is a unique tool in European terms. In the current period, this continuum must indeed be better organised and utilised, even as we see an emerging trend for a centrifugal effect. Aeres's assessment thus doubly reinforces our Institute's policy:

- by hailing the quality of studies conducted and the recognition earned both nationally and internationally by Ifremer;
- by identifying a few important projects for the coming years: regulating the work commissioned by public entities, formalising our strategy for business development, strengthening academic partnership and adapting the scientific strategy of a few of our units.

Thanks to this assessment, the Institute has secured an invaluable contribution for the work to prepare the objectives contract, to be signed by Ifremer and the French State at some point in 2014.

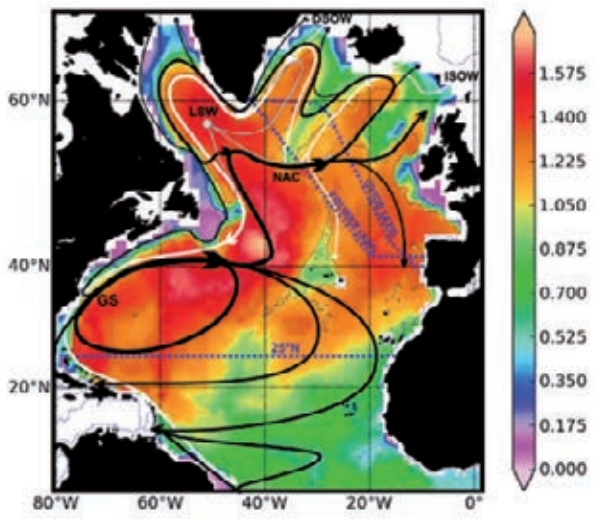
Knowing the ocean, a key to understanding the climate

The ocean is the main reservoir, or sink, which moderates the accumulation of carbon dioxide (CO_2), the major factor of global warming, in the atmosphere. It is therefore essential to understand the mechanisms behind the storage of CO_2 in the ocean to better predict climate change.

Today approximately a quarter of the CO_2 emitted by humans is absorbed by the ocean and while the North Atlantic (as far as the Arctic seas) only represents 13% of the world ocean's surface area, it absorbs about one third.

Between 1990 and 2006, a decrease in the capacity to absorb atmospheric CO_2 by the subpolar North Atlantic Ocean was observed.

Studies carried out in the framework of the international Ovide project which involved researchers from Ifremer, CNRS and its Spanish counterpart CSIC, secured the acquisition of data during repeated observation cruises crossing the ocean.



→ *Circulation pattern and mean accumulation rate of anthropogenic CO_2 in the North Atlantic Ocean in molC per m^2 and per year (colour).*
Black arrows indicate surface currents (GS: Gulf Stream; NAC: North Atlantic Current), grey arrows the intermediate currents (LSW: Labrador Sea Water) and white ones the deep currents (DSOW and ISOW: the waters flowing southward over the Greenland-Scotland sills).

They helped to determine changes in circulation and in CO_2 transport and to evaluate the CO_2 carbon budget in the North Atlantic based on its accumulation and transport by currents. In this study, the North Atlantic was broken down into two main regions, i.e. subtropical and subpolar, in order to understand where the CO_2, and particularly the anthropogenic (of human origin) surplus, is absorbed.

Several conclusions have been proposed for the period from 1997 to 2006.

- **Uptake of anthropogenic CO_2 occurred almost exclusively in the subtropical gyre (an ocean gyre is a vortex or whirlpool formed by a series of marine currents. It is caused by the Coriolis Effect), but it is driven towards the subpolar gyre by meridional circulation.**
- **The slowing down of this meridional circulation is the main cause of the drop in anthropogenic CO_2 transport from the subtropical gyre towards the subpolar gyre, which contributes to limiting the storage of CO_2 from human sources in deep water.**
- **The meridional circulation brings water which is not saturated in CO_2 coming from the South Atlantic. Its slowdown contributes to increasing the CO_2 content at the surface of the North Atlantic and thus to limiting the transfer of carbon from the atmosphere towards the ocean.**

These results help in understanding the interactions between the ocean and the atmosphere and their possible impact on climate phenomena, by revealing the importance of the transformations underway in the realm of the climate.

These studies are a contribution to the World Climate Research Programme and the European Carbochange project. They are highly representative of our Institute's efforts to bring its knowledge about the ocean for use in the major challenges for science and policy, of which global warming and climate change are major examples.

The work carried out led to the following publication: Atlantic Ocean CO_2 uptake reduced by weakening of the meridional overturning circulation, *Nature Geosciences, 6, 146-152.*

Renewal of our Institute's advisory bodies

Ifremer has advisory bodies which can provide guidance, thus enabling the Institute to achieve progress in its work. The two main ones are the scientific council and the technical and industrial committee.

The technical and industrial committee was set up in 2012, chaired by Jacqueline LECOURTIER, who was the general director of France's national research agency (ANR) until recently. The committee's task is to advise the Institute on topics of technological and industrial development, so that the potentially most relevant fields can be determined and partnerships sought to create valuable products and services from our expertise. Its role is all the more important in that the Institute intends to better formalise its strategy for transfer and business development, in keeping with the recommendations by Aeres.

In 2013, the scientific council was completely renewed. Its membership is designed to best reflect the diversity of the fields and disciplines of Ifremer and its partners. Chaired by Pascale DELÉCLUSE, director of research at CNRS and deputy-director of research at Météo-France, the new council met for the first time in November 2013. Its agenda includes processing and utilising the Aeres evaluation and examining the resulting course of action, assessing the technological units, reflection on the network of the environment & resources laboratories, scientific policy and the State-Ifremer objectives contract. This will be a major contribution at a time when Ifremer must draw up its future contract with the State and review the scientific projects of a number of its units.

In addition, the scientific council will be associated with the activities of the board of directors, through its chairwoman, who regularly presents its work to the board.

Launch of a five-year research programme associating Total, Ifremer and the scientific community on the exploration of continental margins

A multi-annual research programme has been drawn up between Total and Ifremer. Dubbed Pamela, for *Passive Margin Exploration Laboratories*, it aims to explore the margins, working on subjects such as the geological structure, distribution of sedimentary bodies, geohazards, fluids and ecosystems. The aim is to explore scientific themes which interest both partners, i.e. the thermal evolution of a margin, spatial and temporal distribution of deposits from a sedimentary system over a climate cycle, characterisation of carbonate systems, sea level recordings, connection of lobes and sedimentary levees at the foot of the slope, the relative role of various factors (canyon profile, type and volume of sediments) on the transport efficiency of canyons, influence of sediment type on hydrate behaviour, detection of plumes in the water column, ecosystems associated with fluid seeps, biodiversity of subsea carbonate platforms, etc.

Along with these two partners, Total and Ifremer, the project will more broadly associate the academic community via CNRS and several universities, and particularly the members of the Marges research grouping.

On 16 July 2013, Jean-Yves PERROT, chairman and chief executive officer of Ifremer and Yves-Louis DARRICARRÈRE, managing director of Upstream, Total, signed a Pamela framework agreement setting out the frame of cooperation between the two entities.

Two initial sub-programmes should be noted:

- the Pamela-Gazcogne project, dealing with mapping and characterisation of fluid emissions, with oceanographic cruises conducted as of 2013;
- the Pamela-Paprica project, which focuses on the interactions between turbidite, gravity and contourite deposits.

In 2014, the programme will continue, with exploratory cruises in the Indian Ocean. This programme highlights the interest of long-term cooperation on common scientific themes, associating industrial firms, universities and research institutions, and giving laboratories multi-annual visibility.

A year of significant involvement in the shellfish farming field

In the context of massive shellfish mortality events observed in recent years, Ifremer brought its support to the oyster-farming profession through observation of these events and surveillance of infections agents, both thanks to its monitoring networks and through specific research studies on the processes involved in the host/environment/infectious agent interactions which lead to these massive mortality rates.

In 2013, abnormal mortality of adult Pacific oysters, *Crassostrea gigas*, was reported in several production areas. The first sign had already been recorded during the summer of 2012. The unusual nature of these mortality events had led Ifremer to propose a specific research programme to the Ministry in charge of agriculture, as of 2012. In 2013, Ifremer analysed samples of commercial oysters to screen for infectious agents (bacteria, viruses and parasites). In the samples studied, the bacteria *Vibrio aestuarianus* was found in all batches of adult oysters. This bacterium is already known to be able to induce mortality in Pacific cupped oysters in the adult stage. It is present in the marine environment and has been monitored for the past ten years or so. Furthermore, several research programmes either at or involving Ifremer include studies on this bacteria (Aestu, Bivalife, Gigassat and Gimepec projects).

Although the bacteria is certainly responsible for the death of the animals, the explanation of the phenomenon is most likely more complicated, involving interactions between oysters, the bacteria and the environment, against a backdrop of global change.

The specific climate context in 2013 could have fostered the multiplication of the bacteria in the environment, or rendered the oysters more sensitive to infection.

Ifremer also compared the bacterial strains collected in 2012 and 2013 with strains collected in the early 2000s. The analyses performed suggest that there has been no emergence of a particularly virulent strain over the last two years.

→ *Rack and bags of oysters*

The specific climate context in 2013 could have fostered the multiplication of the bacteria in the environment, or rendered the oysters more sensitive to infection.

In the context of massive mortality episodes in cupped oysters over the past few years, linked to various infectious agents (OsHV-1 virus, bacteria from the Vibrio genus), Ifremer has played a proactive role in proposing to revamp the way infectious diseases are monitored. The surveillance objectives have been refocused on the early detection of emerging phenomena in order to optimise the chances of controlling their spread, something difficult to control in the aquatic environment. Ifremer is also pursuing research studies in various fields (genetics, reproduction, nutrition, animal husbandry, pathology, immunity, public health and economics) through a range of funded projects.

Other studies to note are those conducted further upstream by Ifremer within the joint research unit UMR 5119 (Ecosym, BOME unit, university of Montpellier II), on the role of different viral or bacterial pathogens (*Vibrio splendidus, V. aesturianus* and OsHV-1 µvar) in inducing innate immunity that will elicit an effective or ineffective response during infectious episodes.

The molecular mechanisms involved in the antiviral response in molluscs remain largely unknown. *In vivo* studies were performed in order to demonstrate the existence of an antiviral response which can be induced in the oyster. During two separate experiments, an injection of a double-strand RNA synthetic viral analogue (poly I:C) was given twenty-four hours before being infected with a suspension of the OsHV-1 µvar virus. The investigation showed it is possible to induce protection in the oysters against infection (significant drop in the viral load, by 89%). This stimulation of immunity does not depend on the RNA sequence injected, but is specific to the antiviral response. Analysing the expression of candidate genes known to be implicated in antiviral response also showed that the observed response displayed similarities to the hallmarks of the type-1 interferon response of vertebrates.

Green T. J., Montagnani, C., 2013. Poly I:C induces a protective antiviral immune response in the Pacific oyster (*Crassostrea gigas*) against subsequent challenge with *Ostreid herpesvirus* (OsHV-1 muvar). *Fish Shellfish Immunol., 35, 382-8.*

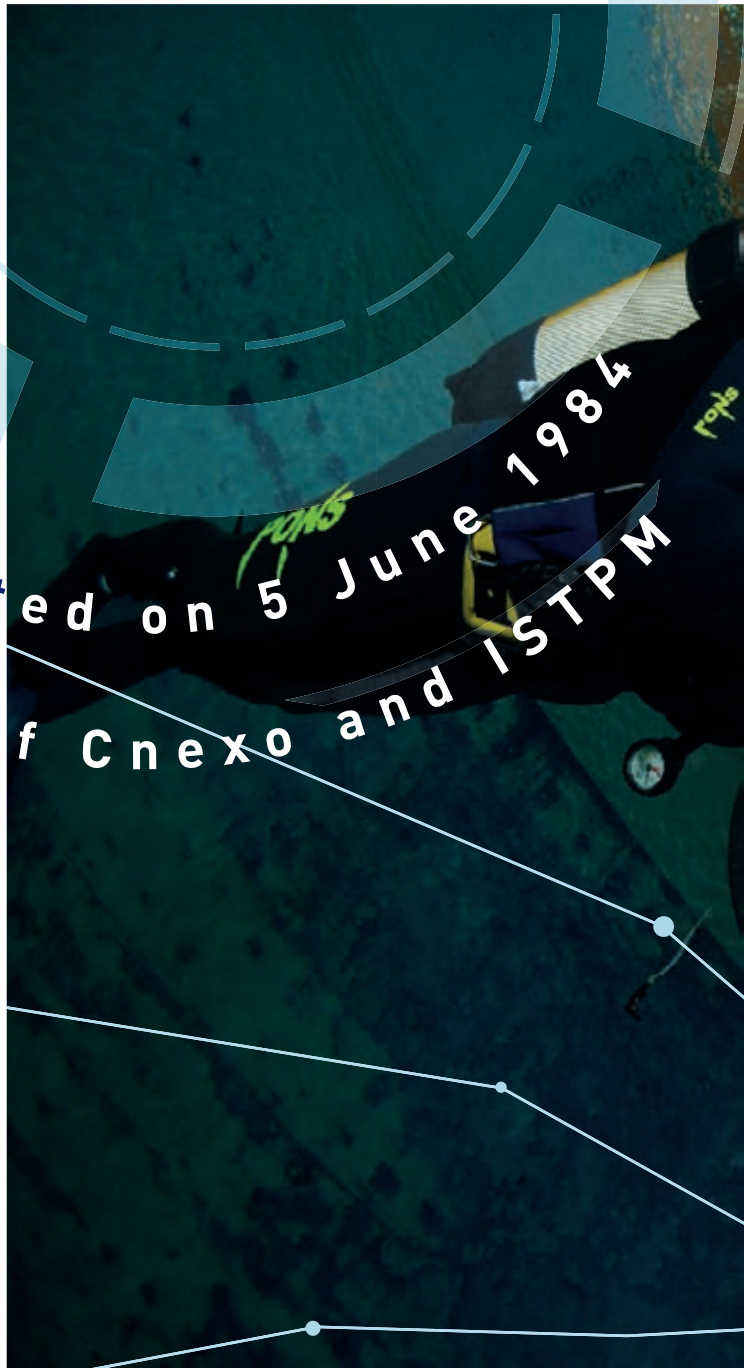
→ *Sampling juvenile oysters to study the antiviral response to OsHV-1*

Ifremer: history, challenges, missions and organisation

The background of our Institute

Ifremer's history combines two different traditions. The first is linked to the marine fisheries field, going back to the maritime fisheries technical service which came into being in the second half of the 19th century. As the outcome of this process, the Maritime fisheries scientific and technical office was created by the 31 December 1918 Finance Act, then took the name of Maritime fisheries scientific and technical institute (ISTPM) on 14 October 1953.

> Ifremer was created on 5 June 1984 with the merging of Cnexo and ISTPM



The latter is linked to the rapid expansion of oceanography. It harks back to the development, more than a century ago, of measurements and cruises to explore the oceans. Following World War II, when large, specialised research bodies like CNES or CEA were coming to the fore, a Committee for the exploitation of the oceans called Comexo was created. It would then give rise to Cnexo, created by law n° 67-7 of 3 January 1967 and intended to become a specialised institution in charge of exploring the oceans, with a significant technological component.

Ifremer was created on 5 June 1984 with the merging of Cnexo and ISTPM.

As set out in the decree which brought it into being, the French research institute for exploitation of the sea, Ifremer, has the remit to conduct and promote basic and applied research, expert assessment reports and action for technological and industrial development intended to:

- know, assess and enhance ocean resources and enable their sustainable use,
- improve methods for monitoring, forecasting trends, protecting and enhancing marine and coastal environments,
- and foster social and economic development of the maritime world.

Scientific and technological stakes

In a context marked by global change and growing uses of the sea, the marine environment is subjected to increasing pressure, i.e. great demand for raw materials or food products from the sea, rising demographics on coasts, and the pervasive presence of pollutants and waste. These trends and the risks of irreversible damage which could ensue give rise to strong social demand.

A major challenge must be met: the Earth's ability to bear the presence of 9 billion human beings by the 2050 horizon. Today, over 60% of the world population lives less than 150 km from the shore, directly impacting sensitive coastal areas. Other questions concern our planet's ability to feed its inhabitants, its development model and the concomitant requirements, primarily in terms of energy sources and raw materials; and finally whether the environments will be able to bear the consequences of these choices.

All of these factors, both local and global, contribute to making the oceans and the marine environment a "new frontier" for mankind.

France holds a singular position in this respect, due to the fact that its extensive continental shelf, the second largest in the world, enables it to be present on three oceans. Through Ifremer, which has emerged as one of the most integrated institutes in the field of marine sciences, France holds another asset. This is especially crucial in a context where the needs for expertise, knowledge and development are seen as increasingly important, requiring moreover that knowledge be integrated.

Marine sciences play a vital role in informing public policies. They open up a way to reconcile both the protection and exploitation of the environment. Indeed, understanding ecosystems, the processes governing them and the services they offer, is an absolute prerequisite in rising to the challenges facing us.

"Today, over 60% of the world population lives less than 150 km from the shore, directly impacting sensitive coastal areas.

The Aster^{X} *AUV* ←

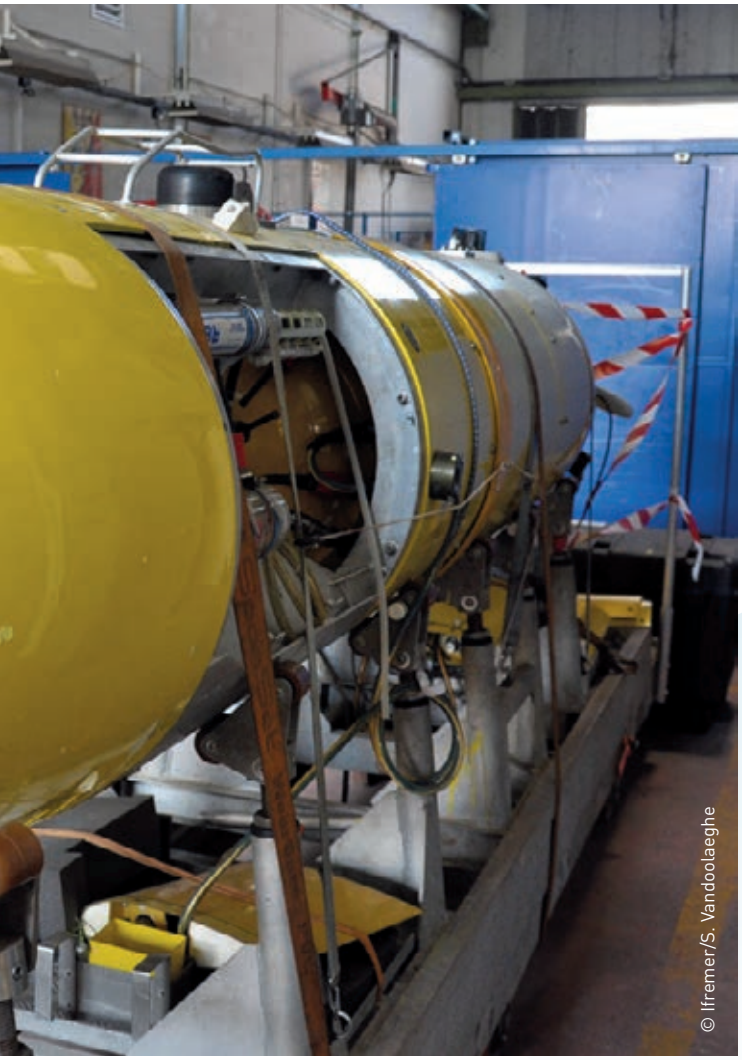
Summary

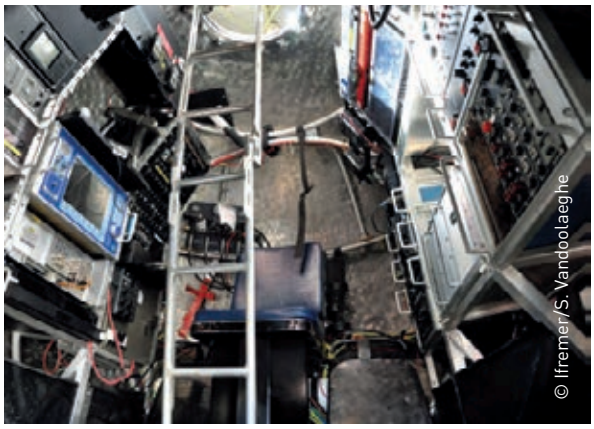
Ifremer's calling

Ifremer contributes, as an integrated research institute in marine science, to the national system for research and innovation as well as to the European research area, by producing:

- fundamental knowledge in a systemic approach making it possible to better grasp the processes governing ecosystems and understand the changes affecting them;
- more finalised results to answer questions raised by society, based on its observation, monitoring and expert assessment capacities, and giving policy-makers support for managing the marine environment and its resources;
- outcomes and technologies contributing to economic development in the framework of a balanced partnership with various economic players, including industrial firms.

To rise to this calling, our Institute is involved in a wide range of research arrangements and partnerships.





→ *Inside the* Nautile *submersible*

- It invests in research excellence, grounded on key disciplines or themes.
- The Institute's research backs up the deployment of maritime policies, whether this concerns the implementation of the Water Framework Directive (WFD), the Marine Strategy Framework Directive (MSFD), the Common Fisheries Policy (CFP) or national strategies for biodiversity.
- Thanks to numerous partnerships with industrial and economic realms, Ifremer is committed to a rationale of business development, which has led to a Carnot institute of excellence called Ifremer Edrome within our Institute.
- Marine scientific research builds upon high level technologies in many fields, such as underwater operations, instrument systems, observatories (coastal, offshore, sea floor), mineral and energy resources, fisheries and aquaculture. Ifremer acts as a turnkey contractor and integrator (naval architecture and vehicle design, sensors, materials, hydrodynamics).
- The Institute is in charge of a large part of the French oceanographic fleet, which has now been brought together with other partners' vessels within a joint service unit (UMS). The quality of the scientific equipment of Ifremer's fleet is inextricably linked to the technological investments made, working closely with our research scientists and engineers and our industrial partners.

On the national scale, the Institute relies on a balanced partnership with universities and research organisations (primarily CNRS and IRD). On European and international levels, it is a driving force for joint programming initiatives, whether for research (e.g. JPI Oceans) or infrastructures (e.g., the fleet, seafloor observatories, marine databases, Argo profiling floats, etc.).

To reach these scientific objectives and entirely fulfil its remit for training and dissemination of knowledge, Ifremer has developed a strategy of cooperation with universities and French research institutions, through joint research units (UMR), research federations (FR) and a dynamic incentive policy to support research groupings (GDR). Each of these forms of association provides an appropriate response to seeking complementarity in skills and expertise, missions and means.

Ifremer is a national institute, established on the coasts of metropolitan and overseas France in order to be close to both our academic partners and to the stakeholders and players of the maritime social and economic realm. The fact that a large part of its facilities and staff are concentrated on the Brest site has enabled our Institute to invest massively in the laboratory of excellence Labex Mer. The dynamic drive for cooperation will be pursued through support for the Labex policy of international reach, to thus grow Ifremer's visibility and attractiveness.

→ *Test tank at Ifremer's Brittany centre*

How the Institute is organised

The territorial organisation is as follows:

› the head office in Issy-les-Moulineaux (Hauts-de-Seine),

› five centres, covering one or more regions or territories:

- Atlantic (managed from Nantes),
- Brittany (managed from Brest),
- Channel-North Sea (managed from Boulogne-sur-Mer),
- Mediterranean (managed from La Seyne-sur-Mer),
- Pacific (managed from Tahiti).

The ocean holds a source of growth for industry. One of Ifremer's ambitions is to disseminate its scientific results and technological developments to social-economic stakeholders. To this end, the Institute must support constant efforts to create long-term conditions for creating value, whilst reinforcing the processes to raise scientific teams' awareness about business transfer and economic development. This means detecting avenues with high potential, legal protection, their maturing and transfer to the private sector, to succeed in creating economic value for our Institute as well as consolidating French industry.

Along with these centres, there are nearly twenty related stations located on the coasts of metropolitan and overseas France.

The five centres (Channel-North Sea, Brittany, Atlantic, Mediterranean and Pacific) ensure local support to the teams of scientists and technicians and relations with local partners, through helping to set up projects and developing cooperation.

Since the new organisation was implemented in 2011, our Institute's structure has three main components:

- science and technology component, made up of the scientific management, four thematic departments uniting scientific and technical staff and the management entity of Fleet resources and operations;
- component underpinning research and expertise, made up of six functional divisions (human resources, finances, legal affairs, business development, communications, international and European affairs) and the accounts department;
- territorial component, with the network of establishments hosting our teams.

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→ *Ifremer Pacific centre*

Scientific management

Under the authority of the general management, the scientific management team proposes and implements Ifremer's scientific policy.
It organises and coordinates the Institute's scientific and technological foresight.
It defines and implements the policy for scientific and technological partnerships, as well as the doctoral policy. It ensures scientific and technological intelligence, on national, European and international. It leads the scientific assessment of the Institute and acts as an interface with the national assessment authorities.

Scientific and technological departments

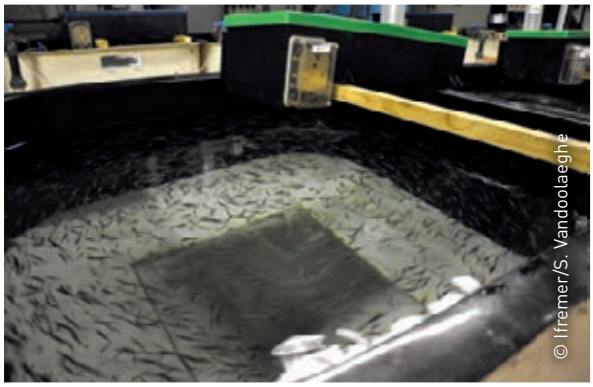
The four science and technology departments are in charge of managing the human and financial resources used for scientific and technological projects and research. They implement these projects and ensure that their development progresses smoothly.

Each department:

- works with the scientific management to outline the contract of objectives and the strategic plan and to formulate the department's detailed scientific orientations and related actions;
- schedules, coordinates and conducts scientific and technical research activities or projects;
- produces expert assessments and delivers opinions and advice in the framework of support for public policy-making;
- manages the experimental scientific facilities or infrastructures within its purview;
- takes part in economic value development of the Institute's activities (proposing, negotiating proposals, signing contracts).

Each of the four departments is made up of units. These units can, depending on their size and/or the way they are structure, be further divided into research labs and/or services.

Biological resources and Environment department



→ *Seabass rearing tank at Ifremer Palavas-les-Flots station*

Its remit is to study and enhance knowledge about living resources in the ocean, so that they can be sustainably exploited while contributing to the social and economic development of the maritime realm, especially the fisheries and aquaculture sectors. The marine environment is a dynamic system which is subjected to significant natural and anthropogenic variability. Pressures of human origin are wide-ranging, including exploitation of living resources, discharges of contaminants and global changes. They have sharply increased over the last few decades, engendering sweeping changes in marine ecosystems and the uses which are dependent on them, particularly in the coastal zone. Improving the good environmental status and the services rendered by marine ecosystems raises complex issues on the functioning and biodiversity of ecosystems, the viability of exploiting living resources, public policies to regulate activities and the interactions between uses. This complexity calls for major multidisciplinary integration.

THE FOLLOWING UNITS ARE PART OF THE RBE DEPARTMENT:

› Marine economics unit (EM) within UMR Amure (UBO-Ifremer)

› Channel-North Sea fisheries resources unit (HMNN)
- fisheries resources laboratory Boulogne-sur-Mer (LRHBL)
- fisheries resources laboratory Port-en-Bessin (LRHPB)

› Southern Bay of Biscay fisheries resources unit (HGS)
- fisheries resources laboratory La Rochelle (LRHLR)
- fisheries resources laboratory Anglet (LRHA)

› Mediterranean fisheries resources unit (HM), within UMR EME (IRD-UMD-Ifremer)

› Fisheries ecology and modelling unit (EMH)

› Fisheries sciences and technology unit (STH)
- fisheries biology laboratory (LBH)
- fisheries biology, technology laboratory (LTBH)

→ *Fishing vessels in the Mediterranean*

› Functional physiology of marine organisms unit (PFOM) within UMR Lemar (CNRS-IRD-UBO-Ifremer)
- invertebrate physiology laboratory (LPI)
- adaptation, reproduction, nutrition laboratory (ARN)

› Biology of exploited marine organisms unit (BOME) within UMR Intrepid (Cirad-Ifremer) and Ecosym (CNRS-IRD-UM2- Ifremer)

› Mollusc health, genetics and microbiology units (SG2M)
- marine mollusc genetics and pathology laboratory (LGPMM)
- protecting shellfish farming production laboratory (LSPC)
- health, environment and microbiology laboratory (LSEM)

› Biogeochemistry and ecotoxicology unit (BE)
- ecotoxicology laboratory (LEX)
- metallic contaminants laboratory (LCM)
- organic contaminants laboratory (LCO)

› Marine resource biotechnologies unit (BRM)
- biorefining by enzymatic hydrolysis laboratory (Biorafᴴᴱ)
- microbial ecosystems and marine molecules for biotechnologies laboratory (EM³B)
- algal physiology and biotechnology laboratory (PBA)

› Overseas France units
- marine resources in French Polynesia unit (RMPF) within UMR EIO (IML-IRD-UPF-Ifremer)
- lagoons, ecosystems and sustainable aquaculture in New Caledonia unit (LEADNC)
- biodiversity and environment (Biodienv) unit in Martinique
- fisheries biodiversity unit (Biodivhal) in French Guiana
- Indian Ocean delegation (DOI)
- Saint-Pierre & Miquelon delegation (SPM).

Physical resources and deep-sea ecosystems department

Its activity is based on locating and understanding the phenomena behind the creation of mineral and energy reserves and deep-sea ecosystems. In studying deep-sea ecosystems, the objective is to describe the biological diversity there and to understand the interactions between biological communities and associated mineral structures using interdisciplinary approaches spanning scales which range from ecosystem to molecular. The department also develops instruments to take *in situ* measurements as well as performing laboratory experiments required for the studies being conducted.

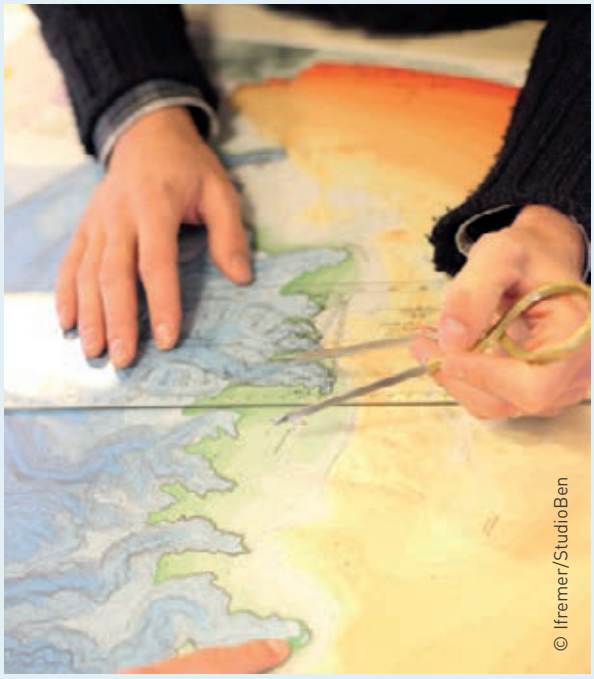
The ocean domain holds a reservoir of mineral (aggregates, nodules, sulphide deposits, crusting, etc.), energy (oil and gas, marine renewable energy sources) and biological (biodiversity, molecules of industrial interest, and so on) resources which are still poorly known. In order to best estimate the potential held by these reserves, in this context, it is essential to conduct fundamental research in order to describe the variety of the geological, ecological and biological processes unfolding there, and the diversity of ecosystems lying beneath the deep sea.

This department both facilitates and manages the Carnot Ifremer Edrome institute (label of excellence which is renewable every five years) and its scientific and technical guidance committee.

THE FOLLOWING UNITS ARE PART OF THE REM DEPARTMENT:

› Deep-sea ecosystems unit (EEP)
- extreme environment microbiology laboratory (LM2E) UMR (CNRS-UBO-Ifremer)
- deep-sea environment laboratory

› Marine geosciences unit (GM)
- sedimentary environment laboratory
- geochemistry and metallogeny laboratory
- geophysics and geodynamics laboratory
- mapping and data processing service



→ *Preparing the navigation plan of an ocean exploration survey*

› Technical research and development unit (RDT)
- behaviour of structures at sea laboratory
- detection, sensors and measurements laboratory
- marine engineering and instrumentation service.

→ *MeDON seafloor observatory deployed off Molène island*

Oceanography and ecosystem dynamics department

This department covers activities which focus on knowledge, observation and modelling of:

› the physical ocean at different scales, from the global ocean to transitional coastal waters,

› pelagic coastal ecosystems, concentrating on the first links in the food chain,

› and benthic coastal ecosystems.

→ *Storm in Brittany*

In relation with research being conducted on observation methodologies and diagnosis, the department collects data from *in situ* instruments, coastal arrays and satellites. It designs and deploys systems for processing, archiving and disseminating these data and develops numerical modelling tools in order to simulate marine ecosystem functions and exchanges at the interfaces.

It contributes to the environmental and health monitoring of coastal waters required by regulations, through the observation and surveillance networks it coordinates.

The department also contributes to the ecosystem approach in aquaculture and fisheries thanks to its network of environment and resources laboratories located along the coast of metropolitan France.

THE FOLLOWING RESEARCH UNITS MAKE UP THE ODE DEPARTMENT:

› Spatial oceanography laboratory (LOS)

› Ocean physics laboratory (LPO) UMR (CNRS-UBO-IRD-Ifremer)

- dynamics of ocean-atmosphere variability team
- North Atlantic team: interior and East margins
- Southern Africa margins and Indian, Atlantic and Southern ocean exchanges team
- *in situ* observation techniques service

› Coastal environment dynamics unit (Dyneco)

- hydrodynamic and sedimentary physics laboratory (Physed)
- pelagic ecology laboratory (Pelagos)
- benthic ecology laboratory (Benthos)
- geomatic applications service (AG)
- service data utilisation for integrated management and surveillance (Vigies)

→ *Mobesens: mobile autonomous system to measure water quality*

› Coastal unit

- phycotoxins laboratory (PHYC)
- nine environment & resources laboratories (LER), present on all seafronts of metropolitan France:

- LER de Boulogne-sur-Mer (LERBL)
- LER de Normandy (LERN)
- LER Northern Brittany (LERBN)
- LER Western Brittany (LERBO)
- LER Morbihan-Pays de Loire (LERMPL)
- LER des Pertuis charentais (LERPC)
- LER d'Arcachon (LERAR)
- LER Languedoc Roussillon (LERLR)
- LER Provence-Azur-Corsica (LERPAC).

These LER laboratories work in the following fields:

- collecting observation and monitoring data for the coastal sea and the littoral,
- research and regional studies carried out in partnership with the theme-based labs and which are focused on coastal and shellfish farming ecosystems,
- issuing opinions for decentralised State services and producing expert assessment reports,
- enhancing the value of knowledge by transferring it to local and regional stakeholders.

Marine and Digital Infrastructure department

This department delivers services and leads projects whose objective is to create and/or constantly improve the infrastructures which underpin research in the field of the fleet and related instruments and information services. Furthermore, the department develops, programs and upgrades all of the information system facilities and infrastructures needed by our Institute.

It also develops and manages the oceanographic data centre which gathers data on the marine environment and makes them available to the scientific community. It designs software for the acquisition, processing and post-processing of data collected at sea. The department is in charge of the development and follow-up of underwater operations, surveying and monitoring systems used for operational or exploratory purposes. It proposes, designs and carries out technological projects to enable vessels, shipboard systems and underwater vehicles to evolve, in order to meet the scientific community's needs.

It develops and operates Ifremer's information systems for marine data collection, validation, databasing and dissemination, in compliance with the national and European directives in effect.

THESE ARE THE UNITS IN THE IMN DEPARTMENT:

- **Information systems and marine data unit (IDM)**
  - management information system unit
  - web master unit
  - information systems engineering service
  - information resources and communications service
  - marine scientific information systems service
- **Vessels and shipboard systems unit (NSE)**
  - underwater acoustics service
  - shipboard software engineering service
  - vessels and facilities service

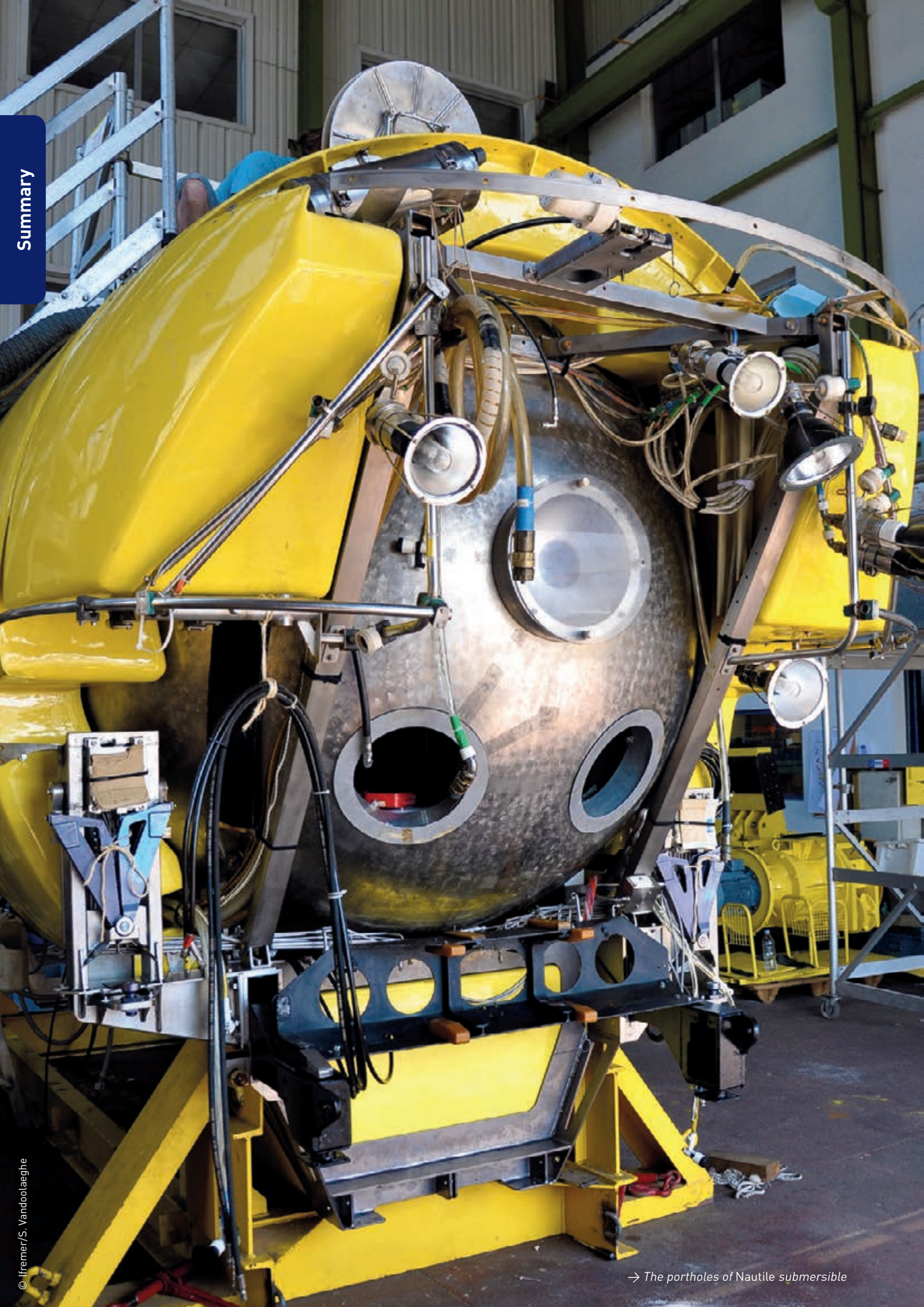
→ *Inspection of acoustic bases and hull of RV* Thalassa *by divers*

- **Underwater systems unit (SM)**
  - positioning, robotics, acoustics and optics service (PRAO)
  - embarked electric and electronic systems service (S3E)
  - operational engineering and mechanical development service (2IDM)

The sea-going vessels and facilities for French oceanographic research have been managed since 2008 by Ifremer, CNRS, IPEV and IRD within the French oceanographic fleet large-scale Research Infrastructure (TGIR FOF). A new phase was begun with the creation in 2011 of a joint service unit (UMS) common to these four organisations to support the French ocean research fleet. It has three objectives:

- developing and implementing integrated scheduling of vessels and large-scale equipment,
- defining and coordinating the fleet development plan, also taking into account the requirements of national public-sector operators who are not members of the UMS;
- coordinate investment policies.

Summary



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→ *The portholes of* Nautile *submersible*

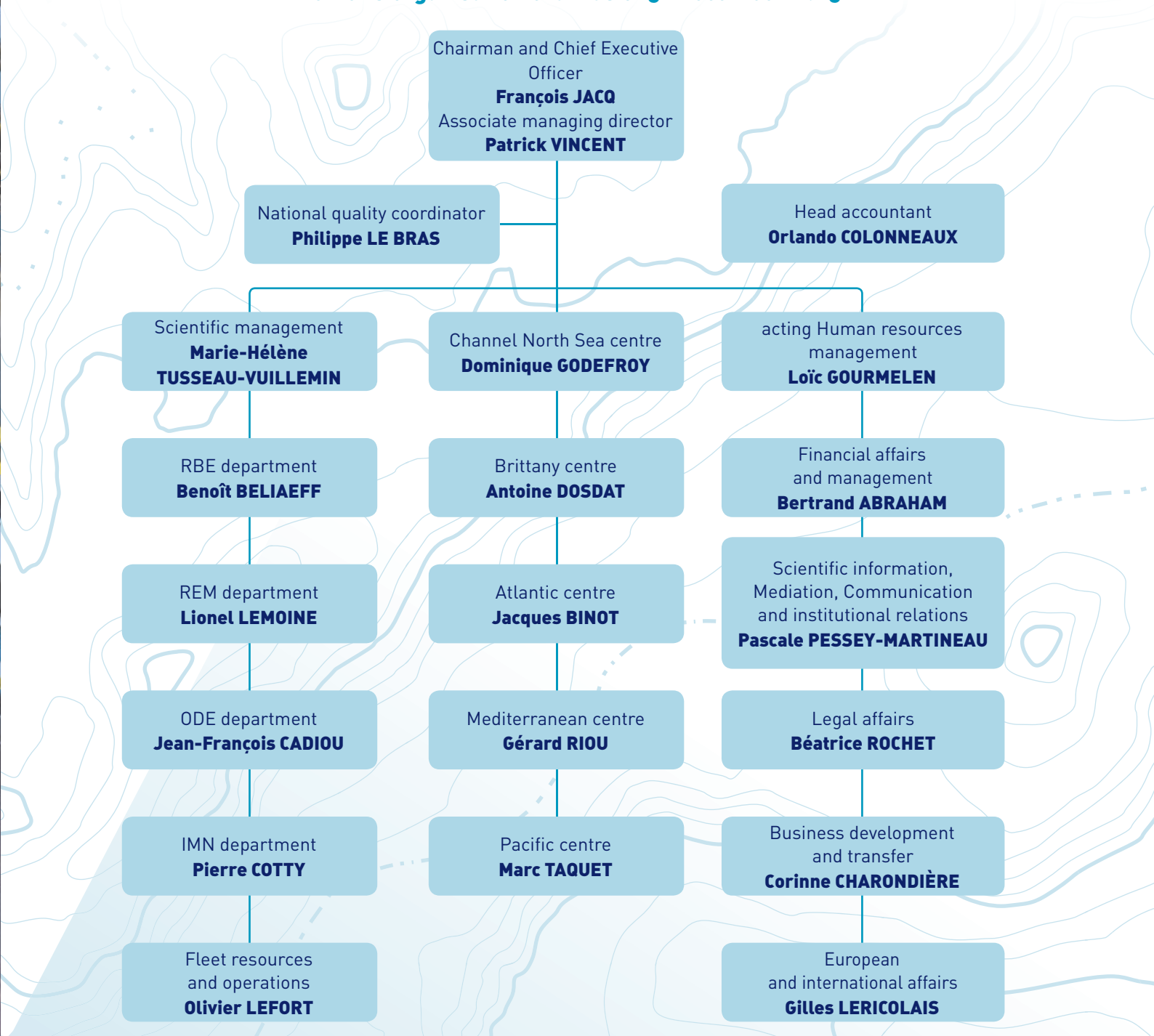
Fleet resources and operations management

The department defines and implements the scheduling of the oceanographic fleet to serve various user communities, interfacing with the joint service unit (UMS) French oceanographic fleet.

It coordinates the investments made on behalf of the fleet. It ensures that the cruise schedule is carried out as planned. It acts as the interface with the Genavir economic interest grouping, which commissions Ifremer's and IRD's fleet. It performs quantitative assessments of cruises and manages Ifremer's partnerships in this respect.

Within the Fleet large-scale Research Infrastructure, is owner and operates via the EIG Genavir, under the French flag, four of the five French ocean-going vessels, three of the seven coastal vessels and all of the underwater vehicles and heavy equipment. One of the main assets of Ifremer's fleet lies in clearly identified teams devoted to technology and instrumentation within the Institute, who develop and ensure the evolution of scientific equipment and facilities and our underwater systems.

Ifremer's organisation chart as of 31 December 2013



Ifremer's scientific activities

A year of research in perspective

Ifremer is one of the prime contributors to developing marine sciences and technologies. It is not an easy task to give a full account of the wide range of achievements of 2013. Therefore, to facilitate the approach, the presentation consists in first addressing strategic orientations, particularly the thought and discussion devoted to developing the strategic plan over the year. Next, some more general indications about the elements of scientific policy and the related indicators are given. And finally, in what is inevitably proceeding by impressionistic touches, a few outcomes or milestones for the year will be described.

Updating the strategic plan: contribution to a European and French research strategy for marine sciences by 2020

Ifremer has updated its strategic plan by refocusing on six scientific orientations or pillars, to which optimising the ocean research fleet and its facilities based on marine data and technological innovations can be added.

These orientations respond to the scientific questions raised and are all objects at the crossroads of these different lines of questioning: marine ecosystems (whether offshore or inshore) or ocean physics for instance (helping to understand energy exchanges, transport and dispersion of contaminants or plankton and production systems linked to the sea). At the outcome of collegial discussions, there were two guiding principles for the updating of the strategic plan's scientific application:

- the will to refocus our Institute's activities on our "core business", bringing added value in scientific, economic and social terms, whilst clarifying Ifremer's role with respect to our academic, public-sector and economic partners.

Thus, the Institute's stance with regard to aquaculture technical centres (in metropolitan and overseas France) is guided by the will to develop the scientific expertise of an integrated institute in this field, without any overlap on overly downstream activities where relevance would be lacking.

- the will to guarantee a systemic scientific approach which can make sustainable "exploiting" of marine environmental goods and services possible.

In an economic context which is marked by growing pressure on raw materials and other resources – particularly of marine origin –, the stakeholders are tending to express increasingly numerous and sector-based expectations. Confronted with this pressure, Ifremer points out that only an ecosystem-based approach will enable the questions raised to be dealt with in a sustainable and lasting manner.

This was the spirit in which the orientations were reviewed, especially that to "Identify and support pathways for sustainable development of fisheries and aquaculture confronted by global change" and that to "Explore the seafloors and, through a systemic approach and context of sustainable development, identify the requisite conditions for exploiting mineral and energy resources".

Synoptic presentation of strategic plan orientations

The drive for multidisciplinary integration

Ifremer's strategic orientations should contribute towards better knowledge about seas and oceans in accordance with issues which are shared worldwide. These priorities represent a move toward greater multidisciplinary integration around societal challenges: global change and its consequences on the environment, knowledge and protection of biodiversity, the integrated ecosystem-based approach and sustainable procurement of non-energy and non-agricultural raw materials.

→ *Recovery of mooring during Ovide cruise*

1 / Learn about ocean dynamics to supplement the diagnosis of global change and anticipate changes in the coastal domain

Observing and quantifying the climate changes underway in oceans' physical, geochemical and biological components. Specifying the ocean's role in the Earth's climate

Rising to the scientific challenge of decadal forecasting by improving knowledge about the mechanisms of variability

The possibility of decadal forecasting of the climate system relies on data acquisition and analysis and modelling. Through our involvement in many partnerships, Ifremer contributes to observing ocean climate variability on the global scale (Argo) and in the North and South Atlantic (Ovide, Samoc). Our research particularly focuses on thermohaline circulation and on the MOC (its meridional overturning circulation cell), which are relevant indicators of climate change.

→ *Samples to measure dissolved oxygen to study variability of currents and water bodies*

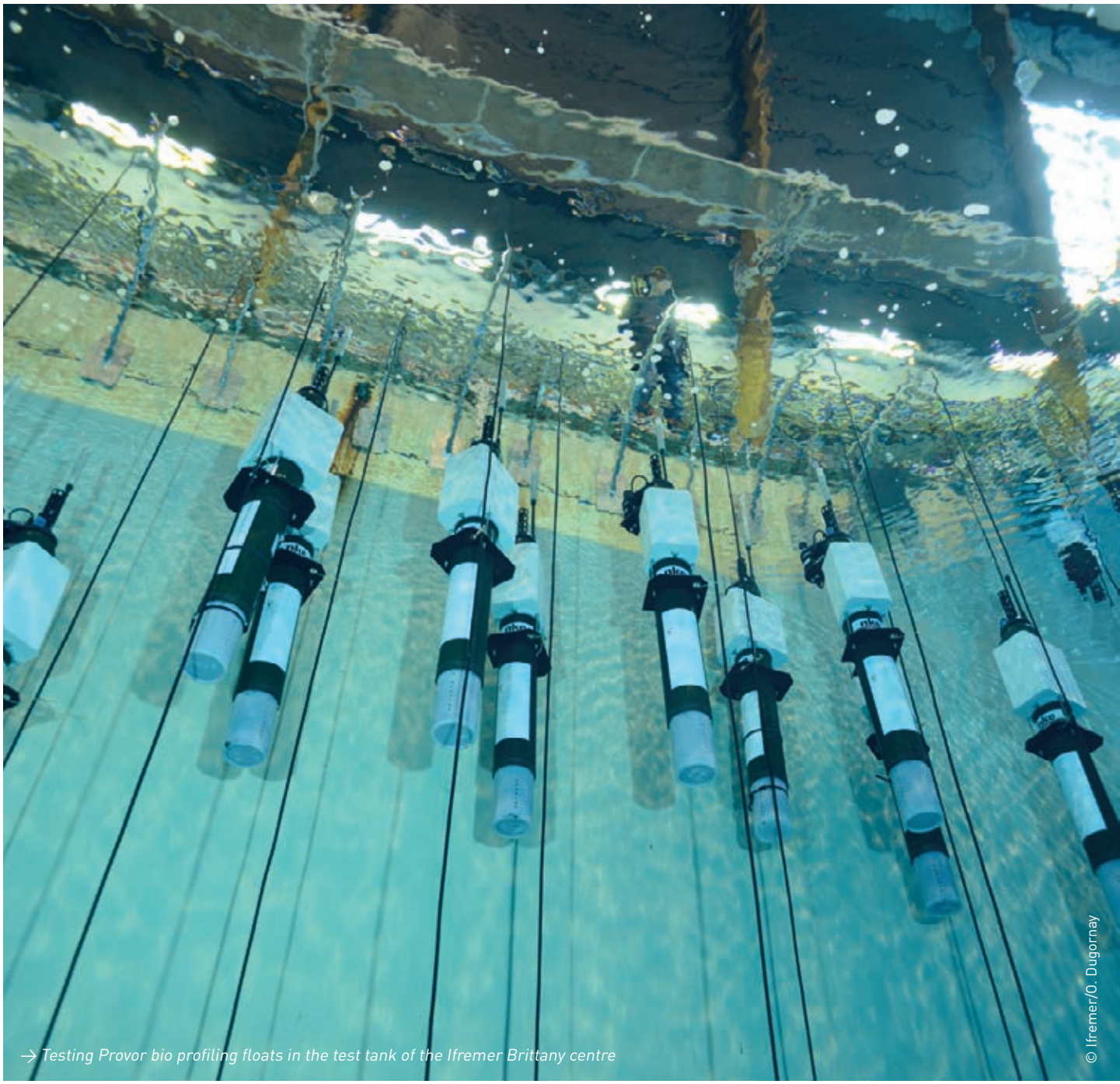
Better appraising ocean dynamics and scale interactions

Satellite observation of the oceans and very high resolution ocean modelling have revealed small-scale, very high-energy phenomena at the sea surface which have an influence on the global matter and heat budgets in the ocean. Ifremer is associated in the work done by LabEx Mer on ways of improving climate and ocean forecasting models based studying the interactions between the various scales and understanding the mechanisms of anthropogenic carbon uptake in the ocean. The Institute is also actively involved in the inter-organisation body called Coriolis (*in situ* oceanographic data centre, in order to organise and optimise France's long-term contributions to the Global Ocean Observation System (GOOS).

Preparing the evolution of the international Argo array while maintaining Ifremer's commitments in French and European contributions

Coupling of biogeochemical cycles with the physical ocean is clearly acknowledged as a major research theme. The success of the Équipex NAOS project has made it possible to now extend physical measuring capabilities beyond 2,000 metres in depth and have access to measurements of biogeochemical parameters from sensors installed on the new generation Argo profiling floats.

→ *Provor sensor from Équipex NAOS project*



→ *Testing Provor bio profiling floats in the test tank of the Ifremer Brittany centre*

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Improving understanding of exchanges between the ocean and the atmosphere

As a leader in observation and quantitative analysis of small spatial scales, thanks to its partnerships with CNES, ESA and NASA, as well as with Jamstec - which secures access to the Earth Simulator supercomputer - Ifremer organises its studies around the implementation of synergy between the interpretation of very high resolution satellite observations, instrumentation developments, analysis of *in situ* measurements and modelling of ocean-atmosphere interactions.

Ensuring long-term and reinforced monitoring facilities in the coastal zone

A requisite component in order to progress in coastal oceanography lies in improving *in situ* monitoring and measurement systems. The aim is the consolidation of a network of high-frequency monitoring platforms within a framework of national partnerships, in agreement with enlarging the scope of the Coriolis oceanographic data centre to cover the coastal domain.

2 / Learn about and characterise marine biodiversity to better protect it

Analysing and understanding the role played by biodiversity in the functioning and resilience of marine and coastal ecosystems' where ecosystem services are produced

Developing capabilities to predict its evolution, taking account of legal, economic and social stakes and providing support for policy-makers.

Organising and developing research on functional biodiversity

Research in the field of microalgae ecology mainly focuses on understanding episodes of toxic species blooms and the factors governing the changes in coastal phytoplankton communities and their diversity.
These phenomena's frequency and consequences on the exploitation of biological resources, particularly in acute crisis situations, as well as the role played by phytoplankton marine ecosystem functioning justify that this theme be given high priority. It is being addressed on several scales, making use of various tools, such as monitoring networks, analysing sedimentary records, targeted studies of specific events and modelling spatial dynamics.

Identifying the ecosystem services produced by marine and coastal biodiversity by developing methodologies for economic assessment of biodiversity

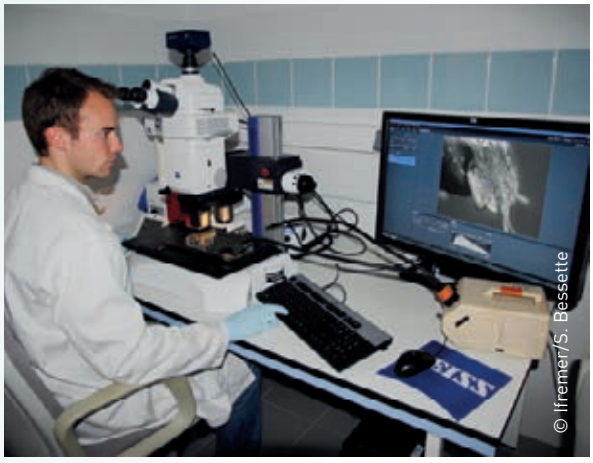
Biological diversity holds a central position in the economic analysis of ecosystem services. Implementing a social and economic evaluation is linked to growing demand from public environmental policies in order to choose measures to be applied.

Modelling marine biodiversity in complex systems and including representation of uses

Ifremer's priority is to lead thought and discussion on the assessment of ecosystem services and on the economy of biodiversity, and to develop research project whose aim is to define and apply conceptual and methodological frameworks. These approaches will lead to drawing up scenarios of how biodiversity could evolve, contributing to the running of the IPBES scientific platform.

3 / Develop enhanced value and use of biological resources through biotechnologies and bioprospection

Collect, isolate and characterise marine microorganisms. Improve value enhancement of the entire exploited marine biomass, particularly by-products. Control its production or supply for the characterisation of biomolecules of industrial interest in the fields of food, health, environment and energy



→ *Observation of symbiotic microbial communities associated with* Rimicaris exoculata *shrimp*

Stepping up research on various aspects of genomics (metagenomics, proteomics, metabolomics)

Utilising genomics tools to identify genetic resources and to inventory species, along with setting up national and regional technical platforms, considerably speeds up the acquisition of the knowledge base needed for biotechnology.

Developing strain collections in the framework of European biological resource centres

This means setting up a procedure to systematically collect microorganisms during ocean cruises, with the objective of enriching the collections in strain libraries.

Pooling Ifremer's strengths in the field of marine bacteria

Research on related molecules (thermostable enzymes, metabolites and biopolymers) will be strengthened for applications in the fields of health and environment.

Developing, improving and transferring conversion bioprocesses which can optimise sustainable use of resources

This involves, in partnership with INRA, implementing modern tools for identification, screening, conversion and analysis of molecular biosynthesis based on the species studied.

4 / Identify and support pathways for sustainable development of fisheries and aquaculture confronted by global change

Making fisheries and aquaculture research and expertise part of the rationale to protect the functionalities of biodiversity and the sustainable use of ecological services for economic and social purposes, in the dual context of global change and rising demand for seafood products

Genetics and aquaculture

The short-term priority is to understand the mechanisms of the atypical mortality episodes hitting Pacific cupped oysters *(C. gigas)* so that measures to prevent, raise alerts and fight these pathogenic organisms can be put in place. They comprise identifying and characterising the virulence of pathogenic organisms; elucidating the interactions between host-environment-pathogens and modelling the outbreaks and persistence of pathogens. Outcomes will be applied to genetic selection, with an attempt to reconstitute sources of larvae by genetic introgression. The approach will be grounded on modelling of the environmental dynamics in pearl farming areas. In French Polynesia, genetic selection will concern characteristics of nacre quality in pearl oysters. In the medium term, genetic research will seek to understand the processes of species adaptation to global change.

Fisheries science, an ecosystem approach

The individualisation of fishing rights, proposed in the review of the Common Fisheries Policy (CFP), raises many questions for research which Ifremer will have to answer. This involves understanding the effects of governance on catch dynamics using multi-criteria approaches, as well as identifying the consequences of choices concerning conservation and exploitation on fisheries fleet economic models.

→ *Sorting room aboard RV* Thalassa

5 / Explore the seafloors and, through a systemic approach and context of sustainable development, identify the requisite conditions for exploiting mineral and energy resources

Mobilising expertise in geosciences, biology, chemistry and technology to improve the multidisciplinary knowledge base for the ocean, in order to meet the new challenges of the deep sea and contribute to the sustainable development of marine renewable energy sources

Observing and understanding the dynamics of interacting processes in the deep sea

Ifremer's studies will contribute to building a knowledge base on the dynamics of interactions between fluids, lithosphere, hydrosphere and biosphere, taking systematic or even long-term observations as a basis and thus to appraise variability over time and space.

Developing new technologies for site exploration, assessment and studies

Achieving better scientific understanding of geological and biological processes on a local scale takes both sampling and high-resolution data acquisition near the seabed, requiring constant development of equipment and facilities (underwater vehicles and instrumentation).

Developing marine renewable energies

Working in liaison with the *France Énergies marines* national platform, Ifremer contributes to public-private partnerships in three prime fields: environmental knowledge and how structures respond (foundations and interactions with the environment); knowledge about the environmental and societal impacts of MRE conversion devices and arrays; and technological innovation, through participation in energy converter device demonstration projects and in their development.

6 / Understand how ecosystems function and develop tools to serve the good environmental status of coastal seas

Promoting innovative research, based on monitoring, to better assess the environmental status of marine ecosystems, understand how they respond to pressures and deliver support for public policies on the environment, health and fisheries. Helping to anticipate changes in regulatory frameworks and development of the monitoring system for surveillance

7 / Contribute to implementing a national and European strategy for marine databases

Protecting, managing and maintaining marine data for the long-term in databases which can be accessed by all users, with the objective of supporting public decision-makers and underpinning research and management in the exclusive economic zone, in accordance with European directives

The Institute especially contributes to strengthening national coordination of marine databases, as in major European projects (SeaDataNet, MyOcean, etc.). It also endeavours to better integrate Ifremer marine databases within scientific observatories for the marine environment.

8 / Optimise Ifremer's fleet, the keystone of the French oceanographic fleet large-scale research infrastructure

Renewing and modernising the national scientific fleet, in the perspective of maintaining its multifunctional dimension and its technological edge, underpinning excellence in research. Consolidating partnerships and pursuing its European integration

As the manager of part of the vessels of the French oceanographic fleet, our Institute is developing its expertise to become the operator of future deep-sea systems and vessels. It is developing partnerships with French and foreign players to thus contribute to the renewal of the fleet. Likewise, it is continuing its efforts towards greater European integration.

→ *Tidal stream turbines*

9 / Promote shared capacity for technological innovation

Integrating state of the art technologies in metrics and operational systems

Proposing technological innovations to serve oceanographic research, exploration for and exploitation of resources, and developing equipment and facilities which will be part of the development of large-scale Research Infrastructures.

This means:

- pursuing technological developments in the Carnot Ifremer-Edrome institute framework and helping support the world of industry by proposing technological expert assessments, site studies and impact measurements;
- contributing to keeping a high level of service in terms of underwater equipment, vehicles and systems;
- promoting and developing observatories around NAOS and the European Euro-Argo (open seas), EMSO (deep sea) and Jerico (coastal) projects, as well as the different measurement systems (buoys, profiling floats, seabed stations, gliders, surface drones, etc.);
- anticipating new tools for monitoring and surveillance incorporating high-frequency *in situ* tools, operational oceanography techniques and numerical modelling.

→ *RV* Pourquoi pas ?

Scientific partnerships

In 2013, Ifremer took part in the "Continental surfaces and interfaces" foresight exercise conducted by INSU. Amongst other things, this think-tank approach enabled a change in the scope of the national coastal environment programme to be enacted. It is now entitled "Dynamics and reactivity of the coastal interface" and includes the scientific challenges raised by the Marine Strategy Framework Directive (MSFD).

Under the aegis of the Coriolis oceanographic observation programme and the Mercator Ocean scientific advisory board, a foresight exercise devoted to operational oceanography was conducted, and its final report published in October 2013. This work mobilised scientists from Ifremer in partnership with the Mercator Coriolis and Mercator Ocean task group, securing the basis to identify the studies which should be conducted in the next few years, when the Mercator Ocean operational system is slated to become a Marine Core Service in the framework of the European Copernicus programme, following on from the MyOcean 1 and 2 research programmes.

Finally, a synopsis of the Coriolis group studies for 2014-2020 was produced with Ifremer's help (synopsis dated 24 June 2013) in preparing for the renewal of the Coriolis agreements, in order to maintain this important tool for observation and collection of oceanographic data on a lasting basis.

The AllEnvi alliance created in February 2010 now plays a greater role, like the other research alliances, in drawing up the national research strategy and in discussions for upcoming programming with the national research agency ANR.

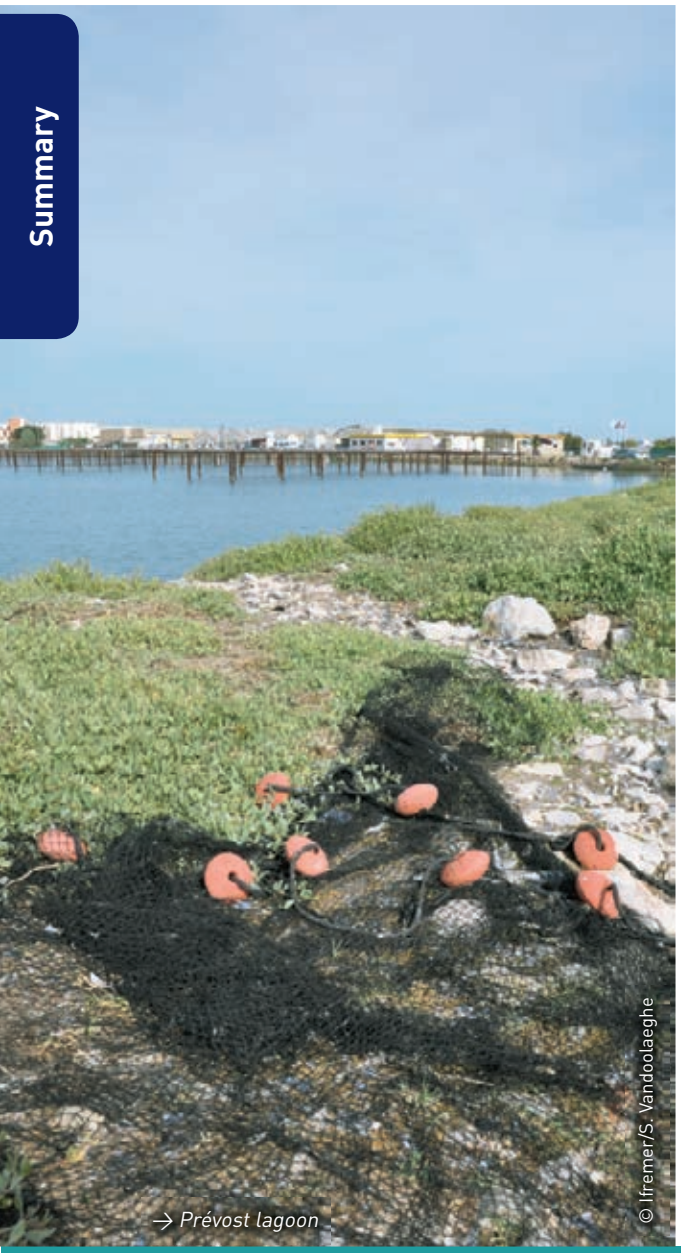
Above and beyond the various thematic groups in which our Institute's experts take part, the most structuring actions involve the Sea task group which is co-led by Ifremer, INSU and INEE, the Infrastructures task group, where Ifremer's contribution came through the Alliance's dedicated vice-chairmanship, its scientific steering committee and its board.

Through these different bodies, Ifremer was able to relay what is at stake for marine sciences and blue growth, in various documents produced during the year as well as at the environmental forum associating the stakeholders in November 2013 (where Ifremer moderated the Littoral workshop). They are moreover most appropriate tools for drawing up joint positions on shared means like infrastructures, such as the fleet and vehicles or environmental monitoring networks.

The foresight workshops (ARP), funded by the ANR, mobilise a range of skills in order to identify the scientific stakes of the future. In 2013, Ifremer actively contributed to the ARP MedMer, devoted to adaptation to environmental changes in the Mediterranean Sea, and to ARP MathsInTerre (mathematics and Earth system complexity). For the latter, Ifremer organised a seminar at the Henri Poincaré institute during which eight marine themes holding mathematical questions to be solved were discussed. The final document should be available in early 2014 and will propose structural actions to improve interdisciplinarity between mathematics and Earth sciences.

"Through these different bodies, Ifremer was able to relay what is at stake for marine sciences and blue growth, in various documents produced during the year.

Summary



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→ *Prévost lagoon*

New UMR joint research units in Languedoc-Roussillon

In 2013, the research units in the Languedoc-Roussillon region prepared their new projects, to begin in January 2015. This will be an occasion of major changes for Ifremer, in keeping with its strategic reorientations. Three hitherto separate laboratories (the environmental resources laboratory in Sète, the fisheries research laboratory of the current UMR joint research unit for exploited marine ecosystems in Sète and the biology of exploited marine organisms team in the current UMR for rational intensification for sustainable fishfarming in Montpellier) have decided to join together within a future joint research unit called the UMR Center for Marine Biodiversity Exploitation and Conservation, associating CNRS, IRD and the university of Montpellier II. The future unit will be the principal regional cluster for marine sciences and mobilise a very broad spectrum of expertise and skills, ranging from microbiology to ecology and including environmental chemistry, fisheries science, fish physiology and ecotoxicology.

The future host-pathogen-environment interactions unit (IHPE) will be more tightly focused on a more specific theme. It groups the RIME team from the current marine ecosystem UMR joint research unit in Montpellier and the current ecology evolution of interactions UMR in Perpignan to form a consortium made up of CNRS, Ifremer and the universities of Montpellier II and Perpignan, supported by a high-performance platform for molecular biology.

Doctoral policy

Ifremer maintained its doctoral policy in 2013 by co-financing twenty-six research grants. Moreover, our Institute is seeking to link and coordinate its doctoral policy with that of partner universities, by co-funding of PhD grants with them. For instance, this is the case in the ocean island environments UMR joint research unit in Tahiti, where work on a thesis began this year thanks to co-financing by Ifremer and the university of French Polynesia, in the UMR for exploited marine ecosystems in Sète, where a PhD student is funded by the university of Montpellier II.

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→ *Ifremer Pacific centre*

In 2013, sixty-four theses were defended by PhD students supervised by Ifremer researchers or those associated in the joint research units under contract. Two hundred forty-six PhD students were hosted for periods of more than three months at Ifremer and at UMR joint research units linked by contract. The corresponding figure for post-doctoral fellows is seventy.

Ifremer's scientific production seen through a few key indicators

An increase in quantity and quality for Ifremer's publications

In 2013, over 450 scientific publications listed at international level in the *Web of Science* were produced by Ifremer. This means publications for which at least one of the authors is a salaried employee of Ifremer. The total number of publications has risen each year; it was 276 in 2000.

Approximately one third of Ifremer publications in 2013 were published in journals whose impact factor (IF) is between 2 and 3. The number of publications in journals with an IF of 3 to 4 (about 120 in 2013) has more than doubled since 2009 and the number of publications appearing in journals with an IF higher than 5 (e.g. *Molecular Ecology*, ISME, PNAS, *Nature Geoscience* and *Science*) is close to 30. Most of the journals in question have an impact factor in the top quartile for their discipline. Ifremer's visibility is also growing steadily, with a clear rise in the rate of citation at three years.

Strategic orientations seen through bibliometric data

- About **40%** of publications concern the field of fisheries and aquaculture,
- **20%** ocean circulation,
- **25%** monitoring and the environment,
- **15%** mineral resources
- and **10%** deal with biodiversity.

A publication can be classified under several themes.

The importance of partnerships is shown through publications

93% of these publications were co-authored with research scientists from other institutes in France or abroad, which attests to our Institute's high level of cooperation with the national and international scientific community. Ifremer is often in a lead position for the results co-published, since a scientific from Ifremer is main author for nearly half of these publications.

Ifremer's primary partners in these publications are academics (e.g. 19% of publications co-authored by the university of western Brittany, 8% by the university of Montpellier and 6% by the university of Paris VI). Other important partners include researchers from CNRS and IRD, respectively co-authoring 15% and 5% of publications with one or more authors being a scientist at Ifremer.

Partnerships in the eight joint research units are particularly reflected in these joint publications, which also show strong partnerships with researchers in foreign institutes or universities. 35% of publications were co-authored with European organisations, primarily Cefas (Centre for Environment, Fisheries and Aquaculture Science, UK), HCMR (Hellenic Centre for Marine Research, Greece), IEO (Spanish oceanographic institute), the universities of Algarve and Lisbon in Portugal, Wageningen university, the Netherlands and the university of Bergen, Norway.

For this reason, the contribution from projects which receive co-funding from the European Union (particularly under FP7) is significant.

Furthermore, more than 30% of publications also have one or several authors from foreign countries outside of Europe, from NOAA, or the universities of California or Cape Town (South Africa) and over 10% have one or several authors from countries in the southern hemisphere. The United States is the country outside of Europe showing the most developed or productive partnership in terms of publications, since more than fifty publications were co-authored by a scientist from the USA. Partnership with China is slowly increasing, with five joint publications to date.

Research, results and partnerships through a few examples of scientific articles

The full diversity of Ifremer's research and results is reflected in our publications. They are available via the *Web of Science*, as well as free of charge thanks to the open access proposed by Archimer.

In the field of biological resources and the environment, there were numerous publications about studies on Pacific oyster pathologies and the research deployed to understand and combat the massive mortality episodes affecting this species.

De Decker S., Y. Reynaud and D. Saulnier, 2013. First molecular evidence of cross-species induction of metalloprotease gene expression in Vibrio strains pathogenic for Pacific oyster *Crassostrea gigas* involving a quorum sensing system, *Aquaculture*, 392, 1-7. http://archimer.ifremer.fr/doc/00124/23539/

Schmitt P., A. Santini, A. Vergnes, L. Degremont, J. de Lorgeril, 2013. Sequence polymorphism and expression variability of *Crassostrea gigas* immune related genes discriminate two osyter lines contrasted in term of resistance to summer mortalities, *PloS One*, 8, 9. http://archimer.ifremer.fr/doc/00157/26861/

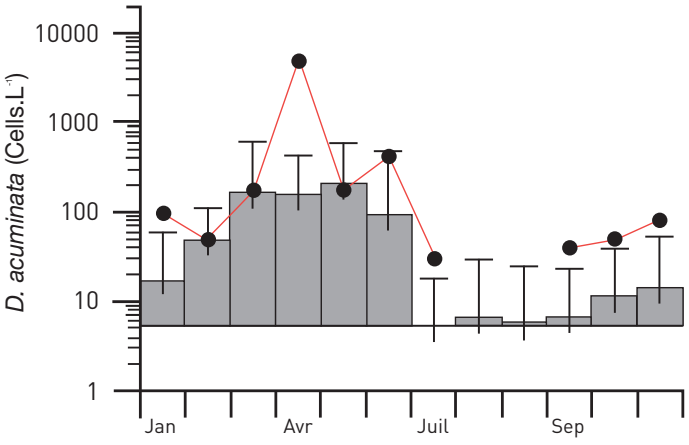
Other publications are devoted to analysing marine ecosystems and the impact of fisheries. In the example given, the conclusions drawn are based on the biological samples and data acquired during ocean research cruises performed over the past ten years in the Gulf of Lion. They describe the trophic structure of ecosystems, taking account of some forty groups of species, from phytoplankton to dolphins. The ANR co-funded the programme, as well as the salary of the post-doctoral research involved.

Banaru D., C. Mellon-Duval, D. Roos, J.-L. Bigot, A. Souplet, A. Jadaud, P. Beaubrun and J.-M. Fromentin, 2013. Trophic structure in the Gulf of Lions marine ecosystem (Northwestern Mediterranean Sea) and fishing impacts. *Journal of Marine Systems*, 111, 45–68. http://archimer.ifremer.fr/doc/00116/22758/

The data obtained via monitoring networks such as Réphy (phytoplankton and phycotoxins) are also used and their value developed through publications, notably in proposing models for the dispersal of toxic algae. Of course these results greatly interest the international scientific community. In this example, research which was co-financed by the European Union, an FP7 programme and additional "Marie Curie" funding for a post-doctoral researcher led to several papers being published. A hypothesis founded on the existence of pelagic seed bank stocks, was put forward to explain the episodes observed and the high concentrations in 2012 on the plateau des Landes shelf.

Batifoulier F., P. Lazure, L. Velo-Suarez, D. Maurer, P. Bonneton, G. Charria, C. Dupuy and P. Gentien, 2013. Distribution of Dinophysis species in the Bay of Biscay and possible transport pathways to Arcachon Bay. *Journal of Marine Systems*, 109, 273–283. http://dx.doi.org/10.1016/j.jmarsys.2011.12.007

Diaz P. A.1, B. Reguera, M. Ruiz-Villareal, Y. Pazos, L. Velo-Suarez, H. Berger and M. Sourisseau, 2013. Climate Variability and Oceanographic Settings Associated with Interannual Variability in the Initiation of *Dinophysis acuminata* Blooms, *Mar. Drugs* 2013, 11, 2964-2981. http://archimer.ifremer.fr/doc/00180/29157/27554.pdf



→ *Monthly means and standard deviation of* D. acuminata *abundance 1990-2013 (2012 data in red). Data from Réphy stations on the Landes plateau*

Ifremer's involvement in regions of overseas France is also illustrated in publications on pathogenic agents affecting shrimp in New Caledonia. This local study enjoyed strong support from Ifremer in metropolitan France, the Pasteur institute and Harvard University. Other publications focused on a subject of utmost importance for French Polynesia, i.e. pearl production by pearl oysters, and the territory's active participation in this research was shown by the presence of authors from the marine resources director and the associated EIG in Tahiti.

• Goudeneige D., Y. Labreuche, E. Krin, D. Ansquer, Mangenot, A. Calteau, C. Médigue, D. Mazel, M. Polz and F. Le Roux, 2013. Comparative genomics of pathogenic lineages of *Vibrio nigripulchritudo* identifies virulence-associated traits. *The ISME Journal*, 7, 1985-1996. http://dx.doi.org/10.1038/ismej.2013.90

• Ky C., C. Blay, M. Sham-Koua, V. Vanaa, C. Lo and P. Cabral, 2013. Family effect on cultured pearl quality in black-lipped pearl oyster *Pinctada margaritifera* and insights for genetic improvement. *Aquat. Living Resour.*, 26, 133-145. http://archimer.ifremer.fr/doc/00152/26310/

A number of publications reported on progress made in understanding the structure and functioning of the microbial ecosystems involved in the methane cycle and in the formation of carbonate chimneys. These results are the outcome of teamwork within UMR joint research units and national and international cooperation, and were obtained thanks to ocean cruises, aboard RV *L'Atalante* for the following example.

• Vigneron A., P. Cruaud, P. Pignet, J.-C. Caprais, M.-A. Cambon-Bonavita, A. Godfroy and L. Toffin, 2013. Archael and anaerobic methane oxidize communities in the Sonora Margin cold seeps, Guayamas basin (Gulf of California). *The ISME Journal*, 7, 1595-1608. http://dx.doi.org/10.1016/j.chemgeo.2013.08.008

• Bayon G., S. Dupré, E. Ponzevera, J. Étoubleau, S. Cheron, C. Pierre, J. Mascle, A. Boetius and J. De Lange Gert, 2013. Formation of carbonate chimneys in the Mediterranean Sea linked to deep-water oxygen depletion. *Nature Geoscience*, 6, 9, 755-760. http://dx.doi.org/10.1038/NGEO1888

The effect of global change on the ocean, on sea level or on CO_2 capture capacities is studied at Ifremer, in the framework of projects which are co-funded by the European Union, FP7 programme, and using ocean research cruises aboard *Thalassa* or *Pourquoi pas?*

• Pérez F., H. Mercier, M. Vázquez-Rodríguez, P. Lherminier, A. Velo, P.C. Pardo, G. Rosón and A.F. Ríos, 2013. Atlantic Ocean CO_2 uptake reduced by weakening of the meridional overturning circulation. *Nature Geoscience*, 6, 146-152. http://archimer.ifremer.fr/doc/00135/24625/

• Riboulot V., A. Cattaneo, N. Sultan, S. Garziglia, S. Ker, P. Imbert and M. Voisset, 2013. Sea-level change and free gas occurrence influencing a submarine landslide and pockmark formation and distribution in deepwater Nigeria. *Earth and Planetary Science Letters*, 375, 78-91. http://dx.doi.org/10.1016/j.epsl.2013.05.013

These publications were co-authored, for a large number of them, by scientists from the university, CNRS and IRD, particularly for research conducted in a UMR. Students working towards a Master 2 degree or a PhD are frequently involved in these studies, and PhD students often indicated as main author.

Delivering a scientific intelligence service to support research and innovation

Conducting a watch on scientific production and producing analyses of scientific metrics or bibliometrics are required forms of support in deploying our Institute's scientific policy.

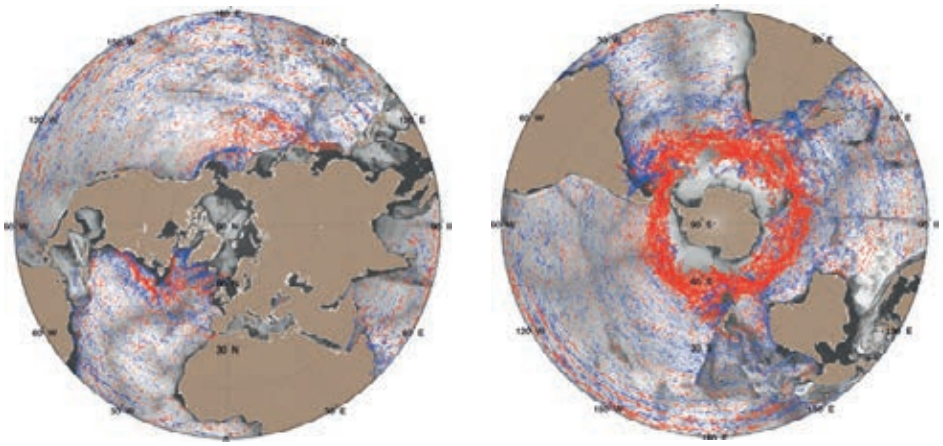
This activity is led by the IST teams at Ifremer, who are themselves part of the La Pérouse library, an unincorporated entity for cooperation set up by the IRD, university of western Brittany and Ifremer.

In 2013, the interest of using scientific intelligence as a decision-making tool was illustrated in the support provided for several scientific projects both within the Institute and in our partner organisations like the marine cluster of Brittany (microplastics, marine renewable energies, mineral resources and marine biotechnologies, marine protected areas, and so on).

In this framework, several targeted information products were created. They include cartographic analyses of the corpus (top tier publications), state of the art from grey literature (research reports, symposia and PhD theses), the press, and theme-based watch newsletters and setting up dynamic web portals.

Scrutinising scientific activities with respect to the strategic plan

For a more detailed illustration of the Institute's scientific activity in 2013, this section reviews a few examples of research carried out by Ifremer in relation to the main strategic priorities indicated above.



© Ifremer

→ *Mean currents at an estimated depth of 1,000 m, based on Andro database, for Northern (left) and Southern (right) hemispheres.*

Orientation 1: Learn about ocean dynamics to supplement the diagnosis of global change and anticipate changes in the coastal domain

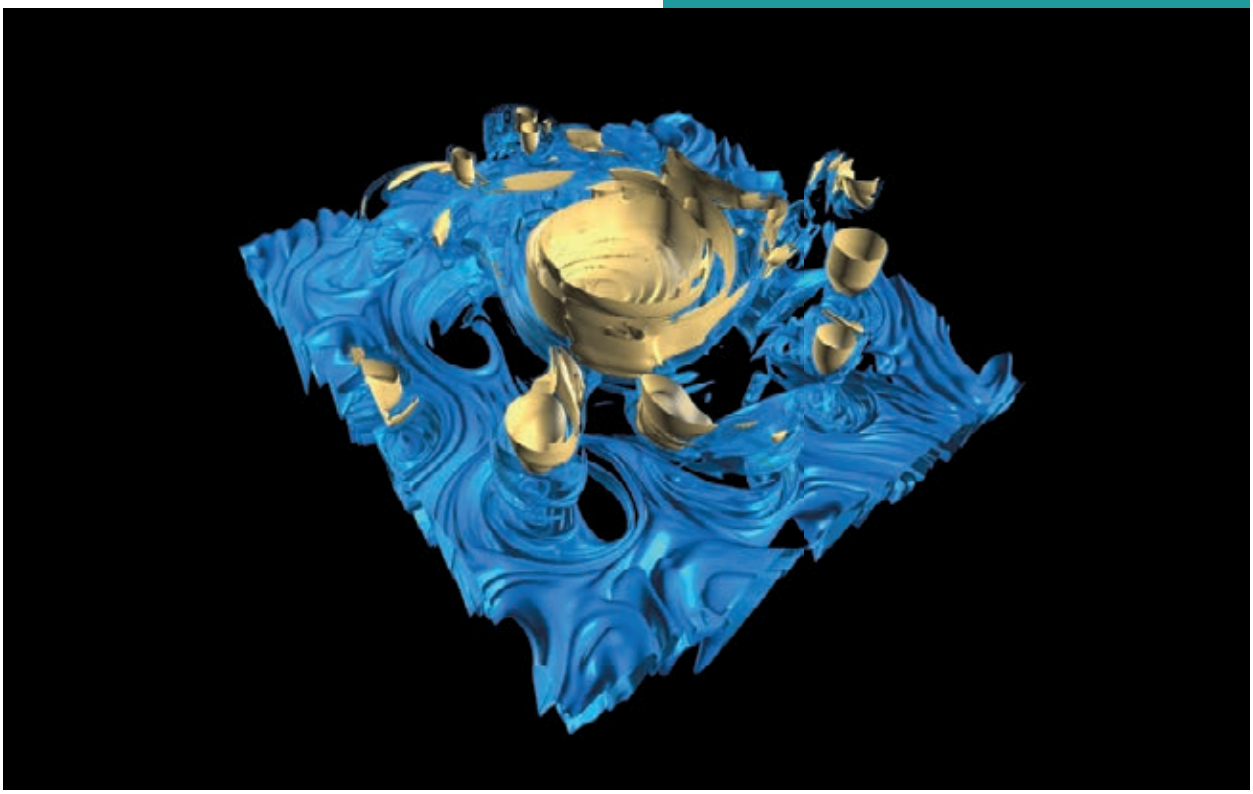
Studying the ocean at very high resolution

It is indispensable to know about ocean circulation and its role in the earth's climate system in order to understand the changes underway and develop models to forecast how it will evolve in future. One major contribution to ocean observation has been the deployment on the global scale since 2000 of the Argo array of profiling floats, making it possible to measure the physical parameters of ocean water bodies to depths reaching 2,000 metres. In the framework of an international programme bringing together over thirty countries, the Coriolis data centre coordinated by Ifremer constantly gathers the sets of data sent by some 3,000 active floats. Making the Atlas Andro data available online in 2013 was the outcome of work done to summarise the observations from the Argo network. Reprocessing of Argo profiling float data covering the period from 2000 to 2009 inclusive enabled a global database of deep displacements to be generated. The displacements delivered by Argo floats make up the Andro "atlas" which can be freely accessed on the site of the ocean physics laboratory (http://wwz.ifremer.fr/lpo/).

The collaborative work done between the ocean physics laboratory and the Japanese oceanographic institute Jamstec to process very high-resolution data led to new results being obtained on the impact of fine-scale ocean features on circulation at the scale of the North Atlantic or North Pacific. The simulations

performed using the Japanese Earth Simulator supercomputer revealed the great informational potential of jointly analysing very-high resolution data for the surface (obtained via satellite) or the deep sea (by novel use of seismic reflection). Estimating the fine-scale dynamics thanks to knowledge about high-resolution sea surface topography is currently being used to develop upcoming international altimetry missions: SWOT (Surface Water Ocean Topography Mission, CNES-NASA) for high-resolution ocean topography measurements and Compira (Coastal and Ocean measurement Mission with Precise and Innovative Radar Altimeter, Japan, Aerospace Exploration Agency JAXA). In all, four co-authored publications were produced in international journals in 2013[1].

High-resolution numerical simulation of the potential vorticity of an eddy of Mediterranean water at a depth of nearly 1,000 m in the Atlantic off the Iberian coast. This quantity enables the saline, warm Mediterranean water in yellow to be distinguished from the Atlantic water in blue. This "meddy" can reach a thickness of 800 m, a diameter of 50 km and current speeds of about 50 cm/s. It is the result of the layer of Mediterranean water spilling into the deep Atlantic via the Strait of Gibraltar.



→ *This image, constructed using very high resolution simulations performed by Lien HUA, shows the destabilisation of a medium scale (100 km in diameter) eddy producing finer-scale eddies*

1/ Ponte A. L., P. Klein, X. Capet, P.-Y. Le Traon, B. Chapron, and P. Lherminier (2013). Using high resolution satellite observations to diagnose the surface mixed layer dynamic, *Journal of Physical Oceanography*, 43, 1345-1355.

Joyce Terrence M., J. M. Toole, P. Klein, N. Thomas Leif (2013). A near-inertial mode observed within a Gulf Stream warm-core ring. *Journal of Geophysical Research-oceans*, 118 (4), 1797-1806.

Bach-Lien H., C. Menesguen, S. Le Gentil, R. Schopp, B. Marsset, H. Aiki (2013). Layering and turbulence surrounding an anticyclonic oceanic vortex: *in situ* observations and quasi-geostrophic numerical simulations. *Journal of Fluid Mechanics*, 731, 418-442.

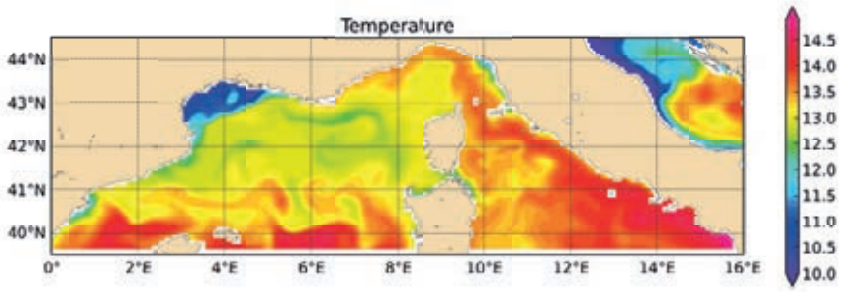
Use of seismic reflection to observe the fine-scale structures of the ocean was tested on the continental shelf of Brittany during the Aspex cruise in June 2012. This made it possible to obtain an unprecedented image of the seasonal thermocline, located at a depth of thirty metres on the continental shelf of Brittany (Iroise Sea), as well as its perturbations by internal ocean waves, thanks to high lateral resolution (10 m) supplied by seismic reflection[2].

Foresight studies on operational oceanography

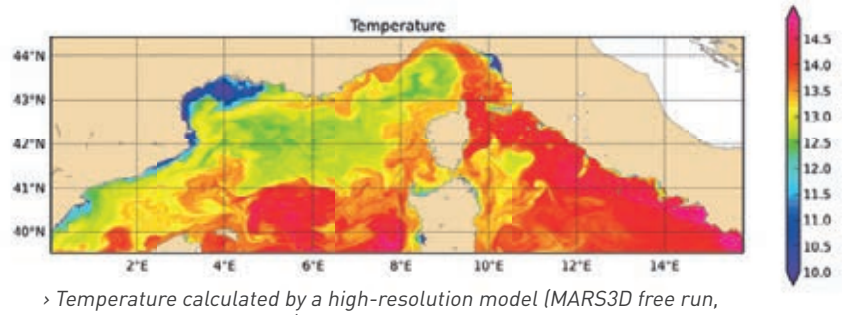
Ifremer contributed to foresight studies on deep-water and coastal domains which were conducted on national and international scales in 2013.

At the national level the foresight work based on a partnership of research and operational stakeholders in the French community (http://www.mercator-ocean.fr/fre/science/gmmc/Prospective-Oceanographie-Operationnelle) is laying the foundations for operational oceanography which will enable physical and biogeochemical parameters to be observed and simulated on deep-sea, regional and coastal scales. It is part of a European movement aiming to build a lasting EC service for operational oceanography ("marine monitoring" strand of the European earth observation programme Copernicus, http://www.copernicus.eu/).

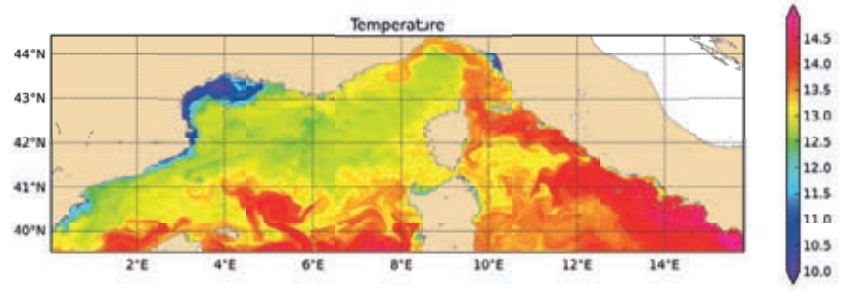
The COSS-TT (Coastal Ocean and Shelf Seas Task Team) working group of *Godae OceanView* (https://www.godae-oceanview.org/) aims to build an international scientific community working on numerical modelling, data assimilation and model validation on the scale of the coastal transition zone. France is represented by the CNRS/Legos laboratory and by Ifremer's Physed laboratory, working in particular on downscaling techniques, including "spectral nudging". The latter technique makes it possible to take advantage of the data assimilation performed on lower resolution global models, for use in high-resolution models which do not assimilate observational data.



› *Temperature calculated by a global model (low resolution, assimilated)*



› *Temperature calculated by a high-resolution model (MARS3D free run, without data assimilation)*



› *Temperature calculated on model with resolution after spectral nudging, thus combining fine-scale structures and the advantages of assimilation*

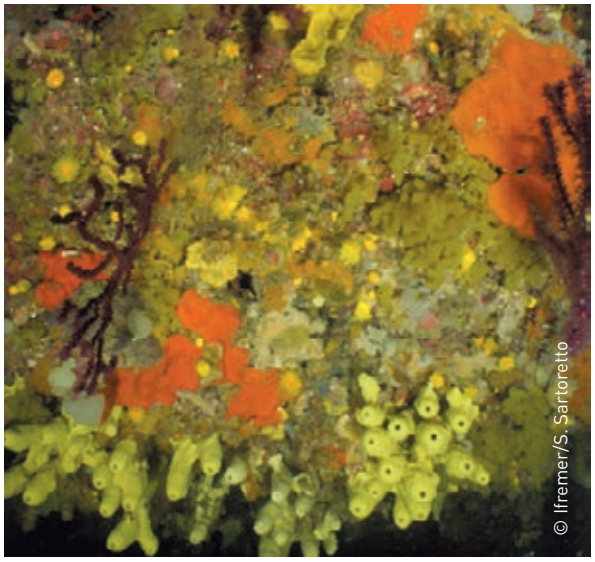
→ *Illustration of the spectral nudging technique used to improve high-resolution numerical outputs by taking advantage of data assimilation techniques applied to global models. The local model (in this case, a Mediterranean configuration from MARS3D[3]; http://wwz.ifremer.fr/mars3d)*

2/ Piété H., B. Marsset, Y. Thomas and M.-A. Gutscher (2013): Seismic reflection imaging of shallow oceanographic structures. *Journal of Geophysical Research-Oceans*, 118 (5), 2329–2344.

3/ Garreau P., Garnier V. and Schaeffer A. (2011). Eddy resolving modelling of the Gulf of Lions and Catalan Sea. *Ocean Dynamics*, 61(7), 991-1003.

Orientation 2: Learn about and characterise marine biodiversity to better protect it

Index for the status of coralligenous formations in the Mediterranean



→ *Porifera and anthozoa making up up a coralligenous seabed in the North-western Mediterranean (region of Marseille)*

A 2013 milestone was the kick-off of the Index-COR project's operational phase, in partnership with the agency for marine protected areas and working in collaboration with several scientific teams from the Mediterranean arc (university of Barcelona, university of Genoa, Pythéas institute in Marseille and university of Nice). The project aims to create an index to assess the conservation status of coralligenous seabeds, these typically Mediterranean bio-concretion structures built by coralline algal crusts.

This habitat is the second biodiversity hot spot in the Mediterranean after that of posidonia meadows (*Posidonia oceanica*) in terms of the number of species inventoried. These are very old structures (some of them several thousand years old) and are subjected to multiple forms of pressure (fisheries, diving, discharges from sewage treatment plants, etc.) which contribute to making this habitat more vulnerable. The method developed in the Index-COR framework was adopted in that of the Cigesmed SeasEra ERA-NET project, also launched in 2013 in partnership with Greece and Turkey, which will allow intercalibration of several indexes covering the scale of the entire Mediterranean.

This simple and robust method can be transferred to environmental managers and is now being further developed and tested. Taking its inspiration from what is done in tropical reef environments (called the "Reef Check" method), it is based on a visual, thus non-destructive approach to analyse the composition of associated benthic communities (macrospecies). It is based on *in situ* sampling (by diver) and photo-quadrats which are post-analysed using PhotoQuad software. Video recordings and notes taken *in situ* by a diver-observer supplement it.

Proliferation of brittle stars at the tip of Brittany

A large-scale phenomenon of *Ophiocomina nigra* proliferation at the tip of Brittany over the past two decades was highlighted in the framework of the Crapo project (Characterisation of diet in brittle star populations; 2010-2013). This spread of the *O. nigra* population has brought about deep-ranging changes which have led, *inter alia*, to another species of brittle star, *Ophiothrix fragilis* being excluded from the area. *O. nigra* now holds a predominant position amongst primary consumers in the benthic compartment in the Bay of Brest and Bay of Douarnenez. For instance, in the Bay of Brest, *O. nigra* was hardly present in 1987, but its density has increased five-fold and its biomass three-fold, making it the dominant species, whereas the biomass of the initially dominant species *O. fragilis* has hardly changed. *O. nigra* now covers practically the entire zone sampled, with the exception of beds of dead crepidula slipper limpets. Today, these two species alone represent over 1,000 tonnes of dry matter in the central basin of the bay.

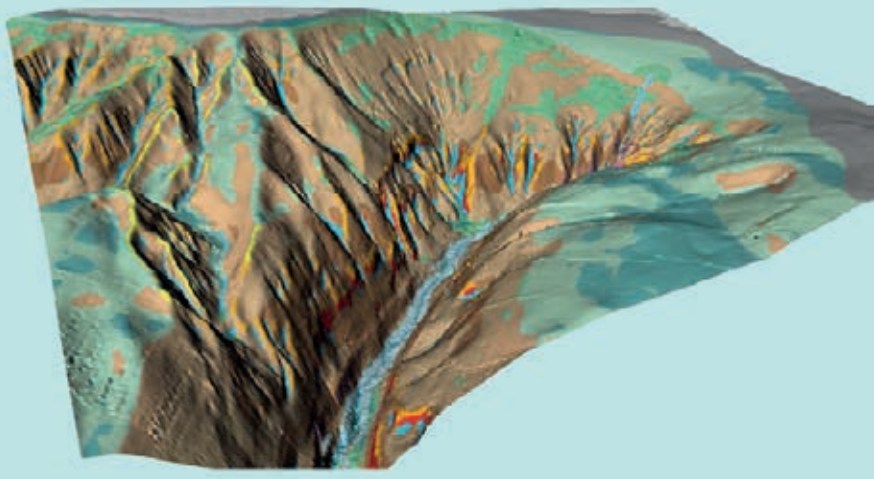
*Black brittle stars (*Ophiocomina nigra*)* ←
in the bay of Douarnenez

End of the Coralfish project: Ecosystem based management of corals, fish and fisheries in the deep waters and beyond

→ *Deep coral reefs in the North Atlantic*

The European Coralfish (coordination by A. GREHAN, National University of Ireland) project's objective was to evaluate the interactions between cold water corals, fish and fisheries, in order to develop tools for monitoring and predictive modelling for ecosystem-based management in six deep-water provinces from Iceland to Greece. For the Bay of Biscay, data from three dedicated cruises are available to supplement historic cruise data and have been analysed in a highly novel approach to create high-resolution mapping of the geomorphology of the upper continental slope and characterise hydrodynamic conditions[4]. The study also delivered characterisation of the habitats and vulnerable species present, mapping of geomorphological sectors which are promising for associations of coral and taking inventory of anthropogenic impacts. It was moreover possible to compare the genetic profiles present in relatively untouched areas with those of areas impacted by fisheries, in order to estimate the reproduction strategy.

→ *Distribution of geomorphological classes at the head of the Odet canyon (grey: continental shelf; green: gentle interfluvial slope and terrace on the canyon flank; yellow and orange: spur and crest; brown: flank of canyon; red: scarp; purple: canyon bank; blue: ravine, bed and thalweg of canyon)*[5]



4/ Khripounoff A., Caprais J.-C., Le Bruchec J., Rodier P., Noël P. and Cathalot C. (2014). Deep cold-water ecosystems in the Brittany submarine canyons (Northeast Atlantic): Hydrodynamics, particle supply, respiration and carbon cycling. *Limnology and Oceanography*, 59 (1), 87-98.

5/ Bourillet J-F., de Chambure L. and Loubrieu B. (2012). *Sur les traces des coraux d'eau froide du golfe de Gascogne*. (On the track of cold water corals in the Bay of Biscay, 8 bathymorphological and geomorphological maps, 1/100.000, Ifremer & Quae (Éd.)

European Macumba project (Marine Microorganisms: Cultivation Methods for Improving their Biotechnological Applications)

Microbial diversity is to a great extent unknown, particularly in the ocean where thousands of different microbial species can develop in each millilitre of water. A large part (99%) of this diversity has not been cultured and is often qualified as being impossible to cultivate. In this project, the LM2E laboratory (UMR6197) is deploying the Cocagne automated platform for culture and isolation, as well as cultivating hyperthermophilic microorganisms in bioreactors.

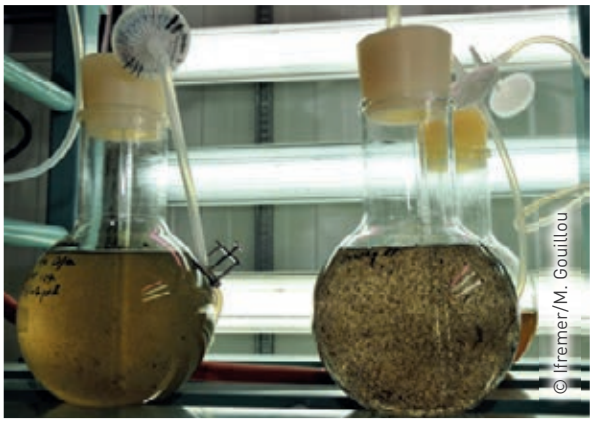
In September 2013, the annual project meeting in Roscoff, focused on improving the conservation of microorganisms in different collections, harmonisation of these collections, use of new generation sequencing (NGS) approaches and data utilisation and the technological developments required in order to improve the capabilities to isolate and culture marine microorganisms.

Kick-off of the European Midas project

The Midas (Managing Impacts of Deep-sea resource exploitation) project, grouping thirty-two European partners, began in November 2013. It focuses on the exploitation of the main deep-sea resources for which the strategic stakes are high (polymetallic sulphides, manganese nodules, cobalt-rich ferromanganese crusts, rare earth elements and methane hydrates). The project's objectives are to identify the scale and duration of potential impacts of extracting these resources from the deep-sea environment. It also aims to develop workable solutions and best practice codes for environmentally sound and socially acceptable commercial activities. It will seek to develop cost-effective technologies for monitoring the impacts of mineral exploitation and the subsequent recovery of ecosystems. Another of its challenges is to work with policy makers in the European and international arenas to enshrine best practice in international and national regulations and overarching legal frameworks.

Orientation 3: Develop enhanced value and use of biological resources through biotechnologies and bioprospection

Bioprospection of microalgae in the New Caledonian lagoon



→ *Culturing flasks for microalgae*

The Amical (French acronym for microalgae aquaculture in New Caledonia) project's objective is to set up a supply chain to produce microalgae in New Caledonia and develop their value for use. An initial avenue for business development will be the utilisation of algal biomass in feeds for aquaculture or even agriculture. Then, depending on the local species selected, value chains for molecules of higher added value will be established. The year 2013 was devoted to setting up the microalgae laboratory (LEMA) in Noumea, supporting the agency for economic development in New Caledonia (Adecal), and to bio-prospection for potential microalgae candidate species on several coastal sites.

The scientific coordination of this project is ensured by the physiology and biotechnology of algae laboratory (PBA) in Nantes.

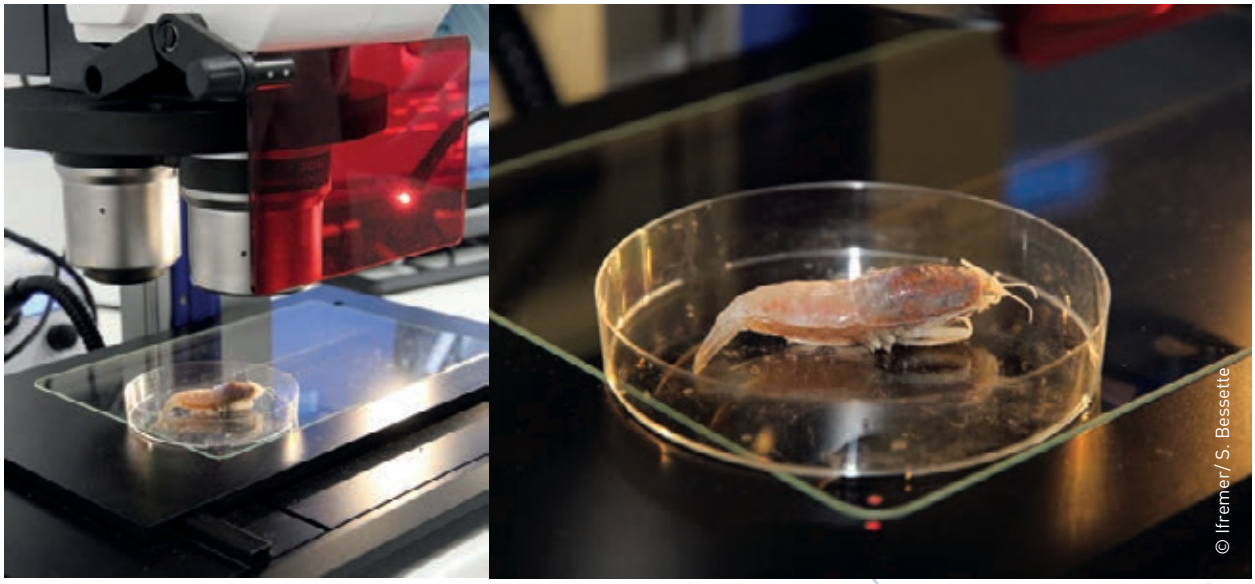
Archaebacteria from hydrothermal vents

One of the research orientations at the microbiology in extreme environments laboratory (UMR 6197 Ifremer/UBO/CNRS) focuses on studying the mechanisms which enable hyperthermophilic archaea to duplicate and conserve their genomes under environmental conditions which promote the appearance of lesions in DNA. One of the models studied,

Pyrococcus abyssi (meaning abyssal fireball), multiplies at the same pace as *Escherichia coli* bacteria, but in a culture medium whose temperature can reach 95°C! Samples of this organism were taken from a hydrothermal vent at a depth of 2,000 m. The group in charge of this research theme uses a combination of approaches including biochemistry, genetics, structural biology and proteomics to find and characterise the thermostable enzymes involved in repairing and replicating DNA. They were able to unveil a network of protein-protein interactions of a hundred proteins implicated in this process (Pluchon *et al.*, 2013. PlosOne) and demonstrate a novel inhibition of DNA polymerase by uracil. This nitrogenous base appears spontaneously in DNA by cytosine deamination into uracil. The rate of transformation rises with the effect of temperature, it was previously shown that this lesion is present in hyperthermophilic *Archaea* genomes (Richardson *et al.*, 2013, Nucleic Acids Research). Numerous discoveries are expected on these hyperthermophilic archaea, both in basic research and with the perspective of technology transfers, for instance with applications in the fields of criminology or paleogenetics.

A PhD student wins the national contest for innovative enterprise creation

The submission by Elefterios CHALKIADAKIS, a PhD student whose thesis is co-supervised by Ifremer and the Pasteur institute of New Caledonia (IPNC), was selected in June 2013 in the national contest organised by the Ministry of higher education and research (MESR) in partnership with OSEO ("Blue biotech: producing marine biopolymers" in the "Emergence" category). The contest aims to support innovative projects and accompany the new entrepreneurs in their search for funding. The start-up that E. CHALKIADAKIS plans to set up in New Caledonia aims to use biopolymers with high added value with microorganisms from unusual New Caledonian intertidal environments.



→ *Observation of symbiotic microbial communities associated with hydrothermal shrimp* Rimicaris exoculata

Orientation 4: Identify and support pathways for sustainable development of fisheries and aquaculture confronted by global change

The demand for animal proteins has led to overfishing of stocks over the past fifty years by professional fisheries. Concomitantly, aquaculture has developed to reach production volumes of 63.6 million tonnes. The challenge for mariculture, which makes great use of catches from industrial fisheries for fish meal, is to understand the mechanisms of feed efficiency in fish, studying both fasting and assimilation of plant-based proteins. These studies are being conducted at the experimental platform of Palavas-les-Flots.

By elucidating the mechanisms, better understanding should also be achieved about how populations in the natural environment evolve when subjected to global change including food web perturbations.

Developing bioeconomic coviability models to analyse fisheries management scenarios in the Bay of Biscay

The ANR Adhoc project led to the development of a bioeconomic model of stochastic coviability applied to demersal fisheries in the Bay of Biscay. The impacts related to trade-offs between ecological, economic and social objectives for the management of mixed fisheries were studied. The approach developed can take the complexity and uncertainty of the dynamic interactions characterising such fisheries into account. Various management strategies were tested and compared, particularly in terms of their probability of ecological viability (i.e. the likelihood that the Spawning Stock Biomass of all stocks studied will be greater than the precautionary SSB threshold) and their probability of socio-economic viability (the likelihood that positive profits for the sub-fleets studied will be maintained). Simulations of reducing fishing capacity by fleet have shown that there are management measures which make the system's co-viability (biological viability of the different species in question and socio-economic viability of fleets) possible, contrary to the outcomes of strategies for single species or those based on maximizing yield[6].

Complex models for the ecosystem-based approach to fisheries

Against the backdrop of climate change and sustainable management of natural or exploited resources, models are increasingly incorporating the dynamics and processes related to complex systems. To explore their properties and determine their relevance for decision-making, reference is often made to global sensitivity analyses. Studies in this field by the Mexico network of partners (Irstea, INRA, university of Côte d'Opale, Cirad and Ifremer) were summarised in the 2013 French publication entitled *Analyse de sensibilité et exploration de modèles développés en approche écosystémique pour l'halieutique*[7] (Sensitivity analysis and exploring models developed in an ecosystem approach for fisheries).

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→ *Pearls*

6/ Gourguet S., Macher C., Doyen L., Thébaud O., Bertignac M. and Guyader O. (2013): Managing mixed fisheries for bio-economic viability. *Fisheries Research*, 140, 46-62.

7/ Faivre R., Iooss B., Mahévas S., Makowski D. and H. Monod (2013). *Analyse de sensibilité et exploration de modèles développés en approche écosystémique pour l'halieutique éditions Quae.*

Understanding biomineralisation processes in the pearl oyster

Reports on studies by the GDR Adequa (for improvement of pearl quality in French Polynesia, 2008-2012) research group on the biological mechanisms involved in grafting and acquiring a knowledge base on the mineralisation processes of pearls in order to improve their quality were presented in Tahiti in November 2013. This research grouping is made up of ten public-sector and private-sector partners in Polynesia and metropolitan France. One of the major results[8] obtained shows that the formation of both shell structures (prism and nacre) is controlled by different groups of proteins. The secretory regime of the mantle epithelium zone which synthesises the prisms is completely different from that of the epithelium synthesising the nacre. This represents major progress in our knowledge about biomineralisation, and should hold significant benefits for the perliculture sector in terms of potential controlling pearl quality.

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Orientation 5: Explore the seafloors and, through a systemic approach and context of sustainable development, identify the requisite conditions for exploiting mineral and energy resources

Structuring of margins

Study continued in the South Atlantic on the formation of passive margins and thinning processes of the continental lithosphere, leading to subsidence and sedimentary infill and determining the margin's thermal history, carried out in cooperation with Petrobras. Combined data from seismic reflection and seismic refraction have given detailed imaging of the deep structure and the segmentation on this section of the margin and made it possible to propose a new model for initial evolution (between 130 and 108 million years)[9].


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→ *Retrieval of Sysif near-bottom seismic module*

8/ Marie B., C. Joubert, A. Tayalé, I. Zanella-Cléon, C. Belliard, D. Piquemal, N. Cochennec-Laureau, F. Marin, Y. Ghueguen and C. Montagnani (2012): Different secretory repertoires control the biomineralization processes of prism and nacre deposition of the pearl oyster shell. PNAS, 109, 20986-20991.

9/ Aslanian D. and Moulin M. (2013). Sanba Project - Final report. Wide-angle and multi-channel seismic experiment in the Santos Basin (Brazil). Ifremer/REM/GM/LGG. Plouzané, France, Ifremer: 213 p.

Integrated study of passive margins

In 2013, Ifremer and Total signed the Pamela (*Passive Margins Exploratory Laboratories*) framework agreement. Five themes were defined, requiring the acquisition of original data in partnership with universities and institutes: geodynamics, sedimentary models, geohazards, fluids and environment. Already in 2013, two actions enabled the mapping and location of fluid escape phenomena based on weak signals detected in the water column of the Bay of Biscay, and thus characterise the interactions between turbidite, gravity and contourite deposits east of Corsica.

Geological hazards

Research on geohazards involves identifying the physical processes at the origin of slope instability or landslides (predisposing or triggering factors), detecting indicators of deformation and assessing hazards. Three high-priority study areas were investigated: the Algerian margin (European Spiral project), the Istanbul region (EU Marsite project) and the western Mediterranean (Prisme2 and Prisme3 cruises). For the latter area, traces of major landslides which were particularly well preserved make it possible to understand the nature of the slide deposits, their shape and age, the mechanical properties of sediments and ultimately, to work back to the causes for their triggering and their recurrence time[10]. Furthermore, for the first time in detail, the relationships between fluid seeps modulated by sea-level change in the Quaternary and the presence of a slide acting as an impermeable barrier[11].

Mineral resources

On this theme, the Iguanes cruise (cooperation between the university of Perpignan and Ifremer) studied the interactions between submarine landslides, fluid circulation and the structure of the French Guiana margin and the margin formed by slippage opposite to passive margins. The Colmeia cruise looked for active hydrothermal fields and traces of movements of the Saint-Paul transform fault located in the Brazilian exclusive economic zone and in international waters (cooperation between CNRS-IUEM, Ifremer-Brazil). The data acquired off Wallis & Futuna during the Futuna cruises made it possible to draft an application for an exploration permit, sponsored by ERA-NET on behalf of the "Futuna" consortium associating Technip and Ifremer (October 2013).

Seafloor observatories

In Europe, the infrastructures for fixed point ocean observatories are gathered within the EMSO (*European Multidisciplinary Seafloor and Water Column Observatory*) project. At the end of 2013, the application for the creation of an ERIC (*European Research Infrastructure Consortium*) entity was submitted by Italy, with the support of ten countries, including France.

Enjoying the support of the European Commission for the next four years, the Fix03 (*Fixed point Open Ocean Observatory*) project, which began in 2013, aims to integrate these deep sea observatories on the scale of Europe. It is complementary to the European Jerico (*Towards a Joint European research infrastructure network for coastal observatories*) project for coastal observation and the Euroargo project devoted to Lagrangian (subsurface) profiling floats. This enlarges EMSO cooperation to comprise the Eurosites/Oceansites mooring lines and the network to measure CO_2 at sea from the ICOS programme.

10/ Cattaneo, A., Jouet, G., Charrier, S., Théreau, E. and Riboulot, V. (2014). Submarine landslides and contourite drifts along the Pianosa Ridge (CorsicaTrough, Mediterranean Sea). In: S. Krastel et al. (eds.), *Submarine Mass Movements and Their Consequences, Advances in Natural and Technological Hazards Research*, Springer, 37: 435-445.

11/ Riboulot V., Cattaneo A., Sultan N., Garziglia S., Ker S., Imbert P., Voisset M., 2013. Sea-level change and free gas occurrence influencing a submarine landslide and pockmark formation and distribution in deepwater Nigeria. *Earth and Planetary Science Letters*, 375, 78 - 91.

Summary

Marine renewable energy sources

Research conducted in 2013 in the framework of the European Marinet project and collaborative work with projects for industrial developments (Winflo, Orca, Sabella) focused on concepts for energy conversion devices (floating wind turbine, tidal stream turbine). These are large structures (which can weigh over a thousand tonnes) parts of which are above water (wind turbines, floaters) and underwater (mooring lines, stream turbines, etc.). They are subjected to the mechanic action of waves, currents and wind and to the corrosive action of the marine environment. Numerical modelling and experimental studies are used to analyse their hydrodynamic behaviour under these mechanical loading effects. In this context, the Homere (*Hydrodynamics Ocean-Meteorology and Marine Renewable Energies*) database for sea states was created.

In addition, Ifremer took part in the work performed for the interim organisation set up to prefigure the Institute for energy transition called "France Énergies marines" and actively contributed to the collaborative Ghydro (methodology guide to assess environmental impacts for tidal stream technologies at sea) project which was completed in 2013.

→ *Trial of floating wind turbine mockup in test tank at Ifremer Brittany centre*

Orientation 6: Understand how ecosystems function and develop tools to serve the good environmental status of coastal seas

Atlantic Area Eunis habitats

In the frame of the MeshAtlantic project (2010-2013), the European research community working on benthic habitat mapping compiled and standardised the existing maps in Atlantic Area countries, between Ireland and Gibraltar, to create a homogeneous map of physical seabed habitats for the entire area. Special techniques for observation and sampling (acoustics, video, ROV, grabs, dredges, divers) to describe the biological and geological nature of the seafloor were deployed, enabling eighty-five new habitat types to be added to the habitat typology for south-western Europe. They are seen from the shore to depths of about 3,000 metres and have been described on the basis of their biological, soil and oceanographic characteristics.

These new habitat types were proposed to the European Environment Agency (EEA) to be included in the European Nature Information System (Eunis) classification. It was also requested that the Eunis classification be revised. The revision work led by EEA began in 2013 and should be completed in late 2014. Ifremer is closely involved through the European project EUSeaMap2 which it coordinates and whose aim is to create a seabed habitat map covering all European seas.

Impact of climate change on ecosystems: assessing the risk of mortality in temperature-sensitive benthic species in the North-west Mediterranean (Climcares)

The Climcares (http://climcares.medrecover.org/) project's objective was to assess the impact of climate change on ecosystems by focusing on how benthic species responded to the summer heat waves along the North Mediterranean coast. A methodology was developed to assess the risk of potential mortality in red gorgonians1, based on use of hydrodynamic modelling (MARS3D) and warming scenarios (in partnership with the *Météo France* national meteorological research centre), observation (temperature monitoring, identification of areas where species live by J. GARRABOU from the Spanish CSIC institute) and experiments (testing the thermotolerance of gorgonians in the aquarium).

12/ Pairaud I.L., Bensoussan N., Garreau P., Faure V. and Garrabou J. (2014). Impacts of climate change on coastal benthic ecosystems: assessing the current risk of mortality outbreaks associated with thermal stress in NW Mediterranean coastal areas. *Ocean Dynamics*, 64,1, 103-115.

Acquisition of data on emerging risks linked to algal biotoxins

A newcomer in France, pinnatoxin has been shown to be the cause of atypical toxicity events observed in shellfish from the French Mediterranean lagoon Ingril in 2011. Since then, the dinoflagellate (*Vulcanodinium rugosum*) producing it has been cultured in the Phycotoxins lab to experimentally confirm its accumulation in bivalve molluscs and to screen for metabolites of interest[13]. Along with pinnatoxin, another toxic compound was identified in *V. rugosum* extracts, in an approach combining chemical screening with (high resolution) mass spectrometry and biological screening by miniaturised bioassay (cytotoxicity)[14]. This compound, called portimine, has greater cytotoxicity than pinnatoxin. The study run under controlled conditions in the laboratory showed that portimine also accumulates in mussels, but to a lesser extent than pinnatoxin. These data will be used as the basis for assessing the health risks presented by this dinoflagellate which was recently discovered in French waters.

Phycotox research grouping

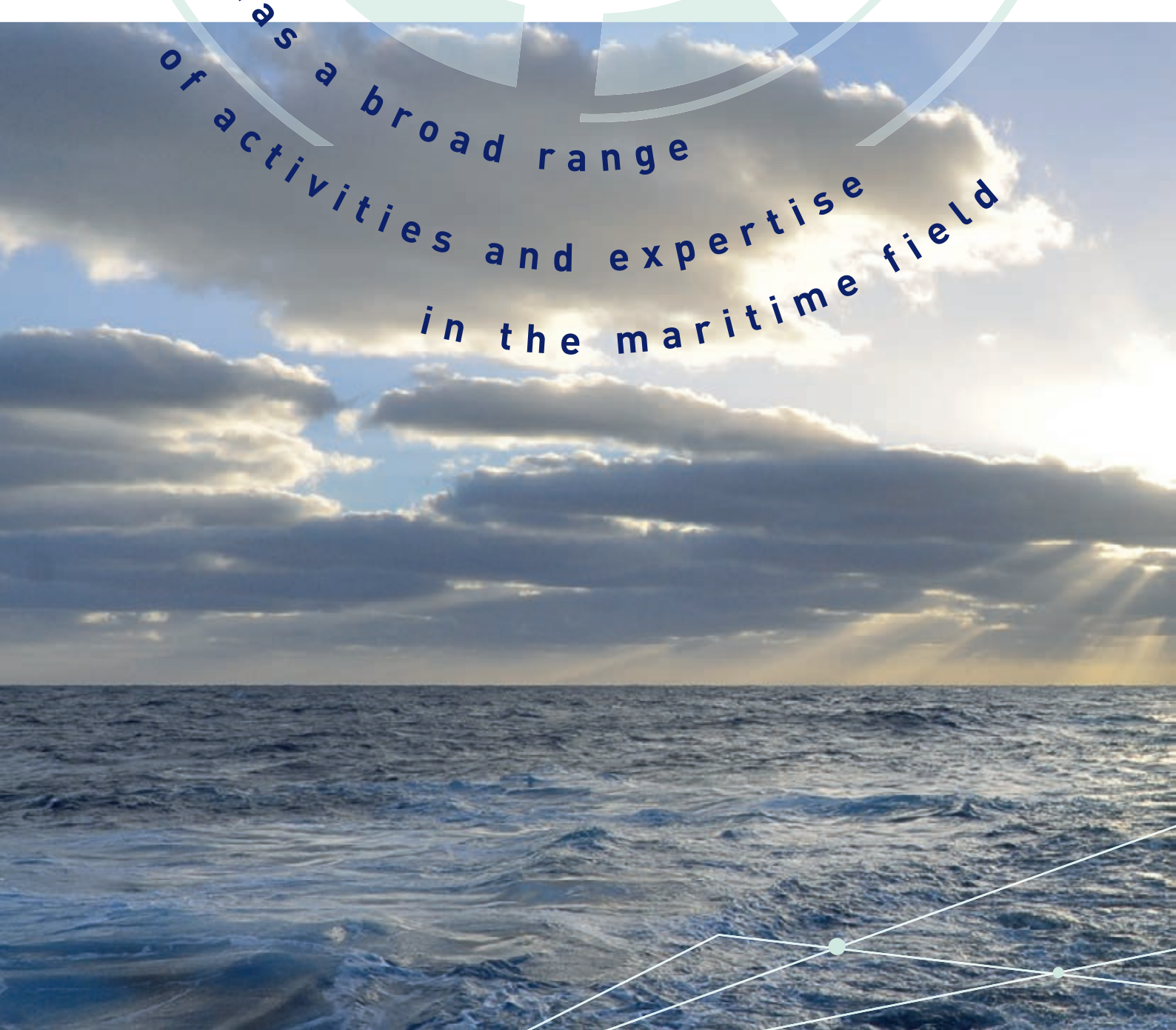
In 2013, Ifremer and CNRS created the Phycotox research grouping (GDR) on the theme of toxic algae and their toxins. The GDR is coordinated by IUEM/Lemar and Ifremer (Phycotoxins laboratory), where twenty-five French teams (from metropolitan and overseas France) are working with the aim to better understand the determinism of these microalgae, the potential impacts of phycotoxins on human health, the impact of *harmful algal blooms* (HAB) on the ecosystem and to identify and quantify the social and economic stakes.

13/ Hess P., Abadie É., Hervé F., Berteaux T., Séchet V., Aráoz R., Molgó J., Zakarian A., Sibat M., Rundberget T., Miles C.O., Amzil Z. (2013). Pinnatoxin-G is responsible for atypical toxicity rn mussels (*Mytilus galloprovincialis*) and clams (Venerupis decussata) from Ingril, a French Mediterranean lagoon. *Toxicon*, 75, 16-26.

14/ Geiger M., Desanglois G., Hogeveen K., Fessard V., Leprêtre T., Mondeguer F., Guitton Y., Hervé F., Séchet V., Grovel O., Pouchus Y.F., Hess P. (2013). Cytotoxicity, fractionation and dereplication of extracts of the dinoflagellate *Vulcanodinium rugosum*, a producer of Pinnatoxin G. *Mar. Drugs*, 11 (9), 3350-3371.

Overseas France, Europe and international

Ifremer has a broad range of activities and expertise in the maritime field



Summary

Ifremer has a broad range of activities and expertise in the maritime field, ensuring our visibility and recognition both in Europe and abroad. The international aspect is proven by the interest expressed by the diverse range of existing partnerships and cooperation agreements (NOAA and WHOI for the United States, DFO for Canada, Jamstec for Japan, SOA for China, collaboration with the universities of São Paulo and Brasilia for Brazil, Kiost for South Korea, and so on). With the countries on the southern shores of the Mediterranean, Ifremer has organised its cooperative work along theme-based or geographical priorities, particularly, but not only, with three Northern African countries (Morocco, Algeria and Tunisia). Furthermore, European partnership is vital for Ifremer, as the new Horizon 2020 (2014-2020) programme has made "blue growth" one of its objectives and EU policies offer our Institute more opportunities.

In a context of limited funding, there are two main orientations to Ifremer's policy:

- maintaining our bilateral or multilateral partnerships, putting the emphasis on concentrating on a limited number of partners and objectives for which cooperation has proven to be efficient;
- making use of the various tools available on the European level to promote collaborative research in marine sciences.

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European affairs

Preparing the European Framework Programme Horizon 2020 (H2020): targeting the first calls for proposals and mobilising Ifremer's departments

The seventh Framework Programme for research and technological development (FP7 RTD), the principal instrument of the European Union's research policy, began in 2007 and ended in December 2013. It is replaced by the new European programme for research and development called Horizon 2020. Officially launched on the 1st of January 2014, this new framework programme will replace the current Framework Programme for research (FP7), the Competitiveness and Innovation Framework Programme (CIP) and the European Institute of Technology (EIT).

This future Framework Programme is organised around three priorities, i.e. excellent science, industrial leadership and tackling societal challenges, and will breakdown this new approach by focusing on major challenges (and no longer on sectors). The latter are based on six pillars:

- health, demographic change and well-being;
- food security, sustainable agriculture and forestry, marine, maritime and inland water research and bioeconomics;
- secure, clean and efficient energy;
- smart, green and integrated transport;
- climate action, environment, resource efficiency and raw materials;
- inclusive, innovative and reflective societies;
- secure societies.

Over the year, Ifremer endeavoured to ensure that marine sciences and blue growth were taken into account in the Horizon 2020 programme. Likewise, Ifremer has prepared its responses to future calls for proposals by mobilising an in-house unit to support project preparation and coordination.

Ifremer's participation in Clora

Ifremer is one of the members of the Clora's (associated research organisation club) inner circle and as such ensures the Permanent Representation in Brussels. The Institute held the Clora chairmanship in 2012 and organised the 21 January 2013 general assembly meeting, along with the steering committee, where the speakers were Robert-Jan SMITS, Director-General of DG R&I and Jean-Pierre AUDY, Member of European Parliament. In 2013, Clora organised eight theme days and four meetings, mainly linked to preparations for H2020 and the related challenges of research and innovation. Ifremer is also involved in the European Union project to take part of the direct costs of large scale research infrastructures into account within H2020 by taking part in a workshop held on 20 February 2013, by the Commission.

At their 23 January 2013 meeting the presidents and chairs of the research alliances, CNRS and CPU, said that a reflection process should be undertaken so that Clora can take account of the new context of alliances being set up (Allenvi, etc.) in the way its own missions evolve. This would mean both strengthening its missions to analyse and/or convey information to or from European authorities, as well as enabling the development of activities to underpin the lobbying strategies defined and enacted by various French players.

The new Common Fisheries Policy (CFP)

The CFP was created in 1983 to adapt the Common Agriculture Policy to the fisheries sector, and is reformed every ten years. Thus the 2013 reform is the third to be conducted. Today the CFP is striving to combine the sustainable exploitation of marine resources with maintaining marine biodiversity and ensuring a decent income to professionals in the sector.

In 2013, the new European maritime and fisheries fund (EMFF) for the period of 2014-2020 was proposed. At the outcome of consultations, the compromise document which was jointly proposed by the European Parliament and Council, provided for a budget breakdown which gives greater weight to inspections and collecting of data for the development of fisheries and

aquaculture. The outermost regions are also concerned, as is funding for the European Union's maritime policy in joint or direct management.

The Common Fisheries Policy and Integrated marine policy programmes in which Ifremer's teams are strongly present (Data Collection Framework and European Marine Observation and Data Network) will be renewed in 2014.

The Galway Statement on Atlantic Ocean Cooperation

The European Union, the United States and Canada signed an agreement in May 2013 for cooperation in research on the Atlantic Ocean, in order to better understand it and promote the sustainable management of its resources. Ifremer was represented during the discussions leading up to this agreement by the coordinators of major European research projects conducted in the Atlantic. The agreement is entitled the Galway Statement on Atlantic Ocean Cooperation and focuses on aligning the ocean observation efforts of the three partners (USA, Canada and Europe). Under this agreement, the three partners should share the observation data collected, coordinate the activities of observatories, promote researcher mobility and determine the priorities of future research together.

Building the European Research Area

Ifremer is working towards the development of a scientific Europe by taking an active part in the construction and the management of large-scale European marine science infrastructures, by being part of the development of European research organisations and by getting involved in think tanks and consultations on research policies. Thanks to its numerous partnerships in Europe, Ifremer is one of the major players in the building of the European Research Area (ERA). This "single market for research" which is being built under the impetus of Member States and the European Commission, includes the twenty-eight Member States of the European Union and eleven associated countries (Albania, Iceland, Israel, Liechtenstein, Macedonia, Norway, Montenegro, Moldavia, Serbia, Switzerland and Turkey). The objective of ERA is to give European researchers access to the resources and the talents needed for the success of the projects over the entire European area. To this end, Ifremer endeavours to promote the specificity of marine sciences and technologies to develop new cooperation networks and to obtain recognition of the importance of these themes.

Launching and governance of a Joint Programming Initiative mirror group: JPI "Oceans"

The joint programming initiative called "Oceans" aims for increased cooperation between funding agencies, ministries and ocean research institutes in order to better structure studies carried out on the European scale.

Ifremer and the ANR represent France within the JPI, working in close coordination with the mirror group run by the Ministry in charge of research. In 2013, it was decided to launch three pilot actions which will be developed in 2014: 1) monitoring in the North Sea; 2) microplastics at sea; and 3) ecological aspects of deep-sea mining. Ifremer will make its contribution.

→ *Sulphides - crinoids and coral on an inactive site*

Continuation of ERA-Nets

The ERA-Net scheme aims, within the European Research Area (ERA) context, to step up the cooperation and coordination of research activities carried out at national or regional level (programmes) in Member States or Associated Countries, thanks to networking of research activities conducted at national or regional level, including the "mutual opening" of programmes, and drawing up and implementing joint activities.

SEAS-ERA strategic agendas to made part of the European marine strategy

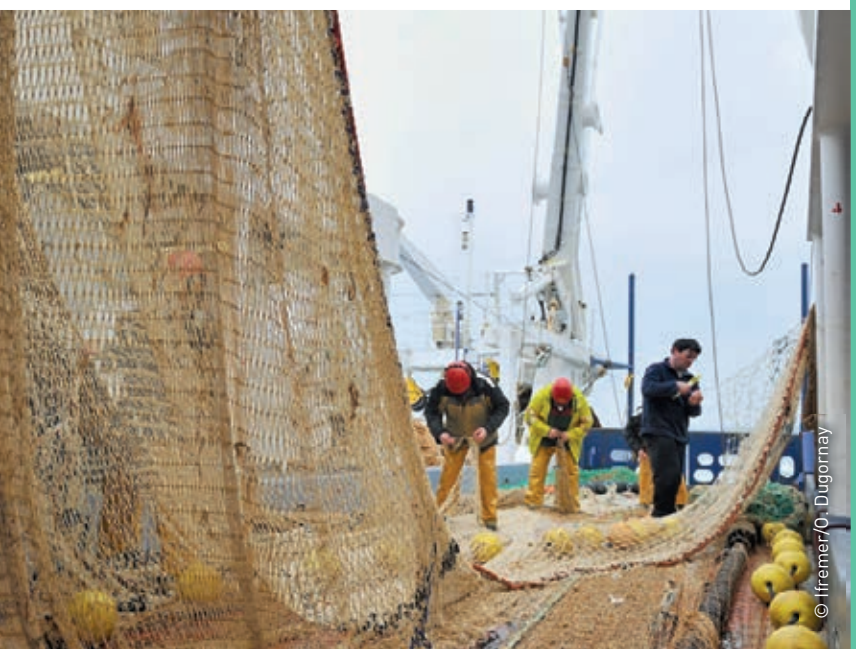
The SEAS-ERA ERA-Net which Ifremer participates in, along with the ANR for the French part, holds the objectives of developing marine research to understand how marine systems function in order to ensure the lastingness of their ecological functions and their uses. The partners of this ERA-Net have taken account of regional specificities, identifying four large eco-regions: the Baltic Sea, Atlantic Ocean, Mediterranean Sea and Black Sea. Ifremer is taking part in two of the building blocks: WP2 on identifying and implementing common programmes and WP4 designed to identify marine research infrastructures in Europe.

The Ifremer pilots presented their results on research infrastructures for the stakes of raw materials in the Atlantic at the Atlantic Forum workshop held in Cork on 4 March 2013.
The Institute also contributed to the international conference on marine research infrastructures in September which was co-organised by the European Community and the CNR and to the EMSO "Ocean Observatories Challenges and Progress" conference in November.

Launching of Cofasp ERA-NET

Cofasp is a new ERA-Net created for fisheries, aquaculture and seafood and launched in 2013, which Ifremer is participating in. It is part of the Europe 2020 strategy, which recognises bioeconomy as an important part of the EU's marine strategy. Cofasp's objective is to lay the basis for exploitation according to the precautionary principles and to enhance innovation in and competitiveness of the primary sectors fisheries and aquaculture as well as subsequent seafood processing and distribution to the consumer. It also aims to define the science, information and data necessary to underpin the revision of the Common Fisheries Policy (CFP) and to ensure its successful implementation by designing complementary national research programmes and outlining monitoring and information/data sharing systems needed.

→ *Repairing the trawl*



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Preparing a process for Euro-Mediterranean cooperation: ERA-NET MED

Countries bordering on the Mediterranean and the European Commission are studying whether a joint Euro-Mediterranean agenda on research and innovation is opportune, in order to formalise the preparation of a Euro-Mediterranean cooperation process in the framework of the Lisbon Treaty's article. In this context, Ifremer took part in exchanges on setting up a strong scientific and economic partnership between the two shores of the Mediterranean, to best address the changes and environmental and human consequences in this region. In 2013, discussions were held between the parties which are part of the ERA-NET MED project (Ifremer is taking part in the think tank within AllEnvi, in liaison with the Ministry of higher education and research).

Overseas cooperation

International cooperation overseas

Ifremer's team in French Guiana began an initial Franco-Brazilian cooperation project in fisheries science, with the objective of setting up longer-term cooperation in the framework of research projects on fisheries biodiversity and knowledge about the marine ecosystem which is common to both regions.

In the framework of an Interreg project (EU funding) on sustainable fisheries, studies by the team in Martinique strengthened regional cooperation with partners in the Caribbean. University partners (in the United States and Venezuela) lent their support in work on genetics and reproduction.

The Reunion Island team deployed its efforts to grow knowledge about tuna species in the Indian Ocean, in partnership with French, European (Portugal) and partners in the area (Seychelles, South Africa).

→ *Shrimp trawlers and trawl equipped with a sea turtle excluder device in the port of Larivot (French Guiana)*

Collaborative work with French territories

Actions involving geosciences and shrimp farming undertaken in New Caledonia are part of a framework agreement and the corresponding special agreements signed by Ifremer with the Pays territorial entity and the provinces. In the marine geoscience field, Ifremer intervened to back up the Dimenc (New Caledonian division of mines and energy) and in that of shrimp farming, to support the aquaculture centre in Saint-Vincent, under the authority of the Adecal (New Caledonia economic development agency).

In French Polynesia, the year's milestones included the continuation of studies to transfer research on shrimp to the local stakeholders, working in liaison with the Ministry in charge of marine resources (MRM). Ifremer's aim is to supply the knowledge and expertise local stakeholders need for their economic development. Transfer of the strain of shrimp studied by Ifremer is projected in the near future.

Structured collaborative work with academia

Above and beyond the actions conducted in the framework of the Irista SIG in Guiana, GOPS and the Corail laboratory of excellence in the Pacific, the agreement for the joint research unit UMR EIO was signed in Polynesia in 2013, bringing together the UPF (university of French Polynesia), IRD, IML (Institut Louis Malardé) and Ifremer. Our Institute has an important position in this UMR, with our entire Polynesian team.

In Polynesia, perliculture studies on improving pearl quality were carried out through multi-partner research work within the GDR Adequa research grouping. In 2013, the results of the studies done in this framework were presented during a seminar which was co-organised by Ifremer and the Marine and mining resource division (DRMM).

This way of structuring the research done in overseas France, taking account of both national and local players, corresponds to the wishes of the French State and local authorities. The projects to create a Marine cluster in Guiana and Reunion fall under this approach.

International cooperation

Ifremer essentially relies on bilateral or multilateral agreements it has signed, in response to France's implementing of a proactive policy in the field of marine research in the 1980s and which have made it possible to acquire its internationally recognised position and serve as a model for numerous emerging countries, such as Brazil, South Africa and Malaysia.

Scientific cooperation in the Mediterranean

To better understand the challenges facing the Mediterranean, Ifremer has established a partnership with the Blue Plan observatory for sustainable development in the Mediterranean. The Blue Plan acts as a Regional Activity Centre for the Mediterranean Action Plan (United Nations Environment Programme UNEP/MAP). In 2013, Ifremer's studies focused on a socio-economic analysis of the fisheries and aquaculture sectors in the Mediterranean and on analysing the maritime activities impacting the Mediterranean Sea basin in the framework of the EcAp (Ecosystem Approach) project which extends the MSFD to the entire Mediterranean. The Blue Plan and Ifremer are also partners within the EU FP7 Perseus (Policy oriented marine environmental research for the southern European seas) programme which was launched in 2011. The programme promotes the application of the Marine Strategy Framework Directive's principles in the Mediterranean and the Black Sea. Perseus launched two demonstration phases in 2013 with Portugal, Spain, Italy and France, which will be enlarged to Greece as well in 2014. The project will end in 2015.

Concurrently, Ifremer is taking part in the Mistrals programme, to be international in reach, led by CNRS/INSU and IRD. Our Institute's participation is founded on our strategic interest in contributing to the study of marine ecosystems' response to human activities and climate change.

The research project called Spiral after the French acronym for deep-sea seismics and regional investigation of northern Algeria, conducted with Algerian and French partners (UMR LDO and Geoazur), continued with the utilisation of data acquired in 2009, notably involving work by nine PhD students.

Associative agreement with Algeria

Following up to the "association agreement" signed by Algeria and the European Union, several twinning projects have been launched. In 2013, Ifremer brought its expertise to the twinning project coordinated by the French fisheries directorate which intends to promote the redeployment of Algeria's national centre for fisheries and aquaculture research and development (CNRDPA) to better restructure the sector and make it an integral part of the country's economic activity.

The project is based on an association between French and Italian partners, also involving the Ministry of ecology, sustainable development and the general council on food, agriculture and rural areas (CGAAER). Exchanges between CNRDPA researchers and managers and Ifremer's experts began in late 2012 and will continue until June 2014. They provide a fulcrum for future scientific cooperation in fisheries and aquaculture. The cooperation also covers the management and organisation of research cruises and exchanges of research staff.

Strengthening Franco-Brazilian cooperation

In November 2013, a scientific seminar jointly organised by Ifremer and the Fluminense federal university was held in Búzios, Brazil, aiming to stimulate Franco-Brazilian cooperation in marine science fields. A letter of intention indicating the main themes for cooperation was published at the end of this symposium. A Brazilian delegation will be present at the Sea Tech Week event to be organised in Brest in 2014. Ifremer's European and international affairs division took advantage of the symposium to organise several strategic meetings on the side, thus asserting our willingness to collaborate in marine research with Brazil. This included meeting the Brazilian Navy, Ministry of foreign affairs and Ministry in charge of fisheries.

Japan: synergies with Jamstec

Since its creation in 1984, Ifremer and its partners (CNRS, universities) have maintained significant scientific cooperation with Japan, in the fields of living resources (aquaculture and shellfish farming primarily), oceanography and deep-sea exploration, especially through the special relations it has with Jamstec (Japan Agency for Marine-Earth Science and Technology). A staff-exchange agreement was signed by our two organisations: in October 2013, a Jamstec research scientist completed his one-year stay between Paris and Brest, which included his taking part in the monitoring of the European Eurofleets project, amongst other things. As for Ifremer, on 1st October 2013, an employee went to Japan both to develop relations with Jamstec and to spark synergies with other entities or partners in Japan and in the Asia-Pacific area.

Cooperation with South Korea

At the end of the year, Ifremer renewed its cooperation agreement (MoU) with the South Korean institutions for oceanographic research (Kiost: Korea Institute of Ocean Science and Technology). Our two institutes have identified numerous fields of potential collaboration, such as marine biodiversity, the impact of climate change on the ocean or exploration of non-living marine resources. Kiost expressed the wish to work more closely in collaboration to develop underwater technologies, with particular interest for human-occupied submersibles.
In the framework of the agreement, there will be increased exchanges of scientific data and use of research facilities (vessels, marine observation buoys), as well as organising workshops, staff exchanges and training for scientists.

→ *Signing of framework agreement by François JACQ, chairman and CEO of Ifremer et Jung-Keuk KANG, president of Kiost*

Cooperation with the United States (NOAA)

Two meetings were held in July and November 2013 between Ifremer and NOAA, to identify and analyse the strategic priorities for cooperation in 2014-2015. The subjects identified for teamwork concern deep-sea ecosystems and canyons, toxic algae, infrastructures and equipment (telepresence, mapping tools), operational oceanography (ARGO) and jointly participating in H2020 in order to tender for calls for proposals on the Atlantic Ocean Research Alliance.

> **"Ifremer can put its expertise in the field of databases to good use.**

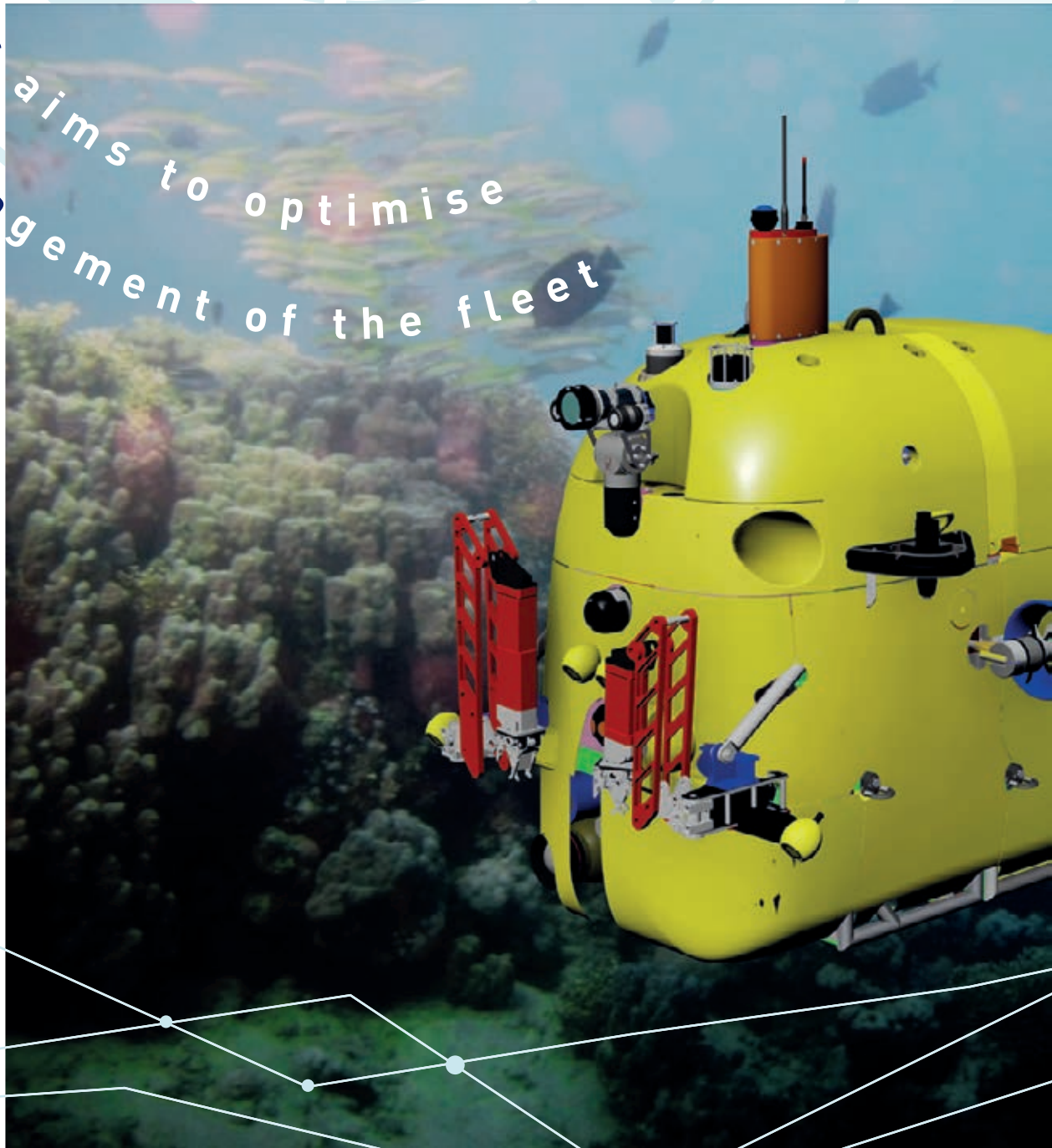
Unesco–IOC

The Intergovernmental Oceanographic Commission (IOC) was created in 1960. This Unesco commission is the United Nations body coordinating ocean science, ocean observatories, ocean data and information exchange, and ocean services such as Tsunami warning systems.
It relies on various programmes, like the Global Ocean Observing System (GOOS), the Joint Commission on Oceanography and Marine Meteorology (JCOMM), the International Ocean Carbon Coordination Project (IOCCP) and the International Oceanographic Data and Information Exchange(IODE).

The IODE committee met in 2013 for its twenty-second session (biennial meetings). Ifremer hosts the French node of the data-sharing network (NODC-National Oceanographic Data Center). One of the adopted recommendations deals with setting up a "Quality management Framework" within the IODE and NODCs, showing the will to achieve technical harmonisation as inspired by European projects like SeaDataNet. Since Ifremer has experience in data quality control processes, it has applied to experiment with this quality-label approach. In this way, our Institute can put its expertise in the field of databases to good use.

Research infrastructures

"Ifremer aims to optimise management of the fleet



Summary

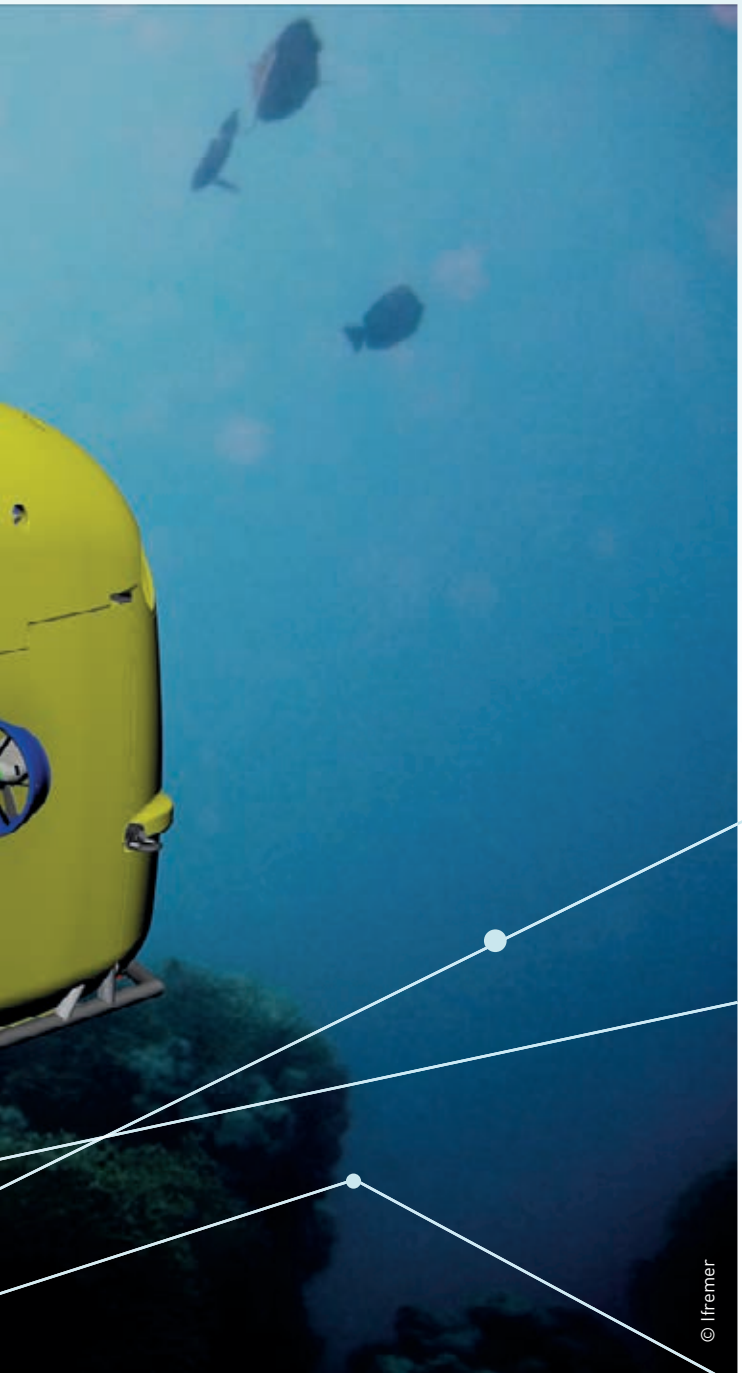
The Fleet LSRI

Since December 2008, the French ocean research fleet has been identified by the Ministry of research and higher education in the French roadmap for large-scale research infrastructures (LSRI). At the request of the supervisory authorities, the four main fleet operators (CNRS, Ifremer, IPEV and IRD) created a joint service unit for the French oceanographic fleet, called the UMS FOF, in March 2011 to optimise fleet management.

UMS FOF

In its assessment report for Ifremer (July 2013), Aeres drew up a mid-term assessment of the way the fleet is managed in the UMS FOF framework. This joint service unit was created in March 2011 with the aim of optimising management of the fleet serving not only scientific communities, but also public service missions and industrial partnerships, while supplying a visible element of national sovereignty.

Aeres indicated that UMS FOF has made it possible to improve cruise scheduling and build the foundations for a true multi-organisational strategy, although noting that this strategy remains incomplete. Aeres wants Ifremer to become a driving force, so that this new system can fully fulfil the objectives for which it was created.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Fleet activity

Over three periods of exercises, the improvement in deployment of sea-going facilities noted has been confirmed. The projected trend set out by the State-Ifremer 2009-2012 target contract has been achieved, not only in fulfilling our public service missions and the research cruises assessed in calls for tender, but also in responding to solicitations for public-private partnerships.

Fleet activity is measured in the number of days that ships are commissioned. For 2013, this was 1,011 days for offshore vessels and 702 for inshore vessels. These figures are in continuity with those of the past two years. They are supposed to guarantee a minimum of three hundred to three hundred fifty cruise days evaluated by the national offshore fleet commission (made up of experts from all the organisations). A high point was reached in 2013, with three hundred and ninety-three days.

There was a drop in the cruise schedule for RV *Thalassa* in 2013, because the recurrent Spanish fisheries missions in the Bay of Biscay are now being carried out on one of their ships. However, the vessel did perform a thirty-day mission on behalf of SHOM. Along with this drop in fisheries science activity, this ship, which has hardly reached its mid-life point, must be modernised to expand its range of possibilities and especially its capacity to host geoscience missions in future.

RV *Le Suroît*, was launched in 1974. In spite of its limited capacities for carrying scientists and equipment, it has proven its interest in the LSRI

system, by making seven cruises, including a forty-two-day mission on behalf of IRD, which was facilitated by integrated scheduling within the UMS.

RV *Pourquoi pas?*'s schedule was set up around the long Shoman mission for SHOM (ninety-five days, from May to July), whilst completing with the ten missions initially scheduled.

The planned schedule for RV *L'Atalante* was disrupted by a public-private partnership collaborative mission in Brazil which did not take place. However, it should be noted that a fifteen-day Essnaut mission was conducted in October 2013 in order to keep the submersive vehicle *Le Nautile* under operational conditions. One hundred cruise days were devoted to missions to support public policies and another hundred to public-private partnership endeavours. The remaining days at sea concern either technical missions or legs in transit, or waiting time.

With the exception of a cruise off Brazil, postponed due to a lack of authorisation, the initially planned fleet schedule was carried out as expected..

Ifremer prepares the renewal of its fleet in connection with the UMS

Although the research bodies which are members of the UMS FOF joint service unit remain the owners of their ships and ensure their upkeep in operational condition, the statutes of the UMS no require their investment policies to be coordinated.

The four operators devoted a period of thought and discussion in 2012 to prepare the renewal of the fleet. Ifremer proposed that a regional vessel of fifty to sixty metres long be built to replace *Le Suroît* (with geoscience, physical oceanography and lightweight vessel deployment capacities), that *Thalassa* be transformed to broaden its scope of scientific missions and that a thirty-five-metre inshore vessel be built to replace those in service in the English Channel-Atlantic area (*Gwen Drez* and *Thalia*).

During 2013, this scenario was validated by the UMS steering committee and the committee for strategic and scientific fleet guidance, an independent entity from the operators, and the plan was transmitted to the Ministry in charge of research. It should also be noted that the High council for large-scale Research infrastructures expressed a favourable opinion, insofar as the plan appears to be reasonable and consistent with respect to scientific requirements.

Ten years of fruitful cooperation with the French Navy

Cooperation between Ifremer and the French Navy goes back to the deployment of the bathyscaphe for the needs of French scientists in the 1970s. In the early 2000s, a novel cooperation agreement which is the only one of its kind between civilians and the navy in the world of oceanography was signed. It deals with the acquisition and operation of two shared vessels, RV *Pourquoi pas?* and the Navy ship *Beautemps-Beaupré*. Each partner enjoys a right of access to the other's vessel (150 days for the French Navy aboard *Pourquoi pas?*, and ten days for Ifremer aboard *Beautemps-Beaupré*). The implementation of this partnership has given full satisfaction to both parties and could pave the way to greater progress in coming years if an extension can be envisaged.

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→ *The oceanographic vessel* L'Europe

EM2040 multibeam echosounder installed aboard *Le Suroît*

Shelf mapping requires accurate surveys, whether for geology and sedimentology studies, habitat mapping or modelling of turbulent physical phenomena. The EM1000 echosounder whose use was shared aboard RV *Thalia*, *L'Europe* and *Le Suroît* had become obsolete, with updates and manufacturer spare parts no longer available for it. Therefore, the decision was made to replace it with a Kongsbberg EM2040 echosounder. Its mechanical installation was done while RV *Le Suroît* was in dry dock (July 2013).

Rejuvenation of RV *L'Europe*

A grant application was accepted under the State-Region plan contract (CPER) and European Regional Development Funds (Languedoc-Roussillon region) for two large projects: the modernization of RV *L'Europe* and contributing to the development of the *HROV* submersive vehicle being built.

The project to rejuvenate RV *L'Europe* will upgrade the ship's acoustics and information system equipment. New scientific fittings and equipment will be installed, particularly an ME70 fisheries multibeam acoustic echosounder which is identical to that aboard RV *Thalassa*, which will enable pelagic and demersal species to be identified and bathymetric maps to be produced. An additional single-beam echosounder (ER 60 333 kHz) using multi-frequency analysis to characterise plankton layers will be added, along with a number of environment sensors (attitude control system, shipboard sound velocity probe, Sippican system) and a VSAT-type permanent ship-shore communications system. During 2013, most of the studies were finalised and the calls for tender were launched. The integration of the equipment is projected for February-March 2014.

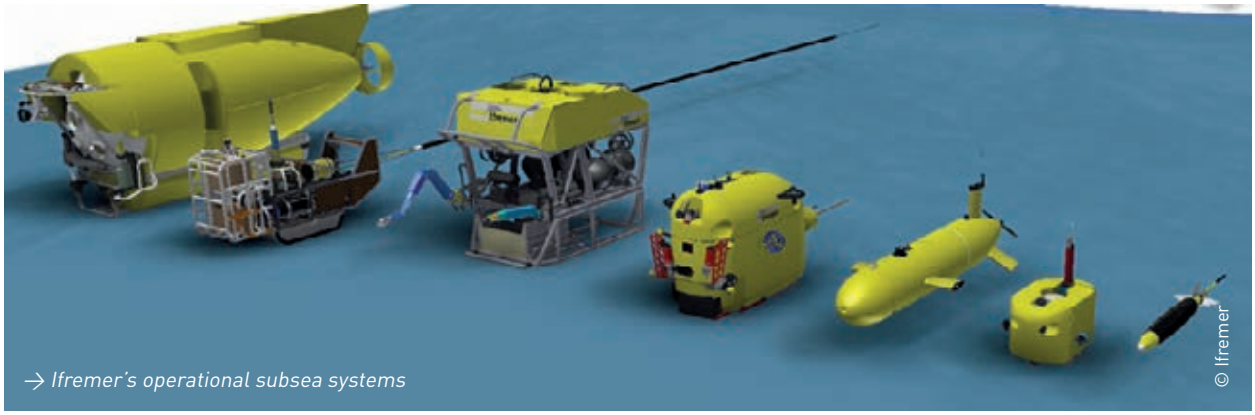
Developing the innovative hybrid underwater vehicle *HROV*

The hybrid ROV (HROV) project entered the integration phase in 2013 and the first operational trials are scheduled for May 2014. This involves giving the scientific community access to a means of intervention, inspection and high resolution mapping (optical and acoustic), with optimised operational costs, based on a hybrid ROV-type submersive vehicle whose possibilities include deployment in remote-operated (ROV) or autonomous (AUV) modes. It can be used for coastal and shelf applications (to 2,500 m) from inshore vessels which do not have dynamic positioning capacity and by offshore vessels, particularly RV *Le Suroît* (without DP) and *Thalassa*. It can be deployed in shallow water by small vessels like RV *Thalia* in the Atlantic or *L'Europe* or *Thetys II* in the Mediterranean.

Ifremer manages the system and in 2013 designed and produced most of the sub-systems.

In the framework of the industrial architect integrator contract that Ifremer signed with the ECA industrial firm for this HROV, and based on *ad hoc* patents filed by the Institute, a non-exclusive licence agreement was signed in March 2013 with ECA to manufacture and commercialise the developments and the results obtained. Additional feasibility studies were undertaken in the context of service provision for an offshore sector industrial client who is interested by the concept.

→ HROV *during integration*



→ *Ifremer's operational subsea systems*

End of EU Eurofleets1 project and launch of Eurofleets2

Successful handover between Eurofleets 1 and 2

2013 was a pivotal year for the two Eurofleets projects, which overlapped for a six-month period. With funding to the tune of 16 million euros over seven years (2009 to 2016), in the framework of FP7 R&D, they are pursuing the objective of promoting European research fleet integration. Eurofleets 1 created an initial consortium of twenty-four partners hailing from sixteen countries. Its successor, Eurofleets 2, was enlarged to include thirty-one research bodies, research fleet managers, universities and industrial firms, from twenty European Union Member States or Associated countries, thus opening participation to entities managing polar research fleets.

Summary

The kick-off meeting for the Eurofleets 2 project was held in Brest from 19 to 21 March, at the invitation of Ifremer and IPEV. More than sixty scientists and fleet operators covering all of Europe's eco-regions were present.
In June the last two ocean cruises financed by the Eurofleets 1 project were conducted offshore from Portugal aboard RV *Marion Dufresne*: the scheduled coring operations were carried out successfully.
The eighteen cruises aboard fifteen European research vessels, including RV *L'Atalante* and *Haliotis*, scheduled following the Eurofleets 2010 and 2011 calls for tender, have thus been entirely completed. Nearly two hundred European and international researchers were thus able to acquire data and collect samples, thanks to the scientific excellence of their proposals which were evaluated and ranked within the project's framework.
Also in June, the final conference for the Eurofleets 1 project was held in Brussels, at the Museum of natural history, with representatives of the European Commission in attendance. Work by a student who was on board during a Eurofleets cruise highlighted how vital TNA (Trans National Access) is for the training of young scientists from Member States which have few or no research vessels.
In September, the proposals for ocean cruises submitted in the framework of the first call for proposals (polar and sub-polar regions) of Eurofleets 2 were examined by the scientific review and logistics review panel of the project and while they were at it, two cruises were immediately scheduled aboard two vessels from Norway and Greenland.
Six other calls for tender will follow, thus giving access to twenty ships, including RV *Pourquoi pas?* for Ifremer.
Along with this, other activities for networking and joint technological research are taking place, with the long-term objective of preparing the assimilation of a group of new, innovative and inter-operable regional research vessels in a future Esfri (European Strategic Forum on Research Infrastructures) roadmap.

→ *Processing sediment cores during the Eurofleets/ Tore cruise*

→ *Telepresence demonstration*

Collaborative work with NOAA on telepresence

Demonstrations of how oceanographic cruises can be followed from shore (telepresence concept) were conducted in collaboration with NOAA, with the objective of optimising the scientific cruises made aboard research vessels. This means that scientific teams on shore can access the same data (videos, mapping, CTD, etc.) as scientists on board the vessel and thus participate in conducting the mission and interact with shipboard teams in real time.

Fleet activities during 2013

Cruises assessed by the National Offshore fleet commission

Vessel	Cruise name	Chief scientist	Organisation	Zones	Topic	Vehicles	Equipment
Pourquoi pas?	BioBaz	F. LALLIER	University Pierre & Marie Curie	Atlantic Ocean	BioBaz: Integrated biology of *Bathymodiolus azoricus*. Cruise for *in situ* measurements, harvesting of mussels for experimental studies on board and onshore, deployments of remote-release instrumented cages and filming to document the zone	*Victor 6000*	
	Momarsat	M. CANNAT	CNRS-IPGP	Atlantic Ocean	Annual maintenance of the ENSO Lucky Strike observatory for 2014-2015	*Victor 6000*	
	Prisme 3	A. CATTANEO	Ifremer	Mediterranean Sea	Study on submarine landslides: mechanical properties, spatial variability, age	Penfeld	Multibeam echosounder
	Odemar	J. ESCARTIN	CNRS-IPGP	Atlantic Ocean	Structure, composition and evolution of active ocean faults	*Victor 6000*	
	Antithesis FC	B. MARCAILLOU	University of the Antilles and Guyana	Atlantic Ocean	Geometry, structure and thermo-mechanical characteristics of the interplate contact of the North Antilles margin: implications for seismology and tectonic deformation of margins		- heat flux coring - multibeam echosounder - OBS
L'Atalante	Colmeia	M. MAIA	CNRS University of Brest	Atlantic Ocean	Origin and evolution of intra-transform accretion systems. Accretion process and cold mantle exhumation. Setting and uplift of the Saint Paul peridotite massif		- multibeam echosounder - rapid digital seismics
	Iguanes	L. LONCKE	University of Perpignan	Atlantic Ocean	Relationship between the deep structure of the French Guiana-Surinam transform margin, sedimentary instabilities and cold seeps. Onset and development of fluid ascents and specificities in the transform margin domain.		- multibeam echosounder - HR seismics - rapid digital seismics
	Oceanograflu	F. LUCAZEAU	CNRS-IPGP	Atlantic Ocean	Heat-flow patterns of a segment of the Mid-Atlantic Ridge at 35° North: characterizing the importance of hydrothermal processes in the young lithosphere.		- heat flux coring
	Prisme 2	A. CATTANEO	Ifremer	Mediterranean Sea	Study on submarine landslides: mechanical properties, spatial variability, age	Penfeld	- multibeam echosounder - rapid digital seismics - Sysif
	Haitisis 2	S. LEROY	University Paris VI	Atlantic Ocean: West Indies	Imaging and characterisation of the Enriquo-Plantain Garden fault system (Haiti)		- multibeam echosounder - rapid digital seismics
	Antithesis-SIS	B. MARCAILLOU	University of the Antilles and Guyana	Atlantic Ocean	Geometry, structure and thermo-mechanical characteristics of the interplate contact of the North Antilles margin: implications for seismology and tectonic deformation of margins		- SMT multitrace seismics - multibeam echosounder - OBS

Vessel	Cruise name	Chief scientist	Organisation	Zones	Topic	Vehicles	Equipment
Le Suroît	Dewex/ Mermex 1	P. CONAN	CNRS	Mediterranean Sea	Study of the role of deep dense water formation in chemical composition and matter budgets in the Mediterranean Understanding the relationships of food webs and hydrodynamic structures		- ADCP - CTD
	Dewex/ Mermex 2	P. CONAN	CNRS	Mediterranean Sea	Study of the role of deep dense water formation in chemical composition and matter budgets in the Mediterranean Understanding the relationships of food webs and hydrodynamic structures		- ADCP - CTD
	Pirata FR 23	B. BOURLES	IRD	Atlantic Ocean	Long time series of cruises to monitor and study climate variability in the tropical Atlantic		- ADCP - Atlas buoys
	AM-MED	M. RABINEAU	CNRS	Mediterranean Sea	Highlighting of evidence of eustatic crises taking place between the Late Miocene and the Pliocene-Middle Pleistocene (from 6 Ma to 0.5 Ma) on the continental margin in the gulf of Lion (from the platform to the slope). These "crises" concern the Messinian Event (drop in sea level of over 1,500 m) on one hand and the Pliocene-Middle Pleistocene crises on the other (establishment and significant growth of ice caps in the Northern hemisphere (3-2.5 Ma).		- multibeam echosounder - HR seismics
	Circée HR	M.A. GUTSCHER	University of Brest	Mediterranean Sea	Calabrian subduction and eastern Sicilian margin, deep structure and active deformation in the Ionian Sea. Long-term earthquake and tsunami hazard.		- multibeam echosounder - HR seismics - rapid digital seismics

Cruises for public-service purposes aboard offshore research vessels

Vessel	Cruise name	Chief scientist	Organisation	Zones	Topic	Vehicles	Equipment
Thalassa	IBTS 13	Y. VERIN	Ifremer	Atlantic Ocean, Eastern English Channel, North Sea	Ecosystem-based approach to fisheries resource assessment		- trawls - nets - CTD - CUFES
	Pelgas 13	M. DORAY	Ifremer	Atlantic Ocean Bay of Biscay	Monitoring populations of exploited small pelagics		- trawls - WV9 and Thyborhon otter boards - CUFES - CTD - acoustics
	Evhoe 13	M. SALAÜN	Ifremer	Atlantic Ocean Bay of Biscay, Celtic Sea	Fisheries resource assessment- Impact of fisheries on populations- Observatory of living resources.	*Scampi*	- trawls - fishing echosounders - Scanmar system - SMFH fisheries multibeam echosounder

Cruises with institutional partners (SHOM)

Vessel	Cruise name	Chief scientist	Organisation	Zones	Topic	Vehicles	Equipment
Pourquoi pas?	Shoman 2013	Atlantic oceanographic group - SHOM	French Navy	Atlantic Ocean	Hydrography cruise for the French Navy's hydrographic and oceanographic service (SHOM).		- multibeam echosounder - CTD - Seasoar
	Essgravi	Atlantic oceanographic group - SHOM	French Navy	Atlantic Ocean	Gravimeter trials		- gravimeter
Thalassa	SHOM	Atlantic oceanographic group - SHOM	French Navy	Atlantic Ocean	Physical oceanography cruise for the French Navy's hydrographic and oceanographic service (SHOM).		- CTD - Seasoar

Cruise under research-industrial partnership

Vessel	Cruise name	Chief scientist	Organisation	Zones	Topic	Vehicles	Equipment
Pourquoi pas?	Gazcogne 2	S. DUPRÉ	Ifremer	Atlantic Ocean	Exploration of continental margins	*Victor 6000*	- multibeam echosounder - HR seismics - rapid digital seismics
L'Atalante	Iguanes	W. ROEST	Ifremer	Atlantic Ocean	Relationship between the deep structure of the French Guiana-Surinam transform margin, sedimentary instabilities and cold seeps. Onset and development of fluid ascents and specificities in the transform margin domain.		- multibeam echosounder - HR seismics - rapid digital seismics
	Prisme 2	A. CATTANEO	Ifremer	Mediterranean Sea	Study on submarine landslides: mechanical properties, spatial variability, age		- multibeam echosounder - HR seismics - Susif
Le Suroît	Gazcogne 1	B. LOUBRIEU	Ifremer	Atlantic Ocean	Mapping of the Aquitaine shelf		- multibeam echosounder - rapid digital seismics

Cruises related to Technical trials missions (MET)

Vessel	Cruise name	Chief scientist	Organisation	Zones	Topic	Vehicles	Equipment
Pourquoi pas?	Esssypen	P. LEON	Ifremer	Atlantic Ocean	Testing of Sysif and Penfeld seabed penetrometer		- Sysif - Penfeld
	Essgravi	H. LOSSOUARN	Genavir	Atlantic Ocean	Gravimeter trials		gravimeter
	Embeop5	P. SIMEONI	Ifremer	Atlantic Ocean	Winding of electro-optical umbilical cable of the ROV *Victor 6000*		
	TVEOP5	P. SIMEONI	Ifremer	Atlantic Ocean	Trials of electro-optical umbilical cable of the ROV *Victor 6000*	*Victor 6000*	
	Essvic	P. SIMEONI	Ifremer	Mediterranean Sea	Trials of ROV *Victor 6000*	*Victor 6000*	
	TVInfo	A .RUÉ	Ifremer	Atlantic Ocean	Modernisation of shipboard information system		
L'Atalante	Essnaut	J-.P. JUSTINIANO	Genavir	Mediterranean Sea	Trials of the human-occupied submergence vehicle *Nautile* following its technical stop for overhaul	*Nautile*	
	TVPAM	Y. LE GALL	Ifremer	Mediterranean Sea	PAM trials		PAM (Passive Acoustic Monitoring)
Thalassa	Essprop	P. CADOUR	Genavir	Atlantic Ocean	Propulsion trials		
Le Suroît	ESSMF	H. FLOCH	Ifremer	Atlantic Ocean	Multibeam echosounder trials following changes of bases		Multibeam echosounder
	ESSAUV	J. OPDERBECKE	Ifremer	Mediterranean Sea	AUV trials	*AUV*	

Logistics cruises

Vessel	Cruise name	Chief scientist	Organisation	Zones	Topic	Vehicles	Equipment
Pourquoi pas?	EMBVIC	P. TRIGER	Genavir	Mediterranean Sea	Loading of the remote operated vehicle *Victor 6000*	*Victor 6000*	
L'Atalante	EMBSMT	H. LOSSOUARN	Genavir	Atlantic Ocean	Loading of multitrace seismic equipment (SMT)		- SMT multitrace seismics
	DEBSMT	H. LOSSOUARN	Genavir	Atlantic Ocean	Unloading of multitrace seismic equipment (SMT)		- SMT multitrace seismics
	DEBSMT/ EMBSISRAP	H. LOSSOUARN	Genavir	Atlantic Ocean	Unloading of multitrace seismic equipment (SMT) and loading of rapid digital seismic equipment		- SMT multitrace seismics - rapid digital seismics
	EMBSISRAP	H. LOSSOUARN	Genavir	Atlantic Ocean	Loading of rapid digital seismic equipment		- rapid digital seismics

The Euro-ARGO large-scale RI facility

→ *Provor Bio profiling float in Équipex NAOS project*

Argo is a key element in the global ocean observation system set up to monitor, understand and predict the role played by the ocean in planet Earth's climate. The large-scale Research Infrastructure Euro-Argo includes France's contribution to the European coordination consortium structure (Euro-Argo ERIC) and the French component in the infrastructure (Argo France). The French contribution to Argo is coordinated within the Coriolis inter-organisation structure.

The final dossier for setting up the European Euro-Argo ERIC was submitted to the European Commission by the Ministry in charge of Research in August 2013. The application included the Euro-Argo ERIC statutes, the scientific and technical appendix and the letters of commitment from the Ministries of the ten participating countries. The ERIC should be officially created in 2014. Its head office will be located at Ifremer's Brittany centre for the first five years.

In 2013, the Coriolis centre, which is also one of the two global Argo centres, processed the profiles of over 3,300 floats. Argo data have been greatly utilised and enhanced by the French scientific community. The main studies conducted have dealt with ocean circulation, characterisation of global warming, utilisation in ocean models, analysing initial biogeochemical measurements and validating satellite measurements. Moreover, major technological developments are underway to prepare the next versions of French Argo floats in the framework of the Équipex NAOS project coordinated by Ifremer.

Future of Coriolis for the horizon of 2014-2020

Based on the conclusions of a working group set up in October 2012 following an agreement by the directors of research bodies (CNES, CNRS/INSU, Météo France, Ifremer, IPEV, IRD, SHOM), Coriolis's executive committee prepared a new framework agreement called "Coriolis 2014-2020: an integrated *in situ* ocean observation infrastructure for operational oceanography and research". The objective remains to pool and optimise the means and resources implemented by the institutions for long-term *in situ* observation of the oceans. Its scope has been broadened to include all French offshore networks which are permanent or long-term and the high-frequency coastal networks. This will meet the objective of better integrating the French contribution to the global and regional ocean observation system.

Technological engineering and tools to serve research and development

Since our Institute has chosen a shared organisation for engineering and technological developments to serve scientific objectives, support the public authorities, to valorise and support large-scale infrastructures (fleet, observation, databases, test facilities, etc.), there is a strong technological dimension underpinning and reinforcing scientific objectives.

First endurance trials for the *SeaExplorer* glider

The underwater glider *SeaExplorer*, developed in partnership with ACSA, ACRI and CNRS, performed its first operational endurance mission between Villefranche-sur-Mer and Corsica for sixty days, over a distance of 1,183 km and with

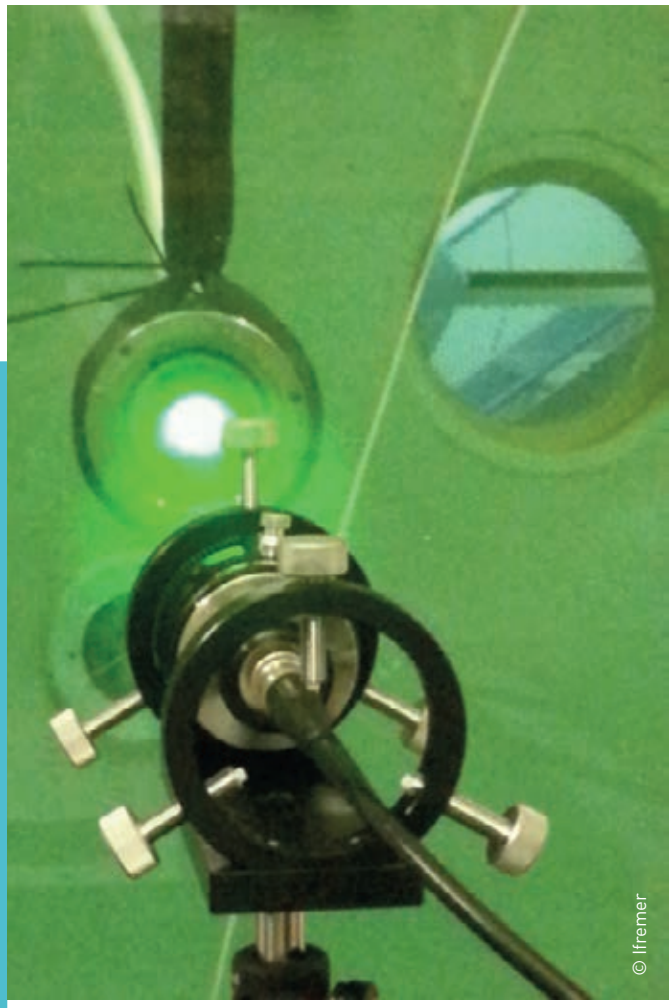
a single charge of its battery. Thus, *SeaExplorer* set a double record in terms of duration and distance covered. Deployed to the south of Nice, *SeaExplorer* navigated at an average speed of 0.5 knot and supplied over 1,168 profiles on a water column from 0 to 500 m deep. Ifremer particularly designed and produced the ballast, the core of the glider's propulsion, which gives it a competitive advantage of performance which is 20% better than competing systems. A licensing agreement is being set up with ACSA for the industrial production and marketing of the product.

Progress in the field of underwater wireless telecommunications (optics, acoustics)

Along with its industrial partners, Ifremer secured funding for a Citeph Opticomm project on developing new underwater optical communication technologies, based on laser transmission and reception by photomultiplier tube or diodes. The project's objective is to develop and submarine optical communication systems which can at short range (10 Mb @ 50m, omnidirectional), give high speed data rates whilst being very energy efficient.
This innovative technique was first assessed through a PhD thesis at Ifremer in partnership with the Fresnel institute, which was able to measure the potential in terms of data throughput under different conditions.

The coordination of all these facilities is ensured by the "research and technological developments" unit of the "physical research and deep sea ecosystems" department. Its objective is to provide all of Ifremer's divisions and projects with infrastructures for trials, qualification and metrology. Amongst other things, this makes it possible to conduct technological research projects for subsea exploration and exploitation, develop and quality scientific instrumentation and check and calibrate measurement sensors used during oceanographic cruises, and so on.
In 2013, thanks to these facilities, 297 tests or calibrations, representing 1,187 days of trials, were performed. These studies benefit both the fleet and external partners.

In 2013, 40% of these trials corresponded to services supplied to academic or industrial partners (principally SMEs in Western France). The figure has doubled with respect to 2012.



→ *Underwater optic communications system in the laboratory*

Technological means to serve science and industry

The main tools are located:

› **at the Brittany centre:**
- test tank, towing tank and tidal tank;
- facilities for testing and qualification for marine and underwater environments (compression chambers, environmental chamber, vibrating/jolting table, mechanical and acoustic tests);
- the metrology lab;
- the flume tank in Lorient ;

› **at the Channel-North Sea centre:**
- the wave and current tank set up at Boulogne-sur-Mer.

Marine and ocean databases

Annual assessment

Eight main theme-based information systems (or databases) which pool the data produced by multiple systems and observation networks can be identified:

- satellite data
- Harmonie (fisheries data)
- Coriolis (physical data)
- Quadrige (coastal environmental data)
- BGM (marine geology database)
- Biocéan (deep-sea environmental data)
- cruise database (reference of oceanographic cruises)
- Sextant (geographical data and portal which is 100% Inspire-compatible).

At the end of the year 2013, the data hosted at Ifremer represented 695 Terabytes of stored volume (+19% from 2012) and 9,491 million records in databases (+21% compared to 2012).

CATDS (SMOS satellite data ground processing centre) begins production

Following an integration phase which was finalised in 2012, data processing chains (ocean surface salinity, soil moisture) from the SMOS satellite have been running on Ifremer's IT facilities.
The operating agreement was signed in January 2013 with CNES, thus delegating the operational responsibility for data service production to Ifremer.

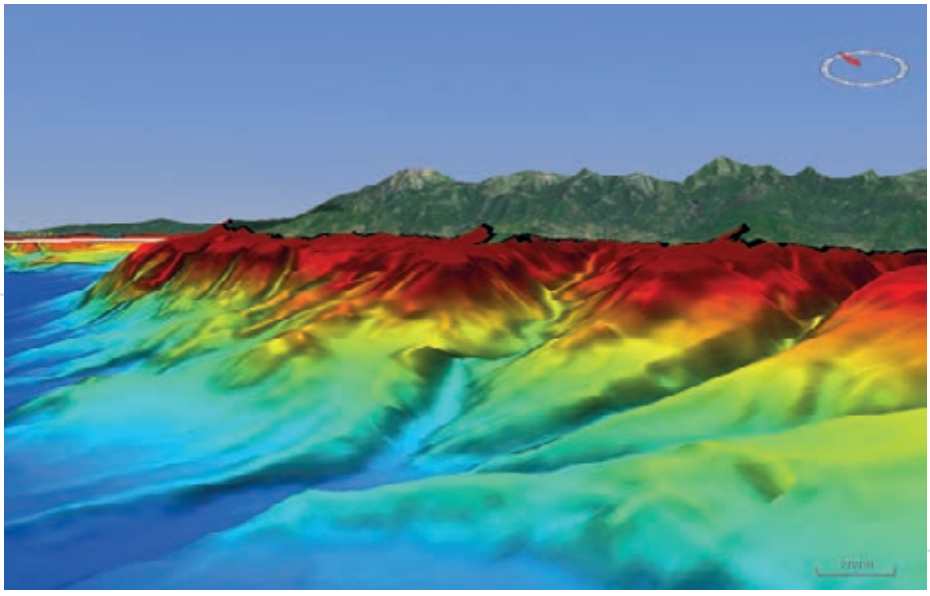
Steps to create earth observation data clusters

In 2013, the main organisations concerned succeeded in forming and organizing four clusters of earth observation data, with governance and working groups. Ifremer took responsibility for the scientific coordination of the "ocean" cluster and is making a significant contribution to the technical aspects of this "networking" of data centres, particularly drawing on the experience of the European Seadatanet, MyOcean, Geoseas and Emodnet project. Coordinated work by CNRS/INSU-Ifremer began in 2013 on *in situ* type data.

Unified management of data catalogues in Sextant

To deliver accurate descriptions of the digital products produced using observational data (climatology, time series collections, bathymetric digital terrain models, modelling results, etc.), a catalogue was drawn up on the Sextant geographical information server base.

This so-called "discovery" catalogue, compliant with the Inspire directive's recommendations (ISO 19115 standard), now supplies an exhaustive listing of definitions, uses and validity limits, product creation methodologies and suppliers, which fulfil, in particular, the expectations of the MSFD, of European infrastructure projects like Seadatanet, Geo-seas or MyOcean and *Marine Core Services* (GMES).



→ *3D west Corsica digital terrain model developed in the Emodnet framework and displayed by the "3DViewer" tool made available by Ifremer*

Summary

→ *Test tank at Ifremer's Brittany centre*

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Support for public policies

Our Institute provides active support for public decision-makers in a broad range of fields. Observation, expertise and research are the three closely related facets of Ifremer's activity. Demands arising from maritime public policies and various economic sectors have their source in scientific questioning. Identifying and dealing with these issues of finalised research will in turn influence the way public policies evolve and how skills will be managed in coming years. The Institute's policy is to ensure that the research foundation which is essential to guaranteeing the quality and the credibility of Ifremer's expertise is protected.

The main public policies concerned fall under the aegis of three ministries:

› *Ministry in charge of the Environment and the Sea*

- policies on water and protection of biodiversity
- policies for marine fisheries, seafood and marine products and aquaculture
- energy policy (working jointly with the Ministry in charge of Industry for raw materials and mining)
- policy to combat climate change
- policy to prevent natural hazards.

› *Ministry in charge of Industry*

- raw materials and mining policy (working jointly with the ministry in charge of the Environment for raw materials and mining)

› *Ministry in charge of Agriculture*

- policy in the field of agrifood industries (in relation to the fisheries and aquaculture policy)
- policy concerning quality control and health safety of agricultural and food products.

In most cases, there are strong ties with the Community framework: Water Framework Directive, Marine Strategy Framework Directive, Habitats, fauna, flora directive and the Common Fisheries Policy.

Requests made to our Institute for these public policies come either from agreements signed at the national level for ministry directorates or from requests made on the local to regional level, which may or may not be supported by regulatory provisions. This support can be supplied indirectly, through agencies like Onema, water agencies, the marine protected areas agency (AAMP) and before long the French agency for biodiversity (AFB).

In 2013, monitoring of the Institute's activity revealed that about 350 full-time equivalent positions, which is substantial part of Institute resources, were devoted to this work.

Ifremer is also led to respond to local appeals for the application of national laws. These actions not covered by the budget or related to agreements are carried out in the context of so-called "public service" missions, where Ifremer is indicated as an organisation to be consulted (by order or decree, decision of the prefecture, etc.). This is particularly the case in questions about spatial planning and development in coastal environments, which represents part of our coastal establishments' activity. It also holds true in the framework of the 2006 decree concerning prospecting, research and exploitation of mineral or fossil substances contained in the seabed in the public domain for metropolitan France and on its continental shelf.

And lastly, there are appeals without a clear legal basis, either because the laws do not exist or in because it is a question of support for the professions in question. These requests and appeals can be numerous and can mobilise significant energy and effort.

Finally, participation in governance bodies, councils or committees whether scientific or not, on levels ranging from local to national, also underpins public policies and activities launched by ministries.

In order to continue to master our development and make optimal use of our resources in a period of staff and budgetary restrictions, a major challenge for our Institute is to succeed, working hand in hand with the authorities, to better regulate our activities, so that they are part of a clear and controlled framework. Part of the year 2013 was devoted to taking inventory of what exists and specify what mechanisms could enable optimal utilisation of skills and expertise at Ifremer, in relation with the preparation of the future objectives contract between the French State and the Institute.

Policies related to water, coasts and coastal zones

Implementation of the MSFD (Marine Strategy Framework Directive)

The Marine Strategy Framework Directive 2008/56/EC of 17 June 2008 established the framework for Community action in the field of marine environmental policy. It is the environmental pillar of the European Union's integrated maritime policy. Through its presence at the European level and its knowledge about the marine environment, Ifremer monitors the progression of this Directive's implementation both nation-wide and over Europe. Specifically, in order to monitor its marine environment action plan (http://sextant.ifremer.fr/en/web/dcsmm/pamm), it was necessary to first identify the knowledge gaps which could hinder the full application of this directive and the achievement of good environmental status in Community waters. To do so, Ifremer took part in the Stages support and coordination action (financed by the EU), which identified and summed up the relevant research results already existing in the European Union and made them available in an appropriate format for use by the relevant authorities. Our Institute has also made significant contributions to defining Good Environmental Status.

The monitoring programme

In 2013, one major part of our work concerned developing a monitoring programme, coordinated overall by Ifremer and the Agency of marine protected areas (AAMP). Proposals from the eleven thematic pilot groups were summarised by the Ifremer-AAMP joint coordination team and submitted to a panel of experts (Paris, 12-13 June). During the summer, the coordination team worked on constructing pragmatic scenarios, giving rise to a consolidated proposal for monitoring systems in early October 2013. The final documents, which will be the foundation of the future MSFD monitoring programme, were submitted to the Ministry of ecology, sustainable development and energy (MEDDE) in mid-December. They will be transmitted to the technical secretariats of the marine sub-regions for use in early 2014, during the period of local consultations and discussions with people in professional sectors, associations, etc.

The programme of measures

Ifremer has also brought its scientific expertise to support the development of a programme of management measures which should enable good environmental status of waters in metropolitan France to be reached in 2020.

Applying the WFD (Water Framework Directive)

The Loire-Brittany Water Agency and Ifremer signed a new partnership agreement on 10 April 2013, which will cover the period from 2013-2018. This agreement further strengthens long-standing cooperation and formalises the shared will on the part of the Water agency and Ifremer to develop the knowledge base on coastal and estuarine waters in the regions of Brittany and Pays de la Loire and improve environmental monitoring there. The partnership will help achieve the targets set by the Water Framework Directive (WFD) for good environmental status of coastal waters.

Three strategic orientations will be the basis for cooperation:

- better knowledge and assessment of the chemical and ecological status of waters in inshore areas and estuaries of the Loire-Brittany coast,
- improved understanding of coastal functions and how it is evolving,
- promoting these studies and communicating their objectives and results to a broad public.

→ *Rocky shore and beach in Morbihan region*

WFD monitoring of Mediterranean lagoons

By using new methods based on passive samplers during the Pepslag 2013 cruise, new data was acquired for a number of organic contaminants thanks to more reliable detection at low concentrations. The results led to twenty out of twenty-three lagoons being ranked as having poor chemical status with respect to the WFD. Of these twenty water bodies, nineteen were downgraded after at least one organochlorine insecticide was detected. These insecticides have been banned since 1992, 1998 or 2007, but they are extremely persistent in the environment.

Aquaref, national benchmark laboratory for aquatic environmental monitoring

In the framework of the second year of Ifremer's chairmanship of the Aquaref consortium, the five members (BRGM, Ifremer, Ineris, Irstea and LNE) reasserted their will to pursue their collaboration in all of the missions which Onema has given to Aquaref, and particularly in laying the foundations for the future strategic plan which will taken the four priorities of support for policy makers into account. They are to:

- ensure operational support to the Ministry to develop appropriate monitoring of aquatic environments, especially for the implementation of the WFD, MSFD and 2008/105/EC EQS Directives;
- deliver technical support on these issues for water agencies and river boards;
- contribute, through technical studies, to improving the knowledge base and quality all along the measurement chain and for various monitoring tools and to disseminate this knowledge to the stakeholders; and
- help implement future monitoring tools.

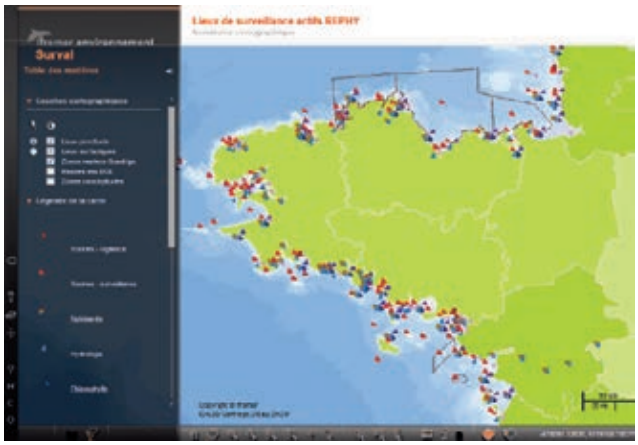
On 19 June 2013 in Paris, Aquaref organised a seminar to present and promote five years of studies on "improving the quality of data from chemical and hydrobiological monitoring". Over one hundred-ten participants attended, coming from water agencies, ministries, laboratories and consultancies, organisers of inter-laboratory comparisons and Aquaref's partner institutions. The aim was to make the results obtained in the Aquaref framework better known, so that the added value of its action is better understood. In fact, Aquaref has set up a website where over two hundred deliverables can be accessed. They include reports, technical guides, data sheets on methods and on substances, inter-laboratory assays, collaborative trials and the national sampling repository.

→ *Inter-laboratory comparisons on intertidal macroalgae*

Making observation and surveillance data available

The tool called Surval (http://www.ifremer.fr/surval2) offers geographical access to coastal environment monitoring and observation data which come from the national Quadrige database.
Via internet, at:

› it gives the possibility of displaying the places where monitoring is done by the main surveillance and observation networks (RÉMI, Réphy, Rocch, Archyd, RSL, SRN, RHLN), with daily updates from the Quadrige² database (as a cohesive repository for networks monitoring the French coastal environment, Quadrige² contributes to meeting France's European commitments, particularly in the frame of the Water Framework Directive,



› display the observational results as graphs and download them, by parameters:

- chemical contaminants (silver, cadmium, etc.),
- hydrology (oxygen, salinity, turbidity, temperature, nitrate, etc.),
- microbiology (*Escherichia coli*),
- phycotoxins, and
- phytoplankton (*Alexandrium, Dinophysis, Pseudonitzschia*, etc.).

Carhamb'ar symposium: marine benthic habitat mapping, from acquisition to restitution (26-29 March 2013, Brest)

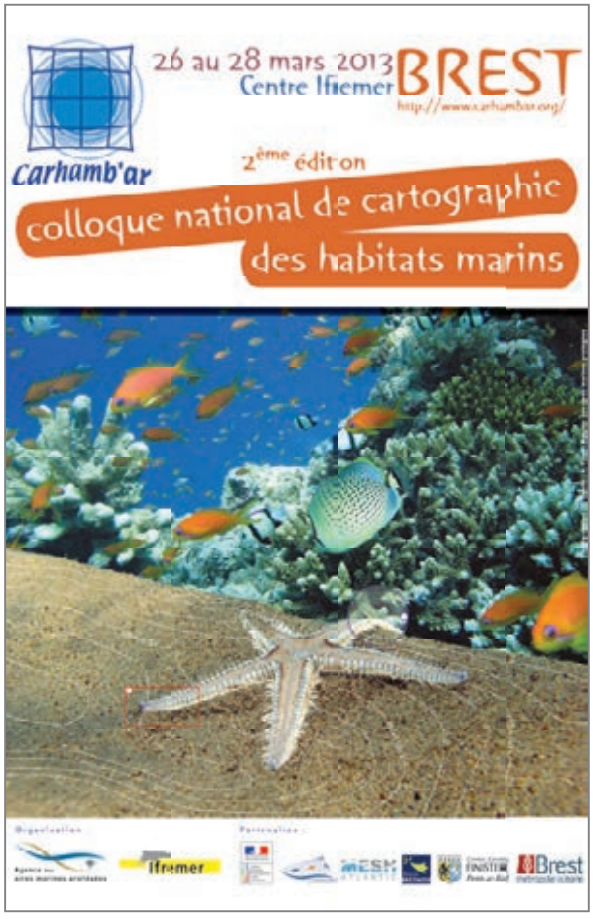
This national symposium was organised by Ifremer and the Agency for marine protected areas (AAMP) at Ifremer's centre in Brest. Nearly two hundred participants, made up of scientists, managers and consultancies were there. The meeting was the occasion for a real dialogue between these different categories of actors. Indeed, mapping is an excellent tool for mediation between those who produce knowledge and those who use it, where numerous stakes intersect:

› scientific stakes, with the need to secure better knowledge about biodiversity and its evolution in response to global change and to the pressures exerted on it by human activities;

› economic stakes, with the development of new uses of marine areas (e.g., development of marine renewable energies);

› management stakes, with the need to protect and sustainably manage marine ecosystems and their resources, especially considering the structuring context of the Marine Strategy Framework Directive (MSFD).

Several papers focused on the use of new tools which enable data acquisition on a larger scale. They have shown the need to work on developing methods to better qualify and homogenise the data collected.



Policy for maritime fisheries, seafood and aquaculture

Data collection and support for European negotiations

The Commission Decision 2010/93/EU defined a multiannual Community programme for the collection, management and use of data in the fisheries sector for the period 2011-2013. Ifremer is the main French operator for this data collection on behalf of the directorate in charge of fisheries. This consists in gathering primary biological, technical, environmental and economic data supplied by all partner organisations, as well as the associated metadata. Ifremer keeps these data in secure databases as well as transferring them to the relevant ministry. 2013 was devoted in particular to preparing the next multiannual programme called Data Collection Multi-Annual Programme (DC-Map), which will cover the period of 2014-2020. Its aim is to converge with the MSFD's future monitoring programme.

In addition, Ifremer provides back-up to the Maritime fisheries and aquaculture directorate (DPMA) for the implementation of the national fisheries policy, which includes complementing the actions set out in the Data Collection Framework. This comprises monitoring actions (within the fisheries information system) and expert assessments.

Ifremer's research studies are based on observation, especially via fisheries information system surveys. Generally, they focus on characterising spatial-temporal dynamics of species of interest for fisheries and concomitantly, on the fleets which exploit them, by investigating the numerous interactions with habitats, broadly speaking, and with other marine organisms, particularly through studies on the food web. Research at Ifremer has developed significant expertise in deterministic or stochastic modelling, to describe and understand processes and help draw up scenarios of trends and, *in fine*, management measures.

2013 was a busy year, with the negotiations on the new common fisheries policy, for which Ifremer has provided ongoing support to the fisheries directorate, notably through its expertise in knowledge about stocks.

Furthermore, during the year, nearly eighty experts from Ifremer were mobilised within organisations supplying consultation and global expertise, like the International Council for Exploration of the Sea (ICES).

Support for the State in the frame of Mayotte's development

A partnership between the Mayotte marine nature park, Ifremer, IRD and DPMA was created in 2012, to set up a fisheries information system in the Exclusive Economic Zone of Mayotte, adopting Ifremer's standard methodology which is used in the DOM French overseas departments.

The first step, implemented in 2013, was to create frames of reference to characterise fishing activities, including a statistical grid approach adapted to the small scale fisheries in Mayotte for the lagoon, inshore and contiguous sectors. Concurrently, a list of fishing grounds was put into Ifremer's databases. A frame of reference by métier (gear, species, area) a frame of reference by species were also defined.

An initial description of the activity of professional fishing and subsistence fishing boats (motorboats) was made, based on the data collected on their activity in 2011. The survey concerned three hundred-eighty-six boats and 30% of the seven hundred-fifty dugout canoes inventoried. At the same time, observations on catches landed were set up in late 2012, with the assistance of four agents who travel back and forth between landing sites. Data on the activity was used to draw up a fleet typology which will be utilised as the basis for catch data collected upon landing. The first results on vessel activity are expected at the start of 2014.

Shellfish farming

In 2013, Ifremer took an active part in the national programme for research and development called "Score". It is coordinated by the national shellfish farming committee (CNC) and is behind a call for tender proposed by DPMA in 2012 to promote finding a way out of the crisis for the oyster farming value chain through selection of oysters with improved survival.

The technical programme is achieved in part by Ifremer's regional innovation platform at Bouin, which has hosted the CNC staff (a manager and two technicians) since 2012, working to produce the different families of oysters needed for the selection. Physiologists and specialists in genetics and animal husbandry from Ifremer are also involved to provide research-level support, so that results obtained in the laboratory can be used by the professionals.

Oyster mortality

Shellfish farming appears to be a vulnerable activity, since it depends on numerous hazards and uncertainties including global change, the presence of various types of pollutants and contaminants, extreme climate events as well as economic challenges (overproduction, etc.). These hazards can produce direct effects through the destruction of part of the yield and/or of shellfish farm installations, but they can also cause drops in production or disorganise it, which in turn can lead to the demise of some companies.

Since our Institute was created, Ifremer has developed research studies targeting marine molluscs of interest for aquaculture in numerous fields which include genetics, reproduction, nutrition, animal husbandry, disease, public health or economics. This long-term research has enabled the Institute to give support to the shellfish farming sector, and especially in difficult situations.

Since 2008, French oyster farms have been confronted with massive mortality rates of Pacific oyster *Crassostrea gigas* spat, in the first year they are reared. These mortality events entail difficulties in procuring young animals and a drop in the availability of Pacific oysters of marketable size.

Studies conducted by Ifremer in the field of mollusc pathology for many years made it possible to identify a variant of the OsHV-1 (ostreid herpesvirus type 1) virus, previously undescribed in France, as of 2008. This viral variant, called µVar, is considered to be the predominant infectious agent responsible for the spat mortalities reported.

Each year since 2008, massive mortality episodes (approximately 75% of animals less than a year old) have been observed along the entire coastline in late Spring, related to a rapid rise in water temperature. In 2013, high mortality rates were noted once again, although they were later, probably due to a cool spring and early summer. The OsHV-1 virus has always been found in the samples analysed. Although the virus (in its µVar form) is considered to be the ultimate cause of mortality, the emergence of this variant is certainly linked to a combination of factors. This makes it very complicated to explain episodes of massive spat mortality, since changes in environmental conditions, rearing practices and so on, come into play.

Summary

Ifremer also brings its expertise to help support professional oyster farmers, in the context of massive spat mortality events, through:

› observation of these events, for environmental monitoring of the duration and intensity of the mortality episodes affecting the batches of "sentinel" oysters,

› surveillance, to enable recommendations to be drawn up for the management of farmed stocks (arrangements to restrict transfers, etc.),

› research studies focusing both on the processes involved in interactions between host/environment/infectious agents leading to these massive mortality events and on processes of genetic selection of animals displaying better survival when exposed to various infectious agents. Since vaccinations and treatments are not possible in the open marine environment, one of the preferred courses of action lies in genetic selection.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→ *Ifremer station at La Tremblade*

In 2013, from the start of the month of July, abnormal mortality of adult Pacific oysters, *Crassostrea gigas*, was reported by oyster-farmers in several production areas. The first sign had already been recorded during the summer of 2012. The unusual nature of these mortality events had led Ifremer to propose a specific research programme to the Ministry in charge of agriculture, as of 2012.

In this sensitive social-economic context, Ifremer was solicited by different county-level directorates for Territories and the Sea, which work with the regional shellfish farming committees to centralise all of the mortality reports filed by the professionals. To this end, the Institute received samples of commercial oysters (two to three years old) from various oyster-farming regions to be screened for infectious agents (bacteria, viruses and parasites). In samples analysed with the "mollusc pathology" network (Repamo) framework, the bacteria *Vibrio aestuarianus* was found in every batch of oysters, and the mortality rates for these batches ranged from 15 to 65%.

This bacterium is already known to be able to induce mortality in Pacific cupped oysters in the adult stage. It is present and lives in the marine environment and can proliferate when the environmental conditions are favourable. It has been monitored over the past ten years and has been the subject of various studies. Several research programmes either at, or involving, Ifremer include studies on this bacteria (Aestu projects commissioned by the DPMA in 2013 and 2014; Bivalife, FP7 KBBE project, http://www.bivalife.eu; Gigassat, ANR, http://www.gigassat.org/; Gimepec, ANR, http://www.gimepec.org/, etc.).

Although the bacteria is certainly responsible for the death of the animals, the explanation of the phenomenon is most likely more complicated, involving interactions between oysters, the bacteria and the environment, against a backdrop of global change. In 2013, there was a special context for the climate, with a fast and high rise in temperatures, freshening of seawater due to rainfall, etc. This could have contributed to the bacteria's proliferation in the environment or may have rendered the oysters more sensitive or less resistant to bacterial infection.

Ifremer also compared the bacterial strains collected in 2012 and 2013 with strains collected in the early 2000s. Genetic analyses showed that

these strains were genetically similar. Moreover, diploid and triploid Pacific oysters were compared in terms of mortality caused by *V. aestuarianus* and this demonstrated that mortality levels observed under experimental conditions were not significantly different for diploids and triploids. It is important to remember that the OsHV-1 virus and the *V. aestuarianus* bacterium do not present any danger for consumers.

In this context of massive mortality episodes related to infectious agents observed in Pacific oysters over the past few years, Ifremer took part in revamping the way infectious diseases are monitored. To this end, surveillance objectives were defined to refocus on early detection of

→ *Taking hemolymph sample in the pericardial cavity of* C. gigas *Pacific cupped oysters*

emerging phenomena, in order to optimise the chances of mastering their propagation, which is hard to control in aquatic environments, and on pooling of facilities to incorporate private, individual or collective systems or initiatives undertaken in the shellfish farming value chain.

Raw materials and mining policy

Advice on applications for permits to exploit or explore marine materials (aggregates)

In compliance with the regulations applying to mineral substances contained in French seabeds, Ifremer was mandated by decree to deliver opinions on permit applications for the mining or exploration for marine materials. These opinions are delivered upon the request of public policy-makers (ministries, prefectures and decentralised State services). In 2013, Ifremer issued four opinions on siliceous materials and six on calcareous materials.

Scientific expert assessment of environmental impacts from the mining of deep-sea mineral resources

CNRS and Ifremer were mandated by the general commissioner for sustainable development (MEDDE) to lead a collective scientific expert assessment (ESCo) on the environmental impacts of exploiting deep sea mineral resources. The objective is to take stock of scientific knowledge about the ecosystems and environments in question and to characterise the potential impacts on environments, services and uses. The final report was prepared during 2013 and will be presented in the first semester of 2014. Our Institute's intervention in this case lies at the crossroads between public policies, summing up the scientific knowledge base and identifying new fields of research.

Extraplac programme

The Extraplac programme's activity was in great part devoted to presenting three new claims during the plenary session of the Commission on the Limits of the Continental Shelf (CLCS) in August. These applications concern the zones of Reunion and St Paul and Amsterdam islands, the Crozet archipelago and Wallis & Futuna. This brings the total of claims for continental shelf limits filed for French maritime areas to nine, five of which have already been examined by the commission.

On the decision of our supervisory ministries, preparation of the claim for Saint-Pierre & Miquelon has been underway since late 2013, to be filed in April 2014.

Permit for nodules in the Clarion Clipperton fracture zone (Pacific Ocean)

The annual report was given to the International Seabed Authority in March 2013. The report covers the utilisation of data on biodiversity in the French permit zone acquired during the Franco-German Bionod cruise performed on site in 2012 aboard RV *L'Atalante*.

Policy concerning quality control and health safety of agricultural and food products

For several years, Ifremer has deployed surveillance networks to monitor chemical contamination along French coasts, detect toxic phytoplankton and toxicity of shellfish in farming and harvesting areas, run microbiology checks in shellfish production zones and monitor pathogenic agents for some molluscs.

A strategic think tank was set up at the end of 2013 within the Institute to envisage the future positioning of the environment resources laboratories (LER) in the Coastal unit which performs this monitoring.

→ *Field of nodules and species of abyssal plain*

Business development activities

Marine sciences offer a vast range of innovations which can contribute to competitiveness and growth. Ifremer's research positions it as a key player in fields of economic interest such as underwater systems, operational oceanography, marine biotechnologies, fisheries science, aquaculture, energy and mineral resources, and so on. Our ambition is both to broaden the dissemination of our scientific results and technological developments towards stakeholders in social-economic realms and to help set up new French economic sectors and value chains by bringing our expertise and scientific facilities to industrial partners.

Marine research progresses thanks to advances made in many fields of technology. This approach makes it possible to overcome barriers for the maritime social-economic sector and relies on laboratories and services (acoustics, electronics, information technologies, mechanics, optics and imaging, robotics, hydrodynamics and material studies in complex environments) as well as on equipment and facilities for numerical simulation and testing. These strengths are Ifremer's foundation for deploying its partnerships.

> Ifremer's ambition is to help set up new French economic sectors

Public-private partnerships

Above and beyond the aims to produce knowledge, fulfil social expectations and contribute to developing the national economy, in particular through helping set up new value chains, Ifremer endeavours to develop transfers and business development based on its studies. This is done through different actions, such as promoting new technologies at trade shows, through service provision contracts, cooperation or licenses with industrial firms and professionals, managing the patent portfolio and collaborative research.

Participation in trade shows

In 2013, Ifremer promoted its products, services, facilities and know-how at five major trade shows.

Ocean Business, 9 to 11 April, England
Sharing a stand with the *Brest Métropole Océane* urban council there to promote the SeaTech Week event, Ifremer's commercial service presented our vessels and vehicles, as well as the full range of embedded software programs from the Vessels and shipboard systems service. Ifremer's observational methods and tools were also presented.

Thetis EMR, 10 and 11 April, Brest
The second Thetis EMR event, international convention for marine renewable energy sources, was held at the Brest Penfeld exhibition grounds. The convention combines conferences and a trade show. Ifremer was present at this opportunity to promote both its test facilities through presentations of European projects in which the Institute is greatly involved such as Merific and Marinet, and its know-how in a wide range of fields like hydrodynamics, instrumentation, materials and structures.


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Itech'mer, 16 to 18 October, Lorient
The trade show for fisheries professionals was the occasion for the Institute to present its test tank facility for fishing gear at the Ifremer Lorient station, and to spotlight its laboratory studies in fisheries biology, in particular the Barconnect (seabass tagging survey) and Obsmer (scientific observers embarking aboard volunteer fishing vessels) projects. Studies by the fisheries technology laboratory were also put in the forefront, especially studies on fuel savings and on reducing the impact of fisheries gear on benthic habitats.


© Ifremer/G. Cavarec

Building the Marine Science, 4 to 8 November, Brazil
In addition to the experts from Ifremer who facilitated the conferences, staff from the Institute's commercial service was also present on a stand covering all fields of marine science. The aim of this French-Brazilian meeting was to create interactions, not just between the two countries but also between different disciplines and the industrial sector. Participants were able to see the various offers of products and services from Ifremer on our stand, particularly for our vessels and vehicles and activities in the offshore sector.

Providing services and partnerships with industry

Fifteen consortium and cooperation agreements were signed, contributing to structuring Ifremer's activity in terms of industrial partnerships.

A framework agreement for a six year period was signed with the Total petroleum group in 2013. This new framework agreement focuses on the structure of continental margins, sedimentary systems, geohazards and instability of the sea floor, fluid and weak signals, and on extreme ecosystems. Along with Ifremer, other academic partners will take part in the research. Data acquisition cruises at sea will be conducted in the Bay of Biscay, the Mozambique Channel and the Gulf of Aden (off Somalia).

A milestone in the first quarter of 2013 was the end of the Vasco project, which compared four ways of storing and recovering industrial CO_2: geological storage, re-use of CO_2 on the industrial market, using CO_2 in oil wells and as an algae bioremediation solution defended by the Ifremer station at Palavas-les-Flots. The outcomes demonstrated that the algae bioremediation solution would prove to be the most relevant and was of interest to the partners.

A framework agreement for cooperation with DCNS, whose objective includes developing and structuring the joint activities of Ifremer and DCNS in fields like energy and mineral resources, underwater technologies and vehicles, test facilities on shore and at sea, *inter alia*, is also being drawn up.

Numerous contracts of a confidential nature are currently being carried out in various fields: agrifood, oceanography, water treatment, cosmetics, pharmaceuticals and more generally in biotechnologies. They will enable their industrial beneficiaries to commercialise new innovative products on their respective markets.

→ *Vasco project*

Carnot Edrome institute, a tool for developing cooperation between research and industry

The Carnot organisation was set up to promote the transfer of technologies, partnerships between public sector laboratories and developing innovation. It aims to recognise the capability of research bodies performing missions of general interest to efficiently cooperate with socio-economic partners, primarily enterprises and whilst growing their visibility, grant them additional financial means (with respect to their budget appropriations) which will support them in securing their scientific and technological expertise and developing and professionalising their relationships with partners.

For IC Ifremer Edrome, the ANR mid-term audit (July 2011) delivered an assessment of the actions accomplished. The general evaluation by the ANR considers that IC Ifremer Edrome fulfils the Carnot programme objectives in a highly satisfactory manner. The Carnot committee hopes that IC Ifremer Edrome will make its very positive experience available to other Carnot institutes.

The Captiven (French acronym for Environmental quality sensors and data on water and soils) project, designed to support innovation and set up by the three Carnot institutes Irstea, Ifremer Edrome and BRGM, has continued its activities. It aims to develop cooperation between these three research institutions with the social-economic realm, especially micro-businesses, SMEs and intermediate-sized companies. Its ambition is to enhance the efficiency of metrological facilities in order to monitor risks and reduce the effects of global change, while at the same time optimising the use of environmental resources.

Inventions, patents and licensing contracts

Ifremer recorded four invention disclosures and filed five patents. The Institute's patent portfolio was updated and two patents in the field of fucanes were abandoned. Ifremer's technology transfer activity took concrete form in the negotiating of twenty-four licensing contracts (twelve concerning patents, nine on know-how and three on software,) two of which (one for a patent and one on know-how) were signed in 2013. Two biological material transfer agreements (MTA) were also signed.

In the realm of underwater technologies, an invention disclosure was received, on a "digital hydrophone" for high resolution (HR) marine seismics, deployed for surveys of superficial sediments.

In the environmental and agrifood fields, the contract with the Sacco company on bacteria used for purposes of food bio-preservation continued and enabled Ifremer to receive its first fees for the technology commercialised.

And in marine biotechnologies, numerous prospects were developed in relation to Ifremer's patents and collection of extremophilic strains, making it possible to select potential industrial firms for contractual agreements in 2014.

Dialogue between science and society

Informing public decision makers, creating natural links with economic players, revealing and promoting scientific results via the media, educating children and young people, creating callings, raising public awareness and empowering people to act in terms of the major challenges related to the marine environment. All of these orientations are part of Ifremer's communications, working along with our partners (universities, organisations, alliances and networks) and with stakeholders involved in scientific and technical culture.

> Ifremer contributed to missions and inquiries conducted in order to inform public policy on a regular basis

Parliamentary hearings

fremer contributes to missions and inquiries conducted in order to inform public policy on a regular basis.

Extraplac, or the 200 nautical miles

Last October, the Economic, social and environmental council (CESE) and Gérard GRIGNON its rapporteur delivered an opinion on the Extraplac programme developed by France for the extension of its continental shelf beyond the two-hundred nautical mile zone (Montego Bay Convention, 1982, article 76). This means that, thanks to its overseas areas, France could extend its jurisdiction over nearly two million square kilometres. Ifremer has made major contributions to the programme and supplied the elements needed for this assessment and related foresight studies.

Reforming the mining code

In 2013, the sustainable development commission held a number of hearings to prepare the reform of the legislation on mining, called the mining code. The chairman Jean-Paul CHANTEGUET wanted to hear from Ifremer and during a round table session in which UFIP, Fedem and BRGM also participated, Yves FOUQUET, head of the geochemistry and metallogeny laboratory at the Brest centre spoke on behalf of our institute. During a final hearing at the French National Assembly, Ifremer was able to set out the general context to put strategic topics such as extending the realm of France's maritime sovereignty (through Extraplac) or managing French mining permits with respect to the ISA.


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Coastal ecosystems

Within the framework of the mission which the Prime Minister entrusted to Philippe MARTIN, at the time Member of Parliament representing the Gers region, on quantitative water management, especially as concerns the functioning of estuarine or coastal ecosystems (reproduction of different fish species, reproduction and development of oysters, and so on) and the fisheries or aquaculture activities taking place there, Ifremer, represented by Jean PROU, who is a research scientist at the La Tremblade station, was heard at the National Assembly in March and was able to explain how important the coastal environment is in order to measure the impact of catchment basin management policies.

Deep-sea fisheries

In the context of European Parliamentary proceedings on the subject of deep-sea fisheries, various contributors from Ifremer were able to provide some perspective. Lastly, in late 2013, Ifremer took part in a joint hearing by the French parliamentary commissions on sustainable development and on European affairs. This was an opportunity to review the scientific and technical context, the knowledge acquired, the uncertainties which still exist and the management models adopted in this context by authorities in charge of these issues. It was also possible for the Institute to highlight its role in studies carried out at European institutions level.

Institutional actions

Ifremer at the first European maritime economy business show, Euromaritime

Ifremer took part in the first edition of this trade show, which was held from 5 to 7 February 2013. As a venue for meetings and discussions, the Euromaritime business show was an opportunity for Ifremer's researchers and engineers to promote their know-how in various fields and enable professionals in the maritime realm to better understand the research programmes conducted by the Institute.
The Institute presented its activities there through five different themes: living resources, mineral and energy resources, biodiversity and biotechnologies, the coastal environment and technologies, services and facilities at sea.

→ *Euromaritime, first European maritime economy business show, Porte de Versailles, Paris*

Ninth economy of the sea congress in Montpellier

The specialised weekly *Le Marin* and daily *Les Échos* newspapers organised the ninth congress on the maritime and coastal economy, held on 3 and 4 December 2013, at Montpellier and Sète. The meetings attracted more than one-thousand decision-makers from the public and private sectors, two-hundred students, major managers from the maritime sector, big figures from the economic world, as well as policy makers. As a partner of the congress, Ifremer coordinated and facilitated these days' events, notably through two workshops "Managing fishing, managing fish stocks that are unknown or virtually unknown?" and "Renewable marine energy: is France well placed?".

Ifremer in the media

With 151 appearances on television and 129 on radio, cited 1,633 times on the web, cited 279 times in French press publications (dailies, weeklies, news magazines, press agencies, the scientific press and publications for youth and children), 533 mentions in the professional and specialised press and 1,702 in the regional press, the total number of times Ifremer was quoted or mentioned in the media in 2013 reached 4,441, i.e. nearly a thousand more mentions than in 2012. The objective of spotlighting our publications, activities and results, as well as Ifremer-related research and societal issues in the media was achieved in various ways.

→ *Report on microplastics research for the* Télématin *TV programme on* France 2

Quae : worth reading

Eight new publications joined the list at Quae, all available in both paper and digital versions.

- *Cartographie morpho-sédimentaire des petits fonds marins du cap d'Antifer au cap d'Ailly,* (Morpho-sedimentary mapping of shallow waters from Cap d'Antifer to Cap d'Ailly) a portfolio of six maps accompanied by a 128-page booklet, a publication coordinated by Claude AUGRIS and Philippe CLABAUD.
- *Biodiversity in the marine environment,* by Philippe GOULLETQUER, Philippe GROS, Gilles BOEUF, Jacques WEBER (coord.), Springer, put on-line on 31/01/2014.
- *Deep-Sea Mineral Resources. Foresight study for 2030,* by Yves FOUQUET and Denis LACROIX. Springer, put on line on 31/01/2014.
- *La vie sous la glace. Une oasis au pôle Sud* (Life under ice. An oasis at the South Pole) by Paul TRÉGUER, Erwan AMICE and Laurent CHAUVAUD. A coffee-table book, illustrated by one-hundred colour underwater photos.
- *L'aventure de l'aiguille aimantée. Histoire de la boussole* (History of the compass. The adventure of the magnetised needle) by Pierre JUHEL. A fine edition, illustrated by photos and old engravings.
- *L'océan sous haute surveillance. Qualité environnementale et sanitaire* (The ocean under high surveillance. Environmental and health quality) by Michel MARCHAND. In the Collection "Matière à débattre et décider" (Matters for discussion and decision).
- *Une mer propre : mission impossible ? 70 clés pour comprendre les déchets en mer* (A clean sea - mission impossible? Seventy keys to understanding waste at sea) by François GALGANI, Isabelle POITOU and Laurent COLASSE. In the Collection "Clés pour comprendre" (Keys to understanding).
- *Plancton marin et pesticides : quels liens ?* (Marine plankton and pesticides: what links?) by Geneviève ARZUL and Françoise QUINIOU. In the Collection "Synthèse" (Summing up knowledge) (xml layout underway for publication in January 2014).

Promoting our knowledge and know-how through images

In 2013, films were made to present and represent the Institute at several events, like the Euromaritime trade show in Paris or during the blue water fleet days organised at the Ifremer centre in Brittany. A film based on images recorded by the *Nautile* submersible during the Mescal oceanographic cruise made in the Pacific in 2012 was presented at the FMISM world festival of underwater pictures in Marseille.

Scientific and technical cultural networking

Framework agreement with the Aquarium *Mare Nostrum* in Montpellier

Ifremer and the *Mare Nostrum* aquarium in Montpellier signed a framework agreement on 11 April 2013. Ever since it opened in 2007, the *Mare Nostrum* aquarium in the conurbation of Montpellier has worked in association with Ifremer, making our Institute a privileged scientific partner. Thanks to this cooperation, which allowed the aquariology teams of *Mare Nostrum* to take part in the research cruises conducted aboard RV *L'Europe* in order to renew some Mediterranean species which live in the

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→ *Signing of the framework agreement with the* Mare Nostrum *aquarium*

The partnerships that Ifremer has with the CCSTI, museums, aquariums and associations were further developed in 2013, though events like:

- *"Azimut"*, the career guidance show in Brest, where twenty research scientists, engineers and technicians from Ifremer facilitated and met some 20,000 visitors, most of them students in their last two years of high school, over the three-day event;
- the festival called *"Les savanturiers de la mer"* at the Cité Tabarly in Lorient (lecture on the *Phénomer* participatory science project and a stand on drones used for measurements) where five researchers, engineers and technicians from the Institute proposed demos and activities over the three days for three hundred visitors;
- the *"Sciences métisses"* festival in April (an Éditions Quae stand and a stand with demonstrations about exploring ocean depths), where, during three days, seventeen Ifremer researchers, engineers and technicians received 1,200 visitors, of which 1,000 were schoolchildren;
- the *"journée de la rade"* or Bay day in Brest, in the framework of the Sea days events, with five scientists and technicians from our Institute, attracting some 200 visitors;
- the *"Faites de la science"* contest organised by the Conference of university deans (UFR Sciences training and research unit);
- participating in popular science demos and activities with the *Petits Débrouillards* association of Brittany;
- *"Nuit des chercheurs"* or Researchers night, at Oceanopolis - a European initiative from its outset - presented during an entire evening by ten scientists, engineers and technicians from Ifremer. The event attracted no less than 4,000 visitors;
- the *Fête de la Science* festival, three days during which researchers, engineers and technicians from our Institute devoted their efforts to manning stands and giving conferences of interest to the 5,000 attendees, including 2,300 schoolchildren;
- participation by six scientists, engineers and PhD students in "Méioscool", where they facilitated an evening event called the 'microscopic night';
- participation in the international conference "The high seas, our future", by lending the CESE our exhibition on "Life in the deep sea";
- participation in the *LVMH Recherche* exhibition on "instruments serving science".

tanks of the aquarium, or the weekly delivery of treated seawater by Ifremer's aquaculture station at Palavas-les-Flots.

Signing of a cooperation agreement between Ifremer and the Oceanographic Institute of Monaco

The Chairman-CEO of Ifremer and Robert CALCAGNO the Chief Executive Officer of the oceanographic institute Foundation Albert I, signed a cooperation agreement on Thursday 14 November 2013 at the Oceanographic museum of Monaco, on the occasion of the president of the French Republic François HOLLANDE's official visit to Monaco. Seeing the complementarity of their expertise in the field of oceanography, marine biodiversity and use made of marine resources, our two institutions wanted to further strengthen their ability to disseminate the results and progress made about the marine environment to the media and to young people.

Exhibition at the Museum of natural history in Toulon

The exhibition entitled "*Méditerranée, mer vivante*" (Living sea) produced by the Museum of natural history of Toulon and the Var region was on show from 2 July to 29 September 2013. Working in partnership with Ifremer and the Port-Cros national park, the Museum focused on the Mediterranean Sea, immersing its visitors into the heart of marine ecosystems, ranging from the Var coast to underwater canyons. Nearly 22,000 people viewed this exhibition. Ifremer's presence was expressed through the world of underwater vehicles and particularly the remote-operated vehicle *Victor 6000* and its related mock-up. The SimuROV simulator was made available to the Museum for the occasion.

Open house days at Palavas-les-Flots

Ifremer's open house days in the Mediterranean were held from 7 to 9 June 2013, at the experimental aquaculture station of Palavas-les-Flots. There were three objectives to this operation, combining communications aimed at institutional entities and at the public with a dimension of cohesion within our institution. Around a thousand visitors discovered the narrow strip of coastline between the Prévost lagoon and the Mediterranean Sea. These three days also fell under two special label events: World Oceans Day and Sea Days. This type of operations gave us the opportunity to invite our partners: the Cirad, hosted at Palavas, the innovative company Coldep and the Aquarium *Mare Nostrum* of Montpellier.

→ *"Open house" days at the Ifremer station of Palavas-les-Flots*

Phénomer, the first participatory science project sponsored by Ifremer

In 2013, Ifremer and partners launched *Phénomer*, a participatory project for sciences designed to better understand the microalgae present in the marine ecosystem. Citizens are invited to report any unusual phenomena at sea which could correspond to a phytoplankton bloom (brown, red or green "coloured water", large amounts of foam, mortality of a species).

Significant efforts to communicate about the project

In March, our communications department contributed to drawing up a file submitted to the call for proposals by the Fondation de France called "What coasts for the future?" 2013-2015. In May, the Foundation granted the entire amount requested i.e., some 150,000 euros over a three-year period. *Phénomer* communications began with the publication of a special issue devoted to the project of Ifremer's newsletter *Les nouvelles de l'Ifremer* on 21 June, which was the launch date for the approach, corresponding to the appearance of the first phytoplankton blooms. In all, the national and above all regional press coverage gave rise to seventy-two articles or reports in the press. These were mainly articles announcing information along with interviews by the head of the project. The summer period and the nature of the topic were favourable factors in achieving this good media coverage. Sixteen *Phénomer* indicator reports were made. They correspond to events which would probably not have been seen by scientists, thus justifying the full interest of the approach.

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→ *Presenting the* Phénomer *programme to students from the Ponant islands middle school on Ushant island and taking samples*

Schoolchildren for *Phénomer*!

The *Phénomer* project also comprises a strand for schools, with educational and scientific aims. The action consists in taking sea water and phytoplankton samples on a very frequent basis at several sampling points located on some of the Ponant islands off Brittany (Batz, Ushant, Molène and Sein), working with members of associations and schoolchildren. The samples will be analysed by the scientists at Ifremer's Dynéco-Pelagos laboratory. This should make it possible to acquire spatial and time series of phytoplankton data at frequent sampling rates and which are removed from influences of the continent. The partners involved are several classes taking part from the Ponant junior high school located on a number of islands and the *Cap Vers la Nature* association which proposes organised activities about phytoplankton to schoolchildren.

Raising young people's awareness

Participation in the Youth jury: declaration at the *Maison des océans*

Ifremer took part in the Youth jury of the world festival of underwater images, organised on 7 June in the Paris area, with the support of the Academy of Paris, the *Aquarium de la Porte Dorée* and the Oceanographic institute of Paris. Pupils from years 8 to 10 (7th to 9th graders) watched and voted on six films, based on joint criteria. Ifremer helped choose the six films which were presented to the students.

Partnership with *Bayard Jeunesse* and *Milan* publishers

Ifremer joined forces with the publishing houses *Bayard Jeunesse* and *Milan* (number one publisher for children and young readers in France) to take part in the operation called *"J'aime ma planète !"* (I love my planet). Starting on 20 March and running throughout April, nearly seven million readers were made more aware about the marine environment, though reports, investigations, special reports, games and activities proposed by twenty magazines and the websites taking part in the operation.

In the April issues of the magazines published by the group, could be found: a special report on the deep sea floors published in *Wapiti*, the portrait of a fisheries science technician from Ifremer explaining his career path in the *Phosphore* magazine for teenagers and students, a video presenting the job of an Ifremer research scientist, his studies and career and his passion for micro-algae on the career guidance website www.Phosphore.com and a six-page report on life in the Abyssal plains in *Astrapi*. The back cover of this issue of *Astrapi* was made of cardboard, with drawings of various elements on that children could cut out and use to build a 3-D model of the *Nautile* submersible!

Along with the magazine contents themselves, an eight-page educational booklet entitled *"J'aime la mer!"* (I love the sea) designed with Ifremer to discover the sea and its treasures, was distributed along with the subscriptions of the following magazines:

- *Astrapi*, for kids aged seven to eleven; 57,800 copies (read by 560,000 readers)
- *Wapiti*, for ages seven to thirteen; 51,600 copies (702,000 readers)
- *Images Doc*, for ages eight to twelve; 56,500 copies (740,000 readers)
- *Okapi*, for readers aged ten to fifteen; 58,000 copies (read by 640,000)
- *Géo Ado*, for ages ten to fifteen; 41,000 copies (670,000 readers).

Science festival

Sciences au Carré(e), the science festival in Paris

Ifremer took part, alongside thirteen other French research institutions, at the *place Carrée* of the *Forum des Halles* in Paris, in the *"Sciences au Carré(e)"* (a play on words for sciences squared/in the square), an innovative event open to all, with free admission, held from 17 to 19 October in the heart of the capital. During the three days, there were 10,000 people in attendance (120,000 people cross the *Place Carrée* square daily) and *"Sciences au Carré(e)"* was one of the flagship events proposed in Paris for the 2013 science festival. The taste-for-science prize dubbed *"Le Goût des sciences"* was awarded during the event on Friday 18 October by Geneviève FIORASO, the Minister of higher education and research.

The science festival on the Atlantic seafront

From 11 to 13 October, Ifremer's Atlantic centre took part in the event called *"Square des sciences"* sponsored by the Museum of natural history of Nantes and gathering sixteen other organisations. It set up a 20 m² stand called Immersion in the universe of marine microalgae. Five scientists and two communications officers relayed each other as facilitators on the stand organised around three focal points: what microalgae look like with the naked eye (coloured water, showcasing the value of the *Phénomer* project); what microalgae look like under the microscope and presentation of the phenomenon of eutrophication; and thirdly, phytoplankton seen from space (highlighting the value of Previmer) and the observation of phytoplankton in the framework of the Réphy monitoring network. The *Square des Sciences* event hosted about 2,000 visitors.

Life at Ifremer

To efficiently and effectively ensure its scientific and technical missions, our Institute has the duty to implement the most rigorous management possible of its resources and facilities. This entails better controlling the administrative and financial management, both to make the best use of the resources it has been endowed with and to accurately monitor how the means engaged in each compartment of the activity are employed. The approach goes hand in hand with a human resources policy which endeavours to put all our existing expertise to best use and to reinforce our institution's scientific strategy for coming years. This method is all the more necessary in that, like many State-owned institutions in France, Ifremer is in a tight financial situation and must contribute to controlling public spending, and all this in a context where the Institute is increasingly solicited.

Constantly improving administrative and financial management in a very tight financial and budgetary context

For several years now, our Institute has undertaken to modernise its administrative and financial practices in order to account for its activities as accurately as possible, while enabling more efficient management of them.

Certification of the accounts

Although Ifremer is not subjected to any regulatory obligations to this end, it began the process of certification of its accounts several years ago. This has borne fruit and now gives us a more comprehensive and stringent vision of our institution's accounts.

The Institute's 2012 accounts were approved by the board of directors on 28 March 2013 and certified by the Statutory Auditors with a clean audit. In addition, an action plan to control accounting and financial risks was presented to the board of directors and will progressively be incorporated into the steps to master risks to be conducted in the framework of Ifremer's quality assurance system. These elements are part of the work laid out to modernize and develop the State's financial management and further back up the confidence held in the reliability of the Institute's accounts.

Working to improve the assessment of the Institute's full cost accounting

The Institute has pursued its work to improve the way it calculates full costs, and in 2013 two actions were especially undertaken to this end: a method to identify and process the costs related to buildings for better itemization of the direct costs and an evaluation of the costs of test facilities, to optimize the tariff of prices charged depending on uses. These efforts also back up our Institute's response to requests from various entities supplying funding, who want a clearer understanding of Ifremer's calculation methods with respect to their own accounting and financial criteria.

Moving towards a new integrated software suite for management

For its management, the Institute relies on software tools which were developed in-house nearly fifteen years ago. In 2012, our organisation decided to utilise an integrated management software suite, an essential requirement to secure the mastery and optimisation of its means and resources. Changes in our in-house practices, underpinned by the implementation of this IT management tool, should make the Institute even more efficient. Above and beyond upgrading our management tools, this is truly an institution-wide project with the following objectives:

- optimisation of management activities, through generally improving data quality and making processes (wages, closing of accounts, etc.) more reliable and streamlined, ultimately leading to potential productivity gains;
- the possibility of compliance with new regulatory requirements;
- contributing to better running of the Institute.

The project's scope encompasses human resource management (wages, administrative management, training, recruitment, and so on), financial management (budget, expenditure, income, accountancy, etc.) and project management. The software suite is based on:

- HR Access for human resource management and
- SAP for financial and project management.

2013 was devoted to the launching of the project and preparing the introduction of the new software within the Institute. The implementation of the accounting part is expected to fall in early 2016 and necessarily as of 2013 this will involve significant work to review and harmonise procedures and adapt them to the new IT context. These efforts are also shared in the field of human resources.

2013 budget and financial figures

The profit and loss account shows a deficit of - 4.2 million euros. This negative balance is the result of costs reaching 185.7 million euros for deferred revenues amounting to 181.05 million euros. The utilisation rate of commitment appropriations was 98.44%. The deferred income for the financial year (M€181.05) represents 95.89% of the estimated expenditure budgeted (M€188.81).

The balance under the heading of investments amounted to + 3.48 million euros. This balance is the result of investment expenses of 17.83 million euros, for 21.31 million euros of resources established. It is positive both thanks to the payment at year's end of 1.86 million euros under the lifting of measures for funding placed in reserve (sum which will be used in 2014) and a slight delay in the completion of projects.

Generally speaking, the 2013 financial year showed great pressure and strain on the budgetary situation of the Institute, whose resources are stagnating in comparison with the increasingly strong demands put upon it.

Consolidated resources

In 2013, not including internal transactions, Ifremer's total resources reached 202.36 million euros, indicating a trend of - 7.87 million euros (- 3.75%) between 2012 and 2013. This trend is the result of the combination of two factors: the rise by + 1.70 million euros (+ 1.09%) in subsidies for public service charges (SCSP) and the fall in contractual resources by - M€9.57 (- 17.99%) recorded in 2013.

As concerns the trend for these subsidies for public service charges, the following main points should be mentioned:

- the subsidy received under the State programme 187, under the aegis of the Ministry of higher education and research (MESR) was set at 151.40 million euros. Between 2012 and 2013, it increased by + 2.59 million euros, i.e. up + 1.74%.

This change was principally due to the decision by the MESR to raise the grant allocated to the Institute at the end of the 2013 financial year, by an additional 1.86 million euros, corresponding to the appropriations initially earmarked.

- subsidies for public service charges allocated by the other ministries were down by - 0.88 million euros in comparison to 2012.

Regarding contractual funding (M€43.62), the trend with respect to 2012 (- M€9.58) shows the drop in the level of operating income (revenues recorded in 2013 to the amount of 40.29 million euros compared to 49.62 million euros in 2012) and the relative stability of co-funding obtained for investments and equipment or facilities (M€3.33 in 2013 from M€3.59 in 2012).

The net drop (- M€9.32) in contracted operating resources recorded in 2013 compared to those taken into account in 2012 is mainly due to the following elements:

- the level of 2013 revenues was affected by the lack of a contractual agreement between the DPMA and Ifremer for the collection, management and utilisation of fisheries data in the framework of the European union policy (DCF),
- the level of its deferred income under write-offs or reversals of provisions dropped, due to applying the new method for posting of provisions,
- the significant decrease in the number of partnerships with companies in the framework of scientific missions mobilising the ocean research fleet, for instance, with the end of the Wallis & Futuna 2011/2012 project and with the Petrobras/Salsa programme being postponed until 2014,
- the Institute's increasing difficulty in maintaining the level of its income from one year to the next in a difficult economic context, with limited basic means available to cover the corresponding contracts, and with increasingly strict requirements and demands from entities providing financing in terms of eligible spending.

Consolidated expenditure

Seeing these means, not including internal transactions, the consolidated expenses of Ifremer reached 203.70 million euros (for a projected budget of M€208.56). The situation in 2013, still excluding internal transactions, was marked by a downward trend in spending of - 7.63 million euros (- 3.61%) from 2012 (M€211.33).

Trend for 2012-2013

The trend is particularly characterised by a notable drop in running costs: - 7.02 million euros with respect to 2012, excluding change in scope and - 5.19 million euros at constant scope.

The payroll came to 108.36 million euros (- M€2.09 from 2012, a difference mainly due to the implementation of the new method of accounting for the employment centre provision). The performance figures take account of a rise by 1.87% in the average pay for current staff (RMPP). The mean labour force receiving wages for the financial year was 1,273 in Full Time Equivalent, compared to 1,280 FTE in 2012.

Finally, the difference in spending for scientific programmes (- M€3.33), directly linked to the teams' missions and the level of resources recorded for the two financial years, can be noted.

Concurrently, the trend in investment spending between the two financial years (- M€0.60) is marginal compared to the differences noted in terms of operating expenses.

→ *Ifremer's Mediterranean centre in the port of La Seyne-sur-Mer*

Overall expenditure 2013

Overall expenditure	Performance 2012	Performance 2012 readjusted (*)	% with respect to total actual expenditure
Payroll expenses (Ifremer)	110,457,064	110,457,064	52.27%
Fleet-related spending	40,173,952	40,173,952	19.01%
Expenses related to scientific activities	39,198,498	39,826,838	18.85%
Logistics / Centres	15,771,667	15,771,667	7.46%
Support spending	4,403,612	3,775,272	1.79%
Cross-cutting activities	500,000	500,000	0.24%
Depreciation - share of revalued assets	820,384	820,384	0.39%
Total expenditure (not including internal transactions)	211,325,178	211,325,178	100%
Payroll expenses (Ifremer + Genavir)	132,935,149	132,935,149	62.91%

(*) credits allocated to scientific and technical information have been incorporated under spending related to scientific activities, in keeping with the 2013 estimated budget

				Trend forecast/ performance 2013	
BR2 2013	% with respect to total actual expenditure	Performance 2013	% with respect to total actual expenditure	in volume	in %
110,791,800	53.12%	108,363,218	53.20%	- 2,428,582	- 2.19%
38,616,222	18.52%	38,307,334	18.81%	- 308,888	- 0.80%
38,036,225	18.24%	35,892,160	17.62%	- 2,144,064	- 5.64%
15,292,764	7.33%	15,289,364	7.51%	- 3,400	- 0.02%
2,881,208	1.38%	3,762,007	1.85%	880,799	30.57%
2,075,525	1.00%	1,219,931	0.60%	- 855,594	- 41.22%
865,000	0.41%	862,960	0.42%	- 2,040	- 0.24%
208,558,744	100%	203,696,975	100%	- 4,861,769	- 2.33%
131,676,800	63.14%	130,425,307	64.03%	- 1,251,493	- 0.95%


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Trend 2012/2013 (in euros)	
in volume	in %
- 2,093,847	- 1.90%
- 1,866,618	- 4.65%
- 3,934,678	- 9.88%
- 482,302	- 3.06%
- 13,265	- 0.35%
719,931	143.99%
42,576	5.19%
- 7,628,203	- 3,61%
- 2,509,843	- 1,89%

Consolidated resources

TOTAL RESOURCES	Performance 2012	BR2 2013	Performance 2013	Trend forecast/ performance 2013		Trend 2012/2013	
				In volume	in %	in volume	in %
Programme 187: Research in the field of environmental and resource management	148,812,315	151,399,952	151,399,952	-	-	2,587,637	1.74%
Programme 113: Landscapes, water and biodiversity	2,661,057	1,647,500	1,647,488	- 12	0.00%	- 1,013,569	- 38,09%
Programme 205 (ex Programme 154): Maritime safety and affairs, fisheries and aquaculture	1,887,255	2,061,812	2,067,712	5,900	0.29%	180,457	9.56%
Programme 206: Food safety and health quality	3,520,098	3,295,648	3,469,609	173,961	5.28%	- 50,490	- 1.43%
Programme 172: Multidisciplinary scientific and technological research	148,509	148,000	148,509	509	0.34%	-	-
Available resources on Grants for Public Service charges	**157,029,235**	**158,552,912**	**158,733,270**	**180,358**	**0.11%**	**1,704,035**	**1.09%**
Contractual resources	**53,203,978**	**51,866,662**	**43,624,427**	**- 8,242,235**	**- 15.89%**	**- 9,579,550**	**- 18.01%**
TOTAL RESOURCES AVAILABLE Not including internal transactions	**210,233,212**	**210,419,574**	**202,357,697**	**- 8,061,877**	**- 3.83%**	**- 7,875,515**	**- 3.75%**
Net book value of assets written off (internal transactions)	347,541	500,000	78,278	- 421,722	- 84.34%	- 269,263	- 77.48%
Depreciation expenses (internal transactions)	26,794,499	39,700,000	24,559,067	- 15,140,933	- 38.14%	- 2,235,432	- 8.34%
TOTAL RESOURCES AVAILABLE	**237,375,252**	**250,619,574**	**226,995,043**	**- 23,624,531**	**- 9.43%**	**- 10,380,209**	**- 4.37%**

Operating income by source

CONTRACTUAL OPERATING RESOURCES - (RG 2012 - 2013)						
		RG 2012	**RG 2013**	**2013/2012 Trend in volume**	**BR2 2013**	**RG 2013/ BR2 2013 Trend in volume (in euros)**
1 - CONTRIBUTIONS FROM STATE						
→ Ministry in charge of the Environment						
- Extraplac		764,795	292,647	- 472,148		
- Other programmes		211,760	110,304	- 101,456		
→ Ministry in charge of Agriculture		322,196	323,345	1,148		
→ Ministry of Defence						
- SHOM: Contribution to RV *Pourquoi pas?* operating expenses		3,761,285	4,408,040	646,755		
- Other programmes		38,416	49,046	10,630		
→ Contributions from other ministries		331,613	265,906	- 65,708		
sub-total (1)		5,430,066	5,449,288	19,221	5,354,882	94,406
2 - FRENCH NATIONAL RESEARCH AGENCY		**2,953,028**	**2,281,938**	**- 671,089**		
sub-total (2)		2,953,028	2,281,938	- 671,089	2,333,137	- 51,199
3 - EU ORGANISATIONS AND INTERNATIONAL PARTNERS						
→ European Union and other international bodies		11,991,637	8,906,681	- 3,084,956		
→ European Space Agency		586,798	379,498	- 207,300		
sub-total (3)		12,578,435	9,286,179	- 3,292,256	14,762,566	- 5,476,387
4 - LOCAL AND REGIONAL AUTHORITIES AND OTHER PUBLIC PARTNERSHIPS						
→ Region, county and other local and territorial authorities		3,319,062	5,297,650	1,978,589		
→ Public institutions and decentralised services		4,432,233	4,791,330	359,098		
→ Onema		1,137,237	1,431,200	293,962		
→ EDF		1,346,937	1,271,074	- 75,863		
sub-total (4)		10,235,469	12,791,255	2,555,786	12,674,259	116,995
5 - PRIVATE PARTNERSHIP						
→ Business sector/Social-professional sectors		13,426,876	7,600,943	- 5,825,933		
sub-total (5)		13,426,876	7,600,943	- 5,825,933	9,867,459	- 2,266,516
6 - MISC. INCOME		**4,991,348**	**2,881,677**	**- 2,109,671**		
sub-total (6)		4,991,348	2,881,677	- 2,109,671	3,251,367	- 369,690
GRAND TOTAL		**49,615,222**	**40,291,280**	**-9,323,942**	**48,243,671**	**- 7,952,391**

Balance sheet and income statement

BALANCE AT CLOSING BEFORE ALLOCATION OF PROFIT OR LOSS					
BASIC SYSTEM	**ASSET**				
BALANCE SHEET	**EXERCICE 2013**			**EXERCICE 2012**	**Trend**
	Gross	**Depr. Prov.**	**Net**	**Net**	**%**
Capital not called up	-		-	-	
FIXED ASSETS					
Intangible fixed assets	**36,165,445.01**	**27,788,692.77**	**8 376 752.24**	**7 366 572,89**	**13.7**
Setting-up and formation expenses	13,270.16	13,269.11	1.05	13.67	- 92.3
Research and development costs	-	-	-	-	
Concessions, patents, licences, trademarks, processes, software and similar rights	31,376,502.19	27,550,485.13	3,826,017.06	4,179,778.10	- 8.5
Purchased goodwill	-	-	-	-	
Other	246,082.16	224,938.53	21,143.63	35,536.73	- 40.5
Intangible assets in progress	1,969,340.56	-	1,969,340.56	740,259.54	166.0
Advances and prepayments	2,560,249.94		2,560,249.94	2,410,984.85	6.2
Tangible fixed assets	**506,221,040.29**	**321,540,233.23**	**184,680,807.06**	**192,056,380.25**	**- 3.8**
Land and developments	7,151,418.74	890,829.77	6,260,588.97	6,307,460.05	- 0.7
Buildings	115,455,437.14	61,144,067.97	54,311,369.17	55,289,914.92	- 1.8
Industrial fixtures, fittings, plant machinery and equipment	125,398,688.19	111,741,376.17	13,657,312.02	15,270,498.15	- 10.6
Collections	961,735.82	-	961,735.82	961,735.82	0.0
Vessels and underwater vehicles	211,657,509.50	116,356,556.19	95,300,953.31	102,307,304.31	- 6.8
Other	35,727,251.34	31,407,403.13	4,319,848.21	4,383,945.60	- 1.5
Tangible assets in progress	4,257,623.82	-	4,257,623.82	4,325,822.95	- 1.6
Advances and prepayments	5,611,375.74		5,611,375.74	3,209,698.45	74.8
Investments	**6,567,543.54**	**164,511.85**	**6,403,031.69**	**6,298,539.74**	**1.7**
Holdings	680,089.93	164,511.85	515,578.08	534,638.08	- 3.6
incl. other forms of investment (Quae)	125,000.00	-	125,000.00	125,000.00	0.0
Receivables attached to holdings	-	-	-	-	
Other forms of investments	-	-	-	-	
Other investments	-	-	-	-	
Loans	5,504,777.76	-	5,504,777.76	5,361,154.65	2.7
Other (deposits and guarantees paid)	382,675.85	-	382,675.85	402,747.01	- 5.0
TOTAL I	**548,954,028.84**	**349,493,437.85**	**199,460,590.99**	**205,721,492.88**	**- 3.0**

BALANCE AT CLOSING BEFORE ALLOCATION OF PROFIT OR LOSS			
LIABILITIES			
	EXERCICE 2013	**EXERCICE 2012**	**Trend**
			%
EQUITY			
Capital (including payments, etc.)	-	-	
Allocation contributions	**1,520,345.97**	**1,520,345.97**	**0.0**
Allocations from State	291,138.30	291,138.30	0.0
Additional allocations from State	543,382.59	543,382.59	0.0
Additional allocations - Organisations other than the State	536,967.50	536,967.50	0.0
Capital donations and legacies	148,857.58	148,857.58	0.0
Premiums from share issues, mergers, assets brought in	-	-	
Revaluation reserves	**22,046,464.37**	**22,046,464.37**	**0.0**
Equity method evaluation difference	-	-	
Retained earnings	**4,085,304.51**	**3,906,397.83**	**4.6**
Legal reserve	-	-	
Statutory or contractual reserves	-	-	
Regulated reserves	-	-	
Optional reserves	4,085,304.51	3,906,397.83	4.6
Other	-	-	
Profits/Losses brought forward	**1,268.48**	-	
Result for financial year (profit or loss)	**- 4,821,856.40**	**178,906.68**	**- 2,795.2**
Investment grants	175,869,743.49	177,967,315.17	- 1.2
Investment grants received	578,154,754.81	560,630,142.48	3.1
Investment grants entered on profit and loss account	- 402,285,011.32	- 382,662,827.31	5.1
Regulated provisions	-	-	
TOTAL I	**198,701,270.42**	**205,619,430.02**	**- 3.4**

BALANCE AT CLOSING BEFORE ALLOCATION OF PROFIT OR LOSS					
BASIC SYSTEM	**ASSET**				
BALANCE SHEET	**EXERCICE 2013**			**EXERCICE 2012**	**Trend**
	GROSS	**Depr. Prov.**	**Net**	**Net**	**%**
Capital not called up	-		-	-	
CURRENT ASSETS			-	-	
Inventory	**48,567.68**	**-**	**48,567.68**	**43,021.13**	**12.9**
Raw materials and other supplies	48,567.68	-	48,567.68	43,021.13	12.9
Work in progress (production)	-	-	-	-	
Work in progress (services)	-	-	-	-	
Intermediate and finished products	-	-	-	-	
Goods	-	-	-	-	
Advances and prepayments	**3,584,797.11**		**3,584,797.11**	**3,712,198.18**	**- 3.4**
Debts	**43,398,819.55**	**2,707,622.26**	**40,691,197.29**	**57,531,429.83**	**- 29.3**
Customer and related accounts receivable	12,538,983.14	2,707,622.26	9,831,360.88	18,100,995.82	- 45.7
Other	30,859,836.41	-	30,859,836.41	39,430,434.01	- 21.7
› incl. payroll and related accounts	104,874.88		104,874.88	77,867.06	34.7
› incl. Social Security and social organisations	0.00		0.00	0.00	
› incl. State and local authorities	30,754,961.53		30,754,961.53	39,352,566.95	- 21.8
› incl. subsidies	10,906,657.44		10,906,657.44	13,635,863.22	- 20.0
Capital subscribed/called and not paid in	-				
Accounts receivable	114,336.03		114,336.03	299,456.02	- 61.8
CASH	**29,038,352.31**	**-**	**29,038,352.31**	**26,260,657.98**	**10.6**
Shares (listed securities)	-		-	-	
Other securities	-		-	-	
Banking	28,992,151.07		28,992,151.07	26,212,900.08	10.6
› incl. private banks	566,431.75		566,431.75	461,582.15	22.7
› incl. postal banking system in Nantes	-		-	-	
› incl. Public finances general directorate	28,263,338.69		28,263,338.69	25,667,707.90	10.1
Cash account	3,662.33		3,662.33	5,486.54	- 33.2
Secondary accounting officers	-		-	-	
Service authorising expenses to be incurred	42,488.91		42,488.91	42,221.36	0.6
Service enabling funds to be received	50.00		50.00	50.00	0.0
Libraries and Publishing unit accounts service	-				
Internal transfers	-				
ADJUSTMENTS					
Prepaid expenses	25,691.46		25,691.46	40,251.58	- 36.2
TOTAL II	**76,210,564.14**	**2,707,622.26**	**73,502,941.88**	**87,887,014.72**	**- 16.4**
Charges over several financial years	-		-	-	
Loan redemption premiums (IV)	-		-	-	
Unrealised exchange losses (V)	-		-	-	
TOTAL GENERAL (I + II + IV + V)	**625,164,592.98**	**352,201,060.11**	**272,963,532.87**	**293,608,507.60**	**- 7.0**

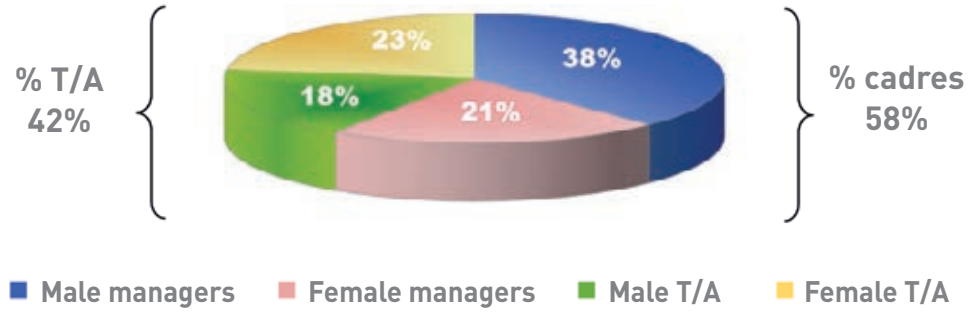
BALANCE AT CLOSING BEFORE ALLOCATION OF PROFIT OR LOSS			
LIABILITIES			
	EXERCICE 2013	**EXERCICE 2012**	**Trend**
			%
PROVISIONS			
Provisions for contingencies	892,545.00	167,545.00	432.7
Provisions for expenses	12,739,336.82	12,689,767.69	0.4
› incl. provisions for pensions and similar obligations	9,021,184.08	8,805,578.00	2.4
› incl. provisions for Unedic commitments	3,007,037.18	3,083,308.00	- 2.5
› incl. other provisions for charges	711,115.56	800,881.69	- 11.2
TOTAL II	**13,631,881.82**	**12,857,312.69**	**6.0**
LIABILITIES			
Loans and related liabilities	**34,771.41**	**34,771.41**	**0.0**
Convertible debenture loans	-	-	
Other debenture loans	-	-	
Loans from credit institutions	-	-	
Misc. loans and financial debts	34,771.41	34,771.41	0.0
Received advances and prepayments	**1,277,540.73**	**4,427,440.27**	**- 71.1**
Operating liabilities	**50,785,161.03**	**60,276,639.07**	**- 15.7**
Trade accounts payable and related accounts	10,736,550.57	17,718,290.78	- 39.4
Tax and social security payable	40,048,610.46	42,558,348.29	- 5.9
› incl. payroll and related accounts	11,537,867.80	11,168,583.58	3.3
› incl. Social Security and social organisations	11,539,884.93	11,414,077.35	1.1
› incl. State and local authorities	4,629,455.69	5,922,874.29	- 21.8
› incl. advances and prepayments received on grants	12,341,402.04	14,052,813.07	- 12.2
Non-operating liabilities	**8,362,470.46**	**10,265,056.16**	**- 18.5**
Liabilities on assets and related accounts	5,660,021.82	8,977,240.86	- 37.0
Other liabilities	2,702,448.64	1,287,815.30	109.8
Liquid debts	-	-	-
ADJUSTMENTS			
Deferred income	170,437.00	127,857.98	33.3
TOTAL III	60,630,380.63	75,131,764.89	- 19.3
Unrealised exchange profit (IV)	-	-	
TOTAL GENERAL (I + II + III + IV)	**272,963,532.87**	**293,608,507.60**	**- 7.0**

A human resource policy aiming for rigorous management and attractiveness of the Institute

The total work force of Ifremer as of 31 December 2013 was 1,500 salaried employees, including 162 on short term contracts.

The breakdown between managerial staff and technicians is 59% managers (36% of whom are women and 64% men) and 41% technicians (56% of them women and 44% men). Half of the salaried employees are over age 45 and nearly a quarter are older than 55.

Breakdown of total staff of 31 December 2013 (111)



→ *New employees seminar 2012-2013*

Summary

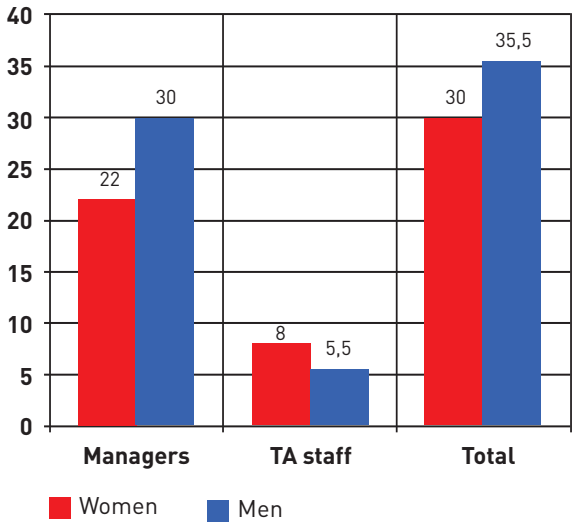
Hiring and wage-related measures in a context of hard budget constraints

The management and the representatives of trade union organisations at Ifremer signed a wage agreement in 2013 on the basis of annual wage negotiations. In a very tight budget context, it was decided to devote the greater part of the funds available to general measures.

Along with these measures, an agreement concerning the revaluation of the hiring scale was signed, taking effect on 1st January 2013, thus aiming to maintain the attractiveness of our institution while staying within the limits of the budgetary constraints. Ifremer will have hired sixty-five new employees in 2013.

A new round of negotiation on the compensation policy began in the second semester. These negotiations will continue in 2014. At the request of the trade unions, they aim to set out the principles of a balanced wage policy for coming years, thus preserving the Institute's attractiveness.

Recruitments on permanent contract
in 2013



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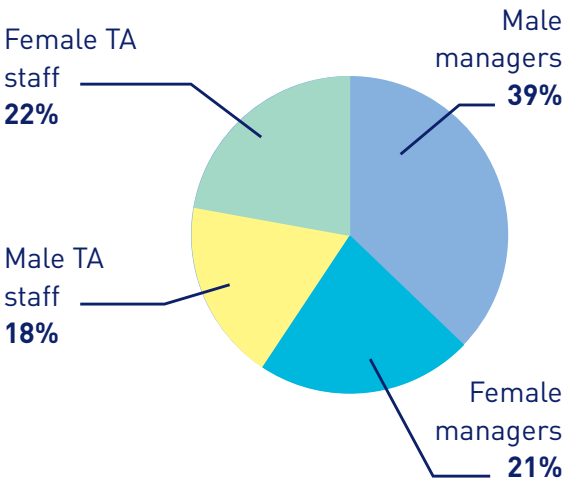
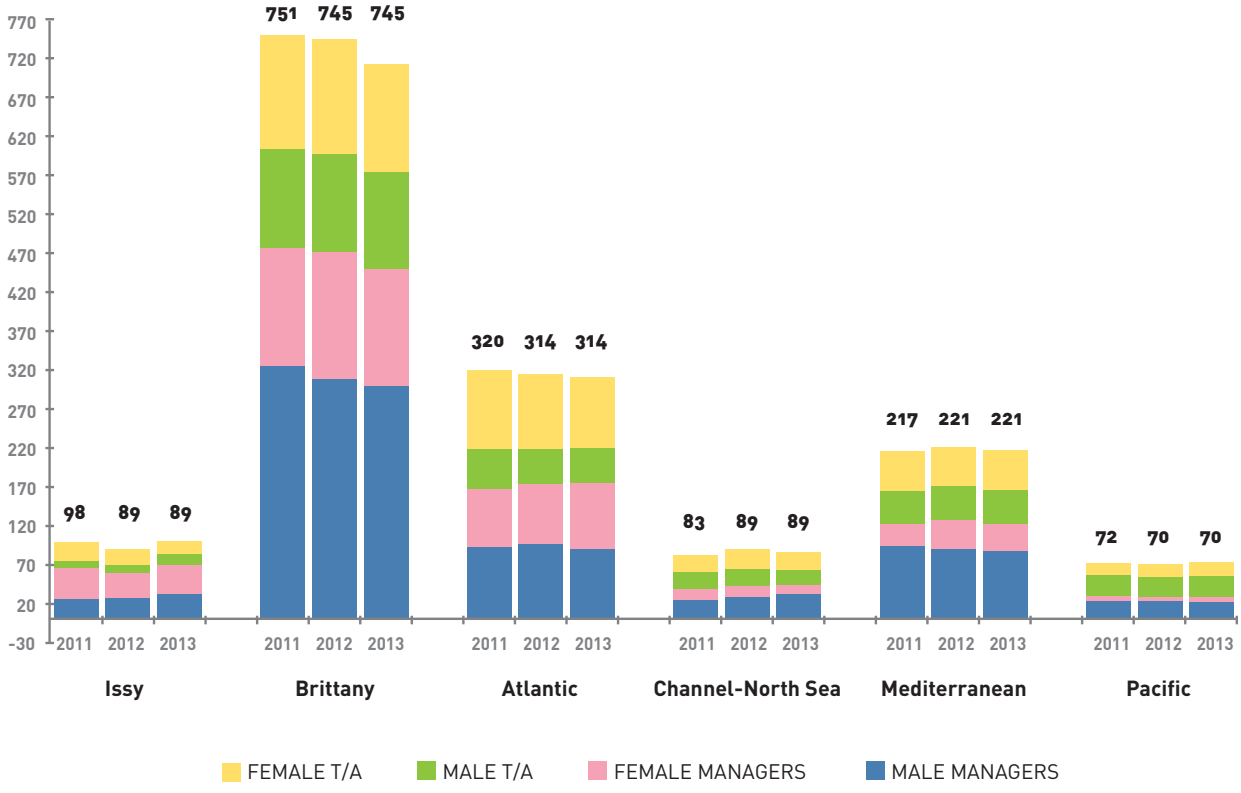
Professional gender equality

The signing of two agreements in 2008 and 2011 on gender equality at work, as well as the progression of representativeness of female personnel with 44% of staff and 36% of management, stresses the commitment to promote mixing of the sexes in jobs at our Institute. Ifremer has pursued its efforts to ensure that the gender representation is balanced, in terms of hiring and of mobility and promotions alike. In 2013, 52% of the employees who got a promotion were women. The Institute is also committed to ensuring that the linkage of work and family schedules in the work-life balance does not hinder the career progression of our employees. To this end, arrangements for the organisation of working time, like individualized schedules or part-time work are proposed. Financial aid for child care and remedial school courses in the form of a service voucher (CESU) also contribute to parenthood and work-life balances.

Breakdown in FTE of staff on full-time permanent contact by staff body and gender



Breakdown of staff in each sector by gender and by category
as of 31 December 2013

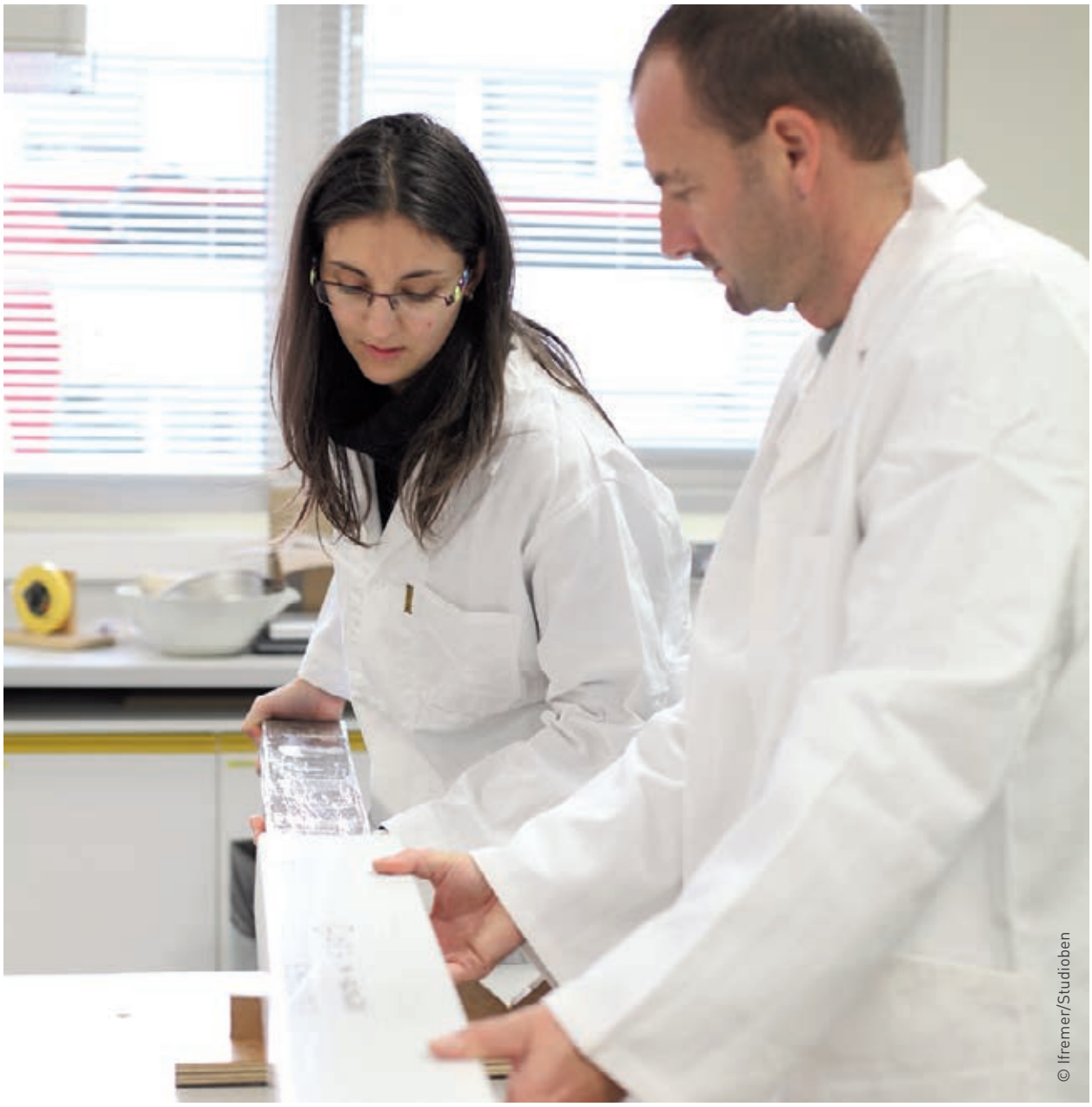


Finalisation of a "generation contract"

Negotiations began concerning the planned agreement for the "generation contract" to benefit young people and older workers. They will continue in early 2014. This project involves a preliminary diagnosis which means taking stock of the following points:

- the age pyramid,
- the characteristics of the young and older employees and the trends of their respective positions in the company over the past three years,
- forecast retirement figures,
- perspectives for hiring,
- so-called "key skills" expertise, which it is essential to preserve,
- working conditions of older employees (hardship or drudgery),
- identifying the jobs or trades in which the proportion of men and women is not balanced.

It will also address measures dealing with the lasting integration of young people (for instance, conditions for integration which notably include setting up a hosting path and a referral person or mentor, conditions for use of internships and work-training contracts), employment for seniors (avoiding arduous tasks, skills assessment, professional interview, preparing end-of-career path) and the interaction between these two groups (transmission of knowledge and skills). It will replace the Seniors agreement signed by Ifremer 2009, which has now expired.



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→ *Research scientists at the Geochemistry and Metallogeny laboratory*

Priority given to training and mobility

By earmarking 3.4% of the payroll for professional training, Ifremer has maintained this level which is well above the legal obligations (1.6%). This enabled the Institute to provide training for 60% of its personnel through 1,400 courses, representing 24,000 hours of training.

Ifremer's contribution also involves hosting and training of young people. This year, this population was made up of seventy-three PhD students, thirty-five post-doc fellows, twenty-three work-training contracts and two-hundred-eighty interns, amounting to eight hundred months of internships, for students whose levels range from two to five years of post-secondary education. Lastly, twenty-four civil service volunteers (VSC) have mainly been posted to Ifremer establishments in Overseas France.

Planned implementation of a new software suite to manage human resources

The year of 2013 was devoted to implementing the modules of the new integrated management software suite for human resources. The objective of setting up this software suite, which is slated to be put into service in early 2015, was to give rise to a simplification of procedures and working methods, by computerizing certain recurrent tasks. The tool will give essential leverage in fine-scale managing of the payroll, by producing and disseminating scoreboards made up of reliable indicators to better manage forecasts.

New employee seminar

In November 2013, eighty-six new employees of Ifremer were welcomed in Brest, to learn about the Institute's organisation and remit and how the various divisions and departments operate, and to become part of the collective culture, as part of an intensive two-day programme which was concluded by a series of visits to the laboratories in Brittany.

Planète Ifremer, to share our information and culture

The second version of *Planète Ifremer*, the Institute's in-house digital journal was put on line last September. With improved ergonomics, more clearly designed headings and more accessible tools, the connection rate has risen sharply and client feed-back from users is positive.

Maintaining the Institute's ISO 9001 certification

For several years now, Ifremer has been engaged in steps for quality assurance which have progressively been extended to the entire Institute. They aim to ensure the reliability and traceability of actions carried out, to promote greater rigour in the management of activities and projects and to give stakeholders, partners and clients of Ifremer assurance of the exacting standards which characterise the way we conduct our actions.

Attentiveness to clients and partners, constantly effecting improvements to their benefit, measuring that targets are achieved, are all the fundamentals of the quality approach. Concurrently, constant care and attention are given to efficiency and effectiveness. These are especially important concepts at this moment in time, when the French State is leading efforts to optimise use of public means and resources.

Ifremer's "quality management system" was certified ISO 9001 on 14 November 2012 for all sites and all activities, including in overseas France. The monitoring audit in December 2013 confirmed this certification, with three minor nonconformities.

The Institute's quality management system is still recent. So Ifremer's efforts mainly tend to anchor the quality approach in the daily practice of each of our activities and to raise the awareness of the personnel. In 2013, significant work was done to complete the deployment and ensure better empowerment and buy-in to the system by teams.

Amongst the actions conducted, considerable work was accomplished to prepare convergence of pre-existing quality systems towards the Ifremer quality system. This is now the case for the Vessels and shipboard systems service ("Design, development, maintenance and dissemination of embedded software aboard ocean research vessels and underwater vehicles"). Work is also underway for the quality systems set up by laboratories in the framework of accreditations, in order to make them simpler and more efficient.

Certifications and accreditations in 2013

- confirmation of ISO 9001 certification for all the Institute's sites and activities
- integration of ISO 9001 certification in the Vessels and shipboard systems service ("Design, development, maintenance and dissemination of embedded software aboard ocean research vessels and underwater vehicles") within the overall system
- confirmation that accreditations will be maintained for all already accredited laboratories
- first accreditation for the health, environment microbiology laboratory (RBE/SG2M), for microbiological analyses
- continuation of the Quality approach, following ITIL/ISO 20000 benchmarking for the Information systems and marine data unit.

Sustainable development

Ifremer has been taking steps over the past several years for sustainable development and mastery of our environmental footprint. To do so, over the year 2013, the Institute maintained its involvement within the Sustainable development club for public institutions, as well as with central, regional and local administrations, to enjoy the benefit of feedback on best practices.

In 2013, actions were taken to further raise awareness on the part of Ifremer staff:

- enriching the intranet site on "sustainable development/corporate social responsibility", in particular, by delivering new data on the greenhouse gas and carbon footprints of the Brittany centre and presenting the new regulations in effect for sustainable purchasing and environmental clauses in public procurement calls for tender. The website can be accessed by all salaried employees;
- at the Atlantic and Brittany centres, demos and events were held during the French sustainable development week, from 1st to 7 April 2013.

The carbon footprint of the Brittany centre was assessed in 2013. Emissions are about 6.4 tonnes per full time equivalent. Twenty-three sources of emissions were taken into consideration. 60% of emissions are due to seven sources: spending related to use of vessels, purchasing of scientific equipment, fuel consumption for heating and scientific and technological processes, commuting to work, various outsourcing and service provisions, IT procurement and constructions.

Various forms of work and repairs were undertaken to achieve better energy efficiency:

- **draught-proofing of roofs, walls and buildings in general (Brittany and Channel-North Sea centres);**
- **windows and doors were changed in four buildings at the Brittany centre and two buildings at the Mediterranean centre, after using infrared thermography to identify the critical points, and at the test tank facility of the Channel-North Sea centre.**

A complete thermographic survey was made of the Seyne-sur-Mer site (Mediterranean centre). The temperature images obtained reflect the state of anomalies and heat loss in the outer walls of buildings and provide the basis for determining the actions to be given priority.

Several studies are underway on connecting Ifremer's Atlantic centre to the heating system grid of Nantes Métropole and on the feasibility of installing a heat pump using seawater with the aim of reducing gas consumption by 50% (Brittany centre).

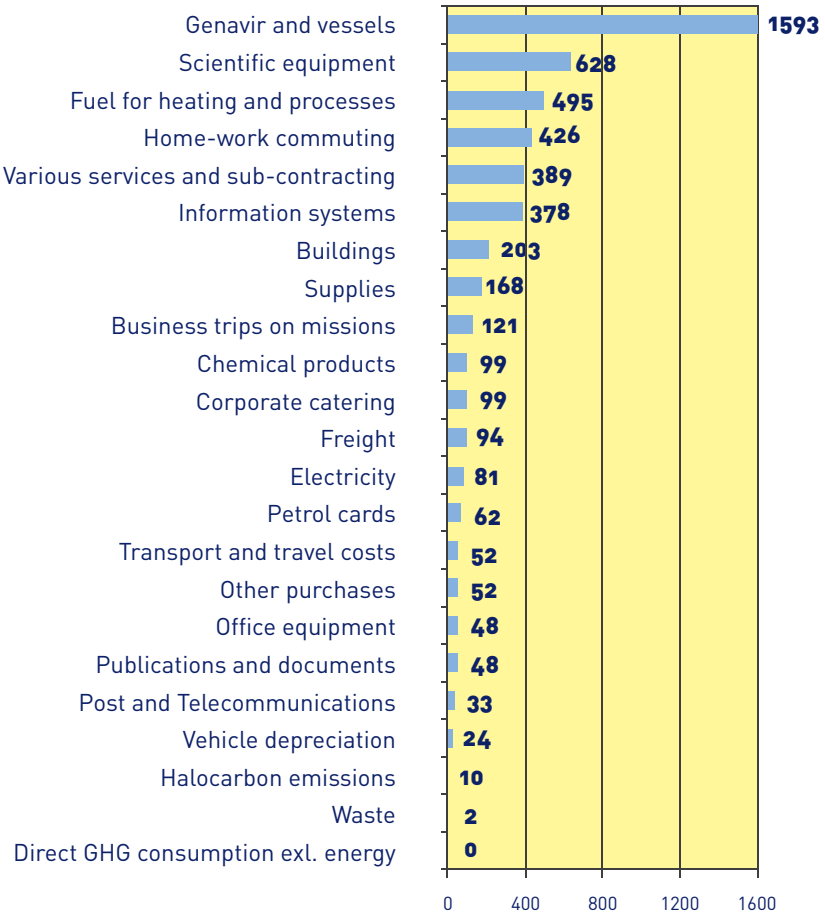
Generally speaking, in order to avoid any leaks and losses, the Institute aims to regularly monitor all its consumptions. To this end, routine monitoring of water consumption has been set up, enabling any anomalies to be detected and savings to be made at the Mediterranean centre. This should become a systematically applied approach in the Institute's various establishments.

Each year, Ifremer runs an analysis of expert opinions and assessments and of top tier publications, to better appraise the type of work that will contribute to a social and environmental accountability approach, as well as reducing our environmental footprint. The analysis is performed with the BLP library's bibliometrics service (Intellixir software).

In 2013 were held:

- number of video-conference systems: 29 (5 new installations since 2012, in Brest, La Rochelle, Noumea, Palavas-les-Flots and Argenton)
- rate of waste processing: 75%.

→ *The European Centre for underwater technology (CETSM) at Ifremer Mediterranean centre*



→ *Detailed results for the Brittany centre's carbon footprint broken down by emission items expressed in tonnes of carbon*

Greater legal certainty

Improving the working tools to make internal procedures more secure was an important orientation in 2013. The Institute implemented a new software suite for legal management developed in-house and called "Corail". It incorporates all past and present legal deeds and documents (all non-model contracts for expenditure and contracts for revenues, industrial property titles, Ifremer shareholdings, etc.). It can be used via the in-house network by the authorised personnel to consult contracts and their state of progress. Being interfaced with the financial management software tool, it delivers optimisation and security, particularly in managing contracts by avoiding mistakes in transcription, and the systems mutually enrich each other.

In addition, a "buying guide for purchases under €90,000" was produced and made available. It is designed to be used by all field staff, including administrative assistants, and accompanied by training sessions held in each centre. This guidebook is particularly useful and necessary to justify compliance with the procedures for competitive calls for tender when grants or subsidies, especially from the European Union, are involved. It complements the existing procedures and contributes to strengthening our legal certainty.

Appendix

Board of directors

as of 31 December 2013

The members of Ifremer's board of directors are appointed or elected for a five year term (order for appointment of the board on 4 May 2010; order of appointment of the Chairman dated 12 September 2013).

CHAIRMAN

François JACQ
Chairman & Chief Executive Officer of Ifremer

MEMBERS REPRESENTING THE STATE

Representative of the Ministry of higher education and research

Élisabeth VERGÈS
General directorate for Research and Innovation

Substitute : Bernard COMMÈRE
General director for Research and Innovation

Representatives of the Ministry of ecology, sustainable development and energy

Claire HUBERT
General commission for sustainable development, Directorate of Research and Innovation

Substitute : Hervé BRULÉ
Deputy director of maritime activities

Christophe CHASSANDE
Maritime fisheries and aquaculture directorate

Substitute : Marie-Bénédicte PEYRAT
Maritime fisheries and aquaculture directorate, fisheries resource sub-division

Representative of the Ministry of defence

Contre-amiral Frédéric JUBELIN
Deputy Chief of Staff Naval aviation operations

Substitute :
Capitaine de vaisseau Bruno ROYER DE VÉRICOURT
Head of the "operational studies", Naval staff operations

Representative of the Ministry of the economy, finances and foreign trade

François POUGET
Research and higher education

No substitute

Representative of the Ministry in charge of Industry

Yves ROBIN
General directorate for competitiveness, industry and services, Ministry of productive recovery

Substitute : Claude MARCHAND
General directorate for competitiveness, industry and services, Ministry of productive recovery

Representative of the Ministry of foreign affairs

Pascal LE DEUNFF
General directorate for globalisation, attractiveness and mobility policies division, scientific exchanges and research cluster

Substitute : Mona DEBBOUN BOUSSEDRA
North Africa Middle East mission officer, general directorate for globalisation, attractiveness and mobility policies division, scientific exchanges and research cluster

Representative of the Ministry of ecology, sustainable development and energy

Laurent ROY
Director of water and biodiversity, general directorate for planning, housing and nature (DGALN)

Substitute : Agnès VINCE
General directorate for planning, housing and nature (DGALN)

MEMBERS CHOSEN FOR THEIR EXPERTISE IN FIELDS CLOSE TO THOSE OF IFREMER

Alain GOULOIS
Total

Pierre-Georges DACHICOURT
National Committee on Marine Fisheries and Marine Farming (CNPEM)

Charles BRAINE
World Wide Fund (WWF)

Martha CRAWFORD-HEITZMANN
Areva

Gérald VIAUD
National shellfish-farming committee (CNC)

ELECTED REPRESENTATIVES OF PERSONNEL

Raoul GABELLEC, CFDT
Larissa HAUGARREAU, CFDT
Jean-Claude MASSON, CGT
Loïc PETIT DE LA VILLÉON, CFDT
Carla SCALABRIN, CGT
Jean TOURNADRE, CFDT
Cathy TRÉGUIER, CFDT

MEMBRES AVEC VOIX CONSULTATIVE

Pascale DELÉCLUSE
Ifremer scientific committee chairwoman

Marie-Pierre CAMPO
mission officer for the Sea, Ministry in charge of Overseas French departments

Christine COSTE
Commissioner for the government, deputy head of department for performance, financing and contractual agreements with research institutions, DGRI

Brigitte KLEIN
General economic and financial inspection, "Ecology and sustainable development" mission

Orlando COLONNEAUX
Head accountant of Ifremer

Michel AYMERIC
Secretary general for the sea

Christine CHOPIN
CCE central works committee secretary

Advisory committees: scientific committee, technical and industrial committee

SCIENTIFIC COMMITTEE

as of 31 December 2013

Members appointed by joint decision of the supervisory authority ministries

Pascale DELÉCLUSE
Ocean circulation and coupled ocean-atmosphere climate models
chairwoman of the scientific committee of Météo-France, CNRM deputy director

Denis ALLEMAND
Coral and acidification, symbioses
scientific director of the Scientific centre of Monaco

Chris BOWLER
Molecular biology
CNRS, École Normale supérieure, director of the environmental and evolutionary genomics section

Francesco CHIOCCI
Marine geology
"La Sapienza" university, Rome

Marion GEHLEN
Marie biogeochemical modelling
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as of 31 December 2013

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director of development, business and economic partnerships

Ludovic DROUINEAU
CGT trade union representative

Christine CHOPIN
CFDT trade union representative

Acronyms and abbreviations

AAMP	Agency for marine protected areas
Adecal	Agency for the economic development of New Caledonia
Aeres	Agency for the assessment of research and higher education
AFB	French agency for biodiversity
AIFM	International association of Mediterranean forests
Amical	Aquaculture of microalgae in New Caledonia
ANR	French national research agency
Archyd	Arcachon basin hydrological network
ARP	foresight workshop
AUV	autonomous underwater vehicle
BRGM	Geological and mining research bureau
CATDS	SMOS satellite data ground processing centre
CEA	Atomic energy and alternative energies commission
Cefas	Centre for Environment, Fisheries and Aquaculture Science (UK)
CESE	Economic, social and environmental council
CFP	Common Fisheries Policy
CGAAER	General council for food, agriculture and rural areas (Algeria)
CIP	Competitiveness and Innovation Framework Programme
Cirad	Centre for international cooperation in agricultural research for development
Clora	associated research organisations club
CLCS	Commission on the Limits of the Continental Shelf
CNC	National shellfish-farming committee
CNES	National space research centre
Cnexo	National centre for ocean exploitation
CNRS	National centre for scientific research
CNRDPA	National research centre for the development of fisheries and aquaculture (Algeria)
Comexo	Ocean exploitation committee
Compira	Coastal and Ocean measurement Mission with Precise and Innovative Radar Altimeter (Japan)
COSS-TT	Coastal Ocean and Shelf Seas Task Team
CSIC	*Consejo Supérior de Investigaciones Científicas*
CST	scientific and technical culture
DCF	Data Collection Framework
DCNS	Naval shipbuilding division
DFO-MPO	Fisheries and Oceans Canada
DGRI	Directorate-general for research and innovation
Dimenc	New Caledonia directorate for industry, mining and energy
DPMA	Maritime fisheries and aquaculture directorate
Edrome	Sustainable exploration and exploitation of mineral and energy resources in oceans
EEA	European Environment Agency
EIT	European Institute of Innovation and Technology
EMFF	European Maritime and Fisheries Fund
EMSO	European Multidisciplinary Seafloor and Water Column Observatory
ERA	European Research Area
ERIC	Education Resources Information Center
ESA	European Space Agency
Esfri	European Strategic Forum on Research Infrastructures
Eunis	European Nature Information System
Extraplac	Programme for the extension of the French continental shelf
Fedem	Federation for minerals, industrial minerals and non-ferrous metals
FOF	French oceanographic fleet
FP R&D	Framework Programme for Research and Development
FP RTD	Framework research and technological development programme
FR	research federation
GDR	research group
GMES	Global Monitoring for Environment and Security (EU programme for Earth observation
GOOS	Global Ocean Observing System
HCMR	Hellenic Centre for Marine Research (Greece)
Homere	Hydrodynamics Ocean-Meteorology and Marine Renewable Energies
HROV	hybrid remotely operated vehicle
ICES	International Council for the Exploration of the Sea

ILM	*Institut Louis Malardé*
INEE	Inter-Agency Network for Education in Emergencies
Ineris	National institute for the industrial environment and risks
INRA	National agronomic research institute
INSU	National institute of sciences of the universe
IOC	Unesco intergovernmental oceanographic commission
IOCCP	International Ocean Carbon Coordination Project
IODE	International Oceanographic Data and Information Exchange
IPBES	Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
IPEV	Paul-Emile Victor polar institute
IPNC	Institut Pasteur of New Caledonia
IRD	Institute of research for development
Irstea	National institute for scientific and technological research for the environment
ISTPM	Scientific and technical institute for marine fisheries
IUEM	European university institute for the sea
Jasmtec	Japan Agency for Marine-Earth Science and Technology
JCOMM	Joint WMP/IOC Technical Commission for oceanography and marine meteorology
JPI	Joint Programming Initiative
Kiost	Korea Institute of Ocean Science and Technology
Lemar	Marine environmental sciences laboratory
LER	Environment and resources laboratory
LNE	National metrology and testing laboratory
LSRI	Large-scale Research Infrastructure
Macumba	Marine Microorganisms: Cultivation Methods for Improving their Biotechnological Applications
Midas	Managing Impacts of Deep-sea resource exploitation
MSFD	Marine strategy framework directive
NAOS	Novel Argo Ocean Observing System
NASA	National Aeronautics and Space Administration
NGO	non-governmental organization
NOAA	National Oceanic and Atlantic Administration (USA)
NODC	National Oceanographic Data Center
Onema	National office for water and aquatic environments
Pamela	Passive Margin Exploration Laboratories
Perseus	Policy oriented marine environmental research for the southern European seas
RÉMI	microbiological inspection network in shellfish-farming areas
Répamo	mollusc pathology network
Réphy	National monitoring network for phytoplankton and phycotoxins in shellfish
RHLN	Normandy coastal hydrological network
Rocch	coastal chemical contamination monitoring network
ROV	remotely operated vehicle
RSL	lagoon monitoring network
SHOM	Hydrographic and Oceanographic Service of the French Navy
SMOS	Soil Moisture and Ocean Salinity
SOA	State Oceanic Administration (China)
SRN	regional nutrient monitoring
SWOT	Surface Water Ocean Topography Mission (CNES-NASA)
TNA	Trans National Access
UBO	University of western Brittany
UFIP	French union of oil industries
UMR	joint research unit
UMS	joint service unit
VSAT	Very Small Aperture Terminal
VSC	civilian service volunteer
WFD	Water Framework Directive
WHOI	Woods Hole Oceanographic Institution (USA)

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