Catchment scale afforestation for mitigating flooding

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After the 2013-14 floods in the UK there were calls to 'forest the uplands' as a solution to reducing flood risk across the nation. At present, 1 in 6 homes in Britain are at risk of flooding and current EU legislation demands a sustainable, 'nature-based solution'. However, the role of forests as a natural flood management technique remains highly controversial, due to a distinct lack of robust evidence into its effectiveness in reducing flood risk during extreme events. SHETRAN, physically-based spatially-distributed hydrological models of the Irthing catchment and Wark forest sub-catchments (northern England) have been developed in order to test the hypothesis of the effect trees have on flood magnitude. The advanced physically-based models have been designed to model scale-related responses from 1, through 10, to 100km2, a first study of the extent to which afforestation and woody debris runoff attenuation features (RAFs) may help to mitigate floods at the full catchment scale (100-1000 km2) and on a national basis. Furthermore, there is a need to analyse the extent to which land management practices, and the installation of nature-based RAFs, such as woody debris dams, in headwater catchments can attenuate flood-wave movement, and potentially reduce downstream flood risk. The impacts of riparian planting and the benefits of adding large woody debris of several designs and on differing sizes of channels has also been simulated using advanced hydrodynamic (HiPIMS) and hydrological modelling (SHETRAN).

With the aim of determining the effect forestry may have on flood frequency, 1000 years of generated rainfall data representative of current conditions has been used to determine the difference between current land-cover, different distributions of forest cover and the defining scenarios - complete forest removal and complete afforestation of the catchment. The simulations show the percentage of forestry required to have a significant impact on mitigating downstream flood risk at sub-catchment and catchment scale.

Key words:

Flood peak, nature-based solutions, forest hydrology, hydrological modelling, SHETRAN, flood frequency, flood magnitude, land-cover change, upland afforestation.