UNIVERSITÉ DE NEUCHÂTEL

CHYN
Centre d'hydrogéologie et de géothermie

MSc in Hydrogeology and Geothermics
Thesis topic proposal 2021

TESTING SIMPLIFIED HYDROGEOLOGICAL MODELS OF COMPLEX ALPINE ENVIRONMENTS

Context and objectives

Snowmelt, runoff, and groundwater discharge from alpine catchments directly affect down-gradient water resources. Developing accurate models of these catchments is highly challenging due to the large variability of hydrological conditions and the high degree of hydrogeological heterogeneity. Numerical modelling of complex hydrogeological settings such as alpine catchments can be approached in several ways.

One approach to modelling is that of a fully-coupled physically-informed model. In these types of models, a large amount of information is integrated to constrain hydrological parameters and properties. These models seek to simulate, as closely as possible, the actual hydrological processes at all points in the domain by directly implementing the principles of physics using finite element or finite volume techniques. Two drawbacks to this approach are the amount of computation resources required to constrain and execute the model and the amount of data required to adequately estimate model parameters.

Another common approach is that of a simplified model. While many varieties of simplified models have been developed, all share common characteristics. Simplified models generally avoid modelling the physical processes directly and instead use a set of equations relating hydrological inputs, residence and outputs. These types of models offer the advantage of simplicity but a major drawback is that only a specific type of output can be obtained from a given model.

The objective of this project is to develop and test simplified modelling approaches for alpine headwater catchments and compare them to more complex fully-coupled models.

Research approach and methodology

The Vallon de Nant (VD) is an alpine headwater catchment characterised by high degrees of topographical relief, snow accumulation, and geological variability. A fully-coupled, physically-informed model that integrates geology, geophysics, remote sensing, and hydrology data has been developed for this catchment. This model will be used as a benchmark for more simplified approaches. Simplified models using a subset of the available data will be developed and tested against a variety of climatic conditions including the effects of future climate change.

Contact for further information

Further information is available from Prof. Philip Brunner (philip.brunner@unine.ch) and Dr. Landon Halloran (landon.halloran@unine.ch).