EGU24-3987, updated on 23 Jan 2025
https://doi.org/10.5194/egusphere-egu24-3987
EGU General Assembly 2024

Trends in torrential flooding in the Austrian Alps: Assessing different types of changes to a mountain hazard profile

Matthias Schlögl[1,2], Micha Heiser[2], Christian Scheidl[2], and Sven Fuchs[2]
[1]Department for Climate Impact Research, GeoSphere Austria, Vienna, Austria (matthias.schloegl@geosphere.at)
[2]Department of Civil Engineering and Natural Hazards, University of Natural Resources and Life Sciences, Vienna, Austria

The occurrence of natural hazard events is heavily affected by climatic drivers and triggers. Changes in these climatic drivers are likely to bring about potentially severe consequences for mountain communities due to shifts in natural hazard occurrence patterns and characteristics. Although there is a well-established scientific consensus regarding cause-and-effect relationships from a physical science standpoint, substantiating these connections can pose challenges for specific hazard processes when viewed through an empirical and data-driven lens (Schlögl et al., 2021).

The Sixth Assessment Report (IPCC, 2021) highlighted changes in intensity/magnitude, frequency, duration, timing and spatial extent of a wide range of climate hazards. Following this line we investigated trends in torrential flooding in the Austrian Alps. Torrential flooding comprises a set of natural hazard processes, which originate in small and steep mountain headwater catchments and are characterized by highly variable discharge and sediment transport volumes.

We used a comprehensive data set data of damage-inducing torrential flooding events as collected by the Austrian Torrent and Avalanche Control Service (WLV). Assuming inventory completeness after 1945 (Heiser et al., 2019), our trend analyses with respect to the core climate change characteristics based on nearly 80 years of event data (and more than 11,000 events) yielded the following results:

- Intensity/magnitude: Using deposition volume as a proxy for event magnitude, a statistically significant decrease over time was detectable. However, caution is warranted due to a potential under-reporting bias for smaller events in earlier years and changes in data recording procedures.
- Frequency: Event frequency exhibited a significant positive trend, with breakpoints evident in the cumulative number of events. Changes in documentation standards in 2005 and high overdispersion in the dataset contributed to challenges in interpreting trends.
- Duration: Lack of data on precise event onset and end impeded reliable assessment of changes in event duration.
- Timing (seasonality): Analysis of date information revealed a peak in event occurrence during summer, particularly in July and August. No significant shifts in seasonality were confirmed,

thereby challenging previous reports of changes in timing of maximum discharge or permafrost degradation.

- Spatial extent: Spatial extent analysis, based on deposition area, was limited to the period 2012-2022, hindering a reliable trend analysis. We acknowledged the lesser relevance of spatial extent for torrential flooding compared to changes in event magnitude.

Summarizing, reliably detecting generalizable trends in torrential flooding characteristics is challenged by issues such as incomplete data, data quality, and dynamically changing drivers. While issues related to documentation techniques can be addressed in future data collection efforts, dynamically changing drivers (including climate change, mitigation activities, exposure dynamics, and land use changes) pose ongoing challenges due to complex interactions and nonlinear effects. We underscore the importance of controlling for these effects when assessing trends in torrential flooding in a changing climate.

References

Heiser M., Hübl J. & Scheidl, C. (2019). Completeness analyses of the Austrian torrential event catalog. *Landslides* 16, 2115–2126 (2019). https://doi.org/10.1007/s10346-019-01218-3.

Schlögl M., Fuchs S., Scheidl C. & Heiser M. (2021). Trends in torrential flooding in the Austrian Alps: A combination of climate change, exposure dynamics, and mitigation measures. *Climate Risk Management* 32: 100294. https://doi.org/10.1016/j.crm.2021.100294.