YOCOCU
outh in Conservation of Cultural Heritage
Georgia 2020
Tbilisi, 19-23 May 2020

Flooding Assessment Coastal Archaeological Sites: Pyrgi as Case Study

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ABSTRACT

Windy episodes in recent years are increasing in intensity and frequency, amplifying the risk to coastal cultural heritage. The increase in wind speed leads to an increase in the height of the waves, generating, as a result, violent sea storms. This will lead to an intensification of flooding phenomena that can give rise to erosion and chemical damage to property located along the coast. In addition, rising temperatures and melting glaciers are the cause of rising sea levels, which can cause intermittent water flow to sites and/or permanent immersion of certain parts of the territory.
The proposed study takes into consideration the archaeological area of Pyrgi, an Etruscan port located along the Lazio coast in the city of Santa Severa (RM), still under excavation. The site in question is adjacent to the coast and has major flooding problems, particularly during autumn and winter. This phenomenon not only leads to both mechanical and chemical problems, but also causes problems during excavation operations.
The work reported is highly interdisciplinary, and its final objective is to characterize the triggering conditions of the flooding phenomenon in order to adopt solutions and interventions to correct this problem.
Through the images acquired by drone, related to the archaeological area, a digital model of elevation of the ground (DEM) is reconstructed, in order to represent the difference in height within the area, and then establish which are the areas of water retention.
This model is integrated with the beach and bathymetry profile for the whole area of the domain

considered. The bathymetric profile near the coast is in fact fundamental to define the evolution of the wave evolution on shallow water. Once the calculation domain of the area of interest was defined, the calculation grid was generated. The numerical approach CFD (Computational Fluid Dynamics) was based on the technique of finished volumes based on RANS (Reynolds-averaged Navier-Stokes) approach with k- ε turbulence closure, two-phase, not stationary.
Tidal and field forcing conditions were evaluated on the basis of data acquired both from synoptic scale data (reanalysis ECMWF) and from experimental acquisition databases in sites near the Pyrgi area (anemometers, wave buoys).
A simulation campaign was conducted for the different tidal conditions and wave heights and the critical flooding conditions were investigated, while assessing the water invasion in the different areas of the Pyrgi site.
Future applications of this approach consist in the assessment of the effects of flooding, analysis and design of site protection solutions and the evolution of coastal erosion phenomena.

Keywords: Coastal Cultural Heritage; Flooding; CFD; Climate Change.

URL: https://youtu.be/-BL8-enH-XE