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Physical modeling of long-wave run-up mitigation using submerged breakwaters

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Natural hazard due to tsunami inundation inland has been viewed as a crucial issue for coastal engineering community. The 2004 India Ocean tsunami and the 2011 Tohoku earthquake tsunami were caused by mega scale earthquakes that brought tremendous catastrophe in the disaster regions. It is thus of great importance to develop innovative approach to achieve the reduction and mitigation of tsunami hazards.

In this study, new experiments have been carried out in a laboratory-scale to investigate the physical process of long-wave through submerged breakwaters built upon a mild slope. Solitary-wave is employed to represent the characteristic of long-wave with infinite wavelength and wave period. Our goal is twofold. First of all, through changing the positions of single breakwater and multiple breakwaters upon a mild slope, the optimal locations of breakwaters can be pointed out by means of maximum run-up reduction. Secondly, through using a state-of-the-art measuring technique Bubble Image Velocimetry, which features non-intrusive and image-based measurement, the wave kinematics in the highly aerated region due to solitary-wave shoaling, breaking and uprush can be quantitated. Therefore, the mitigation of long-wave due to the construction of submerged breakwaters built upon a mild slope can be evaluated not only for imaging run-up and run-down characteristics but also for measuring turbulent velocity fields due to breaking wave.

Although we understand the most devastating tsunami hazards cannot be fully mitigated with impossibility, this study is to provide quantitated information on what kind of artificial coastal structure that can withstand which level of wave loads.