RUN-UP ALONG EMBAYED BEACHES DURING STORMS (BARCELONA, NW MEDITERRANEAN)

Amanda Sancho García [1]* And Jorge Guillén [1]
[1] INSTITUTO DE CIENCIAS DEL MAR (CSIC) - Asancho@Icm.Csic.Es

Abstract
In this study, we analyze the displacement of the waterline associated to the run-up produced during storms at three beaches of Barcelona city. Video images measurements of the run-up were carried out during the most energetic storms between 2001 and 2008. Then, wave run-up observations are compared with a run-up related parameter, which take into account wave characteristics and beach foreshore slope, in order to obtain an equation that can be used to predict the run-up, along these beaches.
Keywords: Beach, Shoreline Evolution

A significant portion of population lives today in coastal areas which are exposed to different hazards such as flooding and coastal erosion. Flooding at the emerged beach during storm conditions is very common in Mediterranean coasts. In Barcelona beaches (NW Mediterranean) these events produce important damages in the coastal structures (i.e. promenade, showers, etc). In this study, three Barcelona beaches have been studied: La Barceloneta, Somorrostro and Nova Icaria (Fig. 1). These beaches are characterized to be artificial embayed beaches with steep slopes and protected with coastal structures. In order to quantify the run-up, the effect of the most energetic storms on theses beaches was evaluated from 2001 to 2008. In total, fifteen storm events were analyzed, all with Hs higher than 3 m during the peak of the storm.

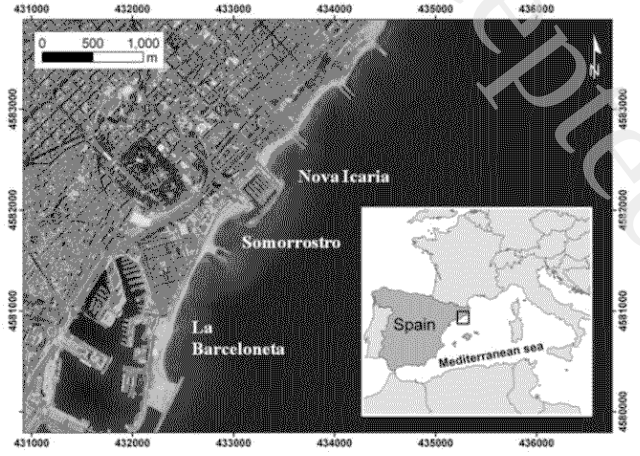

Fig. 1. Localization of Somorrostro, La Barcelona and Nova Icaria beaches (NW Mediterranean).

For each storm event, the hourly waterline position of each beach was obtained from the 10-minute time exposure images by means of an Argus video system [1]. The video system is located atop a building close to the Olympic Marina at a height of around 142 m, and it is composed of five cameras pointing at the beaches and offering a 180° view of the coast (images available at: http://elb.cmima.csic.es). A reference waterline was defined for each beach and storm as the result of the averaged position from all available waterlines of each storm event. The horizontal component of the run-up was obtained using lines perpendicular to this reference waterline. The results show values of the maximum about 50 m in emerged beach area of La Barceloneta (Fig. 2), 30 m in Somorrostro and 40 m in Nova Icaria are flooded during storms. Although flooding is not homogeneous along the beach.

In order to obtain a predictive tool for the run-up in Barcelona beaches, the observed displacement of the waterline at each profile along the beach during the storm (D), was related with a runup-related parameter (F), which includes wave characteristics (significant wave height, H_s, and wave length, L_o), mean sea level (MSL) and beach foreshore slope (tanβ) and represents the horizontal component of the run-up as:

$$F = \sqrt{H_s L_o} + \frac{MSL}{\tan\beta}$$

In general, a significant correlation was found between both parameters. The fit is better in Somorrostro (best fit, $R^2 = 0.50$), than in La Barceloneta (best fit, $R^2 = 0.40$) and Nova Icaria (best fit, $R^2 = 0.27$).

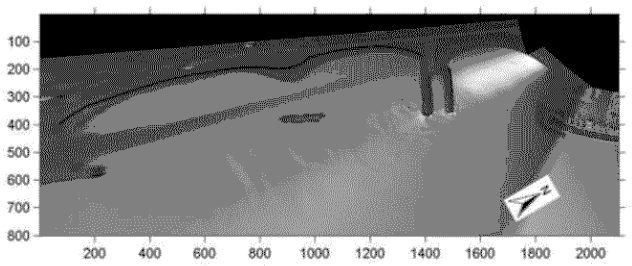

Fig. 2. Picture of La Barceloneta beach on 25th December 2008. The line shows the waterline position at the peak of the storm (27/12/2008). Coordinates are given in metres measured from a local zero.

In conclusion, video-monitoring provides detailed information of run-up during storm events. This data can be used to improve the predictive character of the general run-up equations and give useful information for coastal management.

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References
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