Sensitivity of flood impacts in the main rivers and lakes of Switzerland

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Planning for flood risk mitigation spans decades, with protective structures and spatial measures taking years to yield results. Climate change is projected to increase flood risk by influencing the probability and intensity of flood events. Incorporating a dynamic element in future planning is crucial to adapt to changing flood threats. The impact of climate change on flood risk depends on future greenhouse gas emissions, complicating risk assessment.

Key to risk management is understanding how impacts will increase with more frequent extreme flood events. The change in risk is influenced not only by emission scenarios but also by the current topology between exposed values and flood magnitudes. Narrow river sections with dense construction near the river may strongly react to increased peak flows, while wider riverbeds with elevated buildings may show a less pronounced response. Levee rivers, where water spills over, may not find its way back into the channel, impacting areas behind the levees.

This study adopts a bottom-up, scenario-neutral approach, focusing on the sensitivity of flood impacts to increasing flood magnitudes. Analyzing the topology of human-river relationships allows an assessment of impact increases with more frequently occurring extreme events, irrespective of climate scenarios.

We test a quantitative approach to identify sensitive ranges in the magnitude-impact relationship in Swiss floodplains. The study introduces a combined index derived from slope and curvature along the magnitude-impact curve, offering a quantitative measure of floodplain sensitivity to variations in specific flood magnitude ranges. Our analysis reveals varying floodplain sensitivities for different impact types with no clear spatial pattern at higher regional levels. In addition to assessing the sensitivity of flood impact to climate change, this also examines its susceptibility to hydrometeorological uncertainties, such as those present in flood warnings.

As a product of this study, we are developing the tool "Risk Sensitivity", currently available as a prototype, aiming to map current risk curves for the rivers and lakes of national interest in Switzerland. The tool provides assistance in evaluating the potential influence of climate change on flood impacts, rather than just the hazard, as traditionally done.