Université de Neuchâtel
Centre d'hydrogéologie
et géothermie

MSc in Hydrogeology and Geothermics

Thesis topic proposal 2024

The Seeland projects: Hydrogeology, soil and agriculture

Context and objectives

After the first and the second correction of the rivers and lakes in the Jura region, the Seeland became one of the most important agricultural areas in Switzerland. The Seeland used to be covered by swamps and ponds. Physical and chemical conditions were favourable to peat formation. In the context of the corrections, soils were drained and exposed to ambient air, triggering an important loss of soil through oxidation. The mechanical and bio-chemical erosion processes resulted in a significant subsidence of the terrain.

The groundwater level controls the rate of chemical erosion. On the one hand, there is a need to keep the water table high to prevent/slow down the oxidation of organic soils. On the other hand, in the context of climate change, groundwater is increasingly used for irrigation potentially leading to a drawdown of the water table. Furthermore, the water table affects the irrigation water demands. Controlling the water tables in the Seeland aquifer through the existing drainage network is thus the key to sustainable management of the soil- and water resources. The CHYN is involved in several research projects in the Seeland related to water – and soil resources management.

Methodology

Depending on the interest of the student, a wide range of activities and investigations can be carried out, including the following:

Project 1: Assessment of the potential to use the drainage-nets for means of irrigation. This is an interesting approach because the loss of soil resulted in the drains now being much closer to the surface compared to 20 years ago. Targeted experiments to measure the response of the aquifer to blocking the drains can be carried out in the field. Numerical models will complement the field approaches.

Project 2: The goal of the project is to improve our current understanding of how soil types and hydrogeological conditions such as the depth to water table affect infiltration and evapotranspiration dynamics. In the project, a numerical model simulating irrigation, infiltration and transpiration dynamics for different climate scenarios and soil types will be developed. This project is based on a state-of-the-art, 3d soil map of the Seeland developed using machine learning approaches by the Bern University of Applied Sciences. The project includes targeted field data acquisitions such infiltration experiments.

Project 3: Analysis of the influence of topography and the hydraulic properties of the soil on water logging in agricultural fields. Understanding water logging processes is critical to implementing modifications of the topography of waterlogged areas. In this context, the influence of groundwater dynamics on soil moisture profiles will be assessed through a combination of numerical models, geophysical data and additional field campaigns, including drones.

Project 4: This project aims to study how subsurface water management impacts soil conservation in agricultural peatlands, focusing on the Seeland region in Switzerland. The research involves conducting experiments to characterize soil and hydrogeology, as well as measuring gas fluxes to understand greenhouse gas emissions. By integrating data from soil studies and numerical modeling, the project seeks to develop sustainable water management practices to mitigate soil loss and carbon emissions in peatland areas.

Supervision and collaboration

The projects will be supervised by Prof. P. Brunner, Prof. D. Hunkeler, as well as Clément Roques and Alex Kobayashi.

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