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Comparison of rainfall generators with regionalisation for the estimation of rainfall erosivity at ungauged sites

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Supplement

S1 Shortcomings and lessons learned of the study

There are several shortcomings and lessons learned that should be mentioned in relation to this study. Firstly, it should be noted that the rainfall generators were not modified to achieve best results in terms of erosivity representation. So, although state-of-the-art rainfall generators are applied, there is potential room for their improvement to generate erosive events and thus in the representation of R. For example, the parameters of the ARM model could be optimised to better represent erosive events at the expense of replicating more general rainfall event statistics.

Secondly, a shortcoming of the applied method for the estimation of R is the dependency of the event duration on the resolution of the measurement devices, which has evolved in recent decades. With a higher measurement device resolution, smaller rainfall intensities are able to be measured, which leads to longer wet spells. This effects the results for R in two ways: i) the average intensity I of an event is lowered (due to the higher number of smaller intensities), and ii) the dry period of 6 h to ensure the independency of two erosive events is ‘interrupted’ by single time steps with small rainfall intensities, so that two events are treated as one. So, in case ii) the average intensity I is again artificially lowered. A detailed analysis was carried out for the rainfall time series generated by the Disagg model by simply replacing time steps with rainfall amounts smaller than the indicated threshold by dry time steps. In Fig. S1 the impact of the applied measurement resolution on rainfall characteristics is shown. As discussed, a coarser measurement resolution leads to shorter event durations and smaller event volumes. The total number and volume of erosive events per year decreased with decreasing measurement resolution. R as a summarising variable also decreased with increasing measurement resolution, even if only rainfall intensities <0.02 mm, which are considered non-erosive, are removed. It is assumed that simple modifications to avoid too small rainfall intensities (see for example Müller-Thomy, 2020) by keeping the overall rainfall amount will improve the erosivity factor for the Disagg method.

That R is sensitive to the resolution of its contributing factors has been shown before for the temporal resolution. Resulting R values differ in dependence if time series with Δt=5 min, 10 min, 15 min, 30 min or 1 h are used for their estimation (e.g., Weiss, 1964; Agnese et al., 2006; Yin et al., 2007). This was not analysed in this study but should be considered for consistent R estimations if different temporal resolutions are used within one study.

Thirdly, it can be assumed that the temporal distribution of the rainfall event has an impact on the erosion process (e.g., if I30 takes place at the start or end of an erosive event), which is not considered with the current statistics. From a physical interpretation, light rainfall (filling up the soil storage) followed by heavy rainfall (I30) should be more critical from the erosion perspective than vice versa. However, this is one of the many limitations related to the USLE and RUSLE methodology (e.g., Alewell et al., 2019).

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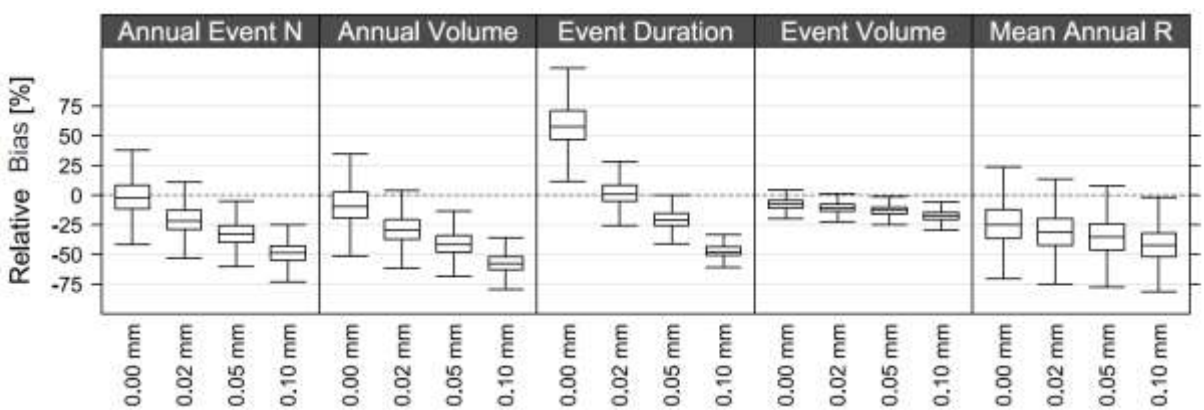

Figure S1: Sensitivity of erosive event characteristics and R to measuring resolution. Thresholds on the x-axis were used to replace smaller rainfall amounts by 0 mm for each 5 min time step before estimating erosive event characteristics. Outliers were excluded due to image clarity. Results are based on all 5min stations in the study area.