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Remote Sensing supports EULAKES project for mapping submerged macrophytes in Lake Garda

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Lake bottoms have an important role in the aquatic ecosystem: bathymetry and morphology may affect the hydrodynamic processes in coastal waters, while the presence of aquatic macrophytes helps to preserve the ecology. Within the context of macrophyte monitoring programs, technical advances in remote sensing with higher spatial and spectral resolutions provide opportunities for big scale ecological studies, with the possibility to assess a multitemporal analysis.
One of the objectives of the EULAKES project has been to map aquatic vegetation cover inside the Garda Lake from hyperspectral MIVIS (Multispectral Infrared and Visible Imaging Spectrometer) aerial images thanks to the application of a bio-optical model inversion technique (BOMBER: Bio-Optical Model Based tool for Estimating water quality and bottom properties from Remote sensing images). MIVIS images, with a spectral resolution of 102 bands, working between 430 and 1270 nm, were previously corrected for atmospheric, adjacency and glint effects before being processed with the BOMBER tool. One complete MIVIS overflight (12 runs) acquired on June 27th 2011, allowed the retrieval of a macrophyte presence map all around the first 7m deep coastal belt, with a validation error of about 10%, resulting from 89 in situ measures performed during images acquisition. A relevant spatial distribution could be observed, with higher aquatic plants concentration in the Southern part of the lake. A further local cover distribution map localized on the Sirmione Peninsula was integrated with previous results to perform a temporal analysis of macrophyte colonization patterns along this reduced littoral zone for the last 14 years (acquisitions on September 1997, July 2005 and July 2010). Considerable modifications in terms of macrophyte structural complexity and colonized areas were detectable: a drastic reduction of well-established dense communities (more than 70% of cover) and increasing of un-colonized areas were followed by a first recovering of moderate to rare cover classes (with density from 10% to 40%). Distribution changes are likely to be linked to water transparency and water level fluctuations. In particular, whether the ongoing climate change could cause a reduction of the water table, more adaptable phytoplankton species could be favored in the competition with more exigent submerged vegetation communities. Finally, the worsening of eutrophication, together with grazing by herbivorous aquatic birds can be associated with the gradual disappearance of macrophyte meadows. This approach can turn out useful in the monitoring of future environmental modifications deriving from any impact and perturbation on the aquatic ecosystem, including climate change effects.