

STORM-INDUCED EROSION OF NOTSUKEZAKI SAND SPIT, JAPAN

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NOTSUKEZAKI SAND SPIT

The hook-shaped sand spit at Notsukezaki (Figure 1) is the longest (26 km) spit in Japan. The spit is located down-drift of the Shibetsu River. Beach erosion became severe in the 1960s after the construction of the Shibetsu Port updrift of the sand spit. The breakwater of the port intercepted longshore sediment transport. The deposited sediment up to 20,000 m³ has been dredged every year. The dredged sediment has been placed on Sections I and II on the spit (Figure 2). In addition, 39 groins of 35 m length were constructed from 1995 to 2015 in order to protect fishing facilities on the spit.

FIELD DATA

Collected data include aerial photographs in 1947 and since 1990, beach profiles along 12 cross-shore lines since 1992, locations of shoreline and vegetation boundary along the entire spit since 2005, and spatial sediment characteristics in 2008 and 2013. The tidal range is 1.6 m. Wind waves were measured at two locations in water depth of about 10 m in winter 2003. The collected data were used to verify the accuracy of spectral wave hindcasting by the Japan Meteorological Agency. Wave transformation in shallow water is included to predict the variation of wave characteristics along the curved spit.

LONG-TERM SHORELINE CHANGE

The decadal shoreline change is predicted using a one-line model including all sediment sources and sinks. The calibrated one-line model is shown to reproduce chronic erosion in Section I (spit stem); chronic deposition in Section II (curved ocean side), and groin-induced erosion and accretion in Section III (curved bay side). This one-line model is being used to quantify the effect of sea level rise where the yearly average tide elevation rose about 0.2 m for the last 30 years in this region.

STORM-INDUCED EROSION

The cross-shore width of the spit is narrowing at certain locations. The smallest width is 70 m. The spit crest elevation above the Japanese datum (T.P.) is low and less than 3 m. As a result, severe storms may cause extensive wave overtopping and overwash, leading to spit breaching. Storm tide (surge plus tide) was observed to exceed 1.6 m. Measured significant wave heights exceeded 3 m. A storm of December 2014 caused appreciable beach erosion (Figure 3), down-drift of a groin constructed in 2013. Measured beach profiles in 2013, 2014 and 2015 (Figure 4) exhibit the impact of this storm where drift ice in winter may have preserved the eroded profile measured in June 2015. The cross-shore numerical model CSHORE is being compared with this storm data and will be used to assess breaching risk for future severe storms.

REFERENCES

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Figure 1. Sand spit down-drift of Shibetsu River and Fishing Port.

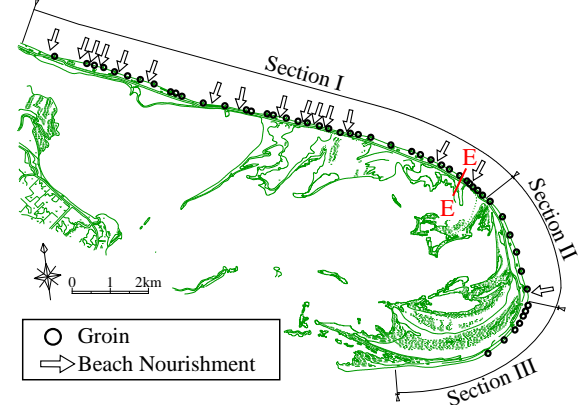


Figure 2. Shore protection measures along sand spit.



Figure 3. Eroded beach and vegetation down-drift of groin along line E-E in Figures 1 and 2.

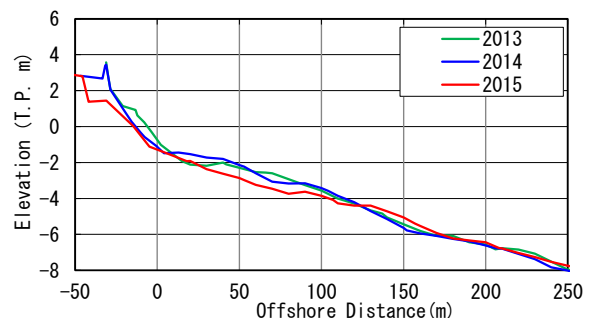


Figure 4. Measured profiles along line E-E in 2013, 2014, and 2015.