



## **Damages from extreme flooding events to cultural heritage and landscapes: water component estimation for Centa River Delta (Albenga, Italy)**

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The main damages caused by floods to cultural landscapes and archaeological sites are the loss or potential destruction of landscape elements and its defining features; alteration of landscape functioning (e.g. movements of roadbeds and shorelines, deposits of mud etc.) and deposition of flood debris.

The monitoring activity of the hazardous events such as floods has a crucial role in the emergency management. In case of flooding of rivers and torrents, it is important to perform monitoring on the land cover change in the areas bordering the riverbeds and in particular on the effects on the built environment. Such actions can be performed shortly after the hazardous event (first rapid mapping) but also over longer periods of time for recovery purposes and risk mapping (e.g. to investigate possible behavior pattern of the water element observed).

The use of satellite imagery for these purposes can be extremely valuable due to an “easy” and remote access to the information, even in the cases of extreme weather conditions, but also due to their compatibility with GIS environments. Here, the operator is enabled to perform specific qualitative analysis. The added value of satellite-born monitoring regards also the fact that it allows the use of multispectral sensor products, allowing thus not only spatial but also radiometric analysis to be used as input information to the risk-prevention actions.

The case study here illustrated regards Centa River that hosts the archaeological site of Albenga within the boundaries of its riverbed. This site, located in Liguria region (Italy), is an area composed of significant historic layers: the church of San Clemente, situated on the right bank of the river is mostly out of water, but becomes partially or even totally submerged in case of great floods. Such extreme events exert constant pressure to the structures and to the surrounding landscapes, deprived of any kind of protection devices. Experts evaluate that this area is still missing an accurate analysis linked with its surroundings and within a context of precarious environmental balance.

In this contribution, the authors have concentrated on the comparison of the estimation of water component in order to observe and possibly quantify the extension of the flooded area, using distinctly the indexes NDVI e NDWI. A sequence of satellite images was used to analyze the land changes occurring after the last major flooding event that has affected the area in 2016. A multi-temporal time-series of Landsat images acquired over Albenga coast in distinct moments before and after flooding event (night between 24th and 25th November 2016) were downloaded from the USGS archive (<http://glovis.usgs.gov/>), while additional Copernicus Sentinel-2 images were considered. Results of the water component estimation were normalized and integrated with other geospatial information (e.g. orthophoto) for further observations. The overall information is envisaged to give some major insight into the behavior of river Centa during and after flooding and to provide qualitative and quantitative inputs to the products required for a more effective emergency management such as rapid mapping, recovery purposes and risk mapping.