SHORT-TERM SWASH ZONE BEACH PROFILE CHANGE MODEL FOCUSING ON BERM FORMATION AND EROSION

Takayuki Suzuki [1] and Yoshiaki Kuriyama [2]

[1] Shirahama Oceanographic Observatory, Disaster Prevention Research Institute (DPRI), Kyoto University, Katata 2347-6, Shirahama, Nishimuro, Wakayama 649-2201, Japan. Phone: +81-739-42-4352, Fax: +81-739-42-5532, E-mail: t.suzuki@ky7.ecs.kyoto-u.ac.jp
[2] Head of Coastal Sediments and Processes Research Group, Marine Environment and Engineering Dept., Port and Airport Research Institute (PARI), Nagase 3-1-1, Yokosuka, Kanagawa 239-0826, Japan. Phone: +81-46-844-5045, Fax: +81-46-841-9812, E-mail: kuriyama@pari.go.jp

1. Introduction

Beach topography responds to waves and currents in the surf and swash zones. During mild wave conditions, berms are formed on the foreshores, and eroded during storms. Numerical models for sediment transport rate in the surf zone have been proposed by many. However, sediment transport models in the foreshore, where berms are formed and eroded, have not been well developed. The objective of this study is to develop a short-term swash zone beach profile change model focusing on berm formation and erosion.

2. Data Description and Method

Beach profile data were obtained at Hazaki Oceanographical Research Station (HORS), a research station for field measurements in the nearshore zone on the Hasaki coast of Japan facing the Pacific Ocean. HORS has a 427 m long pier, which is located perpendicular to the shore. The beach profiles along the pier were measured at 5 m intervals every weekday. Based on the datum level at Hasaki, the mean and high tide levels are 0.651 m and 1.25 m, respectively. The median sediment diameter around the HORS is 0.18 mm.

From the 2.5-year (August 1987 to January 1990) beach profile data, 219 cases of berm formation and 58 cases of berm erosion were picked up by Katoh and Yanagishima (1992). By using these data, Suzuki and Kuriyama (2008) proposed a cross-shore sediment transport rate focusing on berm formation and erosion. In the model, the spatial distribution of the rate for berm formation was modeled with the offshore wave energy flux, and that of the rate for berm erosion was modeled with the berm height. Since the offshore boundary of this model was fixed at the shoreline position of the mean tide level of the initial beach profile, first, the movement of the shoreline position was modeled. From the relationship between the offshore wave energy flux and the shoreline position of the mean tide level (Fig. 1), a good correlation can be seen (R = 0.58). The shoreline position moved seaward direction when the offshore wave energy flux increased. Therefore, the offshore boundary position (i.e., the shoreline position of the mean tide level) was estimated by the offshore wave energy flux. On the other hand, the onshore boundary was defined at the maximum wave run-up position.

3. Results and Conclusions

The beach profile on May 1, 1988 was set as the initial beach profile, and the models were applied for the calculation of the three-month beach profile change (from May 1, 1988 to July 31, 1988). Figure 2 shows the mean beach profile and its standard deviation, which were calculated from the observed data. The averaged shoreline positions and the averaged beach slopes at the mean and high tide levels were 3.2 m, 0.025 and -15.4 m, 0.037, respectively. For the fluctuation of the shoreline position of high tide level (Fig. 3), although the calculated positions sometimes move on and offshore directions, the trend is basically the same as the observed data. The calculated beach slopes around the high tide level show milder than the observed beach slopes (Fig. 4). However, the variation trend is in good agreement. Figure 5 (a) and (b) show the observed data and calculated results of the deviations from the mean beach profiles. Since the offshore boundary was set at the shoreline position of the mean tide level, the offshore ward from the boundary is colored in black. Although there are some differences between the two, the calculated result shows nearly the same beach profile change of berm formation (i.e., 45 ~ 60-day, 70 ~ 90-day) and erosion (i.e., 10 ~ 20-day, 35 ~ 40-day, 60 ~ 70-day) in a qualitative sense.

References

Katoh, K. and Yanagishima, S., 1992. Berm formation and berm erosion, *Proc. 23rd Int. Conf. Coastal Eng.*, pp. 2136-2149.

Suzuki, T. and Kuriyama, Y., 2008. Simple model of cross-shore sediment transport rate for berm formation and erosion, *Proc. 31st Int. Conf. Coastal Eng.*, pp. 1762-1773.

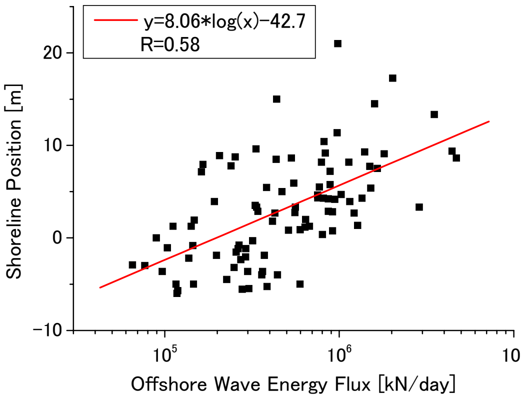

Fig. 1. Relationship between the offshore energy flux and the shoreline position at the mean tide level

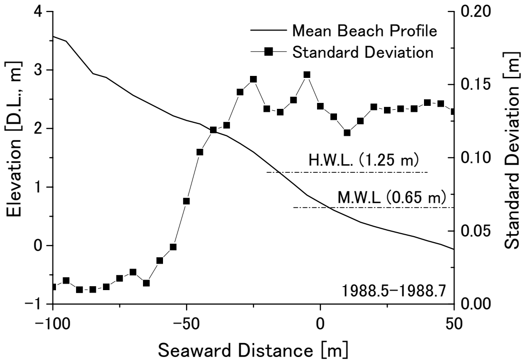

Fig. 2. Mean beach profile and its standard deviation

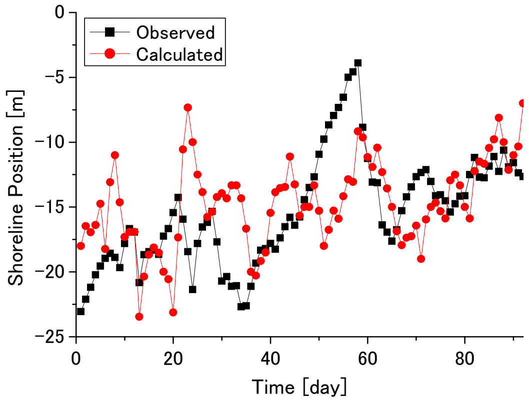

Fig. 3. Time series distributions of shoreline positions at the high tide level

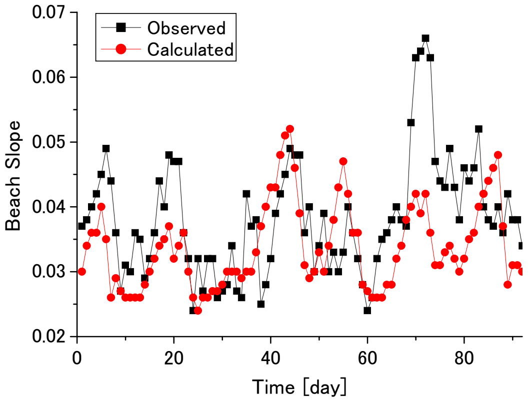

Fig. 4. Time series distributions of beach slopes around the high tide level

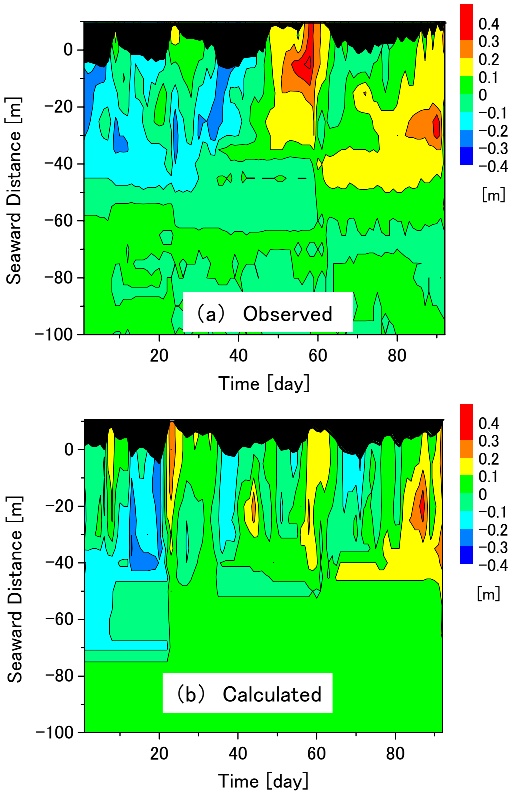

Fig. 5. Deviations from the mean beach profiles (a) Observed data, (b) Calculated results