Geophysical Research Abstracts
Vol. 21, EGU2019-8879, 2019
EGU General Assembly 2019

Obtaining directional wave characteristics in front of nearshore field sites

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Waves are the dominant forcing of the nearshore system and, in order to understand and predict beach morphological evolution, it is crucial to have a reliable source for wave characteristics at shallow water (about 20 m depth). The best sources of wave conditions are measurements devices (e.g., a wave buoy or AWAC) located directly in front of the study site. However, wave buoys are scarce and deploying and maintaining an AWAC is expensive. This means that wave conditions often have to be taken from a buoy located far from the study site or from a large-scale global hindcast model and wave propagation is necessary. Mostly, propagation is done either by using linear wave theory and ray approximation or by using more advanced models such as SWAN. Such methods often lead to errors in quantifying wave conditions, especially in small fetch, complex geometry coasts such as the Catalan coast (Pallares et al., 2014). In particular, the reliability of the obtained wave angles is often questionable (see e.g. Amrutha et al., 2016 and Pallares et al., 2014), which is unfortunate because it is nowadays accepted that the wave angle plays a crucial role in nearshore evolution (e.g., Price and Ruessink, 2011).

The objective of the present work is to investigate the best source for wave conditions in a low-fetch, complex geometry site (Castelldefels beach, Spanish Mediterranean coast), including the method of wave propagation. Although the study site and the closest permanent wave buoy are located relatively close to each other (approximately 20 km), a significant change in shoreline orientation occurs. Using data from this wave buoy or from large-scale hindcast models as boundary conditions, both linear wave theory and SWAN are used to obtain the wave conditions at two locations closer to the study site. The effect of including different processes in SWAN is also investigated. The results are compared with data measured at these two locations, paying special attention to the wave angle. The first results indicate that the best wave conditions are obtained by forcing SWAN with the measured directional spectra from the offshore buoy. Using either SWAN forced by statistical parameters or linear wave theory and ray approximation leads to equally good results for wave height and period but not for the wave angle, because wave refraction across the alongshore variable bathymetry is underestimated. Finally, large-scale hindcast models provide a much worse prediction of wave conditions at the study site, where particularly the wave angle is not reliable.

References

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