THE EFFECT OF WAVE OBLIQUITY ON DUNE EROSION: A FIELD EXPERIMENT

Paul van Wiechen, Delft University of Technology, P.P.J.vanWiechen@tudelft.nl
Jantien Rutten, Delft University of Technology, J.Rutten@tudelft.nl
Marion Tissier, Delft University of Technology, M.F.S.Tissier@tudelft.nl
Sierd de Vries, Delft University of Technology, Sierd.deVries@tudelft.nl
Ryan Mieras, University of North Carolina Wilmington, mierasr@uncw.edu
Katherine Anarde, North Carolina State University, kanarde@ncsu.edu
Stefan Aarninkhof, Delft University of Technology, S.G.J.Aarninkhof@tudelft.nl

INTRODUCTION
Storm conditions can lead to excessive dune erosion with potential floods as a consequence. Barrier islands and low-lying countries protected by dunes are especially vulnerable to dune erosion. To properly assess the risks these areas face, a clear understanding of the physical processes during dune erosion is required.

One of such processes is the effect of wave obliquity on sediment transport in the surf zone. Classic dune erosion models assume that dune erosion volumes decrease under oblique wave attack, because the time-averaged cross-shore undertow decreases in magnitude and with that offshore directed sediment transport decreases (Steetzel, 1993). More recent process-based erosion models predict an increase in erosion quantities, because the generated longshore currents increase surf zone sediment concentrations, and with that offshore directed sediment transport increases (Den Heijer, 2013).

OBJECTIVE
The main objective of this study is to analyse the effect of wave obliquity on dune erosion through a field experiment, by quantifying the effect of the decreasing undertow but increasing alongshore current on sediment concentrations in the surf zone. By better understanding the dominant processes determining sediment concentrations in the surf zone, estimates of sediment transport can be improved, resulting in better (model) predictions of dune erosion during storm conditions.

APPROACH
The field experiment was conducted from November 6 2021 until January 7 2022 on the beach of the Sand Engine, the Netherlands. Two prototype, unvegetated dunes of 5.5 m high and 150 m long were built just above the high waterline. Due to a different orientation and nearshore bathymetry, these dunes eroded differently during moderate storm conditions (Figure 1). Over 40 instruments were installed at the field site, including pressure sensors, offshore and onshore velocimeters, concentration meters, and 1D lidar scanners. Three storms were captured during the campaign. Dune 1 showed major erosion during these events and dune 2 completely eroded away after storm 3.

ANALYSIS AND RESULTS
At both dunes, collocated velocity (ADV), pressure (ADV) and sediment concentrations (OBS) measurements in the surf zone have been collected to determine the effect of the undertow and alongshore current on sediment concentrations. Profile cross sections of the pre- and post-storm dune profiles have been collected to quantify erosion volumes and sediment displacement (Figure 1). Further analysis and conclusions with regards to the objective will be presented at the ICCE.

REFERENCES
Den Heijer, C. (2013). The role of bathymetry, wave obliquity and coastal curvature in dune erosion prediction. Ph.D. thesis.
Steetzel, H. J. (1993). Cross-Shore Transport during Storm Surges. Ph.D. thesis.

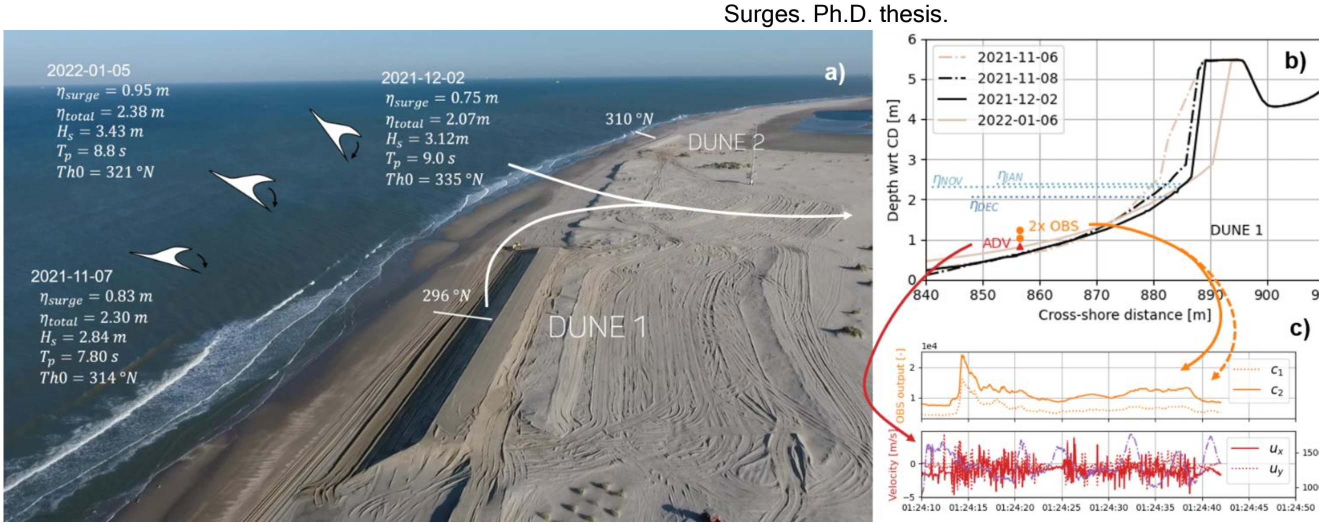

*Figure 1: **(a)** Aerial impression of the field site including measured offshore storm conditions. **(b)** measured post-storm cross-shore profiles of dune 1. **(c)** measured ADV and OBS signals during the peak of the December storm (2021-12-02)*