Institute of Applied Geosciences (AGW)
General Geology Group

Institute for Water and Environment (IWU)
Hydraulic Engineering & Water Resources Management

Master thesis

on the subject

Long-term landscape evolution of an alpine valley under climate-driven hydrological and vegetation changes

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Background / Motivation

Mountain landscapes evolve over timescales of centuries to millennia, where climate-driven changes in hydrology, vegetation, and sediment supply reshape catchment morphology. Understanding these slow, cumulative processes and the influence of non-linear effects of climate change on hydrology and vegetation is fundamental to geomorphology, hazard assessment, and long-term watershed management. To evaluate these effects on the landscape evolution at a catchment scale, requires numerical experimentation using physically grounded landscape evolution models.

Scope of the work

This MSc thesis focuses on applying LandLab, a modular, physics-based landscape evolution model, to the Sarzana Valley catchment (NE Italy). 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
- Simulate landscape/channel-network evolution, focusing on sediment production, delivery, and continuity, and how altered hydrology/vegetation cascades into changes in erosion rates, catchment morphology.
- Data analysis and interpretation of long-term trajectories of sediment fluxes and catchment morphology.
- Discussion of the results
- Redaction of the master's thesis

Remarks

This master's thesis is carried out in parallel with a complementary thesis in Hydraulic Engineering, focusing on how infrastructure affects catchment connectivity under a changing climate and for timescales compatible with lifetime of impounding structures (T<100 years). The thesis will be developed

in collaboration with the IHE Delft (Dr. Alesandro Cattapan). This project is suitable for a student interested in long-term landscape evolution. Experience with programming in Python and data treatment is advantageous. The work can contribute to ongoing research on sediment continuity, climate impacts, and geomorphic response times in alpine environments.