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Interactive comment on "The application of terrestrial laser scanner and photogrammetry in measuring erosion and deposition processes in humid badlands in the Central Spanish Pyrenees" *by* E. Nadal-Romero et al.

Anonymous Referee #1

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General comments:

This manuscript is an interesting work on erosion dynamics in humid badlands on the slope scale. In my view, for its publication in SOIL, the authors should improve it considering a number of aspects. My main concern deals with, mainly, the photo-reconstruction survey (and its error assessment) and the comparison between both techniques taking the LiDAR survey as the reference. In fact, the main objective of the manuscript is to compare both techniques and this comparison seems to be in-

complete. Each technique has been contrasted with itself through DEM differences obtained in different dates to assess erosion and deposition processes. The authors should provide a better explanation of this issue.

Specific comments:

- Title: I think the authors should refer to 'slope scale' in the title of the manuscript. Both techniques have been applied on a relatively small scale considering the badland landscape extent. So the assessment has been limited to 2 slopes (north- an south-facing) rather to the whole landscape.

- Abstract (and all over the manuscript), line 4: I would say that 'remote sensing techniques' is more suitable than geomatic (technologies related to geographic information), especially because the authors are emphasizing the 'non-invasive' approach.

1.2. Review, line 26: Are gauging stations really invasive? Are there 'non-invasive' means of monitoring water depth, velocity and sediment concentration? Is the deployment of ground control points for remote sensing techniques also invasive?

1.3. Page 341, Line 27: I'm not sure 'photogrammetry' is the right term for the technique applied. In other works, it has been termed as 3-D photo-reconstruction, Structure from motion (SfM) or similar terminologies. I would suggest revising the term with a more specific one taking into account the approach carried out by software like Agisoft Photoscan. Later on, the authors use close range photogrammetry, again, I'm not sure if this is accurate enough.

1.3. page 342, line 10: I think there are quite a number of papers dealing with DEM and photo-reconstruction by terrestrial and aerial means. Maybe citing some more of them would be reasonable? The authors have carried out a review on survey techniques in badland areas, but the comparison between the techniques is capital in the manuscript. Maybe a little more digging into LiDAR and photo-reconstruction literature would be advisable.

1.3. page 342, line 11: geomorphology of photogrammetry? Are there no previous photogrammetric studies in badland areas?

2.2., page 344, line 13: Is it not a limitation for all remote sensing techniques?

2.3. page 344, line 22: Can you explain why it provided better 3-D reconstruction? In your case or in the reference case (James and Robson)?

2.3. page 344, line 23: Why taking such a smaller number of pictures? This should be justified. The accuracy of the models is dependent on the number of pictures and perspectives. Did you consider taking closer pictures for occluded areas and merge the faraway and closer models in one final model?

2.3. page 345, line 6: Are you sure that the resolution (and errors) do not depend on the measuring distance in photogrammetry? Photo-reconstruction is based on SIFT detection that strongly depends on the image resolution and distance to object. Normally, faraway objects are reconstructed less densely and with higher errors. In fact, distance might explain why you obtained less point densities in the north-facing slopes. Could you justify the statement?

2.4. page 345: My main criticism to this work if the absence of a direct comparison of DEMs between techniques (considering LiDAR as the reference, as in many previous studies). The error assessment in photo-reconstruction is very limited since its model has not been contrasted with the LiDAR model. Is there any reason for that?

3.1. Could you provide a sediment yield estimate for the slope as the balance of positive and negative differences? Do you think that the measurement precision is small enough to make the centimetre differences significant?

3.3. page 348. How can you explain the large differences between techniques in the north-facing slopes? In my opinion, until a more detailed error assessment is carried out for photo-reconstruction (LiDAR comparison) not much can be said in this particular.

4.1. page 348, line 15: What do you mean by subcentimeter accuracy, milimeter accuracy? I would not be sure that you achieve this accuracy for such long distances, especially, regarding photo-reconstruction.

4.1. page 349, line 9: Here, also the discussion about the accuracy of the techniques would be suitable, i.e. the small variations due to shrink-swelling process cannot be captured by the precision obtained.

4.2. page 350, line 26: To me, the photogrammetric accuracy has not been properly analysed. I would say also that this technique has been tested in a wide range of applications, so I would not term it 'promising'.

4.3. page 351, line 1: Does the quality of the 3-D model only dependent on the lighting conditions? Did you analyse the reconstruction percentage, i.e. percent of areas with points in the model for a given cell resolution? It seems that with such a small number of pictures and perspectives and long distances, there must be areas of the slope not seen by the camera (they can be seen especially in Figure 7). This type of occluding shadows (areas behind prominent elements) might be important, not only the shadows casted by the objects on visible elements. No vegetation issues in the slopes?

4.3, page 351, line 16: Could the authors give brief information on the cost and time-requirements of their application and compared with the references included?

5. page 352, line 20: All the problems could be solved just with higher-resolution images? This is a key point in the manuscript.

Table 3: Do such millimetric differences mean anything taking into account the technique precision? Are the techniques appropriate for such small changes in this short period (several months)?

Table 4: Maybe this table does not provide too much information. Perhaps giving details on the particular time requirements would make it more meaningful?

Figure 1: Should GIS&remote sensing be together? LiDAR and remote sensing should

be separated?

Figure 5-8: Please provide letters and explanation for each figure (dates,. . .). Please, make the labels readable. Provide the software used. Could you indicate (e.g. by arrows) an interpretation of the processes for the largest differences? Would using only 2 colours (e.g. red and blue) in the colour bar more intuitive? Is it possible in the software? Units in the scale bar. A figure and interpretation of the differences of the LiDAR and photo-reconstruction would be highly recommendable as mentioned before.

Technical corrections:

4.2. pag 351, line 1: lighting conditions?

References: I would include additional references as mentioned in specific sections in my comments.

Interactive comment on SOIL Discuss., 2, 337, 2015.