Investigation of bound infragravity waves (IG) shoaling near the coast

Through the use of a semi-analytical solution

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Motivation

Short waves propagate to the coast experience shoaling when the water depth decreases, they start to break and eventually disspate all energy at the coast. Infragravity (IG) waves, in general do not reach the steepness for breaking and they arrive at the shoreline. The near coastal morphology is thus largely determined by the IG wave pattern.

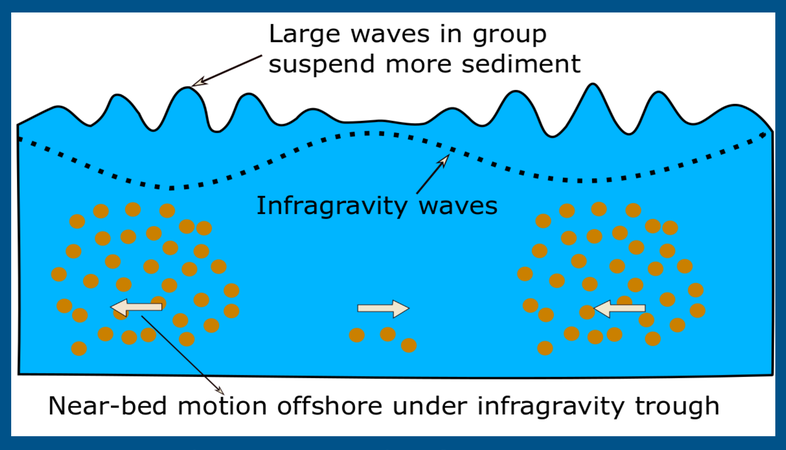

Figure 1: Sediment erosion under infragravity waves.

▪ PREVIOUS INVESTIGATION

The method to evaluate the bound IG energy has been established for homogeneous bottom (LHS60), and they become increasinly invalid as waves enter progressively shallow water. The objective is to propose a new formula to evaluate the energy of bound IG energy on slopes.

▪ METHODOLOGY

By setting up a conceptual 1D model with constant slope in the shoaling zone, a semi-analytical solution could be obtained. A collection of bichromatic waves conditions have been simulated, and a correction factor from the equilibrium solution has been derived.The phase shift between the IG and the short wave groups has been investigated as well.

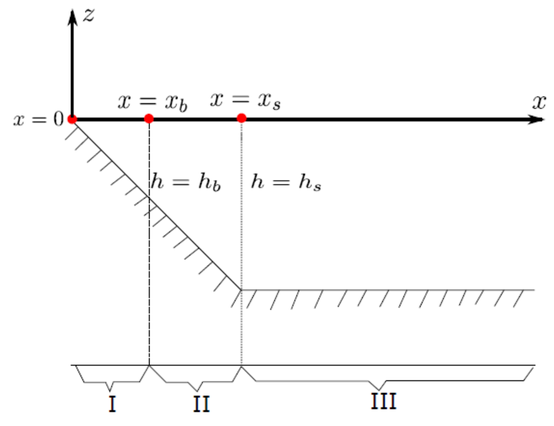

Figure 2: offshore zone, shoaling zone and surf zone decomposition.

Correction factor:

$$\zeta = \zeta_{LHS60} * \left(\frac{h}{h_s}\right)^{\alpha_c} \qquad with\ \alpha_c = -10 * \left(\frac{H}{L}\right) + 2.55 - \beta_s^{-0.155}$$

▪ VALIDATION

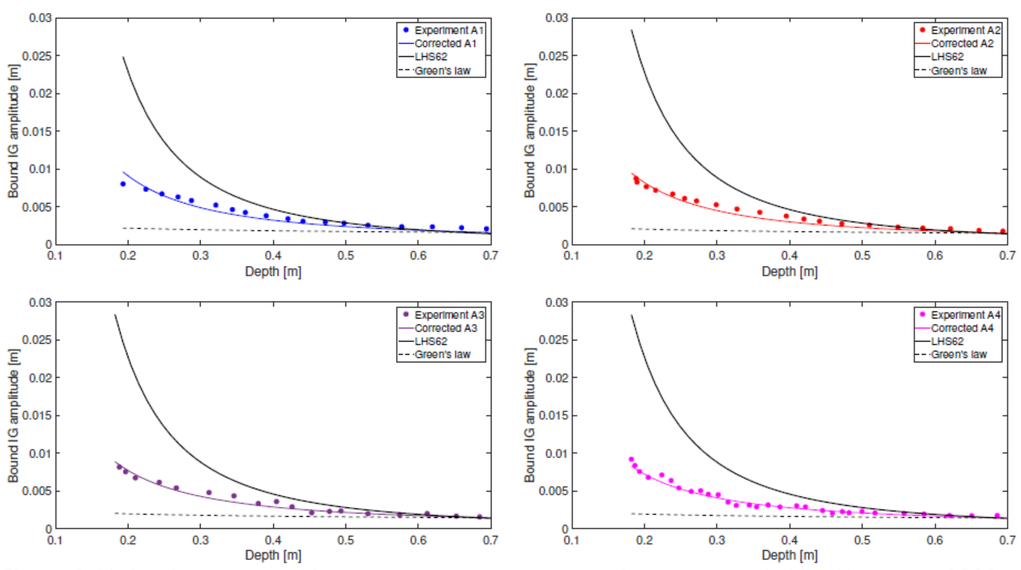

Figure 3: Validation of correction factor to laboratory experiment results in Van Noorloos (2003), set A.

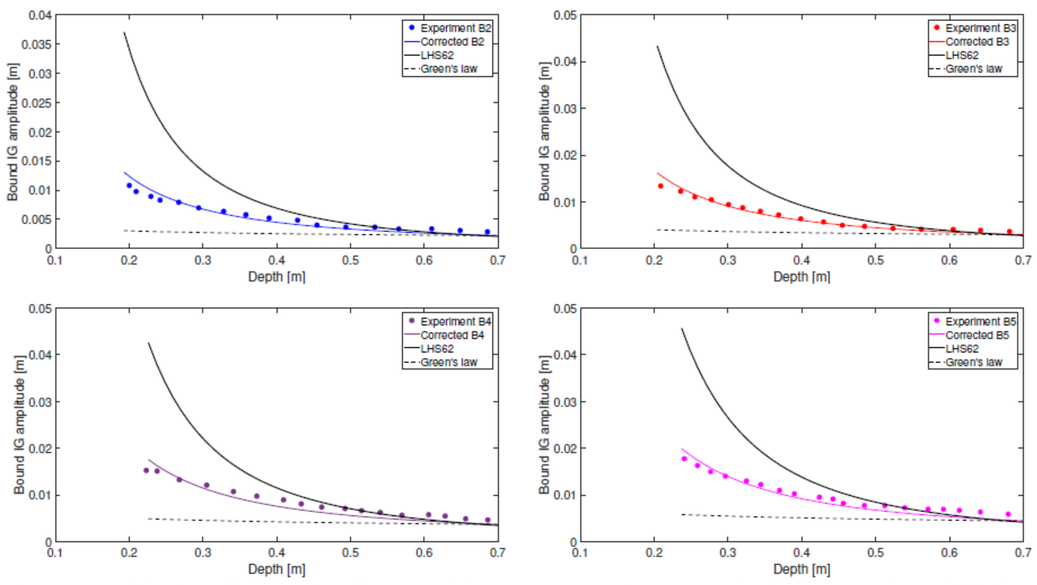

Figure 4: Validation of correction factor to laboratory experiment results in Van Noorloos (2003), set B.

▪ CONCLUSION

1. The state-of-art method for wave run-up calculations overestimates the bound IG energy for a sloping bottom. Therefore, a correction factor has been designed based on parametralizations from semi-analytical solutions that significantly improves the prediction.
2. The phase relationship between the short wave groups and the infragravity waves has been investigated. It is found that even in the innermost of the shoaling zone, the IG waves phase behavior are still strongly governed by the local forcing, and the superposition of free IG waves may enlarge this shift.

▪ REFERENCES

[1] LHS60: M.S. Longuet-Higgins, R.W. Stewart, Changes in the form of short gravity waves on long waves and tidal currents, Journal of Fluid Mechanics, 8, (1960), 505.
[2] J.C.V. Noorloos, Energy transfer between short wave groups and bound long waves on a plane slope, Delft University of Technology, The Netherlands, 2003.

The current study has been submitted to Coastal Engineering and is currently under revision.