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Flow based vs. demand based energy-water modelling

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The water flow in hydro-power generation systems is often used downstream to cover other type of demands like irrigation and water supply. However, the typical case is that the energy demand (operation of hydro-power plant) and the water demand do not coincide. Furthermore, the water inflow into a reservoir is a stochastic process. Things become more complicated if renewable resources (wind-turbines or photovoltaic panels) are included into the system. For this reason, the assessment and optimization of the operation of hydro-power systems are challenging tasks that require computer modelling. This modelling should not only simulate the water budget of the reservoirs and the energy production/consumption (pumped-storage), but should also take into account the constraints imposed by the natural or artificial water network using a flow routing algorithm. HYDRONOMEAS, for example, uses an elegant mathematical approach (digraph) to calculate the flow in a water network based on: the demands (input timeseries), the water availability (simulated) and the capacity of the transmission components (properties of channels, rivers, pipes, etc.). The input timeseries of demand should be estimated by another model and linked to the corresponding network nodes. A model that could be used to estimate these timeseries is UWOT. UWOT is a bottom up urban water cycle model that simulates the generation, aggregation and routing of water demand signals. In this study, we explore the potentials of UWOT in simulating the operation of complex hydrosystems that include energy generation. The evident advantage of this approach is the use of a single model instead of one for estimation of demands and another for the system simulation. An application of UWOT in a large scale system is attempted in mainland Greece in an area extending over 130×170 km^2. The challenges, the peculiarities and the advantages of this approach are examined and critically discussed.