THESIS PROPOSAL 2024

Title : Non-conventional water infiltration strategies for recharge of surface and groundwater reservoirs from a global change perspective in urban area

Impacts assessment on water and soil compartments

Topics	Urban hydrology – Ecological engineering – Sustainable stormwater management – reservoir recharge – Protection – Perservation – Water and Soil sustainable management
Supervisory team	Adrien Wanko, Loïc Maurer, Claire Villette, Dimitri Heintz
Skills	Numerical modeling, hydrology, multivariate data analysis , and knowledge in analytical chemistry would be advantageous (or having a strong willingness to learn them)
Duration	36 months beginning in October 2024
Location	ICUBE – Laboratoire des sciences de l'Ingénierie, de l'Imagerie et de l'Informatique 1 cour des cigarières 67000 Strasbourg (https://icube.unistra.fr/)
Partnerships	Agence de l'eau, Eurométropole de Strasbourg
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Context

The alarming observation of the loss of 65,000 hectares of land each year in France, equivalent to a department every 10 years, cannot be ignored. This urban expansion significantly exacerbates the consequences of rainwater runoff on our water regimes and quality, as well as on public safety. Soil impermeability, by limiting infiltration, leads to increased runoff, higher flow rates at outlets, a decline in groundwater levels, more pronounced low-flow periods in our watercourses, and often overloaded sewage systems, resulting in pollution discharges into our ecosystems. These infiltration issues are associated with climate change, which impacts water resource management. Initiating profound changes (such as the reuse of treated wastewater and groundwater recharge with source control) is imperative to preserve our water resources, mitigate the effects of climate change, and ensure a sustainable future for our territories. These challenges require addressing both qualitative and quantitative aspects of stormwater management. Therefore, it is necessary to develop our understanding of the quality of stormwater using advanced analytical tools and integrate nature-based solutions modeling into a numerical model such as the Storm Water Management Model (SWMM) to enhance our comprehension of integrated stormwater management.

Thesis project

This thesis aims to: i) assess the impacts of urbanized areas and scenarios of land use changes on water flow and contaminant fluxes, as well as the dynamics of physico-chemical and biological characteristics of soils; ii) propose strategies for the infiltration of non-conventional waters, especially rainwater and treated wastewater, to mitigate the adverse effects of global changes. The study will be conducted at various scales (laboratory and field) to characterize inputs from the watershed, and then analyze and model within this watershed the impact of urbanized and de-impermeabilized areas on volumetric and pollutant fluxes; and diagnose the impacts of the reuse of treated wastewater for groundwater recharge.

Structure

The thesis will be conducted within the ICube laboratory (https://icube.unistra.fr/ UMR 7357), and more specifically, within the Mécaflu team. ICube is nationally and internationally recognized for conducting interdisciplinary research in the fields of engineering for health, the environment, and sustainable development. The Mécaflu team is renowned for its expertise in fluid dynamics and the theme of reactive transfers and environmental processes. The analytical aspect of the project will be carried out within the PIMS team, known for its expertise in developing new analytical methods for environmental and exposome-related issues.

Candidate profile

- Water engineering degree / master's degree in environmental science
- Experience with environmental studies will be appreciated
- Willingness to work on field
- English skills (written and/or spoke) would be appreciated
- Curiosity and open-minded

Keywords:
Non-conventional water, stormwater management, numerical modeling, non-targeted micropollutant analysis, porous medium, soil, water bodies