EGU24-12534, updated on 04 Nov 2024
https://doi.org/10.5194/egusphere-egu24-12534
EGU General Assembly 2024

Modelling the effectiveness of multiple natural flood management interventions at a large catchment scale

Qiuyu Zhu, Megan Klaar, Thomas Willis, and Joseph Holden
University of Leeds, Water@leeds, School of Geography, Leeds, United Kingdom of Great Britain – England, Scotland, Wales (gyqzh@leeds.ac.uk)

While natural flood management (NFM) as a resilience flood mitigation strategy is widely used in the UK and Europe, there remains a lack of scientific evidence regarding its effectiveness. The primary uncertainties stem from two aspects: the determination of NFM effectiveness on flood mitigation is limited by the scale of impact assessment; and the combination of multiple NFM interventions implemented within a catchment which may result in flood synchronicity. We argue that the effectiveness of combined scenarios involving multiple NFM interventions within a catchment can vary. We utilize a hydrological model that simulates both instream and terrestrial interventions at a large catchment scale. To demonstrate how scale and interventions interact to determine flood peaks, we integrated various NFM interventions and land cover changes within the upstream catchment into a model, including afforestation, soil aeration, catchment/floodplain restoration and hedge planting. We modelled existing and planned scenarios using a spatially distributed hydrological model, Spatially Distributed TOPMODEL (SD-TOPMODEL). In comparison to previous versions of TOPMODEL, we have improved the simulation efficiency to allow for the simulation of up to a 200-year return period flood event at a larger catchment scale (~84 km^2); and simplified the model parameters which are not related to the effects of NFM interventions and retained three key parameters which are physically significant. Following extensive parameter calibration and validation, the model is stable, providing a reliable fit for flood peaks, with the Nash-Sutcliffe coefficient (NS) between modelled and observed discharge reaching up to 0.905. The modelling results illustrated the effectiveness of NFM interventions in reducing flood peaks at a large catchment scale. Further refinements will involve incorporating additional types of NFM interventions into our next coupled model.