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WAVE BOTTOM BOUNDARY LAYER FLOW AND TURBULENCE UNDER A PLUNGING BREAKING WAVE OVER A RIGID BREAKER BAR

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Motivation

Present understanding of hydrodynamic processes under breaking waves is primarily based on smallscale wave flume experiments. The few large-scale studies with breaking waves offered limited knowledge in particularly the temporal and spatial variation of breaking-induced turbulent kinetic energy (TKE) and its effect on the wave bottom boundary layer (WBBL). Such knowledge seems essential to improve morphodynamic modelling of the surf zone.

Experimental description

This motivated an international project (UK/NL, funded by EPSRC/STW) that included experiments in the large-scale CIEM wave flume (Barcelona), during which the outer and WBBL flow were measured using OD2C Laser Doppler Anemometry and a 1D3C Acoustic Doppler Velocimetry Profiler with high temporal and spatial resolution (*Figure 1*). The experiments involved plunging breaking waves over a barred profile that was rigidized using an asphalt layer. Wave and bed profile conditions were consistent with a recent mobile-bed campaign (van der Zanden *et al.*, *in prep.*), allowing detailed comparison between hydrodynamic and sediment transport processes along the outer and inner surf zone.

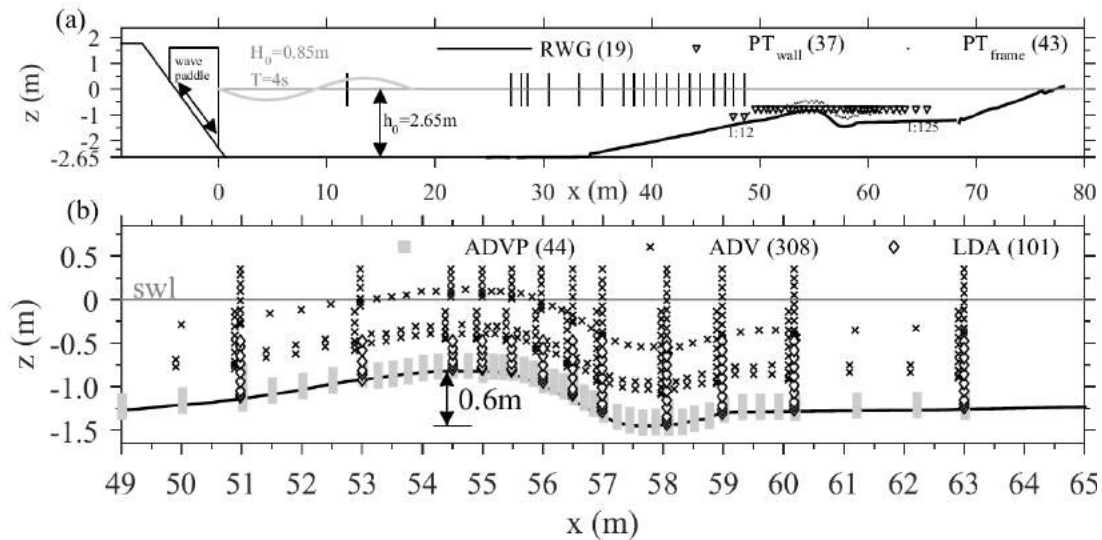


Figure 1 Experimental set-up. (a) Overview of wave flume and positions of water level measurements; (b) Close-up of test section and locations of velocity measurements.

Results

Analysis of the outer flow data revealed strong injection of TKE into the water column upon wave breaking (van der A *et al.*, *in prep.*). Subsequently, TKE is transported downward due to advective (mean current and orbital flow) processes and increases near-bed (at 1 cm) TKE values in the breaking zone, relative to shoaling zone, by over a factor three. At the conference, the effects of TKE invasion on WBBL hydrodynamics will be presented.

References

- van der Zanden, J., van der A, D.A. *et al.* (manuscript in preparation), *Near-bed hydrodynamics along a barred sand bed profile below a full-scale plunging breaking wave.*
- van der A, D.A., O'Donoghue, T. *et al.* (manuscript in preparation), *Flow and turbulence under a largescale laboratory plunging wave over a fixed bar.*