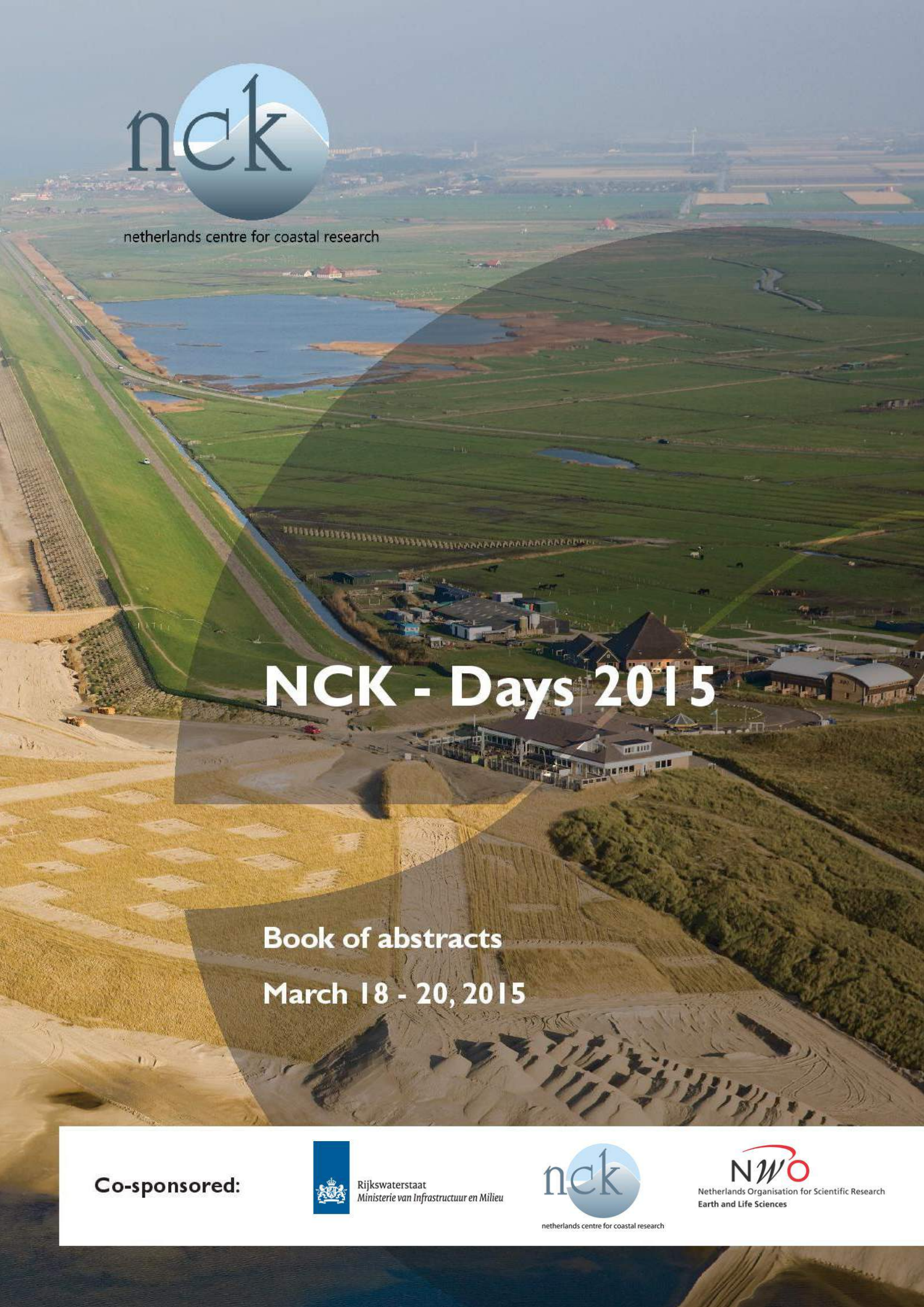

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Sedimentation rate, patterns and dredging effects in Rotterdam harbour access channel, the Maasgeul

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1. Introduction

Access channels to harbours have to be dredged regularly to keep the required navigation depth. Therefore, knowledge of the sedimentation rates in the channel is important to design efficient monitoring and dredging policies. Several theoretical models on the sedimentation of (dredged) channels have been designed in the past (e.g. Galvin, 1982; Van Rijn, 1986). However, field studies are still limited in number (e.g. Gosh et al., 2001).

The Maasgeul is the offshore access channel to Rotterdam harbour and is kept at a depth of -24 m LAT. To keep the channel floor at depth, the Maasgeul is being dredged several times a year up to an annual volume of about 1 million m^3. In this study we used bathymetrical measurements to determine 1) the natural sedimentation rate and patterns in the channel and 2) the effect of dredging activity on the sedimentation rate.

2. Methodology

Analyses were based on monthly bathymetrical grids from 2008-2013 with a 1x1m resolution. For each pixel, trends of bed level in time were calculated in three different ways. Dredging events were determined to be any bed level change ≤ -25 cm in one month. Two aspects are used to quantify the effect of dredging: 1) the 'recovery period' - the time until exceedance of the pre-dredging bed level and 2) the 'recovery effect' - the increased sedimentation rate directly after dredging. The recovery effect is studied by comparing average bed level changes in the subsequent months after a dredging event and related to the depth of dredging.

3. Results

Two of the applied methods to calculate the trend in bed level yielded good results, showing natural spatial patterns (Fig. 1). The southern part of the channel shows higher sedimentation rates as an effect of a dominant northward residual current. Trends calculated between dredging events were averaged to yearly sedimentation rates. These show a clear change

in spatial pattern that can be correlated to the seaward harbour extension 'Maasvlakte II' from 2009-2013.

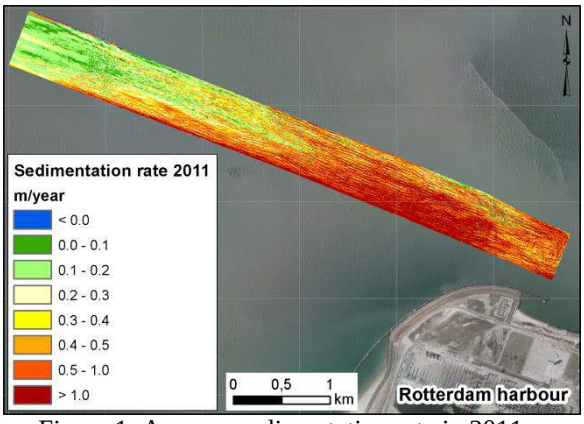

Figure 1: Average sedimentation rate in 2011

The recovery effect is visible in the sedimentation rates that are higher in the first two months after a dredging event. The recovery effect is depended on the dredging depth: the deeper the dredging, the higher the sedimentation rate. This is also expressed in the recovery period: deep dredging results in a relatively shorter recovery period. The average recovery periods are ca. 5 months after 40 cm dredging and ca. 7 months after 1 m dredging, indicating that smaller dredging events are more efficient.

4. Conclusions

The developed methods to determine the natural sedimentation rates in the Maasgeul show clear spatial patterns that can be explained by physical and environmental conditions. In the first two months after dredging, dredging affects the sedimentation rate the most. Smaller dredging events are relatively more effective in terms of recovery period.

The results of this study can be used to optimize dredging and monitoring activities.

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