UNIVERSITÉ DE NEUCHÂTEL

CHYN
Centre d'hydrogéologie et de géothermie

MSc in Hydrogeology and Geothermics
Thesis topic proposal 2021

AQUIFER MAPPING AND MODELLING IN A DYNAMIC ALPINE HEADWATER CATCHMENT

Context and objectives

Alpine catchments play a vital role in sustaining down-gradient streamflow. The hydrology of these catchments is highly dynamic and is generally characterised by an annual cycle including snow accumulation and melt phases. In such catchments, a large percentage of precipitation infiltrates into, and is transported within, the subsurface as groundwater. This water can subsequently discharge to the surface at springs or beneath surface water bodies. 3-D information about the subsurface is crucial for understanding and characterising this cycle of recharge, residence, and discharge of groundwater and for adequate water resource management in alpine regions.

Our study site, the ***Tsalet*** catchment in the Vallon de Réchy (Valais), lies at an elevation range of approximately 2'200 - 2'800 m a.s.l. and covers approx. 1 km^2. A previous study using gravimetry and stable isotope methods revealed the occurrence of large annual fluctuations in localised groundwater storage. A zone of relatively high permeability material (scree and mixed deposits) overlying moraine and quartzite layers is believed to act as a temporary water reservoir during the warmer months, ensuring groundwater discharge to streams at lower elevations. Although surface geology maps exist, the stratigraphy and geometry of hydrogeological units remains unknown.

The goals of this project are to: *a)* measure the depth of the **aquifer/bedrock interface** and the talus/moraine interface in the Tsalet catchment using geophysics, *b)* create a **3-D aquifer model** based on these field measurements, and *c)* explore the **influence of aquifer properties on groundwater discharge** in the context of climate change using this model.

Research approach and methodology

We will use electrical resistivity tomography (ERT) to measure cross-sectional profiles in the middle and lower parts of the catchment where superficial talus and moraine aquifers are present. ERT is a geophysical method that allows us to image the subsurface by taking advantage of contrasting electrical properties. This will allow us to map and understand the configuration of the hydrogeological strata.

Through interpretation of the 2-D resistivity profiles, we will construct profiles of the depth to the bedrock, as well as delineate the talus/moraine interface. To define the ground surface, existing DEM data will be used, complimented by UAV data where needed. This model will be used to understand the dynamics of groundwater storage changes in this catchment and, more broadly, in alpine headwater catchments.

This project links directly to longer-term research projects on the hydrogeology of the Réchy catchment and on using gravimetric methods to measure seasonal and multi-year changes in groundwater storage. Future publication(s) with the MSc student as co-author are foreseen.

Ideally, geophysical surveys will be carried out in Summer/Autumn 2021, prior to the onset of snow.

Contact for further information

Further information is available from Dr. Landon Halloran (landon.halloran@unine.ch). The project will be supervised by Dr. Halloran and Prof. Daniel Hunkeler (daniel.hunkeler@unine.ch).