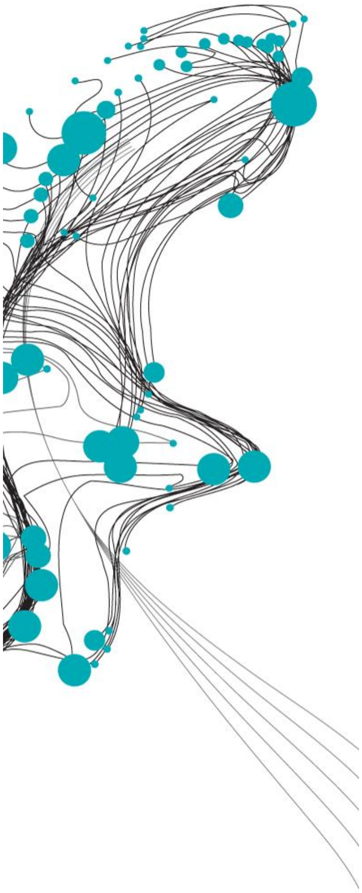

DEFLECTED SAND WAVE MIGRATION DUE TO SEVERE WIND EVENTS ALONG THE BBL-PIPELINE

A 3D NUMERICAL MODELLING STUDY USING EIGHT YEARS OF BATHYMETRICAL DATA

Migrating sand waves may pose risks to subsea pipelines. As a result of migrating sand waves free spans can occur. Free spans may initiate vibrations resulting in pipe fatigue damage. Therefore, it is vital to understand the behaviour of these sand waves for pipe maintenance. This study investigates an irregular and dynamic sand wave field (figure 1) which covers part of the BBL-pipeline, a pipeline from Balgzand (NL) to Bacton (UK). Regular surveys along the BBL show sand waves migrating inconsistent spatially and temporally. This indicates that sand wave migration may be caused by both the regular tide and (severe) wind events, making the migration difficult to predict. The research objective of this study is therefore to improve the understanding in sand wave migration and related wind influences for future pipeline maintenance.

The first part focuses on the survey data. Crests and troughs are selected after a low pass Fourier filter is applied. This shows spatial and temporal inconsistencies in the sand wave migration, resulting in four spatial migration patterns (temporal inconsistencies shown in figure 2). The wind data subsequently shows anomaly magnitudes and angles during 2013 and 2015, which link to the temporal inconsistency of the sand wave migration. This raises the hypothesis that wind contributes to sand wave migration.

In the second part a 3D-hydrodynamic Delft3D-FLOW model is setup to investigate the tide residual currents and wind influence in the sand wave area. Results show a tide-induced residual circulation induced by sand banks. This circulation likely causes the four observed spatial migration trends.

Idealized severe wind scenarios, including wind waves, show a factor of order 10 for wind driven currents compared to the tide residual currents near the pipe. For sediment transport this factor reaches an order 100 comparing a severe wind scenario to a still-wind case. Mainly wind from the south and south-east cause an increase in transport to the north-west. This finding resembles the field observations, indicating a north-west sand wave migration increase during the years 2013 and 2015 with a relative dominant southern wind.

The third part investigates a case where the pipe is in free span. This shows that for general migration trends the model performs well. However, for local analysis of sand wave migration the model uncertainty in the position of the residual circulation is too large.

It is concluded that the model is able to explain the general spatial sand wave migration trends along the BBL. The temporal trend during 2013 and 2015 is better understood, since sediment transport is enhanced during the severe southern wind in these years.

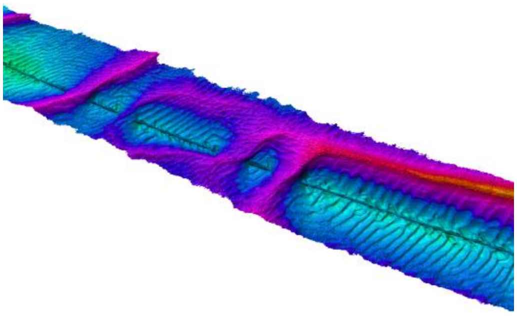

Figure 1: Transect of the BBL-pipeline, including sand waves.

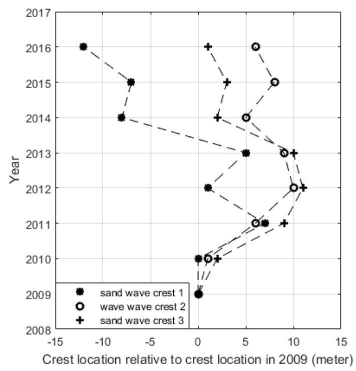

Figure 2: Migration of three sand waves crests in time.

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