Modelling the impact of positioning and pole height of a row of beach buildings on dune morphology

Beach buildings are often placed in rows in front of coastal sand dunes for recreational purposes. As a result, airflow-induced aeolian sediment transport and associated bed morphological change in the vicinity of the buildings may be altered. Various building characteristics influence this, whereas this study focuses specifically on the influence of varying the parameters pole height and distance between the row of buildings and dune. For the computation of change in bed morphology a model has been used that couples a 3D airflow model in OpenFOAM with a 2D-horizontal aeolian sediment transport model, AeoLiS. Simulations were conducted by modeling a row of beach buildings upwind of a vegetated coastal dune profile. The two parameters were systematically varied throughout this study, starting from zero (for buildings placed directly at the dune toe or on the bed) to greater distances and increased pole heights.

Findings showed that a row of beach buildings on poles causes strong erosion around the buildings whereas deposition is enhanced over the dune toe. Although effects on the dune slope and top are minimal, our findings indicate a negative impact on dune growth over the dune slope and a positive effect over the dune top. Increasing pole height generally creates stronger sedimentation-erosion patterns in the vicinity of the buildings. The impact of the buildings on dune morphology decreases as the buildings are placed at larger distance from the dune. The sand supply in the dune is maximized when buildings are placed on long poles at substantial distance from the dune. However, this may result in strong longshore variation in bed level elevation if buildings are placed too close to the dune toe. In addition, results indicated that the critical gap width ratio as found in previous research, lowers for buildings on longer poles.

The model that was used in this study is able to capture morphodynamics over a dune profile including a row of beach buildings. However, validation showed that the computed morphological development over a single day is similar to the seasonal bed evolution as observed in the field, indicating an overestimation of the rate of morphological change in the model. Nevertheless, the magnitude and patterns of the computed morphological bed evolution roughly agrees with field data and are similar to findings by previous researchers.

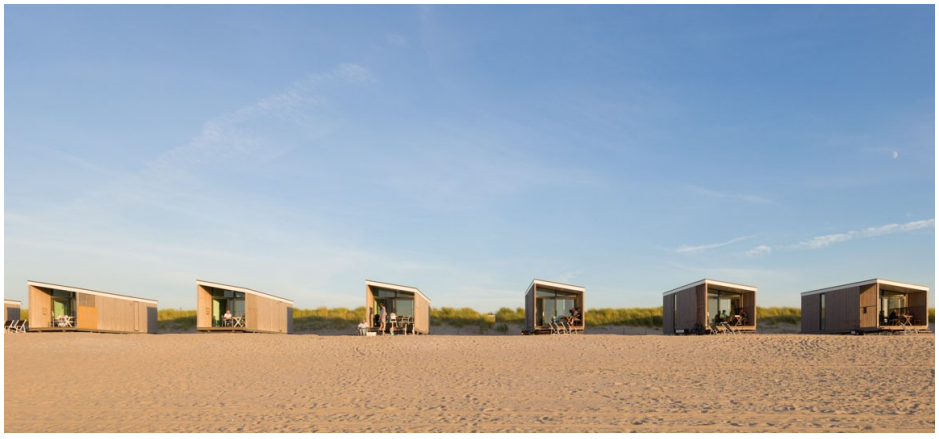

Figure 1: Beach buildings on the Zuiderstrand near Kijkduin

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