



Axe 2 GIS EuroPôle Mer **Global change, Ocean and Marine Ecosystems**

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Executive summary of the proposal for a centre of excellence, 2008-2012

Europôle Mer is a “Groupement d'Intérêt Scientifique” (hereafter GIS), organized in five axis. The GIS Axis 2 is focused on global change, ocean and marine ecosystems. Associated research teams are involved in a number of in situ and satellite observations of the ocean, as well as modelling projects, most of which are part of efforts coordinated at the international level. Among the existing expertise in the region Bretagne, four themes were identified as relevant for enhancing the synergy between the different research groups: the climate variability in the ocean at the basin scale, the exchanges across ocean margins, the impact of small and medium scales, and the marine ecosystems and regional climate change. They are summarized hereafter.

- 1 The interannual to decadal variability of the ocean circulation and physical properties has a strong impact on the biogeochemistry and biology. It is superimposed on, and interacts with, the trends caused by anthropogenic forcing of the climate. In order to fully understand the mechanisms at play, we must intensify our efforts to measure and analyse jointly the variability of the ocean physical properties and biogeochemistry/biology. These observations must be sustained efforts. They must be used in a long-term effort to validate and improve numerical models of the ocean physics and biogeochemical cycles. GIS partners have the competence to carry out such observations and modelling in the Atlantic and in the Southern Ocean.
- 2 At the ocean margins, a better understanding and quantification of the variability of exchanges between the coastal and the deep ocean is needed. Observation of physical and chemical properties must be carried out on longer time scales; we must make use of novel data such as TEIs and biological proxy data and link them with three dimensional ocean measurements and satellite observations. There is a need to develop integrated models of the ocean margins from the physical environment to the marine resources (“end-to-end” modelling).
- 3 The physical properties and circulation of the ocean structure the biology on a large range of scales, from the basin scale to the mesoscale and even the submesoscale. The nonlinear scale interactions are especially important at the ocean margins, where additional effects come into play (internal tides). Studies of climate variability, even at interannual to multi decadal time scales, must take into account those processes that are not well understood and represented in the numerical models.
- 4 Future scenarios for ocean biogeochemistry have been run using low-resolution global IPCC models (IPCC AR4). It is not yet feasible to run realistic regional scenarios of full ecosystem models at the scale of an ocean basin, or an ocean margin. We need to evaluate the different strategies and, most critically, to assess the quality of surface wind data and their impacts on the ocean models.

We propose a strategy that builds on existing or planned projects to strengthen our expertise in key areas and create new synergies. The centre of excellence of GIS Axis 2 must make possible two main outcomes, thanks to strong interactions between the different institutes and research units:

- 1 - new up-to-date ocean ecosystem models focused on biogeochemical cycles, able to address major issues linked to marine resources and regional climate change, and
- 2 - an observing inter disciplinary strategy with a tight coupling between dynamics, tracers and biological activity.

The research of the centre of excellence is organized into three work packages. For each work package, activities supported by the GIS will be pluridisciplinary and directly aimed at fostering international and European collaborations. To reach our goals, we will recruit a researcher with a high level of expertise in pluridisciplinary research at the best international level. The GIS chair scientist, helped by a post-doctorate associate, will initiate original research, new international collaborations, and help coordinate the centre of excellence. Resources allocated to the GIS axis 2 will also mainly be used for funding of post-doctorates and PhDs who will help to achieve the objectives of the three work packages.

The first work package is focused on climate variability, ocean circulation and ecosystem functioning. We plan to document and investigate the climate variability of biogeochemical parameters (including oxygen and TEIs) in relation with physical and biogeochemical processes, in order to address the first two objectives. Our modelling studies will also move towards higher resolution to represent at least partially the mesoscale variability of the ocean ($1/4^\circ$ or more), in order to evaluate its impact on the transport and modification of water masses, as well as on the biological activity and on the structuring the ecosystem. We will make use of improved biogeochemical models that will rely on our in situ observations and process study experiments.

The second work package will address the coupling between physical oceanography, chemistry, TEIs, biology and modelling in order to better understand and quantify (i) the land-sea exchanges and their contribution to the global biogeochemical budgets, (ii) the biological pump and its perturbations at the ocean margins, (iii) the role of the ocean margins on the chemistry, biogeochemistry and global marine productivity of the ocean and (iv) the variability of marine resources at the eastern boundaries of ocean basins. To achieve these objectives, we need to significantly increase the acquisition of geochemical measurements together with physical flux measurements (water and mass transportation). The Bay of Biscay, the Benguela upwelling system and the Agulhas Bank are ideal laboratories to carry out such integrative studies. This will result in new proposals for multi-disciplinary oceanographic cruises, as well as process studies and modelling.

The third work package will aim to constitute an aggregated set of satellite, in situ, model and biological growth records and determine (i) if we can detect meaningful events in large multi-source ocean observation databases, (ii) how consistent the various observations are, and (iii) if we can infer climate variations in satellite remote sensed surface climatologies and biological growth records over the past 15-20 years. The project will necessarily build on a transdisciplinary approach. Associated partners shall lead to conceptual and methodological progress in proxy science and complex system variability knowledge, data management and analysis, theoretical and numerical efforts.