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Hydrology and Earth System Sciences Discussions

Interactive comment on "Interrill erosion, runoff and sediment size distribution as affected by slope steepness and antecedent moisture content" *by* M. B. Defersha et al.

Anonymous Referee #2

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General comments:

This is an interesting paper on the effects of antecedent moisture conditions and slope on soil erosion, splash and runoff rates, especially since there is very little research on soil erosion for soils from this area. The research is of good and the data is interesting but the paper suffers from a lack of detail about the methods and experiments. In addition, some of the results are overstated. The results of the 45% slope experiments are sometimes interpreted as the effects of slopes larger than 25%, even though the results are for only one slope larger than 25%. To show the effects of slopes larger

than 25%, more experiments should have been done (e.g. also at 30, 40, and 60% slopes). It would be better to state that the results for the 45% slope experiments are different or show a different trend and to describe how they are different rather than saying that there is a different trend for slopes larger than 25%. Some of the tables should be combined to one larger table and the text should be improved. I suggest that the authors proof-read the paper in more detail or have it proof-read by a native English speaker.

Specific major comments:

I) P6454L1-6: Give more information on the rainfall simulator. How was the rainfall intensity determined? How variable was the rainfall intensity? Do you have any information on the spatial distribution of the rainfall? Do you have any information on the raindrop kinetic energy?

II) P6454L16: More information is needed on the preparation of the soil. How was a similar bulk density or soil porosity ensured for the different experiments? How was the soil surface leveled?

III) P6461L1-2: The variation in the amount of rainfall intercepted by the different slopes is not negligible and should thus be taken into account!! A slope of 9% intercepts 99% of the water compared to a flat surface. A slope of 25% only 91%, and most importantly a slope of 45% only 71%. Thus there is an almost 30% difference in the amount of water intercepted by the low slope experiments and the high slope experiments. This is not a negligible amount! The numbers presented in this section should be interpreted based on the different amounts of intercepted water, e.g. a large part of the runoff reduction from 51 to 37 mm/hr on P6462L3-5 or the change in runoff on P6463l2 could be explained by the smaller capture area of the larger slope. It is important to give the runoff ratios as well as the runoff amounts.

IV) Be careful how the results are presented and discussed. In order not to overstate the results, the results of the 45% slope experiments should not be interpreted as the

results for all slopes larger than 25% and the change for the 45% slope should not be interpreted as the change that occurs after a 25% slope threshold has been reached. Carefully reread all results sections and rewrite to avoid overstating the results (see general comments as well).

V) P6467 – section 3.4: Calculate the enrichment factors or present the size fractions as ratios (fraction of the eroded or splashed sediment/fraction in the original soil). That way it is a lot easier to understand what these numbers mean and whether splash or erosion was enriched or depleted in certain size fractions. Some of the literature that shows that the eroded sediment is enriched in smaller particles should be referenced as well.

Other specific comments:

1) P6449L21-22: Deposition happens continuously during the erosion process even if the transport capacity is not exceeded. Subsequent re-detachment continues to move the soil particles (see for example the description of the soil erosion process in the Hairsine and Rose model). Rewrite this section so that it is clearer that deposition and re-detachment both occur during the erosion process.

2) P6450L17-18: Theta, b, c, and a are not in equation 2. Move the description of these parameters to the place where they are used (P6451).

3) P6451L5: Intensity and slope are already included in I, p, S, and q so theoretically Kc should not depend on rainfall intensity or slope. Fix or explain why it does and give references.

4) P6452L21: Give reference

5) P6453L18: Describe how variable the rainfall is. How much more rainfall falls in these 6 months?

6) P6454L14: How long? Several years or several decades?

7) P6455L14: So the soil was near saturated? This is different from what previous papers have termed 'prewetted' (eg. Francis and Cruse, 1983 and Benjamin and Cruse, 1983). Explicitly mention this difference.

8) P6455L17: Explicitly mention how many experiments were done.

9) P6455L17-21: Reword this section. It is not clear as the entire sequence is already given on L19.

10) P6455L24: Sometimes erosion rates decrease a lot with additional rainfall. The peak sediment concentrations occur early during an event, while later in an event much lower 'steady state' concentrations are measured. Reword this sentence. Also, it would add to the paper if you would show a graph with sediment concentrations as a function of time throughout a 'storm' sequence. After all, you collected 5-min data but only show and discuss totals.

11) P6456L14: Explain which equation was used

12) P6557l3/section 2.2.9: This section should be significantly shortened given that these models are already described on p6450-6452. References could be made to the equations on those pages rather than discussing them again.

13) P6557l5: How were these models fitted to the data? Maximum R2, minimum sum of squared errors?

14) P6459L10: The organic matter content should already be given in the description of the soils on P6454.

15) P6461L1-10: Better explain why the depths of ponding would be so different for the different experiments. Is this in part related to the soil surface preparation or did the depth change the way you would expect it to change (based on the runoff, slope, similar roughness)? Did different experiments have a different surface roughness? Did rills develop?

16) P6461L4: Insert reference (e.g., Proffitt, A.P.B., Rose, C.W., Hairsine, P.B., 1991. Rainfall detachment and deposition: experiments with low slopes and significant water depths. Soil Sci. Soc. Am. J. 55, 325–332).

17) P6464L28: Explain why flow depth is unlikely to cause this

18) P6464l29: Calculate the streampower to show this. You have all data to calculate it.

19) P6468l1-8: Insert references to previous studies that have shown that eroded soil is enriched in smaller particles and depleted in larger particles.

20) P6470l16: K values did not vary that much with slope steepness, except for Model IV for soil A with dry conditions

21) P6471l1: Be specific. Give the model numbers here (models III and V).

22) Table 1: Give the particle size boundaries as well

23) Table 3 and 5: Explain what 'SEM' and 'LSD' stand for. Also check that the numbers have the appropriate number of decimals/significant figures.

24) Merge table 2, 4, and 6 into one larger table.

25) Merge table 5 and 7 into one larger table

26) Table 8 and 9: It would be more useful to give the enrichment ratios (fraction in size class in splash or wash divided by the fraction in the original soil) or at least to give this in parentheses after the actual numbers. Also check the number of appropriate significant figures.

27) Figure 1: Redraw this figure with a more intuitive set of line colors and line types (e.g. all experiments with wet soils in solid lines and all experiments with dry soils in dashed lines and the three slopes in different colors or with different symbols).

Editorial suggestions:

Note that these are some of the suggestions to improve the readability of the paper. I recommend having the paper proof-read by a native English speaker.

*) P6448L5: replace 'The' by 'This'

*) P6448L9: insert 'rainfall with a' after 'simulated'

*) P6449L6: insert 'the' after 'defined as'

*) P6449L10: insert 'on' before 'steep' and replace 'have' by 'has'

*) P6449L12: remove 'an'

*) P6449L13: replace 'and in turn, it needs' by 'This in turn requires' (otherwise the sentence is too long which makes it hard to read).

*) P6449L26: replace 'an area' by 'areas'

*) P6449L28: replace 'affects' by 'affect the'

*) P6450L5: replace 'varies' by 'vary'

*) P6450L6: insert 'rainfall' before 'intensity'

*) P6450L8: replace 'rain' by 'rainfall'

*) P6450L9: replace 'mostly' by 'can be'

*) P6451L4: replace 'P' by 'p'

*) P6451L5: replace 'intensity' by 'rainfall intensity'

*) P6451L7: replace 'model' by 'models'

*) P6451L14: remove 'also'

*) P6451L18: insert 'the' before 'interrill'

*) P6452L2: replace 'zero. . .cent' by '0-30%'

*) P6452L7: replace ‘assumed’ by ‘assume’

*) P6452L9: replace ‘relationship’ by ‘relationships’

*) P6452L10: replace ‘is’ by ‘are’

*) P6452L23: insert ‘an’ before ‘increase’ (twice).

*) P6452L26: replace ‘measures’ by ‘measure’

*) P6453L1: insert ‘is’ before ‘less’

*) P6453L5: replace ‘following...proposed’ by ‘objectives of this work are’

*) P6453L7: replace ‘using’ by ‘for’, insert ‘the’ before ‘Lake’, and replace ‘(1)’ by ‘(2) to’

*) P6453L10: replace ‘(2)’ by ‘(3)’

*) P6453L11: insert ‘(4) to’ before ‘determining’

*) P6453L17: replace ‘its’ by ‘an’

*) P6453L21: replace ‘This. . .was’ by ‘These experiments were’

*) P6453L25: remove ‘made’

*) P6454L1: insert ‘the’ before ‘FEL’

*) P6454L22: replace ‘effect on’ by ‘an effect on the’

*) P6454L25: replace ‘Eventhuogh’ by ‘Even though’

*) P6455L1: insert ‘the’ before ‘pan’, ‘an’ before ‘effect’ and replace ‘concentration (volume)’ by ‘the volume’

*) P6455L2: replace ‘has’ by ‘have an’

*) P6455L4: remove ‘test area of this’

*) P6455L5: replace ‘with’ by ‘and’ and ‘depth’ by ‘deep’

*) P6455L6: replace ‘is’ by ‘was’

*) P6455L8: replace ‘Drainage’ by ‘a drainage’

*) P6455L9: replace ‘compartments were’ by ‘compartment’

*) P6455L11-12: move this sentence to P6454L10

*) P6456L1: replace ‘within’ by ‘at’

*) P6456L9: replace ‘allowing’ by ‘different’

*) P6456L23: replace ‘Using. . ..the’ by ‘The’

*) P6457L9: insert ‘a’ before ‘rainfall’

*) P6457L16: replace ‘assumed. . .2’ by ‘is assumed to be equal to 2 by various researchers’

*) P6457L19: replace ‘In this study’ by ‘For model II’

*) P6458L1: replace ‘two’ by ‘II’ and ‘that’ by ‘of the’

*) P6458L2: insert ‘The’ before ‘Sf’ and ‘was’ after ‘that’

*) P6458L3: remove ‘and. . ..as’

*) P6458L13: insert ‘the’ before ‘slope’

*) P6458L14: remove ‘which. . .above’

*) P6458L19: replace ‘a’ by ‘the’

*) P6458L20: replace ‘important particles’ by ‘large fractions’ or something similar

*) P6458L24: replace ‘a’ by ‘the’

*) P6459L1: replace ‘a’ by ‘the’

*) P6459L3: remove ‘amount of’

*) P6459L4: replace ‘values between’ by ‘from’ and ‘were’ by ‘was’

*) P6459L5: replace ‘varied’ by ‘different’

*) P6459L7-8: rewrite this sentence. ‘increase strength rapidly with time’ is not very clear.

*) P6459L12: replace ‘better’ by ‘a stronger’

*) P6459L20: replace ‘indicate’ by ‘indicates’

*) P6459L22: replace ‘types’ by ‘type’

*) P6459L26: round numbers so that they have an appropriate number of significant figures/the same number of decimals as the other numbers given here.

*) P6459L28: replace ‘had’ by ‘have’

*) P6460L2: insert ‘rapid’ before ‘aggregate’ and remove ‘rapidly’

*) P6460L7: replace ‘at each level of’ by ‘and’

*) P6460L8: remove ‘the’

*) P6460L9: remove ‘were’

*) P6460L12: remove ‘steeper’ and replace ‘steepness greater’ by ‘steeper’

*) P6460L17-20: remove this sentence. It is double.

*) P6460L21: replace ‘decreasing’ by ‘decrease’

*) P6460L27: replace ‘Different’ by ‘A difference’

*) P6461L2-6: replace ‘pounding’ by ‘ponding’

*) P6461L6: remove the first ‘less’

*) P6461L19: replace ‘reduce’ by ‘reduces’

*) P6461L21: remove ‘than the others’

*) P6461L22: replace ‘of high sealing’ by ‘a surface seal’

*) P6461L24: insert ‘for’ after ‘strength’

*) P6461L26: remove ‘was’ and replace ‘containing’ by ‘having a’ and replace ‘particle’ by ‘fraction’

*) P6462L17: insert ‘likely’ before ‘due’

*) P6462l22: replace ‘within the levels’ by ‘as a function of’

*) P6462l1-5 and l26-30: merge these sections as they have the same information.

*) P6463l9: remove ‘at the probability levels of’ and put ‘p<00001’ in parentheses

*) P6463l15: remove ‘amount of’ and insert ‘yield’ after ‘sediment’

*) P6463l16: remove ‘however. . ...0.57Kgm-2hr-1’

*) P6463l18: replace ‘highly’ by ‘more’

*) P6463l19: insert ‘the’ before ‘combined’

*) P6463l21: remove ‘was’ and place ‘varied’ before ‘significantly’

*) P6463l28: remove ‘the’

*) P6464l1: replace ‘were’ by ‘was’, ‘from’ by ‘for’ and ‘than’ by ‘compared to’

*) P6464l9: insert ‘a’ before ‘lower’

*) P6464l10: replace ‘Even’ by ‘Even though’

*) P6464l11: replace ‘works indicated’ by ‘studies found’

*) P6464l22: replace ‘For. . .yield’ by ‘but’

*) P6464l27: remove ‘availability of’

*) P6464l28: replace ‘may. . .probable’ by ‘unlikely the main’

*) P6465L4: replace ‘high’ by ‘more’

*) P6465L16: insert ‘likely’ after ‘was’

*) P6465L18: insert ‘likely’ after ‘was’ and replace ‘low’ by ‘lower’

*) P6465L20: insert ‘likely’ after ‘were’

*) P6465L23: replace ‘less’ by ‘lower’

*) P6466l2: replace ‘slight’ by ‘slightly’ and ‘decrease’ by ‘decreased’

*) P6466l3: remove ‘was’

*) P6466l5: replace ‘increase’ by ‘increased’

*) P6466l7: remove parentheses.

*) P6466l11: move ‘mean’ after ‘necessarily’

*) P6466l15: insert ‘a’ before ‘better’

*) P6466l23: move ‘in. . ...detachment’ to P6466l22 before ‘When’

*) P6466l26: replace ‘different’ by ‘difference’

*) P6467l2: insert ‘, the’ before ‘highest’

*) P6467l6: replace ‘basic’ by ‘dominant’

*) P6467l14: replace ‘sediments’ by ‘sediment’ and remove ‘were numerically’

*) P6467l15: remove ‘average size’

*) P6467l16: remove ‘enclosed’

*) P6467l24: replace ‘has somewhat relations with’ by ‘is related to’

*) P6467l25 and l2: replace ‘highly enriched’ by ‘high’

*) P6467l27: replace ‘deficient with’ by ‘low in’

*) P6468l4 and l6: remove ‘highly’

*) P6468l5 and l7: replace ‘deficient’ by ‘low’

*) P6468l10: replace ‘at’ by ‘on’ and remove parentheses

*) P6468l11: replace ‘from’ by ‘in’

*) P6468l14: remove ‘were’

*) P6468l15: replace ‘varied’ by ‘different’

*) P6468l19: replace ‘capability’ by ‘validity’

*) P6468l20: replace ‘combinations’ by ‘combination’

*) P6468l21: insert ‘exponent’ before ‘b’, remove ‘was’ and replace ‘between’ by ‘for

*) P6459l7: replace ‘to be’ by ‘was’

*) P6459l13: insert ‘The’ before ‘Effect’

*) P646l15: remove ‘at. . ..however’ and insert ‘, except for the 25% slope’ after ‘treatments on P6456l16.

*) P6469l16: replace ‘Similarly for’ by ‘For’

*) P6469l22: insert ‘also’ before ‘determined’

*) P6469l24: remove the sentence ‘At. . ..contents’

*) P6469l30: insert that this is for ‘soil B’

*) P6470l10: replace ‘q’ by ‘Q’

*) P6470l12L: insert ‘the’ before ‘same’

*) P6470l13: replace ‘Model V’ by ‘Model IV’? replace ‘prove’ by ‘proofs’ and ‘means’ by ‘for’

*) P6470l15: remove ‘were’

*) P6470l18-19: replace ‘are. . ...slope’ by ‘fitted data for the 45% slope well’

*) P6470l24: remove ‘were’

*) P6471l4: replace ‘least’ by ‘lowest’

*) P6471l5: insert ‘an’ before ‘increase’

*) P6471l7: insert ‘the’ before ‘variation’

*) P6471l8: replace ‘almost for’ by ‘For’

*) P6471l12-13: rewrite this sentence. It is not clear and not a good enough introduction for the conclusion section of this research.

*) P6471l15 and l16: replace ‘high’ by ‘higher’

*) P6471l15: replace ‘low’ by ‘lower’ and insert ‘The’ before ‘Effect’

*) P6471l18: put ‘more than 33%’ in parentheses.

*) P6471l21: insert ‘may’ before ‘not’ and remove ‘that’

*) P6471l23: replace ‘contents’ by ‘content’

*) P6472l1: insert ‘the’ before ‘runoff rate’ and replace ‘works have’ by ‘has’

*) P6472l3-5: rewrite this sentence

*) P6472l10: replace ‘the’ by ‘this’ and put ‘more than 25%’ in parentheses

*) P6472l12: replace ‘past experiences’ by ‘previous studies’

*) P6472l16: put parenthesis before ‘1975’ rather than before ‘Foster’

*) P6472l17: insert ‘only’ before ‘detachment’

*) P6472l20: replace ‘transporting’ by ‘transport’ and insert ‘The’ before ‘magnitude’

*) P6472l22: remove ‘set for’ and insert ‘the’ after ‘between’

*) P6472l24: replace ‘unconnectedly’ by ‘independently’

*) P647226: replace ‘However for’ by ‘For’

*) P6472l28: insert ‘to sediment yield’ after ‘proportion’ and ‘the’ before ‘detachment’

*) P6473l5: insert ‘a’ before ‘poor’ and remove ‘coefficient’

*) P6473l6: remove comma

*) P6473l13: remove ‘actual. . .place’

*) P6473l14: remove ‘means’ and put ‘for soils. . ..B) in parentheses

*) P6473l16: remove the first ‘steeper’ and ‘slope’

*) Table 1: replace ‘sand sand’ by ‘Medium sand’

*) Caption table 2: replace ‘types’ by type’

*) Caption table 3: remove ‘and levels’ and replace ‘contents’ by ‘content’

*) Caption table 4: remove ‘levels’

*) Caption table 5: remove ‘and levels’ and replace ‘types’ by type’

*) Caption table 6: remove ‘and levels’

*) Caption table 7: remove ‘and levels’ and include in the first row the headings for the different soil types so that it is clear what the different columns are

*) Table 10: replace ‘Probability level’ by ‘p-value’, ‘Vs’ by ‘vs’ and ‘moistures’ by ‘moisture’. Also this table could be removed as it would be easy to include these numbers in

the text.

*) Table 11: the numbers all have a different number of significant figures. Please check.

*) Table 12: replace ‘Kg S’ by ‘Kg s’ and insert that these models are models III and V respectively.

*) Figure 1 legend: redo the legend. ‘Soil A-dry’ is shorter and easier to understand than Wash/Soil a/dry’

*) Figure 1 caption: replace ‘contents’ by ‘content’

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 7, 6447, 2010.