Dealing with Bedload in Alpine Torrent Hydraulics - New Approaches in Bavaria

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OBJECTIVE

Due to the Bavarian water law, water authorities are asked to assess hazard maps in torrent areas. Especially the torrents with insufficient protection against the 100-year event or with a high risk potential are prioritized for hazard assessment. The general approach is to identify endangered zones by hydrodynamic modelling. The hydrological input for the hydraulic model is calculated with a precipitation-runoff model based on a standardized procedure. The effects of bedload processes, which significantly influences the hazard potential of a torrent, should be considered in the hydrodynamic model. The bedload transport during the flood event has both a serious influence on the volume of the suspension and also changes the geometry of the channel due to erosion and aggradation. Other typical torrent scenarios are log jams by driftwood at water ducts or small bridges.

The main target was to provide a comprehensible standard method for modeling the effects of bedload transport by the hydrodynamic model. The introduction of a standard procedure should bring along advantages like a demand of minimal requirements, reproducibility and also reveals a good balance between effort and quality. The effects of bedload transport should be considered in the hydrodynamic model by two ways:

1. Enlargement of the hydrograph by a bedload aggregate to consider the additional volume and increase of the peak discharge due to bedload transport.
2. Modification of the torrent bed to model areas of aggregation and erosion

PROPOSED WORK FLOW

Depending on the river morphology, two different procedures are suggested to determine the bedload aggregate (no. 1 above). Method (I) is suggested for alpine rivers which represent rather transport limited conditions is suggested and method (II) is suitable for torrents with a bedload limitation:

I. Calculation of capacity of transporting: In Reaches with transport limited conditions the bedload transport formulas are able to assess the transport process quite well. If such reach is limiting the transport downriver to the area of interest (most downstream reach), this reach is considered as „key section“. The capacity of transporting is calculated by a suitable bedload transport formula, the ratio of water and bedload discharge yield the bedload aggregate.

II. Classification of bedload potential: Given quantitative and qualitative factors influencing bedload transport are evaluated by a questionnaire. Scores referred to the answers enable a classification. The total of the score points determine the bedload aggregate.

Figure 1 depicts the single steps of the workflow of both procedures.

To indicate sections with an aggregation or erosion potential (no. 2 above), some results from the hydrodynamic model are used. The relative change of the mean shear stress as a function of riverbed width, along the channel on the alluvial fan, should serve as an indication.

OUTLOOK

For calibration, this briefly described procedure is going to be tested on a sample of torrents in summer. Subsequently a validation by different persons is planned. Some of those results could be presented in the full paper.

The difficulty in dealing with bedload in alpine torrents lies in the heterogeneous factors that have substantial influence on transportation processes. For this reason standards only can give frame conditions how to approach the problem and what

basic factors and procedures have to be taken into consideration. For the described procedure still calibration work has to be done to improve the method.

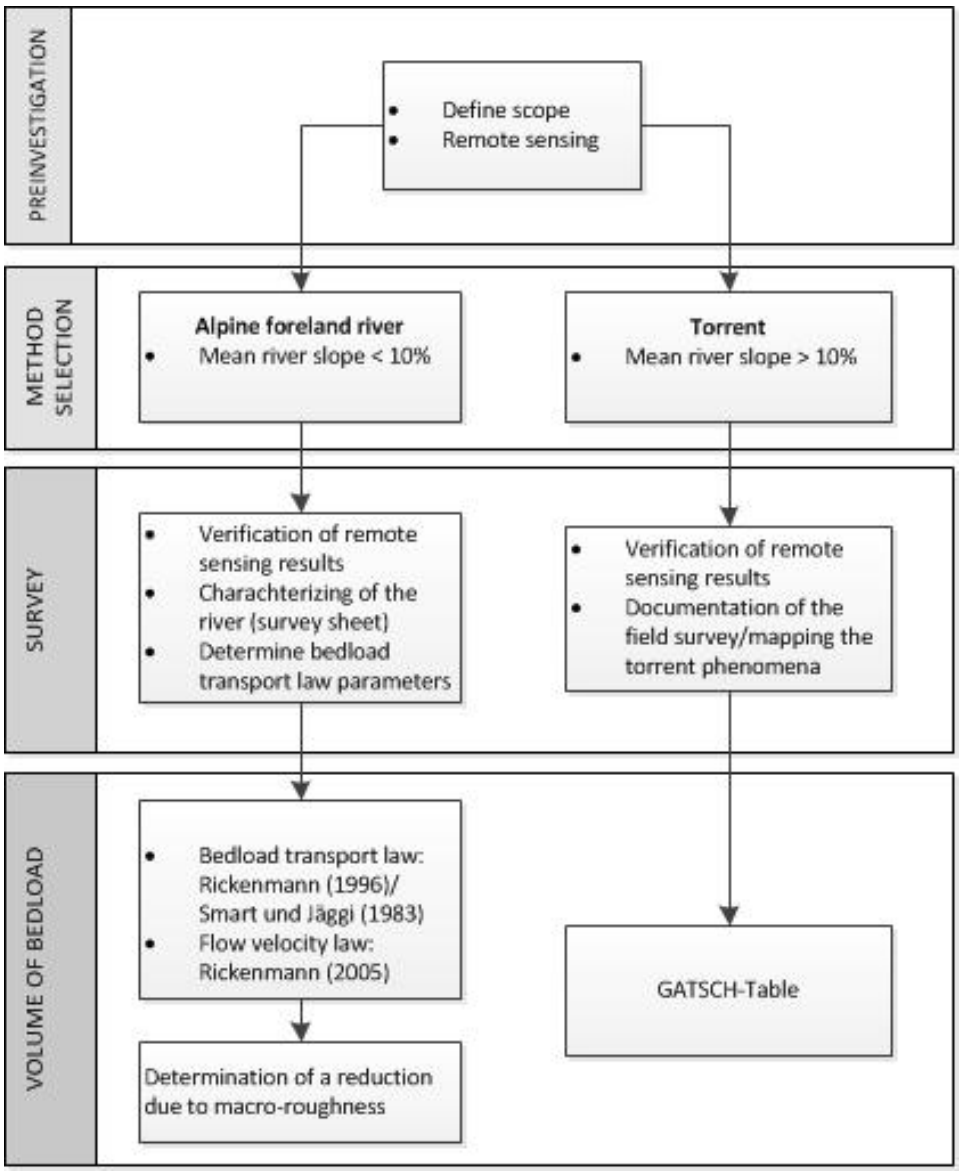

Figure 1. Conceptual progress of calculation the bedload tranport factor for regarding in the hydraulic model

KEYWORDS

bedload; hydraulic modelling; hazard analysis; bedload transport

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