

Semester Project Proposal

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Delivery of final report: TBD

Introduction

Sediment transport is a fundamental component of river dynamics because it governs bed evolution, channel stability and the ability of fluvial systems to recover or maintain their natural form. As river restoration becomes an increasingly important objective in environmental management, it is essential to understand how sediment moves through channels in order to predict how rivers evolve once human interventions are reduced or removed. Laboratory and field studies provide valuable insight into these processes, yet numerical modeling is necessary to investigate long term behaviour under natural conditions and to assess how rivers respond to variations in discharge, sediment supply and channel geometry.

This project aims to evaluate the capability of current numerical tools, with particular focus on BASEMENT, a Swiss hydro morphodynamic modeling software developed at ETH Zurich, to simulate sediment transport and bed evolution in simplified natural and laboratory configurations. The goal is to examine how the sediment transport module behaves in realistic settings and to identify the challenges involved in applying these tools to natural river environments. Through a series of controlled numerical experiments, students will learn how to set up, run and critically interpret sediment transport simulations, gaining practical experience and a deeper understanding of the strengths and limitations of existing hydraulic software.

Project Objectives

The main objective of this project is to train students in the use of BASEMENT for simulating sediment transport and associated bed evolution in both laboratory inspired and natural scenarios. The project will focus on:

- Implementing two dimensional hydrodynamic and sediment transport simulations using BASEMENT.
- Reproducing sediment transport test cases to observe bed adjustments over time.
- Identifying challenges and limitations in the prediction of sediment transport in natural river environments.
- Developing the ability to interpret model outputs and assess the performance of the sediment transport module.

Prerequisites

- Interest in river processes and motivation to learn numerical modeling techniques.
- Curiosity about how sediment transport can be represented with computational tools.
- Basic knowledge of hydraulics or geomorphology is helpful but not required.
- No previous experience with BASEMENT, Matlab or Python is necessary. Motivation to acquire new technical skills is more important.

Expected Deliverable

The student will prepare a report documenting the methodology and results of the project. The document should include at minimum:

- Description of the numerical setup, including model configuration and boundary conditions.
- Explanation of the sediment transport formulations used and justification of selected parameters.
- Presentation of hydrodynamic and morphodynamic results.
- Interpretation of morphological changes and discussion of factors controlling sediment transport behaviour.
- Identification of the main challenges associated with modeling natural river environments.