EGU21-14148, updated on 19 Oct 2021
https://doi.org/10.5194/egusphere-egu21-14148
EGU General Assembly 2021

Run-up of breaking focused waves on a beach studied experimentally in a large scale facility and numerically using hybrid FNPT-RANS model

Shaswat Saincher[1], Sriram Venkatachalam[1], and Ira Didenkulova[2]
[1]Department of Ocean Engineering, Indian Institute of Technology Madras, Chennai, India (shaswat.saincher@gmail.com)
[2]Department of Mathematics, University of Oslo, Oslo, Norway (ira_d2000@mail.ru)

The feasibility of generating long period waves using a piston-type wavemaker was comprehensively demonstrated in [1] for the Großer Wellenkanal (GWK) at 1:100 scale. These included regular waves, elongated solitons, N-waves as well as time-series pertaining to earthquake tsunamis (namely the 2004 Indian Ocean and 2011 Tohoku tsunamis).

In the companion paper [2], the aforementioned long-period waves were simulated using fully nonlinear potential theory (FNPT) and the Korteweg-de Vries (KdV) equations and compared with GWK measurements. It was established that the FNPT and KdV models accurately predicted long-distance evolution of these waves as well as dispersion-induced splitting of elongated solitons and N-waves to the form of undular bores. In addition, the run-up characteristics of the "2009 Samoa tsunami" record and elongated solitons were also studied in [2]. The semi-numerical procedure adopted in [2] for run-up estimation was limited to long non-breaking waves. However, the experimental data collection included also violently breaking focused waves of a smaller period.

In the present work, we apply IITM-RANS3D to simulate the run-up characteristics of breaking focused waves based on experiments carried out in the GWK using a 1:6 slope. An in-house, Reynolds-Averaged Navier-Stokes model (IITM-RANS3D) has been recently developed and hybridized with the in-house potential code IITM-FNPT2D. The RANS framework allows for complete description of breaking wave hydrodynamics and FNPT-hybridization ensures energy preservation for long-duration wave simulations. The run-up problem is considered as a multiphase flow where the beach is physically modelled as a high-viscosity fluid. The simulations would provide valuable insight into the run-up characteristics of breaking bores at large scale as viscous and aeration effects are fully accounted for in the RANS model.

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