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Assessing climate change and socio-economic uncertainties in long term management of water resources

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Long term management of water resources is challenging for decision makers given the range of uncertainties that exist. Such uncertainties are a function of long term drivers of change, such as climate, environmental loadings, demography, land use and other socio economic drivers. Impacts of climate change on frequency of extreme events such as drought make it a serious threat to water resources and water security. The release of probabilistic climate information, such as the UKCP09 scenarios, provides improved understanding of some uncertainties in climate models. This has motivated a more rigorous approach to dealing with other uncertainties in order to understand the sensitivity of investment decisions to future uncertainty and identify adaptation options that are as far as possible robust.

We have developed and coupled a system of models that includes a weather generator, simulations of catchment hydrology, demand for water and the water resource system. This integrated model has been applied in the Thames catchment which supplies the city of London, UK. This region is one of the driest in the UK and hence sensitive to water availability. In addition, it is one of the fastest growing parts of the UK and plays an important economic role. Key uncertainties in long term water resources in the Thames catchment, many of which result from earth system processes, are identified and quantified. The implications of these uncertainties are explored using a combination of uncertainty analysis and sensitivity testing.

The analysis shows considerable uncertainty in future rainfall, river flow and consequently water resource. For example, results indicate that by the 2050s, low flow (Q95) in the Thames catchment will range from -44 to +9% compared with the control scenario (1970s). Consequently, by the 2050s the average number of drought days are expected to increase 4-6 times relative to the 1970s. Uncertainties associated with urban growth increase these risks further. Adaptation measures, such as new reservoirs can manage these risks to a certain extent, but our sensitivity testing demonstrates that they are less robust to future uncertainties than measures taken to reduce water demand.

Keywords: Climate change, Uncertainty, Decision making, Drought, Risk, Water resources management.