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An integrated modelling approach to predict changes in water resources and quality in the Thames Basin (UK) for different future worlds

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Multiple combinations of drivers and pressures act on aquatic systems, which are shaped by historical and present climatic, managerial and socio-economic conditions. Understanding the interactions of these multiple stressors on aquatic ecosystems and predicting future impacts is one of the key challenges for freshwater science, policy and conservation. Numerical modelling is widely used to assess the sensitivity of modelled systems to individual stressors (e.g. climate, pollution, water management), but rarely is their impact assessed in its entirety. This paper presents a modelling study that assesses the impact of various future climatic and socio-economic scenarios on groundwater and surface water systems in the Thames Basin, UK. The work is part of the EU-funded MARS project, which aims to understand the effects of multiple stressors on surface waters and groundwater, their biota, and the services they provide to humans.

The Thames Basin is located in the south-east of England and consists of multiple, separate aquifer systems, which are used for public and private water supply. Two principle aquifers are present within the study area: the Chalk and the Oolitic limestones of the Jurassic. These aquifers provide the main source of flow to the River Thames and its tributaries. They are separated by impermeable clay deposits and are connected only by the surface river network. Simulation of this complex system and its interaction with the rivers required the constructions of a series of linked models: (a) a gridded recharge model, (b) a semi-distributed model of the Oolitic limestone aquifer, (c) a gridded groundwater model of the Chalk and (d) a river water quality model. Using this suite of process models, a set of model runs was conducted to produce groundwater heads, total river flows, and river water quality indicators for different stations across the basin. To enable possible comparison of the stressors-response relationships across Europe, the runs presented a set of storylines of future changes in drivers and pressures as identified by MARS. These aim to describe plausible but different future worlds and associated changes in climate, land use, agriculture, water management and water pollution. Within each storyline, the impact of different climate models and time horizons was tested. Outputs from these simulations were compared with a baseline simulation of 2009-2012 to quantify the impact of the MARS storylines on the groundwater and river system in the Thames Basin. This presentation will show results for selected future world scenario to illustrate the integrated response of groundwater levels, river flows and water quality to the projected climatic and social-economic changes.

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