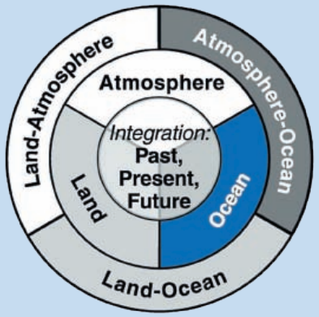
# IMBER

*IMBER is co-sponsored by IGBP and SCOR. In the IGBP family of projects IMBER fits into the Ocean domain.*




GLOBAL CHANGE
IGBP

International Council for Science
Scientific Committee on Oceanic Research

## Get involved

The IMBER Science Plan and Implementation Strategy provides a framework that supports participation of regional, national and individual research efforts in the IMBER project. We invite and encourage the submission of research projects for recognition as IMBER activities.

International/regional/national research groups can submit their project for recognition by the IMBER Scientific Steering Committee (SSC) via the web site (www.IMBER.info). Projects seeking endorsement from multiple IGBP/SCOR projects are welcomed.

## Subscribe to the email list

To be informed regularly about international, national and regional activities of IMBER and to receive announcements about IMBER related events, we invite you to join our email list by visiting our website.


## IMBER International Project Office

Institut Universitaire Européen de la Mer (IUEM)
Place Nicolas Copernic
29280 Plouzané, France
Tel: +33 2 98 49 86 72
Fax: +33 2 98 49 86 09
imber@univ-brest.fr



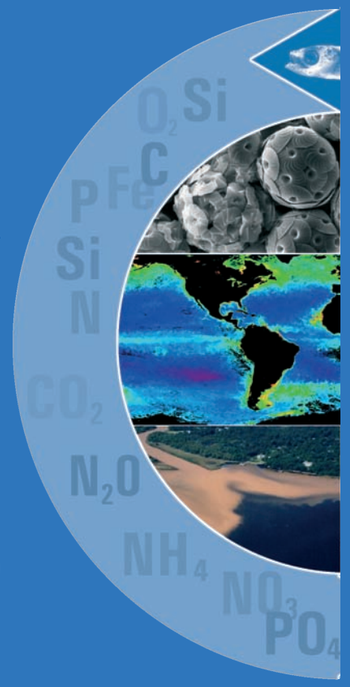
The IPO in France is sponsored by CNRS-INSU, IRD, Brittany Region, UBO and IUEM.


www.imber.info

Integrated Marine Biogeochemistry and Ecosystem Research

introducing

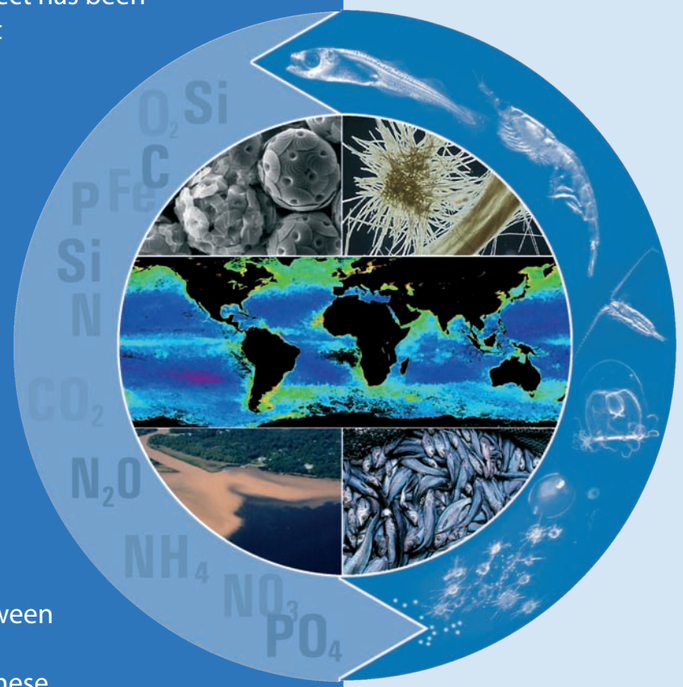
# IMBER




Human activities are rapidly altering Earth System processes that directly and indirectly influence society. Informed decisions require an understanding of which parts of the Earth System are most sensitive to change, and the nature and extent of anticipated impacts of global change. In response to this need, the Integrated Marine Biogeochemistry and Ecosystem Research (IMBER) project has been formed. The challenge to the scientific community is to understand inter-relationships between biogeochemical cycles and ecosystems, and to quantify and predict responses of the marine system to natural and anthropogenic perturbations.

This challenge has led to the IMBER goal, which is:
*"to investigate the sensitivity of marine biogeochemical cycles and ecosystems to global change, on time scales ranging from years to decades."*

Meeting this goal requires the identification of key interactions between marine biogeochemical cycles and ecosystems, and assessment of how these interactions respond to complex natural and anthropogenic forcings, including large-scale climate variations, changing physical and biological dynamics, changing carbon cycle chemistry and nutrient fluxes, and widespread marine harvesting. This research will fill the critical gap between short-term climate events (seasonal scale) and anthropogenic global change (century scale).




IMBER

Integrated Marine Biogeochemistry and Ecosystem Research

# Scientific Questions

## Interactions between Biogeochemical Cycles and Marine Food Webs

*What are the key marine biogeochemical cycles and related ecosystem processes that will be impacted by global change?*

Identifying and understanding interactions between marine biogeochemistry and ecosystems is a major intellectual challenge for IMBER. The inputs, losses, dynamics, and bioavailability of macro- and micronutrients influence ocean life. These factors can have non-linear impacts on metabolic rates and processes, population and community dynamics, and food web and community structures.

Key issues are the transformation of organic matter in food webs, transfers of matter across ocean interfaces, and material flow in end-to-end food webs. Comparisons of diverse systems will provide new insights on how the transformation and transport of elements involved in biogeochemical cycles affect food web dynamics.

## Sensitivity to Global Change

*What are the responses of key marine biogeochemical cycles, ecosystems and their interactions, to global change?*

IMBER will increase our ability to understand and predict the consequences of global change on ocean food webs and biogeochemistry by examining the potential synergistic and antagonistic effects of changes in key variables, such as physical forcing, $CO_2$ and pH, nutrient supply and harvesting of marine living resources.

### Sensitivity to Climate

IMBER seeks an improved understanding of how climate-induced changes in physical forcings (such as temperature, circulation, ventilation and stratification) will force seasonal to inter-decadal variability in food webs, biogeochemical systems, and their interactions.

### Sensitivity to Acidification

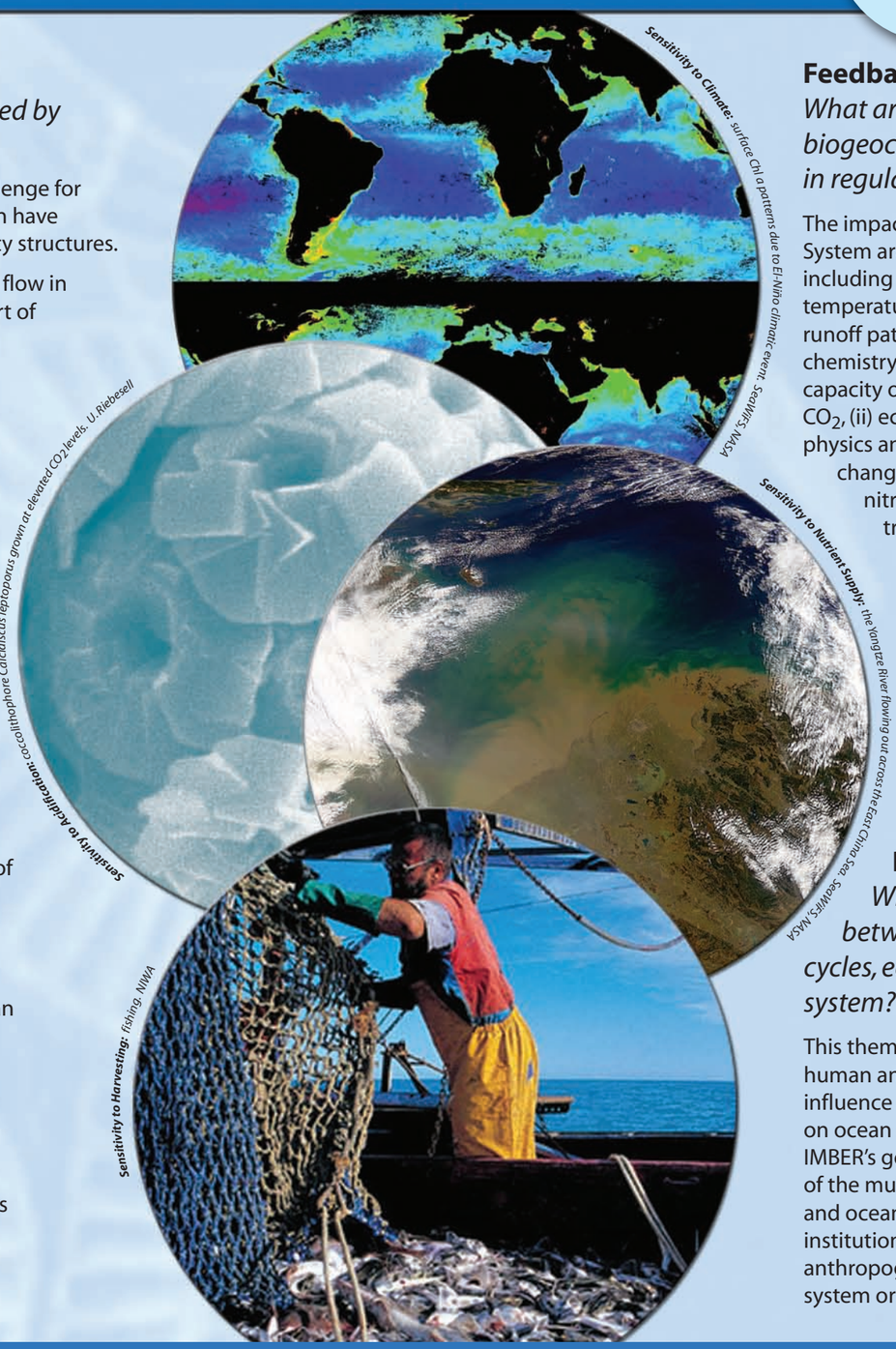
Over the next century, surface ocean $CO_2$ concentrations will approximately double, with acidification of ocean surface waters decreasing calcite and aragonite saturation. These $CO_2$-driven changes in carbonate chemistry will affect marine biogeochemical cycles and ecosystems. IMBER will also study how pH indirectly influences the availability and speciation of macro- and micronutrients and toxic trace metals, and how changes in these factors affect ocean ecosystem structure and function.

### Sensitivity to Nutrient Supply

Marine biogeochemical cycles and food webs respond to additions of macro- and micronutrients to the ocean from human activities. Continued global expansion of oxygen-depleted zones resulting from eutrophication is expected to lead to an increase in denitrification rates that increase the remobilisation of phosphorus and micronutrients from continental shelf sediments. The abundance, distribution and stoichiometry of nutrient elements will affect food web structure and function, and increases in hypoxia and anoxia will affect food webs and cycling of key macro- and micronutrients.

### Sensitivity to Harvesting

Selective exploitation of marine organisms can change the size and age structure of populations, with subsequent impacts on population dynamics and, hence, ecosystems via food web interactions. A particular objective is to understand how harvesting-induced changes in the food web structure will impact biogeochemical cycles and how harvesting of living marine resources impacts marine food webs from top to bottom.




## Feedbacks to the Earth System

*What are the roles of ocean biogeochemistry and ecosystems in regulating climate?*

The impacts of human activities on the Earth System are manifested in many ways, including increasing global mean temperature, changing precipitation and runoff patterns, and changing ocean chemistry. Key issues include (i) the varying capacity of the ocean to store anthropogenic $CO_2$, (ii) ecosystem feedbacks on ocean physics and climate, and (iii) impact of changes in low-oxygen zones on the nitrogen cycle, especially transformations involving $N_2O$. Modelling the potential feedbacks from marine biogeochemical cycles and ecosystems to the Earth System will require detailed understanding of local and regional manifestations of global change in the ocean, and their interactions with other parts of the Earth System.

## Responses of Society

*What are the relationships between marine biogeochemical cycles, ecosystems and the human system?*

This theme focuses on interactions between human and ocean systems. Humans not only influence ocean systems, but they also depend on ocean systems for goods and services. IMBER's goal is to promote an understanding of the multiple feedbacks between human and ocean systems, and to clarify how human institutions can respond, either to mitigate anthropogenic perturbations of the ocean system or to adapt to such changes.


Integrated Marine Biogeochemisty and Ecosystem Research