Geophysical Research Abstracts
Vol. 18, EGU2016-16787, 2016
EGU General Assembly 2016

Impact of ISWEC sea wave energy converter on posidonia oceanica meadows assessed by satellite remote sensing in the coastal areas of Pantelleria island

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Marine renewable energy extraction plays a key role both in energy security of small islands and in mitigation of climate change, but at the same time poses the important question of monitoring the effects of the interaction of such devices with the marine environment.
In this work we present a new methodology, integrating satellite remote sensing techniques with in situ observations and biophysical parameters analysis, for the monitoring and mapping of Posidonia Oceanica (PO) meadows in shallow coastal waters.
This methodology has been applied to the coastal area offshore Pantelleria Island (Southern Mediterranean) where the first Italian Inertial Sea Wave Energy Converter (ISWEC) prototype has been recently installed. The prototype, developed by the Polytechnic of Turin consists of a platform 8 meters wide, 15 meters long and 4.5 meters high, moored at about 800 meters from the shore and at 31 m depth. It is characterized by high conversion efficiency, resulting from its adaptability to different wave conditions, and a limited environmental impact due to its mooring innovative method with absence of fixed anchors to the seabed. The island of Pantelleria, is characterized by high transparency of coastal waters and PO meadows ecosystems with still significant levels of biodiversity and specific adaptation to accentuated hydrodynamics of these shores.
Although ISWEC is a low-impact mooring inertial system able to ensure a reliable connection to the electric grid with minimal impact on seagrass growing in the seabed, the prototype installation and operation involves an interaction with local PO and seagrass meadows and possible water transparency decreasing. In this view monitoring of local PO ecosystem is mandatory in order to allow the detection of potential stress and damages due to ISWEC related activities and/or other factors.
However, monitoring and collection of accurate and repetitive information over large areas of the necessary parameters by means of traditional methods (e.g. diving and plants counting), can be difficult and expensive. To overcome these limits we present an integrated methodology for effective monitoring and mapping of PO meadows using satellite/airborne EO (Earth Observation) techniques calibrated by means of sea truth measurements and laboratory genetics analyses. During last summer a sea truth campaign over the areas of interest has been performed and point measurements of several biophysical parameters (biomass, shoot density, cover) related to PO phenology has been acquired by means of original sampling method on the stations distributed along a bathymetry gradient starting from the ISWEC location, at 31 m. of depth. The Landsat 8 OLI with the Sentinel 2 MSI (recently made available within the Copernicus EU program) synchronous satellite multispectral data, including the entire coastal area of interest, were acquired and preprocessed with the objective to test their improved mapping capabilities of PO distribution and related biophysical parameters on the basis of the previously developed operative methods and near synchronous sea truth data. The processed point samples measurements were then exploited for multispectral data calibration, with the support of the statistic and bio-optical modelling approaches to obtain improved thematic maps of the local PO distributions.