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Invasive species: an increasing threat to marine ecosystems under climate change?

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Planktonic Non-Indigenous Species (NIS) are a potential threat to marine ecosystems: a successful invasion of such organisms can alter significantly the ecosystem structure with shift in species composition that can affect different levels of the trophic network and also with local extinction of native species in the more extreme cases. Such changes will also impact some ecosystem functions like primary and secondary production or nutrient cycling, and services, like fishery, aquaculture or carbon sequestration. Understanding how climate change influences the susceptibility of a marine ecosystem to invasion is challenging as the success and the impact of an invasion depend on many different factors all tightly interconnected (e.g. time of the invasion, location, state of the ecosystem...). Here we present DivERSEM, a new version of the biogeochemical model ERSEM modified in order to account for phytoplankton diversity. With such a model, we are able to simulate invasion from phytoplankton NIS, to assess the likelihood of success of such an invasion and to estimate the potential impact on ecosystem structure, using indicator like the Biopollution index.
In the MEECE project (www.meece.eu), the model has been coupled to a 1D water column model (GOTM) in two different climate scenarios (present day and the IPCC SRES A1B scenario for 2100) in 4 different European shelf seas (North Sea, Baltic Sea, Black Sea and Adriatic Sea). The model has been forced with atmospheric data coming from the IPSL climate model, and nutrient concentration extracted from a set of 3D biogeochemical models running under the same climate scenario. The response of the ecosystem susceptibility to invasion to climate change has been analysed comparing the successfulness of invasions in the two time slices and its impact on community structure and ecosystem functions. At the same time, the comparison among the different basins allowed to highlight some of the characteristics that make the ecosystems more vulnerable to NIS.