CROSS-SHORE SEDIMENT TRANSPORT IN THE SWASH ZONE: LARGE-SCALE LABORATORY EXPERIMENTS

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INTRODUCTION

The swash zone is a highly dynamic boundary between the beach and the surf zone. Swash processes determine whether sediment is either stored on the upper beach or is transported offshore, and thus strongly affect shoreline evolution. Previous experimental studies on sediment transport in the swash zone either focused on detailed sand transport processes at few cross-shore locations, or on a bulk statistics of net transport rates in relation to a few wave conditions (e.g. Alsina et al., 2016 and Van der Zanden et al., 2019). High temporal and spatial coverage measurements of swash hydrodynamics and sediment concentrations are needed to be able to quantify and understand sediment fluxes near the shoreline. Additionally, this relation between intra-swash processes and swash averaged sand transport rates are essential to further development of numerical and empirical models for sand transport in the swash zone.

The present research focuses on the hydrodynamics, sand transport processes and net sediment transport in the swash zone through a series of large-scale wave flume experiments. This research aims to improve the understanding of swash zone sand transport processes, in particular the role of cross-shore sand advection and wave-swash interactions, and bring new detailed insights into the relation between intra-swash processes and net sand transport rates.

METHODS AND RESULTS

The laboratory experiments will be conducted in the large-scale CIEM wave flume at the Universitat Politècnica de Catalunya (Barcelona, Spain). Two types of experiments will be conducted: the “TRANS” experiments focusing on quantifying the net sand transport across the swash zone for a wide range of swash conditions; and the “PROC” experiments focusing on the hydrodynamic and sand transport processes across the inner surf and swash zone. In these experiments different combinations of wave conditions, both irregular and bi-chromatic, and bed slopes will be investigated.

These experiments involve a combination of sophisticated instrumentation such as LIDAR, conductivity concentration sensors to measure sheet-flow concentrations and velocities (CCM+, CCPs), and vertical stacked pore pressure sensors (PT’s) (Figure 1). The measurements will have a much higher spatial and temporal coverage than previous studies.

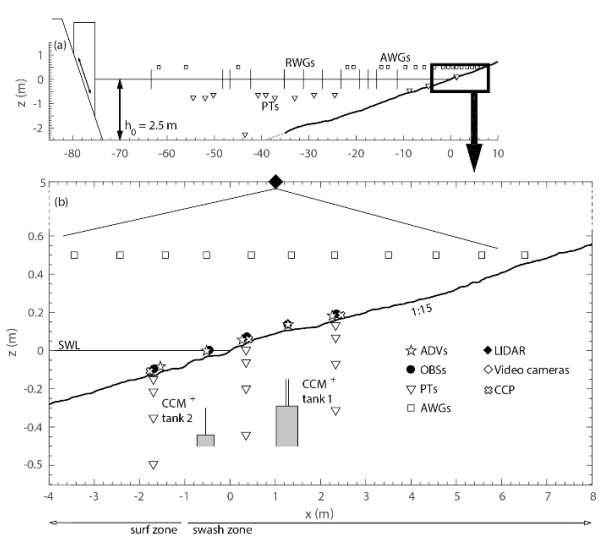

Figure 1 - Experiment set-up in the CIEM large-scale wave flume.

Thus, we will present improved findings on detailed sand transport processes such as advection and wave-swash interactions and its relation with net sediment transport. The obtained data will also be used to validate and improve the XBeach and OpenFoam numerical models, as will be discussed in the ICCE 2020 paper by Kranenborg et al.. The detailed laboratory experiments and advanced numerical modeling will be combined to develop a new parameterization for sand transport in the swash zone.

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