EGU22-13280
https://doi.org/10.5194/egusphere-egu22-13280
EGU General Assembly 2022

Multi-annual geomorphic evolution of excavated foredune notches

Gerben Ruessink[1], Bas Arens[2], and Marieke Kuipers[3]
[1]Department of Physical Geography, Faculty of Geosciences, Utrecht University, P.O. Box 80.115, 3508 TC Utrecht, The Netherlands
[2]Bureau for Beach and Dune Research, Soest, The Netherlands
[3]PWN Drinking Water Company, Velserbroek, The Netherlands

The prevention of marine flooding is one of the most important functions of foredunes along developed coasts. Consequently, many foredunes have been managed into densely vegetated, uniform and stable ridges of sand. While such foredunes reduce the risk of coastal flooding under present-day conditions, it is increasingly feared that they are less resilient to persistent erosion under climate change (e.g., rising sea levels). The dense vegetation blocks the sand exchange between the beach and the backdunes and accordingly, prevents the backdunes from growing with sea-level rise. In various countries around the world, dune management is therefore now adopting a more dynamic approach. The excavation of gaps through the foredune, termed notches, is an increasingly adopted management measure (e.g., United Kingdom, France, New Zealand, the Netherlands) to restore the natural sand pathway from the beach into the backdunes without simultaneously increasing the risk of flooding. In addition, it is hoped that the renewed sand influx improves the natural values of the backdunes by creating more diverse habitats, including bare sand areas for flora and fauna depending on open conditions. The geomorphic dynamics of notches is, however, not well understood, especially on the time scale of years. This also prevents understanding what factors contribute to success (long-term mobility) or failure (rapid stabilization) of dynamic dune management.

Here we analyse the geomorphic evolution of five notches in the foredune of the Dutch National Park Zuid-Kennemerland since their excavation in the 2012/2013 winter (up to October 2021; 8.5 years) using 24 digital elevation models (DEMs) derived from airborne lidar and drone surveys. DEMs of Difference illustrate that the notches have persistently eroded since their excavation, mostly through alongshore widening and steepening of the lateral walls, at an approximately constant volumetric rate of about 17,500 m^3/y. Landward of the notches, depositional lobes have formed that in October 2021 extended up to 280 m into the backdunes and were locally up to 10 m thick. The total deposition volume increased approximately linearly with time by about 33,350 m^3/y, thus surpassing the annual erosion volume by almost a factor of 2. This reflects substantial aeolian transport of beach sand through the notches. Under the assumption that the excess deposited sand all originates from the 850-m alongshore section of beach fronting the five notches, the annual input of beach sand equals approximately 19 m^3/m/y. These results highlight that the notches facilitated highly efficient onshore sand pathways during the entire 8.5-y study period and showed no sign of rapid stabilization. In more detail, the data also suggest that the

notches oriented with the dominant wind direction are more efficient in facilitating this onshore transport than notches with other orientations. Future work will focus on the fusion of the elevation data with high-resolution satellite imagery to better understand the impact of sand deposition on vegetation dynamics and on the role of vegetation in determining the future evolution of the depositional lobes.