Modelling the Water Metabolism of Cities

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Introduction

There are goals for better managing water in cities (Fig. 1), but a lack of frameworks for evaluating performance for cities and their regions. So it's difficult to monitor progress towards these goals or to optimise improvement efforts. We take a first step to address this by proposing a framework for modelling urban water flows at the city-region scale, based on Urban Metabolism and using a city water balance method.

How will it make cities better?

The utility of modelling water metabolism is seen by comparing the information it generates against goals for a Water Sensitive City (Fig. 1)

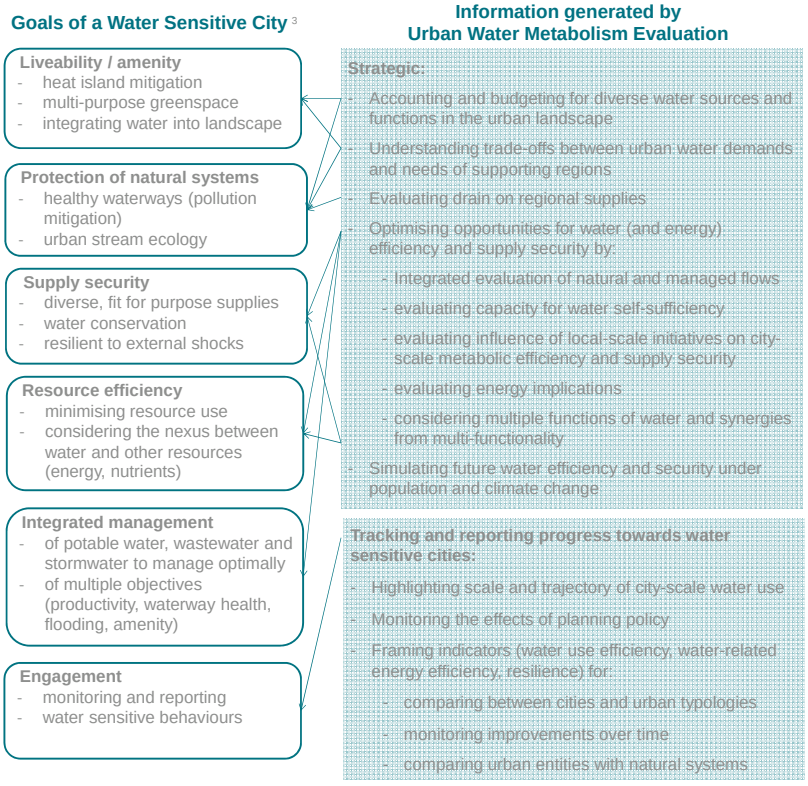

Figure 1. Utility of urban metabolism for advancing water sensitive cities [6]

Urban metabolism evaluation framework

Urban metabolism considers resource flows in and out of cities as you might for an organism[1,2]. Fig. 2 shows what this looks like for water.

Its perspective is on the whole city, with an implied intent of replicating the higher efficiencies of natural systems through circular rather than linear flows, and maximising functionality per resource input.

Figure 2. Example of urban water flows at the whole city scale

The evaluation framework quantifies managed and natural water flows through a defined urban boundary using a *city water balance* (Fig. 3) to generate water metabolism indicators (Fig. 4).

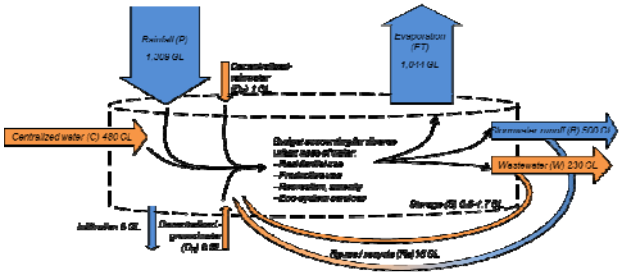

Figure 3. Proposed city water balance model [4]

Water metabolic efficiencies	Per-capita water input from external supplies Per-capita water-related energy input Local-sufficiency ratio (internal inputs : internal demand)
Replicability of external inputs	Potential for decentralised supplies to meet demand
Departure from natural hydrology	Runoff naturalness ratio (post : pre-urbanisation) Evapotranspiration naturalness ratio Infiltration naturalness ratio Stream discharge naturalness ratio

Figure 4. Example water metabolism indicators [5]

References

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