Emergence of different river dynamics through changing vegetation patterns

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Background

Dynamic interactions between river morphology and vegetation affect river channel patterns and riparian species. Most models oversimplify either morphodynamics or vegetation processes. We developed a model coupling advanced morphs dynamics and dynamic vegetation.

Objectives

• Understand and quantify the effect of dynamic vegetation development on the river pattern and morphodynamics of a meandering river.
• Investigate the long-term effect of a riparian invasive plant species on river morphology and native vegetation.

Results static & dynamic scenarios

Static vegetation

- Detrended bed level with vegetation

- No growth and mortality
- Colonisation each year in spring
- Dimensions based on Salicaceae shrub

Dynamic vegetation

- Detrended bed level with vegetation

- Dynamic vegetation processes
- 2 vegetation types: Willows and Poplars

Cross section with vegetation

Results of high water levels during discharge

Cross section with vegetation

Low density invader

- Detrended bed level with vegetation

- Japanese Knotweed introduction after 50 years in dynamic scenario
- Invader colonisation with low density (clonal spread)

High density invader

- Detrended bed level with vegetation

- Japanese Knotweed introduction after 50 years in dynamic scenario
- Invader colonisation with high density (clonal spread + seed dispersal)

Cross section with vegetation

Conclusions

• Dynamic vegetation creates and maintains dynamic meandering, creates nature-like vegetation patterns and age distribution.
• River pattern and dynamics are sensitive to type, density and dynamics of vegetation.
• Increasing vegetation cover decreases sediment transport, sinuosity, meander migration rate and bed level.
• High density invaders reduce native vegetation cover, while lower density invaders increase native vegetation cover compared to the scenario without invaders.

References

Van Oorschot et al. [2015]. Distinct patterns of interaction between vegetation and morphodynamics. Earth Surface Processes and Landforms, DOI: 10.1002/esp.3844

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