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Satellite Mapping of Macro-algae and Phytoplankton communities in the Mar Piccolo of Taranto (Ionian Sea, southern Italy), a confined marine basin heavily impacted by anthropogenic activities

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Mar Piccolo is a semi-enclosed sea of about 21 Km2, consisting of two basins to the north of the city of Taranto. It is subjected to multiple anthropogenic pressures, such as industrial and waste pollution, harbour activities, aquaculture and commercial fishing that affect the environmental quality and can favour the arrival and establishment of alien species. The two basins are very different in terms of both abiotic and biotic features. The western basin is a proper marine coastal area, while the eastern one is more similar to a lagoon with very reduced water circulation and low ecological diversity. Throughout the years, the anthropogenic activities increased their impacts on this ecosystem leading to the spread of various macro-algal species (e.g. *Hypnea cornuta* and *Caulerpa prolifera*) and recurrent noxious episodes of phytoplankton blooms.
During several sea truth campaigns carried out in 2013 and 2014, many data concerning distribution, density, biomass and chlorophyll a and b, related to the populations of benthic macroalgae and phytoplankton, were acquired at different sampling stations located in the two basins of the Mar Piccolo.
The sea truth data collected during these campaigns were integrated with those provided by the new family of multispectral HR satellite sensors, namely Landsat 8 OLI and Sentinel 2 MSI, to preliminarily test their improved capability for seaweed and phytoplankton detailed mapping. Different image based approaches were applied for the essential atmospheric preprocessing focusing on the AOD (Aerosol Optical Depth) and adjacency effects noise contributions removal, taking into account the optical complexity of these shallow waters (case II water). The spectral responses detected by OLI sensor in the form of various blue-green and additional ratios, once atmospherically corrected, were satisfyingly tested for mapping the distribution of phytoplankton communities, through regressive statistical and bio-optical models. The most reliable multivariate models were those obtained for surface and sub-surface distributions of nano-phytoplankton and pico-phytoplankton, respectively. The PLS (Partial Least Square regression) models demonstrated higher robustness for assessing the distribution of all the phytoplankton and Chl a distributions, except for those related to sub-surface micro-phytoplankton, as did the regressive ones. The preliminary distributions obtained via a bio-optical approach, including the OC3 algorithm and full inversion with default settings, showed a general agreement with the previous ones produced by statistic methods. The OLI corrected data were then exploited for assessing the distribution of Caulerpa and Hypnea populations, using a ML (Maximum Likelihood) algorithm through standard supervised classification schema and related station point spectral signatures.
Overall, the implemented methodology, based on the HR satellite sensors, allowed us to suitably map the variability at detailed scale of both submerged vegetation and water column concentration of chlorophyll and different phytoplankton populations, in the Mar Piccolo of Taranto.
Thus, innovative monitoring methods, integrated by the most recent RS techniques, are needed for the sustainable management of this environment, to prevent, control and mitigate the impact of anthropogenic pressures on the environmental quality, human health and activities such as tourism and aquaculture, economically relevant in this context.