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# *Interactive comment on* "Two multi-temporal datasets to track the enhanced landsliding after the 2008 Wenchuan earthquake" *by* Xuanmei Fan et al.

**Xuanmei Fan et al.**

fxm_cdut@qq.com

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Referee #3 – T.W.J. van Asch Comment #1 This paper gives a detailed and useful introduction to two very interesting multitemporal data sets which are probably the first data sets free available for the scientific community. The first data set is a multi-temporal polygon-based inventory of pre and co-seismic landslides, post-seismic remobilizations of co-seismic landslide debris, and post-seismic landslides induced by the Wenchuan earthquake (2008) in Sichuan province China. The second dataset contains information of the debris flows that occurred from 2008 to 2017 in the same area together with information on their triggering rainfalls recorded by a network of rain gauges. The two multi temporal data sets, which are made freely available, offer a good opportunity to analyze, at various scales, the patterns of enhanced land sliding caused by the earthquake. The first data set gives insight about the types and distribution of co-seismic landslides and their types of reactivation. It opens the way for scientist to analyze the factors influencing the distribution of co-seismic landslides, to make comparisons with the distribution of co-seismic landslides in other earthquake area, to analyze the factors causing the reactivation of these landslides and to explain the decrease in temporal frequency. And last but not least the data offers insight in the temporal evolution of the source materials for debris flows which is important for the modelling and understanding of the decrease debris flow frequency after the earthquake. The second data set about the temporal evolution of debris flows in the Wenchuan seismic area is a very rich source of information due to the large number of debris flows which are registered. The combination with information about the triggering rainfall data make it possible to construct general ranges in rainfall thresholds and more specific thresholds in relation to available source material and catchment characteristics. The detailed information about the catchment morphometry in the form of DEMS, time of occurrence of debris flows, antecedent rainfall patterns, available source materials and last but not least runout volumes at the outlet of the catchments make it possible to tests and bench marking all kinds of very detailed to more general debris flow models following different concepts with a very detailed to a more general character. Response #1 Dear prof. van Asch, We thank you for taking the time to review our manuscript. It is really a honour to learn that you deem our work very valuable. We sincerely appreciate your positive comment. Please find our point-by-point reply below. Comment #2 The paper is a good guide for the data sets but some parts need a bit more explanation. I do not understand how the distribution of co-seismic landslides can give insight in the mechanism of an earthquake. Response #2 For instance, a study made by Keefer (1984) and Rodríguez et al. (1999) found a correlation between the magnitude of the earthquake and the distance of landslides to the co-seismic fault. It has been also clarified in the text Comment #3 We need also more comments on the different ways the co-seismic landslides are mapped in the past, the variety in interpretation of individual landslides and their presentation in maps (as points or polygons) and the consequences for analysing these kind of data sets. Response #3 In the past, five inventories have been performed in the Wenchuan earthquake-affected area by Gorum et al. (2011), Dai et al. (2011), Xu et al. (2014), Li et al. (2014) and Tang et al. (2016). They were mapped either as points of the landslide scar areas or polygons with a different degree of accuracy (see Tang et al., 2016) and without distinction between the different types (landslides, debris flows, etc). Both accuracy and representation (as points or polygons) have direct implications for the analysis of the area-frequency distribution and the consequent hazard and risk assessment as well as the analysis of the controlling factors. Additionally, the distinction between different types of landslides accounts for individual analysis according to its nature. It has been also clarified in the manuscript Comment #4 I would like to ask the authors why they think their mapping methodology has delivered the most reliable data set. The mapping of the landslides has been carried out by 5 interpreters following a set of common rules (see Fig 6 ). The authors mention also a methodology given by Harp et al 2006. We need more information about the criteria used by the mapping of these landslides. Response #4 This is the most complete inventory of co-seismic and post-seismic landslides performed and freely available of the Wenchuan earthquake-affected area so far. Our method has a key point compared with earlier works carried out at the same area (Tang et al.; Yang et al.; Zhang et al.). We actually re-mapped and thus quantified the remobilised areas on each imagery rather than providing a qualitative estimation of the activity level. We quantified changes of the level of activity based on the actual polygon-mapping of the remobilised areas (and not on qualitative activity levels), we discriminated between different types of landslides and their location and we investigated a much larger and more representative area. We have now highlighted this in the revised manuscript. Comment #5 In the temporal data set of co-seismic landslide and post seismic reactivation and new landslides are also included debris flows which are small debris flows (hillslope debris flows and so called channel deposits). The question arises what is the difference between these debris flows and the debris flows incorporated in the second data. Probably the two types of debris flows in the first data set have a limited displacement (not reaching the outlet of the catchment. The firs type are so called hill slope debris flows while the second type are channelized debris flows with a limited displacement. A significant amount of materials are involved in these channel deposits , which of course are very important source areas for future debris flows because the highest concentrations run-off water during future events are found in these channels. I suggest to call these two types :a)hills slope debris flows with limited run -out b) mainly channelized debris flows with a limited run-out. Response #5 Actually, in Dataset1 we have two type of debris flows: hillslope debris flows, which are found along the hillslopes, and channelized debris flows, which are found into small channels. Then, the channelized deposits are large amounts of accumulated debris, found in the main channels, were clear remobilizations could not be identified. Furthermore, the source area of these materials is not known as they come from different debris flows and slides (debris and rock slides, debris and rock falls) that occurred upstream. Conversely, the debris flows reported in Dataset2 are big events that reached or approached the outlet of the catchment affecting facilities and/or the population. In such case, the material can come from slides, hillslope and channelized debris flow and, mainly, form the existing the channel deposits material, all of them presented in Dataset1. This has been clarified in the text. Comment #6 Can you also describe their relation with the co- seismic landslides. Give also information in the text about the time period in which these landslide reactivation in the form of debris flows occurred: just after the earthquake or over a longer period? Response #6 A great number of reactivations in the form of debris flows were identified within the first three years after the earthquake (2008-2011). Then, during the following years (2013 and 2015), the number of debris flows decreased considerably although a high amount of co-seismic material is still present in the hillslopes (Fan et al., 2018a). It suggests that the effects of the earthquake will be shorter than what it was initially expected (Huang and Fan, 2013). Some ongoing studies suggest that the changing in the properties of the co-seismic deposits, such as grain coarsening, my play a key role. It has been clarified in the text. Comment #7 In Figure 4 you add a third type of debris flow namely “debris flows in a channel”. What is the difference with the channel deposits? So I would ask for a more precise description of these types of debris flows? Response #7 The difference between debris flow in a channel and channel deposits can be found in Fan et al. (2018a) and has been explained bellow. It has been also clarified in the text. Debris flows were mapped when a fine-material texture along a preferential path could be identified. They can be found along the hillslopes (hillslope debris flows) or into channels (channelised debris flows). Large amounts of accumulated sediments are generally found in the main channels, but in many cases clear remobilisations could not be identified, hence such deposits were mapped as channel deposits. Comment #8 The level of activity in A1, A2 and A3 are defined as a percentage of area which is remobilized Are these activated areas delineated and do we get an impression of the degree of displacement (limited displacement or larger displacement in the form of debris flows see above). I cannot see that in Fig 3 and I have no possibility to open the shape files to look in detail. Response #8 Yes, the remobilised area has been delineated. In the inventory it can be compared the position of the co-seismic deposits and the one of the post-seismic remobilizations. So, the displacement can be calculated. Comment #9 Regarding the debris flows: can the authors also give an estimate about time period in which the pre-earthquake registered debris flows were formed? Response #9 Unfortunately, we do not have a record of the previous debris flows occurred in the area. The most estimate period can be obtained from the year in which they were mapped (2005 and 2007). Comment #10 In the debris flow data base we have no information whether the debris flows started as sliding mass failures or by run-off erosion, which is very important for the type of modelling and for understanding the type of meteorological thresholds. Response #10 We agree with the referee that the initiation mechanisms is important for modelling purposes and definition of rainfall thresholds. According to our experience in the study area, these two processes often concur to the same event, and their relative importance evolves with time during an event. For some debris flows, the event may start as a sliding mass failure from the coseismic landslide deposits, and when the rain is intense, it can generate concentrated surface run-off causing run-off erosion. For some other events, depending on the type of material and terrain, run-off erosion may occur first, and the subsequent entrainment may cause incision and failure of deposits and also erosion and incision of the channel. The processes vary case by case. However, this information is not available in all the papers and in some cases is just estimated or guessed. Therefore, we considered that it should be carefully checked, case by case, by the users of our dataset, when necessary, using the references that we provide therein. Comment #11 I do not understand in the caption of Table 4 the difference between "Time 24" and "T". Response #11 Actually it is "T_Comment" instead of "T". "Time_24_" is a numeric field with the time of occurrence of the debris flow. T_Comment is a text field where it is clarified if "Time_24_" corresponds to the initiation or deposition of a given event. In few cases "Time_24_" also reports a range of days where the debris flow occurred. It has been clarified in the manuscript. Comment #12 The available material during the initiation of the flow changes with time. From where did you get this information? From the first data set about the Multi-temporal inventory of landslides? Response #12 We got this information form other publications that are reported in the database (see "Reference of Data source" in the DF_RG_inventory.xlsx file). Comment #13 The authors also mention a general travel time of 1 hr which makes it possible to get an estimate for the initiation time of the debris flow (important value for calibrating and validating models). I wonder whether that is not a too general statement. Are there no large variations in travel time of debris flows between catchments? Response #13 The referee is right as in our study area there are catchments of different sizes, which influences the travel time. Additionally, the position of the co-seismic deposit where the debris flow initiate and the presence of deposits blocking the river and mitigation works, among others, could also increase the travel time. We delete this sentence to avoid any misunderstanding. Comment #14 To come to a conclusion I would say that





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Discussion paper

these data sets merit to be published and I advise minor revision to give some more explanations on certain aspects. Response #14 Thank you very much for your positive comments and suggestions. We really appreciate all of them

Please also note the supplement to this comment:
https://www.earth-syst-sci-data-discuss.net/essd-2018-105/essd-2018-105-AC7-supplement.zip

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