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An open source simulator for water management

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Descriptive modelling of water resource systems requires the representation of different aspects in one model: the physical system including hydrological inputs and engineered infrastructure, and human management, including social, economic and institutional behaviours and constraints. Although most water resource systems share some characteristics such as the ability to represent them as a network of nodes and links, geographical, institutional and other differences mean that invariably each water system functions in a unique way.

A diverse group is developing an open source simulation framework which will allow model developers to build generalised water management models that are customised to the institutional, physical and economical components they are seeking to model. The framework will allow the simulation of complex individual and institutional behaviour required for the assessment of real-world resource systems. It supports the spatial and hierarchical structures commonly found in water resource systems. The individual infrastructures can be operated by different actors while policies are defined at a regional level by one or more institutional actors. The framework enables building multi-agent system simulators in which developers can define their own agent types and add their own decision making code.

Developers using the framework have two main tasks: (i) Extend the core classes to represent the aspects of their particular system, and (ii) write model structure files. Both are done in Python. For task one, users must either write new decision making code for each class or link to an existing code base to provide functionality to each of these extension classes. The model structure file links these extension classes in a standardised way to the network topology.

The framework will be open-source and written in Python and is to be available directly for download through standard installer packages. Many water management model developers are unfamiliar with the object-oriented structures. We are therefore working on ensuring that using the framework is as simple to use as possible for non software engineers. We are developing example code which covers all aspects of development as well as creating documentation which will range from performing simple tasks to creating complex structures and extension code. As a proof of concept, we are applying the framework to various case studies including the Thames basin river system (UK) and the potentially the Jordanian water resource system. The varied background of the developers in those case-studies as well as the complexity of the modelling will allow us to demonstrate the benefits of an open-source modelling framework for multi-agent water resource systems.