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Hydrology and Earth System Sciences
Discussions

Interactive comment on "How rainfall event characteristics affect the applicability of I_{30} as an index of intense or erosive rainfall: a brief review with proposed new rainfall index" *by* David L. Dunkerley et al.

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I acknowledge the comments of Anonymous Referee #5.

The referee suggests that I and others are working under a 'misconception' about I30 and that '... some people have misinterpreted the function of the I30 index and have MISUSED the I30 because of that' [capitalisation is from Referee #5].

I would argue that on the contrary, the many published works that employ I30 as a stand-alone index of rainfall intensity do so in an entirely valid way. There is no 'mis-

conception' involved, and the comments by Referee #5 appear to me to be entirely unjustified. The use of I30 as a stand-alone intensity index is a well-established and perfectly valid approach to the analysis and description of intense or erosive rainfall. In any case, the literature itself stands in clear disagreement with the argument advanced by Referee #5. Multiple published studies that employ I30 have nothing whatsoever to do with soil erosion nor any connection with the original work of Wischmeier and Smith more than 60 years ago. This does not suggest that these works misuse I30, despite the comments of Referee #5, but rather that research has devised other ways of parameterising rainfall. The literature demonstrates the adoption of many related indexes of intense or erosive rainfall, including I5, I10, I15, and I45, and I would argue that the use of any or all such indices is entirely valid, and indeed, necessary as research problems and their particular contexts raise the need to find an appropriate index with which to describe the role of rainfall in the mechanisms of diverse landsurface processes.

I consequently think that the Anonymous Referee #5 misses the point that in areas beyond the application of the USLE (upon which the referee focusses, to the complete exclusion of other areas that are mentioned in my paper) indexes like I30 are indeed widely-adopted as a means to describe and parameterise intense rainfall (not only erosive rainfall). This usage is demonstrably well-accepted and established in the scientific literature. The need for, and application of, such indices in diverse fields of application was reflected in the carefully-chosen title of my paper ('intense or erosive rainfall'). This is the case in various hydrologic studies, including those in urban environments. Some further examples are cited here, among many more that could be listed, to illustrate and to emphasise the established use of I30 in the published literature. Referee #5 evidently considers all of this work to be based on a misconception and a 'misuse of the I30'. I disagree. Freebairn et al. (2009) used both I30 and P10 as variables in regression models seeking to understand the relationship between rainfall and runoff in cereal cropping lands in Queensland, Australia. Moody & Martin (2001) linked I30 to the unit-area peak stream discharge in several study areas in the USA. Murphy et al. (2015) used I30 as a rainfall index in seeking to account for geochemical

responses of burned areas in Colorado, USA. Petrucci et al. (2012) used I30 as an index to characterise storm rainfall in an investigation of the behaviour of urban rainwater storage systems near Paris. Terranova and Gariano (2014) used I30 as a rainfall index in a study of flash-flooding in Calabria. Brodie & Egodawatta (2011) employed I30 as an index of rainfall in a study of washoff from an urban road surface. Indeed, Brodie & Egodawatta (2011) make informative comments on the possibility that in the context of washoff processes on impervious urban surfaces, fixed time periods such as 30 minutes may offer less explanatory power than measures that vary with the length of rainfall during an event that exceeds a threshold intensity. They observed that with widely-varying storm durations, the use of a fixed time period such as 30 minutes did not lead to consistently good correlations with the load of fine particulates washed from their 75 m study section of bitumen roadway. Dozens of papers could equally be cited that have explored the utility of other rainfall indexes such as I5 and I10, in application to a wide range of landsurface processes and across a range of spatial scales and storm durations. Kean et al. (2016) for instance employ I5 in an analysis of the generation of post-fire debris flows. Additional illustrative papers are cited in Dunkerley (2019).

It is important to reiterate that in none of these studies was the EI30 (USLE) parameter used, but rather I30 as a stand-alone index of rainfall; many of the studies are completely unrelated to soil erosion, and rather deal with aspects of hydrology, flash-flooding, or mass movement. However, although many indexes of intense or erosive rainfall are available and have found application to landsurface processes, that circumstance in no way suggests that the exploration of alternative indexes is based on a 'misconception' or is a 'misuse of the I30'. Rather, I would argue that such exploration, in an attempt to devise parameters to describe rainfall, remains a necessary and important endeavour. In this context, we should bear in mind the need to find suitable measures of rainfall (and especially of extremes in rainfall) for application in studies of the changing character of rainfall under a warming climate with an invigorated hydrologic cycle. The large and rapidly-growing body of literature exploring possible measures

of rainfall extremes (frequently based on upper percentiles such as the 95th or 99th percentiles of some measure of rainfall amount or intensity) for just such application clearly demonstrate this, involving many indices that can be employed using daily rainfall amounts, or hourly amounts, or indeed rainfalls over periods of just minutes, when sufficiently high-resolution data are available. The literature clearly demonstrates that there is no single index which can capture all of the characteristics of a phenomenon as complex as rainfall. There remains a considerable challenge in finding suitable indexes whose application to the study of one or another landsurface process offers a process-based understanding and useful explanatory power.

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