Université de Neuchâtel
Centre d'hydrogéologie
et géothermie

MSc in Hydrogeology and Geothermics

Thesis topic proposal 2026

Assessing Groundwater Recharge and Availability in Crystalline Aquifers in Switzerland

Context and objectives

Groundwater stored in crystalline fractured rocks represents a significant, yet poorly constrained, component of Switzerland's water resources. Previous estimates suggest that these aquifers contribute around 10 to 30 % of the national groundwater resource, but large uncertainties remain due to limited data and simplified assumptions. Current approaches rely heavily on empirical extrapolations from sparse datasets (springs, tunnels, wells), without adequately accounting for spatial variability in lithology, tectonic structures, and topography. This limits our ability to assess groundwater availability under changing climatic conditions, especially in terms of changing seasonal recharge dynamics, resilience to drought and water demand for agriculture.

This MSc project is part of a collaborative initiative with the Swiss Federal Office for the Environment (FOEN) and aims to improve the estimation of recharge and groundwater resources in crystalline environments. The main objectives are to (i) critically assess existing methodologies, (ii) develop a process-based and spatially explicit modeling framework, and (iii) apply it to selected Swiss catchments to better constrain groundwater availability and its sensibility to climate variability.

Methodology

The student will follow a multi-step approach combining data analysis and modeling:

- Review existing methods used to estimate recharge and groundwater resource availability in fractured aquifers,
- Compile and harmonize datasets (geology, springs, wells, tunnels, discharge, and climate data),
- Implement a parsimonious modeling framework coupling land-surface processes and groundwater flow,
- Estimate recharge and groundwater contributions to streamflow in selected pilot catchments,
- Assess uncertainties associated with data limitations and model assumptions,
- Explore possibilities for upscaling results to the ungauged crystalline dominated catchments using statistical learning.

The work will be built on developments from the Waterwise and FutureFlow project, in close collaborators with the researchers involved (team of 6 PhD students and 2 research engineers).

Supervision and collaboration

The work will be supervised by Clément Roques (UniNE), Stefanie Wirth (OFEV) and Benoît Valley (CHYN).

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