EGU21-9636, updated on 23 Jan 2022
https://doi.org/10.5194/egusphere-egu21-9636
EGU General Assembly 2021

Geomorphological numerical modelling of woody dams in CAESAR-Lisflood

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Natural flood management (NFM) promotes the sustainable enhancement of natural fluvial processes to reduce flooding (SEPA, 2015; Wilkinson et al., 2019), and is increasingly popular for use by community groups, contractors and governments (Kay et al., 2019). Reintroduction of wood to a river channel is a popular form of NFM often achieved through seeding natural logjams, or with an emphasis on engineering through installing woody dams (WDs). WDs are currently installed or being installed in catchments in an effort to reduce flood risk, through hydrograph attenuation, increase biodiversity and improve geomorphic heterogeneity (Wenzel et al., 2014; Burgess-Gamble et al., 2017; Grabowski et al., 2019). A further objective is to emulate the effect of natural wood found in river channels by partially, or completely, blocking the channel to accelerate the recruitment of natural wood as part of the natural wood cycle (Addy & Wilkinson, 2016).

There is a growing body of evidence supporting the benefits of NFM, however, the hydrogeomorphic effects of WDs are less well understood (Dadson et al., 2017). There is little scientific underpinning concerning the long-term impact of these features upon hydrogeomorphology at reach and catchment-scales. Very few numerically based studies consider the influence of sediment transport on WDs, and how changes in local bed morphology influence their effectiveness. Most NFM research to date has focused upon modelling the effectiveness of local NFM measures in small catchments (<10 km^2) (Dadson et al., 2017), with less work evident at larger spatial and temporal scales (Kay et al., 2019; Wilkinson et al., 2019).

There is a need for a verified tool that is able to represent WDs accounting for geomorphic processes and interactions between the dams and morphodynamics, different design specifications of dams, and changing efficacy due to geomorphic evolution. We present the new CAESAR-Lisflood (Coulthard et al., 2013) "Working with Natural Processes" toolkit, capable of representing WDs across a digital experimental environment. Global sensitivity testing was conducted using the Morris method (Morris, 1991) to assess the sensitivity of five aspects of the toolkit, and their potentially influences on geomorphology and flood risk reduction.