Rainfall erosivity assessment in Austria

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Background

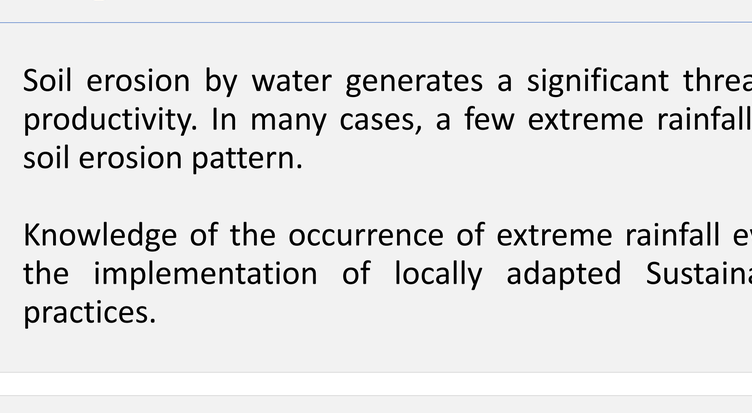
Soil erosion by water generates a significant threat to soil health and agricultural productivity. In many cases, a few extreme rainfall events dominate the long-term soil erosion pattern.

Knowledge of the occurrence of extreme rainfall events in space and time enables the implementation of locally adapted Sustainable Land Management (SLM) practices.

Objective

- Assessment of selected rainfall erosivity characteristics across Austrian agricultural production zones using long-term and high-resolution rainfall records.

Data and methods



Data

27 selected weather stations:

- Precipitation: 5 min. temporal resolution.
- Snow (cm): daily data.
- Temperature (°C): daily data.
- Data period: min. 27 and max. 78 years.

Fig. 1. Rainfall stations across Austria within dominant Agricultural Production Zones.
Alpenostrand: AOR, Alpenvorland: AVL, Kärntner Becken: KB, Nö. Flach- und Hugelland: NFH, Sö. Flach- und Hügelland: SFH, Voralpen: VA, Wald- und Mühlviertel: WM.

Methods

E*I30 each event
Kinetic energy (E)
Maximum 30-min intensity (I30)

Input
- Distinguish rain from snow
- Events selection:
Dry period 6h < 1.27 mm
- Erosive event > 10mm

R-Factor Calculation

$$R = \frac{1}{n}\sum_{j=1}^{n}\left[\sum_{k=1}^{m_j}(E)_k\ (I_{30})_K\right]_j$$

$$E = \sum_{r=1}^{m} e_r v_r$$

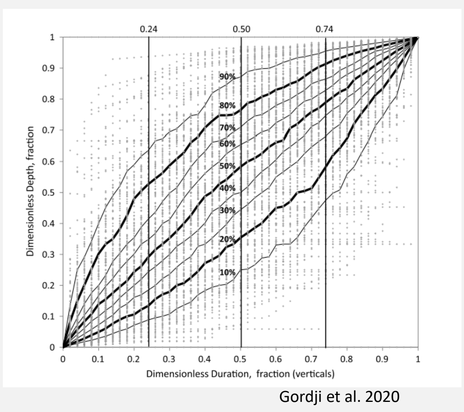
$$e_r = 0.28\left[1 - 0.52_{exp}\left(-0.042 i_r\right)\right]$$

Output
1. Rainfall erosivity (EI30)
2. Erosive event duration (h)
3. Rainfall amount (P mm)
4. Erosivity density (ED)
EI30)/P

K-means algorithm
1. Features
2. Standarizaition of features
3. Number of clusters

Input
1. Rainfall amount
2. Event duration and
3. Max. 30-min intensity

Huff curves (point-developed)
1. Events selection
2. Cumulative-Dimensionless depth and duration
3. Frequency distributions 10%, 50%, and 90% were used



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Results

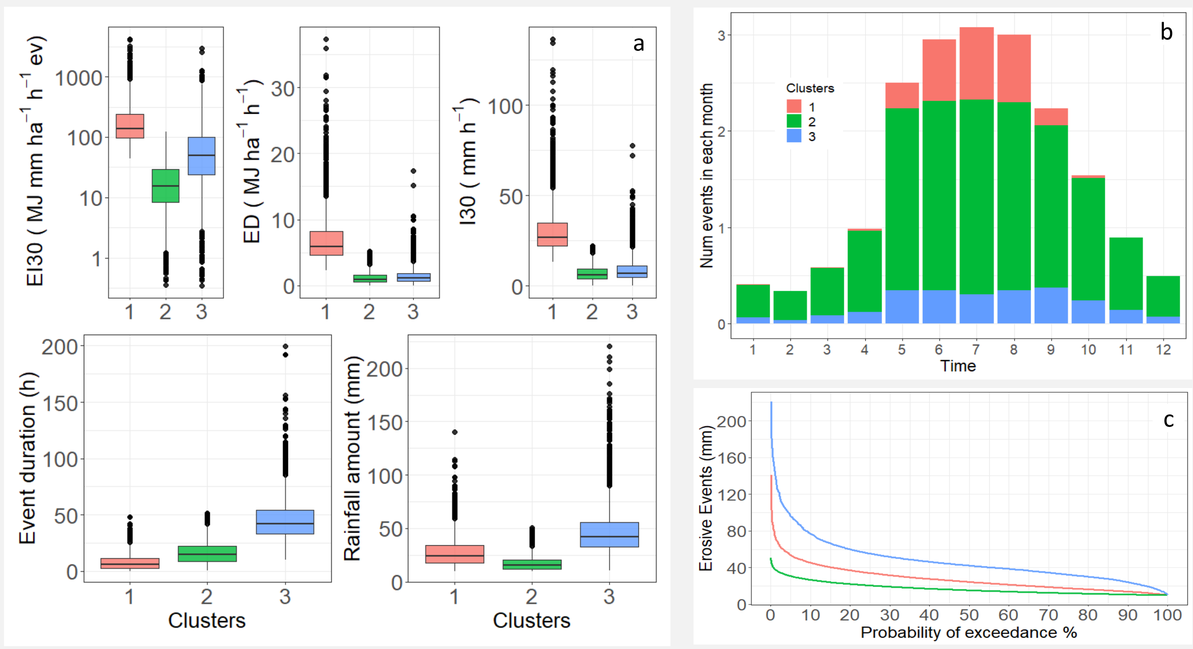

Fig. 2. a) EI_{30}, ED, and rainfall characteristics, b) Intra-annual distribution, and c) exceedance probability curves represented by three dominant clusters.

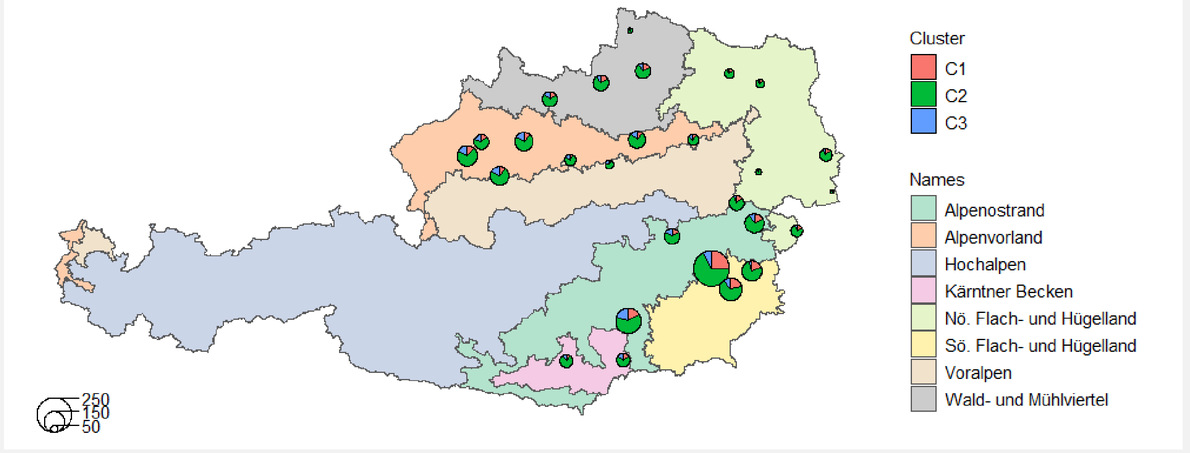

Fig. 3. Spatial distribution of erosive events within dominant Agricultural Production Zones.

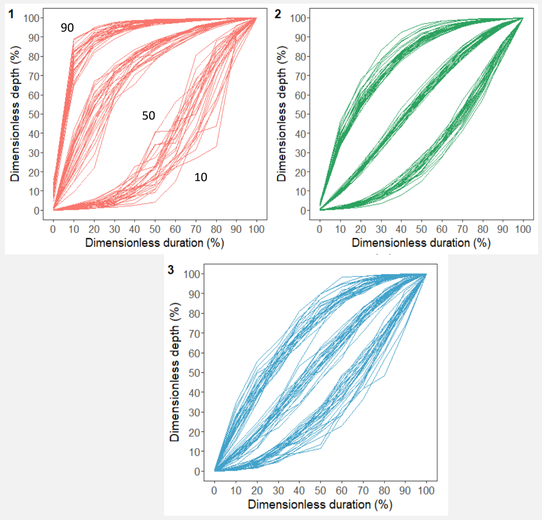

Fig. 4. Huff curves per cluster showing the temporal distribution within a storm.

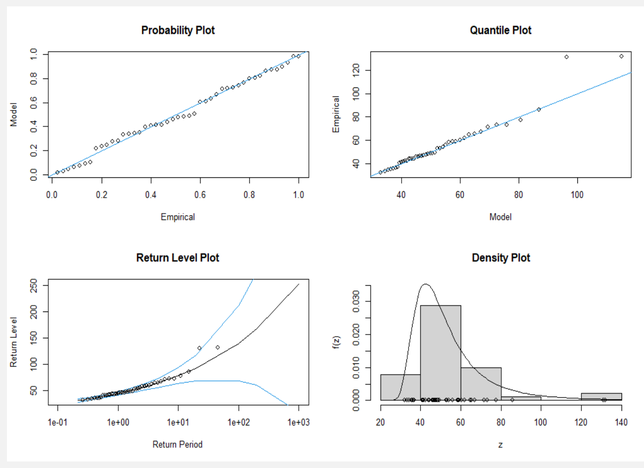

Fig. 5. Generalized Extreme Value (GEV) distribution applied for long-term rainfall records of Petzenkirchen, Lower Austria.

Conclusions

- Clustering of rainfall events, based on selected rainfall erosivity characteristics, identified three major erosive rainfall types (clusters) across Austria's main agricultural production zones.
- Temporal distribution analyses identified a predominant erosive event type (C1) that occurs during the summer months from June to August.
- Erosive rainfalls with the highest impact (higher intensity and short time duration, cluster 1) show a spatially pronounced occurrence in the southeastern pre-alpine areas.

Acknowledgments
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