THE APPLICABILITY OF THE CELLULAR AUTOMATA MODEL DUBEVEG ON AN ANTHROPOGENIC SHORE

A relatively new type of beach nourishment to combat hydrodynamical erosion is the mega-nourishment where large amounts of sand are placed. The pilot project called The Sand Motor is a mega-nourishment of 21 Mm^3, which was constructed in 2011 at the coast near Ter Heijde in the Netherlands. The objectives of the Sand Motor mega-nourishment are to maintain coastal safety and nature development.

This research is focused on modelling dune formation pattern development at this out-of-equilibrium anthropogenic shore. The cellular automata model DUBEVEG (DUne BEach VEGetation) is used. The model includes aeolian sand transport, hydrodynamic and biotic processes to simulate the beach-dune area in a probabilistic rule-based approach.

The DUBEVEG model has not been applied previously for an out-of-equilibrium anthropogenic shore like the Sand Motor. A sensitivity analysis is made and two model revisions that were not in previous versions of the model are implemented.

The model is not able to correctly simulate the observed dune formation patterns at the Sand Motor with the model settings used in previous versions of the DUBEVEG model. The model overestimates the amount of sediment available for transport at the high elevated areas. Including a second aeolian transport direction results in more but lower dunes. Including beach armouring for the high elevated area reduced the amount of dunes on the Sand Motor significantly.

This research shows that it is possible to implement a forced coastline by hydrodynamics, beach armouring and multidirectional wind in the DUBEVEG model, but improvements can be made in future research. The DUBEVEG model in the current form is not applicable for the out-of-equilibrium anthropogenic shores like the Sand Motor because processes are missing. However, Including multidirectional wind (aeolian transport directions) and beach armouring in the model result in a better approach to the observed dunes. Assumed is that improvements in these processes would further increase the approach of the observed dune patterns and increase the applicability of the DUBEVEG model for out-of-equilibrium anthropogenic shores.

Figure 1: A picture of the Sand Motor after completion in September 2011

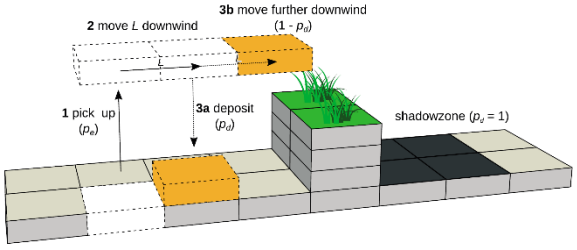

Figure 2: A schematic representation of the cellular automata model DUBEVEG.

Jan Willem van Dokkum

Graduation Date:
27 March 2019

Graduation committee:
University of Twente
Prof.dr. K.M. Wijnberg
Ir. D.W. Poppema
F. G. Silva, Msc