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Hydrology and Earth System Sciences Discussions

Interactive comment on "Scaling effect for estimating soil loss in the RUSLE model using remotely sensed geospatial data in Korea" *by* G.-S. Lee and K.-H. Lee

Anonymous Referee #1

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Recommendation:

- The paper is one of many attempting to use RUSLE or similar hillslope erosion models within a GIS. As described below, the fundamental problem here is exactly the one of spatial resolution that the authors of this paper are trying to address, but their approach is round-about rather than tackling the real issue directly. As described below, I believe that this approach is fundamentally flawed. In addition, as described below there are other significant weaknesses in the reasoning and presentation. For these reasons, I am recommending that the paper not be accepted for publication.

General Comments:

- in RUSLE, the modeled hillslope has a very specific definition, following the path of a drop of runoff from where runoff begins to where you either get deposition (in RUSLE1) or when the sheet and rill flow reaches a concentrated flow channel. The problem with modeling this in GIS is that GIS topographic data usually do not have the vertical resolution necessary to define those hillslopes, as a small swale just a few centimeters deep may define the bottom of a RUSLE hillslope. Varying the grid resolution and using that to define slope length and steepness until you get a best fit between modeled and measured sediment delivery makes little sense, as those lengths and steepnesses bear no correspondence to the physical values that control erosion. It would make just as much sense to simply change the C-factor value until the answers matched.

Figure 4 points out how little sense this makes; surely there is some real average soil loss rate over the watershed, which should not change with the grid size? Note that in this case the true vertical resolution is not defined by the final resolution of the DEM, which is the result of interpolation, but rather by the vertical resolution of the original topographic map.

- the trend of S values decreasing with grid size (figure 3) is what must occur, and that trend would continue out to the logical extreme of modeling the entire watershed with two points, which would indicate a very long slope length and very little slope. The trend shown for L in figure 3 is problematic, as surely increasing the grid size should increase the modeled slope length and thereby increase rather than decrease the L value? I believe that the Desmet and Govers equation used to calculate this shows that normally L will increase with D?

- this Desmet and Govers equation used to calculate the L value does not show a specific limit, but Renard et al. and others specifically mention that the modeled slope length rarely exceeds 100m, and should never exceed 300m. Did your approach limit the size of the slope length?

- the model used here for SDR is clearly an empirical relationship defined for very specific watersheds. It is not defined in the paper whether this model was developed using watersheds similar to this one. As an example of the limited applicability of the SDR model, note that it will produce values of SDR $>$ 1 for any watershed of area $<$ 6085 units (the units for A in this relationship are never defined). Note that the SDR value calculated by this relationship is assumed to be truth in calculating what the RUSLE erosion values should be, which seems tenuous at best. This also raises the issue of what erosion estimation was used to get develop this SDR model in the first place, which is never addressed.

- it is not clear to me exactly what was measured. In one place it sounds as though the sediment in the outflow at the watershed mouth was measured, but in the results it appears that the sediment trapped in the basin was measured, and both appeared to be called Vs. If the trapped sediment was measured, this can be significant, because how the trapping efficiency of the basin was calculated becomes important, as does the assumption that “The sediment is evenly distributed in the reservoirĚ”.

- your statement that RUSLE only works if used at a gird size of 125m really should be supported by substantial analysis of why that might be the case

Specific Comments:

- 136.18 (page 136, line 18): reference for statement on increasing heavy rainfall events?

- 136.21: why are accurate erosion estimates needed to effectively control erosion? Don’t we simply need the implementation of more and better Best Management Practices?

- 139.9: there are very few models that make any reasonable attempt at estimating erosion and sediment delivery on a basin scale, and RUSLE is not one of them. There should be more discussion here of the complexities of moving from the hillslope to the basin scale, with all of the problems of deposition and erosion in the channel network

- 137.16: the sentence starting “The appropriate useĚ.” Is unclear

- 138.14: the sentence starting “The RUSLE modelĚ” is very awkward and unclear

- 142.3: what are the units on Abasin?

- 142.5: doesn’t Yy need to be a rate?

- 142.7: “over the basin” should read “average erosion rate throughout the basin”

- 144.13: first, do you mean at larger grid size, or higher resolution (there is some confusion, based on figs. 3 & 4)?. If you mean as you state that L and S are larger at higher resolution (smaller grid size), can you explain why that might be? That seems counterintuitive for L. Or, if you mean that L and S are larger for larger grid size, then this statement contradicts what the fiig. 3 shows, and is counterintuitive for S.

- figs 3 & 4: don’t you intend the x-axis to be labeled as grid size rather than resolution?

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