



Using convection-permitting climate models and a high-resolution distributed hydrological model to assess future changes in Alpine flash floods.

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Flash Floods are damaging natural hazards which often occur in the European Alps. Precipitation patterns and intensity may change in a future climate affecting their occurrence and magnitude. For impact studies, flash floods can be difficult to simulate due the complex orography and limited extent & duration of the heavy rainfall events which trigger them. The new generation convection-permitting regional climate models improve the intensity and frequency of heavy precipitation (Ban et al., 2021).

Therefore, this study combines such simulations with high-resolution distributed hydrological modelling to assess changes in flash flood frequency and occurrence over the Alpine terrain. We use the state-of-the-art Unified Model (Berthou et al., 2018) to drive a high-resolution distributed hydrological wflow_sbm model (e.g. Imhoff et al., 2020) covering most of the Alpine mountain range on an hourly resolution. Simulations of the future climate RCP 8.5 for the end-of-century (2096-2105) and current climate (1998-2007) are compared.

First, the wflow_sbm model was validated by comparing ERA5 driven simulation with streamflow observations (across Rhone, Rhine, Po, Adige and Danube). Second, the wflow_sbm simulation driven by UM simulation of the current climate was compared to a dataset of historical flood occurrences (Paprotny et al., 2018, Earth Syst. Sci. Data) to validate if the model can accurately simulate the location of the flash floods and to determine a suitable threshold for flash flooding. Finally, the future run was used to asses changes in flash flood frequency and occurrence. Results show an increase in flash flood frequency for the Upper Rhine and Adige catchments. For the Rhone the increase was less pronounced. The locations where the flash floods occur did not change much.

This research is embedded in the EU H2020 project EUCP (EUropean Climate Prediction system) (<https://www.eucp-project.eu/>), which aims to support climate adaptation and mitigation decisions for the coming decades by developing a regional climate prediction and projection system based on high-resolution climate models for Europe.

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