EGU24-1000, updated on 04 Sep 2024
https://doi.org/10.5194/egusphere-egu24-1000
EGU General Assembly 2024

Semi-automatic geospatial modeling supporting restoration actions on a Posidonia oceanica meadow offshore Civitavecchia (eastern Tyrrhenian margin, Mediterranean Sea) using Object-Based Image Analysis on acoustic remote sensing data

Luca Marino[1], Luca Fallati[1], Andrea Giulia Varzi[1], Giorgio Fersini[2], Daniele Piazzolla[3], Sergio Scanu[3], Marco Marcelli[4], and Alessandra Savini[1]

[1]University of Milano-Bicocca, Dept. Of Earth and Environmental Sciences (DISAT), Milano, Italy (l.marino27@campus.unimib.it)

[2]AdSP del Mare Tirreno Centro Settentrionale, Uff. Procedimenti Ambientali Opere, Civitavecchia (RM), Italy

[3]Ocean Predictions and Applications Division, Centro Euro-Mediterraneo sui Cambiamenti Climatici, Italy

[4]University of Tuscia, LOSEM (Laboratory of Experimental Oceanology and Marine Ecology), DEB (Department of Ecological and Biological sciences), Port of Civitavecchia, Civitavecchia (RM), Italy

Marine restoration projects are becoming increasingly important worldwide to mitigate human-driven impacts on marine ecosystems. Nonetheless, their success rate is highly fluctuating and depends upon a number of variables, such as bio-ecological features of the involved species and the geospatial and geomorphological drivers proper to the habitat concerned. Geospatial and geomorphological variables are undoubtedly key factors in controlling benthic species' distribution; therefore, an accurate analysis of the latter is of paramount importance to detect the most suitable sites for the restoration efforts. The National RENOVATE project (ecosystemic appRoach to the EvaluatioN and testing of cOmpensation and mitigation actions in the marine enVironment: the cAse of the civiTavEcchia harbuor), coordinated by CMCC (Mediterranean Centre for the study of Climate Changes) and funded by "AdSP (Autorità di Sistema Portuale) of the north-central Tyrrhenian Sea", is performing an integrated methodology for the compensation of Mediterranean marine ecosystems, damaged by anthropogenic impacts, in selected areas located offshore Civitavecchia harbor, in the central Mediterranean sea. In the context of this project, our work focused on providing high-resolution habitat mapping of a Posidonia oceanica meadow, along with the detection of suitable sites for implementing restoration actions. Geospatial and geomorphometric analyses were applied to the available dataset (i.e. multibeam bathymetry and acoustic backscatter) in addition to design a semi-automatic approach, by using Object-Based Image Analysis (OBIA) techniques, to classify the detected morph-acoustic facies. OBIA techniques consist of two sequential steps: (1) image segmentation into different meaningful image-objects, according to the contextual and spectral characteristics of the pixels composing them; (2) semi-automatic classification on the base of spectral, spatial and contextual characteristics of the image-objects. We developed a workflow to analyze multibeam bathymetry and side scan sonar backscatter intensity data specifically referred to the determination of Posidonia oceanica

meadow extent, and to the detection of all sedimentary pockets within the meadow that appeared to be suitable for restoration actions (according to a set of pre-defined parameters). We defined OBIA rulesets using the eCognition® 10.3 software from Trimble on a multi-scale and multi-layer level, combining and integrating the original dataset and terrain variables obtained from geomorphometric analyses. Such rulesets comprised the application of deep learning algorithms to generate our final classification. We validated our results by comparing them with prior knowledge of the study site (provided by researchers of the Università della Tuscia) and by manual interpretation and classification performed using the software ArcMap 10.8.

The methodological approach here presented and the associated rulesets, have been designed in order to be applied (with the proper case-specific precautions) to the planning phase of any Posidonia oceanica meadow restoration project, and represent a new advance in the field of ecosystem management and restoration.