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Open Software Tools Applied to Jordan's National Multi-Agent Water Management Model

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Jordan is the fourth most water scarce country in the world, where demand exceeds supply in a politically and demographically unstable context. The Jordan Water Project (JWP) aims to perform policy evaluation by modelling the hydrology, economics, and governance of Jordan's water resource system. The multidisciplinary nature of the project requires a modelling software system capable of integrating submodels from multiple disciplines into a single decision making process and communicating results to stakeholders. This requires a tool for building an integrated model and a system where diverse data sets can be managed and visualised.

The integrated Jordan model is built using Pynsim, an open-source multi-agent simulation framework implemented in Python. Pynsim operates on network structures of nodes and links and supports institutional hierarchies, where an institution represents a grouping of nodes, links or other institutions. At each time step, code within each node, link and institution can executed independently, allowing for their fully autonomous behaviour. Additionally, engines (sub-models) perform actions over the entire network or on a subset of the network, such as taking a decision on a set of nodes. Pynsim is modular in design, allowing distinct modules to be modified easily without affecting others.

Data management and visualisation is performed using Hydra (www.hydraplatform.org), an open software platform allowing users to manage network structure and data. The Hydra data manager connects to Pynsim, providing necessary input parameters for the integrated model. By providing a high-level portal to the model, Hydra removes a barrier between the users of the model (researchers, stakeholders, planners etc) and the model itself, allowing them to manage data, run the model and visualise results all through a single user interface.

Pynsim's ability to represent institutional hierarchies, inter-network communication and the separation of node, link and institutional logic from higher level processes (engine) suit JWP's requirements. The use of Hydra Platform and Pynsim helps make complex customised models such as the JWP model easier to run and manage with international groups of researchers.