**Investigating the role of oceanic circulation in plankton communities structure and functioning**

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## Project Summary

An enduring challenge in ecology is to comprehend how marine phytoplankton has developed and maintains its large diversity, characterised by a complex web of interactions, while living in a largely unstructured environment. As local assemblies are controlled by ocean circulation and resource delivery, understanding the relation between the species distribution and oceanographic patterns becomes crucial. A fundamental step to understand and predict the status and functioning of pelagic ecosystems is to abandon the terrestrial concept of *landscape* and, instead, consider the highly dynamic *seascape*, i.e., to fully contemplate that the substrate is a fluid, where resources and organisms are moved around by currents. Processes in the seascape cannot be easily disentangled and many knowledge gaps still exist about the role of its key components. We are also missing an understanding of connectivity to be operationally used for sustainable ES management and policy development. Finally, climate change is impacting the seascapes in many, often subtle ways, with impacts on biodiversity and on its services.

Specifically, the understanding of the oceanic biogeography remains limited; e.g., the level of endemicity of planktonic species, a key question in ecology, remains unconstrained. This has important implications for the response to changes that depends on acclimation capacities but also on the degree of isolation and evolvability of the species, in turn related to the ecosystem connectivity. Here we will thus bring together complex systems, genomics and oceanography to explore how the physical connectivity between oceanic regions determines the local community structures (i.e., the coexistence of many species), supports stable biogeographies and stretches species distributions beyond their optimal conditions, thus impacting on the ecosystem stability. The project plan will exploit the genomic revolution in ecology, due to the direct access to genomic information on real ecosystems. The planned activities will combine the analysis of the recent data on the oceanic metagenomic functional diversity with a hierarchy of conceptual models describing circulation and plankton dynamics with increased complexity. As main intellectual merit, our interdisciplinary team will promote an innovative approach to the understanding of the system via the validation of long standing hypotheses. In addition, the study of the impact of dispersal will allow to bridge terrestrial and marine ecology, with broad impact on marine ecology and, especially, on climate change ecology. Finally, the identification of the degree of locality of species and their equilibrium with oceanic dispersal will create new avenues for theoretical and applied research.