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Using damage data to estimate the risk from summer convective precipitation extremes

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This study explores the potential added value from including loss and damage data to understand the risks from high-intensity short-duration convective precipitation events. Projected increases in these events are expected even in regions that are likely to become more arid. Such high intensity precipitation events can trigger hazardous flash floods, debris flows, and landslides that put people and local assets at risk. However, the assessment of local scale precipitation extremes is hampered by its high spatial and temporal variability. In addition to this, not only are extreme events rare, but such small-scale events are likely to be underreported where they do not coincide with the observation network.

Reports of private loss and damage on a local administrative unit scale (LAU 2 level) are used to explore the relationship between observed rainfall events and damages reportedly related to hydro-meteorological processes. With 480 Austrian municipalities located within our south-eastern Alpine study region, the damage data are available on a much smaller scale than the available rainfall data. Precipitation is recorded daily at 185 gauges and 52% of these stations additionally deliver sub-hourly rainfall information. To obtain physically plausible information, damage and rainfall data are grouped and analyzed on a catchment scale.

The data indicate that rainfall intensities are higher on days that coincide with a damage claim than on days for which no damage was reported. However, approximately one third of the damages related to hydro-meteorological hazards were claimed on days for which no rainfall was recorded at any gauge in the respective catchment. Our goal is to assess whether these events indicate potential extreme events missing in the observations.

Damage always is a consequence of an asset being exposed and susceptible to a hazardous process, and naturally, many factors influence whether an extreme rainfall event causes damage. We set up a statistical model to test whether the relationship between extreme rainfall events and damages is robust enough to estimate a potential underrepresentation of high intensity rainfall events in ungauged areas. Risk-relevant factors of socio-economic vulnerability, land cover, streamflow data, and weather type information are included to improve and sharpen the analysis.

Within this study, we first aim to identify which rainfall events are most damaging and which factors affect the damages - seen as a proxy for the vulnerability - related to summer convective rainfall extremes in different catchment types. Secondly, we aim to detect potentially unreported damaging rainfall events and estimate the likelihood of such cases.

We anticipate this damage perspective on summertime extreme convective precipitation to be beneficial for risk assessment, uncertainty management, and decision making with respect to weather and climate extremes on the regional-to-local level.