Geophysical Research Abstracts
Vol. 17, EGU2015-5104, 2015
EGU General Assembly 2015

The effects of floodplain forest restoration and logjams on flood risk and flood hydrology

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Flooding is the most common natural catastrophe, accounting for around half of all natural disaster related deaths and causing economic losses in Europe estimated at over € 2bn per year. In addition flooding is expected to increase in magnitude and frequency with climate change, effectively shortening the return period for a given magnitude flood. Increasing the height and extent of hard engineered defences in response to increased risk is both unsustainable and undesirable. Thus alternative approaches to flood mitigation are needed such as harnessing vegetation processes to slow the passage of flood waves and increase local flood storage. However, our understanding of these effects at the catchment scale is limited. In this presentation we demonstrate the effects of two river restoration approaches upon catchment scale flood hydrology.

The addition of large wood to river channels during river restoration projects is a popular method of attempting to improve physical and biological conditions in degraded river systems. Projects utilising large wood can involve the installation of engineered logjams (ELJs), the planting and enhancement of riparian forests, or a combination of both. Altering the wood loading of a channel through installation of ELJs and increasing floodplain surface complexity through encouraging mature woodland could be expected to increase the local hydraulic resistance, increasing the timing and duration of overbank events locally and therefore increasing the travel time of a flood wave through a reach. This reach-scale effect has been documented in models and the field; however the impacts of these local changes at a catchment scale remains to be illustrated. Furthermore there is limited knowledge of how changing successional stages of a restored riparian forest through time may affect its influence on hydromorphic processes.

We present results of a novel paired numerical modelling study. We model changes in flood hydrology based on a 98km^2 catchment using OVERFLOW; a simplified hydrological model using a spatially distributed unit hydrograph approach. Restoration scenarios for the hydrological modelling are informed by the development of a new conceptual model of riparian forest succession, including quantitative estimates of deadwood inputs to the system, using a numerical forest growth model. We explore scenarios using ELJs alone as well as managed and unmanaged riparian forest restoration at scales from reach to sub-catchment. We demonstrate that changes to catchment flood hydrology with restoration are highly location dependant and downstream flood peaks can in some cases increase through synchronisation of sub-catchment flood waves. We constrain magnitude estimates for increases and decreases in flood peaks for modelled restoration scenarios and scales. Finally we analyse the potential for using riparian forest restoration as part of an integrated flood risk management strategy, including specific examples of type and extent of restoration which may prove most beneficial.