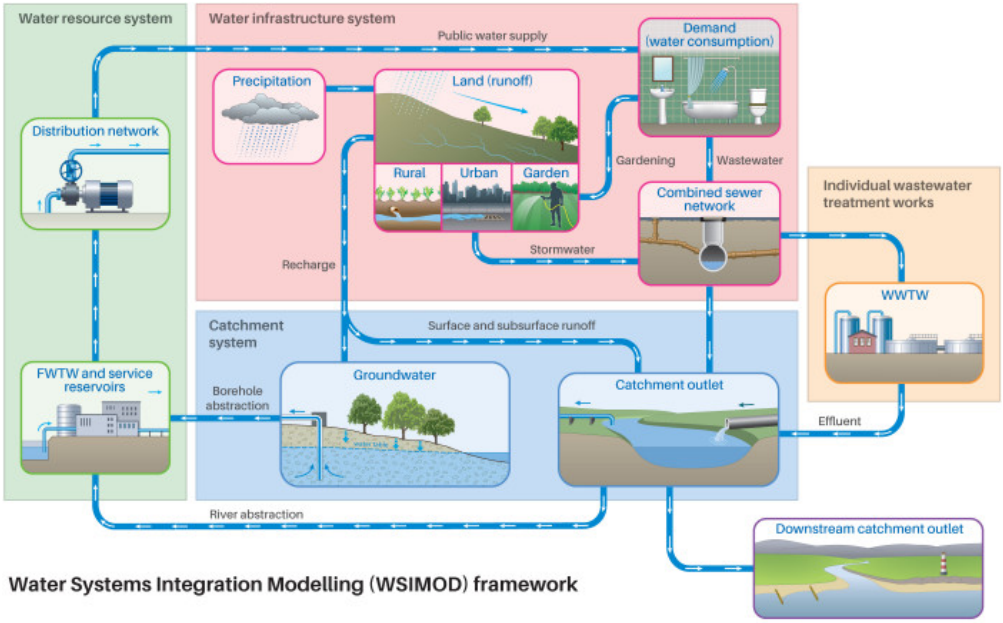
PhD proposal 2026: Towards an integrated assessment of urban water metabolism under global change



Integrated urban water system modelling (adopted Dobson et al., 2023)

Research Context:

Urban water systems face growing pressures from increasing population density, rapid urbanisation, and the impacts of climate change (Flörke et al., 2018). Expanding impervious surfaces, aging infrastructure, and increasingly unpredictable weather patterns make urban areas particularly vulnerable to water-related challenges, such as flooding, water quality degradation, and water scarcity. The current segmented management of surface and underground aquatic environments, drinking water, wastewater, and stormwater is insufficient to address the combined challenges of securing water supplies, enhancing resilience to extreme climatic events, and preserving aquatic ecosystems in the city of tomorrow. The complex interrelationships within urban water systems necessitate a more comprehensive approach, an integrated urban water management (Bach et al., 2014), to manage interactions between various urban water system components and achieve greater water circularity in cities.

Some of the proposed decentralised urban water infrastructures (e.g., at-source stormwater management (Tunqui Neira et al., 2023), decentralised wastewater and grey water reuse; and the mobilisation of alternative resources) have already undergone technical assessment. However, these evaluations are typically limited to project-scale analyses and segmented by specific issues. These solutions have yet to be evaluated on a city-wide scale. Their coherence, complementarity, potential competition, and integration with existing systems still require further analysis to assess their contribution to a new paradigm of urban water management.

To adequately address these global challenges, a shift from traditional, fragmented urban water management to an integrated approach is essential. This approach incorporates several key elements to tackle the complex impacts of urban development and global change: (1) consideration of all components of urban water systems, including surface water and groundwater interactions, drinking water, wastewater, stormwater, and alternative water resources; (2) examination of the need for and usage of decentralised urban water infrastructures from both quantitative and qualitative perspectives; (3) representation of water dynamics across different spatial scales, encompassing both centralised and decentralised systems; and (4) connection with global change (Behzadian and Kapelan, 2015).

Aim and objectives of the PhD thesis

This PhD thesis aims to assess the interactions and impacts of decentralised urban water infrastructures at the city scale under global change, using an integrated urban water system modelling approach.

Objective 1) Identify and characterise decentralised urban water infrastructures that address current challenges in urban water systems.

Objective 2) Develop scenarios for the deployment of decentralised urban water infrastructures in the Paris region.

Objective 3) Further develop WSIMOD (Water Systems Integrated Modelling, Dobson et al., 2023) to assess the interactions and impacts of deploying decentralised urban water infrastructures at the city scale.

Objective 4) Apply the model developed in Objective 3 to a case study in the Paris region to evaluate the interactions of the decentralised urban water infrastructures identified in Objective 1 under the deployment scenarios developed in Objective 2.

Capacity / Candidate Profile:

The ideal candidate should have a strong background in environmental or urban hydrology, water resources management, or related disciplines. Skills in numerical modelling, Geographic Information Systems (GIS), and programming (Python, R, or MATLAB) are highly desirable. Experience with integrated water management, or sustainability assessment will be an advantage. The candidate should also have strong analytical and communication skills, enabling them to interpret complex datasets and present results to both academic and non-academic audiences. Motivation to work in an interdisciplinary environment and interest in addressing global change challenges in urban water systems are essential.

Supervision:

The successful candidate will be supervised by Pr Ghassan Chebbo (Research Director, Director of LEESU; ghassan.chebbo@enpc.fr), Pr Maire-Christine Gromaire (Research Director, marie-christine.gromaire@enpc.fr), and Dr Yangzi Qiu (Researcher, yangzi.qiu@enpc.fr). The PhD will be conducted at the LEESU Laboratory (Laboratoire Eau, Environnement et Systèmes Urbains) at the École Nationale des Ponts et Chaussées, Institut Polytechnique de Paris.

Application procedure:

Interested applicants are invited to send their **CV** and **Personal Statement** to ghassan.chebbo@enpc.fr; christine.gromaire@enpc.fr; yangzi.qiu@enpc.fr.

Please use the following subject line in your email: **“2026 PhD Apply – YourName” .**

References:

Behzadian, K., & Kapelan, Z. (2015). Modelling metabolism based performance of an urban water system using WaterMet2. Resources, Conservation and Recycling, 99, 84-99.

Bach, P. M., Rauch, W., Mikkelsen, P. S., McCarthy, D. T., & Deletic, A. (2014). A critical review of integrated urban water modelling–Urban drainage and beyond. Environmental modelling & software, 54, 88-107.

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Dobson, B., Liu, L., & Mijic, A. (2023). Water Systems Integrated Modelling framework, WSIMOD: A Python package for integrated modelling of water quality and quantity across the water cycle. Journal of Open Source Software, 8(83), 4996.

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