



Institute for Water and Environment (IWU)
Hydraulic Engineering & Water Resources Management
Institute of Applied Geosciences (AGW)
General Geology Group

Master thesis

on the subject

Short-term ($T < 100$ yr) hydro-morphodynamic impacts of infrastructure, in an alpine valley geomorphology

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Background / Motivation

Human interventions (dams, water withdrawal, road placement, bridges and river training) substantially modify sediment transport, connectivity, and consequently geomorphic response of the valleys channel-network over decades. Evidence from the alpine catchments shows that dams can intensify sediment trapping, shift geomorphic hotspots, and alter downstream environmental risk patterns. Understanding these relative short-term (<100 years), management-relevant impacts in small alpine catchments is crucial for sustainable infrastructure planning and mitigation of adverse human interventions in rivers.

Scope of the work

This MSc thesis focuses on applying LandLab, a modular, physics-based landscape evolution model, to explore the $T < 100$ yr (timescale compatible with the lifetime of impounding structures such as dams and weirs) response of the Sarzana valley to human interventions. The study is foreseen to include the following activities:

- Literature review and formulation of input parameters for numerical models.
- Set up and customise the landscape evolution model for the case study of the Sarzana catchment, and implement future climate scenarios
- Implement infrastructure scenarios, such as: placement/removal of small dams or check-dams, water abstraction works and altered discharge regimes, local channelization or bank reinforcement.
- Simulate $T < 100$ yr morphological responses, assessing: sediment supply reduction and its propagation, development of aggradation/degradation reaches, connectivity disruptions and delays in sediment transfer, geomorphic hotspot locations.

- Data analysis and comparison of scenarios with neutral (no-intervention) trajectories and interpretation on how river morphology adapts or destabilizes under anthropogenic forcing.
- Discussion of the results
- Redaction of the master thesis

Remarks

This master's thesis is carried out in parallel with a complementary thesis in Geology, focusing on how climate-driven changes in hydrology and vegetation affect catchment connectivity at geological timescales.

The thesis will be developed in collaboration with the IHE Delft (Dr. Alesandro Cattapan). This project is suitable for a student with interest in hydro-morphodynamics and infrastructure management challenges in mountain basins. Experience with programming and data treatment is advantageous. The work can contribute to ongoing research on sediment continuity, climate impacts, and geomorphic response times in alpine environments.