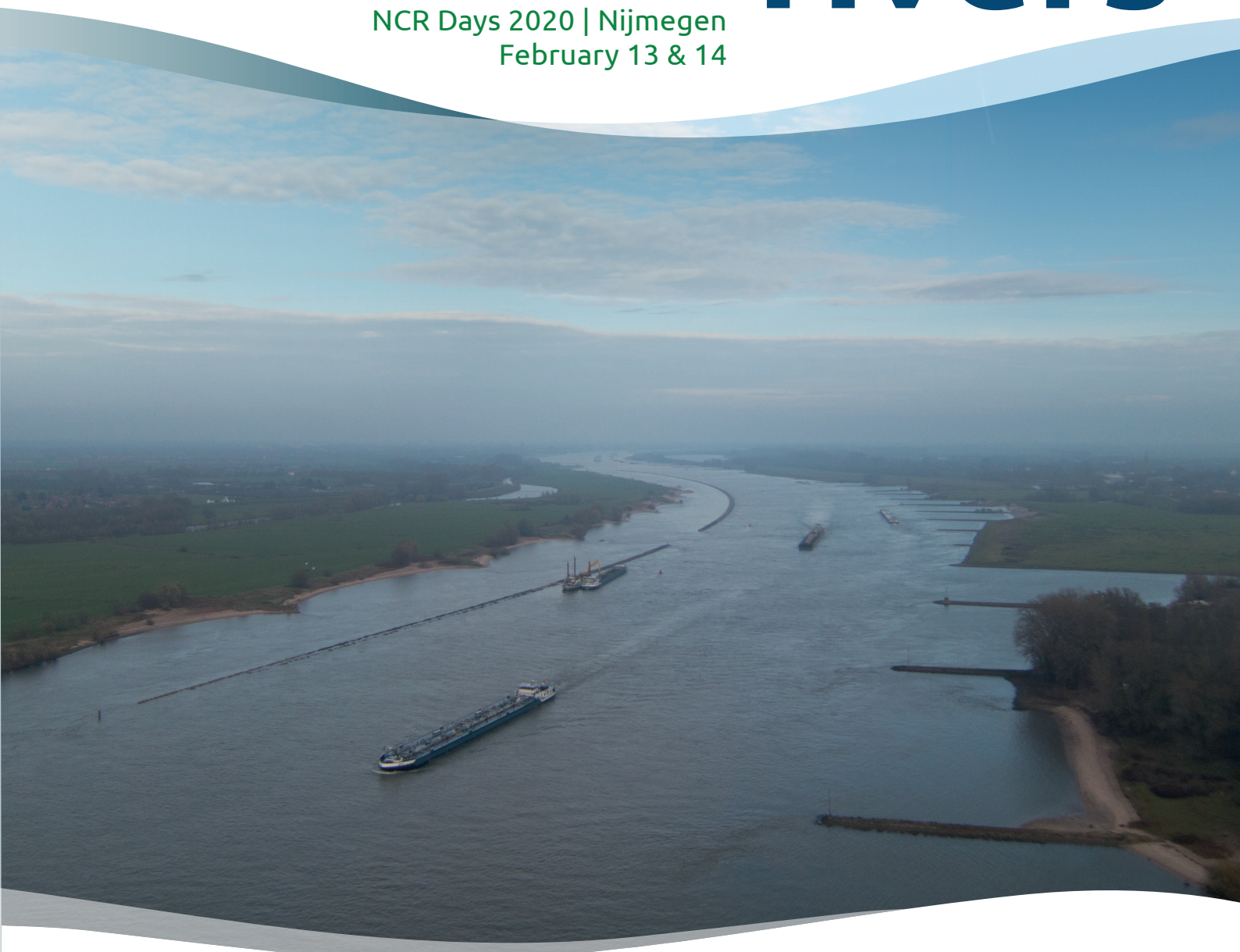
Book of abstracts

# Managing changing rivers

NCR Days 2020 | Nijmegen
February 13 & 14



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Rijkswaterstaat
*Ministerie van Infrastructuur en Waterstaat*

Netherlands Centre for River studies NCR

# The initial morphological impact of the longitudinal dams

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**Keywords —** River interventions, morphological equilibrium

## Introduction

River interventions that are designed to reduce the flood levels in the river or to increase the ecological value of the river, generally cause aggradation in the navigation channel. Such interventions withdraw discharge from the main channel and this reduces the sediment transport capacity. The reduced sediment transport capacity is compensated locally by the river with an increase in the bed level and an increase of the bed slope over the length of the main channel parallel to the intervention. To maintain sufficient navigable depth, the bed level increase due to the construction of river interventions should be minimal. We will use bed level measurements to identify the bed level changes that occurred due to the construction of the longitudinal dams in the river Waal. Bed level changes occur at various length scales. Therefore, we apply wavelet filtering to identify the bed level changes that result from the construction of the longitudinal dams. The construction of the longitudinal dams extracts discharge from the main channel, but also reduces the width of the main channel. The bed level increase in the navigation channel is therefore not equal to a water depth reduction during base flow conditions.

## Method

The bed level in the navigation channel of the river Waal is measured every two weeks since 2005. We average the bed level over the width of the navigation channel to retrieve the one-dimensional longitudinal profile of the river. We subtract the time-averaged longitudinal bed level to remove the steady spatial bed level variation due to river bends, groynes and the bed slope. The remaining bed level changes are the variations around the time-averaged bed level which included bed level changes due to bed forms, scour at groynes, river interventions and the large scale bed degradation. We apply a wavelet transform to identify the spatial scales of the various bed level changes. Using the wavelet transform we can isolate the effect of river interventions.

## Results

The average bed level with out filtering shows degradation until 2016 (Fig 1.). From 2016 the bed level increases. With the wavelet filtering we remove the large-scale and long-term degradation from the signal and this results in a more or less constant bed level until the construction of the longitudinal dams. The aggradation rate increases during the peak flow conditions in 2016 and 2018.

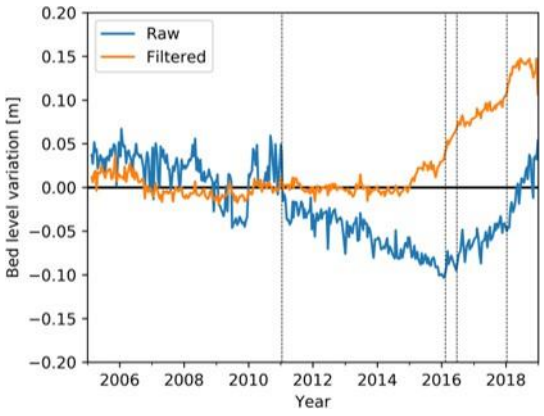


*Figure 1: The bed level and the bed level changes at the longitudinal dams in the river Waal that were constructed in 2015. The vertical red lines denote the start and end of the project area and the drawing in the middle shows the location of the longitudinal dams in the river.*

We show the various longitudinal profiles in a time-space diagram (Fig. 2). The measurements show the deposition and scour that the largest deposition occurs at the upstream side of the intervention and large scour occurs at the downstream side. This corresponds with the expected effect of river capacity increasing interventions. Similar processes occur at the extremities of the individual dams, but the bed level changes are much smaller. Between rkm 912 and 914, the bed level decreased which cannot be explained using the theory, but it might be related to the dredging that occurred during the construction of the dams.

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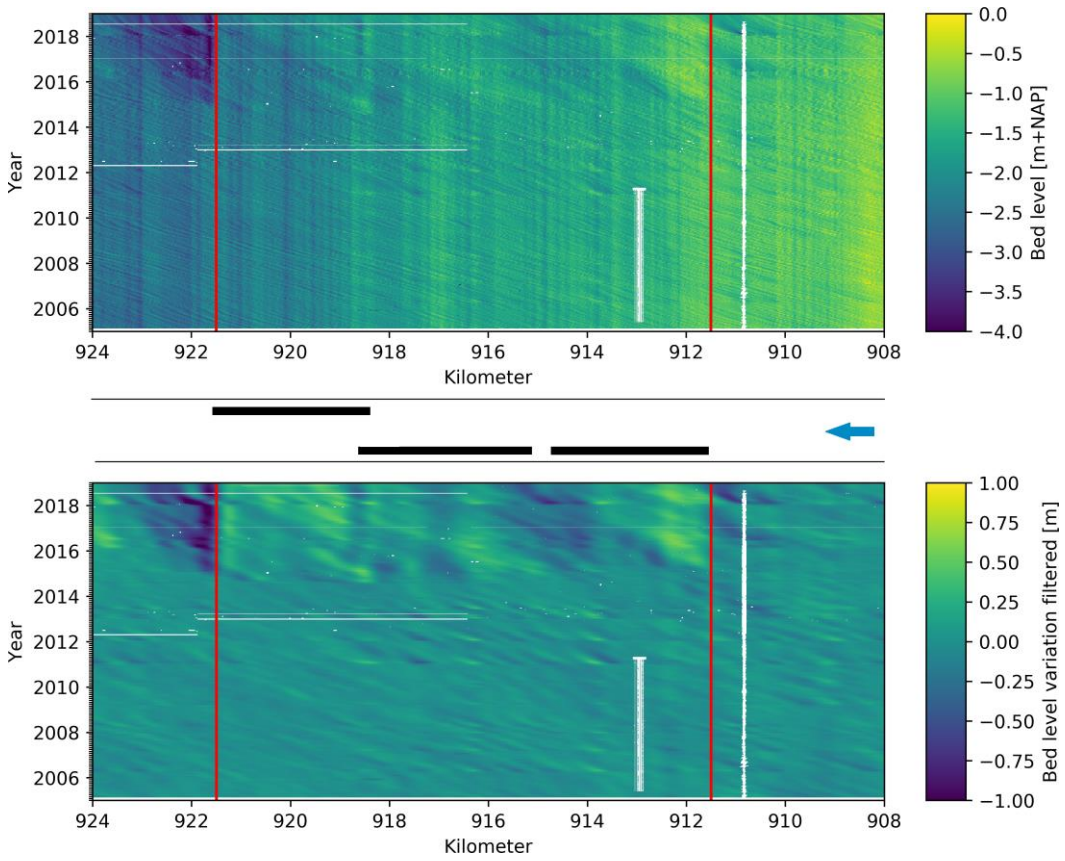


*Figure 2: The bed level and the bed level changes at the longitudinal dams in the river Waal that were constructed in 2015. The vertical red lines denote the start and end of the project area and the drawing in the middle shows the location of the longitudinal dams in the river.*

## Discussion and conclusions

The longitudinal dams cause aggradation in the main channel which is expected since they extract discharge from the main channel and thereby reduce the sediment transport capacity. The measurements clearly show the large aggradation that occurs at the upstream side of the intervention and large scour just downstream of the intervention. This corresponds with the expected initial bed level change that generally occur at interventions. By applying the wavelet filtering, we are able to identify the contribution of the longitudinal dams to the bed level changes in the river while ignoring the large scale bed degradation in the river.

## Acknowledgements

This research is supported by the Ministry of Infrastructure and Water Management-Rijkswaterstaat and by the Netherlands Organisation for Scientific Research (NWO), which is partly funded by the Ministry of Economic affairs, under grant number P12-P14 (RiverCare Perspective Programme) project number 13516. This research has benefited from cooperation within the network of the Netherlands Centre for River studies.