A methodology based on the coupling of marine radar and numerical modeling for beach-inundation prediction.

Giovanni Ludeno¹ and Matteo Postacchini²

¹IREA-CNR, Napoli, Italy (ludeno.g@irea.cnr.it)
²Department of Civil and Building Engineering and Architecture, Università Politecnica delle Marche, Ancona, 60131, Italy (m.postacchini@staff.univpm.it)

Coastal flooding is a sudden and abrupt inundation of a coastal environment caused by a short-term increase in sea level due to a storm surge and extreme tides. Although the coastal flooding is generally a natural process and constitutes an important part of the natural coastal dynamics, in areas with human activities it can constitute a major challenge and lead to loss of infrastructures and lives. For these reasons, an Integrated Coastal Zone Management (ICZM) approach, which spans over the main aspects of the coastal region (from prediction to protection, from engineering to ecosystems, from tourism to sustainability) seems essential to mitigate the mentioned negative impacts. At this aim, during the conference a methodology will illustrate based on the combination of X-band Marine radar with a numerical solver (NSWE), which allows predicting the beach inundation [1]. Specifically, the elaboration of the X-band raw data sequence by means of a dedicated data processing based on the solution of an inverse problem, allows us to reconstruct of the local sea state parameters in terms of peak wave direction, peak wavelength, peak wave period and significant wave height as well as the seabed depth [2]. Such reconstructed data are then exploited for the generation of both initial and boundary conditions, to be used to feed the NSWE model. The initial condition consists of the reconstructed bathymetry (e.g., referring to seabed depths within 5m and 9m) which is extended up to the coast using either an existing survey or an equilibrium-profile-based bathymetry. The reconstructed wave characteristics are used to generate, following [3]'s method, the random time series of free-surface elevation, which characterizes the boundary condition of the flood simulations.

Two different wave spectra, which mimic the actual storm conditions occurring along the coast of Senigallia (Adriatic Sea, central Italy), have been simulated. The beach inundations obtained from baseline and flood tests related to both storm conditions are compared. The results confirm that good predictions can be obtained using the combined of X-Band Radar and NSWE simulations [2]. Such findings demonstrate that, for practical purposes, this methodology provides suitable beach-inundation predictions and may represent a useful tool for public authorities dealing with the coastal environment, e.g. for hazard mapping or warning purpose.

References
