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Integrating the simulation of domestic water demand behaviour to an urban water model using agent based modelling

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The urban water system's sustainable evolution requires tools that can analyse and simulate the complete cycle including both physical and cultural environments. One of the main challenges, in this regard, is the design and development of tools that are able to simulate the society's water demand behaviour and the way policy measures affect it. The effects of these policy measures are a function of personal opinions that subsequently lead to the formation of people's attitudes. These attitudes will eventually form behaviours.

This work presents the design of an ABM tool for addressing the social dimension of the urban water system. The created tool, called Urban Water Agents' Behaviour (UWAB) model, was implemented, using the NetLogo agent programming language. The main aim of the UWAB model is to capture the effects of policies and environmental pressures to water conservation behaviour of urban households. The model consists of agents representing urban households that are linked to each other creating a social network that influences the water conservation behaviour of its members. Household agents are influenced as well by policies and environmental pressures, such as drought. The UWAB model simulates behaviour resulting in the evolution of water conservation within an urban population. The final outcome of the model is the evolution of the distribution of different conservation levels (no, low, high) to the selected urban population.

In addition, UWAB is implemented in combination with an existing urban water management simulation tool, the Urban Water Optioneering Tool (UWOT) in order to create a modelling platform aiming to facilitate an adaptive approach of water resources management. For the purposes of this proposed modelling platform, UWOT is used in a twofold manner: (1) to simulate domestic water demand evolution and (2) to simulate the response of the water system to the domestic water demand evolution. The main advantage of the UWAB – UWOT model integration is that it allows the investigation of the effects of different water demand management strategies to an urban population's water demand behaviour and ultimately the effects of these policies to the volume of domestic water demand and the water resources system.

The proposed modelling platform is optimised to simulate the effects of water policies during the Athens drought period of 1988-1994. The calibrated modelling platform is then applied to evaluate scenarios of water supply, water demand and water demand management strategies.