

Tidal Response to Land Reclamation in Single- and Multichannel Estuarine Systems

Beemster, J.G.W.; van Maren, D.S.; Hoitink, A.J.F.

Publication date
2023

Document Version
Final published version

Citation (APA)
Beemster, J. G. W., van Maren, D. S., & Hoitink, A. J. F. (2023). *Tidal Response to Land Reclamation in Single- and Multichannel Estuarine Systems*. Abstract from 13th Symposium on River, Coastal and Estuarine Morphodynamics, Urbana-Champaign, Illinois, United States.

Important note
To cite this publication, please use the final published version (if applicable).
Please check the document version above.

Copyright
Other than for strictly personal use, it is not permitted to download, forward or distribute the text or part of it, without the consent of the author(s) and/or copyright holder(s), unless the work is under an open content license such as Creative Commons.

Takedown policy
Please contact us and provide details if you believe this document breaches copyrights.
We will remove access to the work immediately and investigate your claim.

Green Open Access added to TU Delft Institutional Repository

'You share, we take care!' - Taverne project

<https://www.openaccess.nl/en/you-share-we-take-care>

Otherwise as indicated in the copyright section: the publisher is the copyright holder of this work and the author uses the Dutch legislation to make this work public.

Tidal Response to Land Reclamation in Single- and Multichannel Estuarine Systems

J.G.W. Beemster¹, D.S. van Maren² and A.J.F. Hoitink¹

¹ Department of Environmental Sciences, Wageningen University and Research, Wageningen, The Netherlands, joris.beemster@wur.nl, ton.hoitink@wur.nl

² State Key Lab of Estuarine and Coastal Research, East China Normal University, Shanghai, China; Faculty of Civil Engineering and Geosciences, Delft University of Technology, Delft, The Netherlands; Deltares, Marine and Coastal Systems Unit, Delft, The Netherlands, bas.vanmaren@deltares.nl

1. Introduction

Intertidal areas play a crucial role in controlling tidal hydrodynamics and morphodynamics in estuaries and tidal inlets. As a consequence, widespread land reclamation of the intertidal zone has led to alterations in tidal dynamics and the associated morphodynamics of estuaries worldwide. Comparatively little research has focussed on the impact of width changes on tidal hydrodynamics, and results that do exist are highly ambiguous (Talke and Jay, 2020). Tie channels in between parallel inlets complicate the tidal motion, as multichannel systems exhibit a hydrodynamic response that differs significantly from the response observed in single channel systems. In this study, we combine idealized process-based modelling and historical data analysis to investigate the effects of intertidal land reclamation on the tidal dynamics of single- and multichannel systems. Specifically, we focus on the Scheldt and Pasur-Shibsa estuaries, which represent a single- and multichannel system, respectively.

2. Main Findings

For single-channel systems, our Scheldt findings indicate that the reclamation of parts of the intertidal area results in increased tidal amplitudes within and landward of these areas. Embankment of the intertidal areas causes a significant loss of intertidal storage. However, the amplified tidal range results in an increase in intertidal storage within the main channel. This increase is due to two factors: a local increase in the tidal range and a stronger landward intrusion of the tidal wave. Consequently, the tidal prism is partially maintained, and the loss of storage within the intertidal zone is partially compensated for by an increase of storage within the channel. Moreover, the removal of the intertidal area enhances wave propagation in the channel, leading to reduced travel times and alterations of the resonance properties.

Multi-channel systems exhibit a similar initial response to widespread land reclamation. However, cross-basin feedbacks can lead to a reorganization of discharge pathways and drastic morphologic changes. Such feedbacks can be instigated through asymmetric or asynchronous land reclamation. In the Pasur-Shibsa estuary, the Shibsa was subjected to earlier and more widespread land reclamation, leading to severe tidal amplification (van Maren et al., 2023). This has led to partial capture of the intertidal storage of the Pasur, and the river discharge it receives. These changes caused severe bank erosion in both the Shibsa and

the channels connecting it to the Pasur, while widespread sedimentation caused the Pasur to degenerate.

3. Conclusions

Our study sheds light on the unexpected morphodynamics that can result from widespread land reclamation and how the hydrodynamic response differs between single- and multichannel systems. Our findings emphasize the need for a comprehensive understanding of the role of the intertidal zone on estuarine tidal morphodynamics.

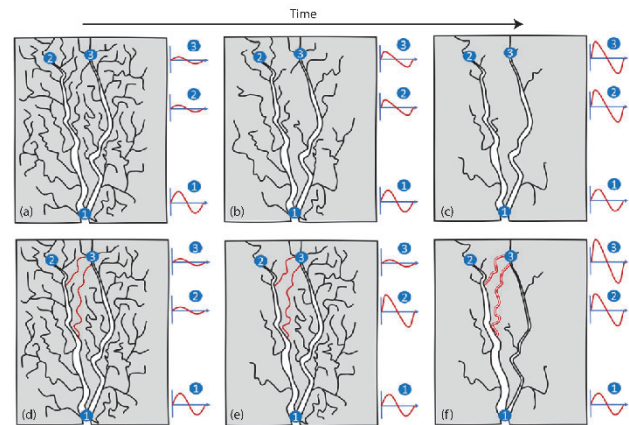


Figure 1. Positive feedback mechanisms leading to tidal deformation and channel network reorganization. Top and bottom rows illustrate the response to land reclamation for two connected and disconnected estuaries, respectively.

Acknowledgments

The Netherlands Organisation for Scientific Research (NWO) funded part of this project through Vici project “Deltas out of shape: regime changes of sediment dynamics in tide-influenced deltas” (NWO-TTW 17062).



References

- Talke, S. A., & Jay, D. A. (2020). Changing tides: The role of natural and anthropogenic factors. *Annual review of marine science*, 12, 121-151.
- Van Maren, D. S., Beemster, J. G. W., Wang, Z. B., Khan, Z. H., Schrijvershof, R. A., & Hoitink, A. J. F. (2023). Tidal amplification and river capture in response to land reclamation in the Ganges-Brahmaputra delta. *Catena*, 220