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Interactive comment on "Soil surface roughness: comparing old and new measuring methods and application in a soil erosion model" *by* L. M. Thomsen et al.

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Author comments to reviewer #3 (R3), O. Gronz.

We would like to thank Dr. Gronz for his constructive comments. We highly appreciate the time and effort taken by the referee to critically review our manuscript. The issues raised by Dr. Gronz are valid, relevant and have improved the paper. Moreover, the reviewer's comments encouraged us to once again think about soil surface roughness and how to capture this parameter. Below please find our response to each of the comments.

R3: Mixture of soil roughness categories. "...From my point of view the chain and pin-link should be used in both directions, as this component of roughness is also contained in the sensor method derived RR. Or the direction of cultivation should also be considered for the point clouds, e.g. by estimating RRs for suitable subsets of the whole point cloud." Response: We agree. Using only measurements along the cultivation direction for the contact-methods (chain and pinboard) while using measurements from the whole 3D point cloud for the non-contact methods is not consistent. We have included the across-cultivation measurements made with the contact-methods to improve the consistency. This choice was made because we wanted to use the data of the full point cloud.

R3: Oriented roughness and ponding. "According to the description of LISEM's usage of RR, surface runoff occurs when surface micro-depressions overflow. Thus, the oriented roughness should be considered for non-isotropic surfaces, like shown in figure 2, depending on the slope's orientation, as the oriented roughness will result in ponding or not" Response: We acknowledge the point about oriented roughness relative to the slope's orientation and ponding. However, we think this is mainly valid for meso-scale-topography oriented roughness such as mouldboard ploughing, whereas harrowing/sowing ridges (micro-scale-topography) only partially influence flow direction and thus ponding. Besides, the flow direction represented in LISEM is a crude simplification of what happens in reality. In reality, preferential flow paths emerge and will also depend on flow magnitude. These parameters are not accounted for in LISEM (nor in most other rainfall-runoff models).

R3. Outliers. "In the text, different definitions of RR are mentioned (p. 983, l. 14-22): one removes the upper and lower 10% extreme values, the other one does not. The latter one is used according to these lines. However, later on the removal of outliers by application of the three-sigma rule is described (p. 989, l. 21 f). Has this removal been applied unsupervised / automatically or was the removed point set at least inspected manually? Depending on the amount of vegetation residuals and considering the given

standard deviations, parts of the residuals will be treated as outliers or not. Is this stable?" Response: The calculation method that removed the upper and lower 10% of the values and the study (Cremers et al. 1998) that concluded removing these values were not necessary, both dealt with contact-methods. Sensor methods capture height data in a different way, and it was observed that arbitrary points were floating far above or below the surface, thus these had to be filtered out as part of the pre-processing data capture. And yes, the choice of three-sigma rule was decided after manual inspection of the point clouds. R3. Vegetation residuals. "In section 3.1, the influence of vegetation residuals is discussed (p.993, l. 16 ff). From the description, it can be concluded that these residuals are included in the point clouds in some methods, in others not. The stereophoto seems to produce holes in the data set at these places (lines 22-25), while the Xtion Pro does not. Unfortunately, there is no comparison between these two methods and the laser for plots with residuals, the laser should be able to capture them." Response: Also reviewer 1 (R1) requested a more systematic point cloud comparison. As we opted for using the full point cloud instead of converting the point cloud to a grid, it was unfortunately beyond the scope of study. It would definitely be a wish-target for future research.

R3. Minor comments. P.982, l. 8: Semicolon inserted. P.982, l. 20f: "Underestimated", replaced by "Overestimated". P. 983, l. 24: Does it make sense to use a runoff event from summer (section 2.5.2) while measuring RR in spring (section 2.2)". Response: This is a valid point, but, besides practical issues related to when fieldwork was possible and when usable rain events were recorded, we think it can be justified, if we assume that in September the land surface was bare (i.e. harvested) and that the surface was harrowed, which could be the case if the farmer did winter-crops, a common practice in the catchment. There is no land-use map of the catchment from September 2010. P. 984, l. 13ff. A short summary of Jester and Klik (2005) has been included. "P. 986, l. 26ff. I do not understand how this description results in the numbers given in Table 1. Shouldn't there be exactly twice as much transects for the roller chain than for the pinboard?" Response: The table has been corrected and some comments added. The

discrepancies in the number of measurements is because at a few locations for the cultivated plots two extra measurements were taken with both chain and pinboard. "P. 993, l. 25. Why should this explanation also apply to the Xtion? Structured light is reflected by plants. They should be contained in the model. But plants are a problem for feature comparison in structure from motion / stereophotos. Have the point clouds been inspected or is the text only an assumption based on the distribution of RRs?" Response: Although structured light is reflected by plants, there is still a limit to the size of structure the technique can reproduce (Mankoff and Russo, 2012). The point clouds have been inspected visually, while unfortunately no systematic comparison has been executed and as such the statement is an assumption based on the distribution of RR values. It would greatly improve the understanding of the pros and cons of the sensors to do a systematic comparison using software such as cloud compare. This would be a wish-target for future work. This has been emphasized in the discussion now. P. 994, l. 7: "'Representative"': Considering the spread of values shown in figure 4, this specific plot shown in figure 5 seems to be at the very low end. Why is it representative. Response: "Representative" has been deleted. 997, l. 14: There are several free software products to derive point clouds from image sets, e. g. VisualSFM. Works even without markers. Response: "Expensive" has been deleted. Thanks for the software tips!

"P. 1003, Table 1: Why is the number of points for forest and Xtion smaller than for stereo-photos? For harrowed and ploughed it is the other way round. Especially, as the Xtion is able to capture plants better than the stereophoto, like mentioned before in the result's section. " Response: The reason why we have concluded that the Xtion is better in capturing the plant structure is that overall the point clouds visually seemed to be more detailed. As can be seen in the table (below), the Xtion has a relative stable number of points per point cloud, whereas the stereo has a much more varying number of points and the relative higher average is the result of the "outlier" – plot ID 3, where the point cloud contain more than double the number of points than at plot ID 1 and 2. More measurements need to be taken and perhaps also under more controlled

conditions to get a deeper understanding of the sensors capabilities to capture plant structures. It has been added as a comment under the table.

Number of points per point cloud in forest locations Plot ID Xtion Stereo 1 59551 41340 2 57570 53080 3 59260 168204 Average 58794 87541

R3. General thoughts. “The model assumptions of LISEM, which are relevant for this paper, seem to be empirical. Thus, they are derived somehow using measurements. Which method has been used to measure RR in this context? Is it possible that properties of the method to estimate RR are already contained in the equation? “ Response: Yes, this is an interesting point. The method to measure RR for estimating the relationship to MDS was averaged values from both laser scanner and pinboards. We have mentioned this in the conclusive remarks.

“LISEM’s relevant model assumptions are described in detail. I would prefer a more detailed description of the applied methods”. Response: This has been requested by the other reviewers as well and is a valid point. We have decreased the focus on the modelling part and removed the detailed description of the LISEM model.

Mankoff, K. D. and Russo, T. A.: The Kinect: A low-cost, high-resolution, short-range 3D camera, Earth Surf. Process. Landforms, 38, 926-936, doi:10.1002/esp.3332, 2012.

Interactive comment on SOIL Discuss., 1, 981, 2014.