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Modelling the impact of climate change on the sustainability of water supply for a rural catchment (Afon Dyfi) in mid Wales, UK

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UK water service providers face several challenges in planning future operations and services. Key amongst these is climate change, the impacts of which in terms of surface water quantity (precipitation seasonality and extreme events) and quality are uncertain. Adding to this, future projections of consumer water demand are indeterminate and climate dependent, which makes planning future water supply strategies difficult. This is particularly true in rural water supply zones that are reliant on abstraction of water directly from river channels, as opposed to through impoundment at reservoirs. Seasonality of river flow is likely to affect these zones more significantly, which will affect the ability of water companies to provide clean water.

In this study, we use the Soil and Water Assessment Tool (SWAT) hydrological model to investigate the impact of future climate change on the abstraction potential of the Afon Dyfi catchment (676 km2) in rural mid-Wales, UK. We consider a worst case scenario approach in modelling the hydrological impacts of future climate change. Specifically, we use the UKCP18 projections based on Representative Concentration Pathway 8.5 and an ensemble of 12 regionally downscaled climate models as inputs to the SWAT model. This ensemble approach explicitly accounts for uncertainty in the climate change projections. To estimate future water demand we first investigate historic relationships between weather factors and total water abstraction in the catchment (used as a proxy for overall water demand). These relationships are then extrapolated to the length of the future study period for all 12 models in the ensemble. The impact of climate change on seasonality and volume of available water as well as on overall consumer demand is compared for the 2030s, 2050s and 2080s. We further analyse the changes in headroom capacity of the Afon Dyfi water supply zone.

We envisage that this approach will allow for robust and informed future planning of the water resource allocation and water supply provision both within the studied area as well as at similar locations elsewhere in the UK. Through studying the impacts of climate change at different time intervals, our research will help to inform the operation and planning decisions of water service providers for the short, medium and long term, allowing for a phased implementation of sustainable, cost and time effective plans.