

YEARLY EVOLUTION OF A NOURISHED SAND BEACH IN THAILAND

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FIELD DATA

Wide sand beaches in Thailand attract many tourists. Pattaya, (Figure 1) is located near Bangkok in the upper Gulf of Thailand, but its beach almost disappeared by 2015. The beach was widened by placing $130 \text{ m}^3/\text{m}$ of medium sand along the shoreline length of 2.8 km between two terminal groins constructed in 2018. These findings are illustrated in Figure 2.

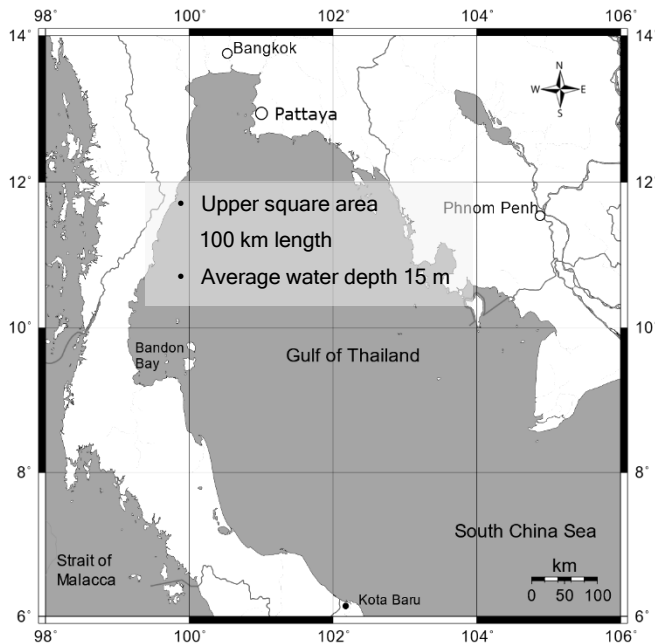


Figure 1 - Pattaya beach in the upper Gulf of Thailand

The bathymetry and topography were measured in 2015 before the sand placement and yearly since 2019 in order to assess the performance of the first major beach nourishment project in Thailand. The Pattaya beach is microtidal with the average tidal range of 1.5 m. The average significant wave height is 0.2 m and the wave energy is low. The borrow site was at a distance of 20 km from the beach. The median sand diameter is 0.3-0.4 mm. The placed sand volume was $363,000 \text{ m}^3$. The berm and foreshore width above the mean sea level was 57 m. The foreshore slope was 0.1. Figure 3 shows the satellite image of the Pattaya beach more than three years after the sand placement.

DATA ANALYSIS

The beach elevation data were analyzed using 30 cross-shore lines normal to the curved shoreline of 2.8 km length between the south and north groins (Figure 4). The predominant wave direction is from the south-southwest.

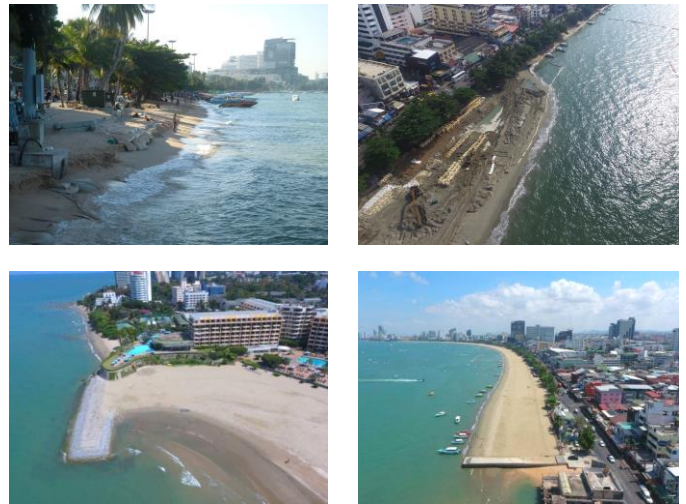


Figure 2 - (a) Pattaya beach erosion (b) during beach nourishment (c) north groin (d) south groin

For each of L1-L30, the profile evolution from the nourished profile in 2019 was examined to quantify the cross-shore and temporal changes of erosion or accretion. The alongshore variation of the bottom elevation change was apparent in the profile evolutions along L1-L30. Figure 4 summarizes the gross sand volume changes in four zones. The alongshore direction is separated into the south (L1-L20) and north (L20-L30) segments. The cross-shore direction is separated into the landward ($x = 600$ to 710 m) and seaward ($x = 0$ - 600 m) segments where the seaward survey coordinate $x = 0$ may be located outside the surf zone during severe storms.

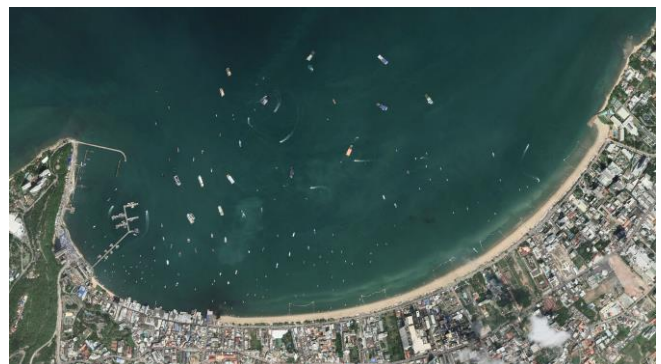


Figure 3 - Pattaya beach (Google earth) on October 22, 2022

The sand volume increased in the landward zone during 2015-2019 was 257K (1K = 1,000 m³) and 105K between L1-L20 and L20-L30, respectively. The sum of 362K corresponds to the placed sand volume of 363K. The sand volume changes in the seaward zone during the transition period of 2015-2020 are difficult to explain. The erosion and accretion patterns during 2020-2023 may be explained by cross-shore and longshore sand transport.

NUMERICAL MODELING

The cross-shore numerical model CSHORE is being used to interpret the field data. The cross-shore tracking model of Laksanalamai and Kobayashi (2023) has been expanded to

predict the alongshore and cross-shore trajectories of sand particles placed on the eroding beach. The sand particle tracking capability may allow us to design beach fill smarter. Additionally, the field data during 2015-2023 do not include extreme storm events. CSHORE is being applied to predict berm erosion and wave overtopping of the wall during storms in order to determine the minimum berm width required against flooding.

REFERENCE

Laksanalamai, J. and Kobayashi, N. (2023): Tracking of small discrete objects submerged in surf and swash zones on sand beaches, J. Waterway, Port, Coastal, Ocean Eng., 149(6).

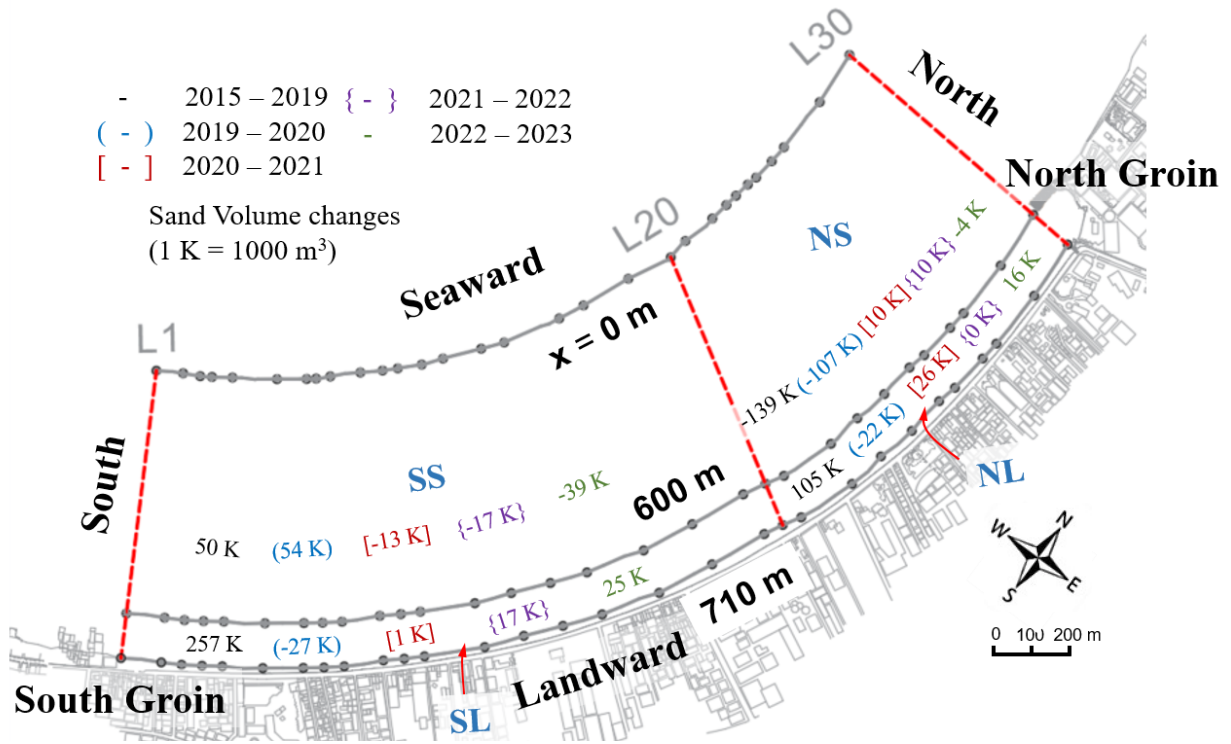


Figure 4 - Sand volume changes in four zones during five intervals from 2015 to 2023.