Distinct patterns of interaction between vegetation and morphodynamics (van Oorschot et al. 2016) [1]

Dynamic interaction between river morphodynamics and vegetation affects river channel patterns and populations of riparian species. A range of numerical models exists to investigate the interaction between vegetation and morphodynamics. However, many of these models oversimplify either the morphodynamics or the vegetation dynamics, which hampers the development of predictive models for river management. We have developed a model coupling advanced morphodynamics and dynamic vegetation, which is innovative because it includes dynamic ecological processes and progressing vegetation characteristics as opposed to commonly used static vegetation without growth and mortality. Our objective is to understand and quantify the effects of vegetation-type dependent settling, growth and mortality on the river pattern and morphodynamics of a meandering river. We compared several dynamic vegetation scenarios with different functional trait sets to reference scenarios without vegetation and with static vegetation without growth and mortality. We find distinct differences in morphodynamics and river morphology. The default dynamic vegetation scenario, based on two Salicaceae species, shows an active meandering behaviour, while the static vegetation scenario develops into a static, vegetation-dominated state. The diverse vegetation patterns in the dynamic scenario reduce lateral migration, increase meander migration rate and create a smoother floodplain compared to the static scenario. Dynamicvegetation results in typical vegetation patterns, vegetation age distribution and river patterns as observed in the field. We show a quantitative interaction between vegetation and morphodynamics, where increasing vegetation cover decreases sediment transport rates. Furthermore, differences in vegetation colonization, density and survival create distinct patterns in river morphology, showing that vegetation properties and dynamics drive the formation of different river morphologies. Our model demonstrates the high sensitivity of channel morphodynamics to various species traits, an understanding which is required for floodplain and stream restoration and more realistic modelling of long-term river development.

Keywords: biogeomorphology; dynamic riparian vegetation model; river morphodynamics; river meandering; vegetation patterns

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http://dx.doi.org/10.1002/esp.3864 [2]

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[1] https://reformrivers.eu/distinct-patterns-interaction-between-vegetation-and-morphodynamics-van-oorschot-et-al-2016
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