COASTAL OVERWASH PROCESSES AND BEACH MORPHOLOGY CHANGE IN YOKOSUKA, JAPAN

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1. INTRODUCTION

Yokosuka Coast is located in the Oppa bay in the eastern part of Miyagi Prefecture, Japan as shown in the Figure 1. This sandy beach is limited by Kitakami River in the north and Nagatsura Inlet in the sound. However, in this study the upper part of Yokosuka Coast, which near to the Kitakami Rive mouth and denoted by a dotted line, will be mostly focused on.

From 4th October 2006 to 8th October 2006, a serve Typhoon 18th was impacted to Yokosuka Coast. The maximum of wave height and wave period was obtained up to 8.4 meters and 12.8 second, respectively. In addition, these low-profile coasts of sand beach and on spit in Yokosuka created a good condition for overwash occurrence during the storm.

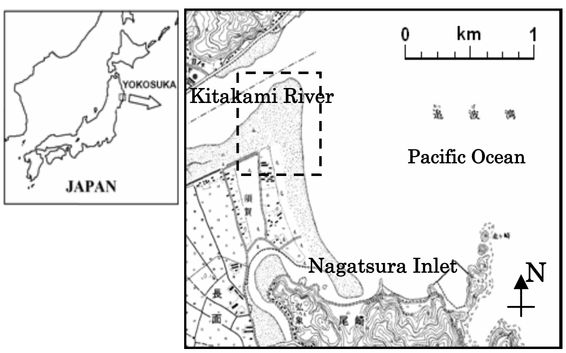


Figure 1: Location of study area

After the Typhoon 18th, there was a big amount of sediment transported and deposited in this area. This was felt up the grasses and trees. It is necessary to estimate the total overwashed sediment volume and their thickness for coastal authorities making valuable plans in the future.

2. OVERWASH PROCESSES

There is a number studies on the overwash process such as Sallenger at el. (2000), and Donnelly at el. (2005). Most of them have classified the overwash processes into two main mechanisms of overwash, namely runup overwash and inundation overwash.

Runup overwash can be defined in terms of the relationship of still water level (*SWL*) and wave runup height (R), to the beach crest (H_c). Figure 2 is the schematic cross-section of a sand beach subject to high surge level and overtopping waves. The excess runup (ΔR) is the difference in elevation between the wave runup heights and the beach crest.

Runup overwash can be divided into two regimes. The fisrt regime is namely a little runup overwash. It occurs when the sum of runup height relevant to the still water level is only slightly larger than the beach crest H_c, and the excess runup is thus small. Few waves overwash the barrier crest and those that do deposit entrained sediment on the crest, if this continues at the same water level; the accreted sediments may stop overwash in the future.

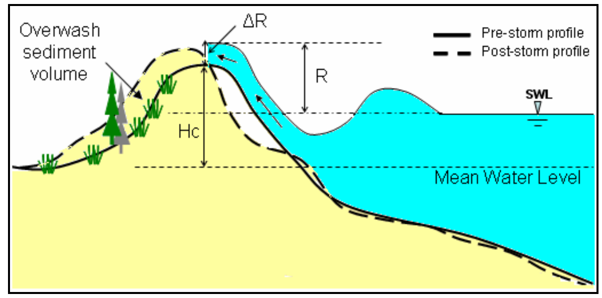


Figure 2: A schematic cross-section of a sand beach

For the second regime, the storm surge level is still smaller than the beach crest H_c; however, the runup height is larger than for the first regime so that many waves have sufficient excess runup height to overtop the beach crest. In this case, the sediment is usually eroded from the beach and dune face and transported to be deposited on the backshore. The beach crest is normally getting lower and a bit move to landward direction.

Inundation overwash occurs when the still water level exceeds the beach crest height H_c. Inundation overwash may cause severe erosion on the backside of the sand beach or dune. In addition, waves on top of the barrier contribute to additional erosion and reduction of the crest. This type of overwash normally destroys the dune and moves sediment quite far inland.

3. BEACH MOPHOLOGY CHANGE

Under the actions of overwash processes the beach morphology will be changed. By analysis of approximately 50 before and after field overwash profiles compiled by Donnelly 2005 in United States has identified five different types of beach morphologic response in connection with overwash. The types encompass crest accumulation, dune lowering, dune rollback, dune destruction, and barrier rollback. These morphological changes are dependent on the hydrodynamic conditions, the beach and back barrier material and the topography and vegetation of the beach and back barrier.

Crest accumulation occurs during low magnitude runup overwash, where the sand is carried up from the beach and dune face to the top of dune crest and the sediment is deposited as the flow reduces at the crest.

Dune lowering implies little or no change in position of the dune crest but a loss in crest elevation. Dune rollback and barrier rollback mean that the shape of the dune or barrier is more or less conserved but the whole system moves in the landward direction. When the water level is below the dune crest, waves attack the beach and dune face causing sediment to move in the offshore direction. Thus, the dune/barrier might be getting lower until there are sufficient wave energy and water level to move most of the sediment landwards.

Dune destruction implies that the dune is completely destroyed either by offshore transport of sediment due to wave attack, or by onshore transport due to overwash. If the sediment is transported offshore it is likely that the dune was destroyed prior to initiation of overwash. The sediments of a dune destroyed by overwash processes are transported onshore.

It should be noted that wave characteristics and water levels during a storm are highly dynamic, and several overwash regimes may occur during one storm, making the estimation of beach morphologies difficult.

4. THE OVERWASH SEDIMENT VOLUME AND MORPHOLOGY CHANGE IN YOKOSUKA

A field survey was carried out in Yokosuka Coast after the Typhoon 18th to measure the elevation of cross-shore beach profiles and the location of these profiles is shown in Figure 3.

Depending on the pre- and post profiles in Figure 4, it can be concluded that the morphology change in this area is mainly crest accumulation and dune rollback in some places.

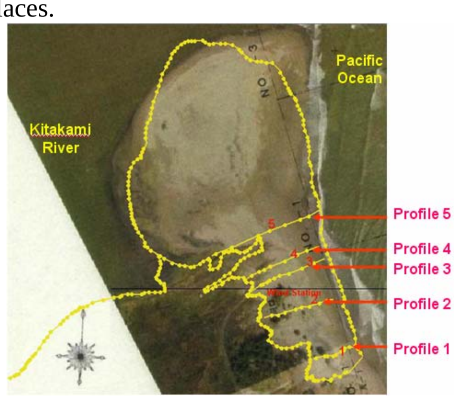


Figure 3: Location of cross-shore beach profiles

By integrating the area between two profiles using equation 1, the cross-shore sediment volume, Q (m^3/m), is calculated.

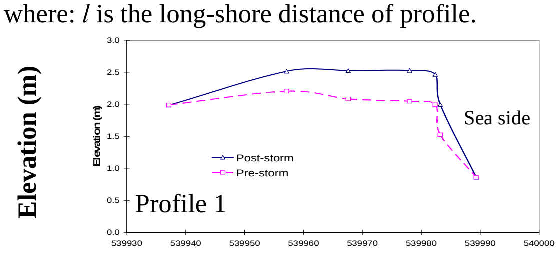
$$Q = \int_{x_0}^{x} \Delta h * dx \qquad (1)$$

where: x_0 is the shoreward location, Δh the changes of profile elevation.

And then, the total overwashed sediment volume, Q_{total} (m^3), is computed by equation 2. The results are shown in the Table 1. The thickness is equal to this volume divided to the deposited area.

$$Q_{total} = \sum_{1}^{n} \frac{Q_i + Q_{i+1}}{2} * (l_{i+1} - l_i) \qquad (2)$$

where: l is the long-shore distance of profile.



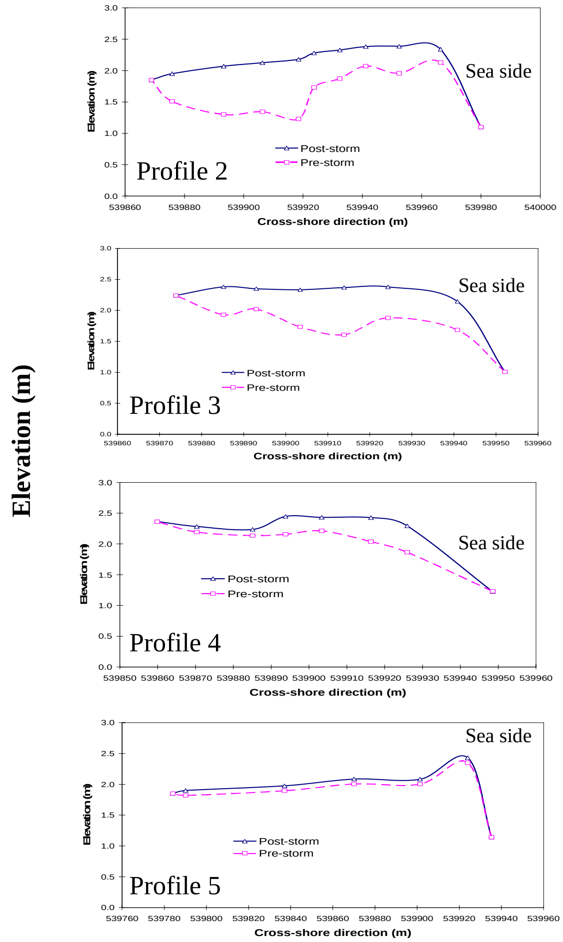


Figure 4: Cross-shore beach profiles in Yokosuka

Table 1: Total overwashed sediment volume and their thickness in Yokosuka Coast

Name	Area (m2)	Sediment volume (m3)	Sediment thickness (cm)
Sand beach	21400	5782.4	27.0
Sand spit	44200	1452.3	3.3
Total	65600	7234.7	11.0

5. CONCLUSION

There are five difference types of beach morphologic response in connection with overwash. The morphology change in Yokosuka Coast is main crest accumulation.

The total overwashed sediment volume is calculated.

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