Mapping coastal erosion vulnerability at Pianosa and Piscinas (Italy) from optical and radar satellite data

Mariano Bresciani[1], Nicola Ghirardi[1], Giulia Luciani[2], Gianfranco Fornaro[1], Virginia Zamparelli[1], Francesca De Santi[1], Giacomo De Carolis[1], Claudia Giardino[1] Deodato Tapete[3], Monica Palandri[4]

[1] CNR - Institute for Electromagnetic Sensing of the Environment; bresciani.m@; ghirardi.n@; fornaro.g@; zamparelli.v@; desanti.f@; decarolis.g@; giardino.c@irea.cnr.it
[2] Politecnico di Milano; giulia.luciani@polimi.it
[3] Italian Space Agency (ASI); deodato.tapete@asi.it
[4] e-GEOS S.P.A.; monica.palandri@e-geos.it

Abstract. This study focuses on the use of remote sensing to map coastal erosion vulnerability in two Italian sites: Pianosa Island (Tuscany) and the region of Piscinas in Western Sardinia. This study was carried out in the framework of Project "Rischi Naturali Indotti dalle Attività Umana – COSTE". For each area, the satellite data processing, which include both optical and radar images, focused on the land/water transitional ecosystem. The results suggested that Pianosa is not suffering from erosion processes, while the vulnerability maps of Piscinas seemed to be closely linked to episodic events of coastal erosion.

Key words: Satellite, Coastal zones, Vulnerability maps.

1 Materials & Methods

The remote sensing data were acquired by the Multispectral Imager on-board of Sentinel-2A/2B (S2). All images (7 for Pianosa and 6 for Piscinas) were acquired between 2016 and 2018 without sun-glint, radiometric noise and cloud-free. For Piscinas site, 3 Synthetic Aperture Radar images, collected by ASI's COSMO-SkyMed constellation in StripMap mode at 3m spatial resolution, synchronous or as much as possible close to the optical images acquisition, were added to the analyses to better identify the coastline through a write function memory. Moreover, the first two images of 2016 (29/10 and 15/11) were used to evaluate the effects of a strong wind event that occurred on the coast of Piscinas. For this study, the first 7 bands of the VIS–NIR region of S2 were used, all reprocessed at the spatial resolution of 10m. The Top of Atmosphere radiance products were atmospherically corrected using the 6SV code [1] and processed using the Sen2Coral add-on-tool and the BOMBER code [2] in order to obtain bottom coverage maps (sand, rocks and phanerogams) and bathymetry. By merging the satellite products, the coastal erosion vulnerability maps have been generated based on substrate type in shallow waters and sand volume variation on land: rocky bottoms and stable meadows of phanerogams seemed preserving the coast, while

the substrate characterized by a loss of phanerogams and a decrease in sand volumes might be considered more vulnerable.

2 Results

The analysis of the temporal evolution of the Pianosa coastline shows that no significant modifications to the shoreline occurred both for sandy areas and the rocky segments. While the synergistic approach between optical images and SAR used for Piscinas shows how along the sandy coast the coastline had a greater variability (up to 20m) than near the rocky shores (up to 5m). Based on bottom type and sand volume variation we have created maps of vulnerability (Fig. 1). The results confirm that the Pianosa coastal zone does not have a problem with the coastal erosion. For Piscinas the least vulnerable map is the short-term (windy event), while the most vulnerable map is the long-term. This is because the wind has led to the deposition of a large amount of sand without compromising the stability of the phanerogams.

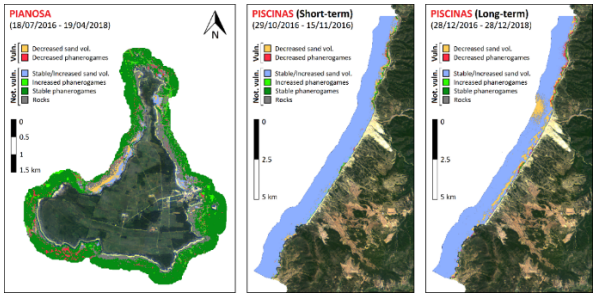

Fig. 1. On the left, the vulnerability map of Pianosa; in the middle, the short-term vulnerability map of Piscinas; on the right, the long-term vulnerability map of Piscinas.

Acknowledgement

This study was carried out in the framework of Project "Rischi Naturali Indotti dalle Attività Umana - COSTE", n.2017-I-E.0, funded by the Italian Ministry of University and Research, coordinated by the Italian Space Agency and developed by e-GEOS and Planetek Italia with the National Research Council of Italy, Meteorological Environmental Earth Observation and Geophysical Applications Processing.

References

1. Vermote E.F., et al.: Second simulation of the satellite signal in the solar spectrum, 6S: an overview. 6S user guide version 3. (2006).
2. Giardino C., et al. : BOMBER: A tool for estimating water quality and bottom properties from remote sensing images. Computers & Geosciences. 45, 313-318. (2012).