Universität Stuttgart

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M.Sc. Topic

How precise can a large numerical model be? Set up a 500-km long, 2d hydrodynamic model of the Rhine River

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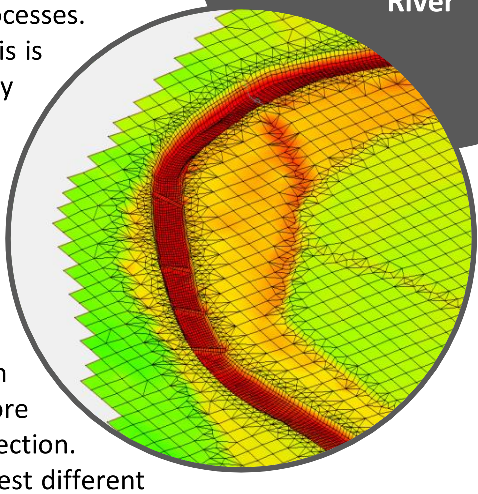
Background



In recent years, two-dimensional (2d) numerical models of rivers have become the state-of-the-art tool for simulating hydro- and morphodynamic processes. However, numerical models are only as good as their input data. This is especially true for the bathymetry of the riverbed, which is often only available in the form of cross sections. Another limiting factor, which primarily determines the mesh resolution of a numerical model, is the available computational capacity. This study provides the unique opportunity to combine a high-resolution digital elevation model of a large river section with great computational capacity on one of our high-performance servers. After a short literature review, the student will analyze the digital elevation model, which covers 500 km of the Rhine River between Iffezheim and the German-Dutch border with a resolution of 1.0 x 1.0 m, before applying a state-of-the art generator to create a mesh of the river section. After applying the boundary and initial conditions, the student will test different mesh resolutions and the computational time needed to run the numerical model. The study ends with a model calibration. This study represents an interesting challenge and at the same time offers the potential for high scientific novelty, as to our knowledge, high-resolution 2d hydrodynamic models on this scale do not yet exist.

Thesis Overview

1. Review literature on 2d hydrodynamic numerical modeling, mesh generation and the Rhine River. Familiarize with the mesh generator and simulation software.
2. Set up a mesh of the river section between Iffezheim and the German-Dutch border.
3. Make reasonable decisions for initial and boundary conditions such as the bed roughness and inflow series of the Rhine River and its tributaries.
4. Run hydrodynamic simulations with different mesh resolutions to analyze the precision that produces suitable computational times.
5. Calibrate the model using existing data for water levels and discharges at different gauges along the Rhine River.

Apply now!

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The thesis can be written in German or English.

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