Seventh Framework Programme Theme 6 Environment

Collaborative Project (Large-scale Integrating Project)

Project no. **212085**

Project acronym: **MEECE**

Project title: **Marine Ecosystem Evolution in a Changing Environment**

D1.4 New model parameterisations

Introduction

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Dissemination Level		
PU	Public	x
PP	Restricted to other programme participants (including the Commission)	
RE	Restricted to a group specified by the consortium (including the Commission)	
CO	Confidential, only for members of the consortium (including the Commission)	

Marine Ecosystem Evolution in a Changing Environment

D1.4 New model parameterisations for ecosystem models to be developed in WP2

Contributors
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Summary

The objective of work this was to analyse the outputs the outputs of T1.1 and T.3 with the goal of improving our knowledge base on driver impacts on marine ecosystems and defining new process descriptions to be implemented in numerical models. This task has been undertaken in collaboration with WP2 to ensure the derived processes are relevant to the model capability and that any new insights through model simulations could be fed back to the meta-analysis and parameterisation work in WP1. As the potential range of analysis was very large, we have focused our efforts on developing parameterisations which help us understand and model the core MEECE drivers, Climate (metabolic theory), acidification, fishing, pollution, alien invasive species and the impact of multiple drivers. Because of the diverse nature of these pieces of work for clarity they are each presented as a separate sub-deliverable. The brief summary of the outputs of each activity follows.

Part A. Acidification (UiB, NERC-NOC)

MEECE has created new formulations of the carbon and nutrient uptake stoichiometry informed by seawater carbon chemistry and phytoplankton bloom conditions. The approach is more realistic than earlier parameterisations that were informed by atmospheric CO_2 by using the in situ carbonate system conditions tom force the uptake stoichiometry. It thus emulates the biogeochemical and physiological conditions experienced in the real bloom situations in the ocean. The parameterizations developed can be readily implemented in ecosystem models either as full ecosystem uptake response or as individual plankton functional type representation dependent on the model setup. **Full details see D1.4a**

Part B. Metabolic Theory (IEO)

Components parameterizations were developed to address;

- *Temperature size relationships in marine phytoplankton: We* provide a theoretical framework for assessing how marine phytoplankton communities might change in the near future.
- *Temperature, nutrients and the size-scaling of phytoplankton growth: We* identify that the unimodal pattern observed by other researchers has the potential to be due to an incorrect temperature correction and to an internal inconsistency in the databases used as a large portion of the picoplankton data contain a correction for photoacclimation effects, while for the rest of the data does not.
- *Prey capture rate parameterization in planktivorous fish and jellyfish:* Clearance rates of jellyfish were found to not differ significantly from those of visually predating fish with the same carbon content. However, jellyfish respire just as much as any animal with similar body carbon (ANCOVA, P=0.072; Fig. 1c). These rates can be used to calculate the energy available for growth and reproduction, or scope for growth.
- *Unified model of life history optimization and metabolic scaling theories for developmental time*. The result show that it is possible to unify in a single model the effects of allometric constraints and reproductive trade-offs on developmental time.

Full details see D1.4b

Part C. Fisheries (HCMR)

The principal aim of the fisheries meta-analysis was to parameterize fishing impacts in ecosystem models. This activity was divided into two sections, first the impact on fish communities mediated through changes in catch and secondly on the impact of benthic components. Summary data from regression analysis for each of the sea area, gear types, functional groups, and dominant species is presented and relationships identified.

Full details see D1.4c

Part D. Pollution (UPiedmont, UNIBO, SDU)

The principal aim of the pollution meta-analysis was to examine the existing literature for potential parameterizations and thereby enable a better understanding of the influence of key pollutants occurring in the marine environment on organism vital rates as well as where possible the combined effects of temperature and these pollutants on lower trophic level key players. As a review of the vast number of contaminants occurring in the marine environments is beyond the scope of this program we focus on contaminants chosen in the experimental component of MEECE. Specifically the report gives an overview on the general impacts of temperature on the body size of marine organisms, the impacts of copper pollution on plankton species diversity and fish, herbicides on phytoplankton growth and nonopyynols on secondary producers. In addition there is a review of the combined impacts of temperature and contaminants on microalgae and higher trophic levels.

Full details see D1.4d

Part E. Alien Invasive Species (KORPI, SAHFOS)

The invasive species work has focused on characterising the impacts, ecological and functional traits of key invasive species with a focus on the data rich Baltic Sea as follows;

Impacts: parameterization of the Invasive species impacts. The meta-analysis covered abundance/distribution range of Invasive species and the magnitude of their impacts on community structure, habitats and ecosystem functioning in the Baltic Sea;

Ecotraits: parameterization of the ecological traits of benthic and pelagic invertebrate and fish IAS. The database on ecological traits of Invasive species was compiled that are widely distributed and are known to cause significant environmental impact within the Baltic Sea, and have potential to spread to the adjacent areas of the North Sea and/or North Atlantic;

Phyto-types: parameterization of the functional traits and environmental tolerance limits for phytoplankton species known to be established in the European regional seas.

Full details see D1.4e

Part F. Multi Driver Responses

The goal of this exercise was to develop multi stressor vital rate parameterizations for key lower trophic level species. To this end, targeted experiments were performed in three clusters to resolve the physiological and biogeochemical responses of key species to the combined effects of acidification, pollution and temperature. The key species examined represented different trophic levels from pelagic autotrophs (diatom, *Skeletonema marinoi*, dinoflaggelate, (*Gonyaulax spinifera*), heterotrophic plankton (protozoa, *Euplotes crassus*, copepod, *Acartia tonsa*) and fish (herring, *Clupea harengus membras*) egg and pre feeding larval stages as well as the potentially invasive benthic species (*Mytilus galloprovincialis*). Phytoplankton, protozoan, and zooplankton as well as mussel metrics relative to stressors included (species dependant) elemental stoichiometry, survival success, growth and developmental rates and reproductive output as critical parameters for developing Individual based, population and community models

Full details see D1.4f

It should be noted that work by CNRS on planktonic ecosystem response to climate change was also included in T1.6. The results of this analysis are presented in D1.5 as they directly helped to inform scenario definition.