axis 6

"Evolution of marine habitats and adaptation of populations"

SCIENTIFIC CONTEXT

Major disturbances of marine ecosystems affect biological traits and adaptive capacity of living organisms, physical habitats, distribution and dynamics of populations, and structure and functioning of communities. Within axis 6, we are proposing to develop an integrated understanding of the biological processes involved in the acclimation/adaptation of marine organisms to past and ongoing environmental changes, such as acidification, warming or hypoxia, as well as exposure to pathogens. Models of individual responses will be coupled to physical and habitat models to assess population changes and we will relate functional microbial and macrobiota biodiversity to environmental drivers.

Keywords

- Biological responses
- Acclimation
- Dynamic Energy Budget (DEB)
- Functional biodiversity
- Metagenomics
- Morphodynamics
- Population dynamics
- Habitat modelling

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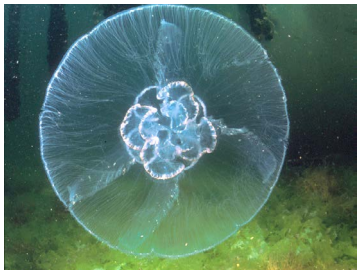

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ROADMAP

Axis 6 will develop projects along the 3 following directions :

- Towards an integrated understanding of the adaptive capacity of marine organisms in response to environmental changes. The potential impact of ocean acidification, warming and biotic interactions (pathogens, toxic blooms) will be investigated at different levels of organization and through transgenerational studies. Strategies to estimate mechanisms of acclimation and adaptation will focus on species comparison presenting differences of sensitivity to environmental changes. In addition to phenotypic plasticity and genetic polymorphism, we will also investigate epigenetic mechanisms through a multigenerational approach.
- Integrated modelling of individual responses, population dynamics and habitat changes. The capacity of predicting habitat changes under different forcing scenarios (climate change, anthropic pressures) will be tested by using process-based models for morphological coupling and sediment dynamics, and applied to study sites for biota responses : the aim is to characterize the variability of bed elevation (in shallow waters), sediment substrates or turbidity levels at different temporal scales, from tides to seasonal changes, but also trends on longer terms (several decades, in relation with climate change). Coupling with population dynamics will be investigated in some cases of engineering species. Among the biological modelling approaches that we propose, Dynamic Energy Budget (DEB) has been currently used in a number of projects developed by a group of researchers in and outside the LabexMERcommunity. Axis 6 will reinforce the capacity building of the partners, the visibility and usage of modeling tools by a wider scientific community. Besides, integrated models are needed to simulate changes of species habitat, to account for the connectivity between populations, the plasticity and the adaptive capacity of single species, and to predict the structure of biological communities emerging from the tradeoffs between life history traits and competition for resources. Multi-scale models will integrate responses at different spatial, temporal, physical and ecological scales in the context of climate change.
- Functional microbial and macrobiota biodiversity. Thanks to the progress made in meta-type barcoding and metagenomic approaches, we will aim at monitoring microbial diversity (bacteria, archaea and eukaryotic microorganisms) in connection with the physical/biological coupled models. A long-term goal will be to develop a microbial observatory in the Bay of Brest and Iroise Sea. One other goal will be to favour collaborations with other international coastal observatories «Microorganisms and environment». We will promote new tools in axis 6, such as single-cell molecular variation and heterogeneity analysis to explore population level function and also metatranscriptomic studies to explore functional biodiversity. The goal is to create further one or more "laboratoires mixtes internationaux" focusing on ecogenomic approaches.

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EXPECTED RESULTS

Interdisciplinary science will be emphasized through the coupling of models or through the building of global change scenarios relevant for habitat dynamics and population responses. Axis 6 will also link to the new axis 8 on Marine Social-Ecological System Management thanks to the knowledge gained in the physical and biological responses to environmental drivers. Through training and international networking, we will contribute to the capacity building of Labex partners with respect to omics, evolutionary marine ecology and biological modeling. On the basis of paleo-ecology and scenarios of future changes, we will document the trajectories of marine organisms in relation to past and ongoing- environmental changes and build new dynamical models of ecosystem changes.