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# Rain rate and its temporal profile: a neglected aspect of rain beahviour.

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One of the criteria generally accepted for meaningful rainfall simulation is a suitably close mimicking of real rain. Most attention has been paid to drop size and drop energy characteristics, and less to the temporal structure of rain events. This reflects a concern with the erosivity of rain in soil erosion research. However, the transport of eroded soils relies largely on overland flow, whose behaviour is more closely related to the temporal profile of rain rate than to drop size or energy. The Huff profile of a rain event can be immensely variable, exhibiting perhaps early or late peaks in rain rate, and often, intermittency manifested as short rainless interludes. Mean rain rates through the whole profile of a rain event are typically low, often 1-3 mm/h, but short bursts of rain may be 1-2 orders of magnitude more intense. Dunkerley (2008, Hydrological Processes 22, 4415-4435) showed that the mean rain rate adopted in 49 rainfall simulation studies was 103 mm/h, with generally constant rain rate over periods of 1 hour or more. In contrast, he reported that 26 studies with substantial records of natural rainfall showed an event mean rain rate of just 3.47 mm/h, and even studies of cyclonic and typhoon rains reported an event mean of 86.3 mm/h. In a minority of studies, the rain rates are designed to correspond with nominated return periods, but rain rate may still be held constant and event duration prolonged arbitrarily. The bulk of rainfall simulation studies have thus failed to capture the temporal properties of rain events, and consequently, we know too little about the hydrologic and erosional significance of rain event profiles. Limited research has shown that temporally varying rain rate profiles are important to hydrology and erosion through mechanisms such as the filling and partial emptying (by infiltration and surface drainage) of ephemeral surface ponds. A decline in rain rate or a cessation of rain permits ponds to become shallower or to empty completely, and may temporarily interrupt the continuity of downslope flows. A delay in the recommencement of integrated flow then follows when rain rate rises. In parallel, changes in the depth of water detained at the soil surface modifies the intensity of drop splash, which is the key grain dislodgment mechanism. The authors of published rainfall simulation studies should seek to offer a reasoned basis for the selection of rain rate and temporal event profile. The use of high intensities and prolonged durations, often adopted to ensure that runoff and erosion become measurable, need particularly careful justification in the context of the local or regional rainfall climate that the rainfall simulation is intended to mimic.