THE EFFECTS OF REGULAR AND IRREGULAR WAVES ON THE EVOLUTION OF A SUBMERGED BERM IN A LOW-ENERGY BEACH

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INTRODUCTION

Submerged berms, also referred to as shoreface nourishments, entail the artificial placement of sand on the nearshore with the purpose of dissipating incident waves and gradually nourishing the beach. The unique characteristics of submerged berms under low-energy conditions are examined in this research. By comparing field data and experimental results, the distinct behaviors of submerged berms under low-energy regular and irregular waves are investigated, leading to the formulation of new insights.

METHOD AND DATA

Three sets of data are utilized in the comparison of the behaviors of submerged berms: field survey data from the West Beach in Beidaihe (Pan et al., 2017), experimental data under regular wave conditions (Pan et al., 2022), and experimental data under irregular wave conditions (Pan et al., 2023). Empirical Orthogonal Function (EOF) analysis is employed to extract the main evolution patterns of the aforementioned data. The comparisons encompass both profile evolution and the primary evolution patterns (eigenfunctions).

RESULTS AND DISCUSSION

According to common reasoning, it can be inferred that the behaviors of the submerged berm under irregular wave conditions are more similar to those observed in the field data. Surprisingly, it is discovered that the behaviors of the submerged berm under regular wave conditions closely resemble the field data, as clearly depicted in Figure 1. The figure illustrates a comparison of eigenfunctions extracted from the field data, experimental results under regular wave conditions, and experimental results under irregular wave conditions. It is evident that the shapes of eigenfunctions in the field data and regular wave experiment cases are similar, whereas the shapes differ in the irregular wave experiment case.

The EOF1 represents the indisputable mean profile function in all cases. In the case of field data and regular wave experiments, EOF2 serves as the function for onshore migration, while EOF3 takes on the role of an asymmetrical shape-changing function. However, when considering irregular wave experiments, EOF2 can be classified as the crest-decreasing function, and EOF3 represents the offshore transport function. Based on common knowledge, it would be expected that field-surveyed data would exhibit greater similarity to the experimental results obtained under irregular waves rather than regular waves. Surprisingly, this study reveals contradictory findings. One possible explanation for this paradox is that the evolution of the West Beach is primarily influenced by swells, which are more similar to regular waves rather than irregular waves generated using the JONSWAP spectrum. Therefore, this study offers a novel perspective for understanding the distinct behavior of submerged berms in projects located in various sites worldwide, where the dominant waves consist of swells (which resemble regular waves) or wind waves (which resemble irregular waves).

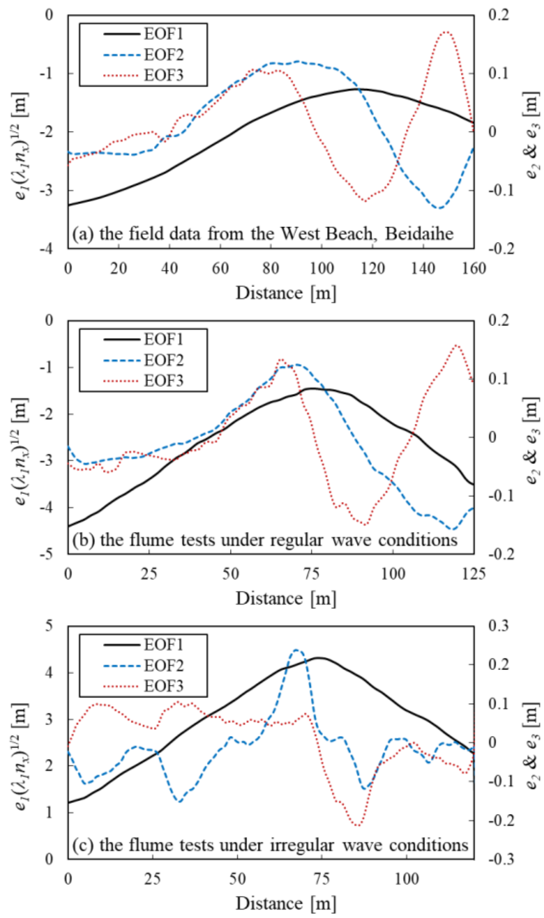

Figure 1 – Comparison among the eigenfunctions extracted from (a) the field data, (b) experimental results under regular wave conditions and (c) experimental results under irregular wave conditions.

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