Marine Ecological Modelling Virtual Laboratory (vLab)

DATA ANALYSIS

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Overview

There are two inherent problems faced when trying to implement dynamic models that apply dispersal and population dynamics for marine species. Firstly, in places below the intertidal ecological zone, sampling is never sufficient to support a robust fit of a model to facilitate good prediction at the scale of local study sites. This is largely due to the requirement of platforms (e.g. boats, research vessels) and highly specialised gear (i.e. samplers) to conduct surveys. Secondly, this approach does not account for interactions between the biological components of habitats (e.g. primary producers, consumers, decomposers). Therefore, the solution proposed for these cases is to model the entire marine ecosystem of specific sites and to develop an online graphical user interface (GUI) to dynamically explore model results on environmental and biological variables and relevant ecological indices. Since the implementation of such an application requires increased computational capacity, the electronic infrastructure of the LifeWatch (ESFRI) Greek hub was used.

The modelling component of the developed application consists of a three-dimensional, coupled hydrodynamic-biogeochemical model available online, as depicted in **Figure 1**.

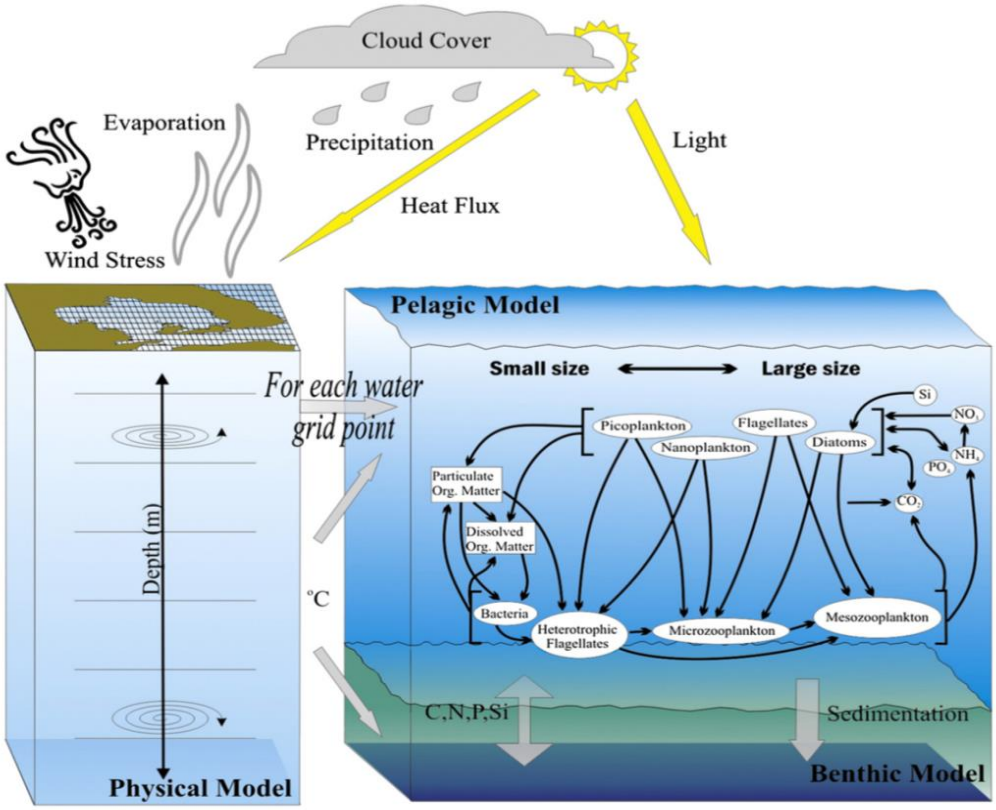

Figure 1. Graphical representation of the two models coupled for the purposes of the application, developed specifically for marine sites.

Requirements analysis and profiling

The models need to be set *a priori* on specific areas and rich in climatic and geomorphological data in order to be sufficiently tuned. Once this is done, the GUI provides an easy interface for scientists and other user groups (e.g. stakeholders, policy-makers, implementers).

Marine Ecological Modelling vLab Interface

The application is accessible through a user-friendly online GUI, available upon registration at https://portal.lifewatchgreece.eu/ (the portal of the LifeWatchGreece Research Infrastructure (ESFRI) https://www.lifewatchgreece.eu/). This interface allows users to examine results in the form of plots by selecting the area, scenario and parameter and downloading the graphs, as shown in **Figures 2** and **3.**

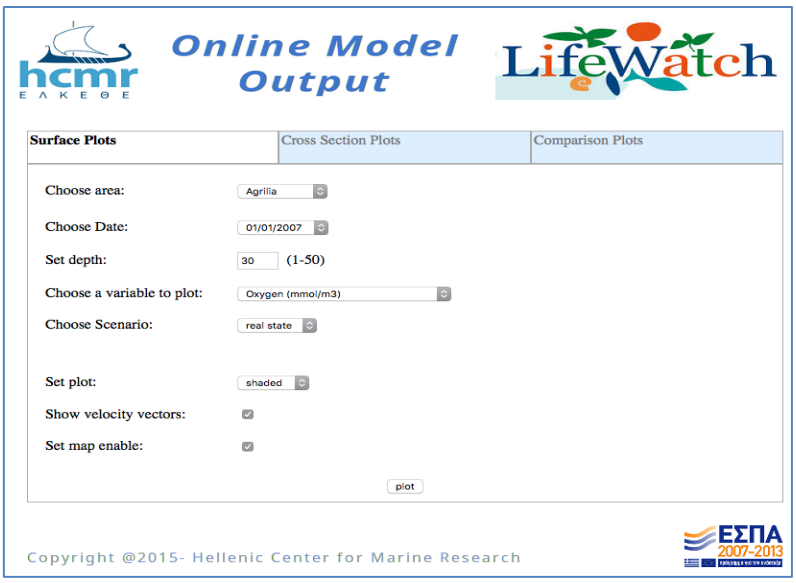

Figure 2. The online graphical user interface (GUI) of the application, showing the surface plotting option.

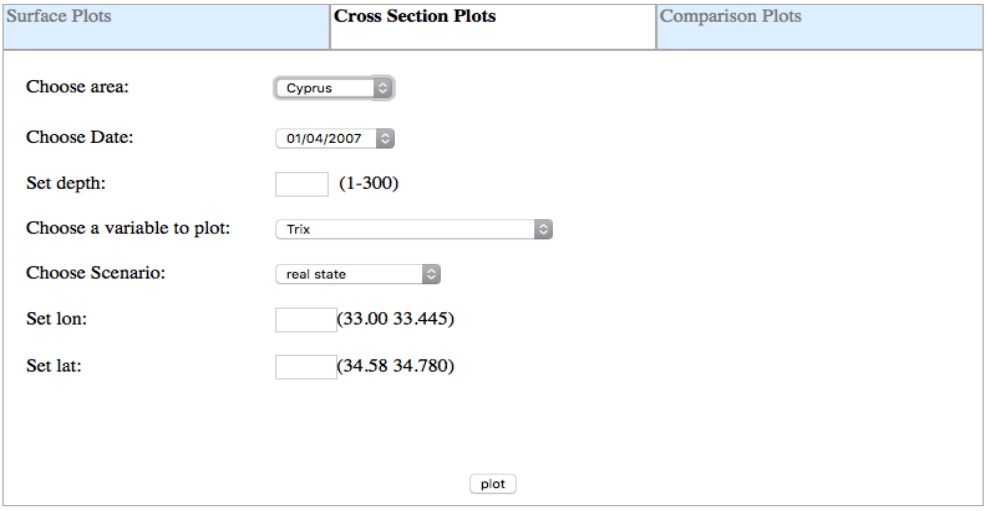

Figure 3. The online graphical user interface (GUI) of the application, showing the cross-section plotting option.

Expected advantages

1. **Big data manipulation** (from multiple sources, including sensors);
2. **Efficiently and user-friendly interface** for analysis of ecological modelling; and
3. **Mapping of important aspects of the marine ecosystem,** such as the distribution of the essential environmental and biotic variables and ecological and biodiversity indices.

Applicability

The GUI is applicable to those cases in which assistance on decision-making regarding marine ecosystems is required. The interface can provide prognosis on where the major abiotic and biotic variables of the ecosystem will shift to, under specific scenarios, and is applicable to almost every area in the world once the models have been set and finely tuned to these areas.

Potential users

Users include: researchers and academics; students; environmental managers; local, regional and national authorities; policy-makers; and those implementing management responses.

Case studies

The virtual lab has been set up for three different marine sites in Cyprus, Pagasitikos Gulf (Greece) and Lesbos Island (Greece), for which appropriate data existed. In **Figures 4 to 7**, certain functionalities of the application are demonstrated.

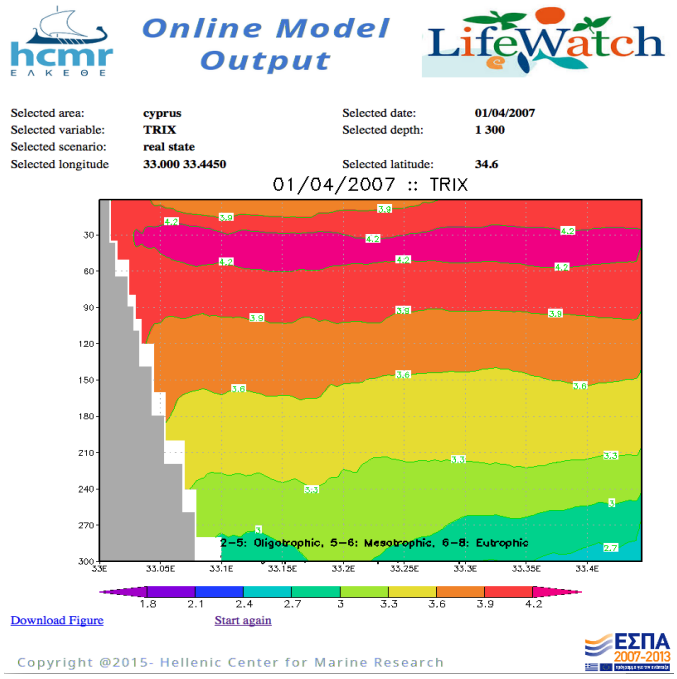

Figure 4. Results of the dynamic ecological modelling application in the Cyprus marine site: distribution of the TRIX index (ecological quality), under the real state scenario.

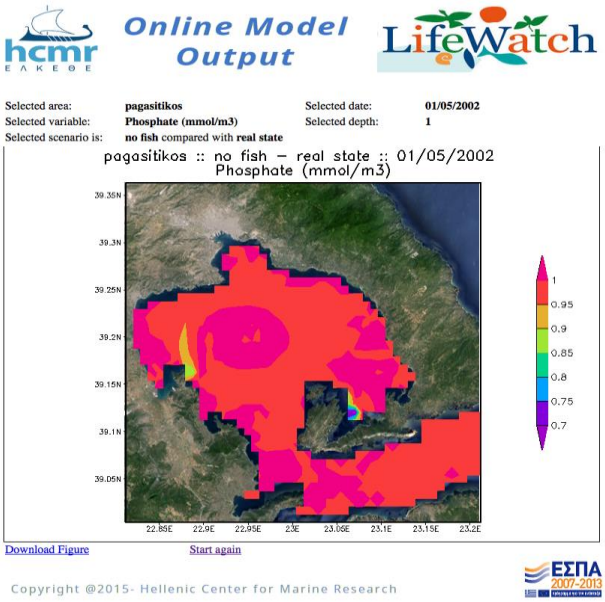

Figure 5. Results of the dynamic ecological modelling application in the Pagasitikos Gulf: comparison of phosphate under different fish load scenarios.

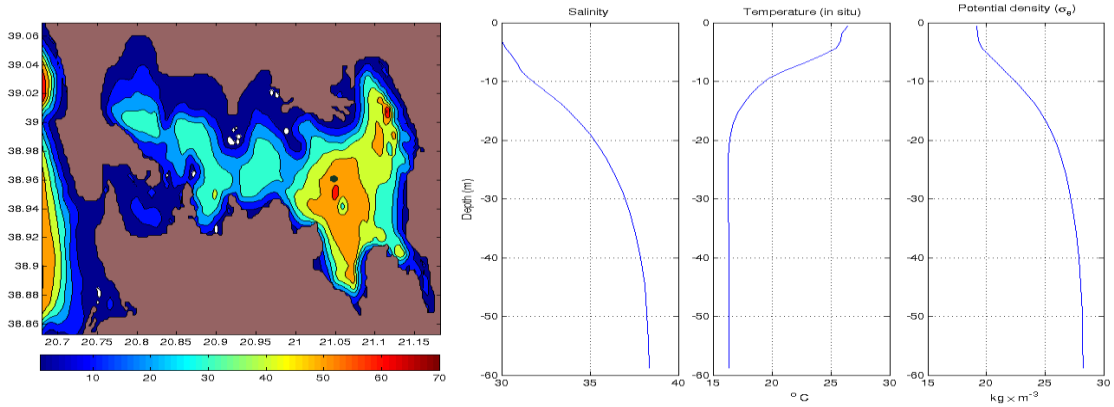

Figure 6. Summer profiles at the deepest part of the Amvrakikos Gulf.

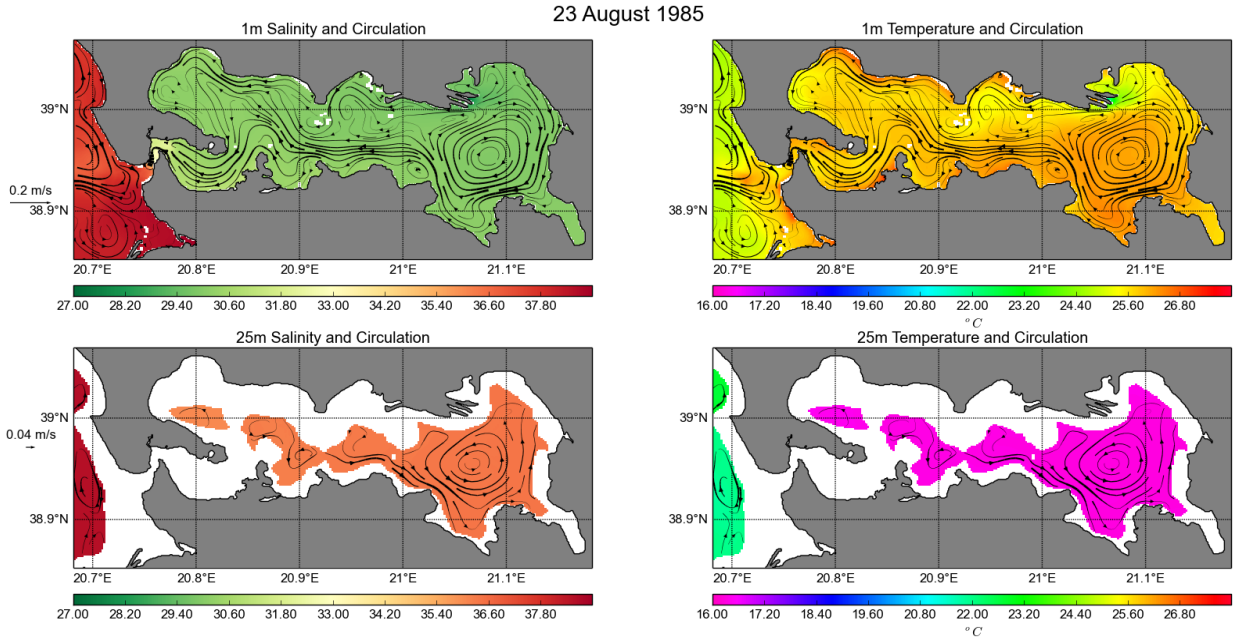

Figure 7. Combined circulation and salinity/temperature values at the surface and bottom of the Amvrakikos Gulf.