CROSS-SHORE MODEL APPLICATION TO HASAKI BEACH, JAPAN: EVALUATION OF PARAMETER SETTINGS

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INTRODUCTION

Japan's coasts is being suffered by significant erosion. There is already a high demand to protect coasts from the erosion but climate change threatens further erosion. Udo and Takeda (2017) projected future beach loss in Japan due to sea-level rise using Bruun rule. However, its restrictive assumption that they probably do not exist in nature makes difficult to assess uncertainties of the projection results. In this paper, Cross-shore (CS) model developed by Larson et al. (2016), which is more realistic model considering the cross-shore sediment exchange, is applied to calibrate the parameter settings at Hasaki beach in Japan, and model applicability was evaluated.

METHODOLOGY

The CS model was applied to the Hasaki beach profile for 10-year period from 6 June 1998 to 27 December 2007. In the model, we used daily profile data and hourly wind data (provided by Hasaki Oceanographical Research Station), hourly significant wave height and period data (provided by nowphas), and hourly tide data (provided by Japan Meteorological Agency). Figure 1 illustrates the beach profile and CS model parameters, i.e., positions of dune foot (y_S), berm crest (y_B), and shoreline (y_G), sediment transport seaward from the dune (q_D), landward wind-blown sediment transport (q_{WS}), and exchange of sediment between berm and bar (q_B). Initial profile was defined by red line, according to the Larson et al.'s (2016) method. The berm crest position y_B is expressed by

$$\frac{dy_B}{dt} = \frac{1}{D_B + D_C}\left(-q_{WS} - q_B + q_D - \frac{dQ_L}{dx}\right) \quad (1)$$

where D_B is the berm crest height, D_C is the depth of closure. Only cross-shore sediment transport was considered because the longshore transport (dQ_x/dx) is negligible at the Hasaki beach. q_D is given using a proportional coefficient C_S. q_B is expressed by following equation with equilibrium bar volume V_{BE} and initial bar volume V_{B0}.

$$q_B = \lambda(V_{BE} - V_{B0})\exp(-\lambda t) \quad (2)$$

V_{BE} is given using a proportional coefficient C_B. λ is derived using a proportional coefficient λ_0. q_{WS} is expressed by

$$q_{WS} = q_{WE}(1 - \exp(-\delta y)) \quad (3)$$

where δ is a coefficient. y_G is calculated from $y_G = y_B + D_B/\tan\beta_f$, where β_f is the slope of the foreshore. The coefficients V_{B0}, C_S, C_B, λ_0, and δ are determined to make the root-mean-square error (RMSE) become minimum.

RESULTS

Figure 2 shows a comparison between observed and calculated y_G. The calculated y_G shows an overall good agreement with the observed y_G. Table 1 lists the optimum coefficients at Hasaki (this study) and those at Portugal, Mozambique, and Sweden (Larson et al., 2016). C_B becomes relatively higher at Hasaki, indicating larger sediment exchange between the berm and the bar.

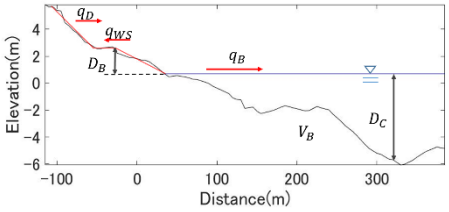

Figure 1 Cross-shore profile at Hasaki Beach and model parameters.

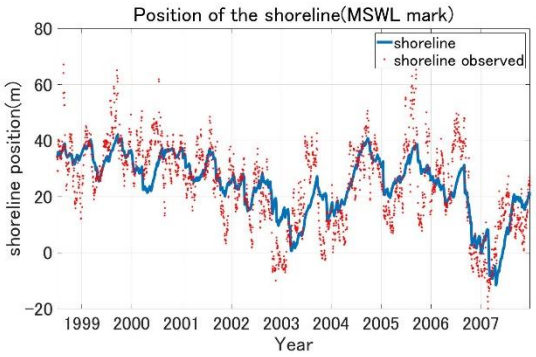

Figure 2 Comparison between calculated and observed y_G.

Table 1 Optimum coefficients at Hasaki and three sites shown in Larson et al. (2016).

site	C_S	C_B	δ	λ_0	V_{B0}
Barra-Vagueira, Portugal	1×10^{-3}	0.08	0.1	0.002	100
Macaneta-spit, Mozambique	1×10^{-4}	0.08	0.2	0.002	65
Angelholm, Sweden	8×10^{-4}	0.08	0.1	0.002	30
Hasaki, Japan	1.7×10^{-4}	0.876	0.0092	0.00031	638

DISCUSSION AND CONCLUSION

The CS model was applied to Hasaki beach. The shoreline calculated by the model with optimum coefficients show a good agreement with the observed data. Additionally, C_B was larger at Hasaki compared to the other sites shown by Larson et al. (2016). Further, the relationships among the coefficients and a method of parameter settings will be shown in the presentation at ICCE2020.

REFERENCES

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