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A cascaded uncertainty framework for cloud-to-catchment flood inundation modelling: Project development and outlook

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This novel study will provide simulations of the impacts of climate change on extreme floods with a systematic assessment of uncertainties as these are cascaded through the modelling framework.
This study will attempt to (1) assess flood inundation impacts and extent as well as its hazards and (2) quantify the cascading uncertainties in a modelling framework to assess the effects of a future climate change. The modeling framework consists of statistically and dynamically downscaled meteorological input from an ensemble of GCMs and RCMs. The inputs will be fed into two rainfall-runoff models, LISFLOOD-RR and Dynamic TOPMODEL, and finally through two flood inundation models, LISFLOOD-FP and HECRAS.
The uncertainties in the modelling chain are many, ranging from uncertainty in spatial rainfall from climate models originating from the resolution of the simulated atmospheric dynamics, the initial conditions and sub-grid parameterisations. Rainfall-runoff models are in turn subject to uncertainties with respect to the observed data, the model structures, and their parameter values. Hydraulic models, as the last component in the chain, not only produce their own sources of uncertainties but also incorporate and include the propagated uncertainties from all other sources. The main aim of this project is to incorporate all these uncertainties at the very end of the chain in a flood risk map.
The research questions of this study are many: (1) how sensitive is the cascade setup to the downscaled meteorological input from the GCMs, particularly with respect to
extreme events; (2) how is the climate change signal affected by the downscaling technique; (3) how can we quantify the sources and magnitude of uncertainties when simulating flood inundation within the context of climate change; (4) how do we deal with multi-scale multi-source uncertainties whilst taking into account the limitations of our observed measurements; and last but not least, (5) How do we develop strategies that improve the efficiency of sampling such a cascaded modeling structure to characterise the uncertainties
The working procedure will consist of three steps. Firstly, a screening methodology is applied to all steps of the modelling chain to identify the main sources of uncertainty. The second step is a full sensitivity analysis built on the results from the screening. In the third step, an uncertainty sampling method called functional clustering will be applied to derive the total uncertainty.
The project has moved into the screening process, where the main sources of uncertainty are to be identified. The uncertainty will at this first stage be assessed individually at each chain of modelling. The entire framework of the project will be presented. The emphasis will be put on the methodology and results from the screening step. Sensitivities of various modelling factors such as model parameterization, spatial resolution and complexity of meteorological input will be presented as well.