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A bottom-up approach of stochastic demand allocation in water quality modelling

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Abstract. An "all pipes" hydraulic model of a drinking water distribution system was constructed with two types of demand allocations. One is constructed with the conventional top-down approach, i.e. a demand multiplier pattern from the booster station is allocated to all demand nodes with a correction factor to account for the average water demand on that node. The other is constructed with a bottom-up approach of demand allocation, i.e., each individual home is represented by one demand node with its own stochastic water demand pattern. This was done for a drinking water distribution system of approximately 10 km of mains and serving ca. 1000 homes. The system was tested in a real life situation.

The stochastic water demand patterns were constructed with the end-use model SIMDEUM on a per second basis and per individual home. Before applying the demand patterns in a network model, some temporal aggregation was done. The flow entering the test area was measured and a tracer test with sodium chloride was performed to determine travel times. The two models were validated on the total sum of demands and on travel times.

The study showed that the bottom-up approach leads to realistic water demand patterns and travel times, without the need for any flow measurements or calibration. In the periphery of the drinking water distribution system it is not possible to calibrate models on pressure, because head losses are too low. The study shows that in the periphery it is also difficult to calibrate on water quality (e.g. with tracer measurements), as a consequence of the high variability between days. The stochastic approach of hydraulic modelling gives insight into the variability of travel times as an added feature beyond the conventional way of modelling.

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