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Editorial

Dynamics of the Coastal Zone

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1. Overview

The coastal zone hosts many human activities and interests, which have significantly increased in the last few decades. However, climate change may have destabilizing effects on such activities all over the world: sea level rise and the increase in the magnitude and frequency of storm events can severely affect beaches and coastal structures, with negative consequences and dramatic impacts for coastal communities from different (e.g., ecological, recreational, environmental) points of view. These aspects add to typical coastal problems, such as flooding and beach erosion, among others, already leading to large economic losses and human fatalities. Analytical, numerical, and physical modeling are thus fundamental approaches to be jointly used by scientists for an exhaustive understanding of the nearshore region in the present and future environment. For this purpose, innovative tools and technologies may help to provide a more detailed interpretation of the coastal processes, in terms of hydrodynamics, sediment transport, bed morphology, and their interaction with coastal structures.

The present Special Issue (SI), titled "Dynamics of the Coastal Zone" and hosted by the *Journal of Marine Science and Engineering*, aims at collecting the most recent contributions focusing on the nearshore region. These deal with different modeling approaches and different analyzed processes, while spanning among several time and spatial scales. Specifically, some of the presented studies analyze the main results coming from notable laboratory facilities [1–4], while the other contributions pertain to the use of advanced modeling approaches [5–9]. Due to the complexity of the coastal environment, some of the SI manuscripts are mainly related to the hydrodynamic processes [1,3,4,6,7,9], while others to the analysis of sediment-transport-related issues [2,5,8]. A further classification concerns the scales: while some works investigate relatively short processes, related to either the wave/intra-wave analysis [1,3,7] or the storm/event scale [2,4,6,9], the remaining works investigate long term effects in the nearshore region [5,8]. The details of the individual contributions are summarized in the following section.

2. Contributions

De Serio and Mossa [1] describe important experimental findings related to the wave-breaking process. They used a fixed sloping beach and different wave conditions. Both spilling and plunging breakers were analyzed in terms of water elevation and velocity distribution shoreward of the breaking location. Observations have allowed understanding turbulent features and coherent motions generated during the analyzed processes.

Eichentopf et al. [2] illustrate laboratory tests aimed at understanding the morphological response of a sandy beach subject to the same wave condition, when different initial profiles are used. All configurations, although starting from different initial conditions, reach the same equilibrium state, this demonstrating that the same wave forcing generates different sediment transport patterns, with the largest beach changes and hydrodynamic differences during the test start. Further, large breaker bars promote energy dissipation and limit shore erosion, while large berms, combined with small or no bars, promote shore retreat.

The laboratory experiments discussed in Howe et al. [3] are focused on the swash zone bed shear stress, measured using both medium and prototype scale configurations. It was observed that peak shear stress coincides with the arrival of uprush swash fronts, while the friction factor slightly changes during the wave cycle and decreases with Reynolds number on smooth slopes. Such estimated friction factors are larger than expected, when plotted on Moody or wave friction diagrams.

Williams et al. [4] focus on the assessment of the uncertainties of wave overtopping occurring at different types of coastal structures. Their laboratory tests are aimed at describing the variation in the main overtopping measures when different wave time series, generated from the same spectrum, are used. Many wave conditions were tested using two different structures, one characterized by a smooth slope, the other by a vertical wall. Large variations of the overtopping discharge are observed when different time series are used.

The work by Albernaz et al. [5] deals with the current and wave induced sediment transport, which requires a suitable parameterization of the wave orbital velocities. This is particularly important when long period simulations are performed; hence, a new parameterization is presented, which accounts for both skewness and asymmetry. Such parameterization was thus implemented in an existing numerical model (Delft3D) and provided suitable coastline predictions in long time periods.

Gallerano et al. [6] describe a three-dimensional solver based on the integral contravariant formulation of the Navier–Stokes equations. The authors analyze the hydrodynamics induced by a submerged breakwater subjected to the wave field and located in a coastal area characterized by a curvilinear shoreline. The aim is that of understanding the circulation patterns, as well as the change in the hydrodynamic conditions promoted by the structure.

In their paper, Moura and Baldock [7] introduce a simple numerical model aimed at evaluating the wave shape during shoaling with concurrent radiation of free long waves. Comparisons with simulations from an existing solver are illustrated, also to investigate the dissipation of free and forced long waves in the surf zone. Results from both models used suggest that both the growth rate and lag of the long wave behind the forcing are frequency dependent, in agreement with the literature and more complex evolution models.

The work by O'Grady et al. [8] provides an analysis of future changes at Lakes Entrance (Australia), through data downscaling from global and regional climate models to force a local climate model at the beach scale. The future sediment transport induced by such modeling has been obtained using empirical and detailed models. The authors introduce a new downscaling method and observe that modeled changes to wave transport are an order of magnitude larger than changes from storm-tide current and mean sea level changes.

Postacchini and Ludeno [9] combine numerical simulations with a typical approach to estimate sea data from X-band radar signals. Such a combination was applied for coastal inundation purposes. First, the application of the radar approach to simulated data allowed estimating both the wave field and bathymetry. Then, such results were used to run numerical simulations of coastal inundation. Results coming from the two steps above suggest that the proposed combination may be successfully used for several coastal purposes (e.g., hazard mapping, warning systems).

The above summaries briefly recap the SI contents, which are related to the main processes occurring in the nearshore region, here analyzed using various techniques and spanning through different scales.

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