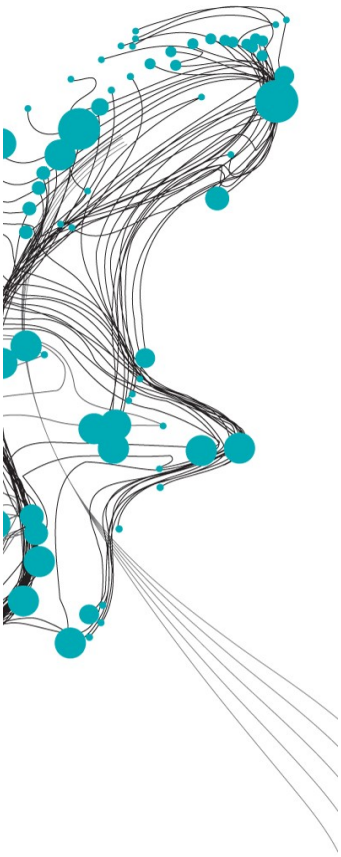
THE IMPACT OF AEOLIAN SEDIMENT TRANSPORT ON VEGETATION DEVELOPMENT IN ENGINEERED COASTAL DUNES AND DUNE VALLEYS



In 2009 a new dune area was constructed in front of the Delfland Coast. This engineered dune area consists of a foredune and a dune valley and is called Spanjaards Duin. Spanjaards Duin was created as a compensation measure for the expected increase in nitrogen deposition from the expansion of the Rotterdam harbour (Maasvlakte 2). The predefined compensation goal is to reach 6 ha of moist dune slack vegetation and 10 ha of dry grey dune vegetation in 2033. This is pursued by creating favourable abiotic conditions for natural vegetation development (Van der Meulen et al., 2014). This research studies three key abiotic influences impacting the development of target habitats. These three influences are: aeolian sediment transport, bed level change and sediment grain size distribution.

Bed level changes and sediment transport pathways were studied in Spanjaards Duin using monitoring data of LiDAR sensors on UAV and airplane. Elevation profiles of the foredune were extracted to study cross-dune morphological development focusing on the influence of planted Marram grass and beach buildings. Bed level changes were analysed in a series of artificial reed bundle fields to identify aeolian sediment transport pathways in the dune valley. A third analysis focused on bed level changes in blowouts located outside Spanjaards Duin as a potential sediment source for the dune valley of Spanjaards Duin. Two types of models were used in this research differentiating in scale. A volume balance approach was used to calculate aeolian sediment transport in Spanjaards Duin on a meso-scale (annual interval). The magnitude of transport was calculated using elevation monitoring data from LiDAR. A simplified direction of transport was assumed using wind measurements. A micro-scale (daily interval) modelling approach was used to model aeolian sediment transport, bed level change and the development of the sediment grain size distribution on the foredune and in the dune valley. For this, the numerical aeolian sediment transport model AeoLiS was used (Hoonhout & de Vries, 2016).

Aeolian sediment transport showed to be driven by high magnitude wind events. Aeolian sediment transport pathways on the foredune were directed cross-shore and transport pathways in the dune valley were directed longshore with lower transport rates. This difference in pathway direction was explained by spatial differences in impact of events with Marram grass a key element in reducing aeolian sediment transport. Beach building's influence showed to be minor. AeoLiS modelling results showed that bed level change and the sediment grain size are interrelated. In the dune valley aeolian reworking took place which resulted in a non-erodible layer dominated by rough particles. This process resulted in a higher threshold for transport and therefore a stabilized bed level. This process was confirmed by field observations and LiDAR bed level elevation data. In these engineered coastal dunes and dune valleys such as Spanjaards Duin it is concluded that two factors highly influence the abiotic conditions. Marram grass as a bodyguard for reducing aeolian sediment transport and nourished sand by highly influencing the bed level changes and sediment grain size distribution in the dune valley.

Job Oude Vrielink

Graduation Date:
12 May 2020

Graduation committee:
University of Twente
Prof.dr. K.M. Wijnberg
Dr. F. Galiforni Silva

Deltares
Dr. M.A. Eleveld

References

Hoonhout, B. M. & Vries, S. D. (2016). A process-based model for aeolian sediment transport and spatiotemporal varying sediment availability. Journal of Geophysical Research: Earth Surface, 121 (8), 1555-1575. doi:10.1002/2015JF003692

van der Meulen, F., van der Valk, B., Baars, L., Schoor, E. & van Woerden, H. (2014). Development of new dunes in the Dutch Delta: nature compensation and `building with nature'. Journal of Coastal Conservation, 18 (5), 505-513. doi:10.1007/s11852-014-0315-2

UNIVERSITY OF TWENTE.