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VLAAMSE BAAIEN DEVELOPMENT PLAN: ESTIMATION OF THE WAVE CLIMATE FOR FLANDERS BAYS USING THE NUMERICAL MODEL MILDWAVE

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1. Introduction

The Flemish coast is situated between The Netherlands and France, at the North Sea. A coastline of just 67 km, though quite sensitive to changes throughout the past centuries, not only due to direct human intervention (land reclamation, construction of coastal structures) but also by the nature itself (e.g. climate (changing) conditions). For the protection of the coast, the development plan "Flanders Bays" has been introduced ("Vlaamse Baaien" in Dutch), based on the following principles: safe - natural - attractive - sustainable - developing.

Within the present study, the numerical model MILDwave has been used for a wave diffraction and wave transformation study (Stratigaki and Troch, 2011) around and behind a series of proposed artificial islands (Fig. 1, left) used for the protection of the Flemish coast within the frame of the Flanders Bays initiative. Here, indicative results for the artificial Wandelaar Island (Fig. 1, right, indicated in a black frame) are presented.

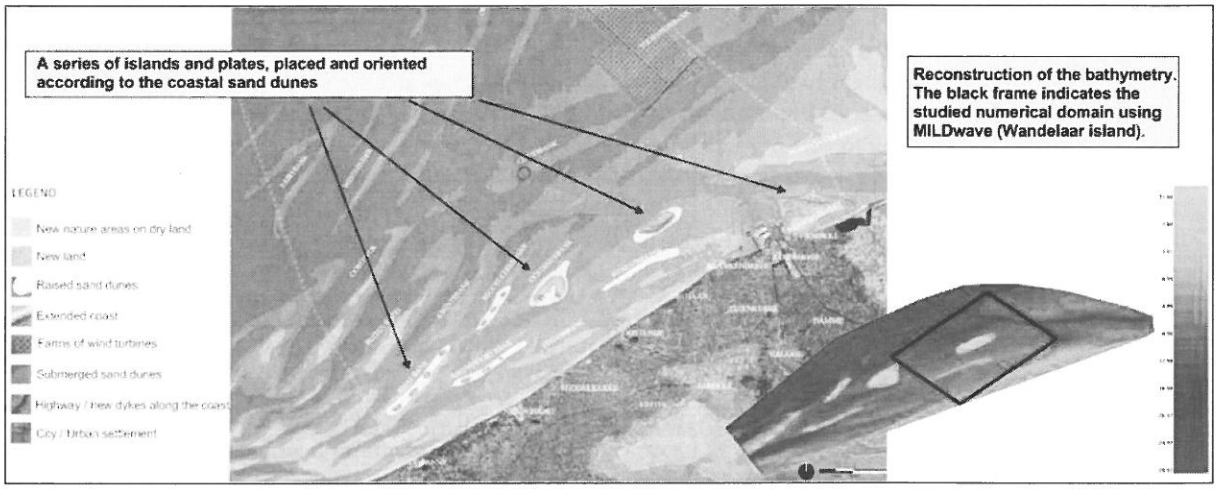

Figure 1. left: The Flemish coastline and the proposed artificial islands within the Flanders Bays plan (Malherbe and Fordeyn, 2012); right: the studied numerical domain using the wave propagation model MILDwave (Stratigaki and Troch, 2011).

2. The numerical model MILDwave - Results and discussion

The numerical model MILDwave (Troch, 1998; Stratigaki and Troch, 2012) is a phase-resolving mild-slope wave propagation model which generates linear water waves over a mildly varying bathymetry and calculates instantaneous surface elevations throughout the domain. Refraction, shoaling, reflection, transmission, diffraction, wave breaking and wave growth by wind can be simulated. Typical applications of the model are the study of wave penetration in harbours, the behaviour of wave energy converters, wave transformation studies and wave diffraction around breakwaters/structures.

In Fig. 2 the H_{m0} contour plot for long-crested irregular waves is given for wave boundary conditions of 1000 yrs return period. The modules for wave breaking and wave growth by wind calculation are active. The effect of wind appears to be limited, as shown in Fig. 3 by comparing the evolution of the H_{m0} values for Cases 1 and 2 along a cross section through the Wandelaar Island. For all simulations, the shadow effect, with

significantly reduced wave heights behind the Wandelaar Island, is clearly visible. The diffraction pattern at the sides of the island features two intersecting rays in its lee, resulting locally in slightly higher H_{m0} values.

Those results show the effectiveness of the artificial island in offering a shelter for the coastline, protecting the Flemish bays against high incident wave heights from the offshore.

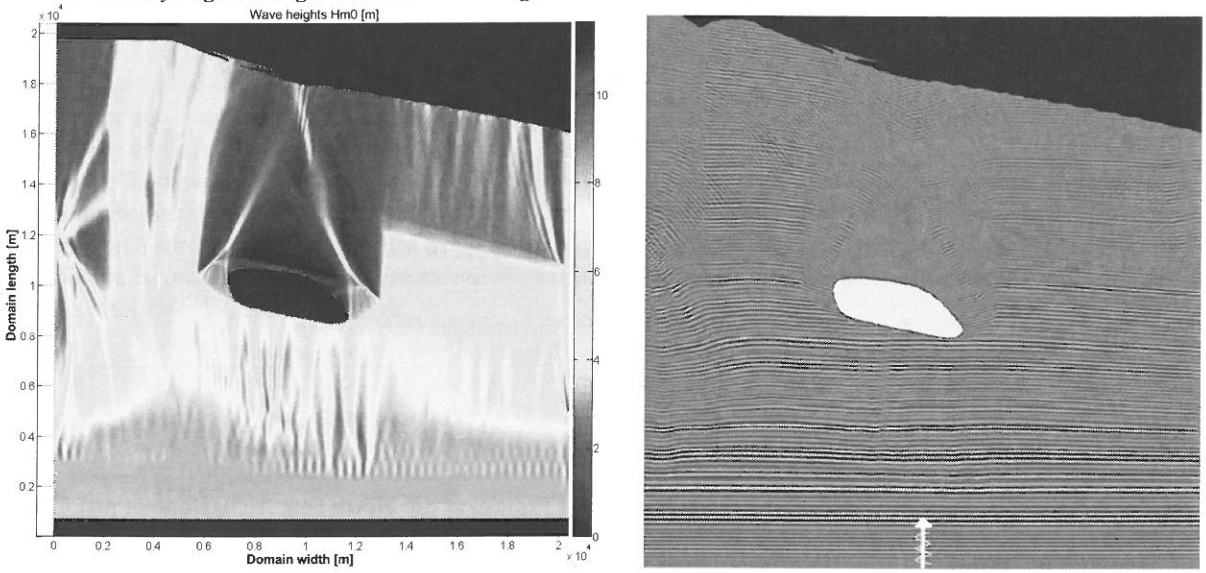

Figure 2. MILDwave results for the Wandelaar Island (H_{m0} = 8.2 m, T_p = 12.6 s, Water level: +7.83 m TAW[a]): left: contour plot of the resulting H_{m0} values; right: instantaneous surface elevations at t = 4000 s (Stratigaki and Troch, 2011).

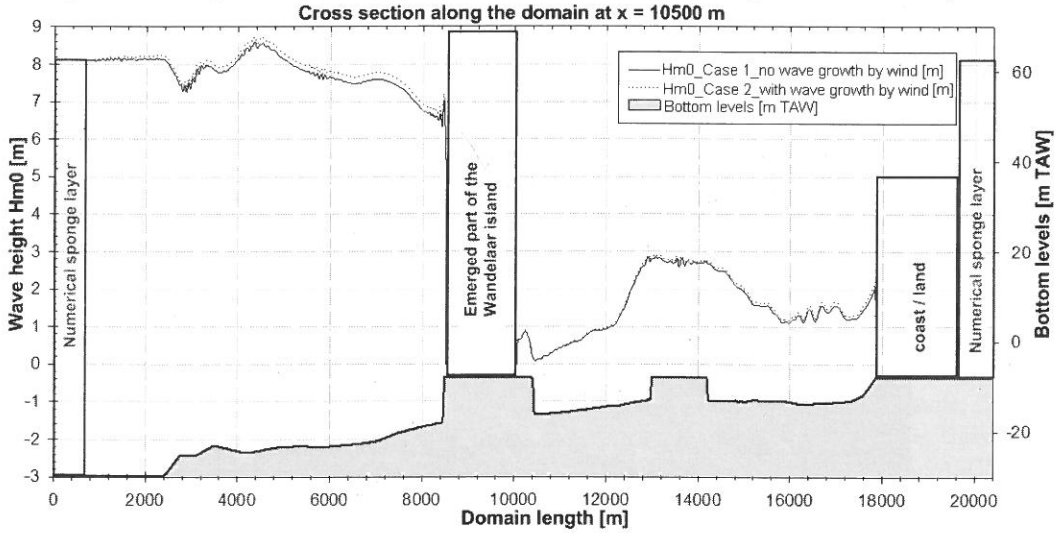

Figure 3. MILDwave results for the Wandelaar Island (H_{m0} = 8.2 m, T_p = 12.6 s, Water level: +7.83 m TAW[a]): cross section along the numerical domain and through the Wandelaar Island (Stratigaki and Troch, 2011).

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[a] TAW is the reference water level by which the level measurements are expressed in Belgium.