Universiteit Utrecht
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Enabling new technology

Sandbar behaviour along a man-made curved coast

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Research question: What explains the temporal variability in 3D behaviour of sandbars at the North and West side of the Sand Engine?

Introduction

Sandbars are known to vary in planshape from linear, two-dimensional (2D) to undulating, three-dimensional (3D) (Fig.1) with imposed wave forcing. 3D behaviour and its forcing mechanism, well-known along straight coasts, is relatively unknown along a curved coast, such as the Sand Engine.

We hypothesize that local differences in 3D behaviour are driven by local variations in wave forcing.

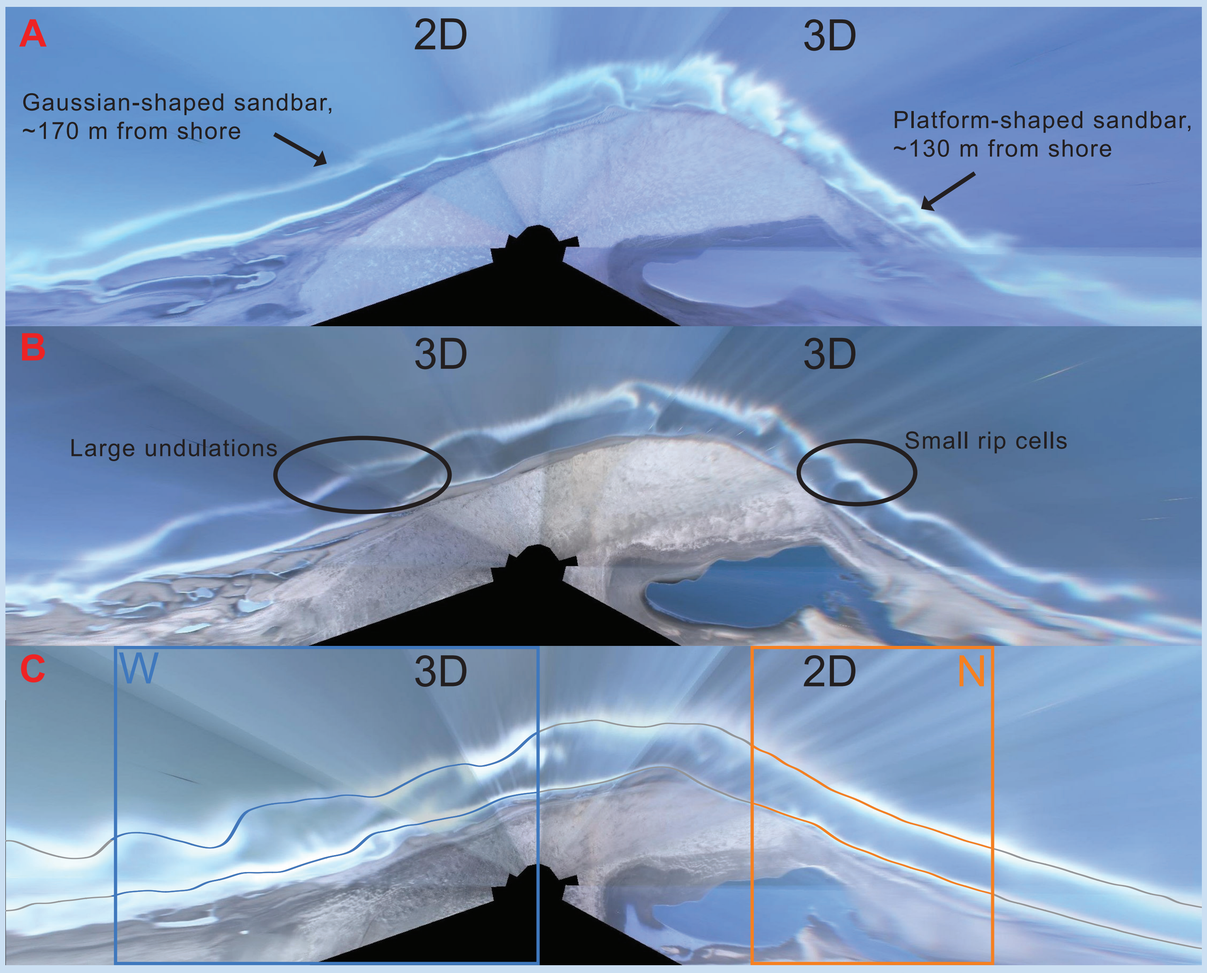


Figure 1. Topview 10-min time-averaged images wherein white lines of preferential wave breaking indicate sandbar (outer) and shoreline (inner). Sandbar morphology varies alongshore and in time. Antecedent bar morphology differs for northern and western side (arrows, circles).

Data and methods

- 2.4-year data set of daily low-tide Argus video images from the Sand Engine
- Detection of sandbar in images (Fig. 1c) and computation of standard deviation *Std* [m] (2D versus 3D), at northern and western side
- Computation wave power P and alongshore wave power P_y from measured wave data

Results

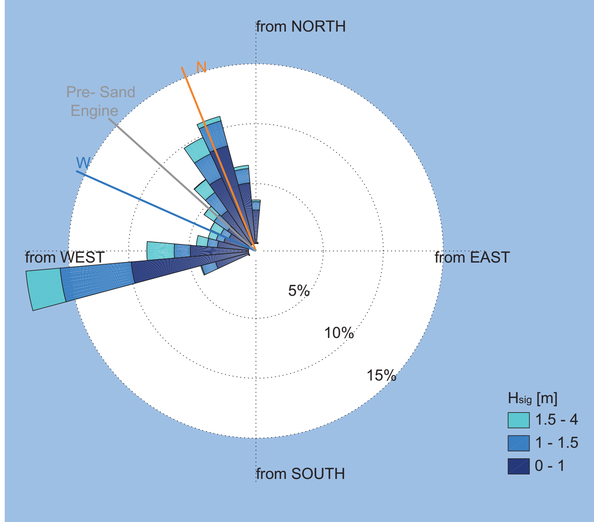


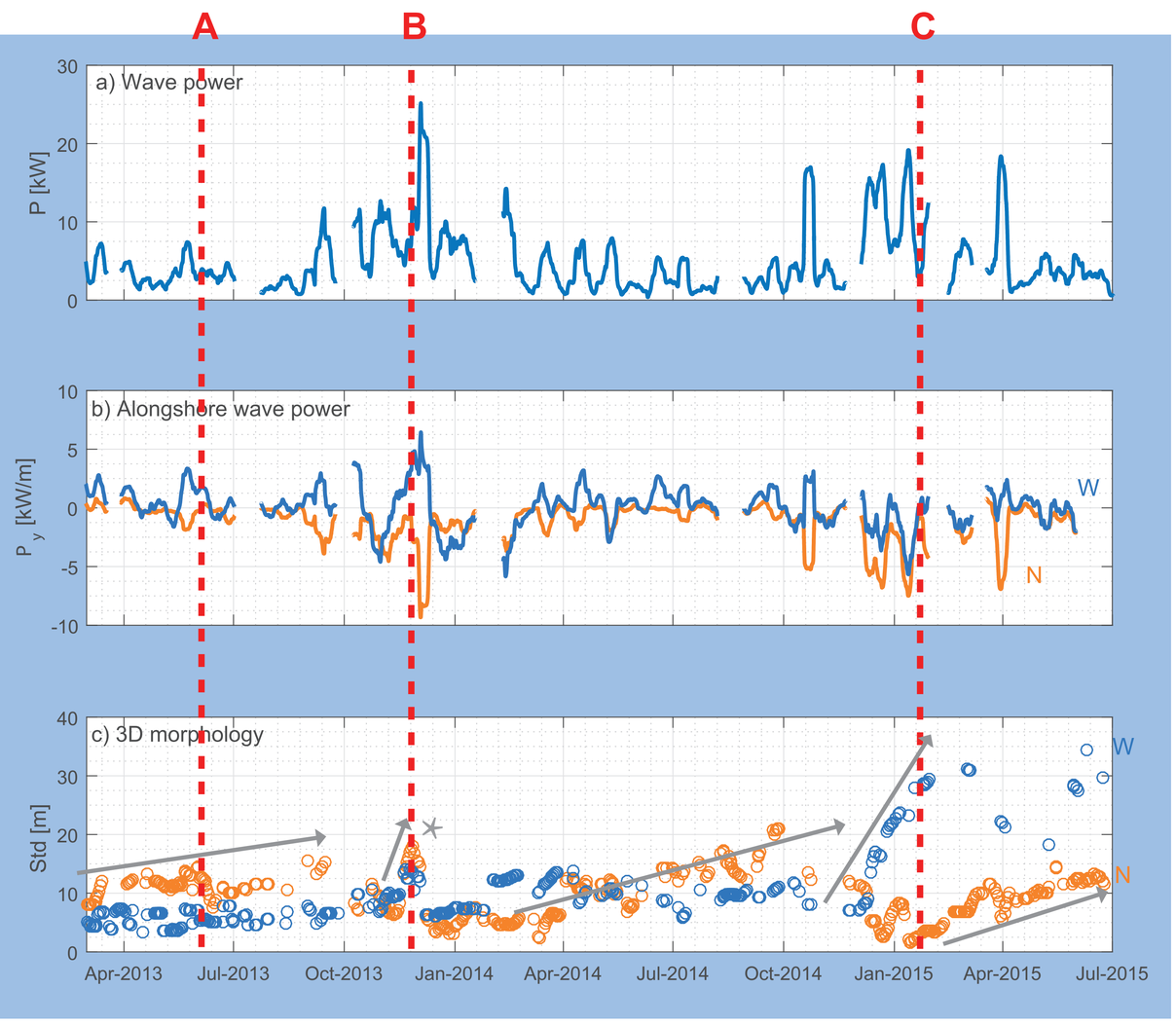
Figure 2. Observed wave conditions during study period. The lines indicate the time-averaged shore-normal at the northern and western side, and for the pre-Sand Engine setting.

- *The waves entered perpendicular or highly oblique at the northern side, and obliquely at the western side.*

Figure 3 (right). 2.4-year timeseries showing 8-day averages of wave statistics (a,b), and standard deviation in sandbar position Std (c).

- *North: 3D morphology increases gradually under calm conditions (e.g. summer) (Fig. 3c, arrows): small rip cells (see Fig. 1a) form, which tend to merge under more energetic conditions*
- *West: 3D morphology increases rather abruptly with events (Fig. 3c, arrows): large undulations form (see Fig. 1b)*
- *3D morphology 'resets' at both sides in winter 2013/2014 by a large event (Fig. 3c, *), whereas 3D morphology increases in winter 2014/2015 under a series of moderate events*

- *Note that antecedent morphology may have contributed to differences in sandbar response for both sides (see Fig. 1)*



Conclusions

- 3D morphology forms gradually under calm conditions at northern side, and more abruptly under moderate conditions at western side.
- Differences in bar response at the northern and western side may be caused by a distinctly different local wave climate, and a different antecedent morphology.

Future bar response?

Given the slow diffusion of the Sand Engine, the orientation of both coastlines converges to the Pre-Sand Engine orientation.
As a result, differences in bar response between the northern and western side, as observed here, are expected to decrease. This will be tested in a model study.