Earth Surf. Dynam. Discuss., 3, C644–C649, 2016
www.earth-surf-dynam-discuss.net/3/C644/2016/

ESURFD_Log

Interactive comment on "3-D models and structural analysis of analogue rock avalanche deposits: a kinematic analysis of the propagation mechanism" *by* C. Longchamp et al.

C. Longchamp et al.

celine.longchamp@unil.ch

Received and published: 20 January 2016

Dear Reviewer, each of your comments are answered in details below: Referee #2 Comment 1: Introduction is quite broad but relatively limited in the presentation of similar modeling approaches. A slightly more complete and updated review could result in a more useful or general overview. The description of large scale features in real landslides could be useful but it is not a primary point to consider. Answer: This point was also highlighted by referee 1 and the authors agree with this comment. The introduction will be completed. Changes in manuscript: modeling approach will be updated in the introduction Comment 2: Data acquisition: probably this paragraph could be titled

Methods or experimental methods. Answer: Thanks for the suggestion, the change will be done. Changes in manuscript: this paragraph will be called "experimental methods" Comment 3: I am not sure which kind of material has been adopted but probably carborundum (not carborandum) or silicon carbide. This is a particular material characterized by high density and very low friction. This is a major point that would be useful to evaluate because there is no description of the material properties, both in terms of internal friction angle and of basal friction angle/coefficient. As a consequence, the interpretation and possible reuse of the experimental data by other researchers would require a basic characterization or at least the reporting of literature or technical data Answer: Thanks for noticing the "carborandum" typo; it will be corrected in the manuscript. A better characterization of the material (including the electrostatic effect) will be proposed. Measurements of friction angle and basal friction will be carried out in our laboratory and included in the text. Changes in manuscript: The "carborandum" mistake will be corrected; a better description of the carborundum will be proposed. Comment 4: Dimensional analysis could be named or considered even if most of the scaling laws and dimensionless number have been already reported in the literature. Some mention or value could be given or simply report the variables values so to allow for a computation of the numbers. Answer: As answered for Referee 1, no dimensional analysis was carried for this study but we based our values on number of literature. Changes in manuscript: Some scaling values obtained by previous authors will be reported in the manuscript. Comment 5: The problem of the electrostatic effects could be relevant considered the extremely small mass/volume of material adopted in the tests. A more specific description of carborundum is required also on this basis. Answer: we will add the electrostatic effect within the description of the carborundum as proposed in comment 3. Comment 6: For the colored granular material and for a better understanding of the possible processes and structures, it would be useful to know the material properties of the colored sands at least to evaluate the differences and for possible use by other researchers. Answer: As for the carborundum, measurements of friction angle and basal friction will be carried out in our laboratory Changes

in manuscript: a better description of the color sand will be added to the manuscript. Comment 7: Study of the effects of roughness is an interesting aspect of this research. At the same time it is not common to compare this to realistic conditions where usually roughness is no a fixed bed condition. In fact, most of the times the basal surface is naturally rough but is also erodible (I.e. not fixed). Answer: Indeed, our roughness is not realistic compared to realistic conditions but it gives good insight of how the basal roughness influences the motion of the propagation. To simulate the roughness with erodible basal surface could be interesting for further studies. Changes in manuscript: A comment on this will be added in the text. Comment 8: Fixing slope angle to 40° is reasonable but at the same time neglect to study the relevance of slope angle in controlling flow evolution and deposition. Answer: The influence of the slope angle on the flow evolution and deposition is the object of a future publication. Nevertheless, few lines about the slope influence can be added to this research to clarify the influence, referring to other authors. Changes in manuscript: Few lines will be added about the slope influence Comment 9: The relevance for counting the number of colored grains within a specific area should be explained more. Answer: Changes in manuscript: few lines will be added to clarify this point. Comment 10: Methods: again, the type of system adopted for the acquisition should be better detailed. For example, the number of fps for the high speed camera, or the resolution and precision of the laser scanner. Answer: Changes in manuscript: Some complementary information about the data acquisition will be added to the text. Comment 11: Sfm is introduced in quite a general way but then is dismissed by simply saying that is not relevant because does not work with this kind of material. So there is no mean at introducing it. Light scattering at the grain surface could also be a problem with laser scanning and so this could be mentioned or at least it should be said if really important considering the scale of the problem. This point is partially tackled but not clearly stated. Answer: For other study we carried in our laboratory (paper in prep.), no problems of reflection were observed when using carborundum, contrary to the photogrammetry that result into a noisy point cloud when it is scanned by the Lidar. For this reason, we applied photogrammetry to

the colored sand. The advantage of the photogrammetry with the colored sand is that we have a colored point cloud and way more point compare to the Lidar. On the other hand, acquisition with the Lidar allowed us to have point clouds of all experiments carried out with carborundum. We attempted to adapt the method for different situations. Moreover, the SfM is cheaper compare to Lidar. Changes in manuscript: Precisions and a better comparison of the two techniques will be provided in the text. Comment 12: Gradient operator filtering: not novel per se, but anyway it is found useful to the aim of the study and helps in a clearer definition of the structures. Answer: Thanks for the comment. Indeed the filtering helps in a clearer definition of the sturctures. In order to highlighted how our method is useful (cheaper, faster and easy to use), some comments will be added in our manuscript and compared to other methods. Changes in manuscript: Comment 13: Visual inspection: I have to admit that from the figures the internal structures are extremely difficult to be seen and recognized. At the same time, the authors should describe a little bit more the role or effects of different materials, of the friction characteristics of the involved materials. Answer: Changes in manuscript: As previously discuss, characterization of the material will be add to the manuscript. However, some complementary description of the figure of the visual inspection will be added taking into account the role and effects of the different materials. For the figure, we will try to make it clearer. Comment 14: High speed videos: the general quality of the images is low and this could be simply a problem of the uploaded file resolution. Nevertheless, apart for the colors the general evolution is poorly constrained. The reason for passing from carborundum to sand should also explain at least to clarify the possible effects. For example, why in this case there is no attention to the electrostatic effects named at the beginning for the adoption of carborundum? Answer: For the high speed camera, we had to find the better compromised with resolution and fps. Indeed, with more fps, the resolution decreases. Nevertheless, it may be a problem within the uploading file, it has to be controlled and adjust. The reason for passing from carborundum to colored sand is due to the problem with the method used as it has been explained in the text and in comment 11. Changes in manuscript: Few lines

will be added in addition to those of the comment 11 about electrostatic effects and on the reasons of the choice of the different materials Comment 15: Frank slide: probably is too much to introduce the Frank slide example as it is in the manuscript, considering the length of the description (just a few lines). Answer: Changes in manuscript: the description of the Frank Slide has been moved to the chapter now called “experimental methods”. Comment 16: Discussion: there is some interpretation in terms of time for the formation of the internal features. It should be clear that there is no real observation in time for the formation of the internal features. So talking about a possible order of formation is at least improper. The same could be said about the significance of these features about the flow. Answer: we thank the referee for this comment and we agree on it, after this we decided not to include an interpretation of the formation of the internal features/time because it is not possible in the framework of our study Changes in manuscript: Comment 17: In the description of flow and formation of structures I think it should be carefully considered how a flow in extensional regime could be at the same time exerting a compressional action. In a certain way this seems not possible unless a clearer explanation is given (see e.g. step 6 in the sequence). Answer: Changes in manuscript: the description will be cleared in the manuscript Comment 18: The effect of the layering (transversal to the release geometry) should be mentioned. Answer: Changes in manuscript: this layering effect will be added to the text. Comment 19: As said above the internal structures do not seem to be so clearly recognizable. Furthermore, if the material in the tail is slower and much slower than the frontal part it is unclear how the pushing action is occurring. Answer: Changes in manuscript: A more detailed description has been added to the text in order to clarify it. Comment 20: The various steps are in a certain way re- expressed in the successive list of points when internal structures are described - Point 1 in the discussion: the velocity at the front is assumed similar to the one at the back: is this possible or realistic considering that thickness is different, no pressure contribution is present and that the tail motion is lasting more? Answer: As said in the answer to the comment 16, we decided to remove the figure 13 as the internal deformation can not be interpreted in our study Changes

in manuscript: Comment 21: It is said that it is possible to understand now why the structures are not randomly distributed. Actually, no one ever said that they are or should be randomly distributed; on the opposite it is clear that there is a reason for the general disposition and order of formation. Answer: we agree with the referee that the sentence could be misleading, we should say that our study confirm that the structures are not randomly distributed and that there is a similarity of the distribution between laboratory and real cases. Changes in manuscript: sentences will be rewritten in order to avoid any misunderstanding about this point. Comment 22: Referencing: I suggest to complete a search for granular flow modeling considering some interesting laboratory results about the propagation along slopes, on hard or soft layers with different characteristics and the description of internal structures or formation of lateral levees as delimited by sort of strike slip features. Some other piece of research describes the evolution in time of granular flows during their motion and deposition. Since older works from Gray to more recent ones. An interesting one has been published by Rowley et al., 2001 and more in recent papers. Answer: we agree with these comments and we will expand our bibliography. Changes in manuscript: new references will be added to the text and the introduction and the discussion will be changed accordingly.

Interactive comment on Earth Surf. Dynam. Discuss., 3, 1255, 2015.