Morpho-dynamics of supply limited rivers with weirs: case study of the River Meuse

Sediment balance and morphological processes

Hermjan Barneveld, 21 September 2021

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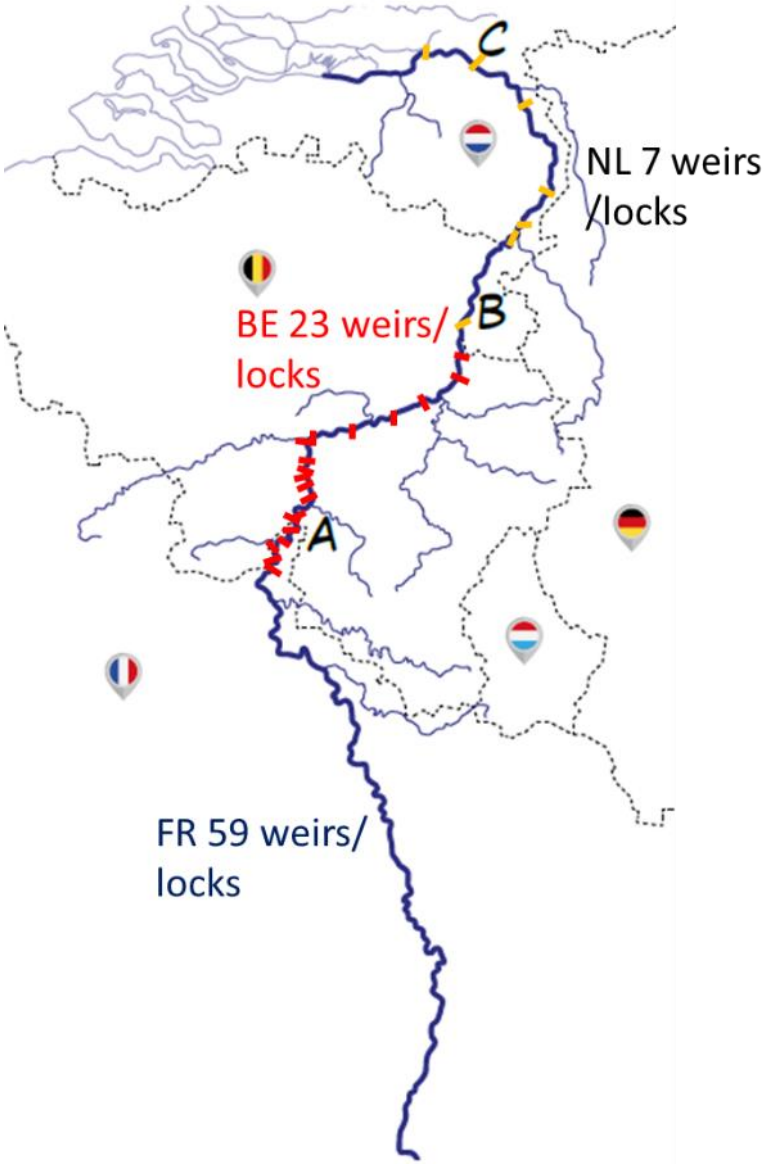
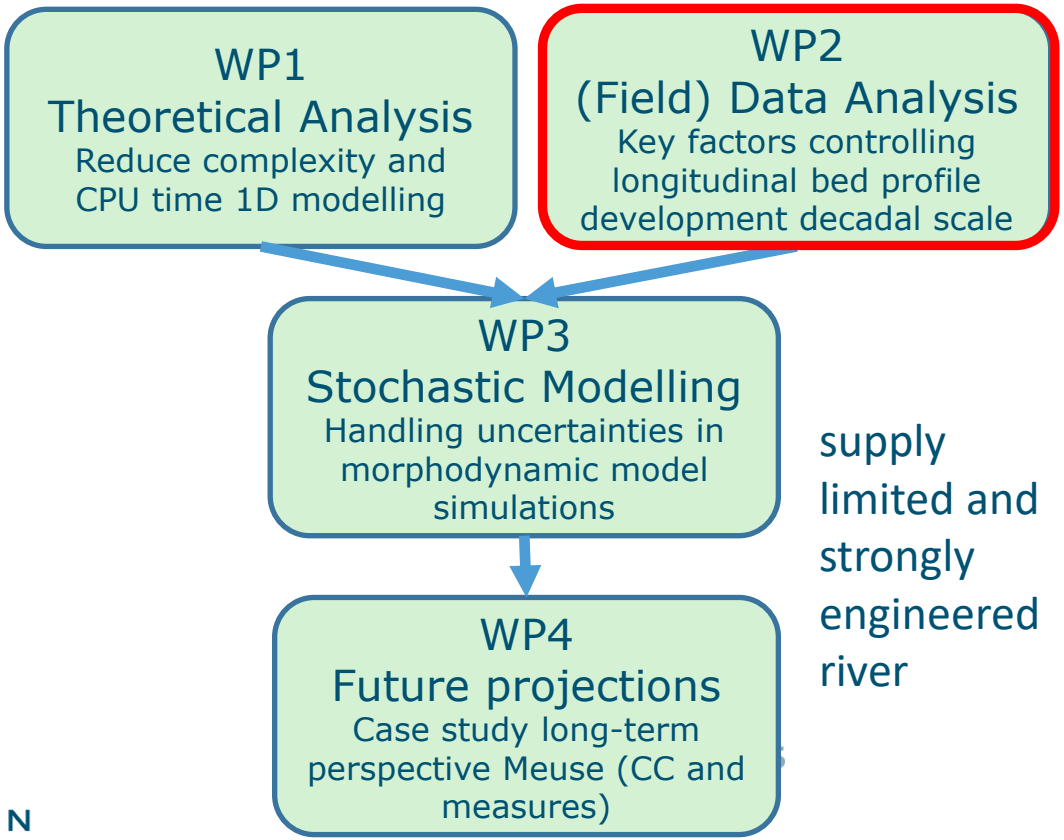


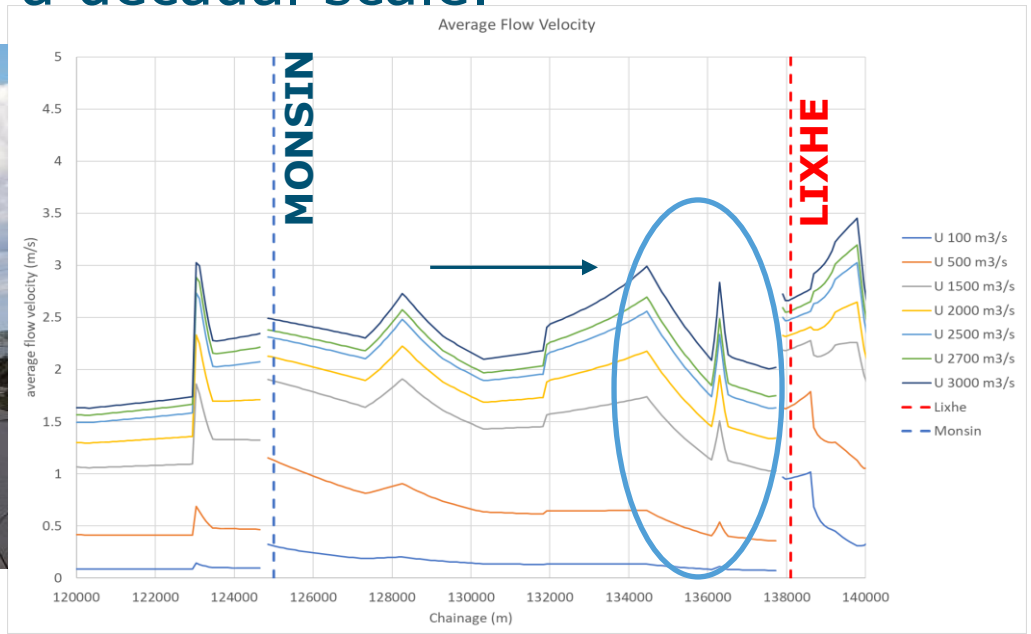
Morpho-dynamics of supply limited rivers with weirs: case study of the River Meuse

Improve morphological modelling methods for prediction of bed profile change in a supply-limited river with weirs.



WP2 (Field) Data Analysis
Key factors controlling longitudinal bed

1. Influence of weirs, sediment management, sediment mining and natural processes on the morphological system and sediment connectivity?
2. Establish the key factors controlling longitudinal bed profile development at a decadal scale.



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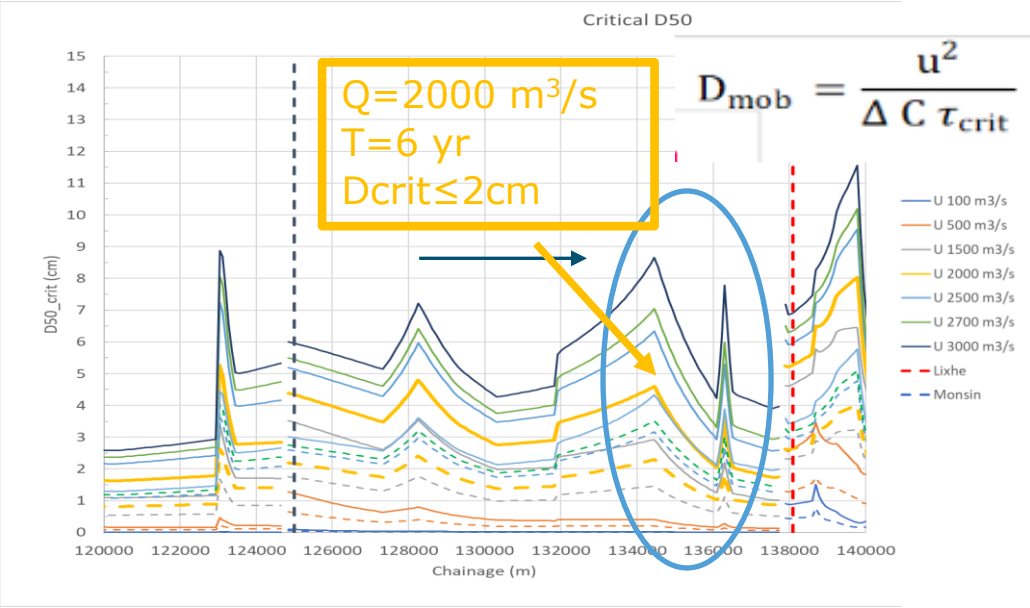
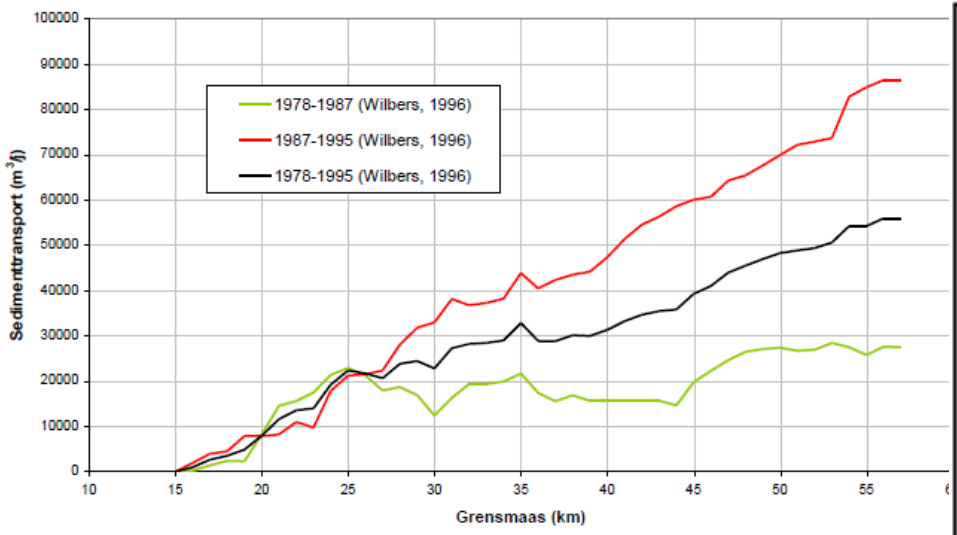
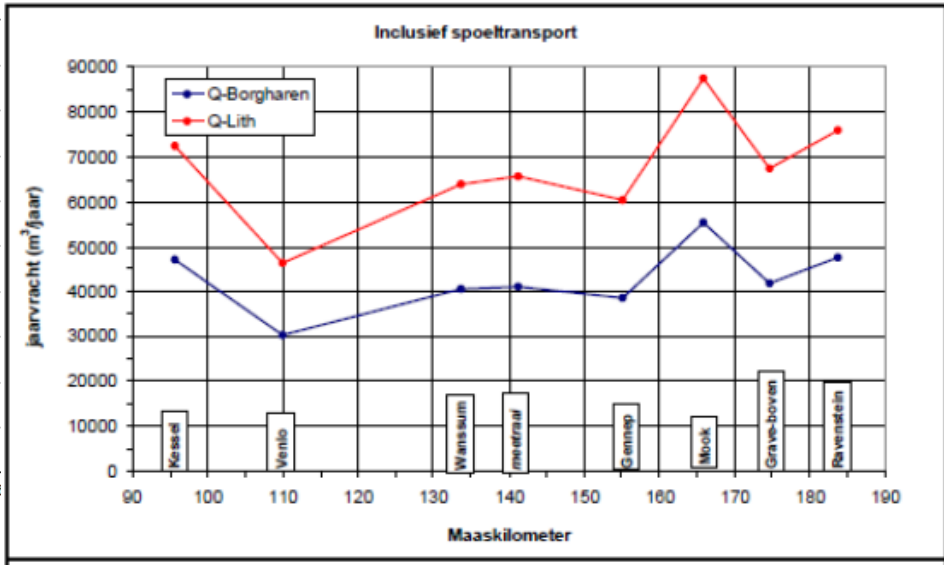


WP2 Sediment balance, before 1995

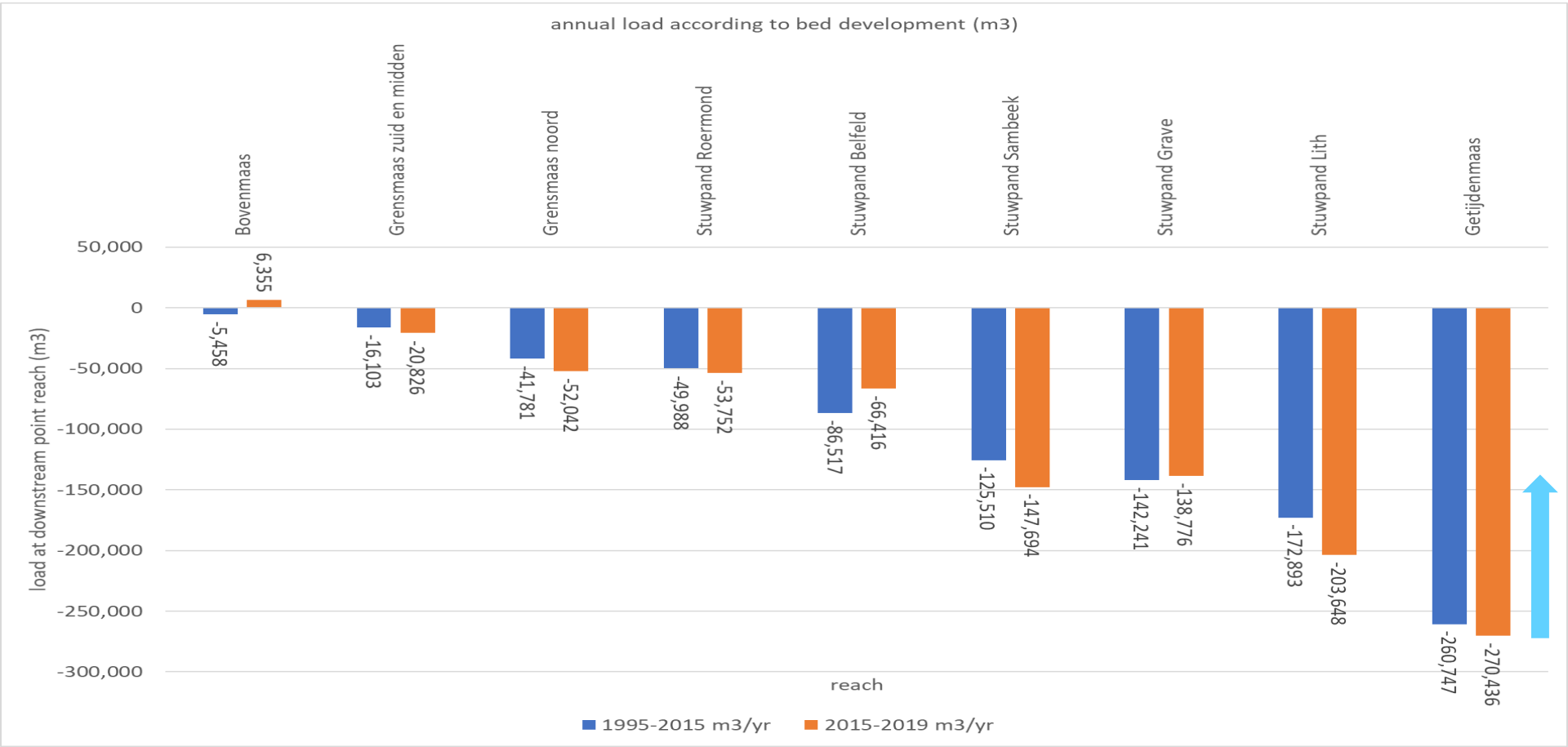




Figuur 4-5 Sedimenttransport in de Grensmaas op basis van bodempeilingen (Wilbers, 1996)

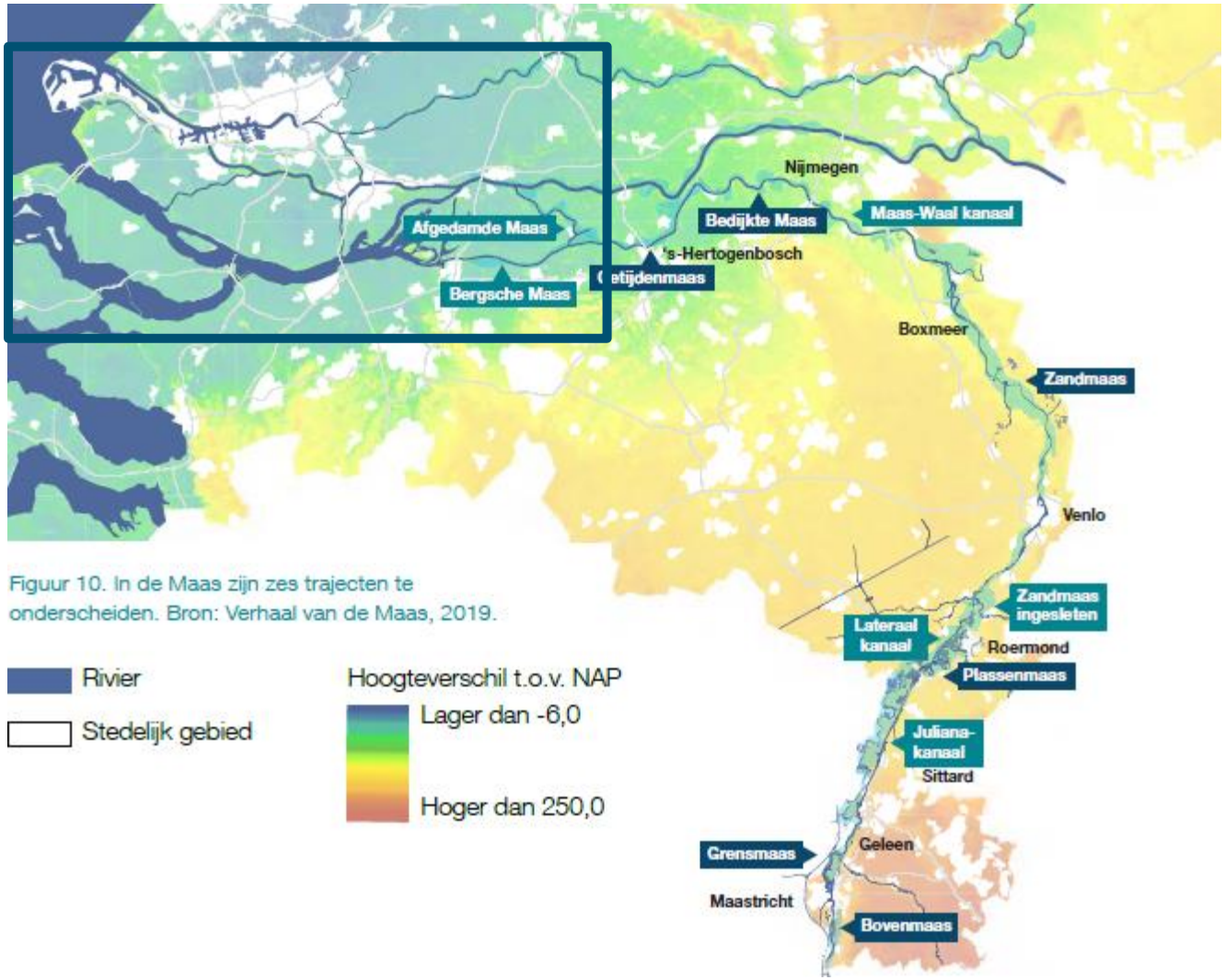
- Very rough estimate
- Before MeuseWorks (Room for the River)

WP2 Sediment balance, since 1995



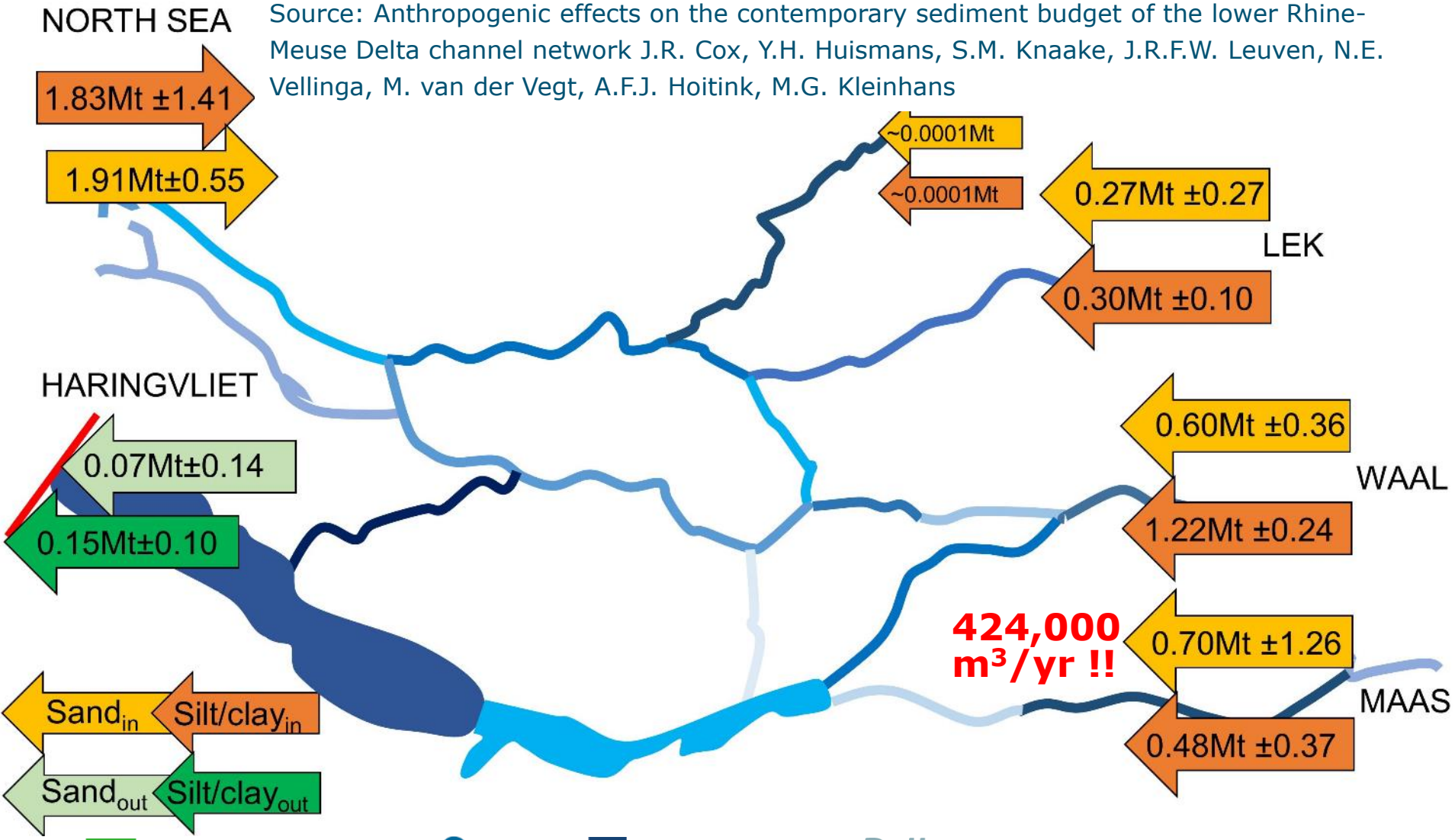
- Include impact of dredging, aggradation floodplains, tributaries, eroding banks, missing bed level information

WP2 connection to delta?



Figuur 10. In de Maas zijn zes trajecten te onderscheiden. Bron: Verhaal van de Maas, 2019.

WP2 connection to delta?



Source: Anthropogenic effects on the contemporary sediment budget of the lower Rhine-Meuse Delta channel network J.R. Cox, Y.H. Huismans, S.M. Knaake, J.R.F.W. Leuven, N.E. Vellinga, M. van der Vegt, A.F.J. Hoitink, M.G. Kleinhans

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International context

Questionnaire France, Belgium, Netherlands

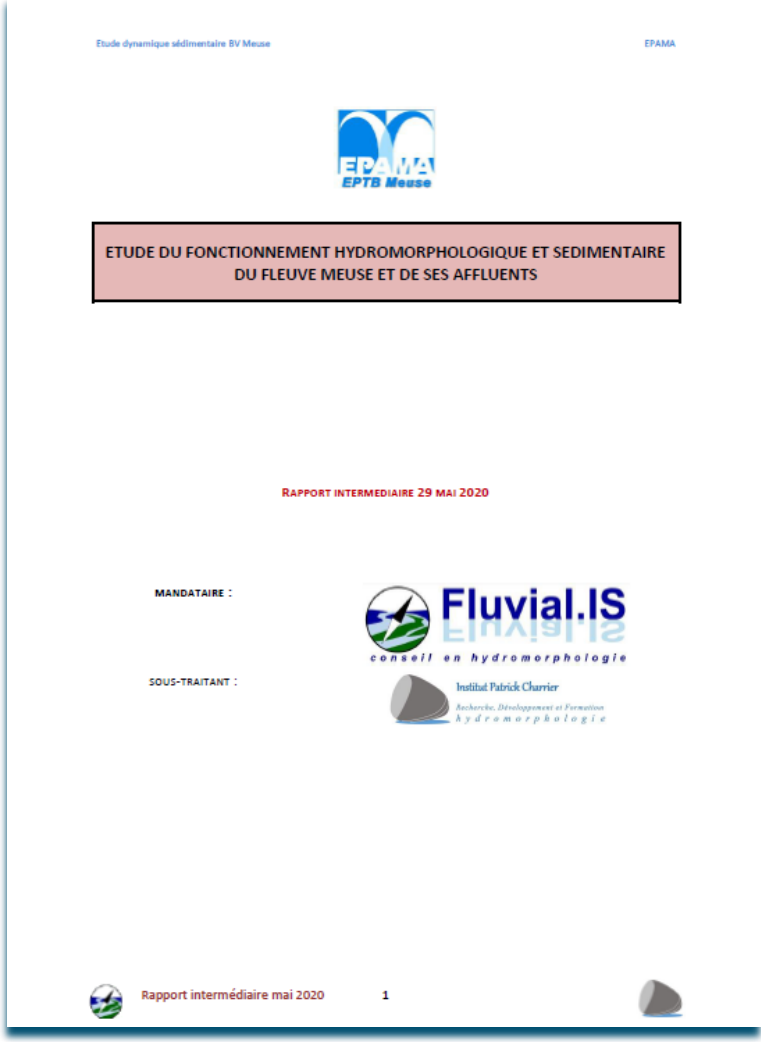
1. *Sediment management (regulations, quantities)*
   = Dredging for:
   a. Nature
   b. Water quality
   c. Flood safety
   d. Navigation
   e. Sediment mining

   No international agreements

2. *Sediment loads and composition*
   Limited information, but studies underway

France - Sedimentary study EPAMA Mission "Know the river" (underway)

1. Hydromorphological and sedimentary functioning
2. Part of biodiversity strategy (WFD)
3. What
   - ✓ disrupts connectivity?
   - ✓ causes flooding?
   - ✓ hinders the ecological continuity essential to ecosystems?



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1. hydromorphological and sedimentary functioning
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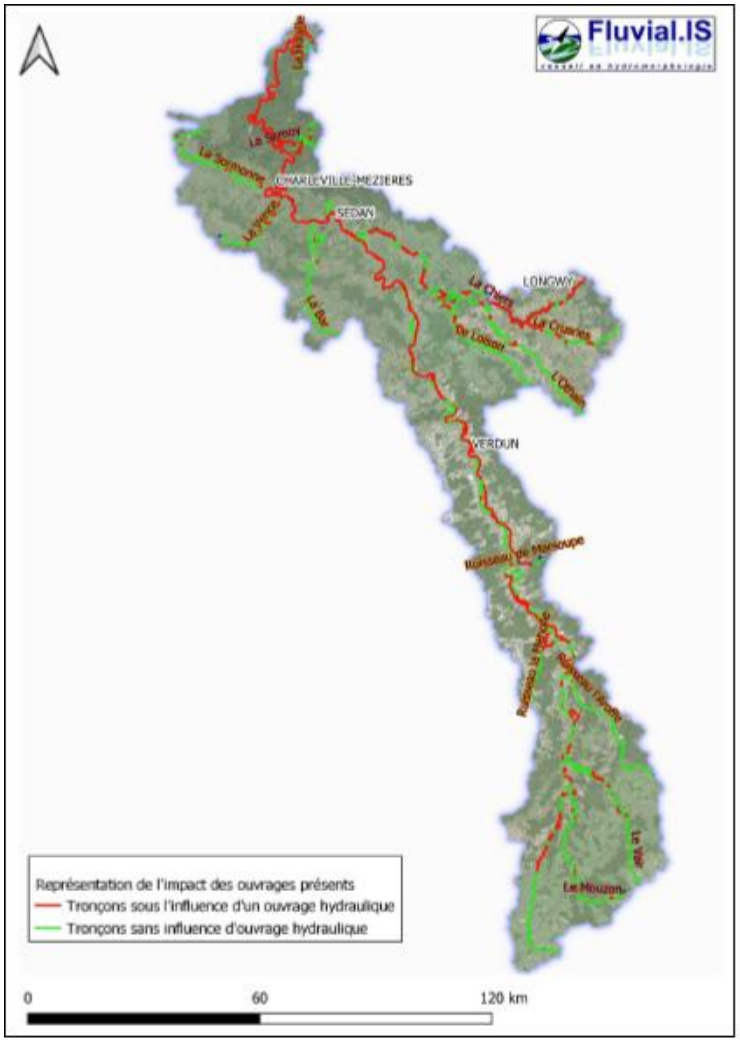
3. What
   - ✓ disrupts connectivity?
   - ✓ causes flooding?
   - ✓ hinders the ecological continuity essential to ecosystems?
4. Understand the system
5. **Improve management and interventions**

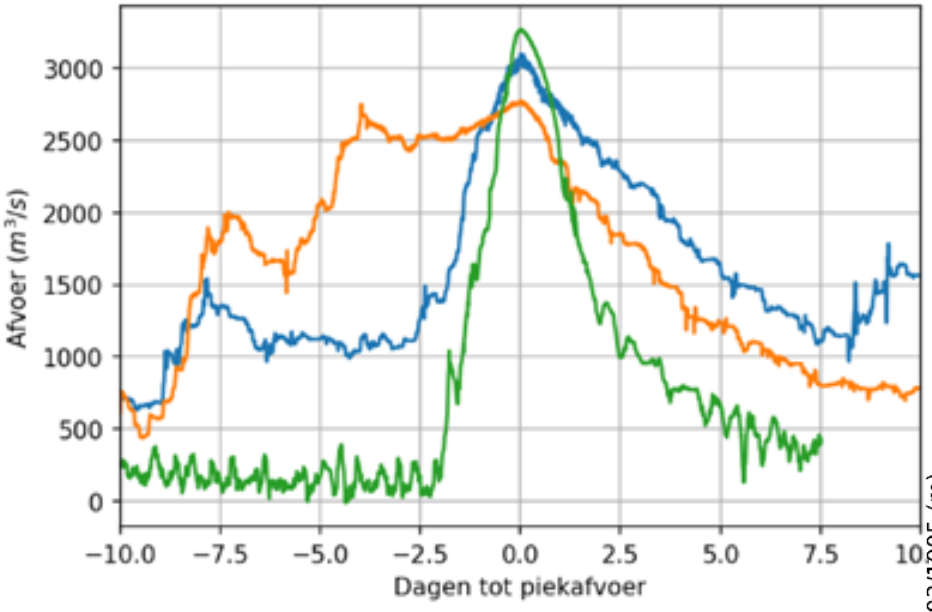


The Netherlands – ‘Stories’ and Research Programme Morphology (underway)

Story of the Sediment
1. Geology and human impact
2. Morphological description
3. Morphological trends
4. Impact on river functions
5. Guiding principles

Research programme
1. Processes
2. Modelling
3. Monitoring
    1. Sampling
    2. Sediment transport

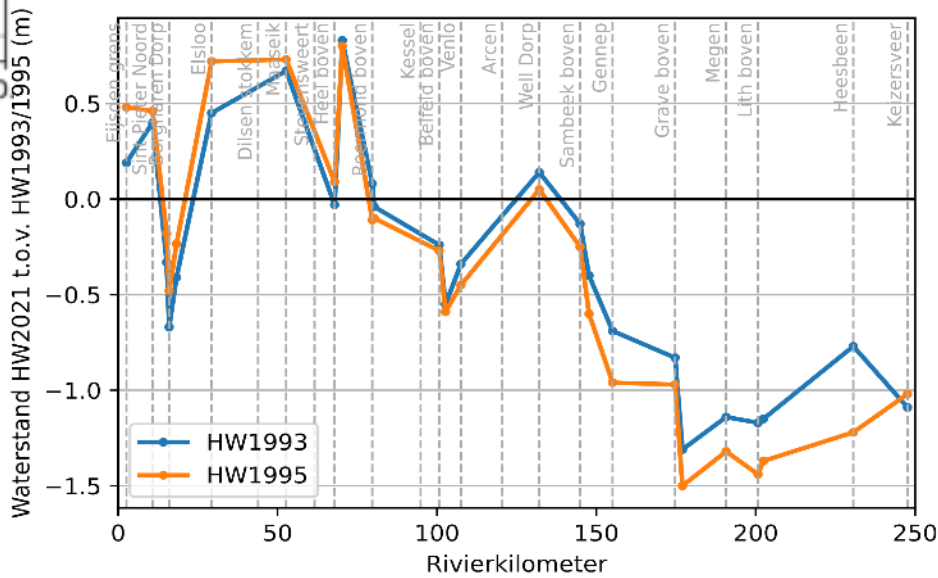
Flood July 2021



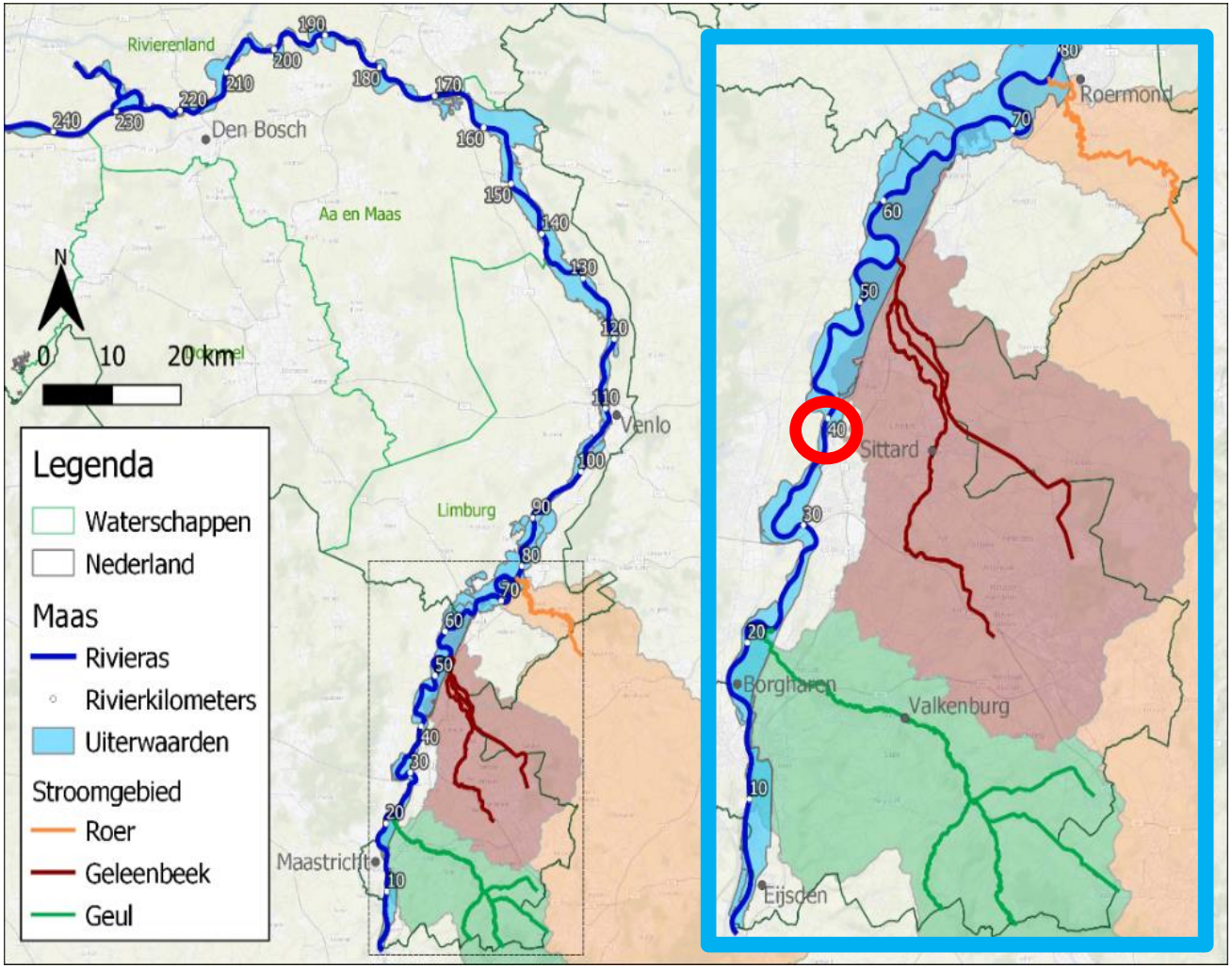
Source: Hoogwater 2021 Feiten en Duiding (Flood 2021 Facts and Figures), Sept 2021

- 1:100 – 1:200 flood at border
- For summer much lower frequency

- Downstream less extreme in peak discharge and water level (1:5-1:10)

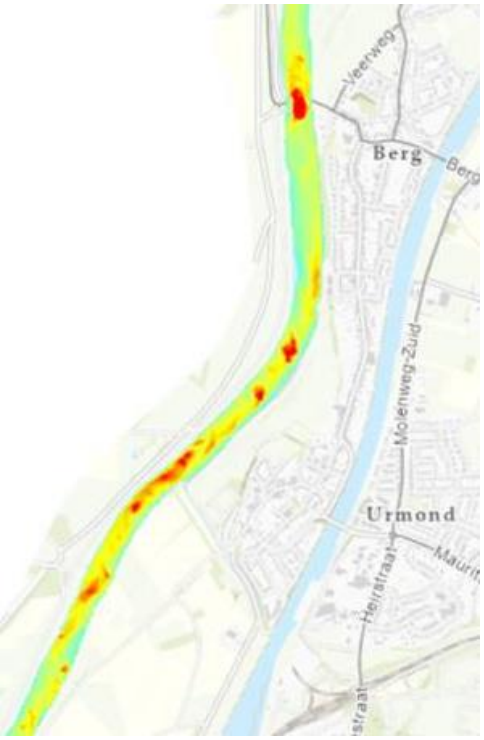


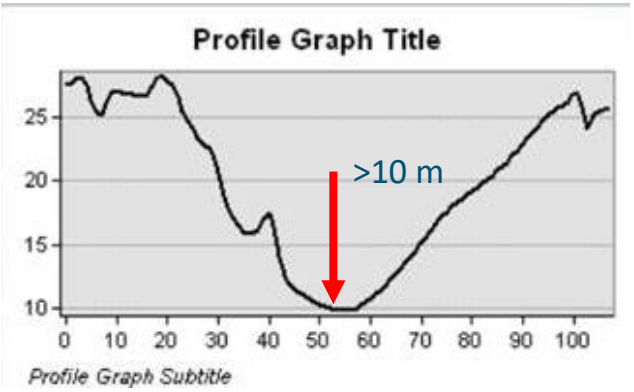
Flood July 2021



Source: Hoogwater 2021 Feiten en Duiding (Flood 2021 Facts and Figure), Sept 2021

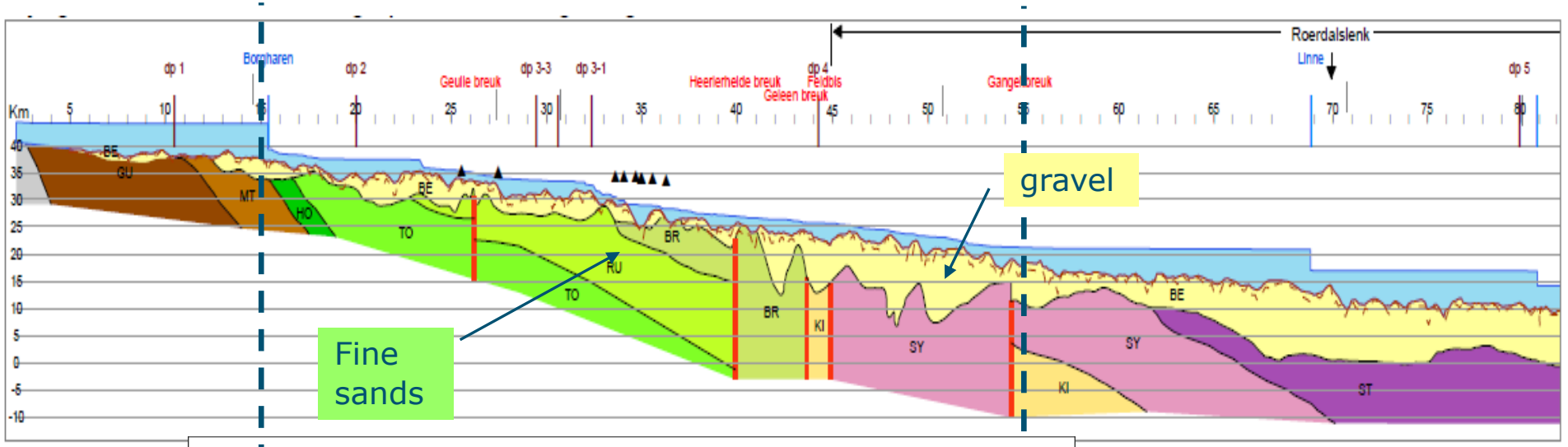
Flood July 2021 – morphological changes

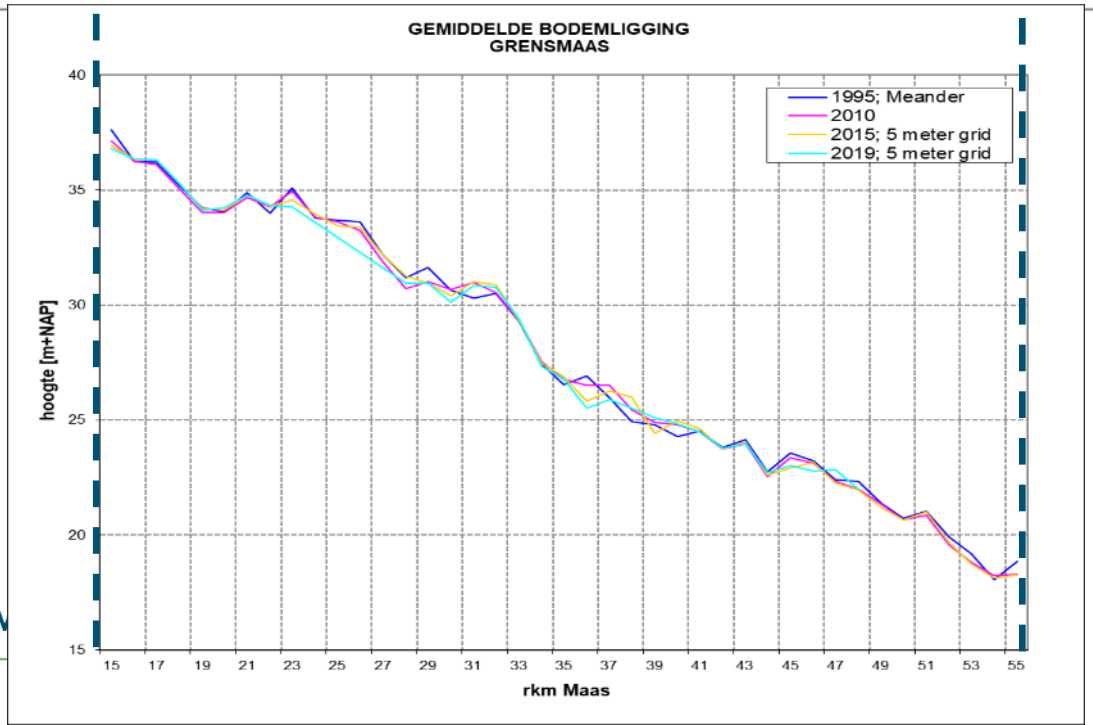




Source: Data RWS-CIV

Flood July 2021 – morphological changes

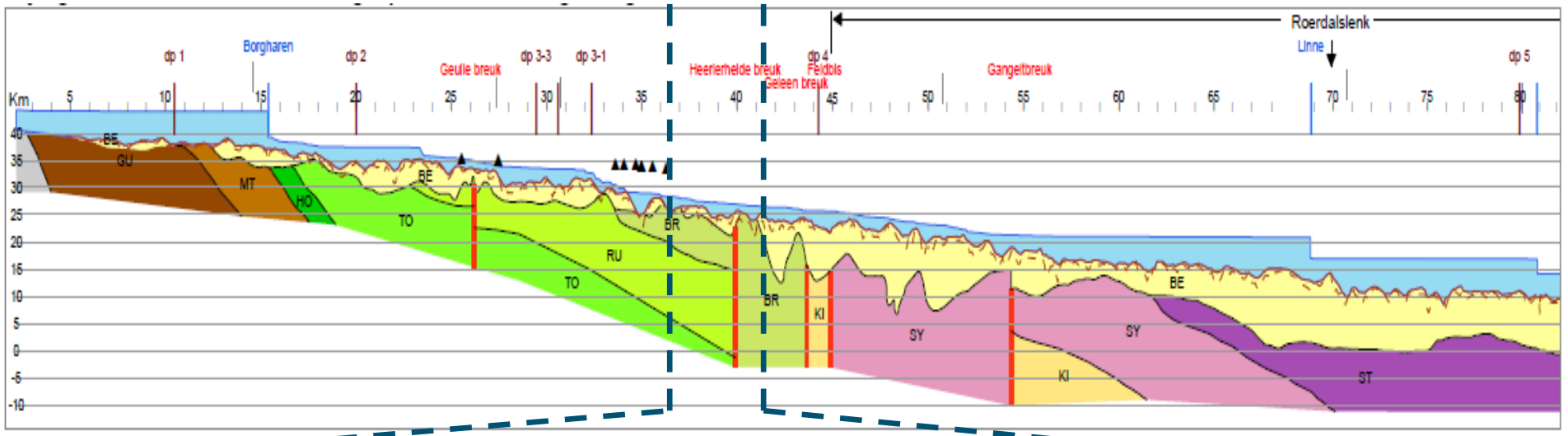


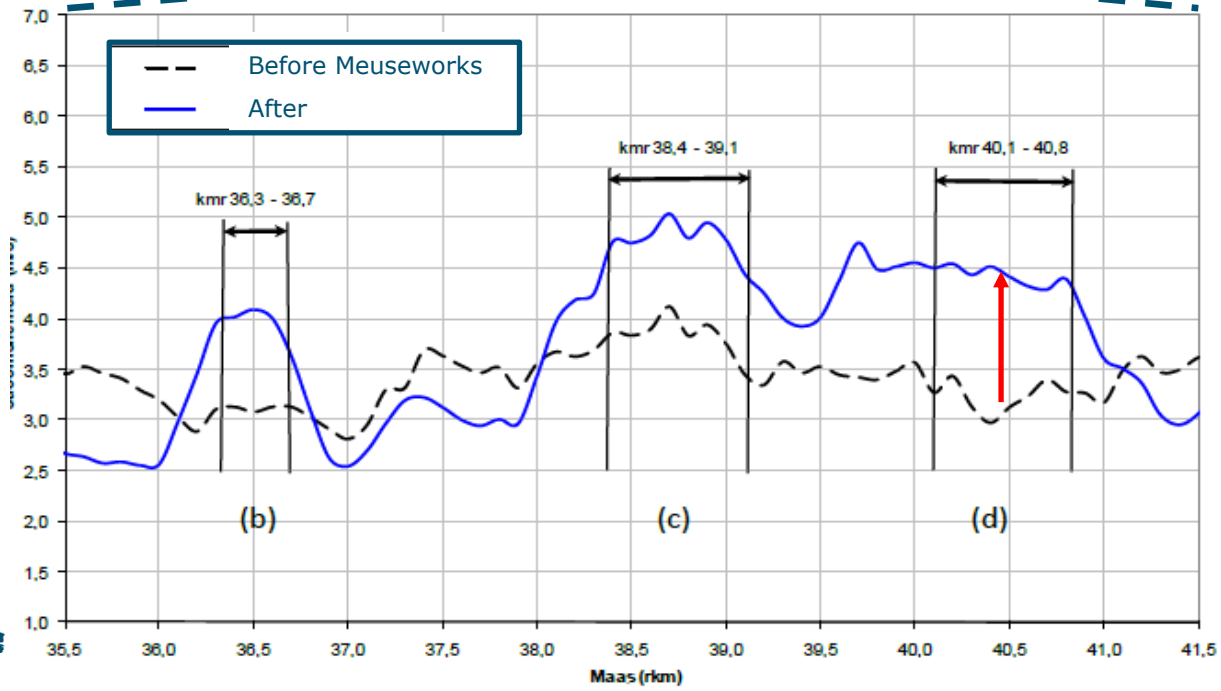


Source: Meijer D.G., J. Lambeek en J.D. van der Werff ten Bosch (2011): Inventarisatie en interpretatie ondergrondgegevens Maas.

Bed erosion ≈ 2 cm/yr

Flood July 2021 – morphological changes

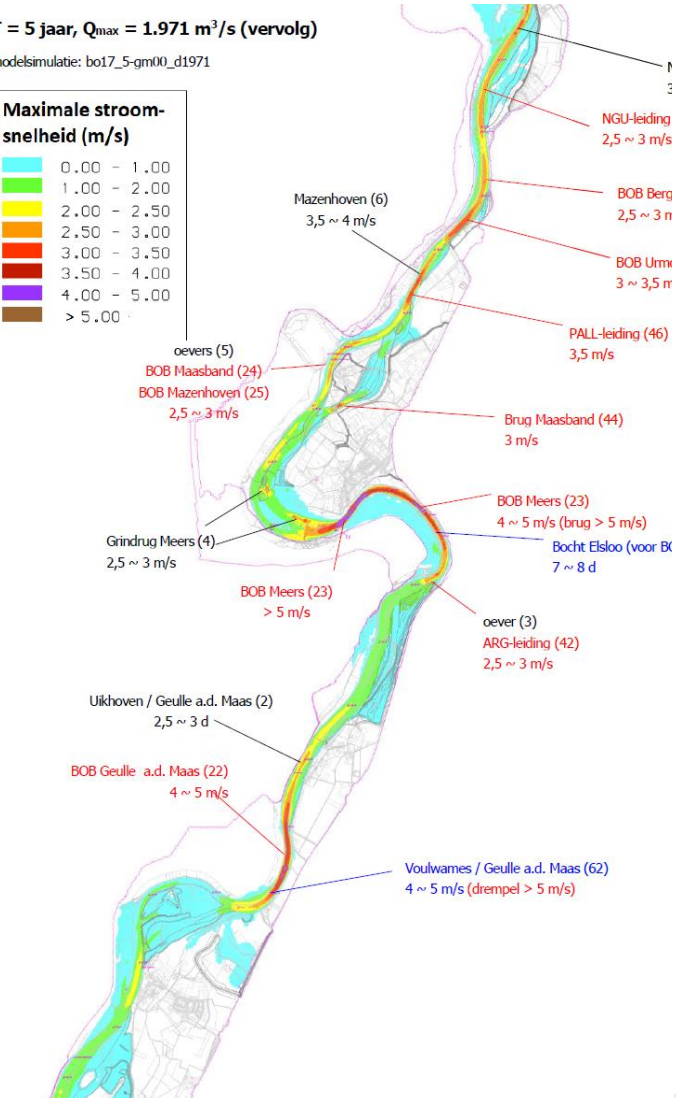




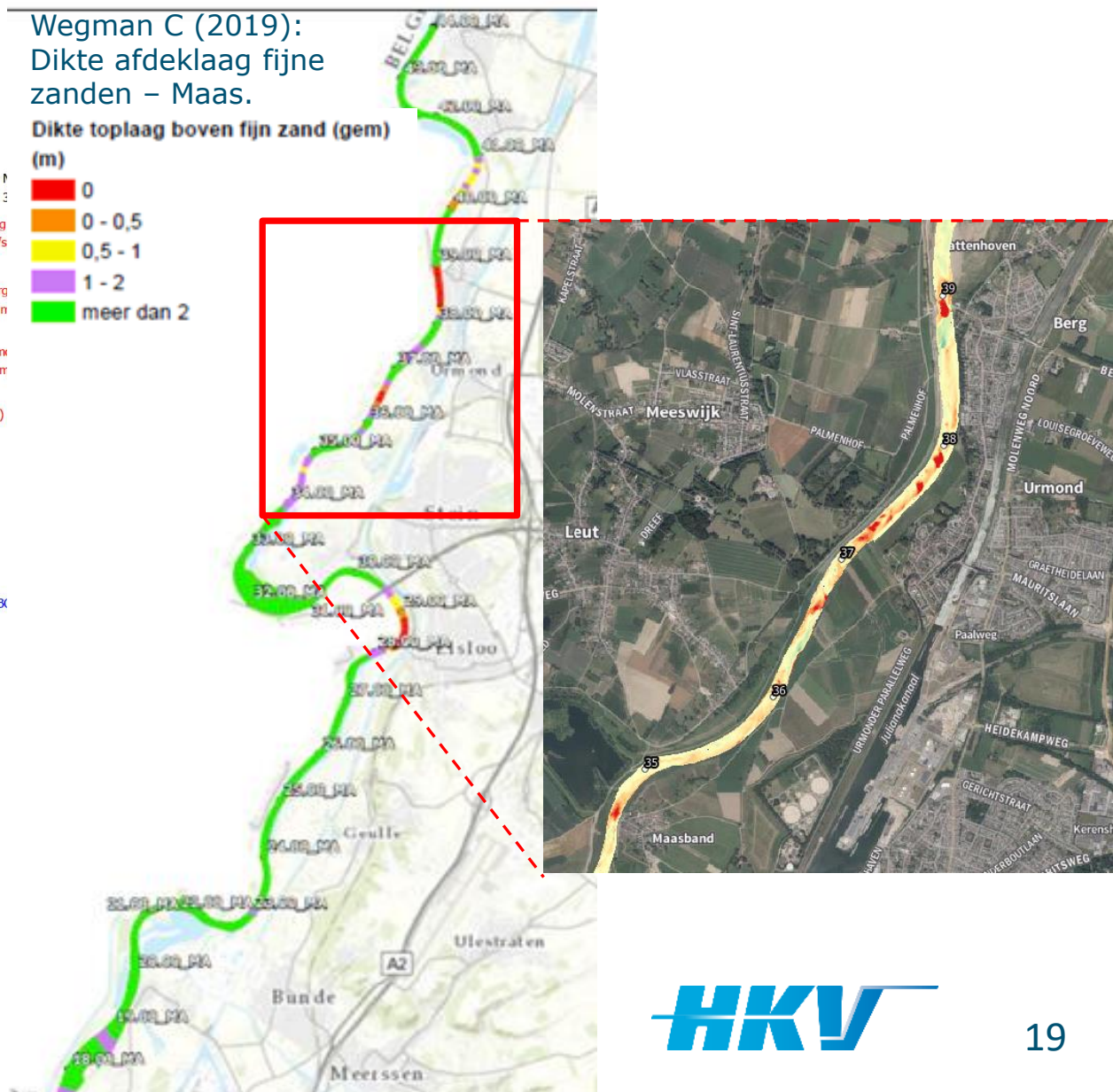
High and increased flow velocities.
Source: Meijer D.G. en J. Vieira da Silva (2007): Gemeenschappelijke Maas te Lanaken en Maasmechelen: Zuidelijke sector, Rivierkundige en grondwaterstudie van de geplande ingrepen.

Flood July 2021 – morphological changes

Meijer, D.G. en R.C. Agtersloot (2020): Stroomsnelheden in de Gemeenschappelijke Maas.

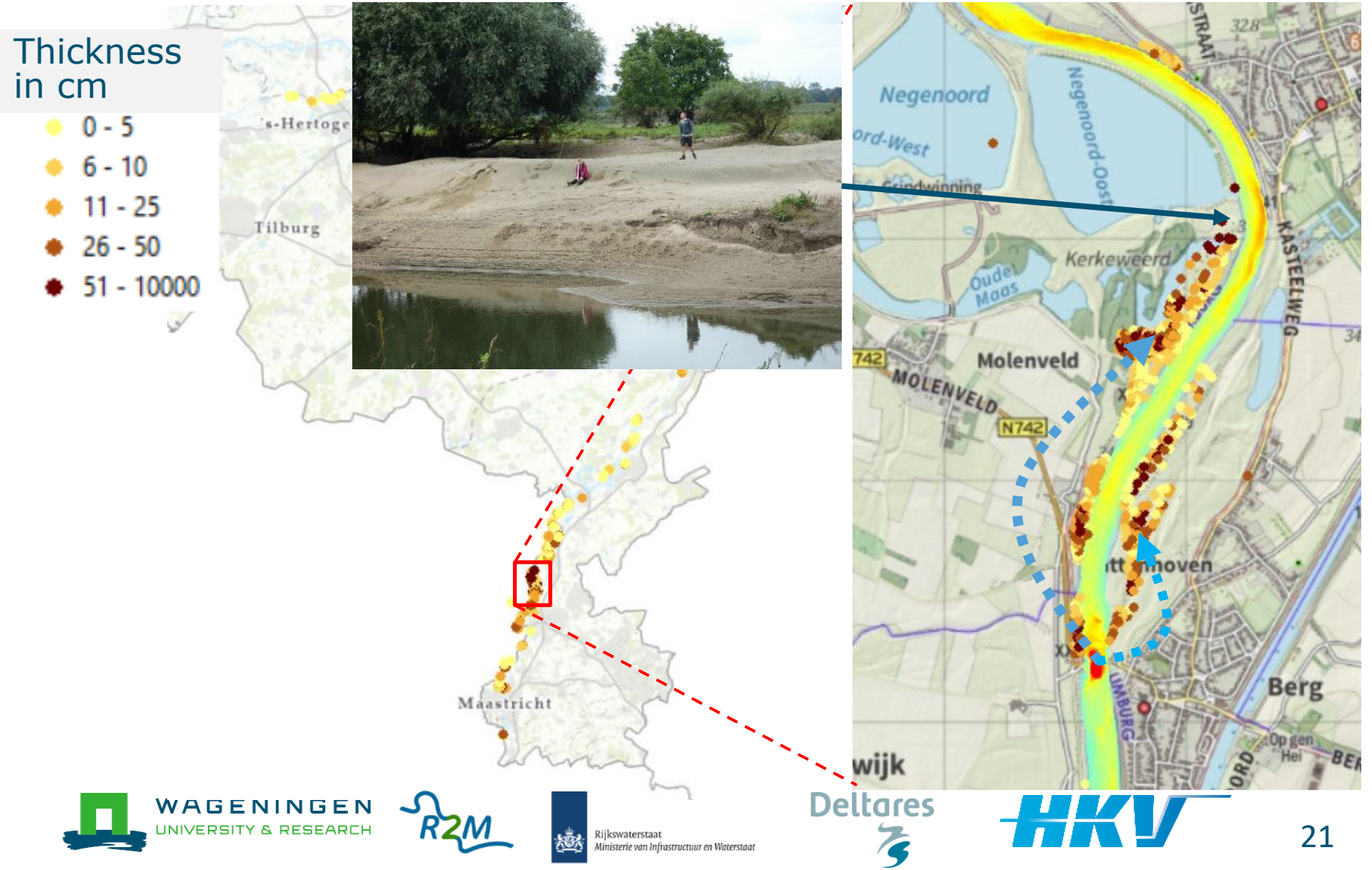


Wegman C (2019): Dikte afdeklaag fijne zanden – Maas.



Fieldwork August 2021 – floodplain sand deposits

Flood July 2021 – morphological changes



Take away

1. Challenges sediment balance
2. Consider as a system
3. 2021 Summer Flood
    a) New sediment sources ‘participate’
    b) We reached status for which large morphological changes may be expected
    c) Provides much new data: knowledge processes and improvement models
    d) Sediment management more urgent

Thanks for your attention and questions !

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