FIELD MEASUREMENTS OF WAVE INTERACTIONS WITH A DIKE ON A SHALLOW FORESHORE USING AN "ARTIFICIAL DIKE" CONCEPT

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INTRODUCTION

Low-lying countries typically have mildly-sloping beaches as part of their coastal defence system. Many countries in north-western Europe have coastal urban areas that rely on this type of defence system, which consists of a low-crested impermeable sea dike with a relatively short promenade, and a long (nourished) beach in front that acts as a very/extremely shallow foreshore as defined by Hofland (2017). Along the cross-section of this hybrid beach-dike coastal defence system, storm waves are forced to undergo many transformation processes before they finally overtop the dike. These hydrodynamic processes include shoaling, sea and swell wave energy transfer to sub- and superharmonics via nonlinear wave-wave interactions, wave dissipation by breaking and bottom friction, reflection against the dike, wave run-up and overtopping on the dike, bore impact on a wall or building, and finally reflection back towards the sea interacting with incoming bores on the promenade.

Field measurements of all these processes at the same time are very challenging but necessary since these suffer from neither scale nor model effects. Field data are therefore crucial to evaluate design methodologies, which rely on physical and numerical modelling. This paper presents the field setup and the design features of the innovative artificial dike, unique in the world.

FIELD MEASUREMENT SETUP

The field measurement site "Living Lab Raversijde" is located in Ostend, Belgium (Figure 1), where wind, waves, water levels, bathymetry and beach profiles are measured over 10 years (2021-2030). It consists of (1) offshore measurements using colocated directional wave buoys and ADCP's with a shallow sand bank in between to investigate the generation of infragravity waves; (2) three intertidal poles with colocated current and pressure sensors, and sediment suspension meters to measure the wave transformations and beach profile changes; (3) an artificial dike to measure the wave overtopping and impact on storm walls on the dike, and the wind.

Measuring wave overtopping at existing dikes has been reported before (Wenneker, 2016; van der Meer, 2019). However, in Belgium none of the existing dikes are in contact with the sea because of beach nourishments, requiring a different approach. The concept of the artificial dike (Figure 2) is to bring the dike and instrumentation closer to the sea (lower, at about the high tide level on the beach), and was designed so that every storm season at least 5 events can be measured. The artificial dike was constructed in 2021, and consists of 4 typical cross-sections, where the overtopping is measured at the dike crest and at the end of a promenade (both without and with a storm wall present where the impact forces are measured). At the conference the design of the artificial dike will be presented in more detail, with a performance evaluation based on the first measured storms.

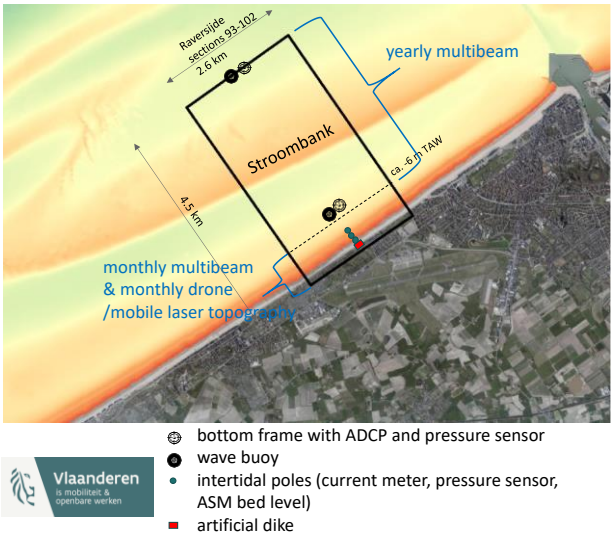

Figure 1 - Field setup of "Living Lab Raversijde"

Figure 2 - The artificial dike and intertidal poles at low tide (top left and bottom) and high tide (top right)

REFERENCES

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