

Fielding floods for farms and (low) flows: a toolbox for assessing the reuse of small flood reservoirs as irrigation reservoirs

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Droughts have long been recognized as significant natural hazards that impose severe impacts on multiple sectors worldwide. Under climate change, these impacts will likely become more severe and more frequent in the future, prompting a need for increased water resources resilience in even temperate and water rich regions. At the same time, temperate regions have often contended with flooding as the primary hydrological hazard, with many regions having built small reservoirs as protective flood retention basins. Small reservoirs-- those with a dam height of < 15 m, a surface area of < 0.1 km², and / or a storage volume of up to 1-2 million m³-- have additionally been proposed as decentralized solutions to water scarcity in arid regions. However, their potential to increase water resilience in temperate regions-- especially when additionally operated for flood protection-- is still unexplored. To this end, a toolbox was programmed in MATLAB to optimize the adapted operation of small flood reservoirs for one of two additional purposes: streamflow supplementation to mitigate streamflow drought conditions, or irrigation demand to mitigate water stress in local farmland. This can be done with either perfect-knowledge conditions or forecasts, and most of its features require typical hydrological modelling inputs and outputs. Here, we introduce the toolbox and use it to analyze the operation of 30 reservoirs in southwestern Germany to determine their potential water supply benefits. Our results that indicate that the potential water supply benefits of repurposing flood reservoirs for drought protection can be quite high, particularly for agriculture, and can be operated without increasing flood risk.

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