

# DUNE EROSION AND SAND BAR MIGRATION DURING A STORM EVENT: LARGE-SCALE WAVE FLUME TEST AND NUMERICAL SIMULATION

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## INTRODUCTION

The coastal sand dune is an important natural coastal protection system in the nearshore region from storm wave damage. USACE (2013) introduced coastal dune as Nature and Nature-Based Feature for coastal resilience. Therefore, accurately predicting the dune erosion and sediment transport is very important not only to protect the coastal community from the extreme wave but also to provide design guideline for restoration. However, the ability to accurately predict the coastal dune morphodynamics has not been enough improved.

The main objective of this study is to investigate erosion and deposition mechanisms of dune and sand bar by obtaining the synoptic data set of movable bed experiment during the entire storm event. Using the experimental data, this study tried to verify the numerical model (XBeachX). Moreover, box cores were used to track the storm history in surf and swash zone.

## MOVABLE EXPERIMENTS IN THE WAVE FLUME

The experiments were conducted in the wave flume (100m (L) x 2 m (W) x 3 m (D), partially glass-walled flume) at Chonnam National University, South Korea. A simplified initial beach and dune profile with the d50 of 0.15mm silica sands was selected from the representative dune and beach profiles on the west coast of Korea based on field observation data (Figure1).

Capacitance wave gages and an electromagnetic current meter (EMC) were installed to measure offshore boundary condition. Wave gages (WG), ADV, ADV profiler, and an echo-logger were collocated on the movable cart to measure instantaneous water surface elevation, velocity profile, and acoustic backscattering strength. CCTV cameras and stereo cameras were installed on top and side of the flume for image processing to investigate the wave transformation and dune erosion process.

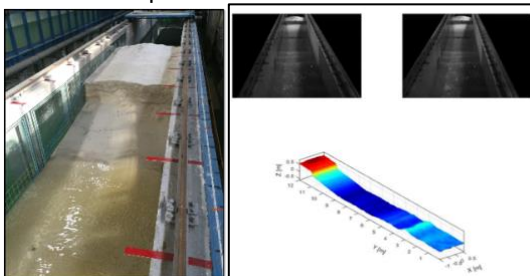


Figure 1 - Dune area in the flume (left) and the result of the dune profile and wave transformation from stereo image processing (right).

The experiments were carried out by multiple-PI from different institute to overcome the limitation of measurement environments such as instruments and various technologies (numerical modeling, stereo-imaging, deep learning, and geology). The right panel of Figure 1 shows the example result of stereo image processing for dune geometry and waves in surf and swash zone. Dune face was significantly eroded and two sand bars were formed during the storm wave condition with highest surge level.

## NUMERICAL SIMULATION

The process-based model, XBeachX was employed to predict the dune morphodynamics during storm wave condition (Roelvink et al., 2018). In this study, the numerical simulations were performed using WTI settings as semi-empirical parameters. The model was tried to calibrate dune face slope by changing the parameter of berm-slope.

## STORM ACTIVITIES

After finishing the experiments, ten box-cores were taken from the swash zone to the offshore sand bar area to examine storm wave imprints in the sedimentary records (Figure 2). The box-core sample analysis results showed that the hummocky-like structures, used as an indicator of storm activities, were found on the offshore sand bar.

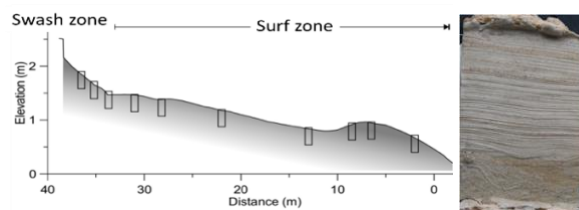


Figure 2 - Cross-shore locations of box-cores (left) and the sedimentary facies analysis from epoxy peels (right).

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## REFERENCES

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