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Generation and run-up of extremely long waves using bottom-tilting wave maker

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It is widely accepted that solitary waves are too short to properly model tsunamis (Madsen et al., 2008), which requires development of novel long wave generation methods. In response to this call, Rossetto et al. (2011) used a pneumatic pump to release volume of water into wave basin in a controlled manner, and Goseberg et al. (2013) developed a close-circuit wave flume in which waves are driven by pipe pumps for virtually arbitrary surface profiles. Here presented is yet another long wave generation method using the bottom-tilting wave maker (Lu et al. 2016).

Experiments were carried out in a wave tank (2 m long, 0.1 m wide and 0.2 m high). The bottom of the tank consists of two parts: 1-m-long fixed part and 1-m-long flapping part. The hinge of the flapping bottom is at the junction of the two bottom parts. The slope of the fixed bottom part can be adjusted.

Using the analytical solution of the linearised equations, the numerical solution of nonlinear equations (both Nonlinear Shallow Water Equations and Boussinesq equations) and experimental measurements, it will be demonstrated that the new wave maker could generate waves that are orders-of-magnitude longer than the solitary wave and with both positive and negative fronts.

In addition, we report run-up of the long waves generated by the bottom-tilting wave maker. Hundreds of cases were investigated with different combinations of fixed bottom slope, water depth, trajectory of the moving bottom. Both positive and negative waves were studied. One of the key results is that run-up heights scale with the slope of the front. This is consistent with the theoretical results by Chan and Liu (2012).

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