Reconstruction of the 2000 flood event in Baltschieder

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INTRODUCTION

The small village of Baltschieder is located on an alluvial fan at the Rhone River in Canton Wallis. In the year 2000 the village was afflicted by a devastating flood discharged by the tributary Baltschiederbach. Due to heavy rainfall on the previously saturated soil in the catchment, the resulting discharge activated extensive sediment transport. This was additionally boosted by the steep channel in the Baltschieder Canyon with a mean bottom slope larger than 10%. The sediment trap upstream of the village was filled up and the adjacent channelized reach of the creek was blocked within short time. This caused a diversion of the creek course towards the village so that huge amounts of sediment were deposited in the upper part of the village. The estimated damage sum is more than 50 million Swiss francs. The event has been documented by photographs allowing for the assessment of thickness and spatial extent of the sediment depositions. Furthermore, estimates of the event sediment discharge are reported by several authors. The estimated volume of gravel depositions varies between 70,000 to 95,000 m³, and that of fines is roughly in the same range.

MOTIVATION AND METHODS

During this extraordinary flood event a combination of water and sediment affected buildings and infrastructure which had a distinctly different impact than that caused by flooding only. This urged to reconstruct the event by numerical simulation to obtain a better understanding of the determining factors and to provide a basis for the development of new vulnerability concepts (see poster with same title. With regard to model capabilities, the water flow and the sediment transport processes were considered to be mainly fluvial, because the main depositions occurred on the alluvial fan where the bottom slope is gentler than in the canyon. Thus, the software BASEMENT has been used for these simulations. This 2D model is based on the depth- averaged shallow-water equations which are solved on an unstructured grid using a finite-volume method combined with Riemann solvers to ensure flexibility and stability. To simulate mixed-sediment bed-load transport, a Hirano-Exner model was employed that includes various approaches suitable for mountainous conditions.

RESULTS AND CONCLUSION

As shown in this contribution the progress of the 2000 flood event in Baltschieder has been successfully reconstructed by numerical simulations. The effects of different model approaches and parameters are discussed based on the variation of the sediment discharge at the upstream boundary condition, the number of fractions and sediment grain sizes, the bed-load transport formula, as well as other transport model specific parameters.
In Figure 1 a simulation snapshot is depicted. The simulation results indicate that the spatial extent and the thickness of depositions strongly depend on the configuration of the transport model. However, the spatial discretization of the model perimeter turned out to be crucial. Without accurate consideration of the topography, the flow path of water and sediments and therefore of the depositions cannot be rendered appropriately. The present work highlights the potential of numerical modelling for advanced assessment of flood hazards considering sediment transport.

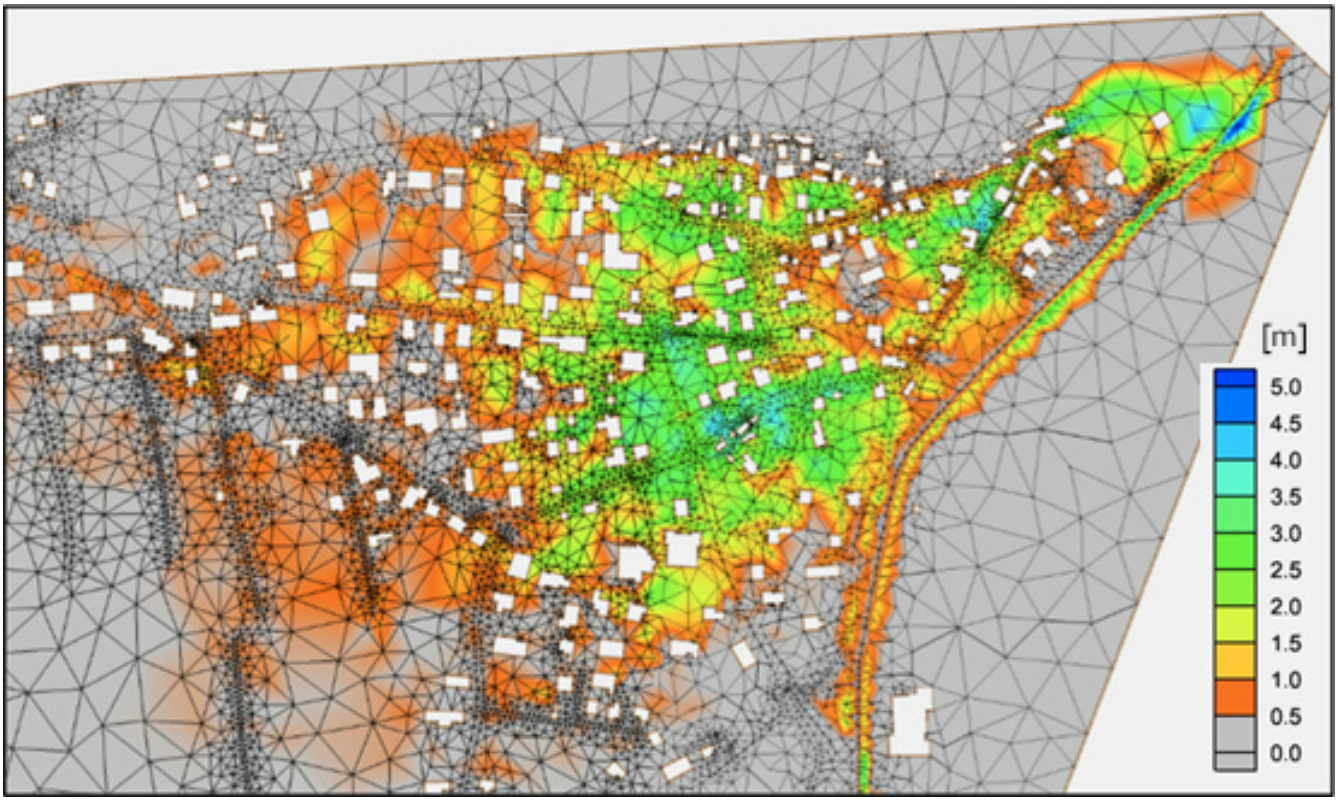

Figure 1. Map of Baltschieder village with contour plot of sediment deposition thickness (snapshot of numerical simulation).

KEYWORDS

2D model; flood assessment; numerical simulation; sediment transport

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