

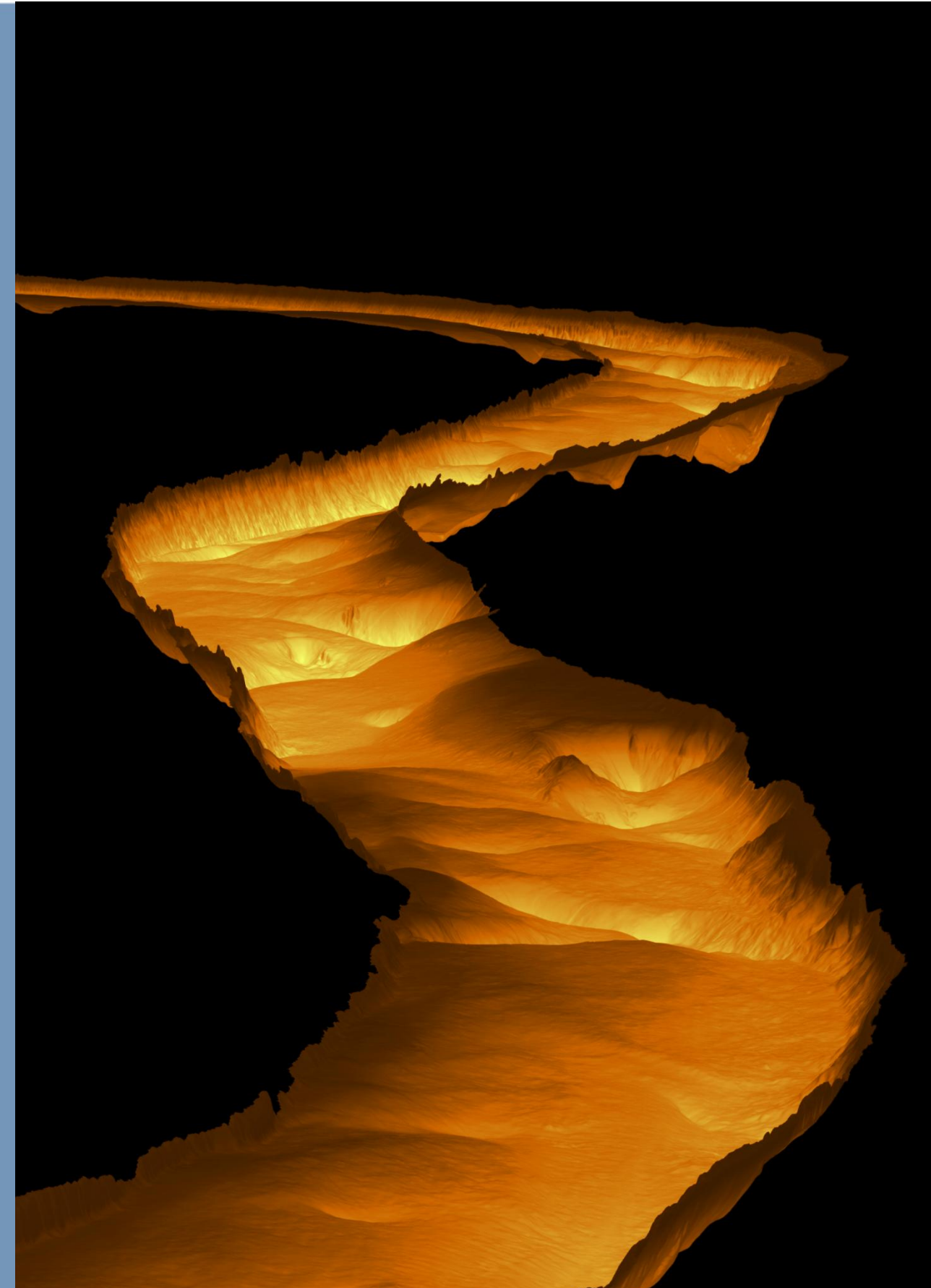
Weerbare Waterbouw

Zomerhoogwater van juli 2021 legde kwetsbaarheid van
de Maas pijnlijk bloot

Hermjan Barneveld, rivierkundig adviseur/onderzoeker,
HKV en Wageningen University & Research

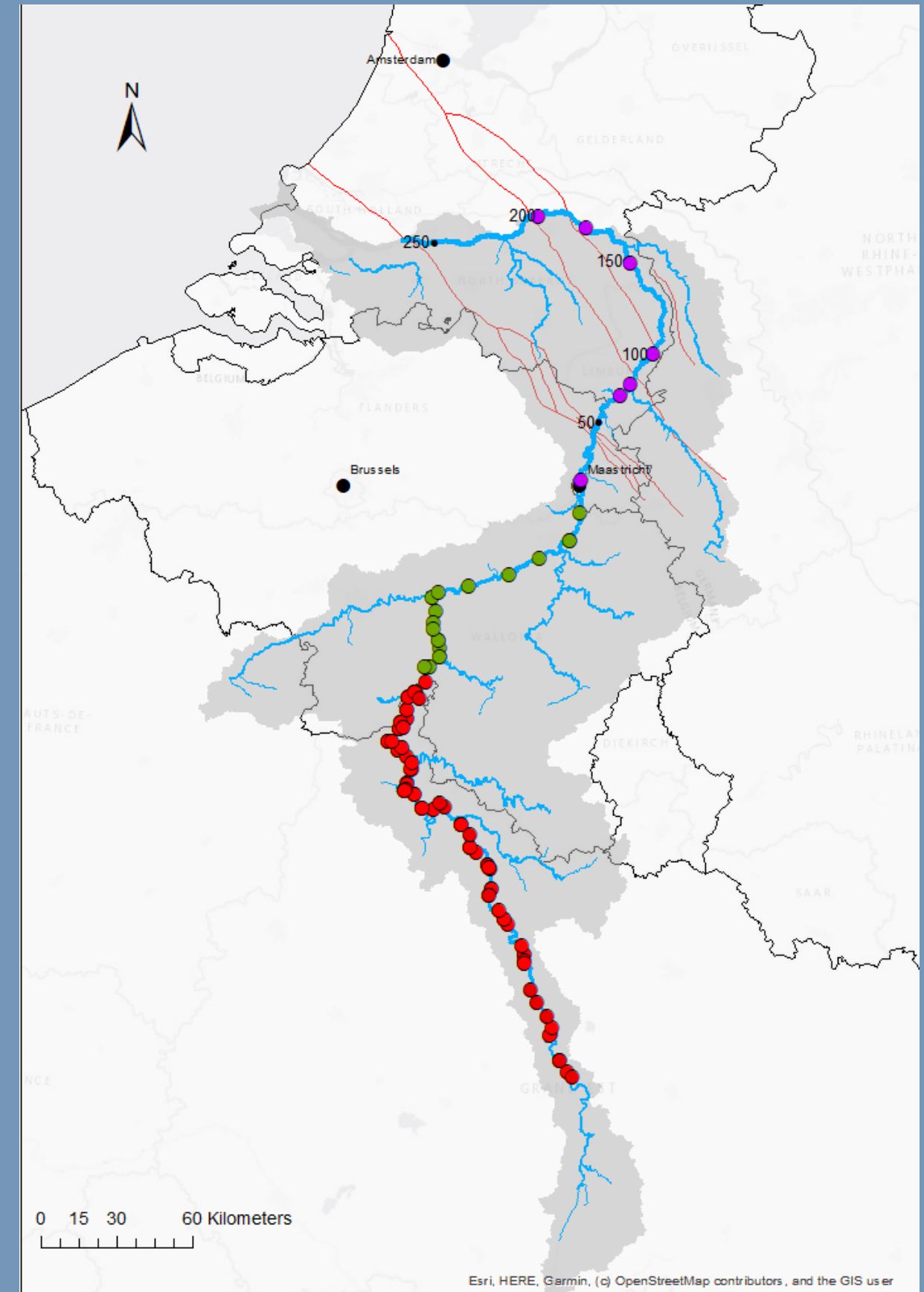
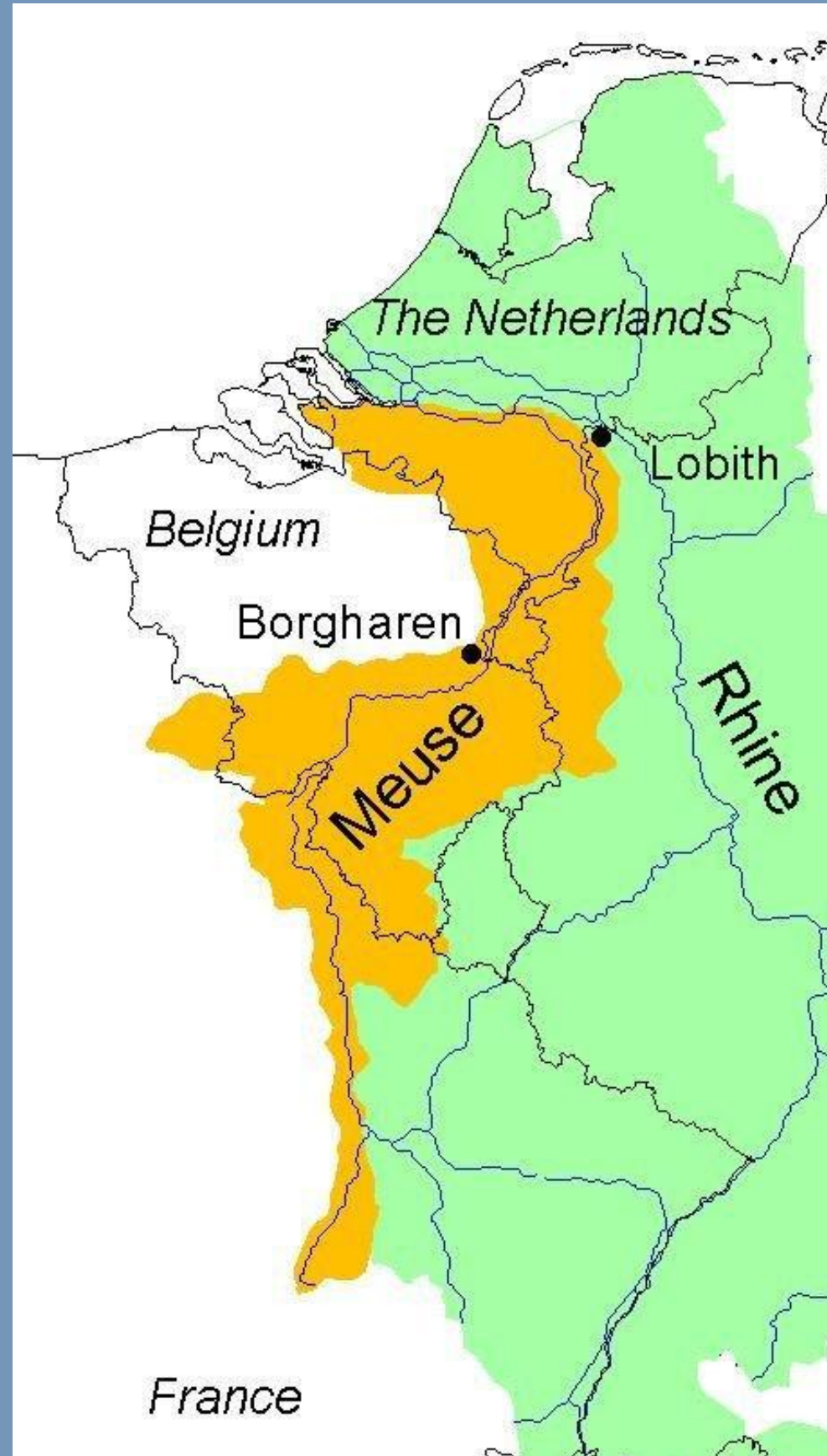
Inhoud

- Introductie
- Waarom nu ?
- Wat hebben we geleerd ?



Introductie

- Stroomgebied Maas



Introductie – Hoogwater 2021

neerslag



Koude put, vergelijkbaar met Valencia 2024

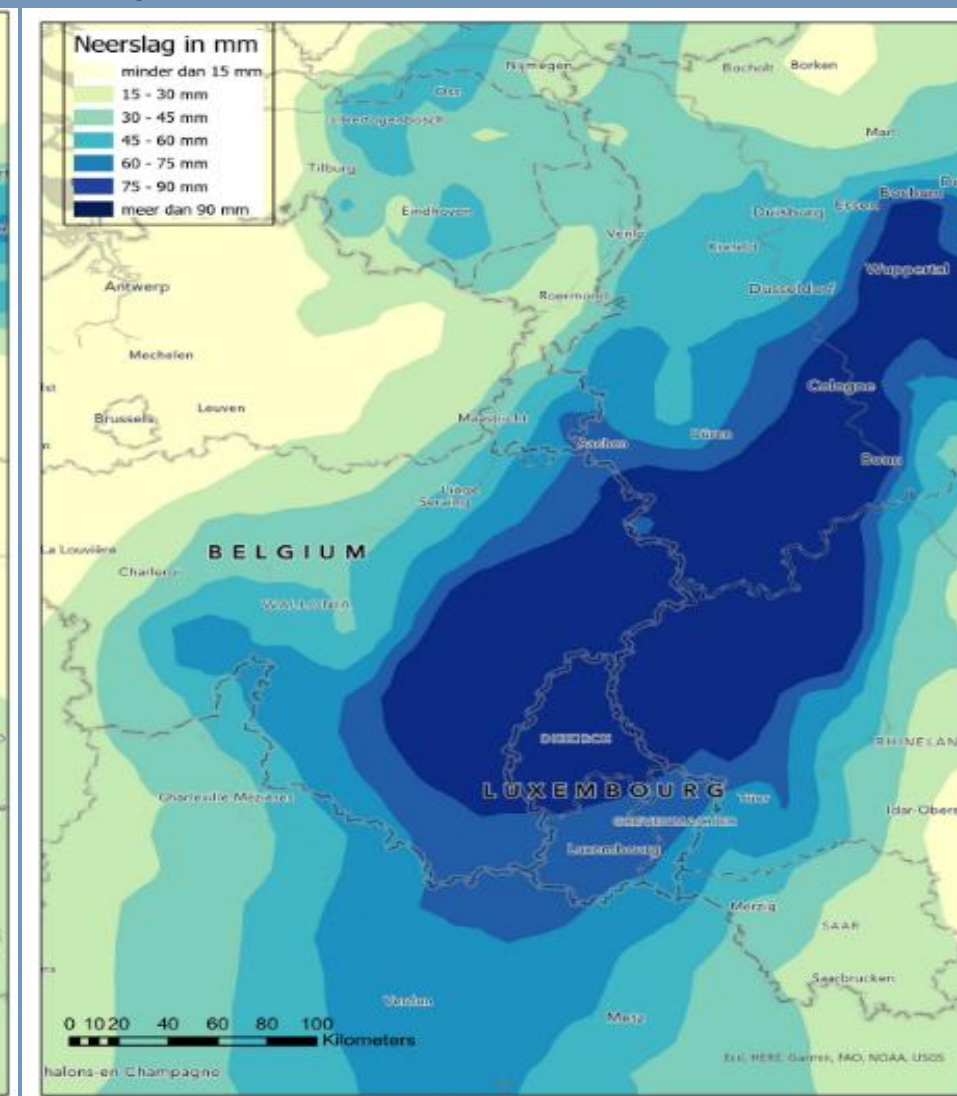
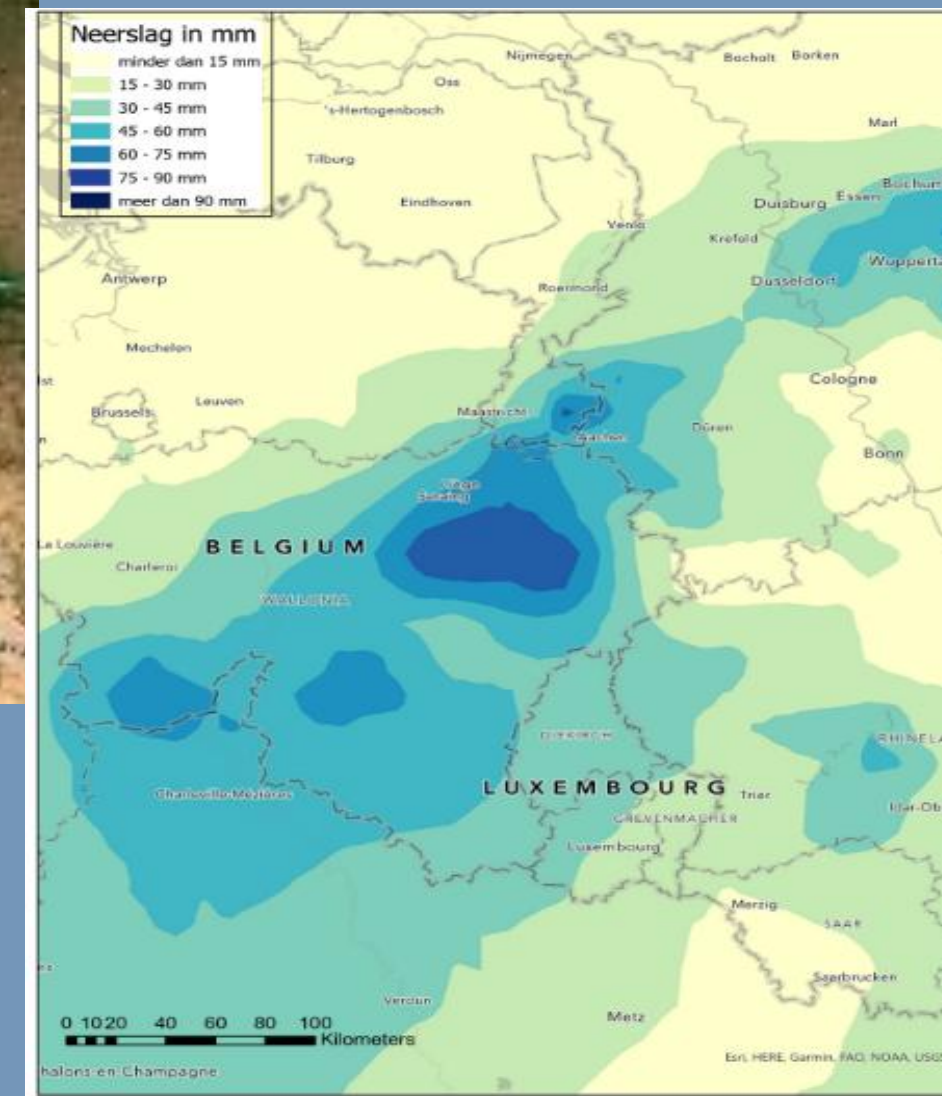
Near earth surface

Middle atmosphere

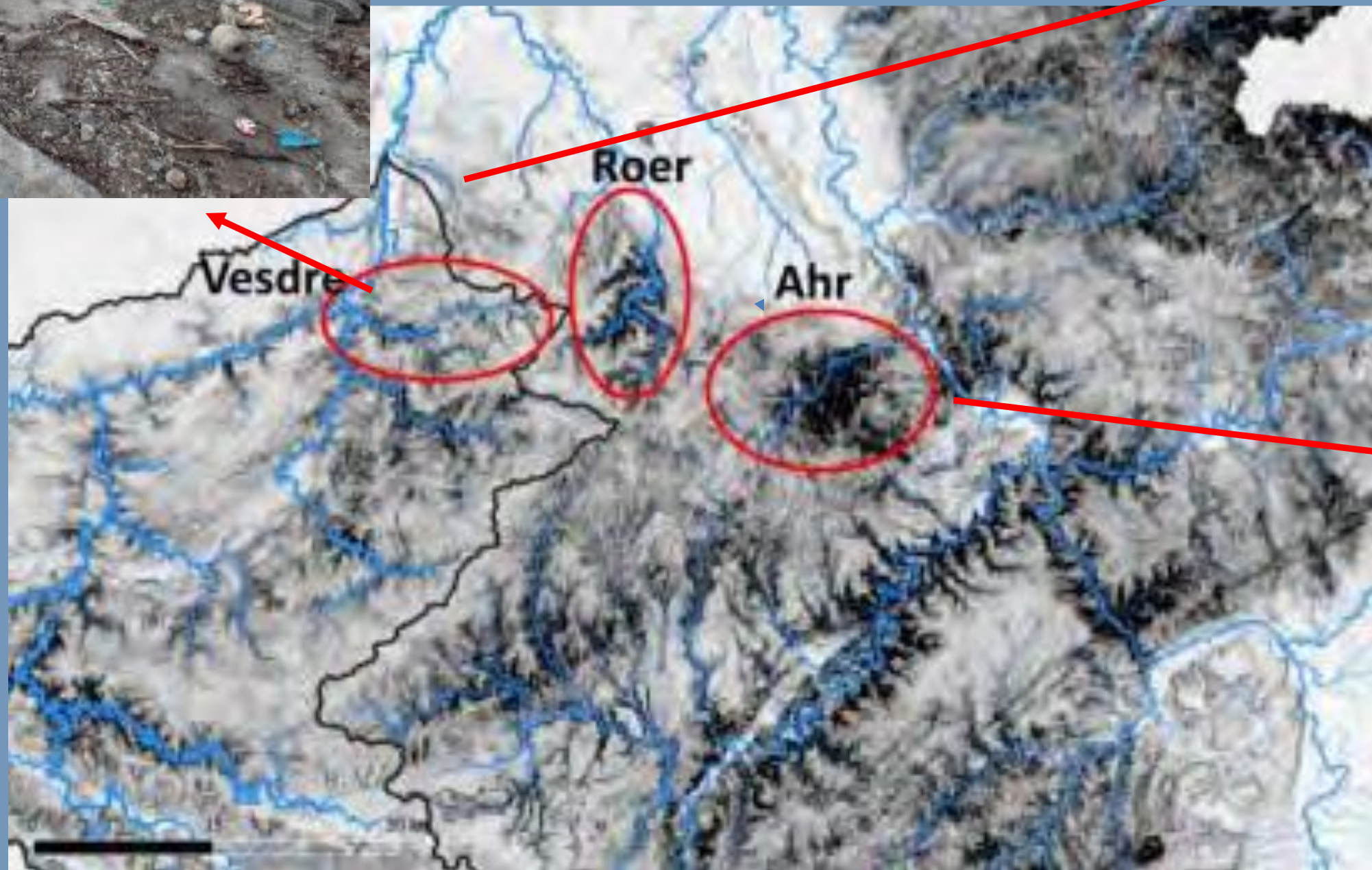
Neerslag 13 Juli

14 juli

Neerslag telde op tot 160 to 180 mm in 2 dagen over groot gebied. Langzaam bewegend



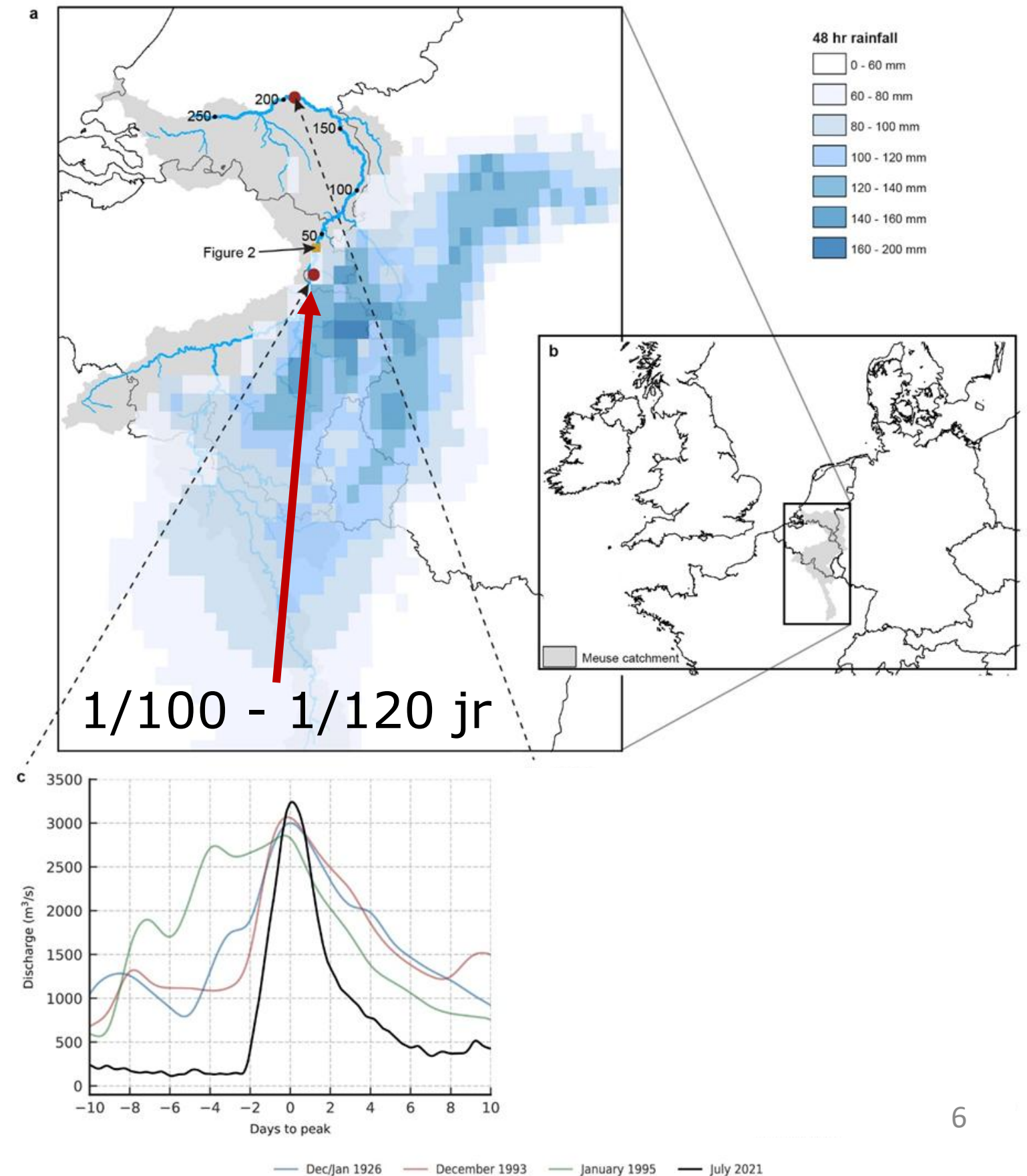
Introductie – Hoogwater 2021



Introductie – Hoogwater 2021 op de Maas



RWS, juli 2021, $Q = 3.310 \text{ m}^3/\text{s}$

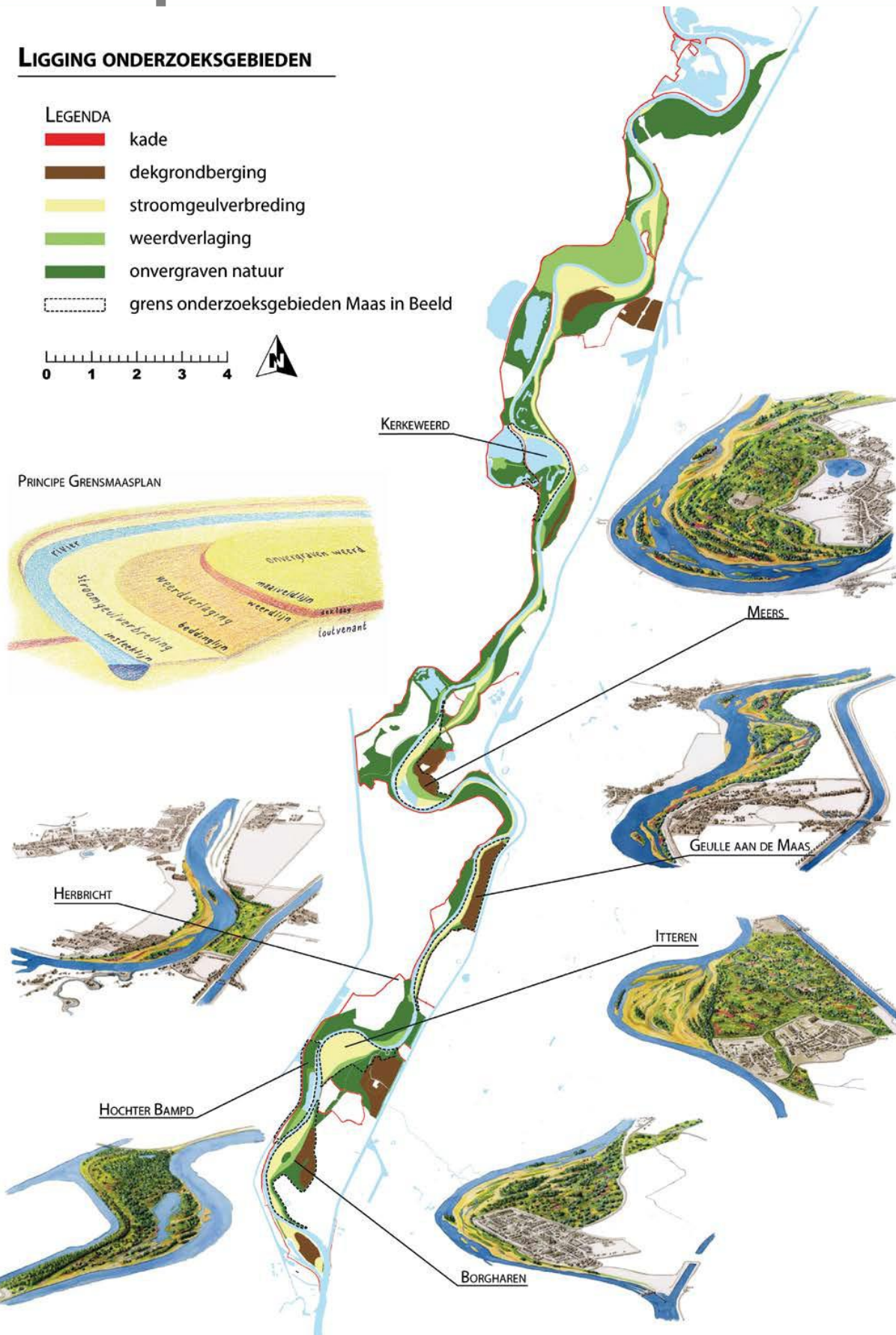


Introductie – Hoogwater 2021 op de Maas

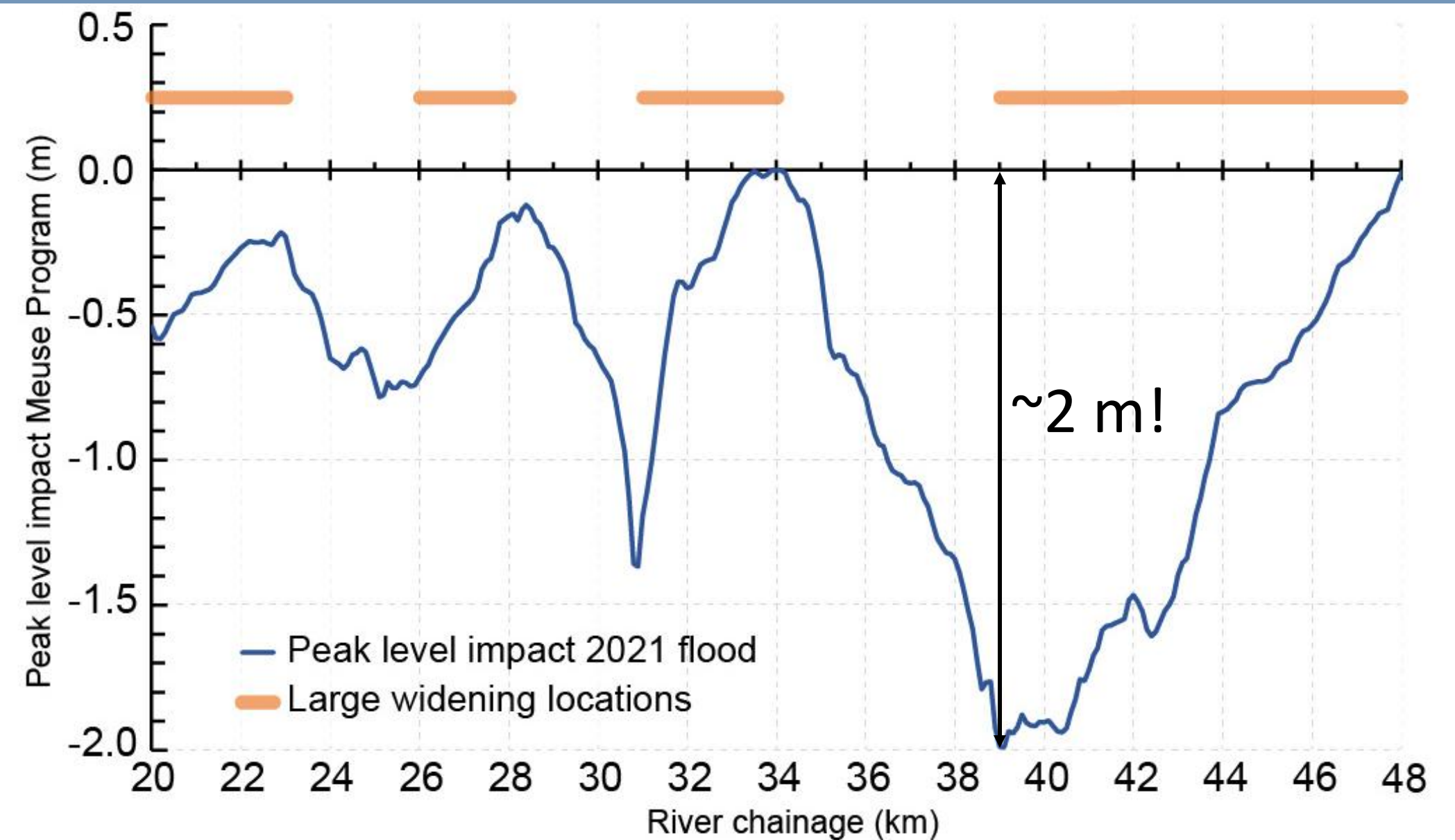
Maaseik (Belgium)



Introductie – Hoogwater 2021 op de Maas



Maaswerken 1995 – 2021



Introductie – Hoogwater 2021

onder water

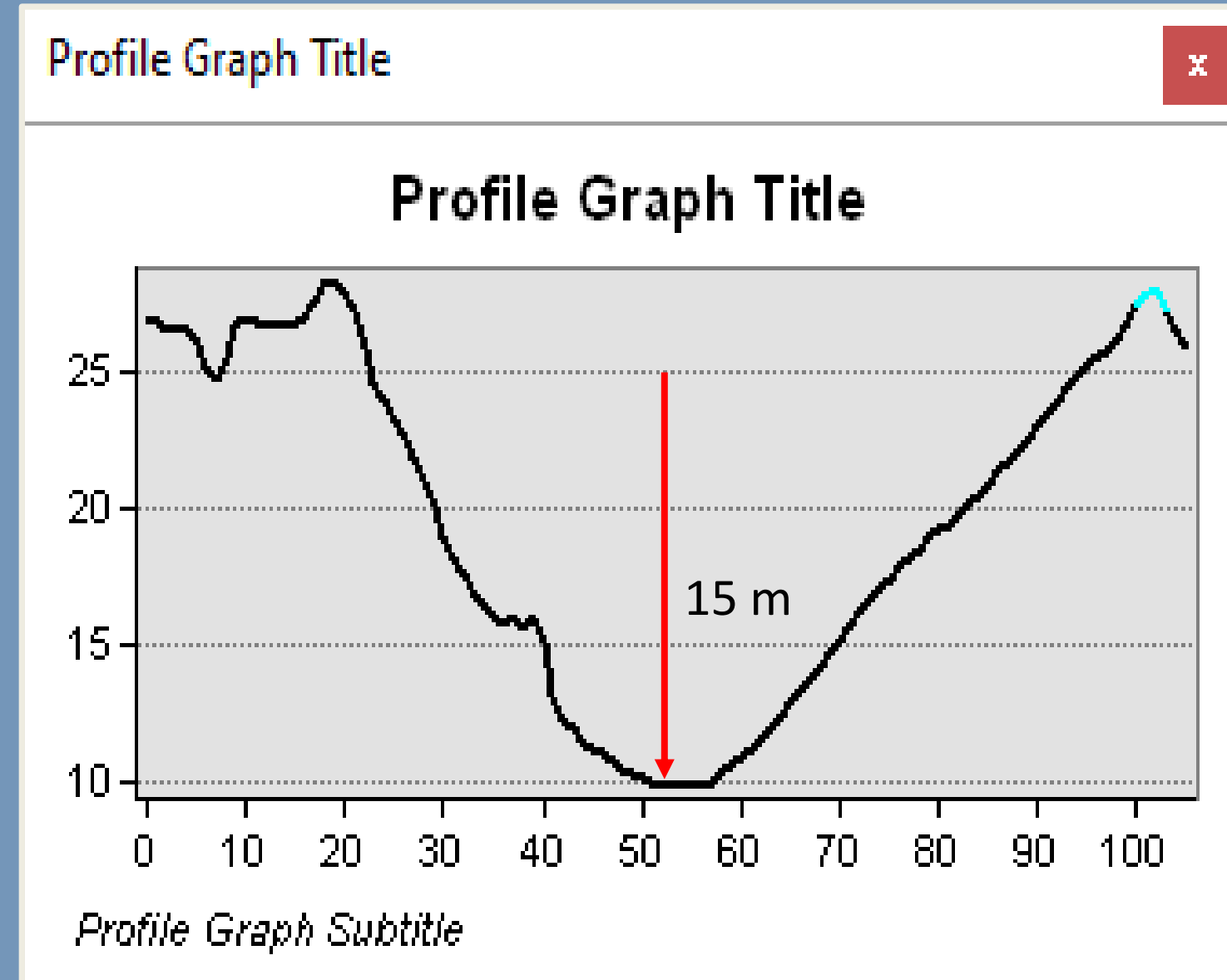
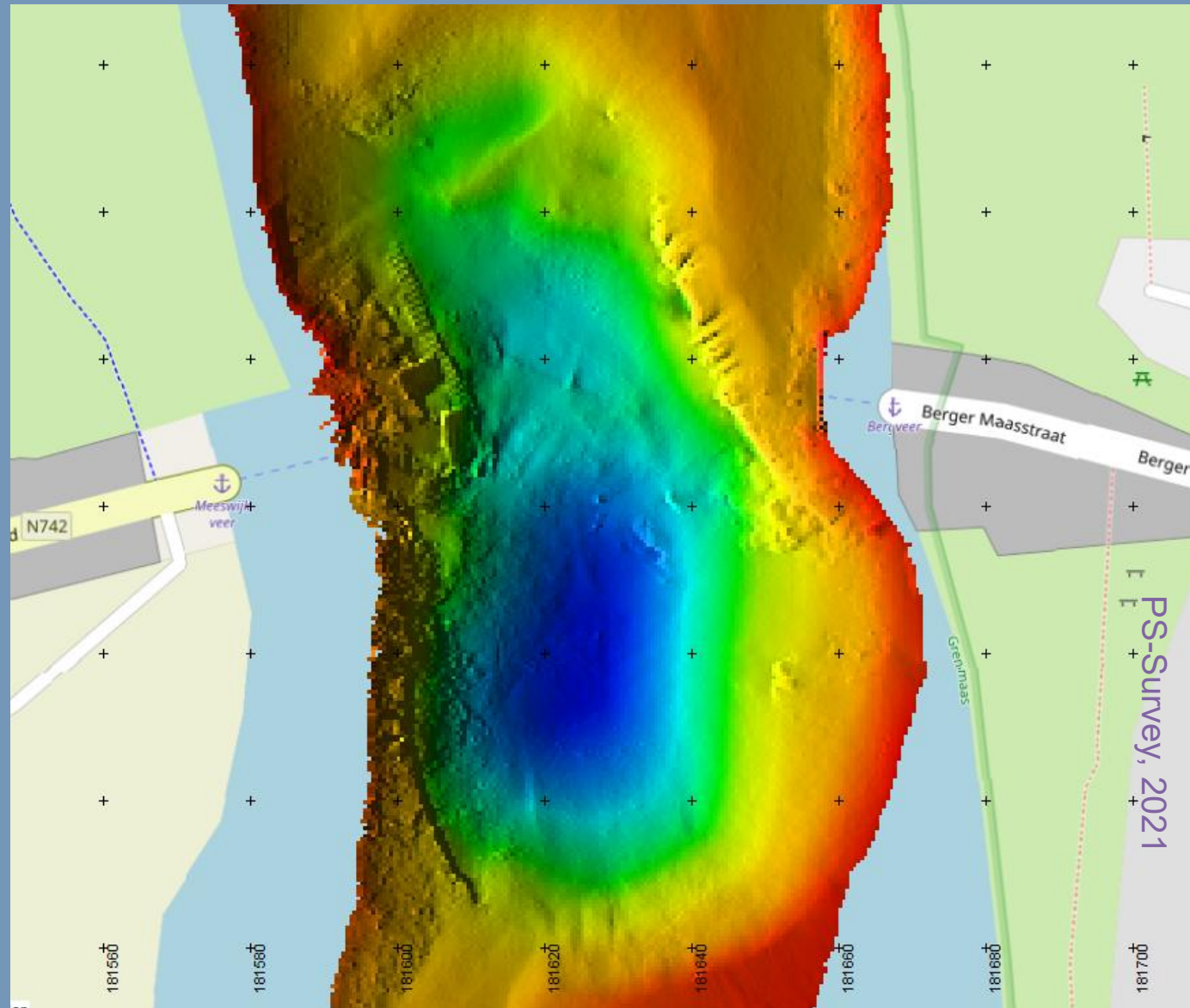
Bram Vernhout



Roy Frings, 2021

Introductie – Hoogwater 2021

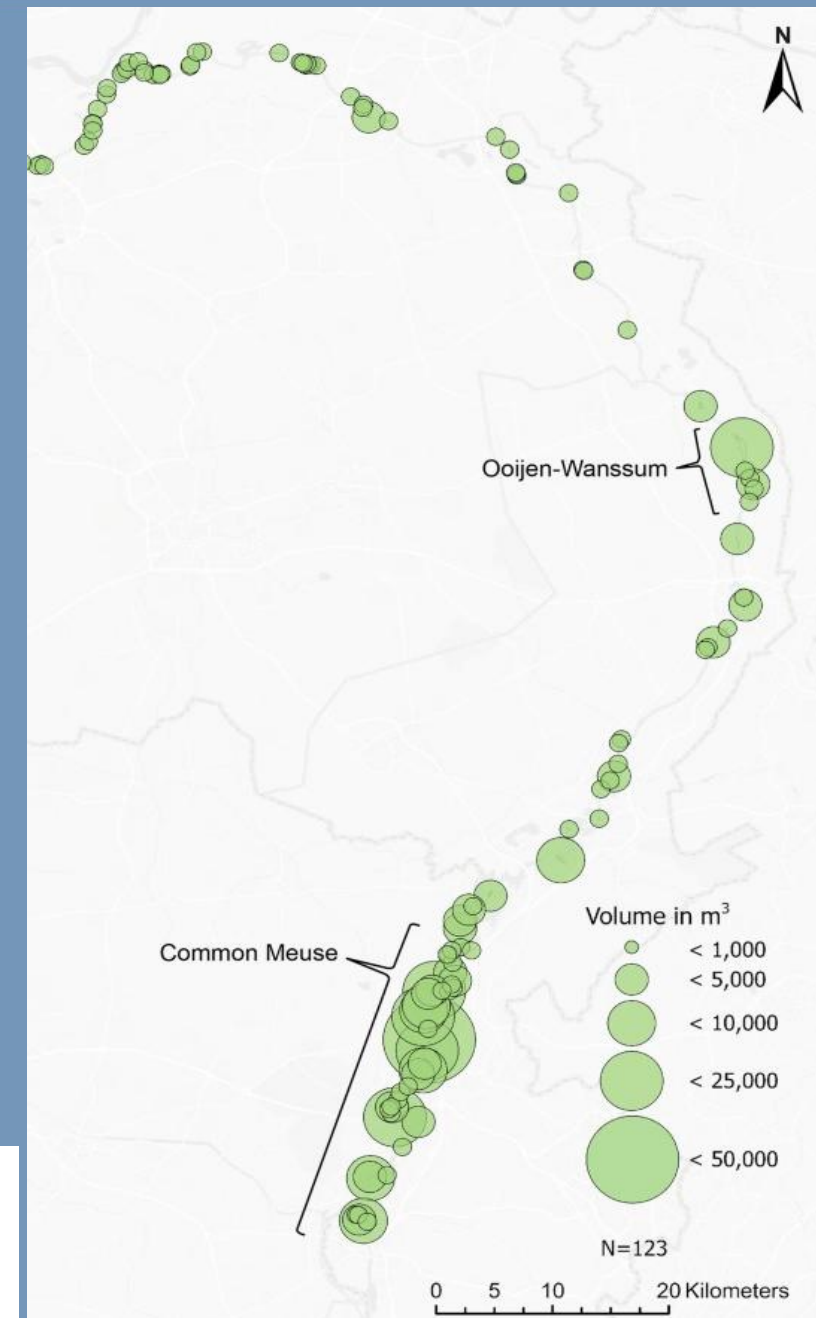
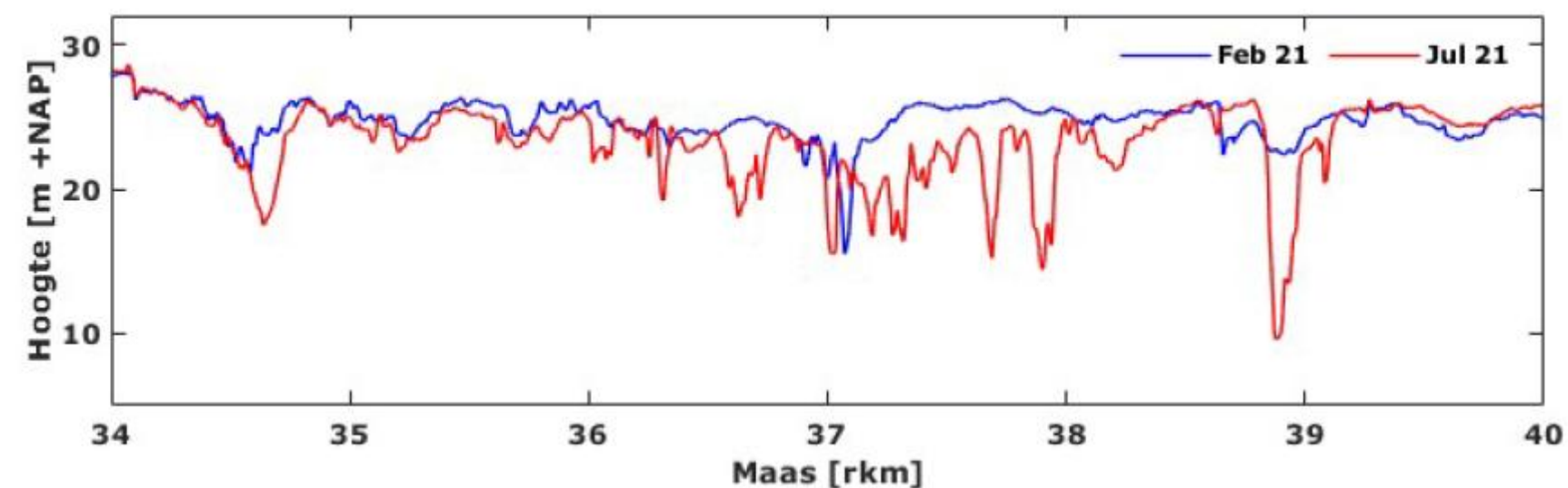
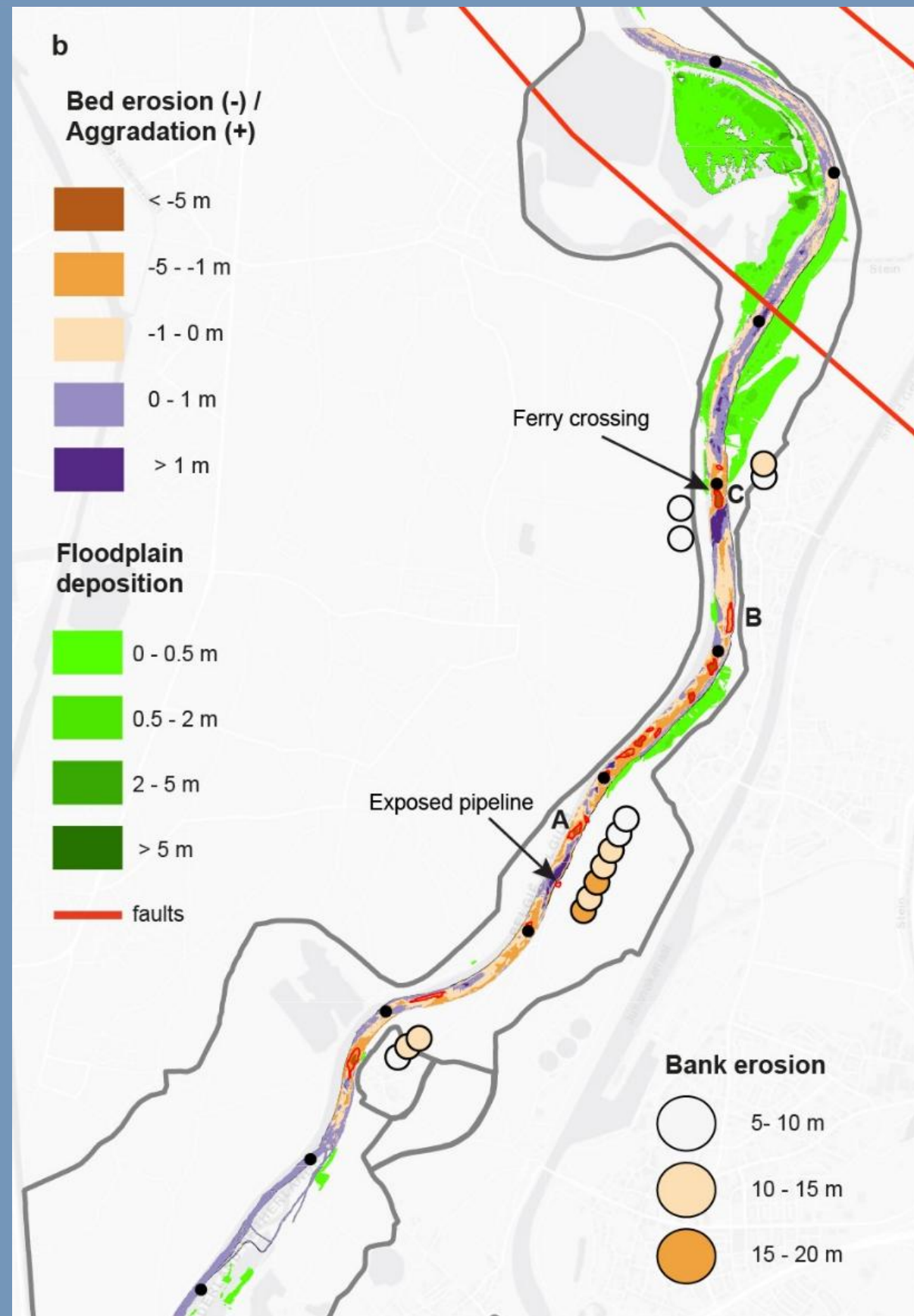
onder water



Introductie – Hoogwater 2021 onder water

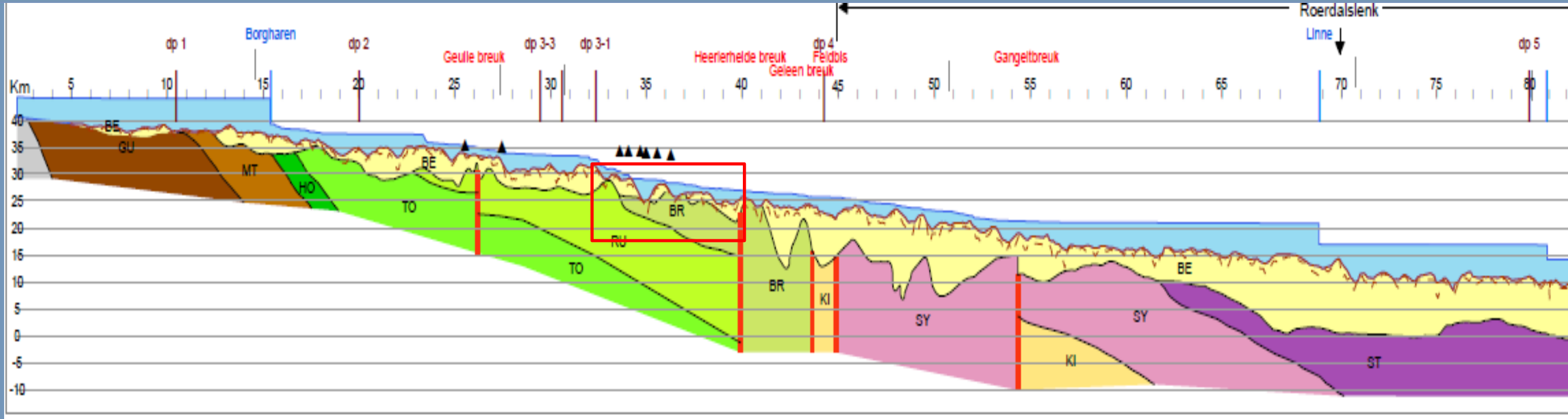
Barneveld et al 2025

Waarom nu?

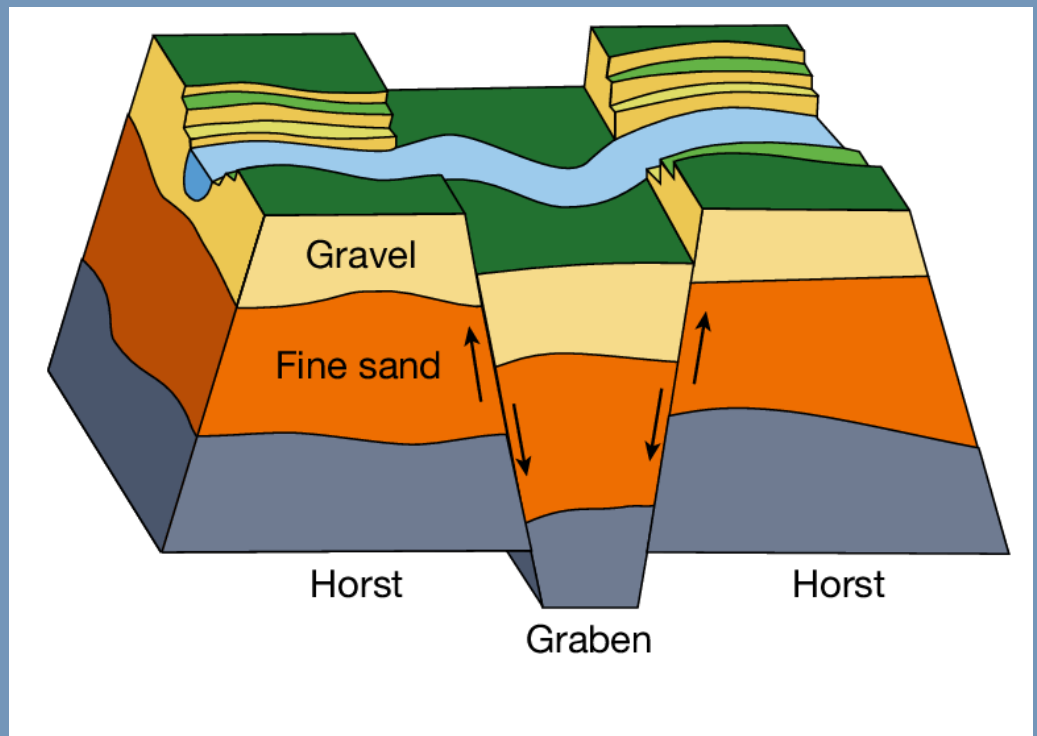


Waarom nu?

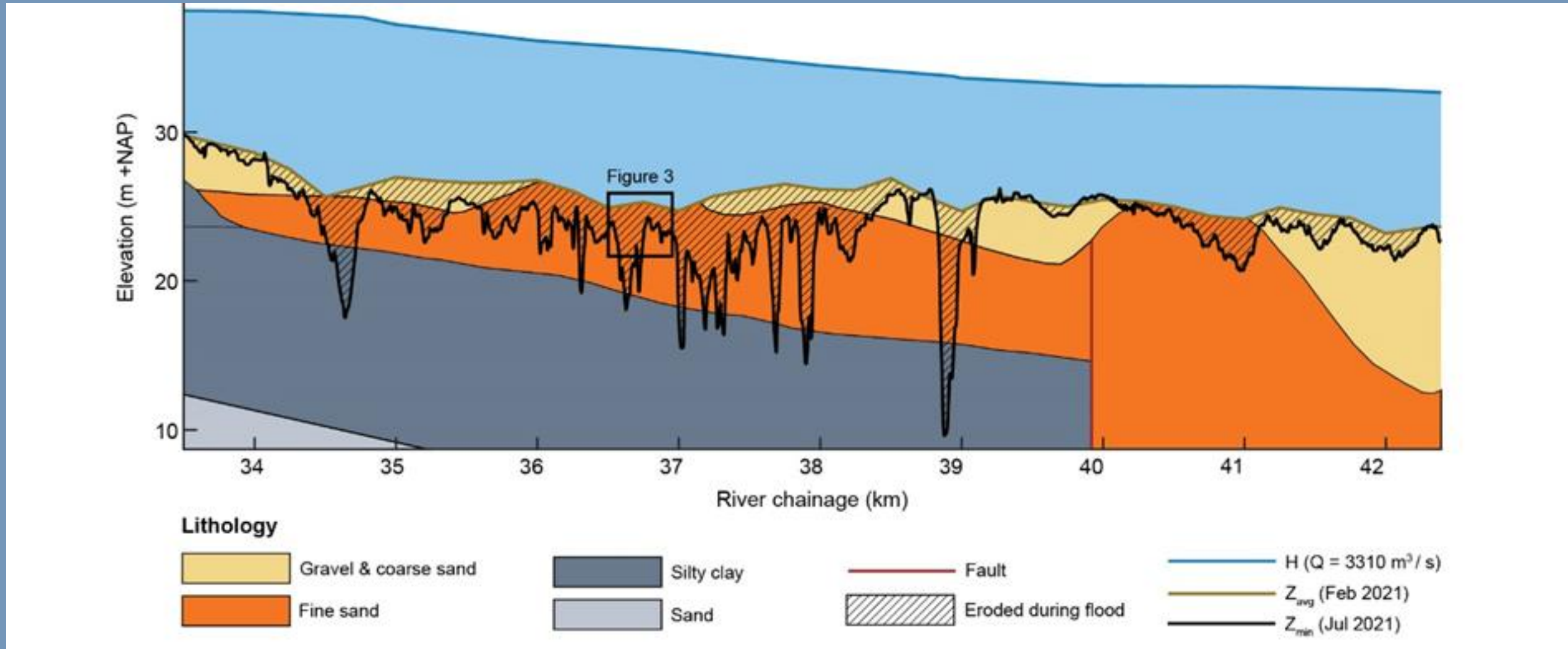
Tectoniek



Arcadis (2011)



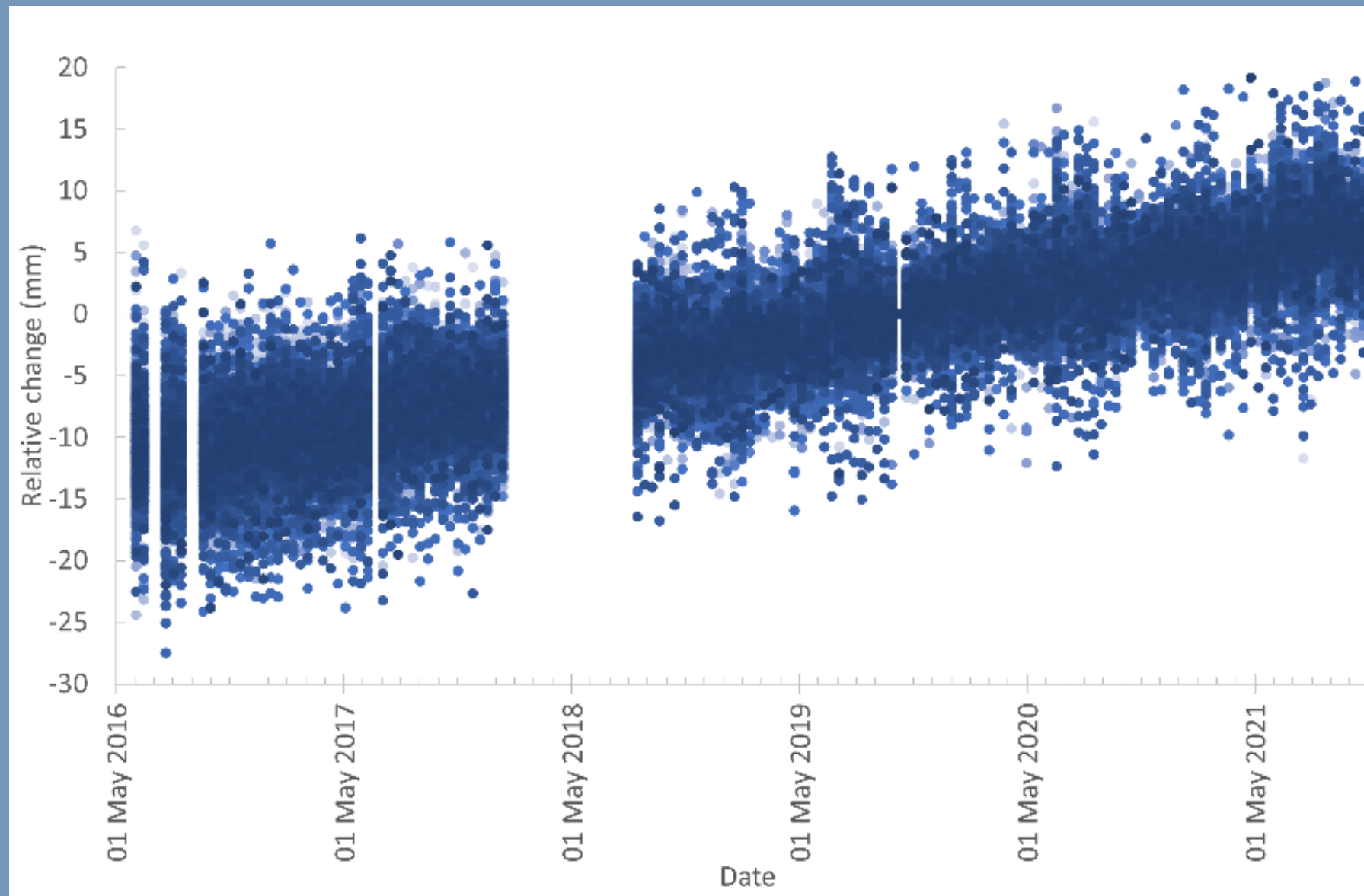
Barneveld et al (2025)



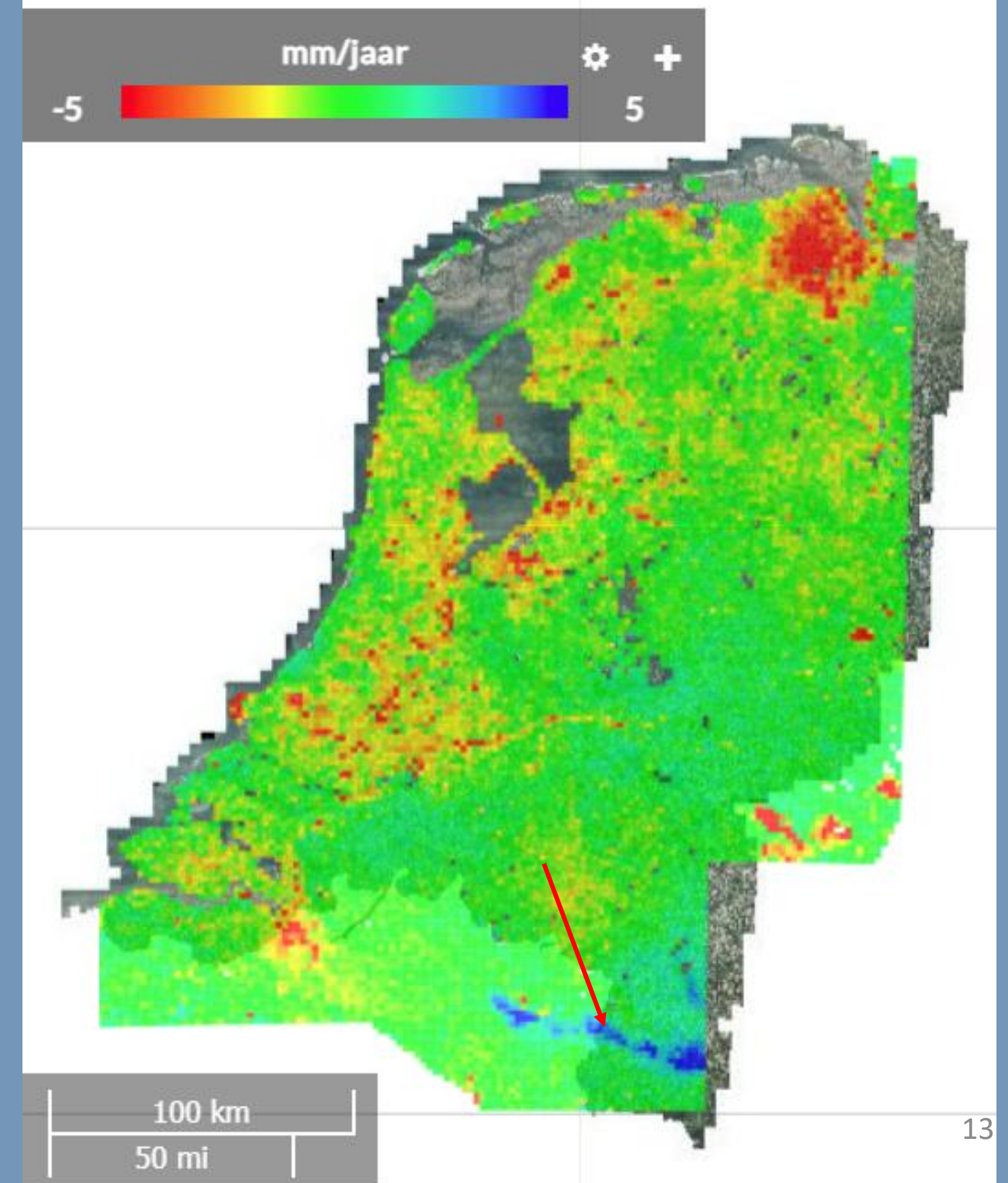
Waarom nu?

Neo-tectoniek

Sentinel data, dank aan Pierre-Yves Declercq, Geological Survey of Belgium (GSB-RBINS)



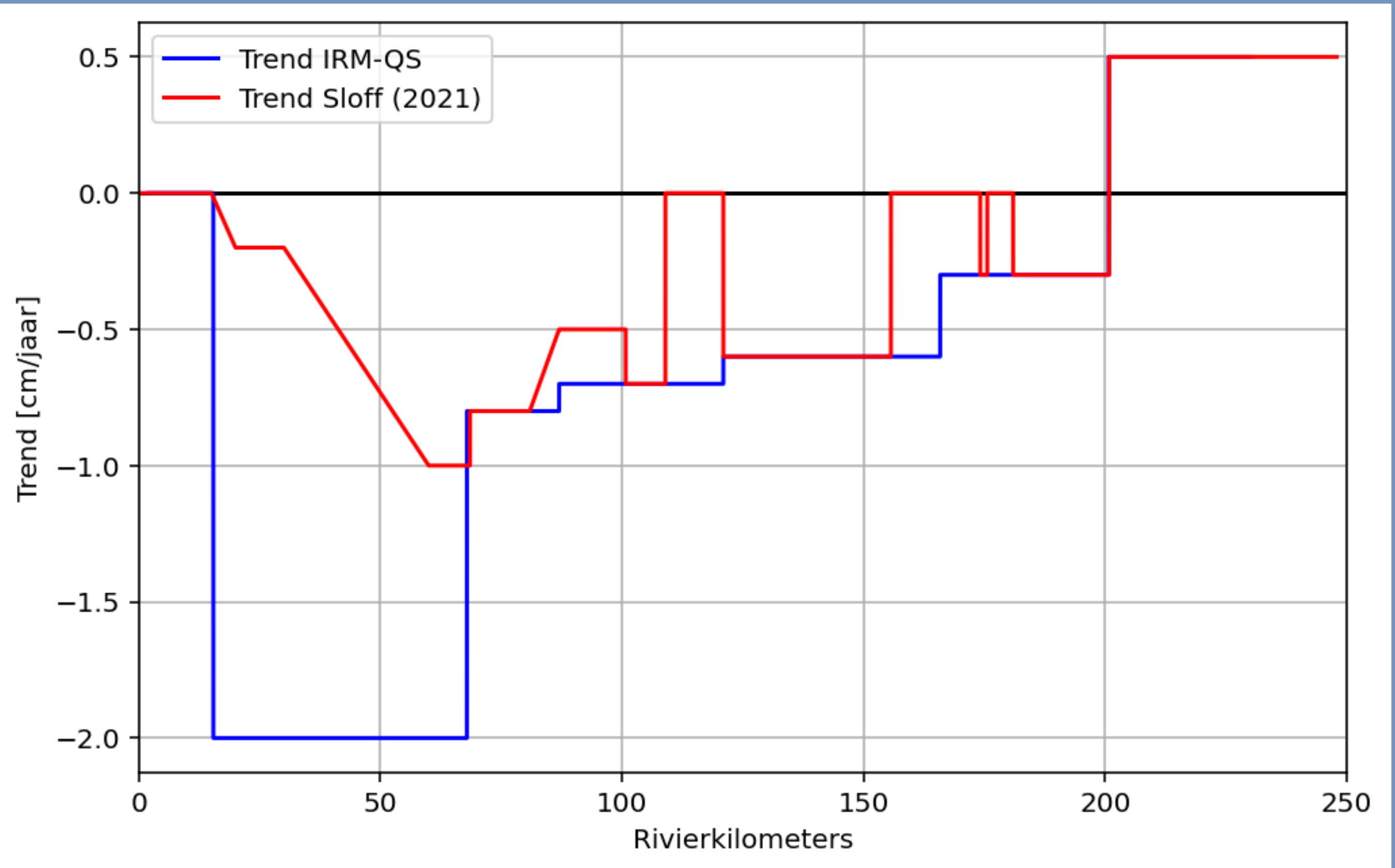
www.bodemdalingskaart.nl



Waarom nu ?

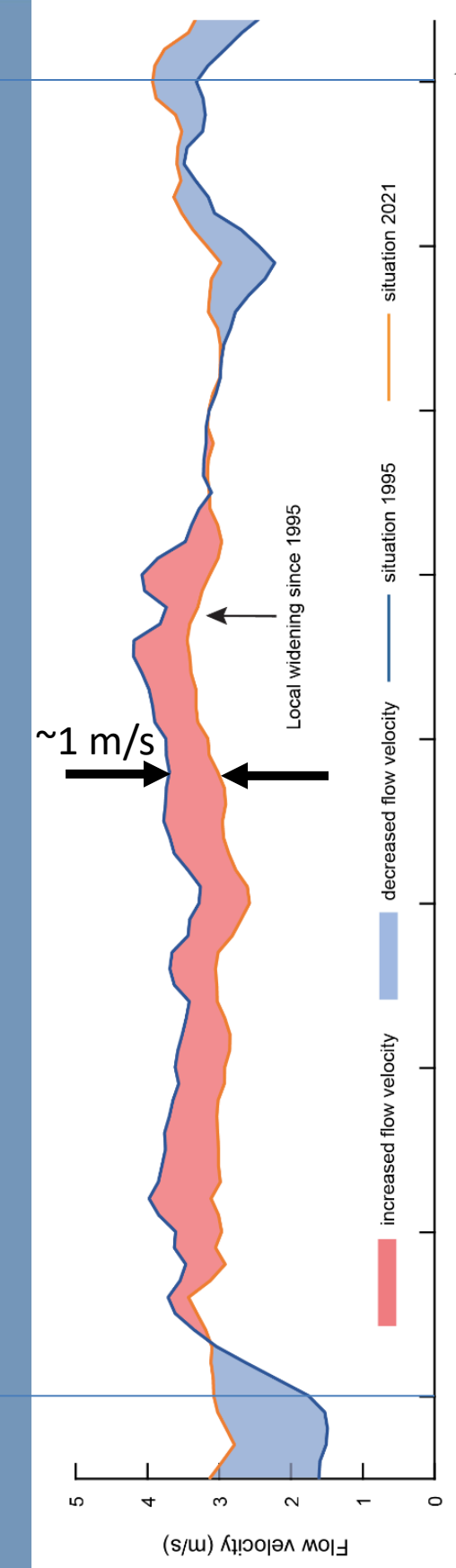
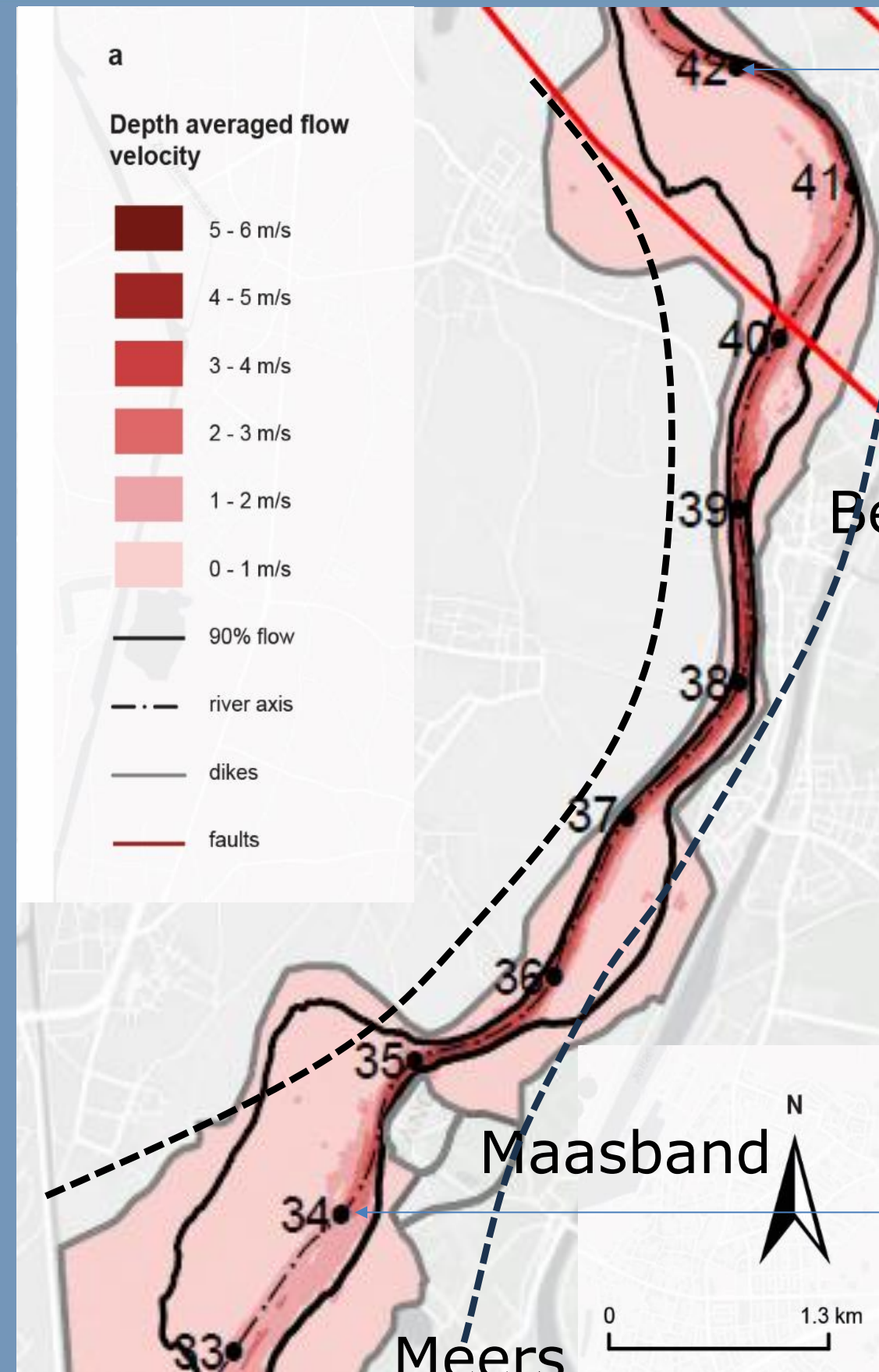
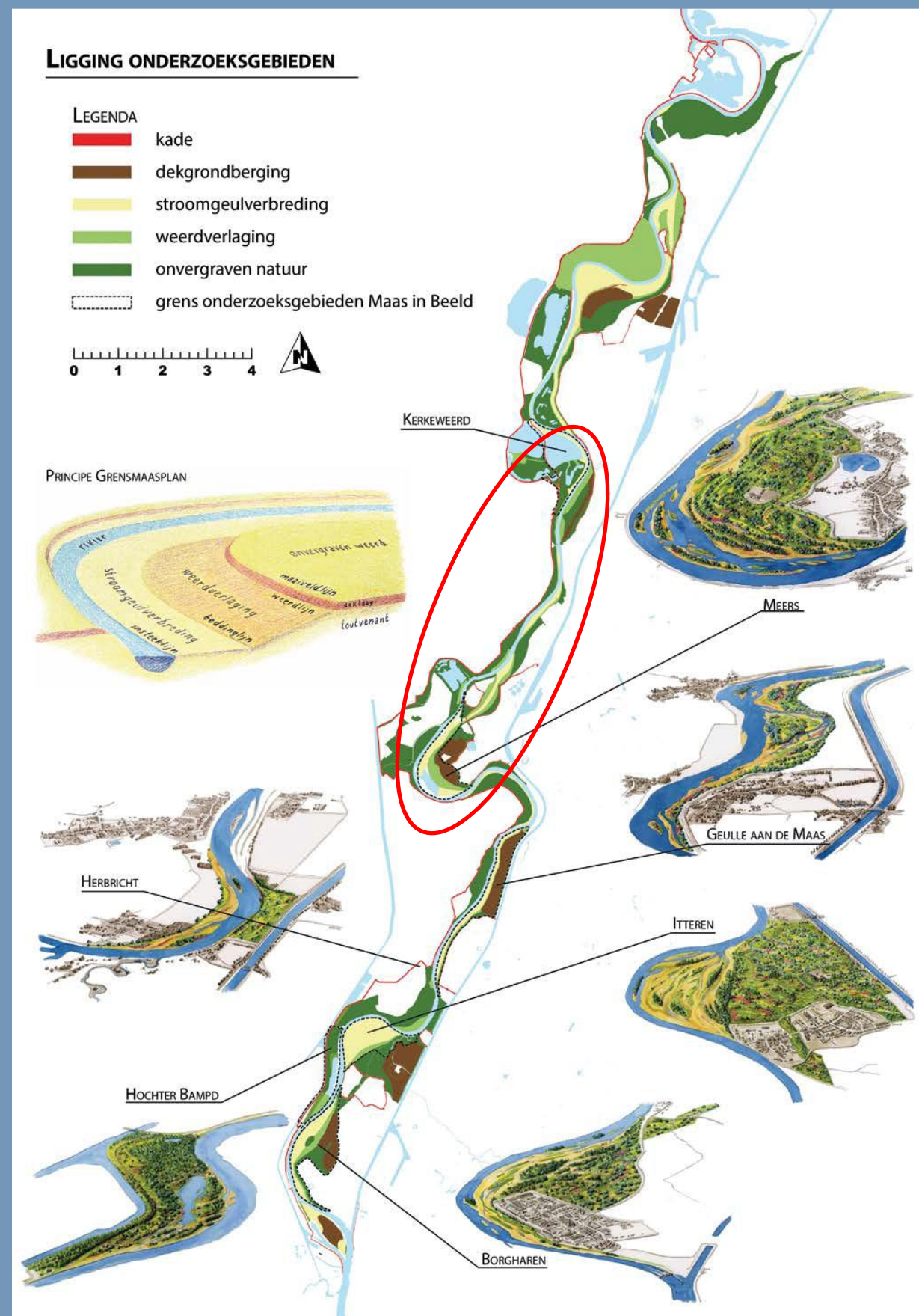
De mens aan het werk

Langjarige
erosietrend Maas



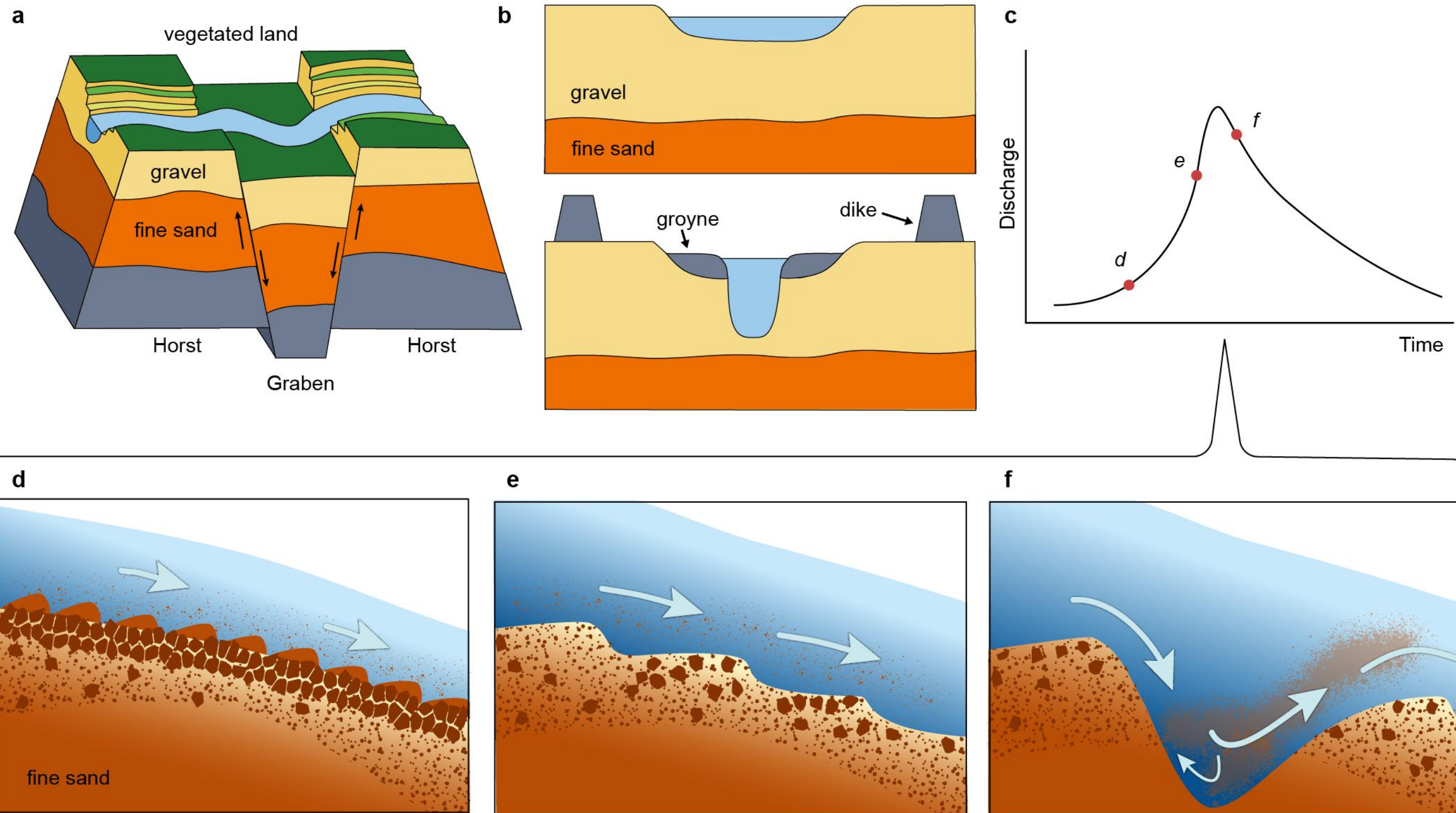
Waarom nu?

De mens aan het werk



Waarom nu?

Samengevat

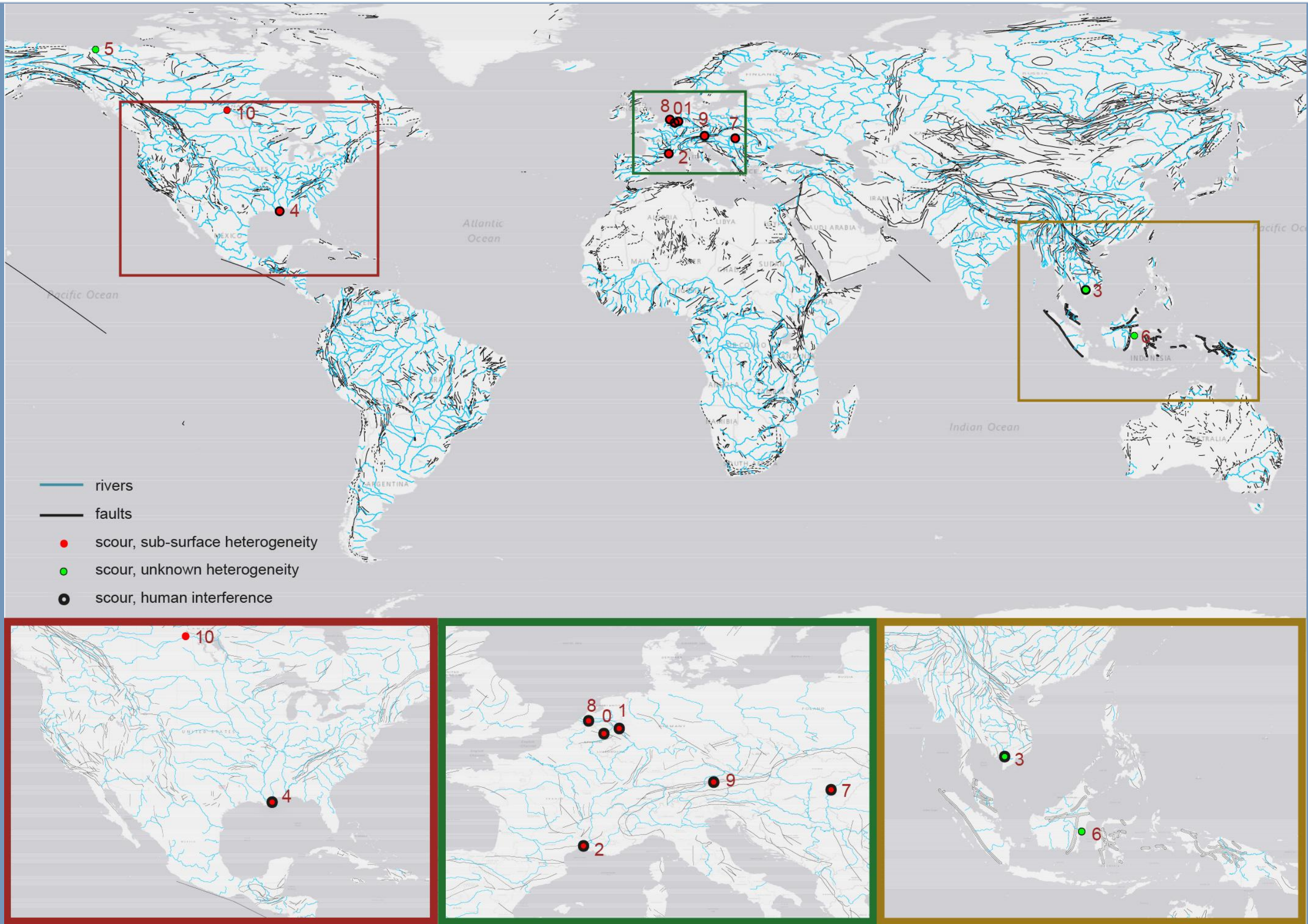


Barneveld et al (2025)

Waarom nu?

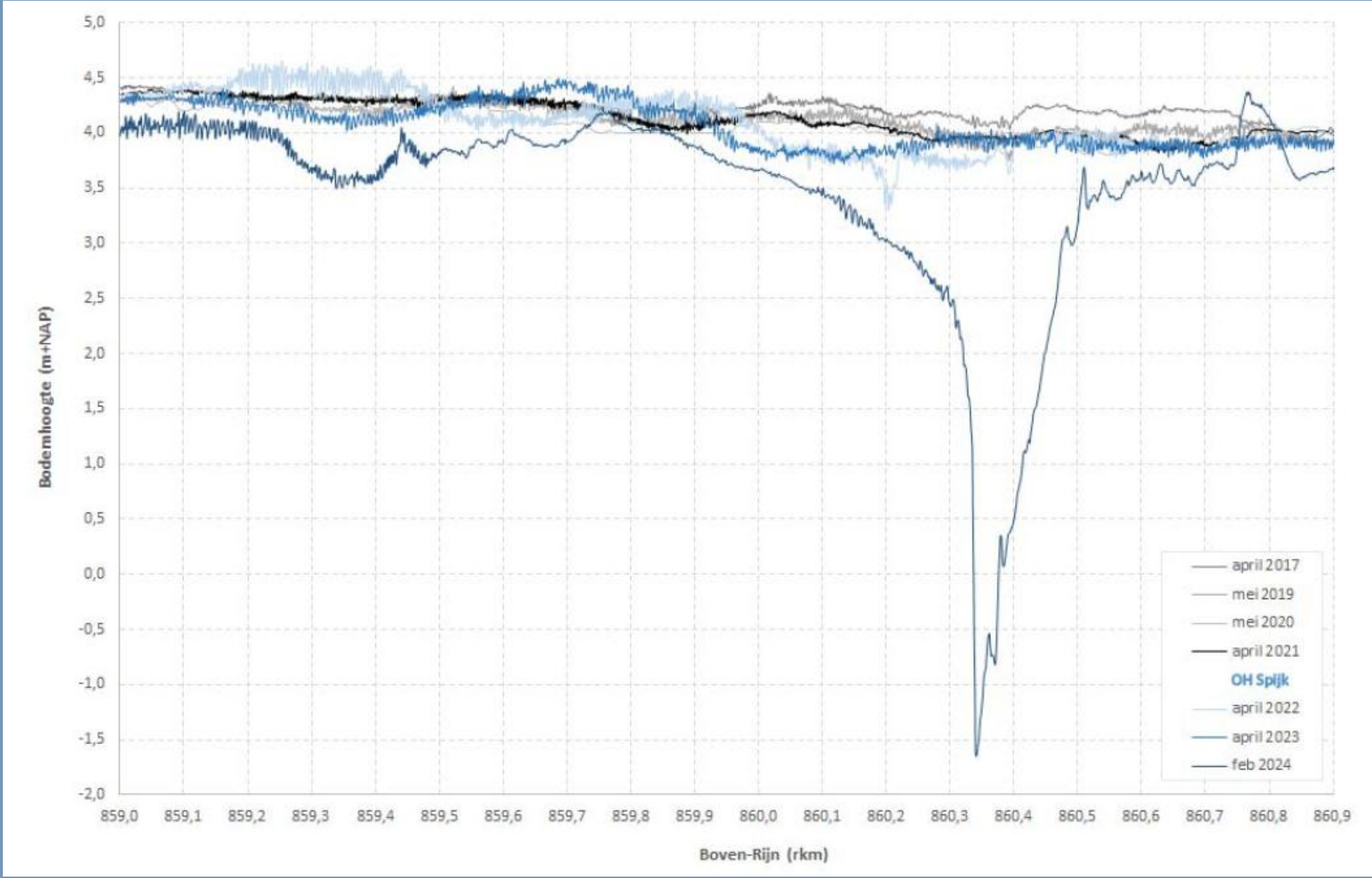
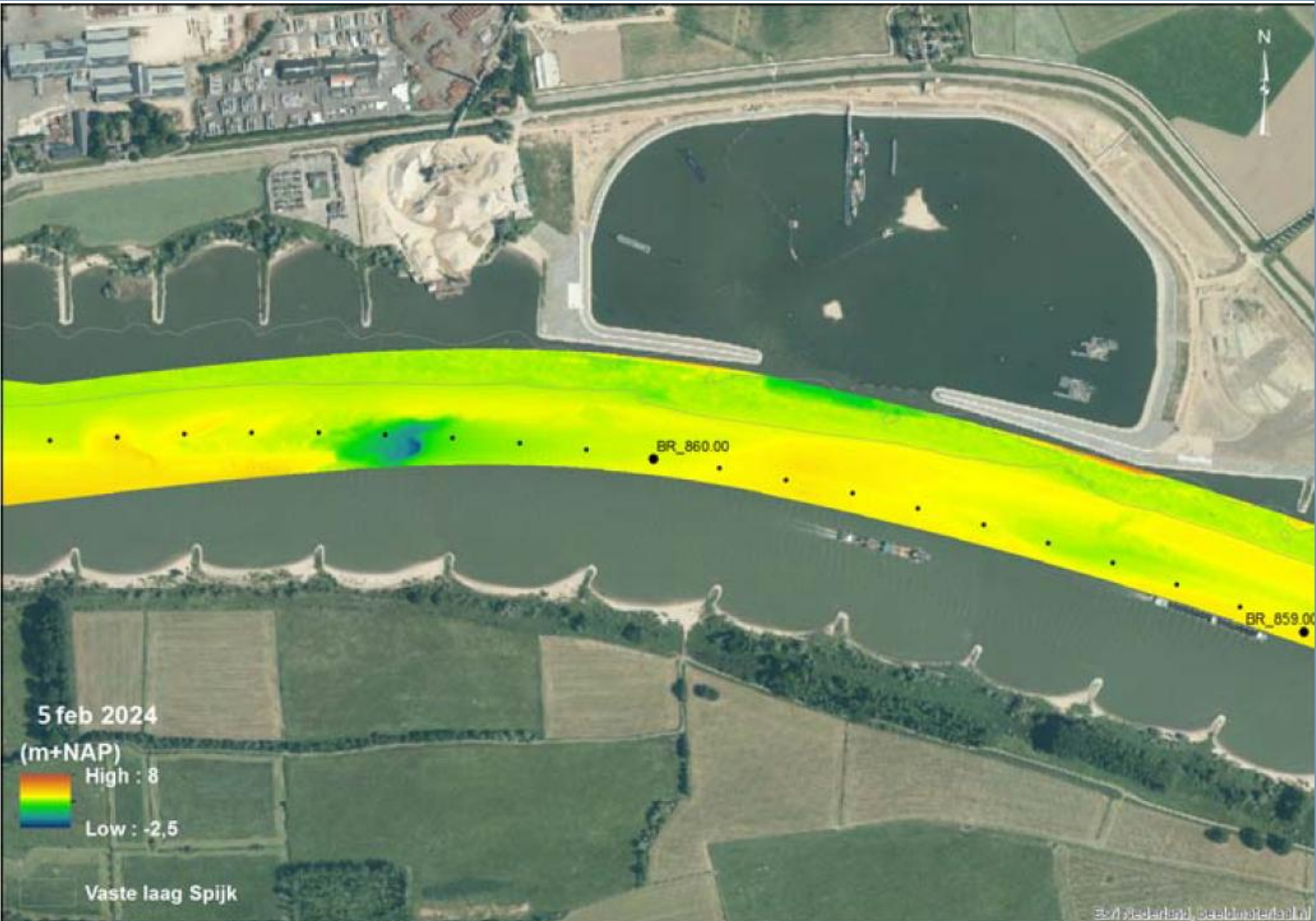
En niet uniek

Barneveld et al (2025)



Waarom nu?

En niet ver weg



Reneerkens (2024)

Wat hebben we geleerd – Take home

- Ruimte voor de Rivier: prima maar ..
- Voorkom nieuwe knelpunten
- Engineered systeem heeft grenzen
- Beheers / Stop erosietrends
- Ken de ondergrond (en het systeem)
- (onder)ken de grey swans → stress test



Meer weten, meedenken?



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Extreme river flood exposes latent erosion risk

[H. J. Barneveld](#) , [R. M. Frings](#), [E. Mosselman](#), [J. G. Venditti](#), [M. G. Kleinhans](#), [A. Blom](#), [R. M. J. Schielen](#), [W. H. J. Toonen](#), [D. Meijer](#), [A. J. Paarlberg](#), [R. P. van Denderen](#), [J. S. de Jong](#), [J. G. W. Beemster](#), [L. A. Melsen](#) & [A. J. F. Hoitink](#)

Nature **644**, 391–397 (2025) | [Cite this article](#)

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Abstract

Climate change is expected to increase the frequency and magnitude of river floods¹. Floods not only cause damage by inundation and loss of life^{2,3} but also jeopardize infrastructure because of bank failure and riverbed erosion processes that are poorly understood. Common flood safety programmes include dyke reinforcement and river widening^{4,5,6,7,8,9}. The 2021

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<https://doi.org/10.1038/s41586-025-09305-3>

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NEWS AND VIEWS 12 August 2025

Dank voor uw aandacht

Impact of catastrophic flood might have been exacerbated by river-management programme

Efforts to engineer a river to reduce flood risk might have unintentionally contributed to severe erosion of the riverbed, worsening the impact of the flood.

By [Alvise Finotello](#) 

