Adaptive mesh refinement in flood simulations – a case study in an alpine river

Michaela Sichert[1]
[1]Department of Geoinformatics - Z_GIS, University of Salzburg, Austria

Background

Hydraulic modelling

- Accurate results depend on a high mesh resolution causing high computational costs [3]

Adaptive mesh refinement (AMR)

- Increase the computational efficiency in comparison to non-adaptive uniform grids [2]

Gerris Flow Solver (GFS)

- Features AMR based on adaptive quadtree grids in 2D models [1]

Research questions

Investigate the effects of AMR on the model results in an alpine environment

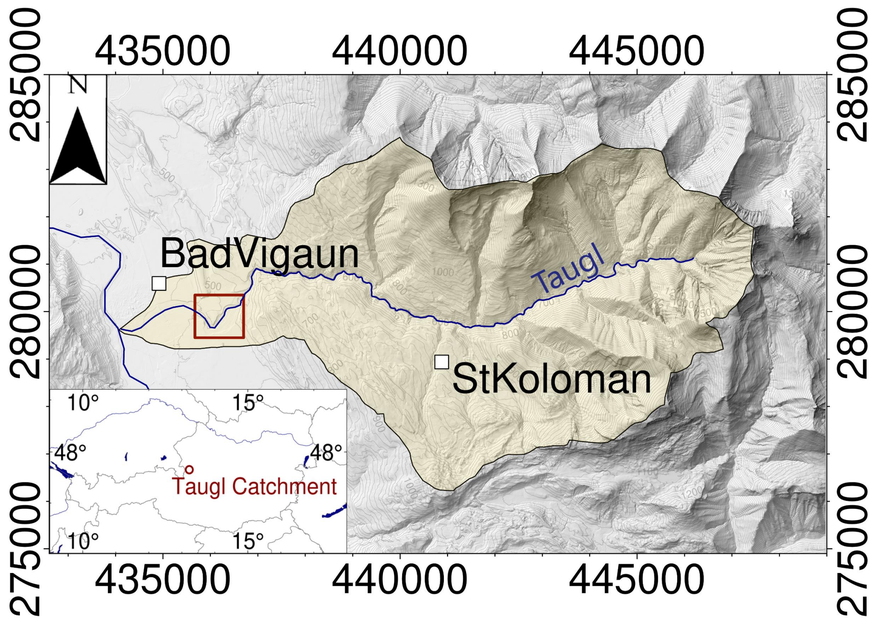
Comparing the results from an AMR model and a non-uniform static mesh refinement (SMR) model

RQ 1: Quantify the effects of AMR on the computational costs

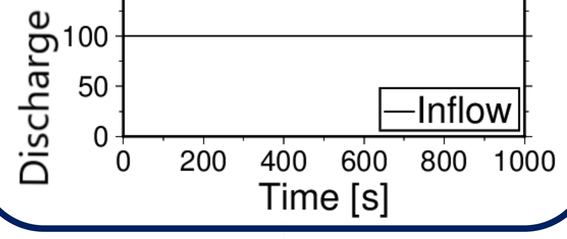
RQ 2: Analyse the impacts on the accuracy of different hydraulic parameters

Study site

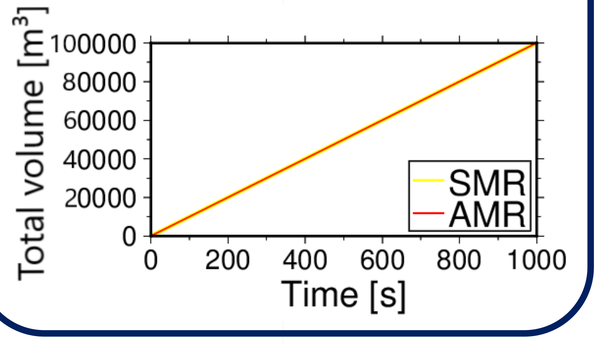
The study site refers to a channel section of the **Taugl River** in the Salzburger Land



Inflow hydrograph



Model validation



Methods

Hydraulic models generated with GFS

Refinement if cells are located within the inflow area or if:

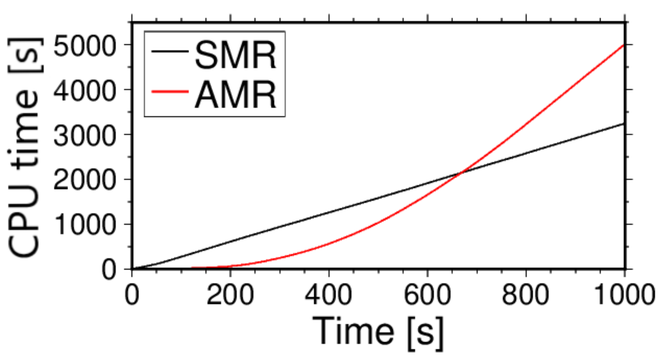
Non-uniform SMR model	AMR model
• terrain reconstruction error is larger than 0.75 m	• cells are flooded

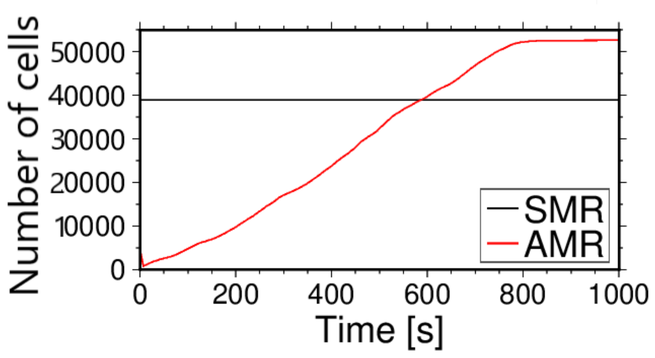
All other simulation parameters (e.g., discharge) are kept constant in both models

RQ 1: Effects on the computational costs

Compared to the SMR counterpart, the AMR model requires:

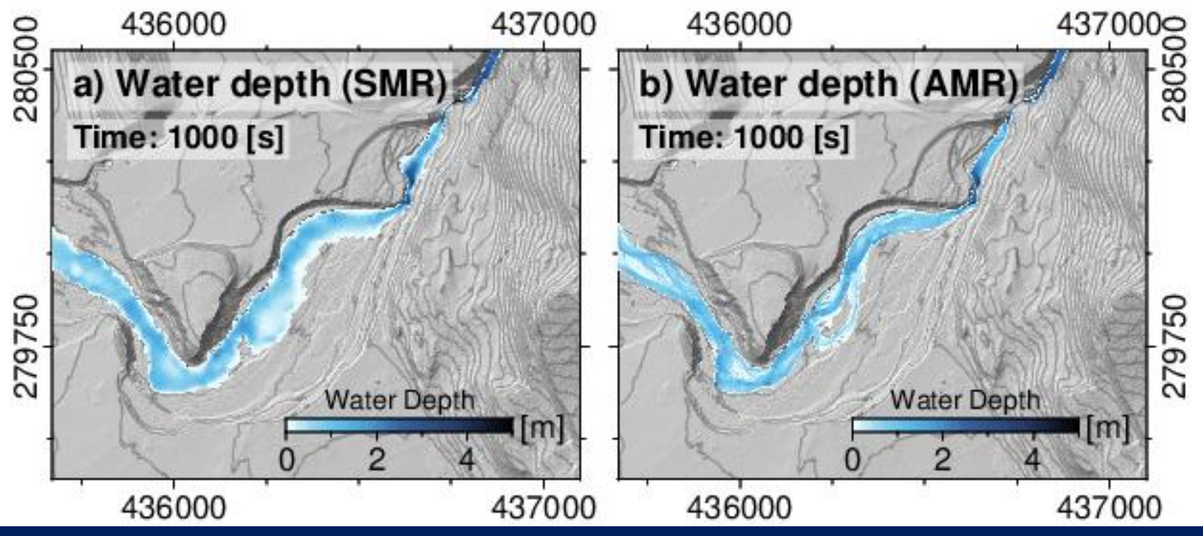
- 54 % more CPU time
- 35 % more cells





RQ 2: Impacts on the accuracy

Higher accuracy achieved with the AMR model: the SMR model predicts a 25 % larger inundation



Conclusion: The AMR model requires higher computational costs but is more accurate

[1] AN, H., YU, S., LEE, G. & KIM, Y. 2015. Analysis of an open source quadtree grid shallow water flow solver for flood simulation. *Quaternary International,* 384**,** 118-128.
[2] HU, R., FANG, F., SALINAS, P. & PAIN, C. C. 2018. Unstructured mesh adaptivity for urban flooding modelling. *Journal of Hydrology,* 560**,** 354-363.
[3] HUANG, W., CAO, Z., PENDER, G., LIU, Q. & CARLING, P. 2015. Coupled flood and sediment transport modelling with adaptive mesh refinement. *Science China Technological Sciences,* 58**,** 1425-1438.

Michaela.Sichert@stud.sbg.ac.at