

EXTRACTION OF TRANSVERSAL AND LITTORAL SEDIMENT TRANSPORT VECTORS FROM SHORELINE OBSERVATION DATA

Changbin Lim, IHCantabria - Instituto de Hidráulica Ambiental de la Universidad de Cantabria limc@unican.es

INTRODUCTION

To mitigate beach erosion problems requires a direct understanding of longshore trends or periodic cross-shore evolutions. Furthermore, it is necessary to understand how transversal and littoral sediment transport when high waves incidence and the waves gradually calm. Shoreline changes are mainly caused by a combination of long-term background erosion, medium-term redistribution erosion, and short-term episodic erosion.

Although it is important to specifically identify the causes of beach erosion, there is a lack of research that clearly classifies various phenomena from observed coastline data. Therefore, this study suggests a methodology to extract transversal and littoral sediment components from observed shoreline data according to the conservation law of sediment mass. In addition, the methodology of this study was applied to the shoreline data observed in Jeongdongjin, Korea to classify each component of sediment transport. Figure 1 (a) and (b) show the characteristics of transversal and littoral transport around the groin and detached breakwater, respectively.

METHODOLOGY

Recently, Lim et al. (2023) proposed a governing equation for a shoreline change model that can simulate not only short-term episodic shoreline response but also long-term shoreline distribution. Accordingly, the net cross-shore sediment transport per unit length of beach, q_{net}^c , is calculated from the transversal shoreline change in observed data.

Additionally, Jung et al. (2004) proposed a methodology to extract the longshore sediment transport from observed data by analyzing the existing shoreline change model proposed by Pelnard-Considere (1957) using an implicit method. Using long-term observed beach data, Rahmawati et al. (2021) applied this method to several beaches in Indonesia (i.e., Kuta Beach for 13 years, Karang Beach for 15 years, and Samuh Beach for 18 years).

In this paper, the equation proposed by Jung et al. (2004) was applied to coastline data modified to satisfy the law of sediment mass conservation to estimate sediment transport components for each grid. In other words, a method to estimate net transversal sediment transport due to beach retreat is presented, and littoral drift is calculated accordingly during the shoreline survey period.

FIELD APPLICATION

On the east coast of Korea, waves are relatively high and occur at an oblique angle in winter. Jeongdongjin Beach is located on the east coast of South Korea. And Jeongdongjin Beach suffered frequent erosion damage due to oblique high waves every winter. Accordingly, a groin was constructed at Jeongdongjin Beach as part of the coastal maintenance project, Korea.

Therefore, it is necessary to analyze how effective the groin construction at Jeongdongjin Beach is in controlling sediment transport. In this study, the shoreline was observed at Jeongdongjin Beach a total of 6 times at daily intervals from December 15, 2021 to December 20, 2021. Figure 2 shows the coastline observed six times at Jeongdongjin Beach. Using the proposed methodology, Figure 3 shows an example of extracting transversal and littoral sediment transport vector using observed shoreline data.

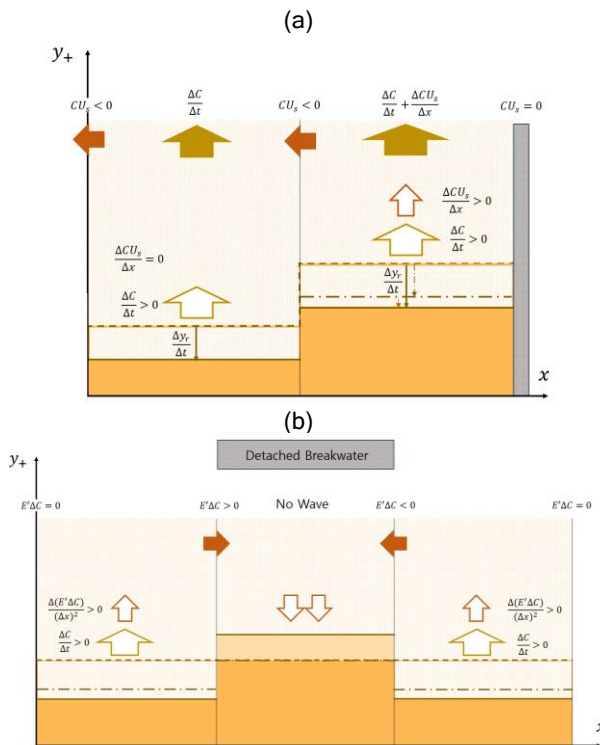


Figure 1 - Conceptual diagram of shoreline change owing to littoral drift and beach retreat owing to transversal drift: (a) groin; (b) detached breakwater.

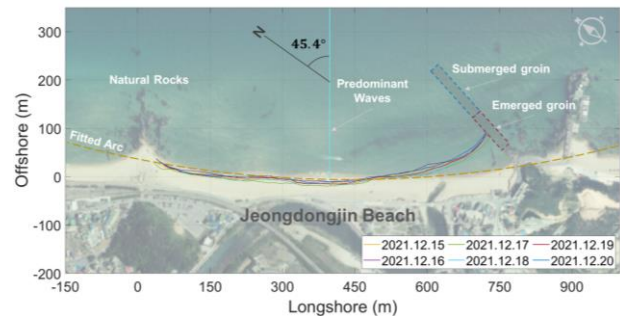


Figure 2 - Field observation at Jeongdongjin Beach, Korea.

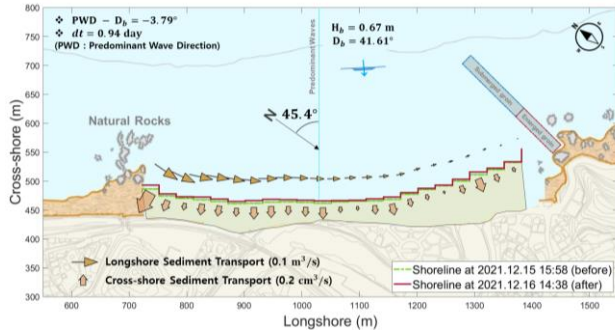


Figure 3 - Transversal and littoral sediment transport vector at Jeongdongjin Beach, Korea from December 15, 2021 to December 16, 2021.

CONCLUSION

Sediment transport occurs through a combination of several complex phenomena such as long-term background erosion, medium-term redistribution erosion, and short-term episodic erosion. In this study, we proposed a methodology how to extract cross-shore and longshore sediment transport vector from observed shoreline data. Here, net transverse sediment transport is calculated through beach retreat owing to wave incidence. Then, longshore sediment transport is extracted from the modified shoreline to satisfy the conservation law of sediment mass. And the proposed methodology was applied to Jeongdongjin Beach, where the shoreline was observed in December, 2022. This study is expected to contribute to presenting fundamental data that can be used to approach the placement of coastal structures such as breakwater and groin from the perspective of sediment movement control. In addition, this methodology is expected to be helpful not only in understanding the beach characteristics, but also in coastal management.

ACKNOWLEDGEMENTS

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Reference

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