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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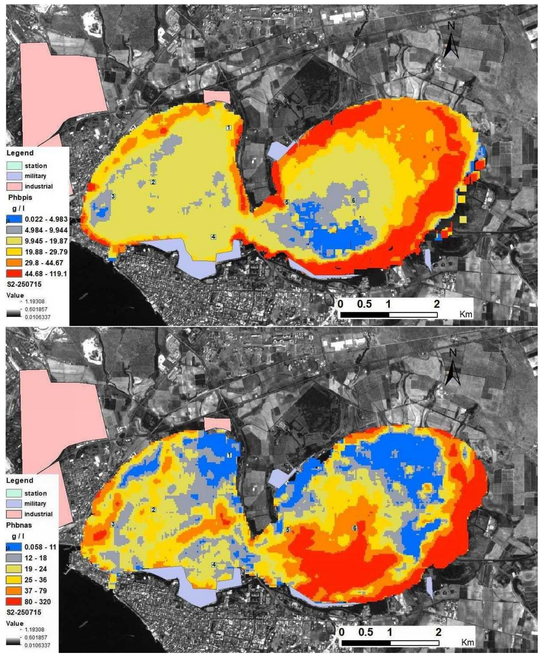
Mar Piccolo is a semi-enclosed sea (21 Km^2), consisting of two basins to the north of the city of Taranto
It is subjected to multiple anthropogenic pressures, such as industrial and waste pollution, harbor activities, aquaculture and commercial fishing that affect the environmental quality and can favor 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 macroalgal species (e.g. *Hypnea cornuta* and *Caulerpa prolifera*) and recurrent noxious episodes of phytoplankton blooms

During 2013 and 2014, several campaigns were carried out to investigate distribution, density, biomass and chlorophyll *a* and *b*, related to the populations of benthic macroalgae and phytoplankton

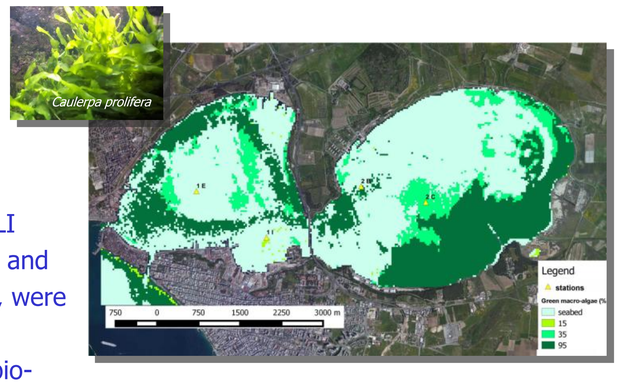
Data acquired at different sampling sites were integrated with those provided by the new family of multispectral HR satellite sensors, Landsat 8 OLI and Sentinel 2 MSI, to preliminarily test their improved capability for macroalgae and phytoplankton detailed mapping
Different image based approaches were 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)



Biomass surface concentration distributions of pico (upper) and nano (lower) phytoplankton assessed trough Landsat 8 OLI multispectral data of June 2013

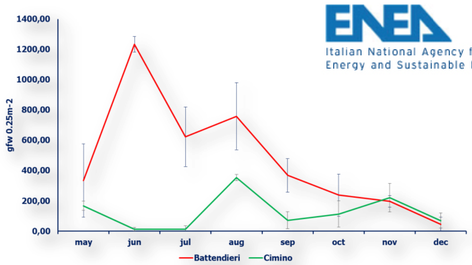
The spectral responses detected by Landsat 8 OLI satellite sensor in the form of various blue-green and additional ratios, once atmospherically corrected, were tested to map the distribution of phytoplankton communities, through regressive statistical and bio-optical models
The most reliable multivariate models were those obtained for surface and sub-surface distributions of nano- 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 the regressive ones did

The positions of sea truth measurements stations for phytoplankton /Chl *a* (red circles), macroalgae (yellow triangles) including alien species (Battendieri and Cimino sampling sites)

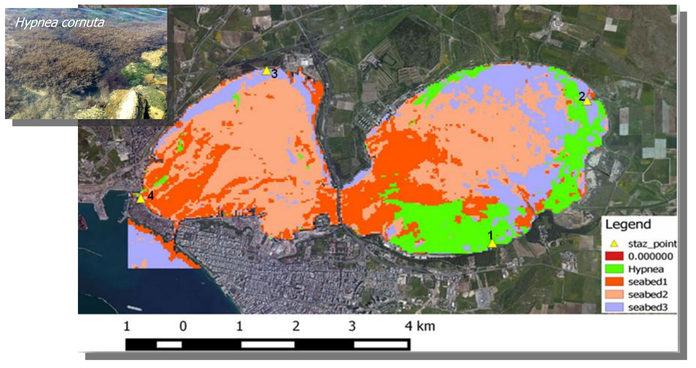


Macro-algae cover (%) distribution classes derived from supervised classification of atmospherically corrected OLI multispectral data

Green macro-algae cover (%) distribution on the Mar Piccolo of Taranto assessed by means of atmospherically corrected Landsat 8 OLI multispectral data acquired on 13-06-2013 and suitably calibrated using *in situ* point measurements (the yellow triangles in the overlay of the above figure)



During 2014, the highest values of biomass (g/fresh weigth) of *H. cornuta* were registered in first finding of Battendieri (red) and Cimino stations (green), reported respectively with labels 1 and 2 in the figure below



H. cornuta distribution derived from supervised classification of atmospherically corrected OLI multispectral data
Additional biomass measuring stations of 2014 were included

The recent Landsat 8 OLI multispectral optical sensor was exploited to map *H. cornuta* distribution in the Mar Piccolo of Taranto, on the basis of multi-temporal *in situ* data, acquired during the entire growth season (August 2014.) *In situ,* different biomass values were recorded between two stations (Battendieri and Cimino) that allowed us to properly calibrate the remotely sensed data

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 communities, in the Mar Piccolo of Taranto
Innovative in situ and laboratory 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 and climate change on the environmental quality, human health and economically relevant coastal activities