

Kort door de bocht:

Invloed van waterberging op de hydraulica van laagland beken



RiverCare
Towards self-sustaining multifunctional rivers



Witteveen + Bos

stowa
STICHTING TOEGEPAST ONDERZOEK WATERBEHEER

Rijkswaterstaat
Ministerie van Infrastructuur en Milieu

WATERSCHAP
vechtstromen

Waterschap
Aa en Maas

Waterschap
De Dommel

waterschap
limburg

Waterschap
Rijn en IJssel
WATERBEHEER: VEILIG EN OP MAAT

WAGENINGEN
UNIVERSITY & RESEARCH

Aanleiding

- Oorzaken:
 - Extremere natte en drogere seizoenen
 - Grondwaterdaling -> inklinking
 - Ecologische degradatie
 - Kwetsbaarheid voor klimaatverandering
- Een oplossing: water berging in 'bovenstroomse' gebieden in Nederland-> bouwen met natuur



Het perspectief

	Verandering in Q	Verandering in h
lokaal		
regionaal		

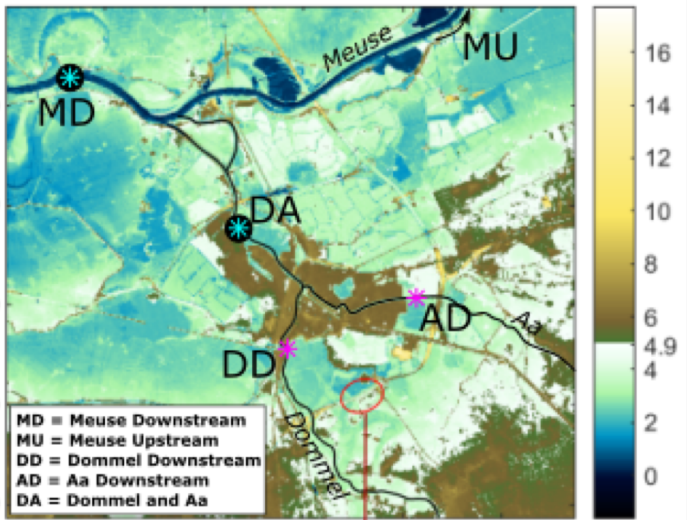


Samenvallen van afvoergolven





Introductie

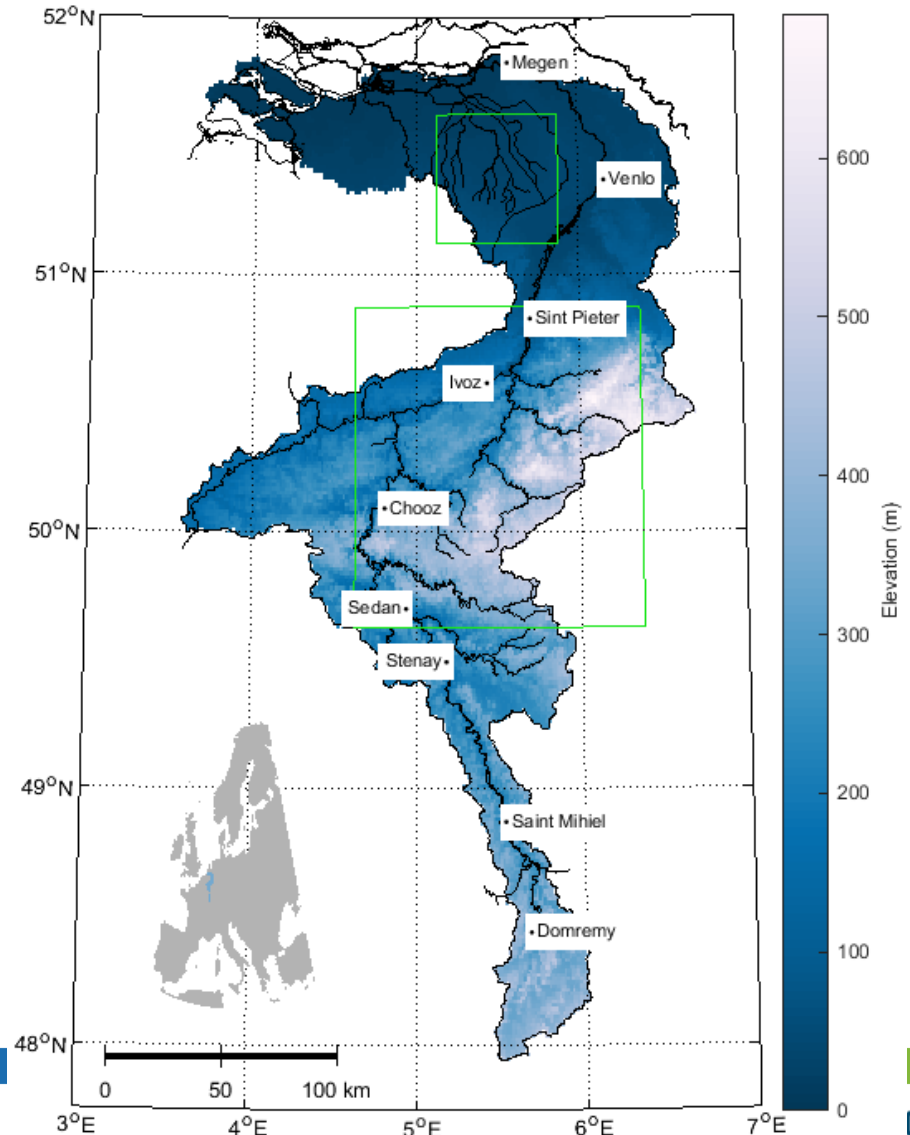




Introductie

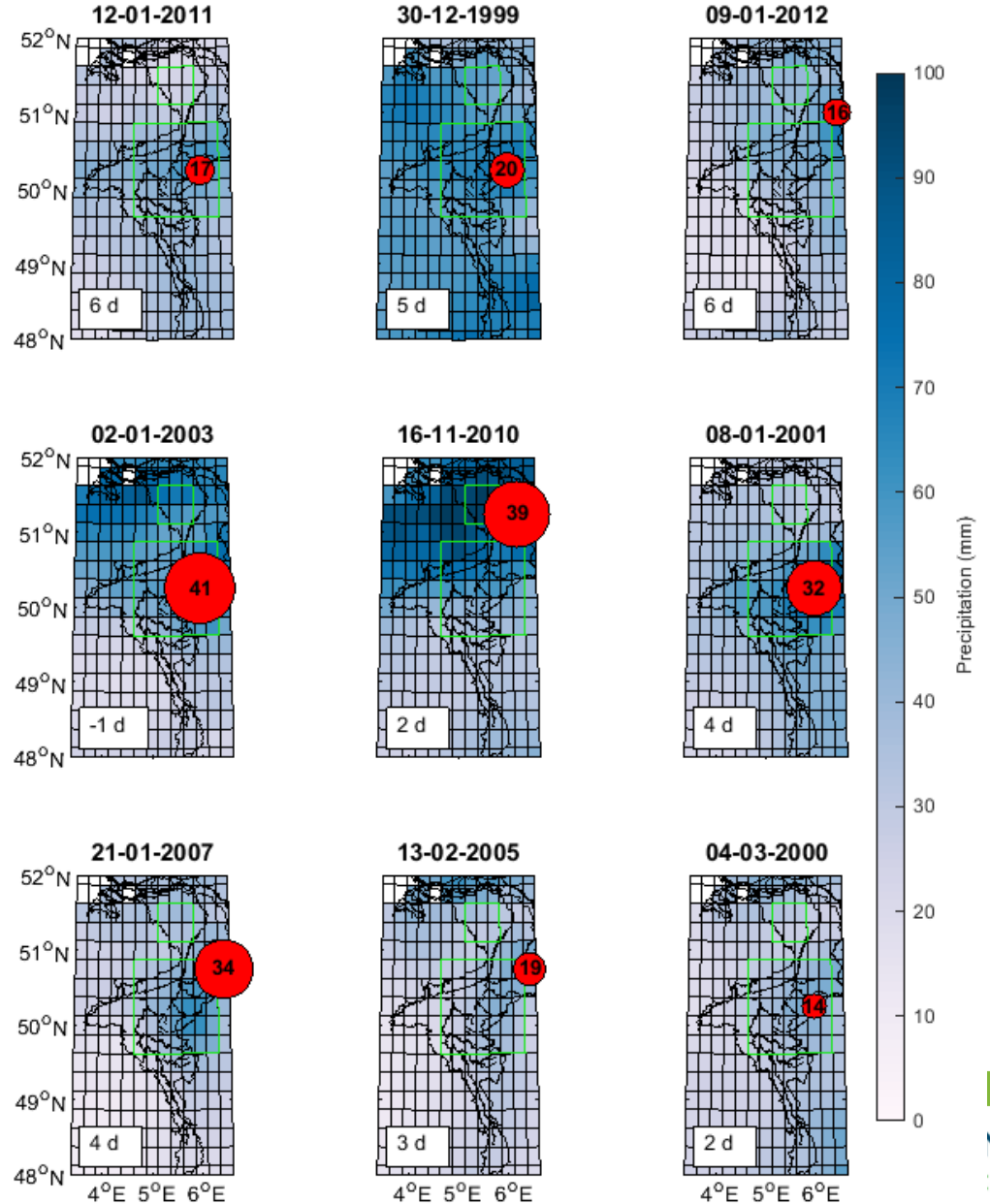
Hypothese:

- Neerslag is niet ruimtelijk gecorreleerd
- Stroomgebieden verschillen in oppervlakte



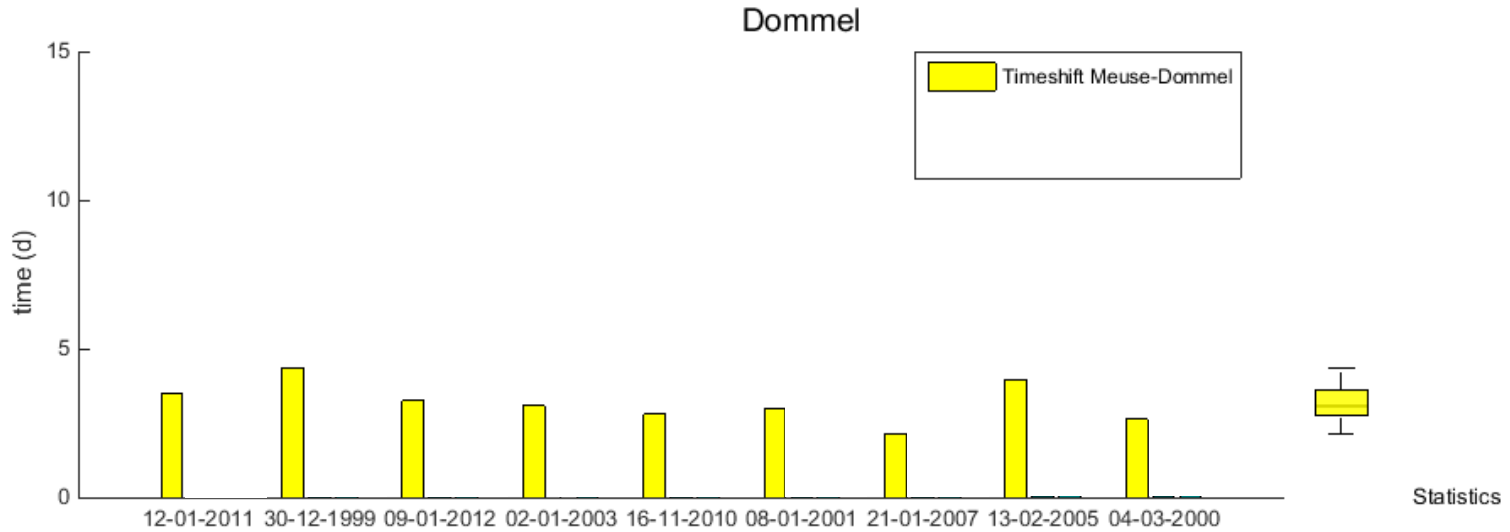


Neerslagverdeling





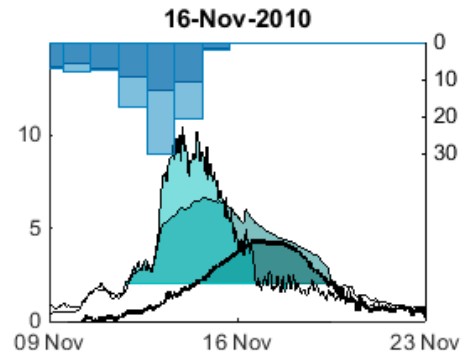
Tijdsverschillen afvoergolven





Samenvallen van afvoergolven

normalized Q (-)

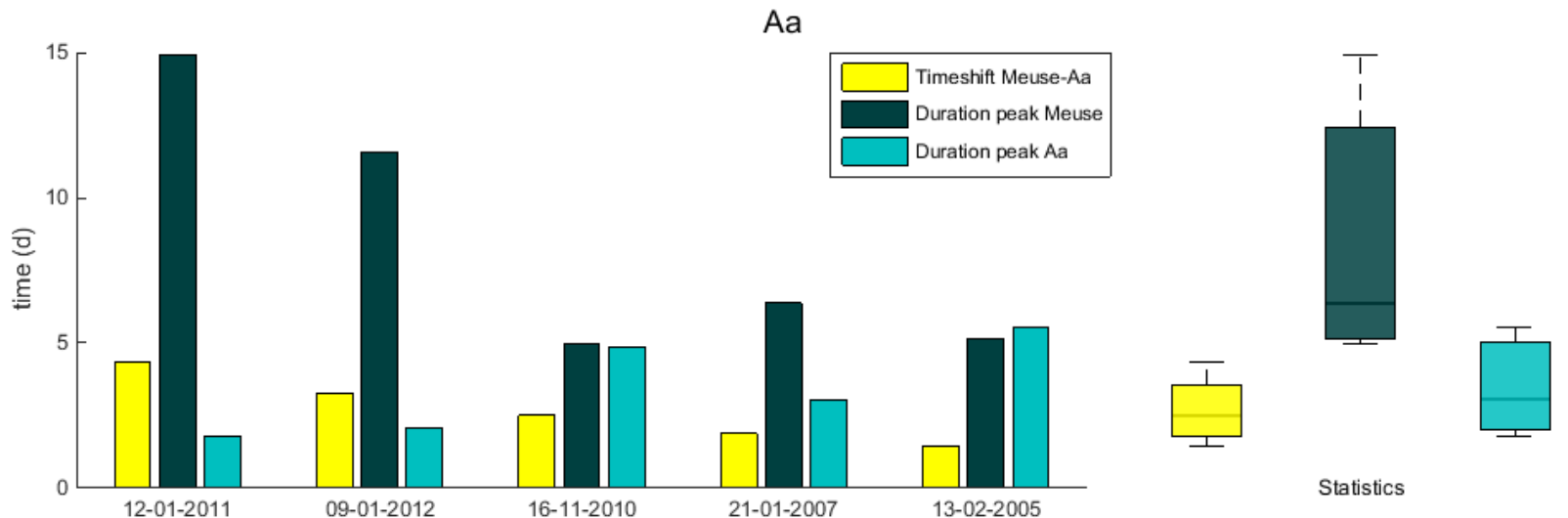
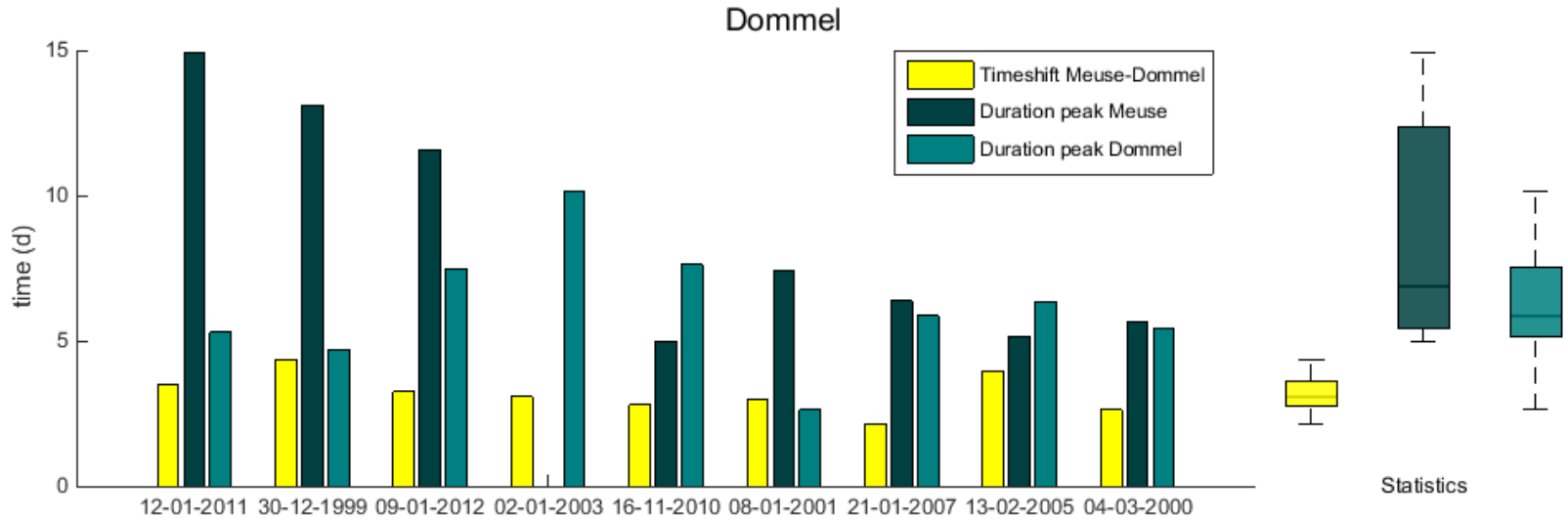


P (mm)



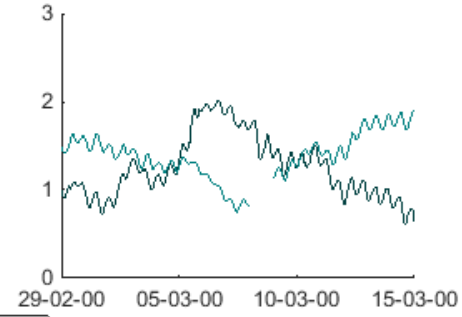
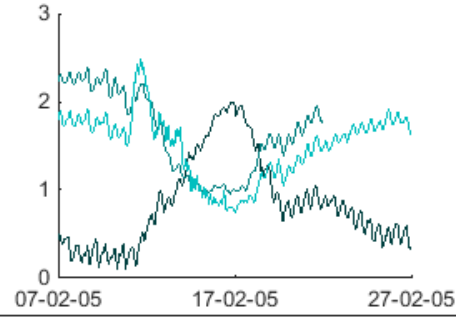
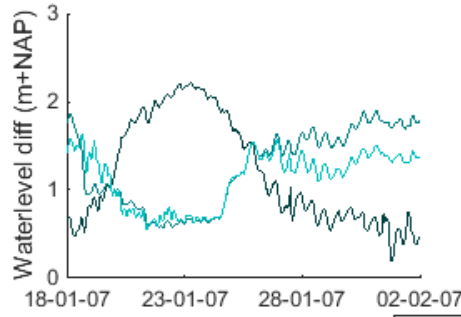
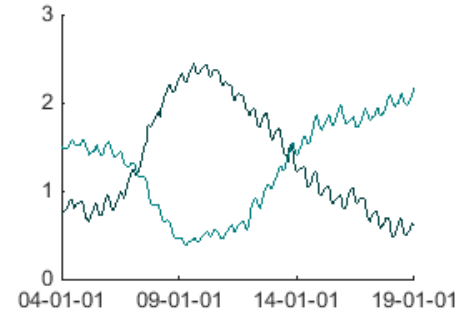
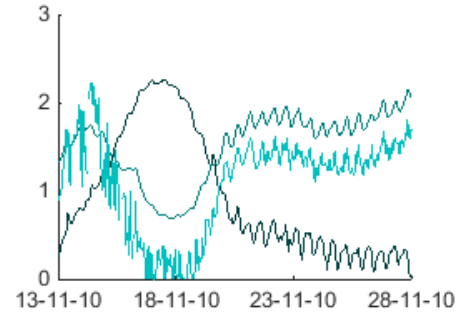
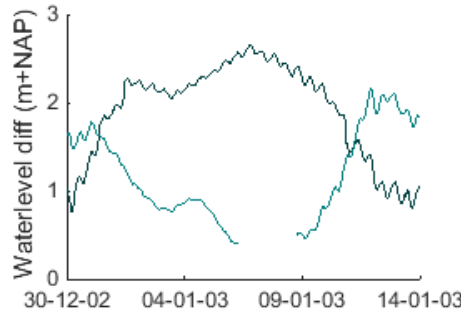
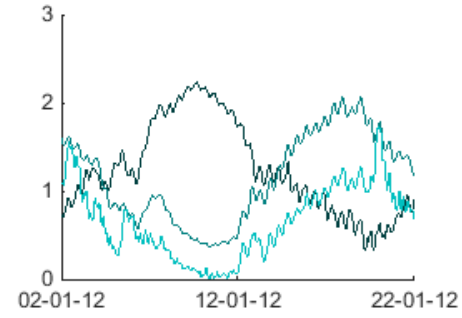
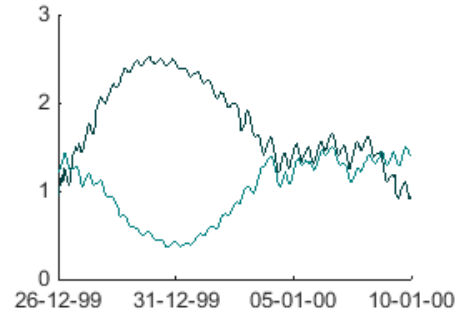
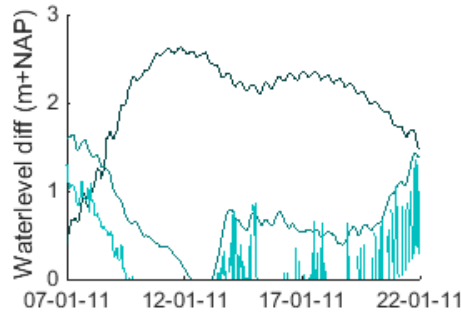


Tijdsverschillen en duur afvoergolven





Waterstandsverschillen





Conclusies

- De neerslagverdeling zijn vergelijkbaar voor beide stroomgebieden
- Samenvallen van afvoergebieden treedt elke keer op bij de onderzochte confluente als gevolg van de duur van afvoergolven
- De hoofdrivier stuwt de waterstanden in de zijrivieren op tot 1.5 meter

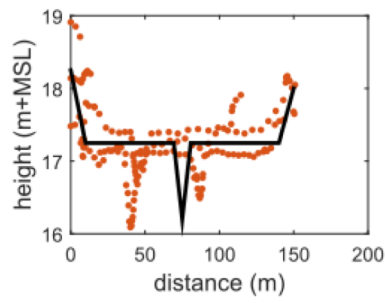
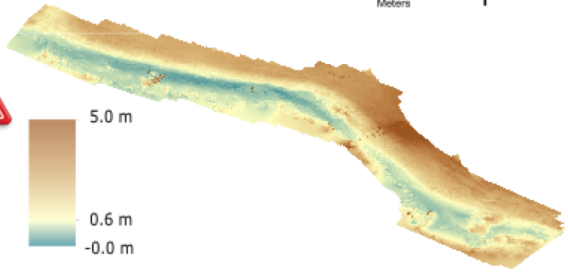


Hout in beken

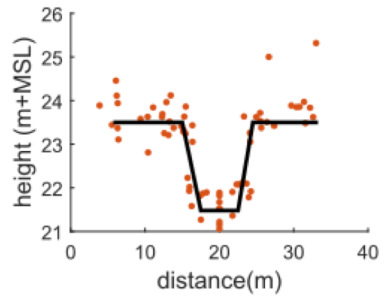
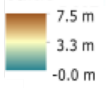


Beken

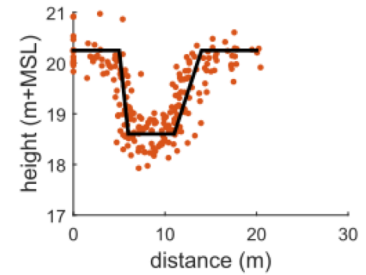
Leerinkbeek



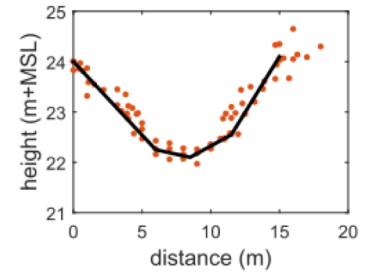
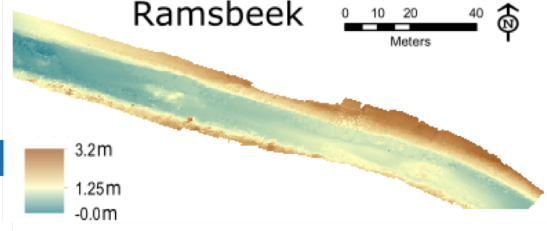
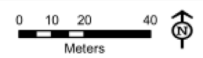
Tungelroysebeek



Tongelreep

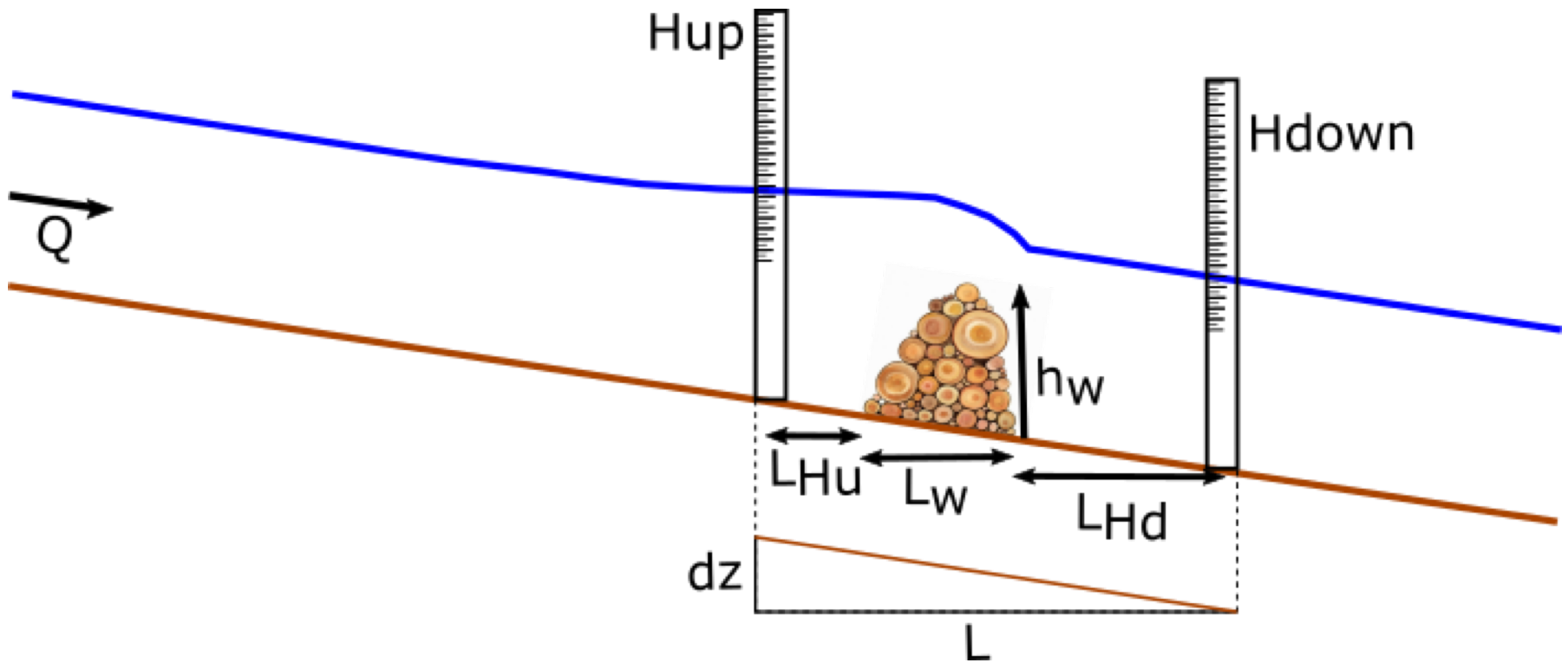


Ramsbeek



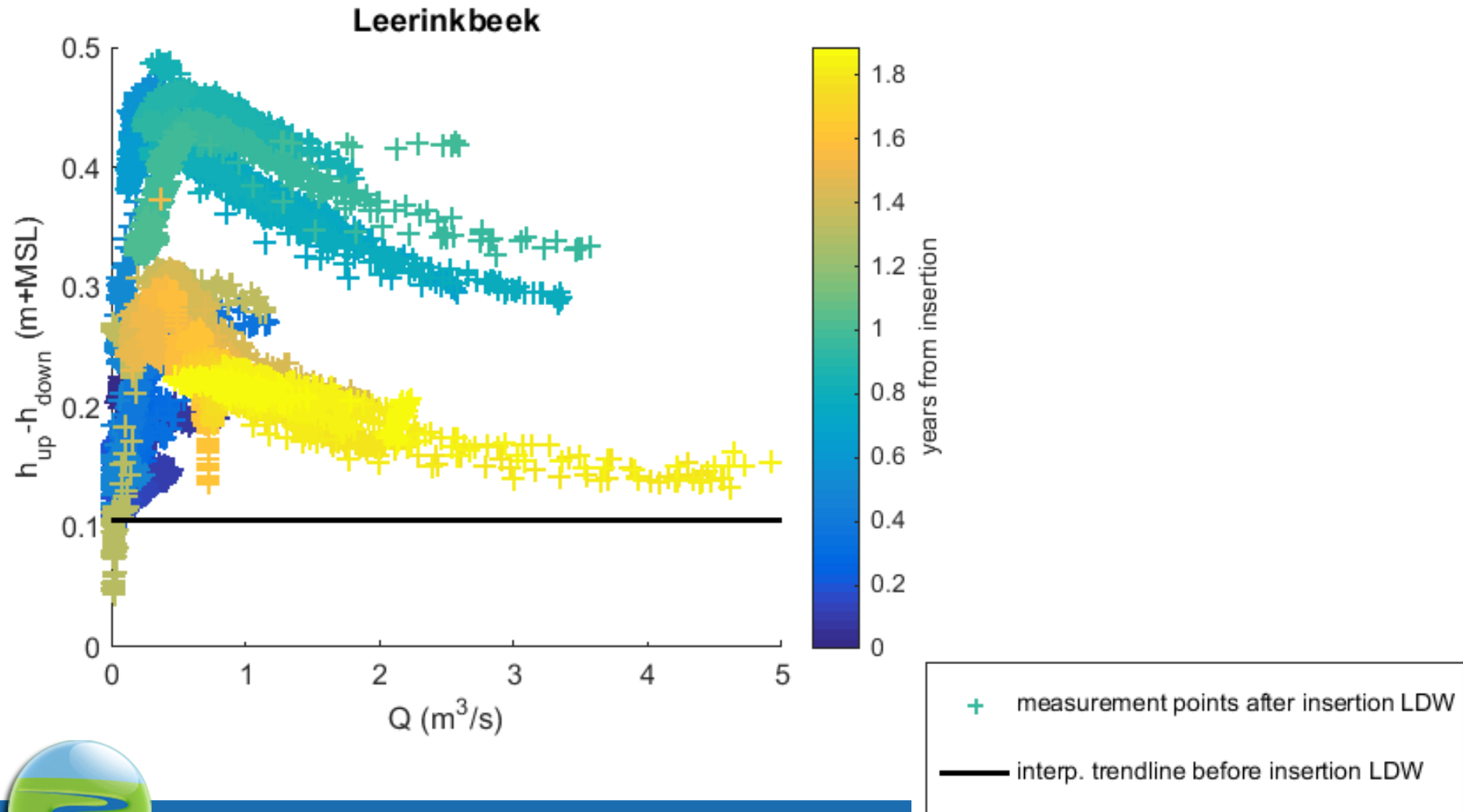


Meetopstelling



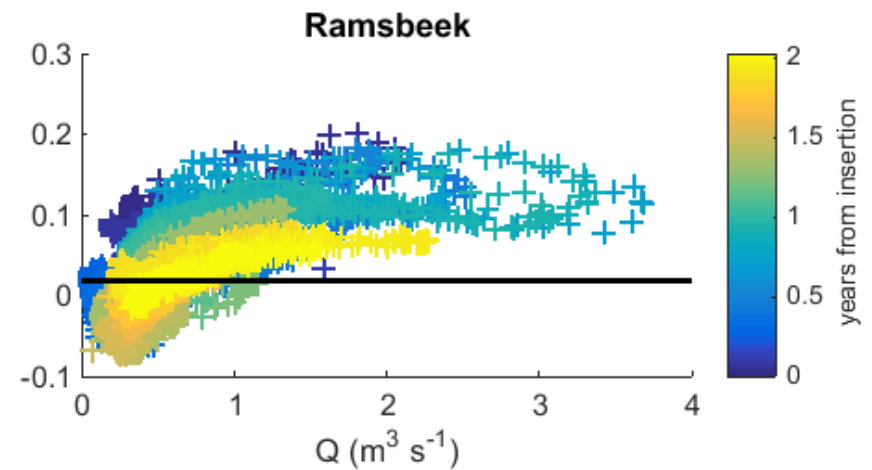
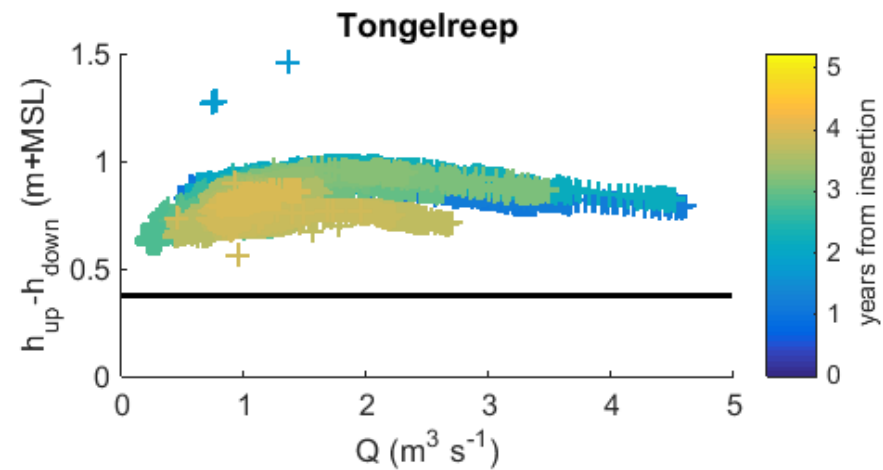
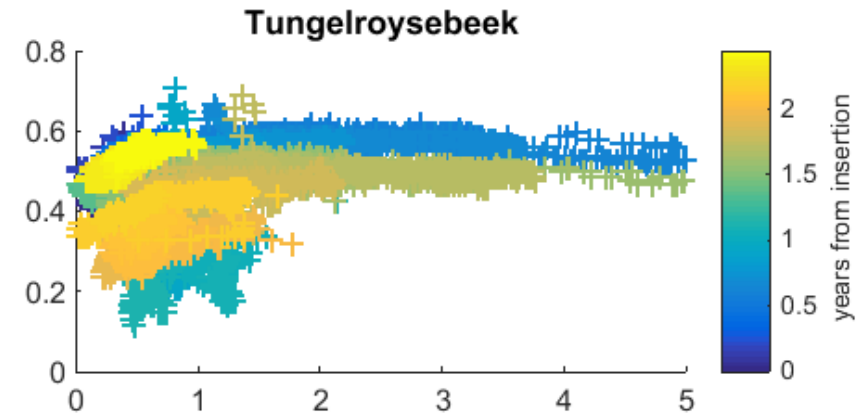
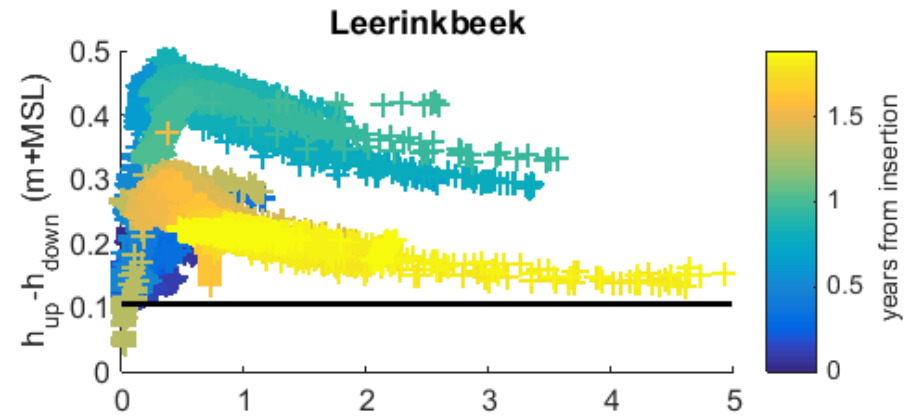


Resultaten



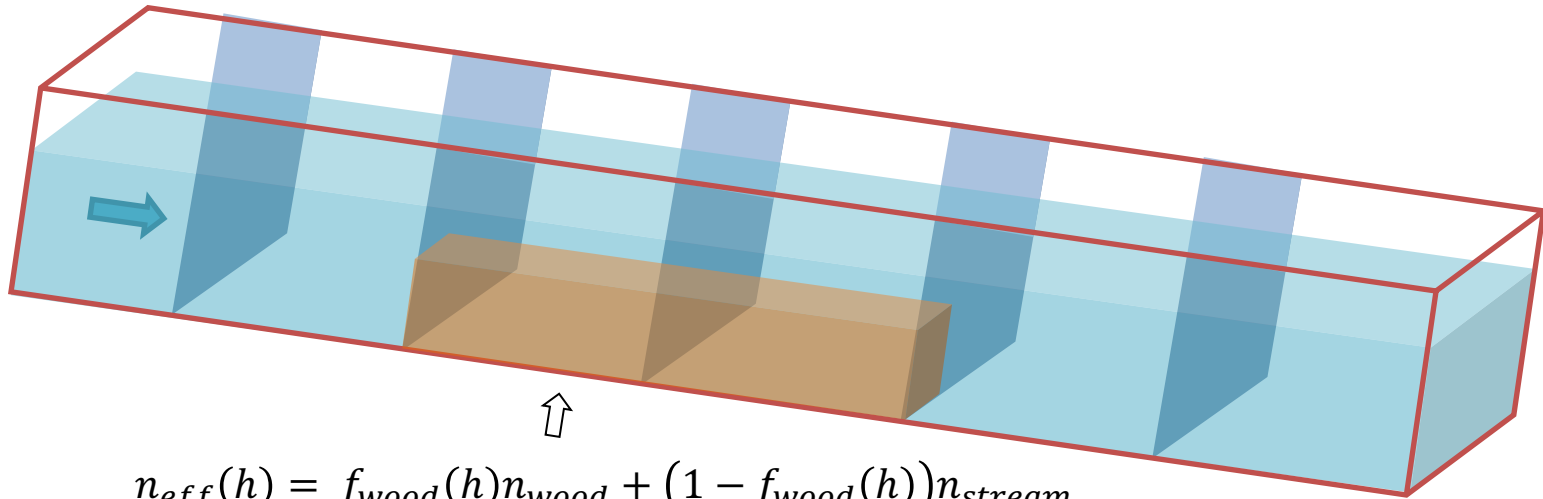


Resultaten





Parametrisch model



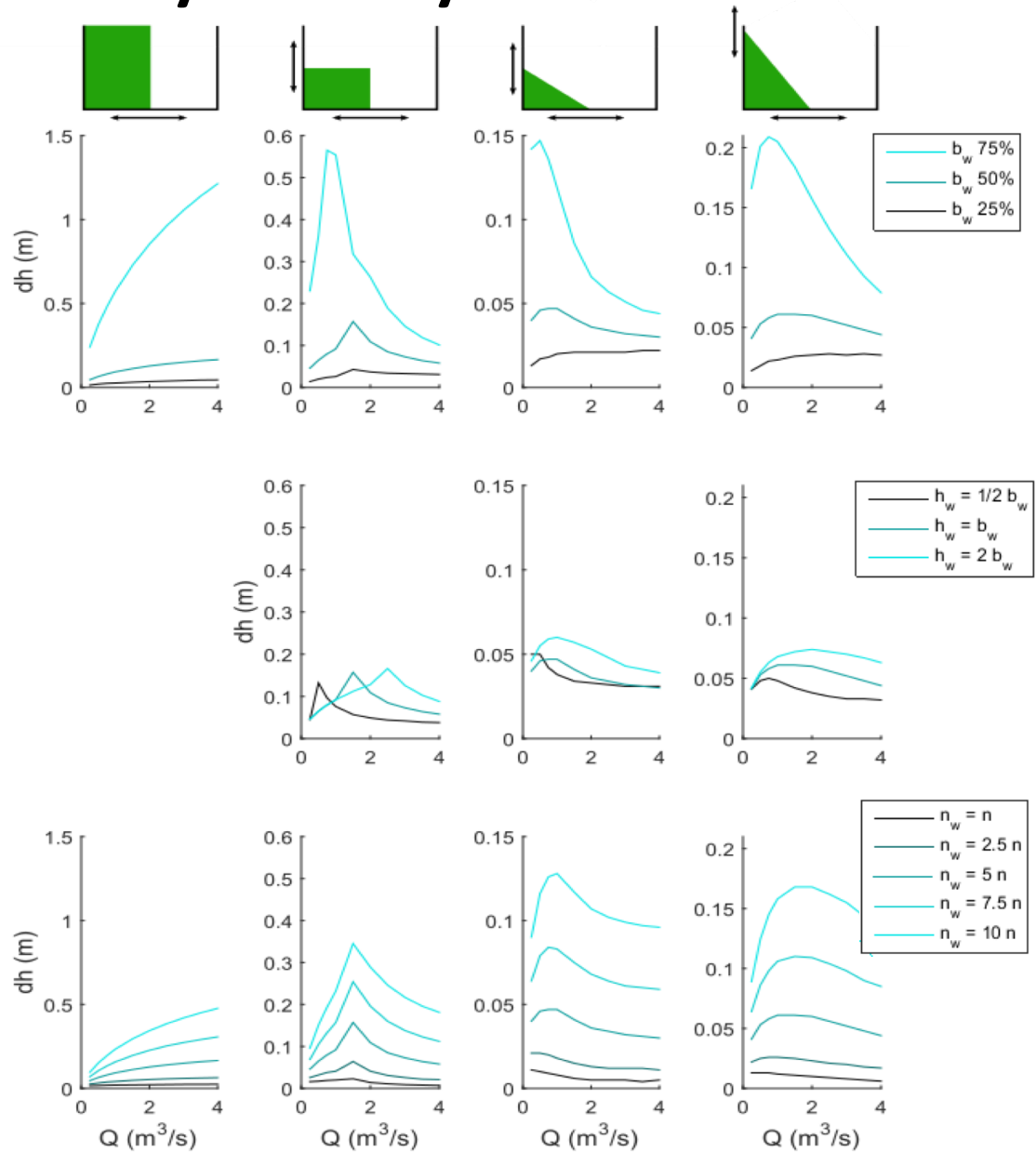
$$n_{eff}(h) = f_{wood}(h)n_{wood} + (1 - f_{wood}(h))n_{stream}$$

$$\frac{dh}{dx} = \frac{S_0 - S_f(h)}{1 - Fr^2(h)}$$



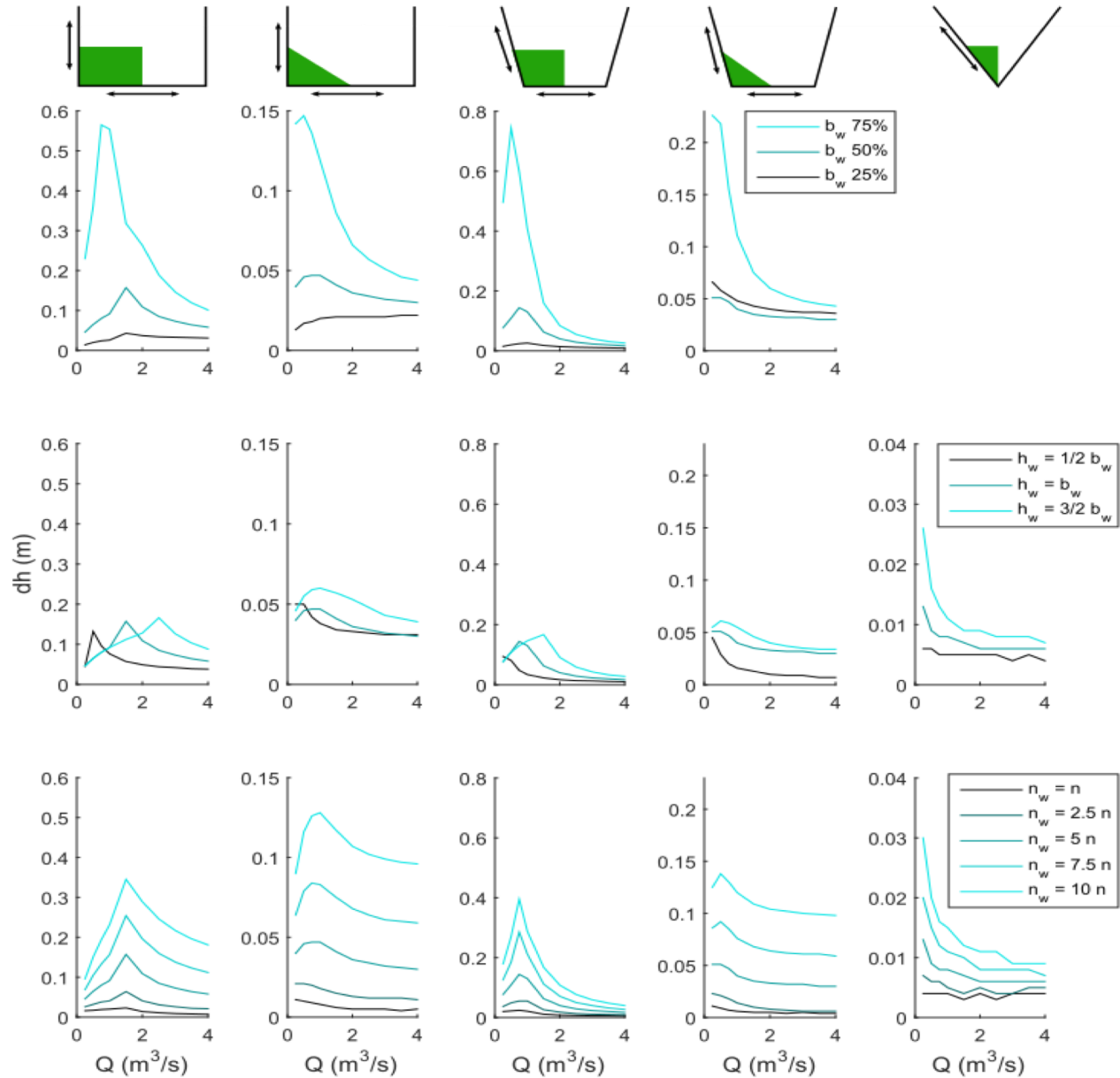


Sensitivity analysis





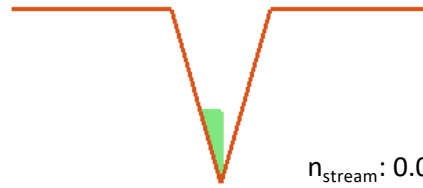
Sensitivity analysis





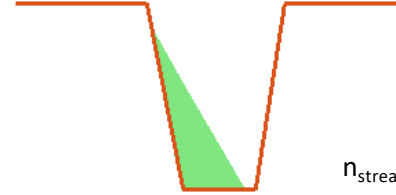
Kalibratie van het model

Leerinkbeek

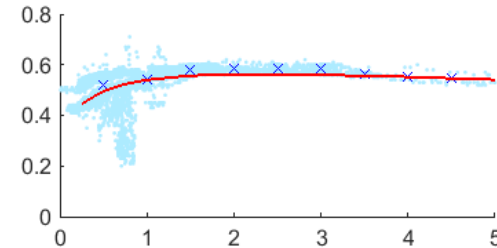
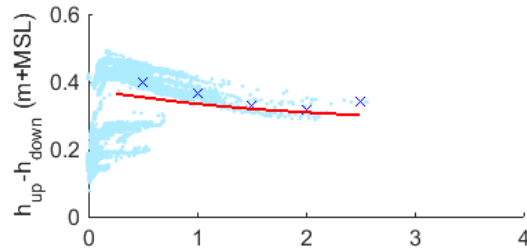


$n_{\text{stream}}: 0.025 \text{ s m}^{-1/3}$
 $n_{\text{wood}}: 0.1 \text{ s m}^{-1/3}$

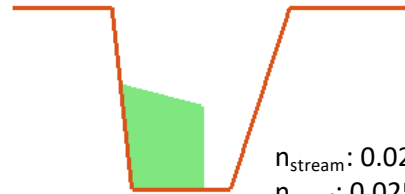
Tungelroysebeek



$n_{\text{stream}}: 0.03 \text{ s m}^{-1/3}$
 $n_{\text{wood}}: 0.045 \text{ s m}^{-1/3}$

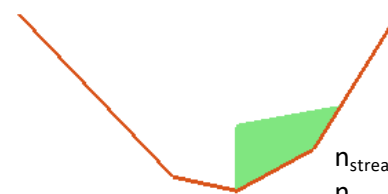


Tongelreep

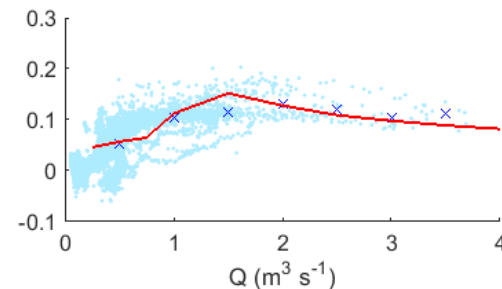
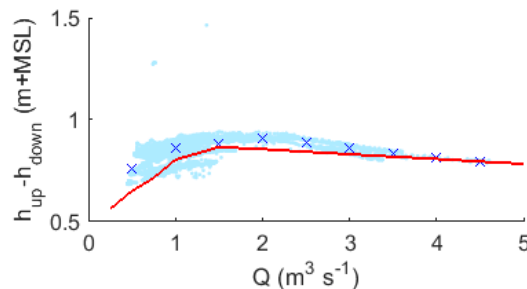


$n_{\text{stream}}: 0.025 \text{ s m}^{-1/3}$
 $n_{\text{wood}}: 0.025 \text{ s m}^{-1/3}$

Ramsbeek



$n_{\text{stream}}: 0.025 \text{ s m}^{-1/3}$
 $n_{\text{wood}}: 0.075 \text{ s m}^{-1/3}$





Conclusies

- Opstuwing door hout in beken kan bij hoge afvoeren worden verminderd
- De effecten van opstuwing veranderen in de tijd als gevolg van morfologische aanpassingen van hout en bedding
- Vermindering van opstuwing bij hoge afvoeren kan worden voorspeld door gebruik te maken van de kenmerken van de hout en bedding in het conceptuele model

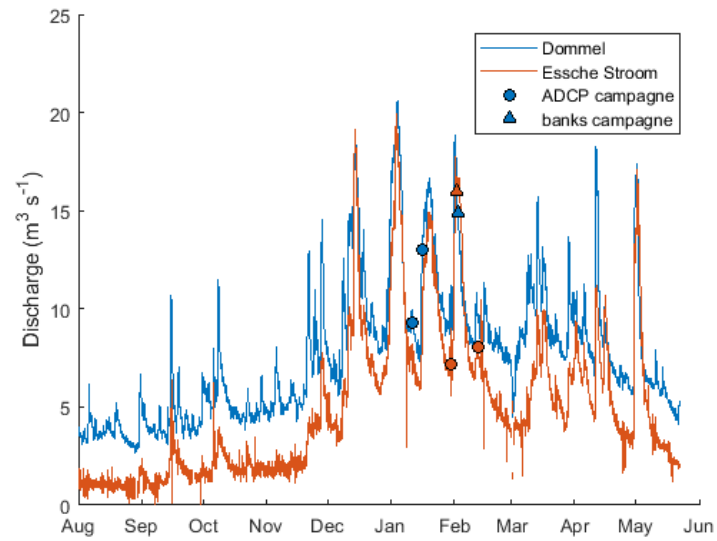


Bochten



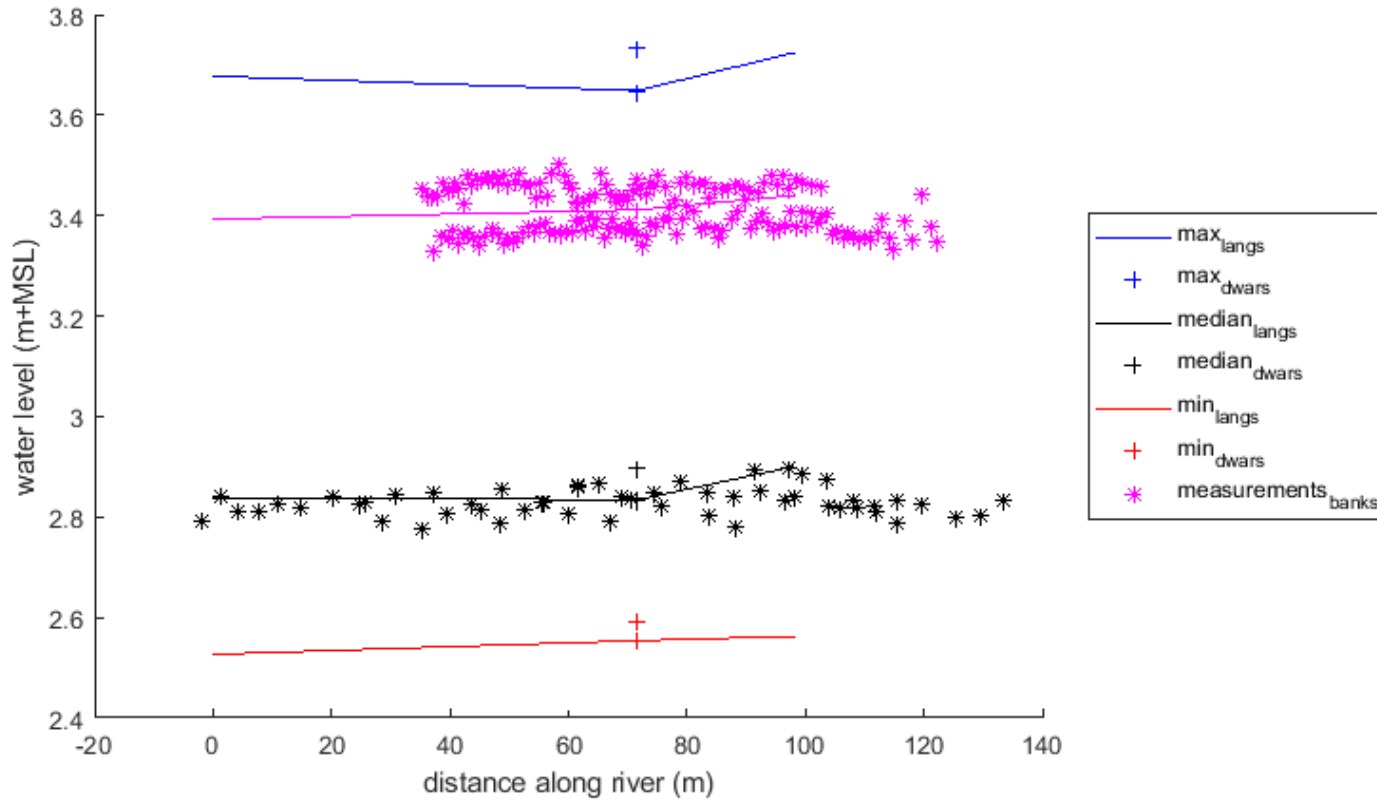


Bochten





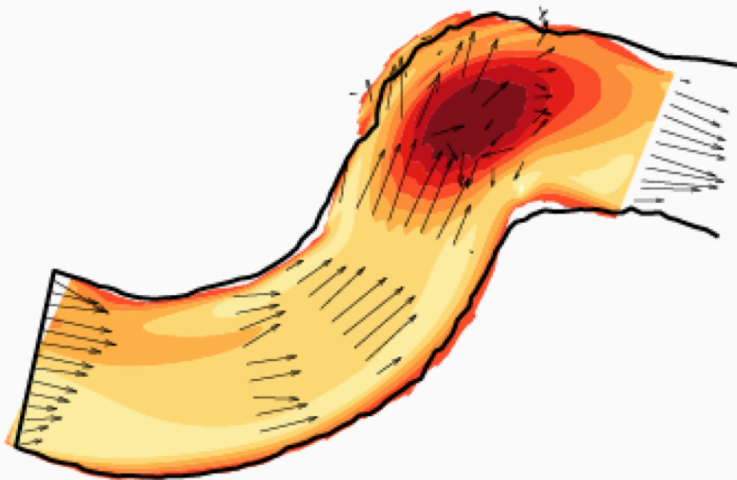
Resultaten: Essche stroom



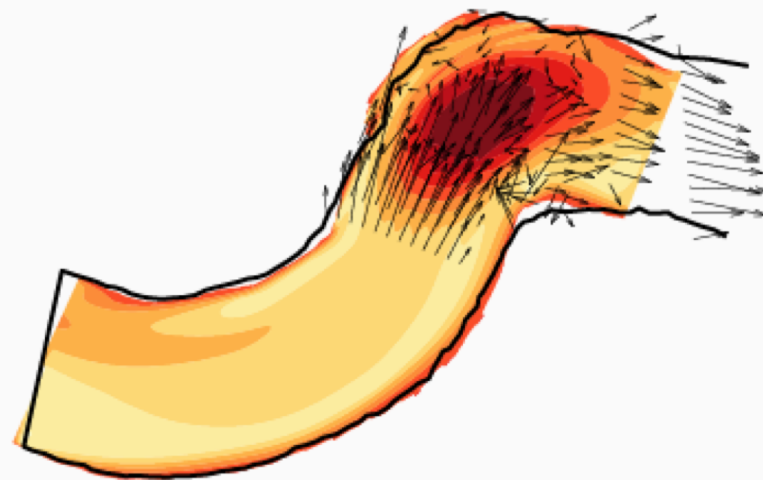


Resultaten: Essche Stroom

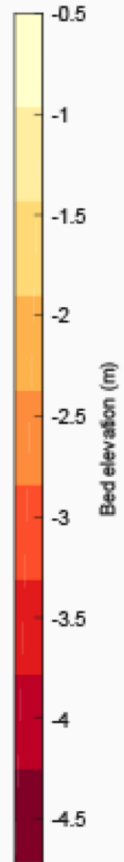
$Q = 7.2 \text{ m}^3 \text{ s}^{-1}$

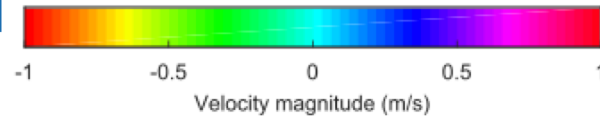
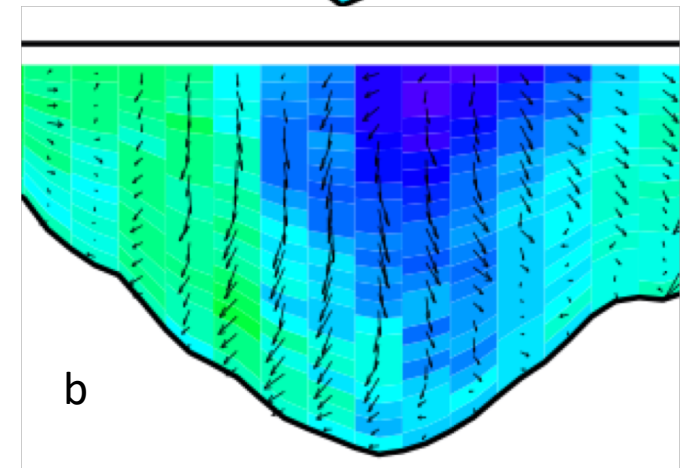
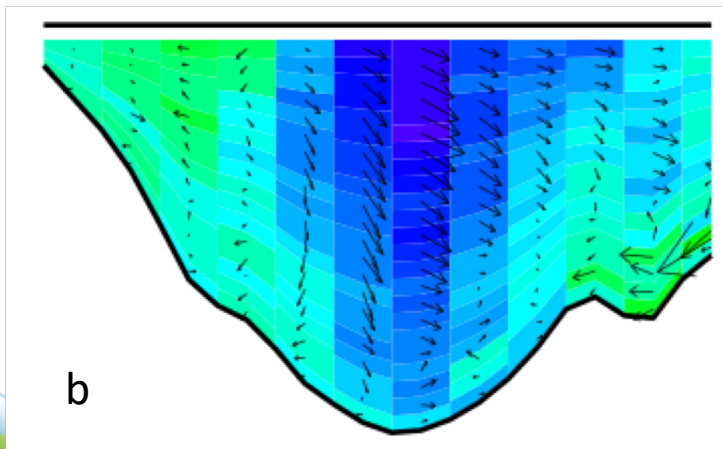
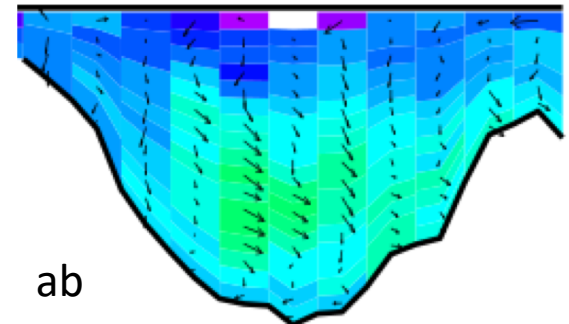
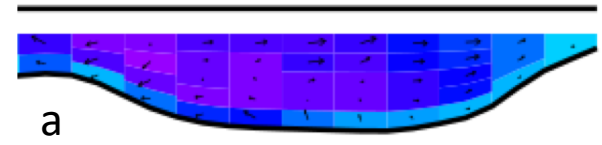
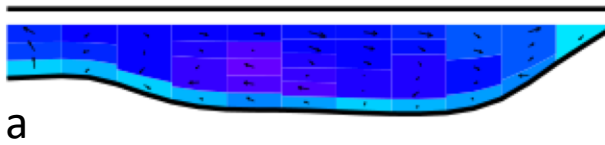
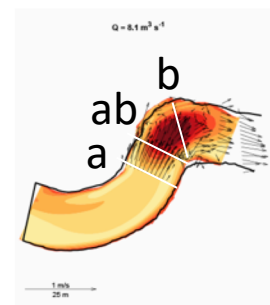
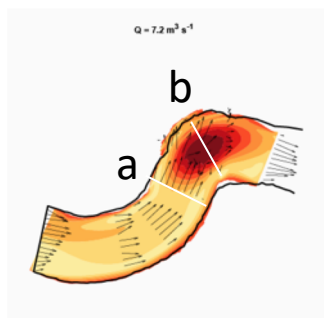


$Q = 8.1 \text{ m}^3 \text{ s}^{-1}$

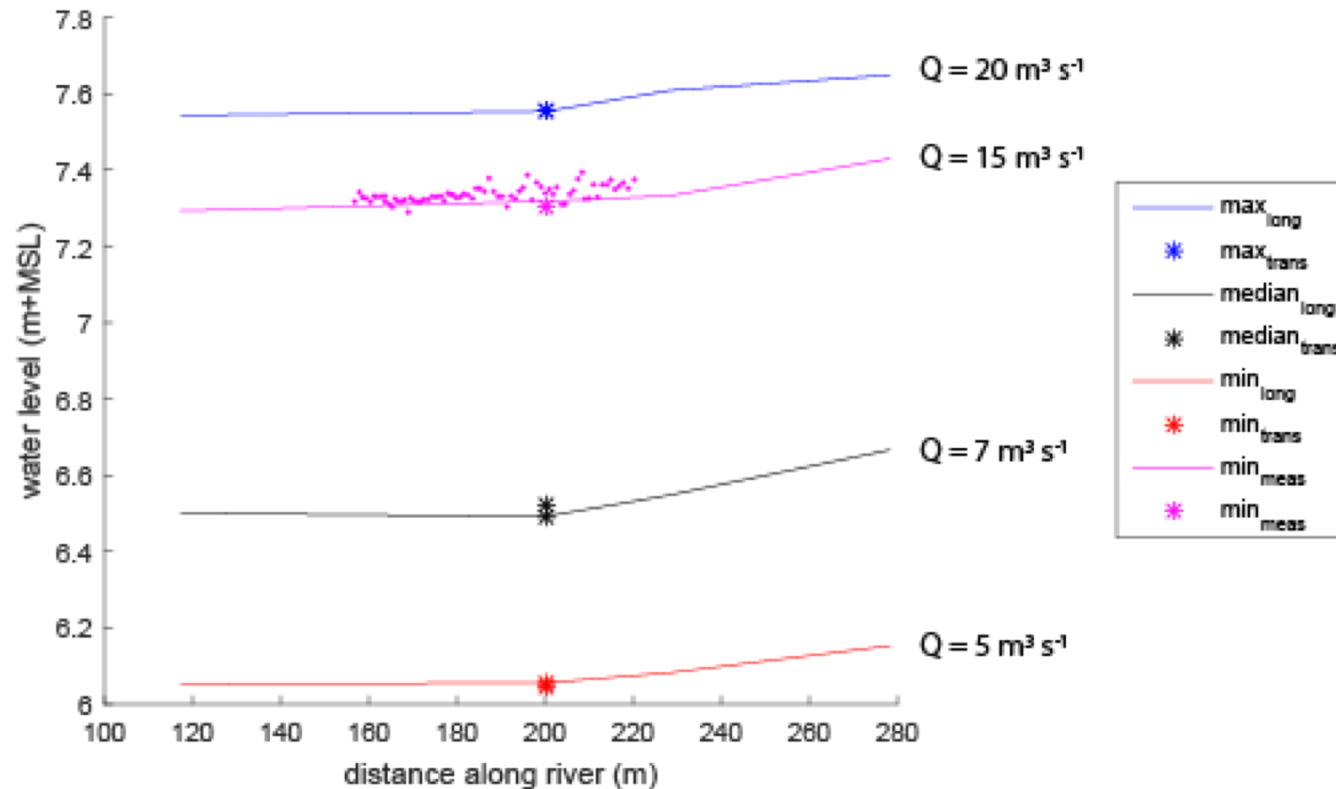


1 m/s
25 m



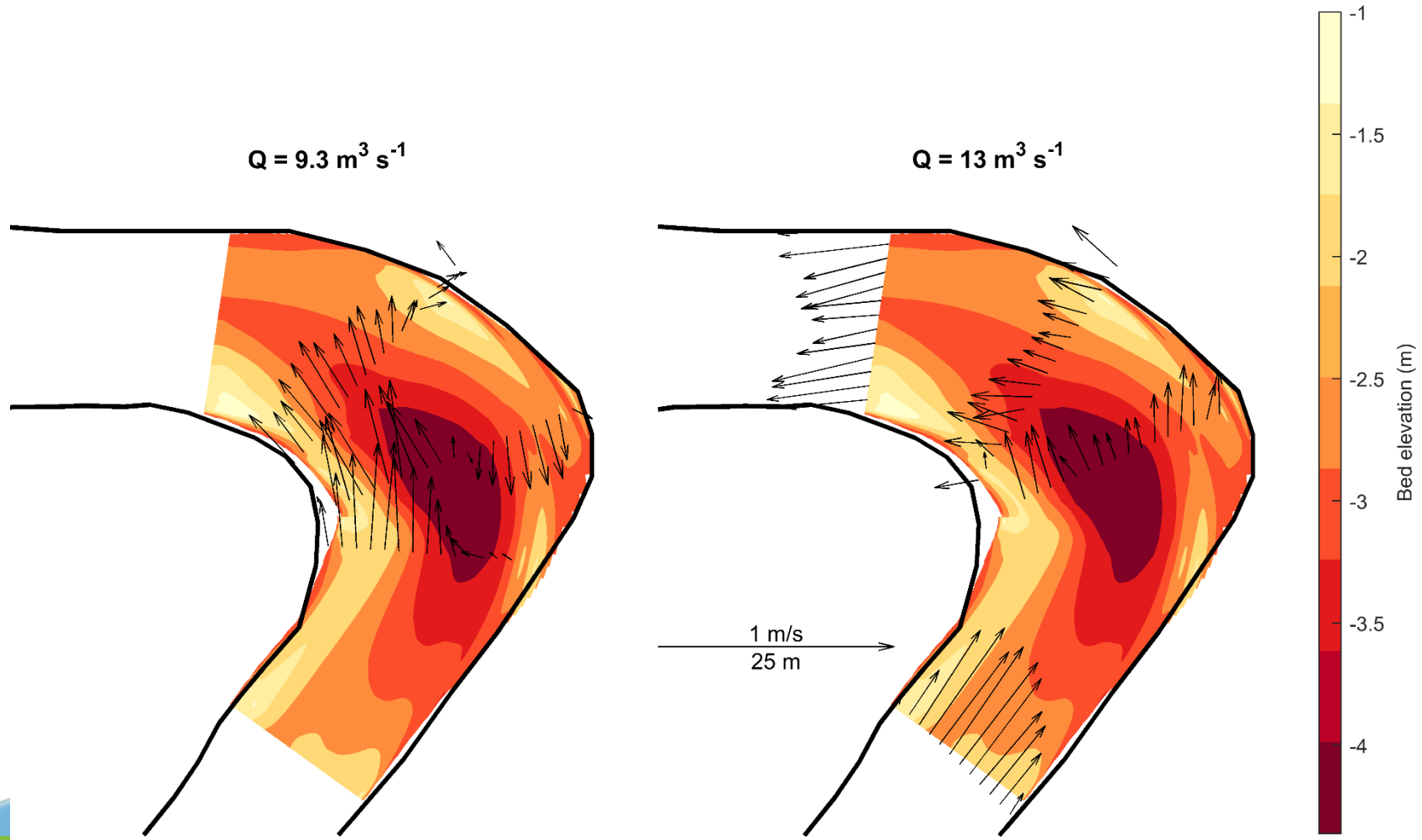


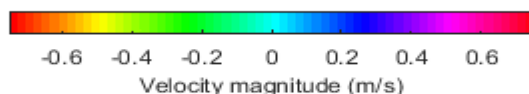
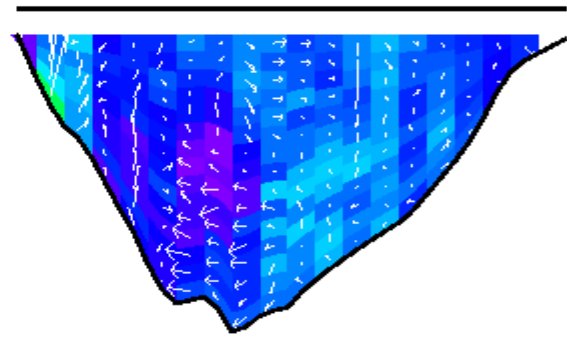
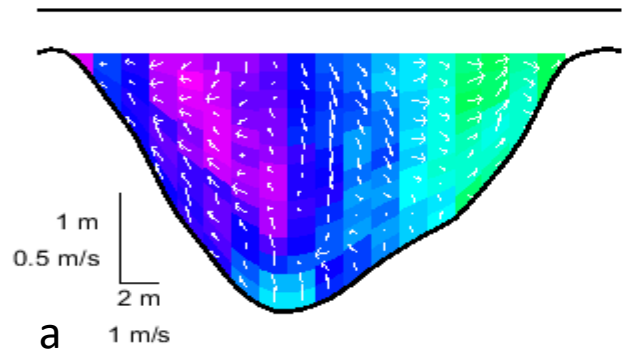
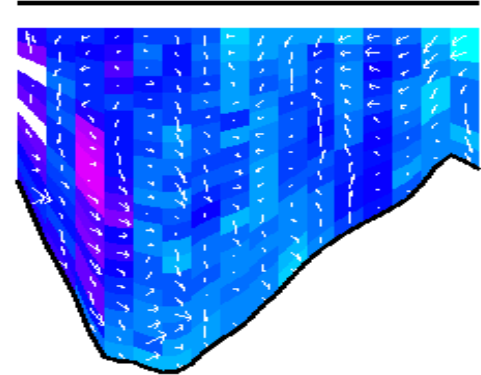
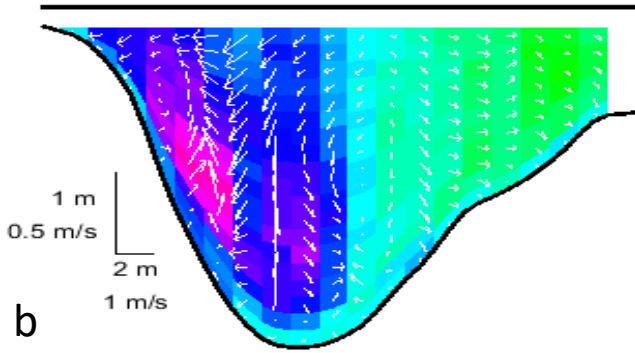
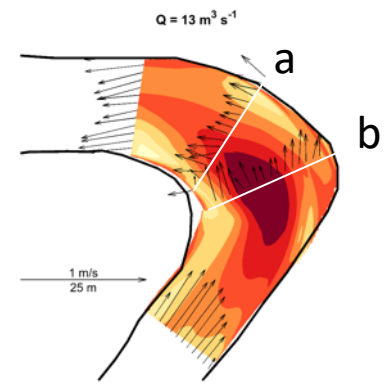
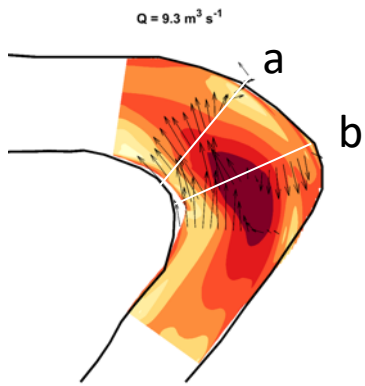
Resultaten: Dommel





Resultaten: Dommel







Conclusies

- Er zijn geen opstuwingseffecten in de lengterichting gevonden bij scherpe bochten
- De 'neren' kunnen toe- en afnemen in grootte en kunnen zelfs verdwijnen
- Scherpe bochten laten 'neren' en secundaire stroming zien, zoals ook te zien is in grote rivieren



Bedankt voor
jullie
aandacht!

Witteveen + Bos

