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# Pre- and post storm measurements at lab Bergen-Egmond

## Introduction

The Interreg North Sea Region Building with Nature (BwN) project is funded by the European Union and aims to develop knowledge about Building with Nature through pilot projects to stimulate the application of this concept by European Governments. In the BwN project, partners from The Netherlands, Germany and Denmark work together. Seven coastal sites were selected ('living laboratories') to generate the evidence-based knowledge that is currently lacking to incorporate building with nature solutions in national policy and investment programs.

Bergen-Egmond is one of the selected sites, and here the goal is to understand the behaviour of shoreface and beach nourishments with respect to the sandy coastal management strategy and coastal characteristics. Figure 1 shows the location of the study area.

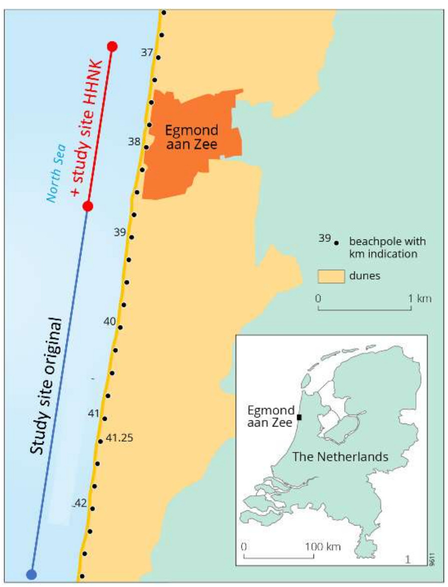


*Figure 1. Location of the study area with RSP numbering. The origin of the local coordinate system used here is beach pole 41.25, with positive x and y in the seaward and southward directions, respectively. In 2020, the study area has been expanded with the area of interest of the Hoogheemraadschap Hollands Noorderkwartier (HHNK) Water Board.*

Within the BwN project the Source-Pathway-Receptor (SPR) approach will be used to understand where sediment originates from (the source), what the general net pathway is and where these sediments finally settle (receptor). This will provide insight into the smart application of nature-based solution in the light of the total system change, such as sea level rise. From June 2020 to June 2021 the project will focus on the effect of Building with Nature techniques on influencing the SPR for storm surge events. XBeach will be used to assess how (for each selected lab) the Source Pathway and Receptor for water and sediment can be influenced in such a way that benefits for society or the

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ecosystem (receptors) can be achieved. This will include 1) Validation of expected dune erosion during storm surge events, and 2) Running scenarios for the strategic placement of nourishments to assess the short-term reduction of dune erosion due to “design” storm surges.

In order to complete task 1 (XBeach validation), observations on storm-impact on the coast of the labs are needed. The Dutch lab Bergen-Egmond is the study site for the ‘quick reaction force’, a site where field data is collected directly preceding, during and following storms since 2017. The BwN study funded the deployment for the winter of 2020/2021

## Measurements and equipment

A pre-storm season measurement has been done on in October 2020 and a post storm season topographic measurement in March 2021. Full bathymetric (sonar-equipped jetski) and topographic (mobile laser scanner) surveys have been done before and after the storm season. This dataset will subsequently be used to validate the XBeach model at Bergen-Egmond using the XBeach version and calibrated settings for the Dutch coast (Dutch coastal assessment, BOI).

The measuring equipment used consists of a GPS base station, the jet ski (Figure 2), a 4wd all-terrain vehicle equipped with LiDAR (Figure 3) or a drone () and a GPS roller assembly (Figure 5) for the intertidal parts of the area. The water depth under the jet ski is measured with a Hydrobox Single Beam Echo Sounder (SBES, measurement frequency 10 Hz). An important parameter for determining the water depth using echosounding is the speed of sound in water. This is measured using a CTD (YSI Castaway). Positioning (in all directions) is done by means of a Septentrio GPS receiver. An accurate position can be calculated using the so-called Real Time Kinematic (RTK-GPS) technique. The GPS position is corrected with correction values obtained via a GSM internet connection with LNR Globalcom BV. The distance from the GPS antenna to the transducer of the echosounder is fixed. This converts water depth to bottom position relative to the GPS position. SBES and GPS measurements are logged on a laptop by HYPACK hydrographic software. A display on the front of the jet ski shows real-time information to the driver, such as position, status of the instruments and the survey lines to be sailed and completed.


*Figure 2. Jetski with equipment*

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Figure 3 shows an off-road vehicle with the mobile LiDAR sensor on it, as used for this survey. Figure 4 shows the drone with a mobile LiDAR sensor. Via WiFi or 3G, the Lidar system is connected to a laptop containing the control software for the measurement system. RTK-GNSS correction values can be sent to the system via 3G/WiFi/UHF. On the laptop, all measured values of the various sensors are visible in real time. The point cloud is also built up in real time on the surveyor's screen during scanning. The surveyor monitors all sensor values in real time to ensure a high-quality measurement conducted.


*Figure 3. Photo of the mobile LiDAR sensor on an off-road vehicle.*

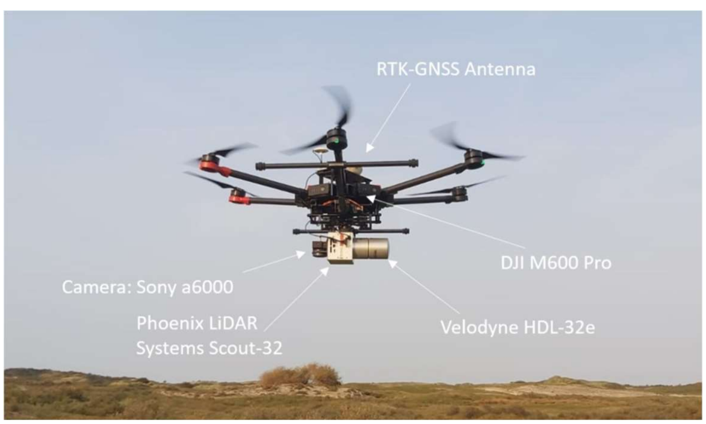


*Figure 4. Photo of the mobile LiDAR sensor on a drone*

With the GPS roller assembly shown in Figure 5, the intertidal parts of the area can be measured that are inaccessible for both the jet ski and the 4WD all-terrain vehicle. Positioning (in all directions) is done by means of the Leica Viva GS14 GPS receiver. This is mounted on a lead bar that is integrated with a unicycle and wheelbarrow frame. Measurements are done continuously while walking. On the handheld module, real-time information such as position, status of the instruments and the survey lines to be run and completed can be read and set. Accurate position is calculated using RTK-GPS.


*Figure 5. GPS roller assembly*

## Measurement results

The prestorm season measurements were carried out on Saturday 15, 16, 17 (LiDAR) and 19 (offshore) October 2020. Figure 6 shows the topography along the survey tracks, i.e. the measured height of the beach surface and foreshore in meters relative to NAP, measured in October 2020. Figure 7 shows a detail of the LiDAR point cloud. There were many fishing nets around the low water line and in the channels that still carried water at low tide. Despite attempts to survey both sides of the nets, a few places remained where it was not safe to do so. Those gaps can be seen in the top views of the measurement data.

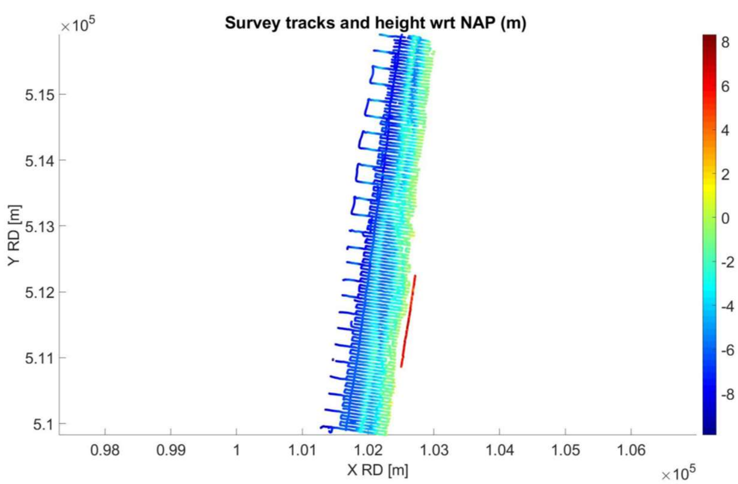


*Figure 6. Topography along survey tracks measured in October 2020*

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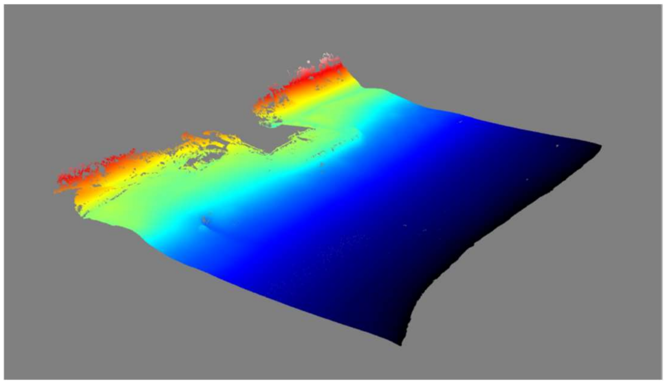

*Figure 7. Detail of LiDAR point cloud measured in November 2020*

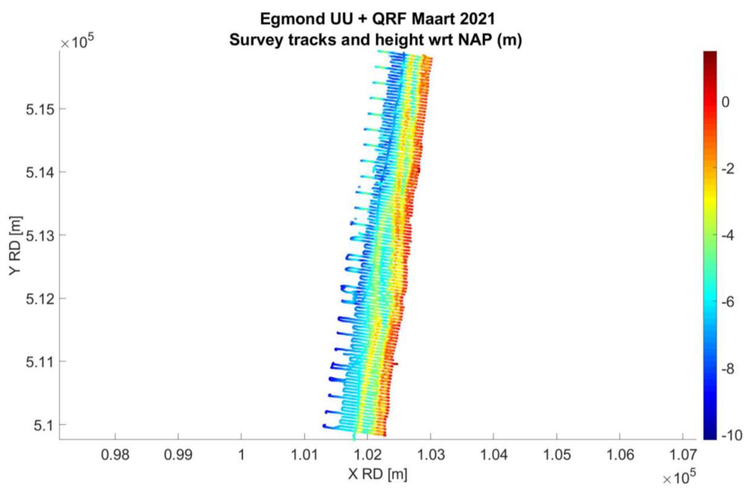


*Figure 8. Topography along survey tracks measured in March 2021*

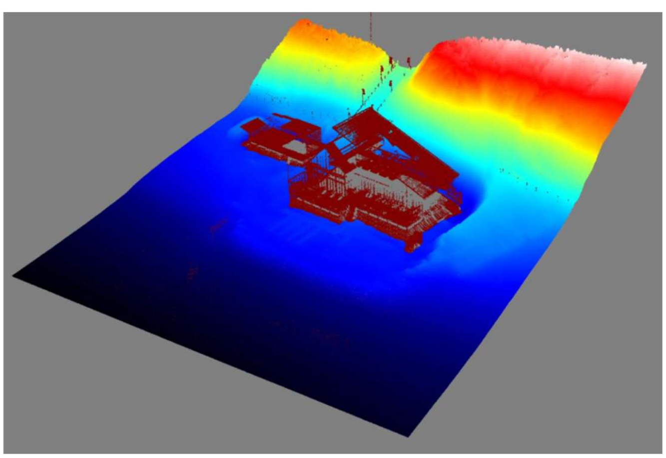

*Figure 9. Detail of LiDAR point cloud measured in March 2021.*
*The removed objects (beach clubs, people, posts) are brown coloured.*

# Memo

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## Dataset

The data and the measurement reports are stored on the following QRF repository
https://repos.deltares.nl/repos/QuickReactionForce/