FIELD OBSERVATIONS OF INFRAGRAVITY WAVES DURING STORM LESLIE IN A WAVE-DOMINATED INLET

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Abstract

This study investigates the role of infragravity waves (IGW) on the hydrodynamics of a wave-dominated inlet (Albufeira lagoon, Portugal) during storm Leslie (October 2018) through the analysis of field observations. Measured significant IGW heights reached up to 0.9 m in the surf zone, at adjacent ocean beaches, and 0.4 m at the flood-delta. At the flood-delta, IGW were more energetic than wind-generated short-waves by up to a factor of 2. These large IGW are expected to contribute significantly to sediment transport during storm conditions.

Keywords: Albufeira lagoon; Hydrodynamics; Storm conditions.

1. Introduction

The morphological changes at wave-dominated inlets are well known to be dependent on the wave forcing. For instance, the Albufeira lagoon (Portugal) naturally closes during winter after storm events. Infragravity waves (IGW) are ocean waves with periods between 25 s to 250 s in certain cases associated and enhanced by wave grouping in the incident wind-generated waves (SW). The IGW amplitude increases during storms so that IGW can dominate the hydrodynamics near the shoreline (e.g. Bertin *et al.*, 2018). However, their role on the hydrodynamics in a wave-dominated inlet under storm conditions has scantly been explored before. The present study tackles this research gap through an analysis of field observations.

2. Field experiment and data analysis

The field experiment took place at the Albufeira lagoon between October 12 and 15, 2018. During this period, the Portuguese coastline was hit by the storm Leslie, which made landfall on October 14 and triggered energetic offshore wave conditions recorded by Sines buoy (Figure 1a).

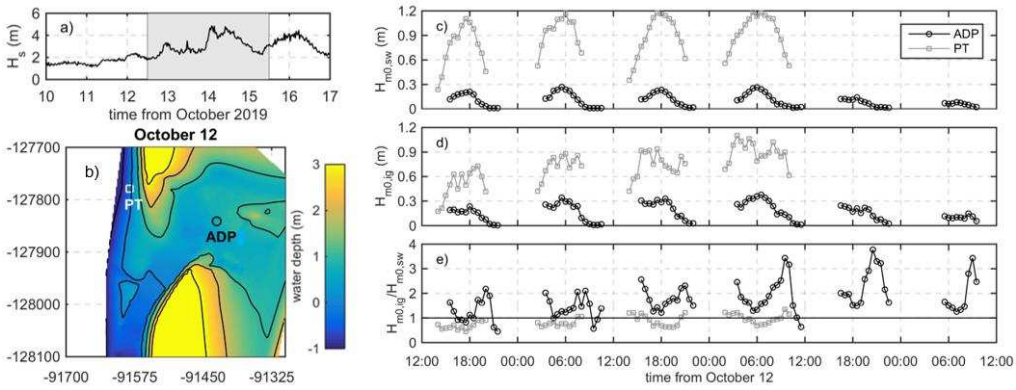

Figure 1. Time-series of significant wave height (a) recorded by Sines wave buoy. Digital elevation model obtained with the topographic survey performed on October 12 (b) and spatial locations of the acoustic Doppler current profiler (ADP) and the pressure transducer (PT). Water depth is referred to mean sea level and the horizontal coordinates are referred in the ETRS89 PT-TM06 system. Time-series of significant short-wave (c) and infragravity wave (d) height and the ratio between significant infragravity and short wave heights (e) at the ADP (circles) and PT (squares) locations.

The present analysis considered pressure measurements registered by a pressure transducer (PT) at 4 Hz and by an acoustic Doppler current profiler (ADP) at 2 Hz (Figure 1b). The wave energy spectrum was computed every 20 min using Welch's method. We calculated the significant IGW height ($H_{m0,ig}$) and the significant SW height ($H_{m0,sw}$). The integration limits were set to (0.0039-0.04) Hz and to (0.04-0.3) Hz, respectively.

3. Results and discussion

The propagation of SW and IGW between the adjacent beach (PT) and the flood-delta (ADP) is strongly influenced by the inlet channel (Figure 1b). During storm conditions, the depth-limited $H_{m0,sw}$ decreases by ~80%, from 1.2 m outside to 0.3 m inside the lagoon (Figure 1c) while $H_{m0,ig}$ only decreases by ~40%, from 0.9 m outside to 0.4 m inside the lagoon. As a result, the ratio between $H_{m0,ig}$ and $H_{m0,sw}$ is, in general, larger at the flood-delta than at the adjacent beach (Figure 1e). This analysis highlights the role of IGW inside the Albufeira lagoon. These IGW are expected to drive large orbital velocities and, therefore, to contribute to the sediment transport in wave-dominated inlets particularly in high energy wave conditions.

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References

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