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# Modelling rock-avalanche induced impact waves: Sensitivity of the model chains to model parameters

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New lakes are forming in high-mountain areas all over the world due to glacier recession. Often they will be located below steep, destabilized flanks and are therefore exposed to impacts from rock-/ice-avalanches. Several events worldwide are known, where an outburst flood has been triggered by such an impact. In regions such as in the European Alps or in the Cordillera Blanca in Peru, where valley bottoms are densely populated, these far-travelling, high-magnitude events can result in major disasters.
Usually natural hazards are assessed as single hazardous processes, for the above mentioned reasons, however, development of assessment and reproduction methods of the hazardous process chain for the purpose of hazard map generation have to be brought forward.

A combination of physical process models have already been suggested and illustrated by means of lake outburst in the Cordillera Blanca, Peru, where on April 11th 2010 an ice-avalanche of approx. 300'000m3 triggered an impact wave, which overtopped the 22m freeboard of the rock-dam for 5 meters and caused and outburst flood which travelled 23 km to the city of Carhuaz.
We here present a study, where we assessed the sensitivity of the model chain from ice-avalanche and impact wave to single parameters considering rock-/ice-avalanche modeling by RAMMS and impact wave modeling by IBER. Assumptions on the initial rock-/ice-avalanche volume, calibration of the friction parameters in RAMMS and assumptions on erosion considered in RAMMS were parameters tested regarding their influence on overtopping parameters that are crucial for outburst flood modeling. Further the transformation of the RAMMS-output (flow height and flow velocities on the shoreline of the lake) into an inflow-hydrograph for IBER was also considered a possible source of uncertainties. Overtopping time, volume, and wave height as much as mean and maximum discharge were considered decisive parameters for the outburst flood modeling and were therewith assumed dependent values.

The resulting 54 runs were evaluated by an ANOVA-analysis for each dependent variable. Results show, that the model chain is able to correctly reproduce the 5m-overtopping wave. Further the dependency from the input parameters could be assessed for every dependent variable. It was e.g. shown, that RAMMS-calibration has the strongest influence on all variations, it is more crucial then the uncertainties introduced by assumptions on the initial rock-avalanche volume.
The study shows, that from a hazard-assessment point of view, combinations of model chains are acceptable and permissible.