Nonlinear effects on the statistics of wave run up on a beach

Supervisor: Petr Denissenko (School of Engineering)
Co-supervisor: Colm Connaughton (Complexity and Mathematics)

Project Outline and Objectives

After the devastation caused throughout the Indian Ocean region in 2004 by the "Boxing Day" tsunami, the problem of "wave run up" (that is the dynamics of a wave impacting on a gently inclined shore) has become very topical in coastal engineering and geophysical fluid dynamics. When a wave impacts an inclined sea shore, the runup height may significantly exceed the wave initial magnitude. Calculation of the runup height for various types of incoming waves is an important component in the prediction of damage caused by tsunami, freak waves and the coastal erosion caused by more regular wave patterns. It has been shown theoretically that the shape of the incoming wave influences the runup height. For example, runup of a wave with a steeper front is higher than that of a symmetric one.

Thus for tsunami, a crucial parameter is the distance from the epicentre to the shore, because it defines not only the wave magnitude, but also its shape formed both by the dispersion and the non-linear effects. On a less catastrophic end of the problem, shore erosion caused by, for example, passing ferries depends on the wave length and the shape of the generated wave train.

While many theoretical and numerical investigations are carried out on solitary disturbances, less is known about impact stochastic waves. The aim of this project is to understand a recent theoretical article [1] devoted to statistical wave runup and compare theoretical predictions with experiments recently conducted at the School of Engineering.

Required Background and Methodology

Some interest in the application of fluid dynamics to problems in geophysics. Basic programming skills (eg MatLab) and a willingness to work with experimental data.

Research Outcomes

By the end of the project, you will test the validity of theoretical predictions on the runup statistics for the incoming wave with the narrow-band spectrum. The runup programme is being continued and the proposal has been submitted to conduct experiments at a larger facility, GWK in Hannover, a 300 metre length, 5 metre width, and 7 metre depth wave flume. The large amount of reliable data is expected to aid further theoretical developments.

PhD prospects

This project can be easily extended into a longer PhD project as part of an emerging experimental and theoretical collaboration between Warwick Engineering (Denissenko), Physics (Rowlands) and Maths (Connaughton and Nazarenko) and leading world experts in the geophysics of tsunamis (Pelinovsky and Didenkulova). Topics of particular importance which could form the basis of a PhD project include the interaction of sequential runup waves and the influence of the near-bed boundary layer.

References

[1] I. Didenkulova, E. Pelinovsky, and A. Sergeeva. Statistical characteristics of long waves nearshore. *Coast. Eng.*, doi:10.1016/j.coastaleng.2010.08.005, 2010.

Contact Information: Petr Denissenko, School of Engineering, University of Warwick. Phone: 28010, E-mail: p.denissenko@warwick.ac.uk.