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SUSTAINABILITY OF THE MULTI-CHANNEL SYSTEM IN THE WESTERSCHELDE UNDER INFLUENCE OF DREDGING AND DISPOSAL

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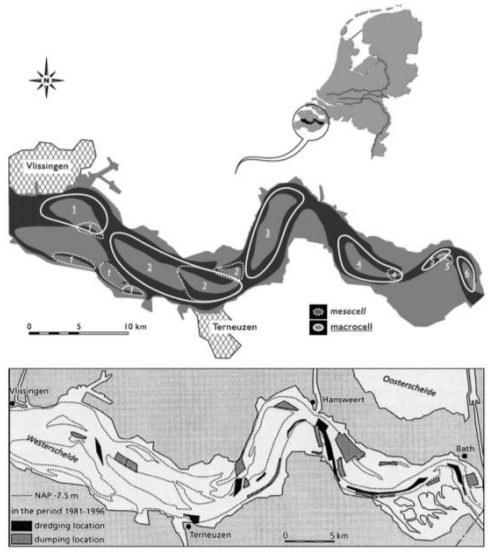
Introduction

The multi-channel system in the WS is considered as an important natural characteristic which needs to be preserved.

The sustainability of the multi-channel system is influenced by the dredging – disposal activities.

Further in this presentation:

- Review of the studies so far
- Identification problems
- Proposed further research



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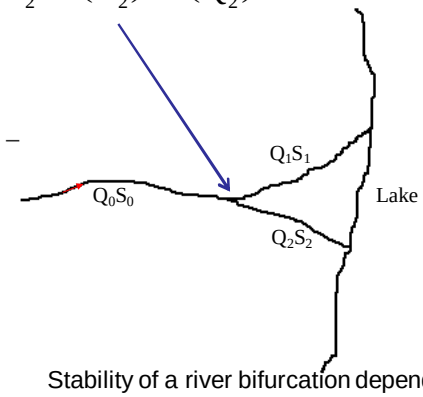
River bifurcation

$$\frac{S_1}{S_2} = \left(\frac{B_1}{B_2}\right)^{1-k} \left(\frac{Q_1}{Q_2}\right)^{k}$$

Transport at inflow side determined by Nodal-point relation & at outflow side by transport capacity



$$\frac{dh_1}{dt} = f_1(h_1, h_2)$$

$$\frac{dh_2}{dt} = f_2(h_1, h_2)$$

Stability of a river bifurcation depends on how the sediment transport distribution at the bifurcation depends on the discharge distribution

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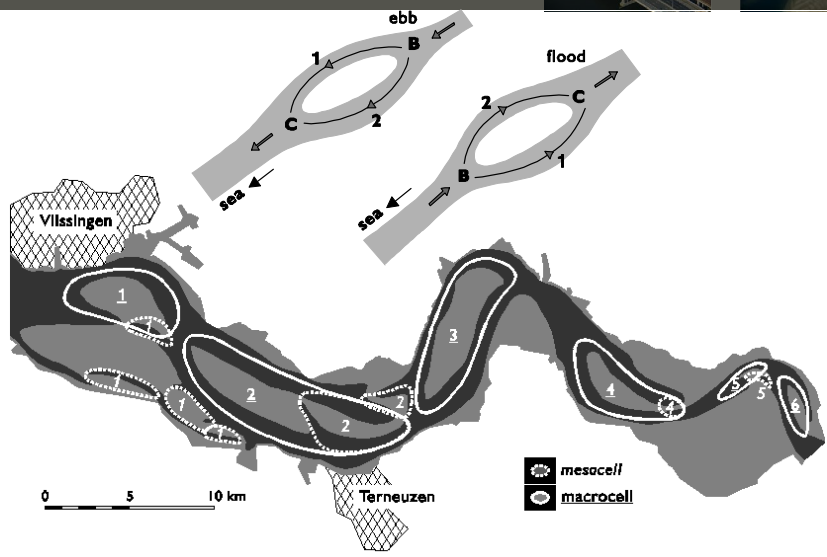
Cells of flood-ebb channel systems



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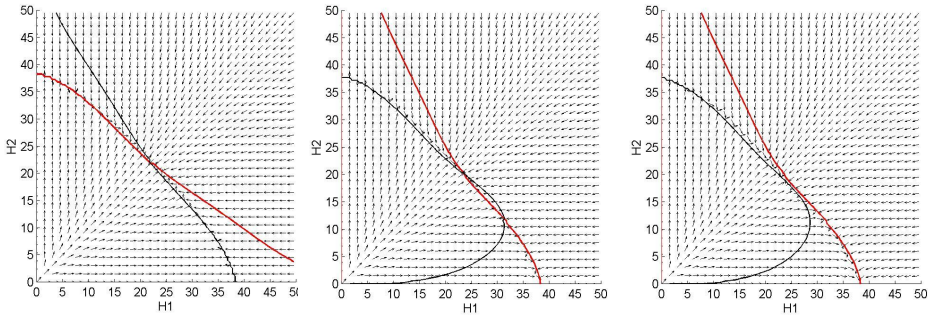
Influence of disposal

Wang & Winterwerp (2001), Jeuken & Wang (2010)

No dumping | 5% dumping | 10% dumping



There is a limit for disposal for the stability of the multi-channel system
Conclusion verified with 1D network model

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Problems / shortcomings of the analysis

- The determined limit for disposal rate is related to the sediment transport capacity at equilibrium, which is unknown because an estuary is never in equilibrium
- The timescales associated with channel degeneration are large and have not been determined. Including mud influence in the analysis is required but has not been done yet.
- Only a isolated single macro-cell has been considered in the analysis so far. Interactions between the neighbouring cells have not been considered.
- Little attention is paid to the smaller scale morphological development within a macro-cell, e.g. channel-shoal interaction

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Multi-channel stability in a changing environment

Extend and deepen the data analysis of Jeuken and Wang (2010)
Analytical and numerical modelling
Evaluation of the impact of sand-mining
Develop / improve rules to account for the 'autonomous development'

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Influence of mud on the multi-channel stability

Mud-transport modelling to obtain better insight into the mud transport in the estuary
Extend the stability analysis for the two-channel system with the transport of mud to examine if and how mud transport influences the stability of the multi-channel system
Improve the formulation to predict the morphological time scale of changes in channel stability taking into account the influence of mud transport and deposition

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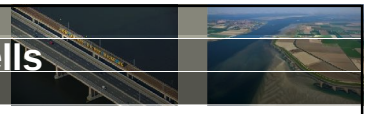
Interaction between macro-cells



Analyse the development of cell 3 with special attention to the distinction between 'autonomous' development and impact of dredging & disposal, using field data and model results.

Investigate the risk of the formation of a long cell by merging cells 2,3&4.

Investigate the effect to the neighbouring cells 2 and 4 if Middelgat is silted up. The investigation can be based on process-based modelling for schematised case as well as for the real geometry

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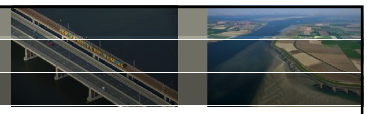
Meso-scale development



Investigate the effect of length of cell on the stability of the two-channel system. Compare the development of sills in channels to the development of tidal watershed in the Wadden Sea

Extend the stability analysis by including the exchange of water and sediment within the cell via the tidal flat and the connecting channels

Analyse sensitivity of a number of characteristics of a macro-cell to the stability of the two-channel system. The characteristics include different sizes of the two channels (length, width, depth)

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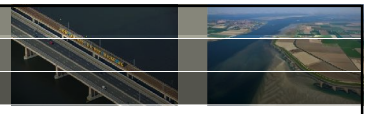
Concluding remarks



Further study on the stability of the multi-channel system in the Western Scheldt is required

Basis for the required study is formed by the substantial progress in studying the morphological development in the Western Scheldt in the recent years:

- new insights into the morphological system
- improved model suits
- extensive available data

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