

INFLUENCE OF TYPHOON TO WAVE SETUP AT RIVER MOUTHS

Tohoku University	Graduate Student	○ Xuan Tinh NGUYEN
Tohoku University	Fellow Member	Hitoshi TANAKA
Nihon University	Fellow Member	Hisao NAGABAYASHI

1. INTRODUCTION

The interaction between ocean and river is very complicated area since it contains a lot of different processes. Of which the wave setup at a river entrance or tidal inlet due to an extreme event such as typhoon is a big concerning issues nowadays in terms of river mouth morphology change, saline intrusion, and navigation transportation. There many researchers have been working on wave setup such as Tanaka (2000) and Dunn (2001). According to Tanaka (2000), the wave setup at river mouth is the height of Mean Water Level (MWL) above Still Water Level (SWL). In most of cases, the estimation of wave setup at a river mouth have been based on water levels measured some distance upstream from river mouth and then compared with a tidal level that measured in deep water where wave effects can be neglected. The main purposes of this study are to in-depth investigating the wave set-up at different morphological river entrances or tidal inlets based on collected data sets within Japan and to propose an index for estimating the wave setup height at river mouths. .

2. STUDY AREA

At the beginning of October 2006, a serve low pressure system called typhoon 18 was impacted to Japan coastline. The maximum of wave height was obtained up to 8.4 meters in the Enoshima wave station. In addition, a very significant wave setup was observed at many river mouths or tidal inlets along to coastline. This study is focused on 8 river entrances within Japan as shown in the Figure 1.

Because of each river has their own morphology. For example, with and without jetties construction, or with and without sand spit at river entrance so the wave setup height needs to be analyzed individually and compare between them.

3. DATA COLLECTION

In order to achieve the above objectives, the requirement data sets are wave height in deep water, tidal level and water level near to river entrance, as well as the river discharge at the same time of event. The average water depth at river mouth is also necessary. Tidal level data was gained from Ayukawa Port, Sendai Port and Onahama Port as can be seen in Figure 1. The water level in rivers will be compared with the closest tidal level station. Offshore wave height data was taken from three stations, namely Enoshima, Sendai and Fukushima.

4. RESULTS AND DISCUSSIONS

Monthly water level rise (WLR), which is equal to water level in the river mouth minus to tidal level, wave height in deep water, H_0 , and river discharge in Kitakami River, Q , are plotted in the Figure 2. At the time of WLR occurrence, the wave height and river discharge equal to 5.56m and

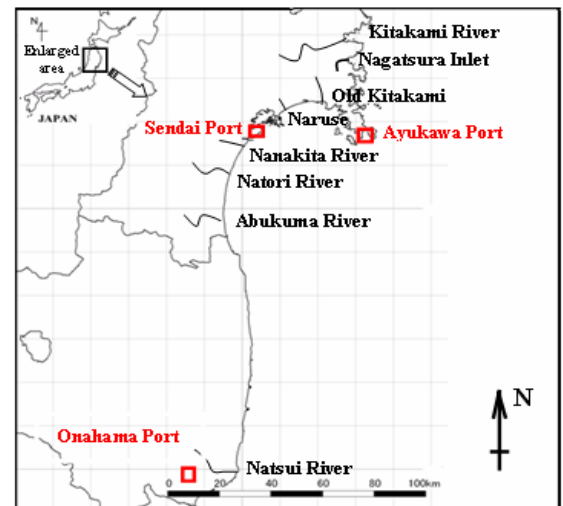


Fig. 1: Location map of 8 river entrances in Japan

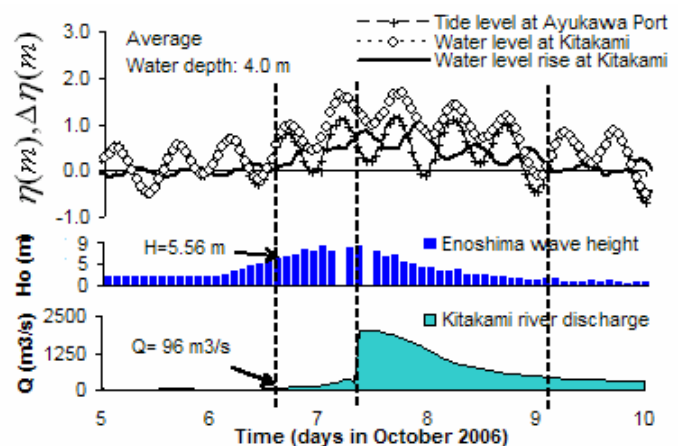


Fig.2: Water level rise at Kitakami River.

96m³/s, respectively. And then WLR increases together with wave height while river discharge is still very small, this is suggested that the WLR in Kitakami is mainly influenced by wave motion such as wave breaking at the entrance. However, after the peak of wave height, the WLR continually increases a little bit (Figure 2), it means the river discharge affected to the WLR but smaller in order of magnitude compares to wave height effects. This phenomenon is again confirmed in Naruse, Natori and Abukuma Rivers mouth.

The increase of water level at a river entrance can be attributed not only to wave set up, but also to backwater effect due to constriction of the flow caused by shallow and narrow of rivers or tidal inlets during ebb tide. These effects are clearly found in Nagatsura Inlet, Nanakita and Natsui River which have the average water depth at entrance around 1.1m to 1.5m.

To investigate the wave setup height due to wave we have to neglect these effects by only considering the water level rise values during the high tide level. Using the regression method, the relationship between wave setup height and offshore wave height can be expressed by following equation

$$\Delta\eta = aH_0 \quad (1)$$

where: $\Delta\eta$ is wave setup height at the entrance (m), H_0 the offshore wave height (m), a regression slope.

The regression slope, a , which is also mean the percentage of wave setup compare to offshore wave height, is plotted up with the dimensionless of relative wave height, d/H_0 , where d is the average water depth at river entrance as shown in Figure 3. These results illustrate that the wave setup height increases as average water depth decreasing. A larger river mouth will be obtained less wave setup. The regression slopes at Nanakita and Natsui River in this study are well in agreement with Oshiyama et al. (2001).

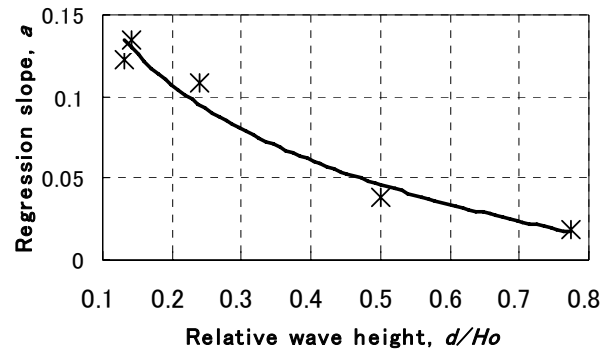


Fig.3: Relationship of wave setup and relative wave height

5. CONCLUSIONS

Wave setup height is not only depending on the offshore wave height but also depend on river discharge during the high tide. Wave setup height was attained to from 10 to 14 percent of offshore wave height for the cases of shallow and narrow river entrance, and from 0.2 to 7 percent for deep and width river mouths. Wave setup height is inversely proportional to the average water depth at river entrance. The coastal engineers can be roughly estimated the wave setup height at each river mouth using Figure 3 if the dimensionless d/H_0 is known.

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