Comment:

The authors rightly take the EI_{30} measure as the reference given its wide-spread use. However, they fail to discuss properly the kinetic energy component of this indicator, and the issues of measuring/estimating it. The kinetic energy of rainfall can be measured (e.g. with disdrometers), but given the non-availability of such measurements for most stations, mostly it is estimated based on empirical equations. The authors simply present equation (2) but fail to give a rationale for it. Other studies exist that compare various existing empirical relationships (e.g. van Dijk et al, 2002, Journal of Hydrology 261, 1-23 and see also Salles et al. 2002, Journal of Hydrology 257, 256-270), and should at least be discussed here.

Response:

Kinetic energy (KE) is generally suggested to indicate the ability of a raindrop to detach soil particles from a soil mass. It can be expressed as volume-specific (KE_{mm}) and time-specific (KE_{time}). KE_{mm} (MJ m^{-2} mm^{-1}) is the amount of KE per unit area generated by a unit volume of rain, and KE_{time} (MJ m^{-2} hr^{-1}) is that generated in a unit of time. KE_{time} can be converted to the more commonly used KE_{mm} by dividing by an instant intensity (Kinnell, 1981). Since the direct measurement of KE requires sophisticated and costly instruments, many different estimating methods have been developed that incorporate rainfall intensity (I) using logarithmic, exponential, or power law KE-I relationships.

McGregor et al. (1995) compared the KE equations used in the USLE and RUSLE, and noted that, for intensities between 1 and 35 mm hr^{-1}, the results from the RUSLE were about 12% less than those predicted by USLE. Both the USLE and RUSLE were compared with the results of the equation of McGregor and Mutchler (1976), which was developed based on 29 standard recording rain gauges in the Goodwin Creek Watershed in northern Mississippi, USA. The results showed that the annual erosivities predicted by the equation of McGregor and Mutchler (1976) and the USLE were almost identical, whereas the RUSLE predicted values that were about 8% lower. Further, since the rate of increase in instant rainfall intensity was small, McGregor et al. (1995) suggested that the equation of Brown and Foster (1987) be modified, changing the rate of increase in instant rainfall intensity to 0.082 rather than 0.05. Foster (2004) used the 0.082 value in the RUSLE2.

After reviewing more than 20 exponential KE_{mm}-I relationships based on natural rainfall data observed in a variety of climate classifications, van Dijk et al. (2002) derived a general predictive equation, which was as follows:

$$e_r = 0.283[1 - 0.52\exp(-0.042 i_r)] \qquad (1)$$

Salles et al. (2002) suggested that a power law KE_{time}-I expression was the most appropriate and that the constants of the power law were related to rain type, geographical location, and measurement technique. A range of values for the stratiform rain (Salles S). Equation 2a and Equation 2b suggested by Salles et al. (2002) respectively for convective rain and stratiform rain using power law form:

$$e_r = 13.5092 i_r^{0.2} \qquad (2a)$$

$$e_r = 9.1878 i_r^{0.3} \qquad (2b)$$

It is, however, usually difficult to define if a storm should be classified as convective or stratiform based on the breakpoint data alone.

Six different kinetic energy-intensity (KE-I) formulas were evaluated including equations recommended for the Universal Soil Loss Equation (USLE), Revised USLE (RUSLE), the second version of RUSLE (RUSLE2), van Dijk and Salles et al. (including Salles C and Salles S) using one-minute rainfall data from 18 stations. When R factor values calculated based on the other five KE-I relationships were compared with RUSLE2, the results of USLE, van Dijk and Salles S were very similar to that of RUSLE2, with the average deviations of 0.4%, -2.6% and 2.4% respectively, whereas the deviations of RUSLE and Salles C were -9.3% and 9.9% respectively (Table 1).

Table 1 Comparison of R factor values by USLE, RUSLE, van Dijk, Salles C and Salles S with that by RUSLE2

Station name	R factor (MJ mm hm^{-2} hr^{-1} yr^{-1})	Deviation of R factor (%)				
	RUSLE2	USLE	RUSLE	van Dijk	Salles C	Salles S
Neijiang	1368.7	0.4	-9.5	-2.6	9.2	1.0
Tonghe	1632.5	0.1	-9.2	-2.8	9.7	2.5
Wuzhai	781.9	2.6	-10.6	-0.8	10.8	-0.3
Yangcheng	1503.3	0.9	-9.8	-2.1	9.5	0.4
Suide	992.8	1.1	-10.0	-2.0	10.6	2.0
Yan’an	1233.7	1.2	-9.2	-1.6	11.2	3.4
Guanxiangtai	3188.1	-1.6	-7.9	-4.3	9.6	6.1
Miyun	3575.0	-1.8	-7.8	-4.5	9.3	6.0
Chengdu	3977.0	-0.7	-8.9	-3.7	9.1	3.0
Xichang	3021.0	2.0	-10.2	-1.3	10.3	0.0
Suining	4091.3	-0.8	-8.5	-3.6	8.9	3.1
Neijiang	5097.9	-1.1	-8.3	-3.8	9.0	3.9
Fangxian	2298.4	1.1	-8.5	-1.4	11.5	4.3
Huangshi	6049.4	0.1	-9.2	-3.1	9.8	3.0
Tengchong	3648.9	2.3	-10.9	-1.1	10.4	-0.9
Kunming	3479.0	0.4	-9.7	-2.7	9.4	1.2
Fuzhou	5871.1	0.9	-9.4	-1.8	11.0	3.0
Changting	8258.5	0.0	-9.1	-2.9	9.6	2.6
Avg.	2871.2	0.4	-9.3	-2.6	9.9	2.4

References:

Brown, L.C., Foster, G.R. (1987). Storm erosivity using idealized intensity distributions. Trans. ASABE., 30(2), 379–386.

Foster, G. R.: User’s Reference Guide: Revised Universal Soil Loss Equation (RUSLE2). U.S. Department of Agriculture, Agricultural Research Service, Washington D.C., 2004.

Kinnell, P.I.A. (1981). Rainfall intensity-kinetic energy relationships for soil loss prediction. Soil Sci. Soc. Am., 45(1), 153–155.

McGregor, K.C., Bingner, R.L., Bowie, A.J., Foster, G.R. (1995). Erosivity index values for northern Mississippi. Trans. ASABE., 38(4), 1039–1047.

McGregor, K.C., Mutchler, C.K. (1976). Status of the R factor in north Mississippi, in: Soil erosion:

prediction and control. Soil and Water Conservation Society, Ankeny, IA, pp.135–142.
Salles, C., Poesen, J., Sempere-Torres, D. (2002). Kinetic energy of rain and its functional relationship with intensity. J. Hydrol., 257, 256–270.
Van Dijk, A.I.J.M., Bruijnzeel, L.A., Rosewell, C.J. (2002). Rainfall intensity-kinetic energy relationships: a critical literature appraisal. J. Hydrol., 261, 1–23.