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Numerical study of breakwater failure due to tsunami-like undular bore impacts: The case of the port of Soma.

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The Tohoku tsunami, that impacted the Japanese coast in 2011, caused great damages on many offshore vertical breakwaters ranging from the erosion of the rubble mound to the partial displacement or total collapse of caissons. The breakwater failure mechanisms were function of the tsunami wave types that vary along the Japanese coast according to the bathymetry features. The Iwate coast, characterized by deep water depths and steep slopes, was mainly impacted by tsunami overflow leading in particular to the failure of the world's deepest breakwater of Kamaishi. In the shallow waters of the Sendai bay, observations showed that breakwaters protecting harbor entrances were impacted by short waves train resembling to undular bore. This work aims to investigate this latter type of tsunami wave impacts that are less reported in the literature. We chose to focus on the highly damaged offshore breakwater of Soma, located in the south part of the Sendai bay. The hydrodynamics conditions during the tsunami impact are investigated using the VARANS Thetis code (Desombre et al., 2012), which allows to simulate both the free surface flow and the flow inside the rubble mound simulated by a porous medium. The model is forced at the offshore boundaries by the Funwave Boussinesq code that describes the transformation of the tsunami waves from the source to the generation of undular bores in shallow waters. The study includes the computation of forces acting on the caissons. We discuss the relevance of describing the hydrodynamics at the short wave scale to assess breakwater stability in the course of tsunami-like undular bore impact.

References

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