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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.**

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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). 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). 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 thank the reviewer for the comments, but we would like to address following issues that the reviewer may have looked overlooked. Firstly, the area we investigated is much larger than that covered by Tang et al. (it is almost three times larger, please see 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.

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

We thanks the reiewer for the comment. For the coseismic inventory, as there are some other inventories available, we are able to compare our inventory with other polygon-based inventories, such as Dai et al. (2011); Xu et al. (2014) and Tang et al. (2016), please see the new section3.1.4 in the revised manuscript. For the post-seismic inventory, our dataset is the first multi-temporal dataset that is freely downloadable from an open repository. Unfortunately, there are no other multi-temporal 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.

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. Most of check dams were built in 2011-2012. Unfortunately, detailed date information for each dam is missing.

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 invento-



ries.

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 m3). 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.

Please also note the supplement to this comment:
https://www.earth-syst-sci-data-discuss.net/essd-2018-105/essd-2018-105-AC9-supplement.zip

Interactive comment on Earth Syst. Sci. Data Discuss., https://doi.org/10.5194/essd-2018-105, 2018.

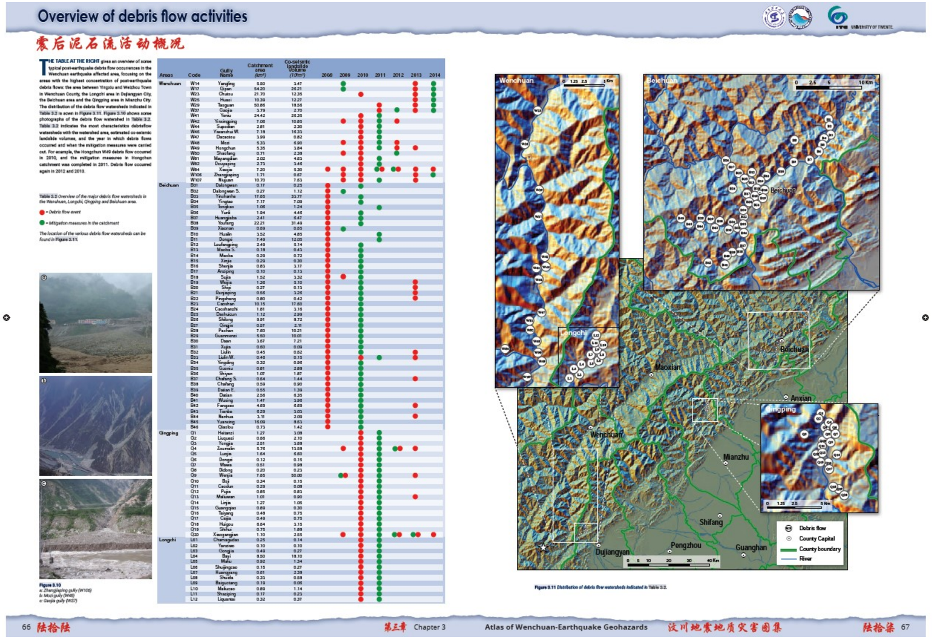
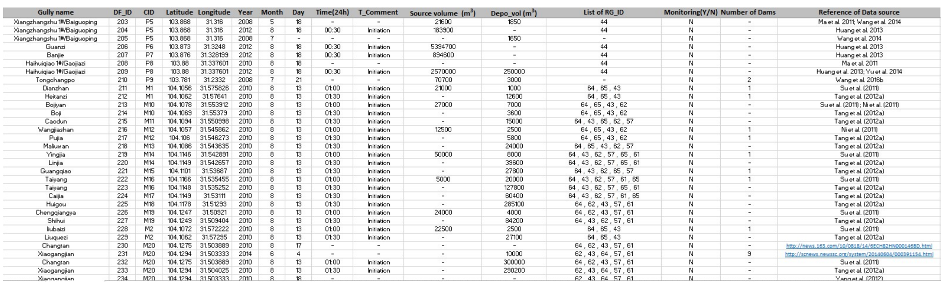



**Fig. 1.** The debris flow information from the Atlas (Tang and van Westen)





| 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/10/0818/14/6ECH82HN000146BD.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) |

**Fig. 2.** A screenshot of our debris flow database

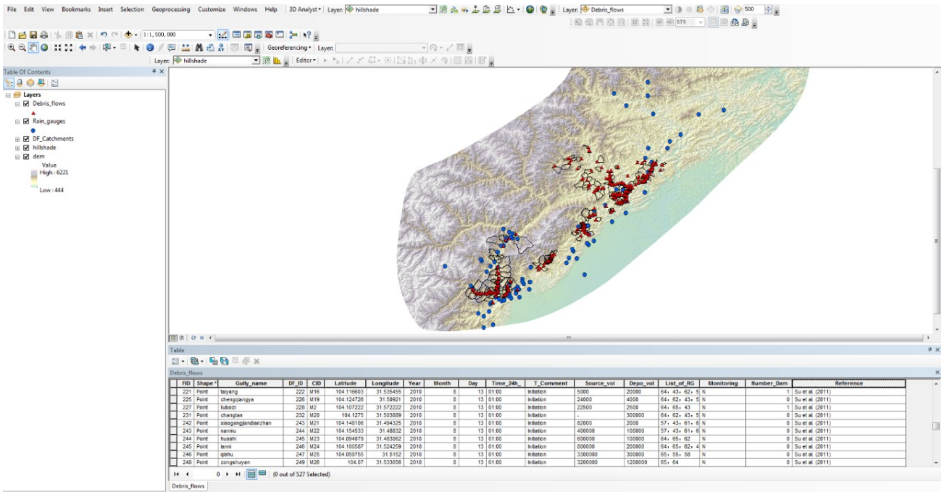


**Fig. 3.** A screenshot of the GIS shp file with detailed attributes



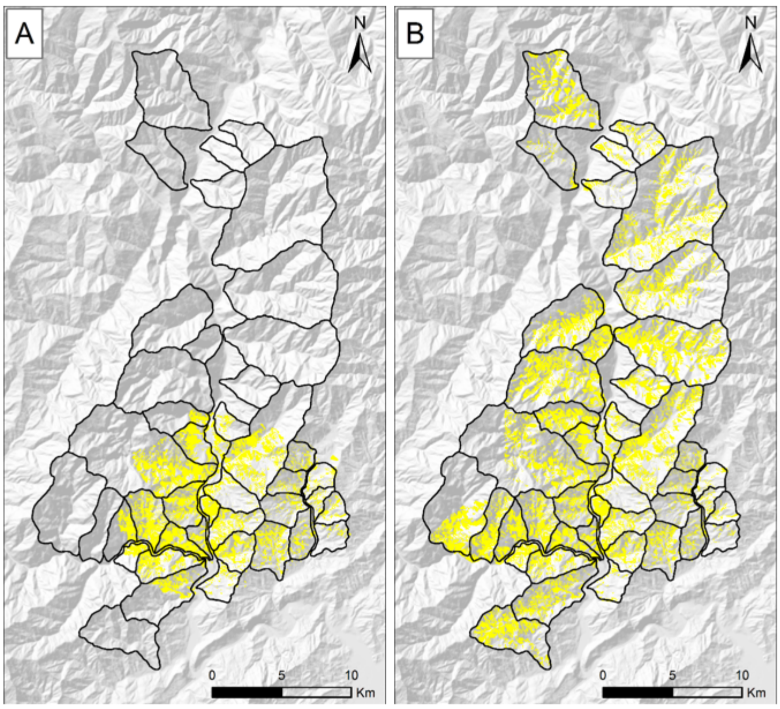



*Figure 4: co-seismic mapping performed by Tang et al. (2016) (A) and by the authors of the manuscript (B).*

**Fig. 4.** Co-seismic mapping performed by Tang et al. (2016) (A) and by us (B).

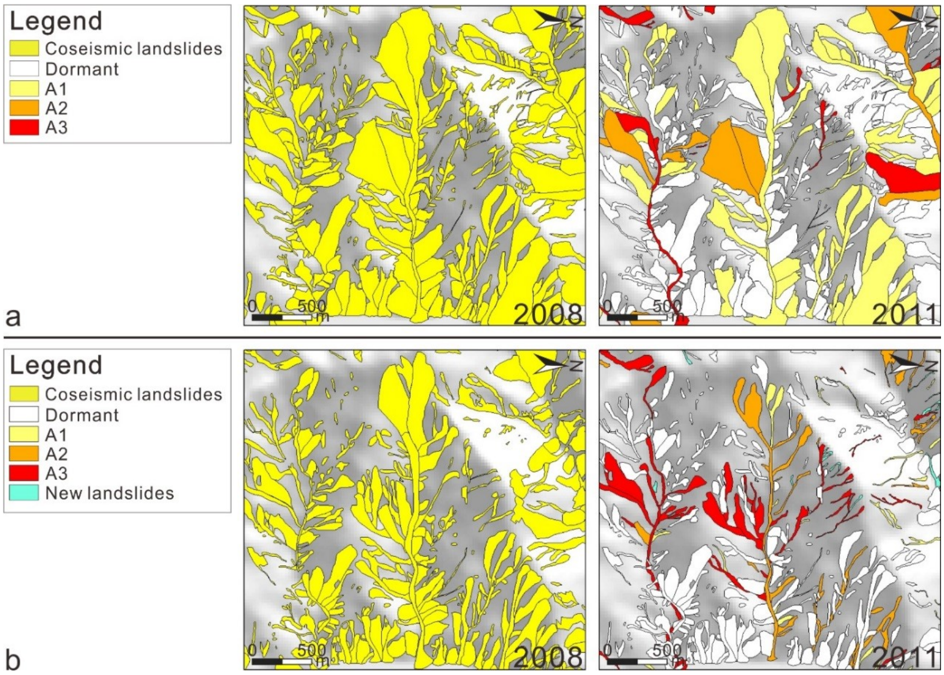



**Fig. 5.** Coseismic and post-seismic inventory for year 2011 performed by Tang et al. (2016) (a) and by us (b).