EXPERIMENTAL STUDY OF GUIDED WAVES OVER THE OCEAN RIDGE

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ABSTRACT
Long waves can be trapped by oceanic ridges due to refraction effect, and such guided waves travel along the ridge and transfer their energy to rather long distance. The guided wave is constrained over the top of the ridge and propagates slower than the free long wave, which leads to the largest amplitude waves arriving later and duration of tsunami activity longer. The existence of trapping effect of ocean ridges has not only been demonstrated mathematically (Buchwald 1969; Zheng et al. 2016), but also been verified by the interpretation of tide-gauge data and numerical models on global tsunami events (Koshimura et al. 2001; Titov et al. 2005).

Due to the complexity of ocean topography and poor cover of field measurement networks together with the varied quality of these data, evident divergences can be found from the theory to the measurements and numerical results. This study conducts experiments to examine water waves traveling along the idealized theoretical ridge, compare the wave profile and the propagation speed with the theory.

The hyperbolic-cosine squared oceanic ridge is built at the centerline of the wave basin (10 X 52 m) (Figures 1 and 2). The width of the symmetric ridge is 2m, the water depth is 5cm at the top and 30cm outside the topography. Impact waves are generated by a plexiglass cube tank without bottom at the top of the ridge at the upstream end. The water level within the tank is rose by extracting the air with a vacuum pump, and then the water column drops out to generate the impact waves by quickly open the snuffle valve. The surface elevations are measured by means of resistance wave gauges along the ridge.

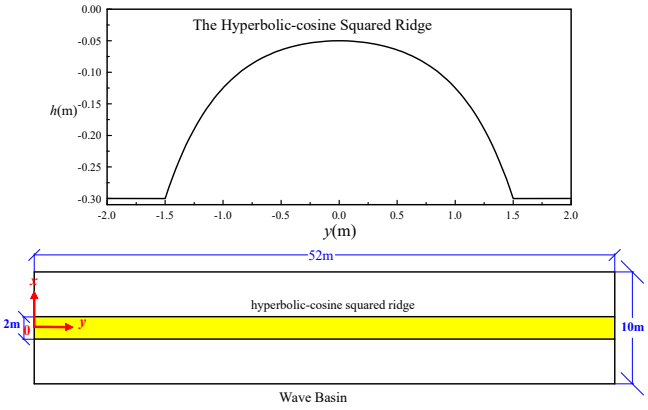

Figure 1 Definition sketch of the experimental setup

The trapping effect of oceanic ridge on wave propagation is examined with the measured data. The cross-ridge wave profile and the propagation speed of the trapped wave is extracted from the experiment data to compared with the theory.

Figure 2 - View of the oceanic ridge in the laboratory

REFERENCES

Buchwald, V. T. (1969). "Long Waves on Oceanic Ridges " Proceedings of the Royal Society of London Series a-Mathematical and Physical Sciences, 308(1494), 343-354.

Koshimura, S., Imamura, F., and Shuto, N. (2001). "Characteristics of Tsunamis Propagating over Oceanic Ridges: Numerical Simulation of the 1996 Irian Jaya Earthquake Tsunami." Natural Hazards, 24(3), 213-229.

Titov, V., Rabinovich, A. B., Mofjeld, H. O., Thomson, R. E., and González, F. I. (2005). "The Global Reach of the 26 December 2004 Sumatra Tsunami." Science, 309(5743), 2045-2048.

Zheng, J.-h., Xiong, M.-j., and Wang, G. (2016). "Trapping mechanism of submerged ridge on trans-oceanic tsunami propagation." China Ocean Engineering, 30(2), 271-282.