

PNEC

The French Coastal Environment Research Programme

Overview of 1999-2002 activities

Editors
Jacques Clavier
Michel Joanny
François Carlotti

Modélisation
des écosystèmes côtiers

Comportements des polluants

Observation et surveillance
de la mer côtière

Mise en valeur
de la mer côtière et économie
des ressources marines



bilans & prospectives

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Foreword

The PNEC national coastal environment programme involves several organisations (Ifremer, CNRS/INSU, IRD, Cemagref, BRGM, CNES, Total), with the objective of understanding how coastal ecosystems function. Considerable human activity takes place in these ecosystems (50% of the European population is concentrated in a coastal zone of 50 km). This anthropisation brings on deep-ranging modifications and disturbances in these shore environments (estuaries, bays, lagoons, etc.) This means that the coastal area is a repository influenced by catchment basins inputs, in terms of productivity and disturbances (dystrophy, anoxia, etc.) as well as ecosystem health and marine yields (micropollutants, microbiology, etc.).

Marine activities themselves, like fisheries and aquaculture, generate major modifications in food webs and their biodiversity, while creating chronic overfishing of some target species.

Tourist activities, urban growth and developing harbour industries also contribute to perceptible modifications of some coastal areas.

All these reasons justify the interest that the scientific community has for these coastal ecosystems. Located at the interface between land and sea, multidisciplinary studies are sustainably mobilising the scientific community of institutions which are working in both catchments and coastal areas. The aim is to encourage a range of scientists, from hydrodynamics specialists, biologists, geochemists, biochemists, chemists and modelling experts to economists and specialists in the human activities developed there, to work together on these "worksites".

However, the so-called theme-based actions will bring together specialists in a given field on a more focused research question, thus "nourishing" the worksites with the most innovative research.

The final objective is that the PNEC, by developing knowledge about the impact of human activities on ecosystem functioning, will provide guidance for decisions made by those managing these sensitive sectors, in the framework of a policy for sustainable development.

Le Programme national d'environnement côtier (PNEC) est un programme pluriorganismes (Ifremer, CNRS/INSU, IRD, Cemagref, BRGM, CNES, Total) qui a pour objectif de comprendre le fonctionnement des écosystèmes côtiers. Ces écosystèmes sont fortement anthropisés (50 % de la population européenne sont concentrés sur une zone littorale de 50 km). Cette anthropisation induit de profondes modifications et perturbations de ces milieux littoraux (estuaires, baies, lagunes...). Ainsi, la zone côtière réceptacle des bassins versants va dépendre de ces apports aussi bien pour sa productivité, ses dérèglements (dystrophie, anoxie....) que pour la santé des écosystèmes et des productions marines (micropolluants, microbiologie...).

Les activités marines (pêche et aquaculture) génèrent elles-mêmes de profondes altérations des réseaux trophiques et de leur biodiversité, tout en générant pour certaines espèces cibles, une surexploitation chronique.

Les activités touristiques, l'urbanisation et le développement des industries portuaires contribuent aussi à des modifications sensibles de certaines zones du littoral.

L'ensemble de ces raisons justifie l'intérêt que la communauté scientifique porte à ces écosystèmes côtiers. Situées aux interfaces terre/mer, leurs études pluridisciplinaires mobilisent, de manière durable, la communauté scientifique des organismes qui travaillent, aussi bien sur les bassins versants que sur les domaines côtiers. L'objectif est de chercher à faire travailler ensemble sur des zones ateliers appelées « chantiers » aussi bien les hydrodynamiciens, les biologistes, les géochimistes, les biochimistes, les chimistes et les modélisateurs, que les économistes, spécialistes des activités humaines qui s'y développent.

Les « actions thématiques » par contre permettent de réunir les spécialistes d'un domaine sur une question de recherche plus ciblée, permettant de « nourrir » les chantiers de la recherche la plus innovante.

L'objectif final est que le PNEC puisse, par le développement des connaissances de l'impact des activités humaines sur le fonctionnement des écosystèmes, permettre, dans le cadre d'une politique de développement durable, d'orienter les prises de décision des gestionnaires de ces secteurs sensibles.

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Overall presentation

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Introduction

The coastal environment, transition zone between the continental landmass and the sea, differs from the open ocean in physico-chemical and biological properties. It has a contrasted hydrodynamic regime, contains high levels of nutritive elements and contaminants, benthic processes predominate over pelagic processes, and levels of biological production and ecological diversity are high. It is also a zone heavily dominated by human activity and is therefore particularly impacted by anthropogenic modification.

To study the coastal zone as thoroughly as possible, the national coastal environment programme (PNEC, Programme national environnement côtier) structures research work with the aim of increasing fundamental knowledge in response to sociodemographic demands. Research activities are either focused on geographical worksites or theme-based.

The PNEC was created in 1999 to group together the scientific objectives of four national existing programmes supported by different research institutions:

- national programme of coastal oceanography (PNOC);
- national programme on the determinism of the recruitment (PNDR);
- national programme on algal toxic blooms (PNEAT);
- national programme on coral reefs (PNRCO).

An Inter Institutes Committee (CIO) on the basis of national priorities gives the general

orientations of the programme. The CIO is composed of the institutions financing the programme, but it also includes ministries and different specialized agencies. A call for tender is issued annually.

A Scientific Council (CS) of 17 members examines proposals, which refer either to worksites or to topic research activities as regards:

- their adequation to the objectives;
- their originality and the innovative character of the approaches and the expected results;
- the competence and adequacy of the applying research teams;
- the operational organization of the project and the justification of the budget required.

For every proposal, the CS suggests a priority order together with a budget. The CIO takes the final arrangements. The members of the CS of the PNEC also participates in the scientific selection of the proposals to the other national programme dealing with coastal environment named "LITEAU". The task of LITEAU, supported by the Ministry of Ecology and Sustainable Development, is to make scientific results available to administrators and policy makers as methods and tools necessary for an optimal use of coastal areas. The PNEC in 2002 involves the equivalent of 240 full-time scientists, working in 75 laboratories, in a total of 45 public institutions (universities or others). The impressive size of this machine is a measure of

The PNEC budget breakdown (k€) and number of publications.

	1999	2000	2001	2002	Total	N° pub.
Bay of Seine	129.6	45.7	-	-	175.3	24
Bay of Biscay	83.9	109.0	198.2	137.2	528.3	23
Gulf of Lion	106.7	45.7	38.1	99.1	289.6	56
Mediterranean lagoons	106.7	61.0	30.5	114.4	312.6	25
New Caledonia	30.5	47.3	64.8	64.8	207.4	45
French Guiana	76.2	76.2	122.0	91.5	365.9	31
Bay of Mont-Saint-Michel	-	4.6	22.9	122.0	149.5	5
Eastern English Channel and South Bay of the North Sea	-	4.6	-	22.9	27.5	14
TRA 1	102.1	118.9	111.3	83.8	416.1	15
TRA 2	118.1	114.3	126.5	71.8	430.7	50
TRA 3	50.3	24.4	28.2	14.6	117.5	18
TRA 4	30.5	76.2	76.2	45.8	228.7	71
TRA 5	10.4	79.3	39.6	61.4	190.7	8
TRA 6	15.2	80.0	19.8	18.3	133.3	10
TRA 7	91.5	93.8	80.8	73.2	339.3	33
Total	951.7	981.0	958.9	1 020.8	3 912.4	428

what is at stake: supplying the "upstream" information required for the integrated management of coastal areas.

The total budget dedicated to the PNEC over the 1999-2002 period reached about 3 900 k² (see table).

Eight worksites

The worksites correspond to operations carried out in the same geographic zone over several years. They make it possible to conduct multidisciplinary research around a major linking theme: flux of contaminants, fishery ecology, biogeochemical cycles, impact of drainage basins, eutrophication and run-off in tropical environments, sediment dynamics or living resources, for example. The eight worksites studied are: Eastern English Channel, Bay of Seine, Bay of Mont-Saint-Michel, Bay of Biscay, Gulf of Lion, the Mediterranean lagoons, the lagoon of New Caledonia and French Guiana.

Eastern Channel and Southern Bight of the North Sea worksite

Ecology and impact assessment of *Phaeocystis* blooms in the Eastern Channel and Southern Bight of the North Sea

The Primnesiophyceae *Phaeocystis* spp. are small size planktonic algae. *Phaeocystis* blooms are a common seasonal occurrence in the Eastern Channel and Southern Bight of the North Sea, and they are generally related to anthropogenic disturbances.

The worksite aims to study the bloom of *Phaeocystis globosa* in the Eastern Channel and south part of the North Sea to understand:

- the occurrence of the bloom of *Phaeocystis globosa* in the area, specifying the natural and anthropogenic causes;

- the consequences of these *Phaeocystis* outbursts on the marine ecosystems and their users.

Bay of Seine worksite

Interactions between nutrients and major contaminants and benthic and pelagic systems

The Seine river, with its discharge of freshwater rich in particulate and dissolved matter as well as contaminants, creates the largest disequilibrium in coastal plankton production in the English Channel.

The objectives of the worksite developed in the Bay of Seine (in continuity with other programmes on the upstream and downstream basins of the Seine) are to collect *in situ* data and to establish mathematical models describing:

- the effects of the nutrients and organic matter content of the water of the Seine on the major biological compartments (pelagic and benthic);
- the fate of certain contaminants transported by the Seine (heavy metals such as cadmium and PCBs - polychlorinated biphenyls -, stable, toxic organochlorine molecules) and their possible accumulation in living organisms.

This project combines *in situ* and in laboratory measurements, digital modelling of the system, study of the flux of matter in the foodweb and of the flux of trace contaminants.

This work will make it possible to predict the consequences for the ecosystem of the sediment transported by the Seine, according to the season and to anticipate fluctuations in biological production downstream from the river, as a function of policies concerning the purification of urban and industrial effluent in the drainage basin.

Scientific question	Environmental forcing factors	Worksite
Influence of <i>Phaeocystis</i> blooms	Epicontinental, tide-dominated sea	Eastern Channel and Southern Bight of the North Sea
Land-derived pollution	Epicontinental, tide-dominated sea	Bay of Seine
Ecology and human impact	Epicontinental, tide-dominated sea and intertidal zone	Bay of Mont-Saint-Michel
Fisheries and the ecosystem	Tide and wave-controlled shelf	Bay of Biscay
Carbon fluxes and the ecosystem	River and storm-controlled margin	Gulf of Lion
Ecology and aquaculture in restricted ecosystems	Environment heavily constrained by human activity	Mediterranean lagoons
Functioning of tropical mangrove ecosystems	Massive longshore sedimentary transfer (Amazon river)	French Guiana, shore-to-shelf range
Reef environment and human impact	Drainage of tropical soils and human settlements	Noumea lagoon, New Caledonia

Bay of Mont-Saint-Michel worksite

Study the functioning of “the maritime anthropogenic system” of the Bay of Mont-Saint-Michel

The Bay of Mont-Saint-Michel is a vast sedimentary enclave situated in the south-eastern part of the Norman-Breton gulf, in the central English Channel. The decrease of the shellfish production, as well as the proliferation, in the bay of Cancale, of an invasive gastropod, the limpet *Crepidula fornicata*, bring to ask questions on the trophic balances between the cultivated and wild molluscs, as well native (intertidal and subtidal filter-feeder benthos) as invasive. The researchers of the worksite aims to answer the following two major groups of questions:

- can the trophic capacity of the bay become restrictive for the development of the shellfish farming and which repercussions could have an increase of the stocks of farming bivalves on the wild populations of filter-feeders and consequently on the general functioning of this ecosystem?
- considering the exceptional ecological and economic interests of this bay, how the marine ecosystems could be restored, even be rehabilitated, if it happened that they are altered more or less profoundly by anthropogenic disturbances?

In this context, the worksite Bay of Mont-Saint-Michel addresses (1) the trophic capacity of the bay and (2) the degree of resilience of some benthic populations and the restoration ability of the ecosystem following accidental or programmed anthropogenic changes.

Bay of Biscay worksite

Study of the functioning of the ecosystem of the coastal regions off the mouths of the Loire and Gironde rivers, with the aim of improving management of the fishery environment

The Bay of Biscay is a large open bight on the North Atlantic Ocean, with dynamics involving large seasonal and pluriannual variations of water masses. It is also heavily affected by human activities, fishing in particular. This industry is of prime economic importance in the area: catches exceeded 100,000 tonnes in 1997 and 1998. It results in various disequilibria, particularly

for fish stocks (anchovies, hakes and sardines). The management of stocks does not take sufficiently into account the functioning of the hydrological structures of the Bay of Biscay and the ecosystems in which the life cycles of the species exploited take place.

The goal of the researchers of this worksite is to increase our knowledge on fishery ecology:

- study of hydrological structure and functioning and the causes of variations in the pelagic and benthic systems;
- the consequences for fishery resources and for fishing management;
- the impact of demersal fishing on the foodweb structure.

The expected benefits of this research are diverse: greater knowledge concerning plankton production and the biomass likely to be produced in the gulf, understanding of the links between climate and the renewal of pelagic fish stocks, diagnostic elements for assessing the impact of aquaculture.

Gulf of Lion worksite

Transfer between pelagic and benthic systems due to the Rhone river plume

The Gulf of Lion provides a complex example of the carbon cycle in a coastal environment: wide well-defined continental plateau, considerable transport in the Rhone of material from the landmass, marine hydrodynamics dominated by the Ligurian currents, periodic alternation of frequent and violent winds.

The principal objective of this worksite is to establish an annual budget of carbon and associated elements to characterize, in particular, the sources and losses of material in the Western Mediterranean: material carried by the Rhone, changes in production and pelagic and benthic transformation, sedimentation and geochemical changes in the sediment.

The research currently underway concerns interactions between material transported to the sea from the landmass, physical factors and living species and interactions between open-water organisms and those from the bottom. This work will increase our understanding of the natural and human factors affecting the functioning of the coastal ecosystem.

Mediterranean lagoons worksite

Integrated study of the Mediterranean lagoonal ecosystem and socio-economic implications

The Mediterranean lagoons are ecosystems with high levels of biological diversity and primary production, and productivity favourable for certain exploitable resources (filter-feeding shellfish).

Their location at the frontier between land and sea subjects these lagoons to many hydroclimatic constraints, some of which increase with human activity, leading to various types of dysfunction (e.g. dystrophies and microbial contamination).

This worksite deals, in particular, with the lake of Thau, the oyster and mussel production of which accounts for 10% of national shellfish production.

The approach used involves the description, using mathematical models, of the various physical and biological processes controlling the productivity and health of these ecosystems. The aim is to increase understanding and to develop the tools required for diagnosis of major environmental phenomena or evaluation of the effects of changes.

Maintenance of the equilibrium between aquaculture and tourist activity in these confined and fragile ecosystems constitutes one of the major challenges of integrated management.

New Caledonia lagoons worksite

Impact of terrigenous sediments on lagoonal populations

In New Caledonia, the lagoon is subject to increasing human pressure linked principally to mining, the development of tourist activities and fishing and, locally, to urbanization of the town of Noumea. Three types of discharge affect the equilibrium of the lagoonal environment:

- particulate waste matter, responsible for hypersedimentation;
 - metals, which may have an inhibitory effect on organisms;
 - organic and inorganic dissolved and particulate effluent of urban origin, responsible for eutrophication of the environment.
- The objective of this worksite is to increase our understanding by analyzing and modelling the mechanisms of transport and trans-

formation of the principal terrigenous and human products discharged into this tropical lagoon.

Increasing our understanding of these mechanisms will make it possible to determine the role of natural and human influences on the evolution of the ecosystem.

Research at this worksite is structured into four domains:

- sources, transport and fate of terrigenous and human-origin materials;
- biological, sedimentological and chemical functioning of the lagoonal system;
- spatial and temporal variations in the growth of lagoonal organisms;
- development of indicators for reef and lagoonal ecosystems for ecosystem monitoring.

French Guiana worksite

Hydrosedimentary flux, mobility of the coastal zone and living resources

The major objective of the French Guiana worksite is to increase our understanding of the consequences of short- medium- and long-term variations in currents and in the transport of particulate and dissolved matter from the Amazon for the structure of coastal ecosystems in French Guiana, including mangroves. Two study strategies have been implemented:

- *in situ* observation campaigns for the continental plateau and the mudflats of the estuary of the river Kaw;
- integration of the results using two approaches: a hydrodynamic model developed for the continental plateau and the coastal zone, and analysis of results transmitted by satellite (temperature, turbidity) and by aerial digital video and spectroradiometry.

This information and environmental syntheses are preliminary steps towards studies combining hydrosedimentary dynamics and biological processes:

- morphological variations in the coastline, excessive silting-up and erosion, possibilities for development and coastal access;
- steps in biological colonization and the production of coastal mudflats (passage from a bare mudflat to a mature mangrove swamp);
- reproduction and nutrition strategies of marine populations (coastal fish and prawns exploited by local fishermen).

The expected results deal with the management of port and estuary infrastructures and of coastal areas, the preservation of the ecosystems of French Guiana, the location and characteristics of the coastal feeding grounds for prawns, the evaluation of the productivity of usable stocks and the impact on fish reserves of the fishing of these stocks.

Seven topic research actions (TRA)

Topic Research Actions (*in French* ART, *Action de recherche thématique*) concern operations transverse and innovative in nature, associated with or independent of work-sites, developed in the short term. They encourage the development of new lines of research, the sharing of complementary methodological approaches and bring together a dispersed scientific community, focusing on a project of high priority. They are by definition flexible, open and changeable. They are designed such that their results may be applied to the worksites.

TRA 1. Biogeochemical cycles in temperate and tropical coastal environments since the last climatic cycle

This research project concerns knowledge of the fluxes of natural substances and contaminants between water, sediment and organisms (e.g. carbon, nitrogen, phosphorus, silicon; heavy metals and synthetic molecules). It involves the assessment of matter during rapid environmental variations (e.g. tides and meteorological sequences), striking events such as those recorded in sediments (sediment archives) or biological construction (coral reefs).

It deals with:

- the process of transfer at the water-sediment interface, including the early transformation of sediments (diagenesis), remobilisation in the water column or integration into the food chain;
- the identification and quantification of the mechanisms of transfer and redistribution of matter that operate in transitory situations in which the link between human activity and climatic events plays a key role.

TRA 2. Population dynamics: hydrodynamic structures and biological cycles

The principal objective of this project is to increase our understanding and to predict fluctuations in the abundance of organisms and populations of marine animals in response to variations in the environment on various scales.

The species studied (zooplankton, fish and bottom-dwelling organisms with planktonic larvae) have complex life-cycles in which the successive forms pass through stages with different morphological, ecological and behavioural characteristics. Each stage has specific interactions with the environment. The relationships between biological and physical processes are thus studied both at the level of the organism and at the level of the population. This research involves a biological study of the species and analysis of the distribution of a population, and observation *in situ*, laboratory-based experimentation and digital modelling. Specialists in hydrodynamics of the water-sediment interface study the transport and dispersion of the species considered during the course of the various stages of its biological cycle.

TRA 3. Toxic or harmful algal blooms

Algal blooms are increasing due to growing perturbations in coastal environments. A few of the microalgal species (phytoplankton) produce toxins, which may be present in the vegetable cells or excreted into the surrounding environment. Excreted toxins may kill fish and shellfish. The toxins present in phytoplankton cells may be ingested by shellfish, which may then be consumed by humans, leading to poisoning with severe consequences such as paralysis, diarrhoea and amnesia.

To prevent the emission of toxins and to limit their effects, the research carried out aims to investigate:

- the environmental conditions favouring toxin production;
- the mechanisms triggering toxin production in each species;
- the kinetics of accumulation and elimination of toxins in shellfish.

Two species are particularly dangerous to humans, as they act by blocking nervous influx: *Alexandrium tamarense* in the Mediterranean lagoons and *Alexandrium minutum*

in North Brittany. Other species producing toxins that cause amnesia are also considered.

TRA 4. Effect of hydroclimatic factors on the variability of ecosystems in the coastal environment

Coastal populations and ecosystems are very sensitive to hydrological and climatic conditions and to diverse disturbances associated with human activities. The study of these relationships between populations and environment at various spatial and temporal scales requires the development of new methods and tools for observation and analysis: statistical analysis of exceptional planktonic events, modelling of the dynamics of marine species, exploitation of satellite images for the characterization of physical forcings. The methods developed are then applied to diverse worksites of the PNEC or to large coastal surveillance networks such as Réphy (the French national phytoplankton and phycotoxins monitoring network; *Réseau de surveillance du phytoplancton et des phycotoxines*).

The computer programs, which are widely distributed among the research teams, are continually updated. This project, via schools and seminars, creates a forum for mathematical oceanography.

TRA 5. Microorganisms and the coastal environment

This project aims to stimulate novel research into bacterial ecology, in relation to the questions raised by the various PNEC worksites and microbiological health concerns.

It contributes to the development of molecular biological techniques for studying the functioning of bacterial communities and the ecology of new species (without requiring traditional culture techniques). It deals with the links between viruses, bacteria and planktonic species in terms of competition and predation and with the mechanisms regulating bacterial production in coastal ecosystems. These research activities are increasing our understanding of the response of bacterial communities to UV irradiation and heavy metals, with respect to changes in organic matter. They make it possible to study the fate of contaminating bacteria that present a risk to human health, particularly bacteria attached to particles, within natural ecosystems.

TRA 6. Dynamic equilibrium in the coastal zone

The interactions between the various uses of the coastal zone lead to conflicts that are becoming one of the major problems in the management of coastal zones. Analysis of economic dynamics combined with scientific studies on the functioning of ecosystems should make it possible to design tools to assist in decision-making and evaluation of public policies. The aim of this project is to develop such tools (modelling and simulation) designed:

- to evaluate the economic stakes associated with the coastal environment by describing the interactions between dynamic and economic agents and natural factors;
- to identify and to quantify the benefits and costs of economic activity and changes in collective well-being;
- to develop suitable means of regulation;
- to simulate the effects of intervention policies;
- to formulate development strategies.

Emphasis is placed on the identification and socio-economic evaluation of the environmental functionalities of coastal environments.

The fields of application concern, in particular, strategies for protecting coastal environments thought to be fragile, consideration of the effects of a possible increase in sea level or an increase in the number of extreme meteorological events that might result from a climatic change, and evaluation of the impact of major accidents such as oil pollution incidents.

TRA 7. Sediment dynamics

This project focuses on the instability factors of sandy beaches and the movements of coastal sand bodies. This involves the coupling of morphology, sediment dynamics and hydrodynamic currents. It integrates two lines of research, the first of which aims to answer the following questions:

- how do coastal sand bodies form and change?
- what are the physical laws most suitable for representing sediment flux?
- what is the role of hydrosedimentary processes in the large-scale, long-term changes in a coastal sand system, and how do these processes interact on various time scales?

To answer these questions, the research teams combine digital modelling with

experimentation *in situ* or laboratory simulations and apply these tools to worksites typical of various hydrodynamic conditions of French coasts.

The second line of research is devoted to exchanges of particles at the water-sediment

interface. It involves the development of a new system (an erodimeter) for measuring the erosion capacity of fine sediments under the influence of basal currents, which will be tested at various PNEC worksites.

The PNEC organization in 2002

The Partner Institutes

This consortium of seven French national research institutes has set up the PNEC and contribute to its financing:

Ifremer	French research institute for exploitation of the sea (<i>Institut français de recherche pour l'exploitation de la mer</i>)
CNRS/INSU	National centre for scientific research (<i>Centre national de recherche scientifique</i>), National institute for sciences of the universe (<i>Institut national des sciences de l'univers</i>)
IRD	Research institute for the development (<i>Institut de recherche pour le développement</i>)
BRGM	Office of geological and mining research (<i>Bureau de recherches géologiques et minières</i>)
CNES	French space agency (<i>Centre national d'études spatiales</i>)
Cemagref	Agricultural and environmental engineering research institute (<i>Centre du machinisme agricole, du génie rural et des eaux et forêts</i>)
TOTAL	French oil company Total

The Inter-Institutes Committee (CIO, Comité inter-organismes)

This committee meets once a year to decide the main programme orientations and budget breakdown:

Nicole Lenôtre (BRGM); Nicolas Gendreau ou Pierre Élie (Cemagref); Aurélie Sand or Alain Podaire (CNES); Jean-François Minster (Ifremer), chairman of the Committee; Sylvie Joussaume (CNRS); Jacques Boulegue (IRD); Pierre Michelier (TFE).

The Scientific Council (CS, Conseil scientifique)

This advisory committee (see the list below as of January 2003) meets twice a year to select proposals to the PNEC tender and to keep track of the research programme development.

Jacques Clavier (chairman)	Institut universitaire européen de la mer (IUEM), Brest
Loïc Antoine	Ifremer, Nantes
Martine Antona	Cirad-Tera/Ere, Montpellier
Pieter Augustinus	Department of Physical Geography, Utrecht University (the Netherlands)
Michel Bhaud	Observatoire océanologique, Banyuls-sur-Mer
François Carlotti (executive secretary)	Laboratoire d'océanographie biologique, Station marine d'Endoume
Jean-Pierre Gattuso	Observatoire océanologique, CNRS/INSU-UPMC, Villefranche-sur-Mer
Pierre Chardy	Laboratoire d'océanographie biologique, Station marine d'Arcachon
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Patrick Gentien	Créma, L'Houmeau
Laura Giuliano	Centro Nazionale delle Ricerche, Istituto Sperimentale Talassografico, Messina (Italy)
Michel Joanny (executive secretary)	Ifremer, Brest
Christiane Lancelot	Univ. libre, ESA (Écologie des systèmes aquatiques), Bruxelles (Belgique)
Patrick Lassus	Ifremer, Nantes
Pascal Lazure	Ifremer, Brest
André Monaco	Cefrem, laboratoire de sédimentologie, Perpignan
Fereidoun Rassoulzadegan	Observatoire océanologique, laboratoire d'océanographie biologique, Villefranche-sur-Mer
Jean-Pascal Torreton	IRD, Nouméa (Nouvelle-Calédonie)

The Bureau

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Other cooperations

Several worksites and topic research action projects correspond to French participation in international programmes such as:

GEOHAB, Global ecology and oceanography of harmful algal blooms

GLOBEC, Global ocean ecosystem dynamics

ICRI, International coral reef initiative

LOICZ, Land ocean interactions in coastal zones

(1) Since January 2003. The previous Bureau (1998-2002) was composed of Hervé Chamley (chairman), Claude Alzieu and Guy Boucher (executive secretaries).