Response to the referees' and short comments

Dear referees,

We are very grateful for your valuable comments. Please find our detailed responses below, in italics. Revisions to the manuscript are highlighted in yellow in the "revised manuscript" file, attached. For convenience, we also attach a version of the manuscript with changes incorporated. We hope you are satisfied with our revisions, and we are happy to receive further feedback.

With our best regards,

Xuanmei Fan and co-authors

Referee #1 – A. Strom

Comment #1

Dear Authors,

Thank you for interesting paper. It can be accepted after minor correction in Table 3. It seems that V_{total} is in m^3 not in millions m^3 (otherwise values are too large). I think that you can avoid separating of 3 orders by commas.

Response #1

Dear prof. Strom,

We thank you for taking the time to review our manuscript and we sincerely appreciate your positive review. Table 3 has been corrected according to your comment.

Referee #2 – Anonymous

Comment #1

The authors describe two datasets of post-earthquake geohazard events that were collected after the 2008 Wenchuan earthquake. One if a multi-temporal landslide inventory of the area along the Minyang river near the epicenter, and the other a database of debris flow watersheds and debris flow events. The authors have published this data and made it freely available to other researchers, which is a very important step towards an improved understanding of post-earthquake geohazards.

Response #1

Dear referee,

We thank you for taking the time to review our manuscript, and for your valuable and constructive comments. Please find our detailed reply below. For further information about the contents uploaded in the repository, please find a copy of the word document named "readme.doc" (also placed it in the repository) at the end of this file.

Comment #2

Initiatives for collecting coseismic landslide inventories have been recently undertaken by Tanyas et al (2017) and Schmidt et al. (2017) who established a web based repository of landslide inventories (https://pubs.usgs.gov/ds/1064/ds1064.pdf and https://www.sciencebase.gov/catalog/item/583f4114e4b04fc80e3c4a1a. The current inventory could also have been submitted to this platform so that also post earthquake inventories can be shared. Nevertheless, the sharing of this inventory is important.

Response #2

We are aware and strongly support the initiative by Schmitt et al. However, our work concerns post-earthquake inventories. As such, it does not strictly fit in the scope of the database compiled by Schmidt et al., which is in fact entitled "An Open Repository of Earthquake-

Triggered Ground-Failure Inventories". With the present work, in fact, we wish to promote the sharing and collecting of datasets that concern the post-earthquake geohazards and their spatial and temporal evolution. We chose Zenodo (created by OpenAIRE within EU's programme Horizon 2020, and hosted at CERN) to reposit our dataset, and we chose this open-access journal (ESSD) to present our work and encourage other researchers to share theirs.

Comment #3

It is another issue, however, whether this merits a publication which is mostly descriptive, and repetitive. The description of the data set for post-earthquake landslide and analysis results were presented in an earlier paper of the authors in Landslides (doi: 10.1007/s10346-018-1054-5, 2018a) and the debris flow dataset was also presented in Tang and Van Westen (2018) (Tang, C., & van Westen, C. J, 2018, Atlas of Wenchuan-Earthquake Geohazards: Analysis of co-seismic and postseismic Geohazards in the area affected by the 2008 Wenchuan Earthquake. Science Press). Why was the dataset not attached to the earlier publication in Landslides? This paper contains relevant limited new information.

Response #3

As the referee recognised, only results from the dataset of post-earthquake landslides have been presented in an earlier paper, where some of the implications that can be drawn from it have been discussed. However, the dataset has been refined and updated since then, and is therefore ready to be published in an open-access repository only now. After the submission of the paper, the latest imagery of the area is available, so we also updated our post-seismic landslide inventory for the years 2017 and 2018.

Regarding the dataset of debris flows, this is the first time that such a large multitemporal dataset is published and described. As the co-author (a contributor) of the Atlas, I can guarantee there is no such comprehensive debris flow database published in the Atlas. In the Atlas, only some case studies and results from specific areas are reported with multi-temporal information, as shown in a descriptive table that includes about 90 debris flows (as shown in Fig 1).

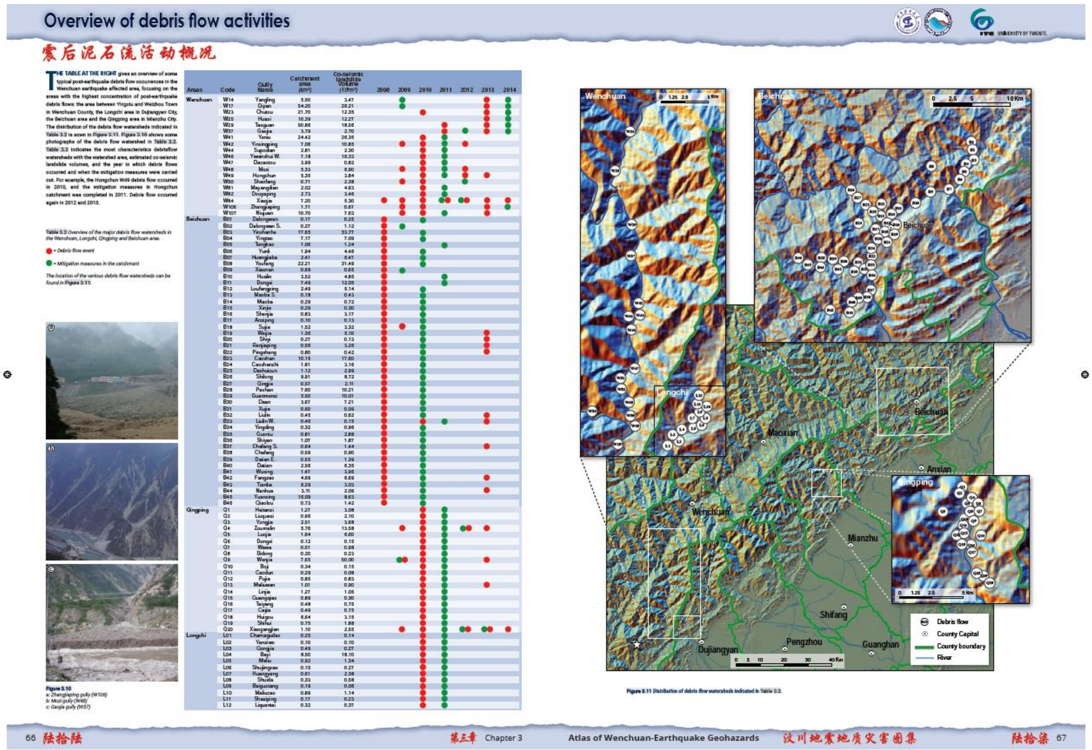

Figure 1: The debris flow information from Atlas (Tang and van Westen): page 66-67. The table lists 92 debris flows mainly from four regions (Wenchuan, Beichuan, Qingping and Longchi)

and includes only the rough location, year of occurrence and an estimation of the total amount of coseismic landslide volume.

*Our dataset covers a much large area and a longer time frame than that used by Tang and van Westen in their Atlas. It includes **527 post-seismic debris flow events**, almost 6 times more than the list in the Atlas. Most importantly, we presented detailed information of each debris flow event, such as the accurate occurrence time, source and deposition volume, rainfall information of surrounding rain gauges etc. The database are both in Excel format (Figure 2) and geo-referenced GIS shp file format with detailed attribute table (Figure 3).*

Gully name	DF_ID	CID	Latitude	Longitude	Year	Month	Day	Time(24h)	T_Comment	Source volume (m^3)	Depo_vol (m^3)	List of RG_ID	Monitoring(Y/N)	Number of Dams	Reference of Data source
Xiangzhangshu 1#/Baiguoping	203	P5	103.868	31.316	2008	5	18	-	-	21600	1850	44	N	-	Ma et al. 2011; Wang et al. 2014
Xiangzhangshu 1#/Baiguoping	204	P5	103.868	31.316	2012	8	18	00:30	Initiation	183900	-	44	N	-	Huang et al. 2013
Xiangzhangshu 1#/Baiguoping	205	P5	103.868	31.316	2008	7	-	-	-	-	1650	-	N	-	Wang et al. 2014
Guanzi	206	P6	103.873	31.3248	2012	8	18	00:30	Initiation	5394700	-	44	N	-	Huang et al. 2013
Banjie	207	P7	103.876	31.328199	2012	8	18	00:30	Initiation	894600	-	44	N	-	Huang et al. 2013
Haihuiqiao 1#/Gaojiazi	208	P8	103.88	31.337601	2010	8	18	-	-	-	-	44	N	-	Ma et al. 2011
Haihuiqiao 1#/Gaojiazi	209	P8	103.88	31.337601	2012	8	18	00:30	Initiation	2570000	250000	44	N	-	Huang et al. 2013; Yu et al. 2014
Tongchangpo	210	P9	103.781	31.2332	2008	7	21	-	-	70700	3000	-	N	2	Wang et al. 2016b
Dianzhan	211	M1	104.1056	31.575826	2010	8	13	01:00	Initiation	21000	1000	64 , 65 , 43	N	1	Su et al. (2011)
Heitanzi	212	M1	104.1062	31.57641	2010	8	13	01:30	Initiation	-	12600	64 , 65 , 43	N	1	Tang et al. (2012a)
Bojiyan	213	M10	104.1078	31.553912	2010	8	13	01:00	Initiation	27000	7000	64 , 65 , 43 , 62	N	-	Su et al. (2011) ; Ni et al. (2011)
Boji	214	M10	104.1069	31.55379	2010	8	13	01:30	Initiation	-	3600	64 , 65 , 43 , 62	N	-	Tang et al. (2012a)
Caodun	215	M11	104.1094	31.550998	2010	8	13	01:30	Initiation	-	15000	64 , 43 , 65 , 62 , 57	N	-	Tang et al. (2012a)
Wangjiashan	216	M12	104.1057	31.545862	2010	8	13	01:00	Initiation	12500	2500	64 , 65 , 43 , 62	N	1	Ni et al. (2011)
Pujia	217	M12	104.106	31.546273	2010	8	13	01:30	Initiation	-	5800	64 , 65 , 43 , 62	N	1	Tang et al. (2012a)
Maliuwan	218	M13	104.1086	31.543635	2010	8	13	01:30	Initiation	-	24000	64 , 65 , 43 , 62 , 57	N	-	Tang et al. (2012a)
Yingjia	219	M14	104.1146	31.542891	2010	8	13	01:00	Initiation	50000	8000	64 , 43 , 62 , 57 , 65 , 61	N	1	Su et al. (2011)
Linjia	220	M14	104.1149	31.542657	2010	8	13	01:30	Initiation	-	39600	64 , 43 , 62 , 57 , 65 , 61	N	-	Tang et al. (2012a)
Guangqiao	221	M15	104.1101	31.53687	2010	8	13	01:30	Initiation	-	27800	64 , 43 , 62 , 65 , 57	N	1	Tang et al. (2012a)
Taiyang	222	M16	104.1166	31.535455	2010	8	13	01:00	Initiation	5000	20000	64 , 43 , 62 , 57 , 61 , 65	N	1	Su et al. (2011)
Taiyang	223	M16	104.1148	31.535252	2010	8	13	01:30	Initiation	-	127800	64 , 43 , 62 , 57 , 65 , 61	N	-	Tang et al. (2012a)
Caijia	224	M17	104.1149	31.53111	2010	8	13	01:30	Initiation	-	60400	64 , 43 , 62 , 57 , 61 , 65	N	-	Tang et al. (2012a)
Huigou	225	M18	104.1178	31.51293	2010	8	13	01:30	Initiation	-	285100	64 , 62 , 43 , 57 , 61	N	-	Tang et al. (2012a)
Chengqiangya	226	M19	104.1247	31.50921	2010	8	13	01:00	Initiation	24000	4000	64 , 62 , 43 , 57 , 61	N	-	Su et al. (2011)
Shihui	227	M19	104.1249	31.509404	2010	8	13	01:30	Initiation	-	84200	64 , 43 , 62 , 57 , 61	N	-	Tang et al. (2012a)
liubaizi	228	M2	104.1072	31.572222	2010	8	13	01:00	Initiation	22500	2500	64 , 65 , 43	N	1	Su et al. (2011)
Liuquezi	229	M2	104.1062	31.57295	2010	8	13	01:30	Initiation	-	27100	64 , 65 , 43	N	-	Tang et al. (2012a)
Changtan	230	M20	104.1275	31.503889	2010	8	17	-	-	-	-	64 , 62 , 43 , 57 , 61	N	-	http://news.163.com/10/0818/14/6ECHB2HN000146BD.html
Xiaogangjian	231	M20	104.1294	31.503333	2014	6	4	-	-	-	10000	62 , 43 , 64 , 57 , 61	N	9	http://scnews.newssc.org/system/20140604/000391154.html
Changtan	232	M20	104.1275	31.503889	2010	8	13	01:00	Initiation	-	300000	64 , 62 , 43 , 57 , 61	N	-	Su et al. (2011)
Xiaogangjian	233	M20	104.1294	31.504025	2010	8	13	01:30	Initiation	-	290200	62 , 43 , 64 , 57 , 61	N	-	Tang et al. (2012a)
Xiaogangjian	234	M20	104.1294	31.503333	2010	8	18	-	-	-	-	62 , 43 , 64 , 57 , 61	N	-	Yang et al. (2012)

Figure 2: A screenshot of our debris flow database includes 527 debris flows events with detailed information (Excel format, can be download from https://doi.org/10.5281/zenodo.1405489)

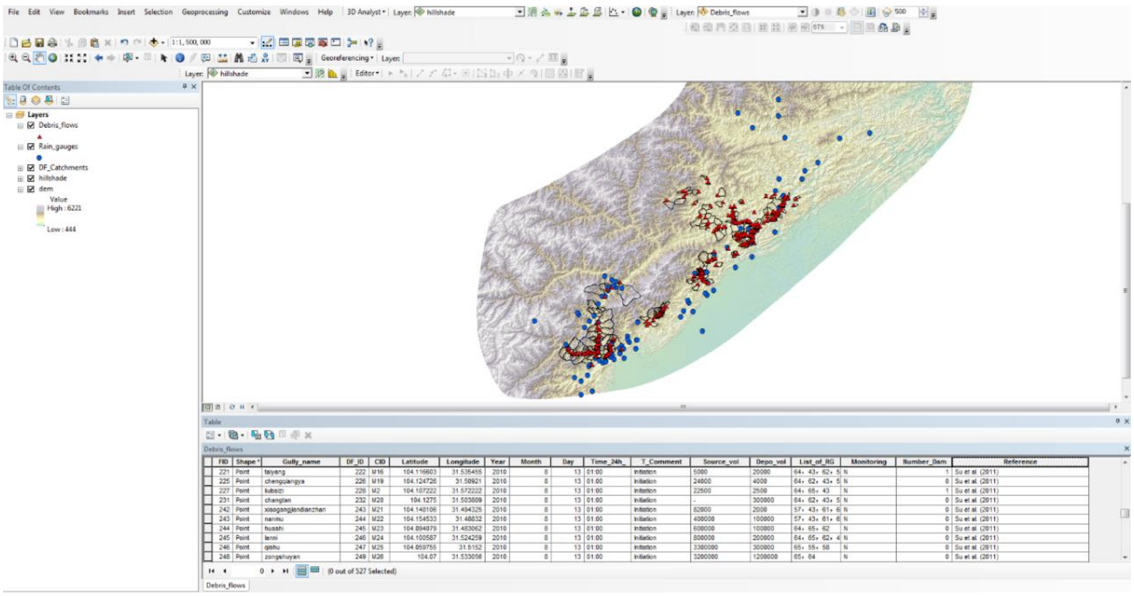

Figure 3: A screenshot of the GIS shp file with detailed attributes (can be download from https://doi.org/10.5281/zenodo.1405489)

Regarding the descriptive nature of the manuscript, this is actually intentional. Our aim is to present the datasets, their coverage, the methods for their preparation, and to provide descriptive statistics. We wish in fact to provide the community with the source data, and with the tools to understand them and evaluate their reliability and value. We believe that detailed interpretations or discussions of our data also would fall beyond the scope for which this article has been thought, and be more appropriate for a different editorial context. We have read the journal guidelines and inquired the editors during the preparation of the manuscript and dataset (i.e. prior to submission), and we understand the scope of the journal is for the publication of articles on original research data (sets).

Some choices in the selection of data also are, on purpose, as inclusive as possible. This is the case, for instance, of the selection of the rain gauges that are coupled to a debris flow event: we chose a distance which is large enough to ensure that all the relevant rain gauges are included (given the high variability of rainfall in the mountain area) and we avoided on purpose to make arbitrary choices (e.g. by selecting only the closest rain gauge to the debris flow event) which would make the dataset less usable and flexible. These choices remain up to the users of the datasets, who can thus make them according to their purpose and justify them.

Comment #4

Methodologically, the analysis of the post-earthquake landslides is based on an earlier paper by Tang et al. 2016 (https://doi.org/10.5194/nhess-16-2641-2016). Also because they mapped almost the same area. The existing study has extended this area a bit but followed basically the same approach and classification method.

Response #4

We disagree on these points. Firstly, the area we investigated is much larger than that covered by Tang et al. (it is almost three times larger! Figure 4, below). Secondly, the method has a key difference. In fact, differently from earlier works (Tang et al. 2016), where the same coseismic landslide polygon was used in the following years to evaluate, qualitatively, the level of activity in the attribute table (Figure 5-a), we quantified at each time changes of the level of activity based on new, actual polygon-mapping of remobilised areas (Figure 5-b). We have now pointed out this better in the revised manuscript. Note that only for ease of visualization and to facilitate comparisons, we retained the same definitions of the activity levels (A0-A3) as those given by Tang et al. However, it is clear that their meaning is not the same, because we actually re-mapped and thus quantified the remobilized areas on each imagery rather than providing a qualitative estimation of the activity level.

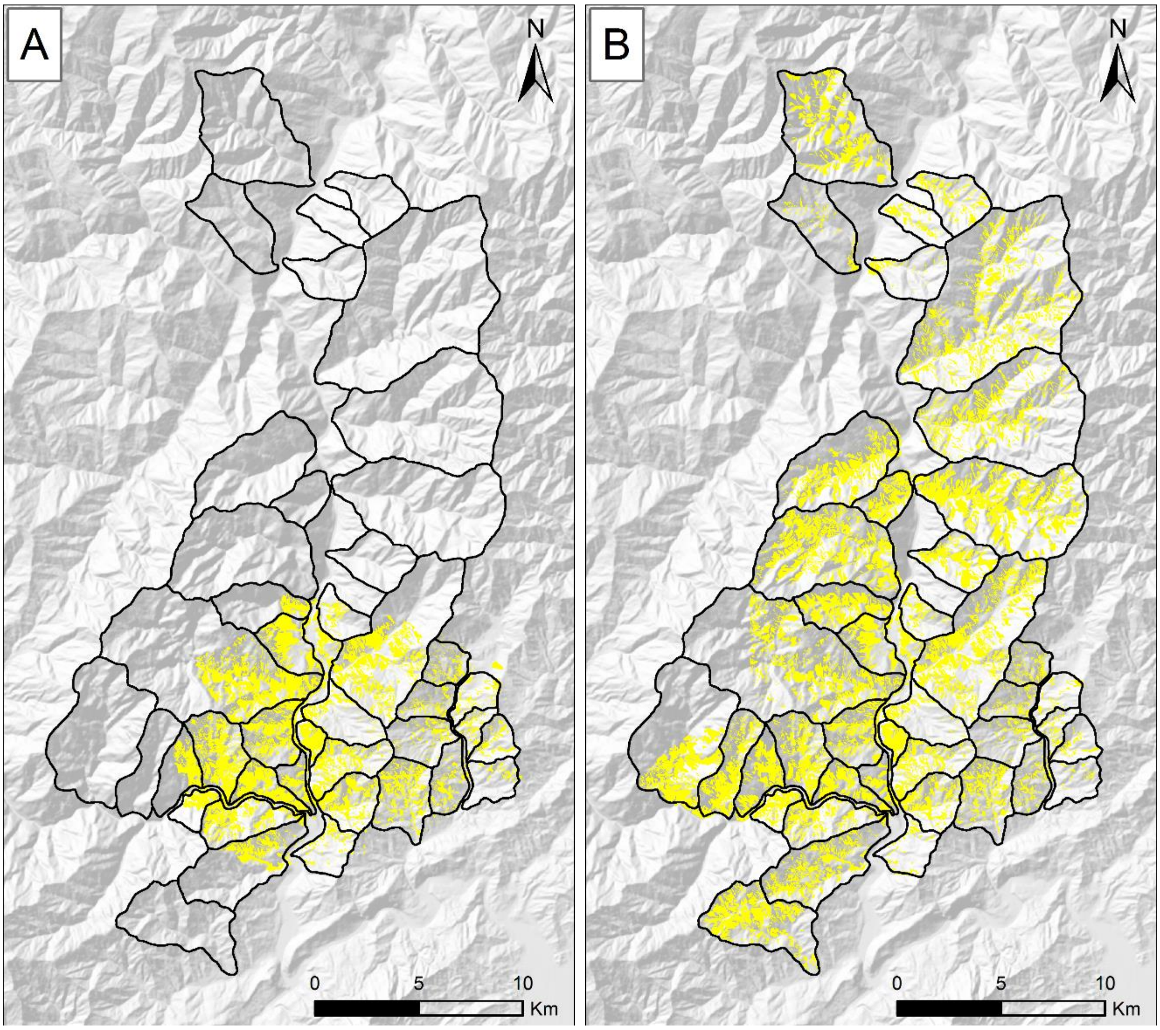

Figure 4: co-seismic mapping performed by Tang et al. (2016) (A) and by the authors of the manuscript (B).

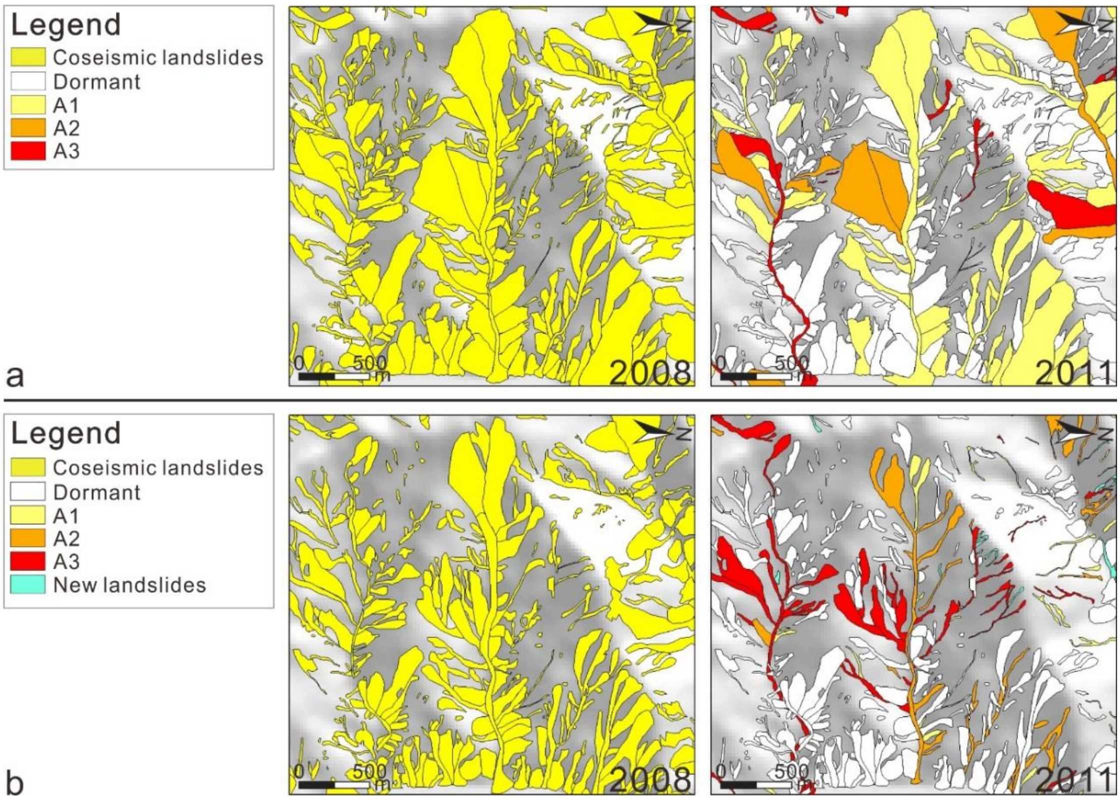

Figure 5: coseismic and post-seismic inventory for year 2011 performed by Tang et al. (2016) (a). In 2011, the same coseismic landslide polygons are used and the activity level is stored in the table of attributes. Conversely, in our multi-temporal inventory (b), we delineated the remobilised area.

Comment #5

If the paper is about the dataset, then it would be better to focus more on a quantitative analysis of the dataset. For instance by quantitatively analyzing the completeness and accuracy, and by comparing the dataset with other data sets for the same area (e.g. there are several co-seismic and postseismic landslide inventories made for this area).

Response #5

Our dataset is the first multi-temporal dataset that is freely downloadable from an open repository. Unfortunately, there are no other multitemporal datasets that cover the same area. Thus, we are unable to make a quantitative spatial analysis of our dataset for completeness and accuracy. Only qualitative comparisons could be made, by comparing our maps to those produced by other authors, but their value in a publication could be questionable.

Comment #6

The debris flow watershed database should also contain information on when and what was carried out in the watershed in terms of mitigation measures. A real analysis of debris flow occurrence, rainfall, and treatment of the watersheds is basically missing.

Response #6

Most of the mitigation measures carried out in the watersheds are landslide dams which retain the material during storms. In the Dataset 2 (see the repository: https://doi.org/10.5281/zenodo.1405489), we specified the number of dams present in each catchment. As pointed by the referee, it would be very interesting to know when the dams *were built. Unfortunately, this is information is missing in most of the cases so we did not included in the repository.*

Comment #7

What is the relationship between the two datasets? Are the events mapped as debris flows in the landslide dataset the same as in the debris flow dataset?

Response #7

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 remobilisations could not be identified. Furthermore, the source 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 the slides, hillslope and channelized debris flow and, mainly, form the existing channel deposits material, all of them presented in Dataset1. Dataset2 events have been reported by several authors (see references) but they were not systematically mapped, and this is why they have been represented as points. Differently from events in Dataset1, Dataset2 events in some cases include the information about the day and time of the occurrence. Therefore, these events can be correlated with the triggering rainfalls, included also in the Dataset2, to perform analysis of magnitude-frequency (temporal) for a later application of early warning systems, for instance. Nevertheless, these Dataset2 does not allow to carry out spatial analyses about the source material in terms of controlling terrain factors, or spatial and temporal evolution of instabilities; such analysis have to be carried out using the Dataset1. This has been clarified in the text.

Comment #8

The paper has a bit too many references for not being a review paper. In my view the number of references could be reduced a bit, only using the really relevant ones.

Response #8

We deleted some non-key or redundant references.

Comment #9

Specific comments: 1/16: event should be events

Response #9

Corrected.

Comment #10

2/23-24: landslide inventories are important for more reasons than indicated here. This could be further elaborated

Response #10

We re-elaborated this part in the manuscript.

Comment #11

2/26-27: "several" seems it of an understatement. This work contains over 44 inventories.

Response #11

We changed to "many".

Comment #12

2/33: examples of references are also from other earthquakes, like Kashmir (Saba et al).

Response #12

In fact, we write "after major earthquakes, particularly after …", meaning that Chi-Chi and Wenchuan are the most important, i.e. for which the most extensive research has been carried out, but not the only ones.

Comment #13

4/10: how realistic are these empirical area-volume relationships when you compare them for your study area. This would be interesting in terms of the dataset, and the resulting conclusions that can be drawn from them. If you take the data from Parker et al (2011) and your own dataset and compare the area-volume relationships, they might show large differences.

Response #13

Both Parker et al. and Xu et al. employed their relationships to estimate coseismic landslide volumes after the Wenchuan earthquake. Nevertheless, their results show large variability because of how the relationships were calibrated, hence the large difference between the estimations that we reported (0.8 and 1.5 billion m^3). A discussion on the reliability of these area-volume relationships is beyond the scope of this work, but can be found in the supplementary material (online resource n. 2) attached to Fan et al. (2018c). We included a reference to this in the revised manuscript.

Comment #14

6/1-6: Why did you not use different DEMs before and after the earthquake, given that the earthquake produced large differences in elevation?

Response #14

Unfortunately, a post-earthquake DEM for this area is not available. Also, we wish to point out that the earthquake did produce significant differences in elevation, but these are localized close to the fault rupture.

Comment #15

6/7: Why did you use two pre-earthquake scenes if the aim was to map post-earthquake changes? And one of these was a Landsat image with very coarser resolution than the others (See table 1)

Response #15

The use of multiple scenes is desirable in studies that requires to define a pre-earthquake background level of (rainfall-induced) landsliding (e.g., landslide rates, landslide patterns, etc.) so that the earthquake-dependent contribution can be extracted. Using a single scene would be questionable because a normalization, e.g. by using storm rainfall, cumulated rainfall, etc., cannot be verified.

Regarding Landsat's low resolution, we are aware of that, but we still deemed preferable to include this map rather than providing only one pre-earthquake image. The readers / users of the dataset can make their own evaluations on whether to use this map or discard it.

Comment #16

6/9-10: Why did you delineate the co-seismic landslides? This has been done by at least 4 other researchers?

Response #16

We needed to delineate them by ourselves to be able to provide a fully consistent multitemporal dataset. Differently, we would be unsure whether coseismic and postseismic maps are complete/reliable to the same extent. With this regard, we saw that different mappers can obtain different results in a small area, such as the control area we used in our study (see Figure 7 in the manuscript). Additionally, in the new section we added in the manuscript named "3.1.4 Comparison with existing inventories", we could check the differences between the inventories performed by Dai et al. (2011), Xu et al. (2014) and Tang *et al. (2016). We conclude that the differences are important and, therefore, it reinforces the idea of performing a new mapping although previous ones already existed.*

Comment #17

6/12 and Figure 4: How good can you separate debris flows from channel deposits? Debris flows end up in the river channels in such a steep environment.

Response #17

It is true that at the debris flow depositional area, the difference between debris flows and channel deposits can be quite challenging as both deposits are mixed. In case that the remobilization of the channel deposits occurs before than the debris flow deposition, the latter will be easily mapped. Conversely, the debris flow fan will be underestimated. However, in our study area, the debris flow deposits are deposited in a relatively flat deposition area avoiding the spreading of the deposit (Figure 4 in the manuscript). Therefore, the underestimation of the depositional area compared with the runout is quite small and it does not have a high influence for area assessment purposes.

Comment #18

Table 1: Country should be county

Response #18

Corrected here and elsewhere in the text.

Comment #19

Figure 3: A comparison with Tang et al. (2016) who did the same would be relevant in the analysis section.

Response #19

A comparison with Tang et al. (2016) has been carried out. For the ease of visualization, a figure comparing the two different mapping methods has been added.

Comment #20

Figure 4 and 5: these are also very similar to the ones in Tang et al. (2016)

Response #20

These figures are necessary to clarify to the readers the classification of landslides that we used (which is different from that of Tang et al.) and to exemplify what each level of activity means (this is not present in Tang et al., who only show two "examples of changes in landslide activity" without referring to the levels of activity explicitly). Furthermore, we mapped different types of landslides which were not considered in Tang et al. (2016) such as "channel deposits" and the differentiation between "hillslopes" and "channelized debris flows".

Comment #21

12: Uncertainties. Did you only map one small watershed by all mappers? This test area seems to be rather straightforward? It would have been good to show more on the background of the mappers, in terms of experience and background knowledge, and how the results were for all mappers individually.

Response #21

Yes, only this watershed was mapped by all mappers for testing purposes, because it contains all types of instabilities and activity levels present in the study area. Therefore, the results of these two features can be compared between all mappers (results for each mapper can be found in the supplementary material of Fan et al. (2018a). We decided to use this control area as a mean to quickly get an estimate of the error that could be produced by manual mapping performed by different subjects. ***As far as we know, this has not been done at all in other multitemporal inventories performed through manual mapping.*** *We appreciate the suggestions of the referee, though, as it would be interesting to be able to quantify the role of* *different background and experience of the mappers, even though they agree on the same sets of rules for landslide identification and classification. However, a much larger area mapped by all mappers would be necessary for this, which is very time consuming, and this goes beyond the scope of this paper.*

Comment #22

Also, comparison with other inventories generated by others would have been relevant.

Response #22

Please refer to our Response #5.

Comment #23

Table 3: consider rounding off the values.

Response #23

We believe the values should reflect the actual sizes and volumes. In this way, they are verifiable from the shape files that are provided in the repository.

Comment #24

Figure 7: provide more description and conclusion on the results of the area-frequency analysis.

Response #24

More description has been added to the "Descriptive statistics" part. More detailed information about the area-frequency analysis can be found in Fan et al. (2018).

Comment #25

15/18 : Describe more how the multiple dates of occurrence for so many watersheds were collected. How many surveyors? How often did they visit the areas? Etc.

Response #25

Most of the debris flow were obtained from literature review which includes 76 references (see file named "References of data sources" in the repository). For the bigger and most catastrophic events, we performed field investigations and interviews to the local residents with a minimum of two surveyors. There not exists a fixed period where we go to the field as it mostly depends on the rainfall, which is the most important triggering mechanisms for the post-seismic events. We also collected information form the monitoring system that SKLGP has installed in some catchments (see Figure 1). We clarified this in the text.

Comment #26

16/1-2: for how many of the debris flow watersheds was it possible to get rainfall data within 5 km?

Response #26

391 over 527.

Comment #27

16/12-14: describe the method in more detail and give reference to other work.

Response #27

We added information to describe the method and references to other works.

Comment #28

Table 4: how was the volume of the deposits determined?

Response #28

These events have been taken from the literature. Therefore, it will depend on each author.

Comment #29

Figure 8: Is this not already published?

Response #29

It is not published as we made this figure specifically for this publication.

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 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

Referee #4 – T. Gorum

Comment #1

The Wenchuan earthquake is a major event where many slope failures have been recorded (200,000>) in one single event. I think this is the most important earthquake in the last century in terms of the amount of debris that exposed. The importance of this earthquake in landslide science is not only due to the number of landslides it triggered. The change in the type and size of the landslides after the earthquake showed that the effects of the earthquake could last much longer than expected which is emphasized in the manuscript. The dataset revealed by this study was produced from very high resolution images to map the pre- and coseismic landslides, post-seismic reactivations of coseismic landslide debris and new landslides in the main earthquake struck the region. Unlike other studies in this respect, this contribution is based on the extensive results of the earthquake and made the data freely available to other researchers which are quite important to improve the current knowledge state regarding the coseismic landslide hazard. Moreover, the two multi-temporal data sets presented in this study have the potential to contribute for better understanding the relaxation phase of the landscape after major earthquakes and the full impact of earthquake-induced landslides on the landscape. This will allow for a more comprehensive understanding of temporal perturbations caused by strong earthquakes. My suggestion is that these two valuable datasets worth to be published after minor revisions.

Response #1

Dear Prof. Gorum,

We thank you for reviewing our manuscript. We sincerely appreciate your positive review. Please find our detailed reply below.

Comment #2

Please clarify the main difference between debris flows in different data set of co-seismic landslide and post-seismic reactivation and new landslides. Some of them, especially post-seismic reactivations, looks like torrents and/or channelized debris flows.

Response #2

Debris flows exhibited a finer material texture along a preferential movement path. They were found along the hillslopes (named hillslope debris flows) and into small channels (named hillslope debris flows). *.It has been clarified in the text*

Comment #3

Please consider changing the title of 3.1.3 “Simple statistics” to “Descriptive statistics”.

Response #3

Done for 3.1.3 and also for 3.2.3.

Comment #4

In general, the manuscript is lack of a rigorous description of the landslide volume calculations. Please give more details about the volume estimation of the debris flow deposited at the fan area and also for other volume estimation that has been used in the study for landslides.

Response #4

The volume of the debris flow deposited at the fan area (Dataset2) has been obtained from the existing literature. Regarding the volume calculated for the other landslides, it is true that just little information has been given about this. Actually, it has been done on purpose as the objective of the paper is to give a general vision of the prepared inventory and a few examples of different analyses that can be performed with this. Nevertheless, more information about the area-volume relationship can be found in Fan et al. (2018a). It has also been included bellow:

The volume (V) of the co-seismic landslides was estimated from the mapped areas using the empirical relation suggested by Xu et al. (2016), which was calibrated on a large set of co-seismic landslides triggered by the Wenchuan earthquake:

$$V = 1.315 \cdot A^{1.208}$$

where A is the landslide area (m2) and V is the estimated volume of the landslide (m3). The relation brings an uncertainty (±1 standard deviation in the calibration set) on the calculated volume of +14.7%/-13.8% (Xu et al. 2016). We employed the same volume-area relationship to calculate also the volumes of post-seismic remobilisations and new landslides, as we did not have any means to constrain them further. However, this assumption might cause an overestimation of the post-seismic landslide volumes, as bedrock landslides (a portion of the co-seismic landslides) are generally deeper than soil/debris landslides (the post-seismic remobilisations of the co-seismic deposits) with the same area, as noted by Larsen et al. (2010) and Parker et al. (2011).

The document "Readme.doc", attached in the repository, has been pasted here for the ease of referee 2. This document explains the different files found in the repository.:

Dataset 1

It contains shapefiles of the pre-, co-, and post-seismic landslides and the catchments where they are located. The area of study has an extension of 462.5 km^2 and it is located in the 2008 Wenchuan Earthquake epicentre. The information is distributed in 7 shapefiles. Information about each layer and attributes is detailed in Tab. 1.

Table 1 Reference image used to map the landslides, acquisition date, attributes and description of each layer contained in the dataset.

Name of the layer (.shp)	**Reference image: source / resolution / band**	**Acquisition date**	**Attributes**
DF_Catchments		-	Shape, Name, CID, Country, Area, Grad_chan, Grad_Mchan, Grad_catch, Leng_chan, Drain_Dens, Reli_Mchan, Reli_chan, Reli_catch
2005	Spot 5 / 2.5 m / multispectral	Pre-earthquake (July 2005)	ID, Shape, Area, CID
2007	Landsat 4 / 30 m / multispectral	Pre-earthquake (September 2007)	ID, Shape, Area, CID
2008	Aerial photos / 1-2.5 m / RGB-panchromatic	Co-seismic (May-July 2008)	ID, Shape, Area, Type, CID
2011	Aerial photos + Worldview 2 / 0.5-1 m / RGB-pansharpened	Post-seismic (April 2011)	ID, Shape, Area, Type, Act_level, CID
2013	Aerial photos + Pleiades / 0.5-2 m / RGB-panchromatic + multispectral	Post-seismic (April 2013)	ID, Shape, Area, Type, Act_level, CID
2015	Spot 6 / 1.5 m / pansharpened	Post-seismic (April 2015)	ID, Shape, Area, Type, Act_level, CID
2017	Spot 6 / 3 m / RGB	Post-seismic (April 2017)	ID, Shape, Area, Type, Act_level, CID
2018	Spot 6 / 3 m / RGB	Post-seismic (April 2018)	ID, Shape, Area, Type, Act_level, CID

Attributes: Shape (type of element: polygon, line, point); Name (Name of each catchment); CID (identifier for each catchment); County (Name of the county where the catchment is located); Area (Area of each element in m^2); Grad_chan (mean slope of the whole channels present in the catchment in decimal degrees); Grad_Mchan (mean slope of the main channel present in the catchment in decimal degrees); Grad_catch (mean slope of the catchment in decimal degrees); Leng_chan (total length of the channels present in the catchment in m); Drain_Dens (Leng_chan/Area in m^{-1}); Reli_Mchan (Relieve of the main channel: highest altitude minus lowest altitude of the main channel in m), Reli_chan (Relieve of all the channels present in the catchment: highest altitude minus lowest altitude of the channels m), Reli_catch (Relieve of the catchment: highest altitude minus lowest altitude of the catchment m); ID (identifier of each element); Type (type of landslide: s – slide; d – debris flow; cd – channel deposit); Act_level (level of activity of the landslide: 0 – activity level A0, dormant landslide; 1 – activity level A1; 2 – activity level A2; 3 – activity level A3; 4 – new landslide).

Dataset 2

It contains the records of the debris flows that occurred from 2008 to 2017 in Wenchuan (W), Pengzhou (P), Mianzhu (M) and Anxian (A) countries and the information on their triggering rainfalls recorded by a network of rain gauges. Information about each layer and attributes is detailed in Tab. 2.

Table 2. Structure of the dataset of debris flows and their triggering rainfalls.

Folder name	File name	File type	Layers/sheets	Attributes (columns)
DF_RG_inventory	DF_RG_inventory	Shape file (.shp) and spreadsheet (.xls)	debris_flows	DF_ID, CID, Gully_name, Latitude, Longitude, Year, Month, Day, Time_24h_, T_Comment, Source_vol, Depo_vol, List_of_RG, Monitoring, Reference
			rain_gauges	RG_ID, CID, coordinates, temporal resolution, units, data references
R_DF_ID_X*	A_B_CDEF	Spreadsheet (.xls)	-	date and time, amount of rain

Attributes: DF_ID: identifier of the debris flow; CID: identifier of the catchment to which the debris flow or the rain gauge belong; Gully_name: name of the catchment; Latitude: latitude of the debris flow event (º); Longitude: longitude of the debris flow event (º); Year: year the debris flow event occurred; Month: month the debris flow event occurred; Day: day the debris flow event occurred; Time_24h_: time at which the debris flow occurred (24 h); T_Comment: specifications on the time of occurrence of the debris flow (initiation, deposition or range of days); Source_vol: available material during the initiation of the debris flow (m^3); Depo_vol: volume of debris flow deposited at the fan area (m^3); List_of_RG: list of rain gauges (identifier) located in proximity to the debris flow event that were actively recording throughout the time window of interest for that debris flow; Monitoring: specifies if additional monitoring data are available for that event (Y: yes; N: no); References: source of each debris flow event.

* one folder for each debris flow event being “X” the debris flow event identifier (DF_ID). Each folder contains the rain gauges located within a distance of 5 km for a given event. “A” indicates the relative position of each rain gauge from the debris flow event in ascending order; “B” refers to the rain gauge identifier (RG_ID); C, D and E indicate the year, month and day of the debris flow event, respectively, and F refers to the starting time of the rain. Rain is expressed in mm. Each spreadsheet provides data from 7 days before to one day after the date associated with the debris flow event (DF_ID). Full data series are available, from the authors upon request, for further analysis.

Examples of well-monitored catchments

It contains two excel files with detailed information about Wenjia Gully, at Miangzhu Country, and Hongchun and Er gullies both located at Wenchuan country. Information about each layer and attributes is detailed in Tab. 3.

Table 3. Structure of the dataset for the monitored catchments.

File name	File type	Sheets	Attributes (columns)
Er_vel_rain_disc_dens	Spreadsheet (.xls)	debris_flows	Latitude and Longitude of each station (º),Rainfall intensity measured at R1 (mm/h); Discharge measured at S1, S2 and S3 (m^3/s); Flow density measured at S1 (g/cm^3) and Flow depth (m) vs flow velocity (m/s) measured at S1 (Peng et al., 2018)
Rainfall data	Spreadsheet (.xls)	Qingping_a	Rain gauge coordinates, Date, Daily rainfall (mm), Cumulative rainfall (mm) (You et al., 2018)
		Qingping_b	Rain gauge coordinates, Date, Time (h), Hourly rainfall (mm), Cumulative rainfall (mm) (You et al., 2018).
		Hongchun	Rain gauge coordinates, Date, Time (h), Hourly rainfall (mm), Cumulative rainfall (mm) (Tang et al., 2011)
		Er	Rain gauge coordinates, Date, Time (h), Hourly rainfall (mm), Cumulative rainfall (mm) (Cui et al., 2018)

Doc files:

“References of data sources.docx”: It contains a list of all the references.

Short Comment #1 – W. Yang

Comment #1

The 2008 Wenchuan earthquake triggered more than 190,000 landslides over 100,000 km^2 (Xu et al., 2013). This amount of coseismic landslides significantly altered local strata leading to enhanced post-seismic landsliding which may last for many years. Therefore, studying post-seismic landslide evolution is crucially important for the mountain hazard research groups as well as disaster management communities. Fan et al. provide a multi-year landslide inventory in the epicentre area and some debris flow data as well as precipitation data in the Wenchuan earthquake affected region. These landslide data in such a vast region is very scares. The multi-year landslide inventory in the Wenchuan region is very difficult to acquire, because the region is very large and also remote sensing images of this region are frequently contaminated by heavy clouds. From their work, it is obvious that Dr. Fan and her colleague devoted massive amount of money, time and energy in collecting and interpreting these data. If these datasets can be openly published, it has the potential to greatly push forward the frontiers of the post-seismic landsliding studies.

Response #1

Dear Dr. Yang, we are very grateful for your positive comment. We too believe that the availability of input datasets is of fundamental importance for a variety of studies and analyses through which the research community can improve the understanding of post-seismic landscape processes substantially. This is the spirit with which we compiled our datasets, that we are now making them available to the community.