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Evaluating rainfall kinetic energy - intensity relationships with observed disdrometric data

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Rainfall kinetic energy is required for determining erosivity, the ability of rainfall to detach soil particles and initiate erosion. Its determination relay on the use of disdrometers, i.e. devices capable of measuring the drop size distribution and velocity of falling raindrops. In the absence of such devices, rainfall kinetic energy is usually estimated with empirical expressions relating rainfall energy and intensity. We evaluated the performance of 14 rainfall energy equations in estimating one-minute rainfall energy and event total energy, in comparison with observed data from 821 rainfall episodes (more than 100 thousand one-minute observations) by means of an optical disdrometer. In addition, two sources of bias when using such relationships were evaluated: i) the influence of using theoretical terminal raindrop fall velocities instead of measured values; and ii) the influence of time aggregation (rainfall intensity data every 5-, 10-, 15-, 30-, and 60-minutes). Empirical relationships did a relatively good job when complete events were considered ($R2 > 0.82$), but offered poorer results for within-event (one-minute resolution) variation. Also, systematic biases where large for many equations. When raindrop size distribution was known, estimating the terminal fall velocities by empirical laws produced good results even at fine time resolution. The influence of time aggregation was very high in the estimated kinetic energy, although linear scaling may allow empirical correction. This results stress the importance of considering all these effects when rainfall energy needs to be estimated from more standard precipitation records. , and recommends the use of disdrometer data to locally determine rainfall kinetic energy.