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Hydrological modelling for flood risk estimation in an alpine catchment: model setting and uncertainty

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The present study introduces the general strategy to implement a hydrological-hydraulic model to simulate flood risk in a high alpine catchment in Switzerland under uncertainty.
The hydrological model to be used is based on the Water balance Simulation Model, WASIM-ETH (Schulla et al., 1997), a fully distributed hydrological model that has been successfully used previously in the alpine regions to simulate runoff, snowmelt, glacier melt, and soil erosion and impact of climate change on these. A sound sensitivity analysis is conducted in order to choose the discretization threshold derived from a Laser MNT model, to which the hydrological model yields the best compromise between performance and time computation.
The study region is the Vallon de Nant catchment (10 km2) in the Swiss Alps. A previous research done in a low range mountainous catchment in Germany showed that the spatial uncertainty of rainfall is an important factor of uncertainty in the hydrological modelling. Given these findings and given the high variability of the rainfall in alpine catchments, a quite dense network of meteorological stations is used together with a runoff gauge to calibrate the hydrological model. Each step in the hydrological and the flood risk assessment undertakes uncertainty: evaluation of the main sources of uncertainty as well as the evaluation and communication of uncertainty is an important aspect of the proposed methodology. To calibrate the WASIM-ETH model, the Monte Carlo Markov Chain Bayesian approach is privileged (Balin, 2004, Schaefli et al., 2007).
The Bayesian approach offers a straightforward way to deal with different sources of uncertainty and is used in the present research study in order to integrate uncertain input data and model structure to estimate parameters and build the hydrologic response of the study catchment and to propagate this for further flood mapping analyses.