

{rokbox title=|Conceptual representation of the OSMOSE-MED end-to-end model applied to the whole Mediterranean Sea :: Image: Authors|
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Abstract: The Mediterranean Sea is one of the main hotspots of marine biodiversity in the world. The combined pressures of fishing activity and climate change have also made it a hotspot of global change amidst increasing concern about the worsening status of exploited marine species. To anticipate the impacts of global changes in the Mediterranean Sea, more integrated modelling approaches are needed, which can then help policymakers prioritize management actions and formulate strategies to mitigate impacts and adapt to changes. The aim of this study was to develop a holistic model of marine biodiversity in the Mediterranean Sea with an explicit representation of the spatial, multispecies dynamics of exploited resources subject to the combined influence of climate variability and fishing pressure. To this end, we used the individual-based OSMOSE model (Object-oriented Simulator of Marine ecOSystEms), including 100 marine species (fish, cephalopods and crustaceans) representing about 95% of the total declared catch, at a high spatial resolution (400 km²) and a large spatial scale (the entire Mediterranean basin) – the first time such a resolution and scale have been modelled. We then combined OSMOSE with the NEMOMED 12 physical model and the Eco3M-S biogeochemical low trophic level model to build the end-to-end model, OSMOSE-MED. We fitted OSMOSE-MED model with observed or estimated biomass and commercial catch data using a likelihood approach and an evolutionary optimization algorithm. The outputs of OSMOSE-MED were then verified against observed biomass and catch data, and compared with independent datasets (MEDITS data, diet composition and trophic levels). The model results – at different hierarchical levels, from individuals to the scale of the ecosystem – were consistent with current knowledge of the structure, functioning and dynamics of the ecosystems in the Mediterranean Sea. While the model could be further improved in future iterations, all the modelling steps – the comprehensive representation of key ecological processes and feedback, the selective

parameterization of the model, and the comparison with observed data in the validation process – strengthened the predictive performance of OSMOSE-MED and thus its relevance as an impact model to explore the future of marine biodiversity under scenarios of global change. It is a promising tool to support ecosystem-based fishery management in the Mediterranean Sea.

Keywords: Ecosystem model, Ecosystem Approach to Fisheries Management, OSMOSE model, NEMOMED model, Eco3M-S model, Global change