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M. Agulles, G. Jordà, 2024. [Quantification of error sources in wave runup estimates on two Mediterranean sandy beaches](#) Coastal Engineering 187 (2024) 104402. <https://doi.org/10.1016/j.coastaleng.2023.104402>

Abstract: Projected future sea level rise and marine storminess is a serious threat for beaches as they induce beach flooding and erosion. Among other factors, wave runup play an important role in beach evolution and must be robustly assessed. However, little attention has been paid to the uncertainties associated to its characterization and how do they compare to other sources of uncertainty. We have quantified the impact of several sources of error in the estimation of wave runup on sandy beaches. Understanding what factors are more influential in the accuracy of the results will help to determine the main sources of uncertainty in beach flooding projections. A calibrated state-of-the-art numerical modelling system has been setup for two beaches in the Mallorca islands (NW Mediterranean). The system has been forced with the best available information of nearshore incoming waves and has been validated against observations to define the benchmark accuracy. To determine the key factors affecting the accuracy of the system's results, different systems configurations have been tested with different degrees of complexity. Our results show that using the most sophisticated modelling system with the best information on boundary conditions, bottom bathymetry, and submerged vegetation leads to a swash RMSE comparable to the standard deviation of the observed swash. We have also found that the choice of lateral boundary conditions (i.e., source of information for the incoming waves) can double the RMSE and induce large biases. Our results also show that using a simple empirical approach usually underestimates the wave runup. However, in locations with vegetated seabed there is a compensation error, and the empirical approach can lead to acceptable results if forced by nearshore waves. In addition, we have compared the error estimates obtained with uncertainties associated to projected sea level rise. Our findings suggest that the uncertainty associated with wave runup modelling should be considered in the assessment of the total uncertainty of future beach flooding, since the analysis performed indicates that this uncertainty can account for between 16% and 60% of the uncertainties linked to mean sea level projections.

Keywords: Wave runup, Uncertainty, Numerical modeling, Empirical equation, Sandy beaches