INFRAGRAVITY WAVES AT A TIDAL INLET

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INTRODUCTION

The generation and propagation of infragravity waves at sandy coasts has received significant attention (e.g. Herbers et al., 1994). This is in contrast with tidal inlets where both observations and modeling studies are scarce. Here we present novel observations and modeling of infragravity waves over an ebb-tidal delta located at Ameland, the Netherlands (Fig. 1). The objective is to understand the evolution of the free and bound infragravity waves as they propagate from the deeper shelf onto an ebb-tidal shoal and into the ebb-channel, establish their pathways and examine the potential in sediment transport. The latter is important in view of the anticipated large-scale ebb-tidal delta nourishment at this location to protect the coast from future storm impacts.

METHODS

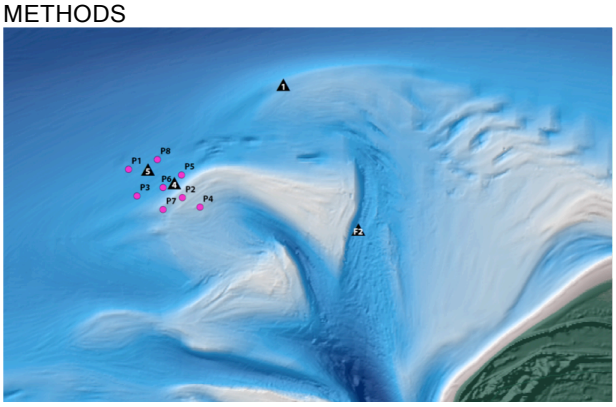

Figure 1 - Ameland ebb-tidal delta with locations of pressure sensors (pink dots) and frames (triangles).

Observations have been obtained with a grid of instruments consisting of 8 stand alone pressure sensors and 4 frames equipped with co-located velocity and pressure measurements at Amelander Inlet during the 40-day SEAWAD field experiment in 2017 (Fig. 1). Bi-spectral analysis is used to estimate the free and bound fraction of the infragravity waves within the frequency range of 0.005-0.05 Hz at all locations (Herbers et al., 1994). The free infragravity (FIG) waves are predicted with the model of Rijnsdorp et al. (2021).

RESULTS

Using hourly bursts of the measured pressure and velocities at Frame 4, located at approximately 8 m water depth, the incident wave height shows a range in wave heights up to 4 m (upper panel Fig 2). Computing the total and bound infragravity wave height using the bi-spectral analysis shows that the infragravity wave height is dominated by the FIG waves at this location (middle panel). Comparing the predicted and observed FIG wave height shows that a significant part can be explained by FIG waves generated at adjacent shores (lower panel).

CONCLUSIONS AND OUTLOOK

Novel observations of infragravity waves at a tidal inlet show the presence of significant infragravity wave energy with significant wave heights up to 0.5 m in approximately 8 m water depth. This infragravity wave height is shown to consist of a combination of bound and free infragravity waves that varies with the incident conditions. Inter-comparison of the observations with other locations and SWAN modeling is used to examine the spatial evolution within the inlet of the infragravity waves in conjunction with the incident waves.

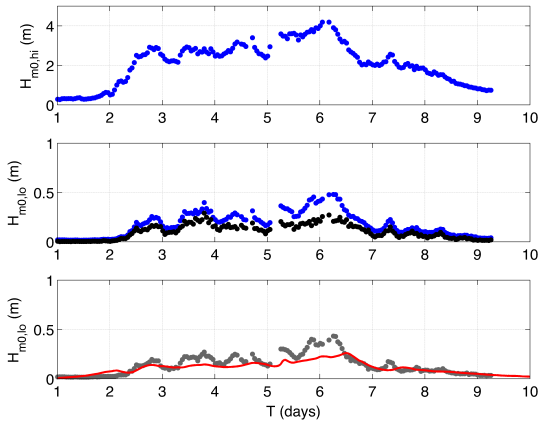

Figure 2 -Frame 4: Upper panel: Observed significant incident wave height. Middle panel: concurrent total (blue) and bound (black) significant infragravity wave height. Lower panel: Predicted (red) and observed (gray) free infragravity wave height.

REFERENCES

Herbers, Elgar and Guza (1994): Infragravity-frequency (0.005 Hz -0.05 Hz) motions on the shelf. Part I: Forced waves, J. Phys. Oceanogr., 24, pp. 917-927.

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