Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

Laboratory of Hydraulics,
Hydrology and Glaciology

Master's Thesis
HS 2024

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Supervision: Dr. D. Vetsch
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(Schroders Capital)

Enhancing flood loss modelling: DEM data and ML in subgrid-scale modelling

Close to 1/3 of the world's population is exposed to flood risk. Climate change leads to increased global flood frequency and severity, compounded by trends like urbanization, which exacerbate losses and highlight the need for more effective risk transfer mechanisms. Effective risk transfer relies on adequate flood loss modelling. However, current models are limited by Digital Elevation Model (DEM) data quality and coarse grids that fail to capture intricate flow paths, especially in urban settings (Fig. 1). Subgrid-scale models like porosity methods can be used to reduce computational demands, but they remain prohibitive for large scale applications. More recently, machine learning (ML) methods are finding applications to enhance flood model performance.

Fig. 1: Flooding in Houston TX (Source: cnn.com)

This thesis focuses on the interplay between DEM quality, mesh resolution, and the impact on flood loss estimations. Furthermore, the potential of ML-based subgrid-scale models will be assessed. The student will begin with a review of current flood loss modeling techniques, emphasizing DEM and subgrid modeling. Following this, a hydraulic model will be implemented to conduct a sensitivity analysis on DEM quality and resolution. The insights from this analysis will be used to generate a high-resolution synthetic dataset for training an ML subgrid model, aiming to develop a proof of concept for this method.

The collaboration with Schroders Capital, a leader in the insurance-linked securities market, provides the student with insights into reinsurance risk transfer and advanced numerical modelling techniques.

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Remarks: Research-oriented thesis; numerical 2D modelling skills and programming skills are required.