Household water demand and welfare loss for future Europe

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Matching the availability of water to its demand in Europe is a major challenge for the future due to expected economic and demographic developments and climate change. This means there is a growing need to estimate future water demand and to optimize the water allocation to all end users to counteract welfare loss. At the European scale it is currently not possible to assess the impact of social and economic changes on future water demand or to prioritize water allocation amongst different sectors based on economic damage without extensive use of assumptions and generalizations. Indeed, our review of existing regional optimization models for Europe reveals that the social-economic component of the water use system needs to be improved by complementing them with detailed water use estimates and cost/benefit functions in order to determine the optimal situation. Our study contributes to closing this knowledge gap for the European household sector by quantifying future water demand and the effect of water pricing, as well as providing a method for the calculation of monetary damage due to unmet demand at the highest spatial resolution possible. We used a water demand function approach in which household water consumption depends upon some exogenous drivers including water price, household income, population and household characteristics and climate conditions. For each European country, the annual water consumption per capita was calculated at regional level (NUTS3) and subsequently disaggregated to five kilometer grid level based on a population density map. In order to produce estimates of water demand, the evolution of the explanatory variables of the water demand functions and population density map were simulated until 2050 based on related variables such as GDP and demographic projections. The results of this study will be integrated into the JRC hydro-economic modelling framework for an assessment of the Water-Agriculture-Energy-Ecosystems Nexus.