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2024_2_BGS_KU: Securing future groundwater supplies: development and evaluation of numerical, statistical and machine learning methods for continuous simulation of groundwater yields

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A major challenge facing the UK is the impact of climate change on water resources. The latest UK Climate Change Risk Assessment highlights high risk to public water supplies due to reduced water availability, even under conservative warming scenarios. Projections of more frequent and intense drought events will impose critical constraints on the ability of water companies to meet future demands, and create pressures on flows maintaining sensitive river ecosystems. The UK water industry currently lacks adequate tools to assess and manage groundwater resources under increasing stress. Existing methods use simple 'curve-shifting' of historical data to assess the impact of climate change on water resource availability, which does not take account of the non-linear response often observed in supply boreholes, particularly in fractured aquifers such as the Chalk in south-east England [1]. The approach is also inconsistent with surface water assessments based on rainfall-runoff models, which is at odds with EU and UK Government policy for an integrated catchment-based approach to water management.

Recent developments in multi-scale groundwater modelling have enabled the simulation of pumped water levels, and therefore borehole yields, in response to regional drought. This has been achieved by coupling a high-resolution 'local' numerical model of flow to a borehole, SPIDERR [2], to a regional groundwater model [3]. This approach offers great potential for simulating variations in the accessible groundwater resource in complex heterogeneous aquifers, but is computationally intensive and not easily applied by practitioners.

This project aims to develop a complementary, user-informed, open modelling framework in collaboration with, and for use by the UK water industry to assess groundwater deployable output (DO) as part of statutory water resource management planning [4]. This could involve the linking of statistical or simple conceptual models of regional aquifer levels [5, 6] and river flows with SPIDERR, and / or the application of statistical or machine learning methods that directly simulate changes in borehole yields in response to recharge, abstraction, regional aquifer storage and river flow. The project will develop such models, evaluate their skill against historical observations, and apply them to assess the impact of projected changes in climate variability on groundwater supplies, within the context of wider water resource assessments in the UK.

References

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