Dear Editor and reviewers,

We thank you for the insightful suggestions and comments, which greatly improved this paper. Following your suggestions and comments, we have revised the manuscript accordingly. Below please find our point-by-point responses. The comments are in black and our replies are in blue. We also highlighted changes in the manuscript in red.

Editors' comments:

I'm not sure if it would be any help, but a few years ago we described what we thought the geological manifestation of such swarm-related activity might look like in an ancient example from the Alps. See here: Dempsey, E.D., Holdsworth, R.E., Imber, J., Bistacchi, A. & Di Toro, G. 2014. A geological explanation for intraplate earthquake clustering complexity: the zeolite-bearing fault fracture networks in the Adamello Massif (Southern Italian Alps). Journal of Structural Geology, 66, 58-74, doi: 10.1016/j.jsg.2014.04.009

Thank you for your suggestions. Dempsey et al. (2014) provided geological evidence of the fluid-faulting interaction during the reactivation of interconnected fault networks, which is fundamentally consistent with our seismic observations. Whereas swarm 5 in our study further illustrates how the interaction between fluid diffusion and stress triggering can result in multiple isolated fault structures and fluid reservoirs being activated in a complex extended sequence that includes multiple large earthquakes. We added more content to discuss this point and cited this reference in the revision. (Lines 213-215)

"Geological investigation has highlighted similar role of fluid-faulting interaction during the reactivation of interconnected fault networks (Dempsey et al., 2014). Therefore, the evolution of swarm 5 further illustrates how the interaction between fluid diffusion and stress triggering when large faults are present can result in multiple isolated fault structures and fluid reservoirs being activated in a complex extended sequence that includes multiple large earthquakes (Figure 4)."

Reviewer #1 (Comments to the Author):

This is a review comment to the manuscript entitled "Intersection between tectonic faults and magmatic system promotes swarms with large magnitude earthquake around the Tengchong Volcanic Field, SE Tibetan Plateau" by Min Liu and colleagues submitted to Geology. The authors built an enhanced seismicity catalog and identified five earthquake swarms in the Tengchong Volcanic Field with multiple migration fronts indicative of fluid-driven earthquakes. In my opinion, the observations are very impressive and provide a detailed view of how a swarm sequence in volcanic settings may unfold. The catalog generated can also be an excellent resource for further in-depth modeling that could enhance our understanding of earthquake behaviors in volcanic settings. The manuscript is also very well-written, and I believe that the work would be of interest to the broader audiences of Geology.

I find no significant issues with the generation of the seismicity catalog or the analysis done by the authors. However, I think that some of the interpretations may need further justifications and the limitations of some of the arguments may need to be more clearly stated. There are also some other minor points that I outlined below. I believe that the authors can easily respond to these points, and I highly recommend publishing this manuscript after minor revisions.

Thank you for recognizing our work. Below please find our point-to-point replies.

Detailed comments:

Line 73-75: "While earthquake swarms sometimes occur on tectonic faults ..., they are less common than in volcanic regions". I don't think that this is true. Volcanic swarms are more common than tectonic swarms. In fact, the authors did point this out later in the manuscript: "tectonic swarms are less common than volcanic swarms" on Line 196.

Lines 73-75 in fact indicate that tectonic swarms are less common than in volcanic regions. (Line 74)

Line 119-120: The authors mention that for "mainshock-aftershock sequences", "the largest event occurs at the beginning of the sequence". This is not necessarily true because they can contain foreshocks. I suggest that the authors say "the largest event occurs toward the beginning of the sequence" instead.

Accepted. (Lines 110-111)

Line 127-128: When mentioning the back front for the first time here, I would recommend that the authors also cite the first paper that discusses the back front, which is Parotidis et al. (2004), similar to how the authors cite Shapiro et al. (1997) for fluid migration fronts. Since not all readers of Geology are seismologists, the authors should also describe what the back front is. One could illustrate them by drawing the back front in the figures (e.g., Figure S3).

Accepted. In the revision, we used purple curves to indicate potential back fronts in Figure S3. (Line 119)

Line 132-143: Swarm is a term without a formal definition. While you call swarm 5 a swarm, I would like to note that in Phase II, III, and IV, they look just like aftershocks of the M4.2, M5.2, and M5.2 events. Each of these phases seems to follow the famous Bath's law, the largest aftershock is about 1.2 magnitude smaller than the mainshock. The decay also seems to follow Omori-Utsu's law of aftershocks. Maybe it is a good opportunity here to more appropriately define "swarm" as you referred to in this paper.

Aftershock-like events are in fact common in swarms, because each earthquake may trigger aftershocks due to stress transfer, especially for relatively large earthquakes, as seen in the 2017-2018 Maple Creek swarm (Pang et al., 2019) and the 2016-2019 Cahuilla swarm (Ross et al., 2020). In our study, earthquake swarms are defined as earthquake sequences that lack a distinct mainshock occurring toward the beginning of the sequence. Thus, the cluster including three mainshock-like events M4.2, M5.2, and M5.2 can also be classified as earthquake swarms. We have made it clear in the revision. (Lines 110-111)

Line 165-167: I would also at least cite the original paper on the back front which is Parotidis et al. (2004).

Accepted. (Line 155)

Line 174: "Rock experiment" makes me think of a lab-scale rock friction study. However, Guglielmi et al. (2015) studied real faults in the field. Maybe an "In-situ" experiment may be more appropriate here.

Accepted. (Line 163)

Line 178-179: Here, you mention that some swarms are driven by both fluid diffusion and aseismic slip. In particular, fluid first induces aseismic slip and then triggers seismicity. Therefore, fluid remains a fundamental underlying driver of the swarms. I don't think this is necessarily true. While there is no doubt that fluids play a major role, they may not necessarily be the underlying "dominant" driver of the swarm. For example, there is an example of the 2020 Westmorland swarm in the Salton trough, California (Sirorattanakul et al., 2022), which is driven by both aseismic slip and fluid diffusion, but aseismic slip is the dominant driver. The swarm also has a migration front and back front. You can further test your theory by fitting both migration front and back front using the model from Parotidis et al. (2004). If you can fit them with a single diffusivity, fluid is probably the dominant driver. In the Westmorland example, a single diffusivity cannot fit both the main migration front and back front. In fact, apparent diffusivity for the migration front is inferred to be around 100 m2/s, while it is only 4 m2/s for the back front. Therefore, in such a case, the driving mechanism for the migration front is probably not the same as the back front, which turns out to be an aseismic slip.

We agree that comparing migration fronts and back fronts may help illuminate the underlying drivers of swarms. However, earthquake triggering due to stress transfer may lead to bias in diffusivity estimation from back fronts. In TVF, these swarms exhibit clear diffusive migration fronts indeed, and we cannot find any evidence supporting aseismic slip (e.g., linear migration front). Thus, we infer that fluids served as the fundamental underlying driver of these swarms. Note that this interpretation is only for swarms in the TVF, and we do not deny that there have been compelling evidence that swarms in other regions have involved aseismic slip. We have made it clear in the revision. (Line 168)

Line 186-187: There is an alternate explanation for high apparent diffusivity. Kim and Avouac (2023) have shown that the apparent diffusivity is generally not the same as actual hydraulic diffusivity because earthquake nucleation is not instantaneous. Therefore the migration of seismicity does not precisely reflect the exact location of fluid migration. Therefore, it is plausible that apparent diffusivity just overestimated the hydraulic diffusivity. In that case, the apparent diffusivity is no longer constrained to 0.01 - 10 m2/s.

Thank you for your suggestion. We added more discussion about Kim and Avouac (2023) in the revision. (Lines 177-179)

"Besides, a recent numerical modeling also implied that actual hydraulic diffusivity may be higher than that inferred from seismic migration fronts due to the non-instantaneous earthquake nucleation."

Availability of the catalog: I don't know whether the authors plan to release the catalog, as there is no mention of data availability. In my opinion, the catalog produced here has a lot of value, and I would highly encourage the authors to share the catalog in a public data repository.

Thank you for recognizing our catalog. We have attached it in the revision.

General comment on color coding in the figures: In general, I think it is more meaningful to color code the events by time (or time since the first event) rather than the event index. This allows the readers to also assess any time gaps in seismicity data.

Thank you for your suggestion. We tried to color these events by time. However, the detailed migration will be hidden due to the long time span in some swarms (e.g., swarm 2; see figure below). In the revision, we thus still color these events by event index, which can better exhibit the detailed evolution of these swarms.

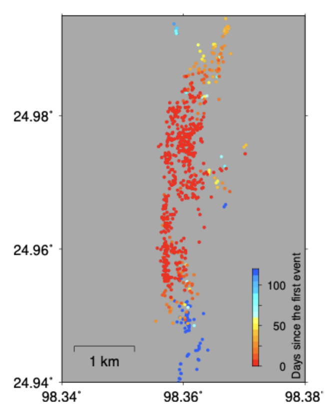

Figure 3: I find the color coding of the large events very confusing. Maybe it can be helpful to number or index these large events or mark them as "start" or "end" based on whether it marks the beginning and the end of that

particular phase. For Figure 3g, I do not see the location of the white star.

Sorry for the confusion. We now use white stars to mark the three main events in the revision. Meanwhile, we emphasized that the three main events divided swarm 5 into four phases in the figure caption. Besides, Figure 3g is mainly for highlighting the ring-like fault, and we have made it clear in the figure caption. (Lines 349-355)

Figure 4: In the third stage, you mention "shaking from a large earthquake can break previously sealed reservoir". You are implying dynamic triggering here. Why can't static stress also break the previously sealed reservoir?

We agree that static stress triggering can break the sealed reservoir as well. We have revised the descriptions of stages 2 and 3 in Figure 4.

Stage 3: "*Static and dynamic stress due to earthquakes can break previously sealed reservoir(s), with resulting fluid diffusion triggering more seismicity and further extending the earthquake sequence.*"

Supplementary Text S4: It would be good to discuss the completeness magnitude for the catalog or even show the magnitude distribution (Gutenberg-Richter plot) as a supplementary figure.
Thank you for your suggestion. We added a supplementary figure (Figure S9) to exhibit the G-R relationship (Mc=0.8) in the revision.

Supplementary Text S5: You mention that you do a manual inspection of event clusters and exclude background earthquakes and those that follow a single Omori's law. First, how do you characterize "background" earthquakes? I assume you look at the seismicity rate and compare those with the rate from the non-clustered earthquakes? Second, why are you limiting this to a single Omori's law? In mainshock-aftershock sequences, you also expect aftershocks of aftershocks. Therefore, you would expect the rates to be a superposition of multiple Omori's law. While in general, there should be only one dominant decay, sometimes one can have doublet mainshocks (and they are still not swarms).
1) Background earthquakes were defined as non-burst clusters in time, which were selected based on the manual inspection of seismicity rate.

2) We agree that the seismicity rate of mainshock-aftershock sequences should be a superposition of multiple Omori's law. But this phenomenon can also be observed in swarm sequences, because each earthquake may trigger aftershocks due to stress transfer, especially for relatively large earthquakes. In our study, swarms represent earthquake sequences without a distinct mainshock occurring toward the beginning of the sequence. Thus, these earthquake sequences that include mainshock-aftershock-like sub-sequences occurring later in the sequence (e.g., swarm 5) can also be classified as swarms.

In the revision, we reorganized the description of swarm identification to make the two points above clear. (Text S5)

"We systematically detect potential earthquake swarms from our newly developed catalog. Based on 3D earthquake hypocenters, we initially identified 664 earthquake clusters using the DBSCAN algorithm (Ester et al., 1996) with the sphere radius and minimum number of points defined as 0.5 km and 1, respectively. Eleven clusters with at least 100 events are then selected for manual inspection where we only keep burst-like clusters and exclude those mainshock-aftershock sequences with the largest events occurring toward the beginning of sequences. This leaves us with five earthquake swarms containing 5,905 events (Figures S1-S2)."

Supplementary Text S6: I found the observations that the focal mechanisms aligned well with the ring-like structure very impressive. I think it could be worth highlighting this more in the main text.

Due to page limit, we simply highlight this point briefly in the revised main text. (Lines 137-139)

Supplementary Figure S1: It would be beneficial to also include the cumulative number of events vs. time on the same plot. This can help the readers better assess whether they truly look like swarms or aftershock sequences (e.g., Phase II, III, IV of swarm 5).

Thank you for your suggestion. We added the cumulative number of events with time in Figure S1.

References

Kim, T., and J.-P. Avouac (2023), Stress-based and convolutional forecasting of injection-induced seismicity: Application to the Otaniemi geothermal reservoir stimulation. Journal of Geophysical Research: Solid Earth, 128, e2022JB024960.

Parotidis, M., S. A. Shapiro, and E. Rothert (2004), Back front of seismicity induced after termination of borehole fluid injection, Geophysical Research Letters, 31(2).

Sirorattanakul, K., Z. E. Ross, M. Khoshmanesh, E. S. Cochran, M. Acosta, and J.-P. Avouac (2022), The 2020 Westmorland, California earthquake swarm as aftershocks of a slow slip event sustained by fluid flow, Journal of Geophysical Research: Solid Earth, 127, e2022JB024693.

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Reviewer #2 (Comments to the Author):

This manuscript is VERY WELL written and is in good form for quick publication. I have included some very minor grammatical suggestions in the attached edited manuscript. I believe that the data collected, the methods of earthquake detection, and interpretation of results are all robust and worthy of publication. My major concern is with the figures and I'm hoping my concerns can be quickly remedied. Most of my concern is with Figure 3. I think each individual plot is too small and is hard to see the details that the authors describe in the manuscript. I realize there are figure limits to the submission but if there was a way to increase the size of each sub-panel that would be great. I have a feeling that the figures will be even smaller after formatting for publication. Other than that, I found the manuscript to be well-written and a pleasure to read.

Thank you for recognizing our work. We tried printing Figure 3 on an A4 paper and found that all details discussed in the main text can be clearly exhibited. Thus, we decided to keep the original version of Figure 3 in the revision. Meanwhile, we accepted the grammatical suggestions and made changes accordingly in the revision.

Reviewer #3 (Comments to the Author):

In this manuscript, Liu et al. examine earthquake activity near the Tengchong Volcanic Field in the southeastern Tibetan plateau using advanced seismological techniques. They build a new catalog of events using a data processing pipeline that includes deep-learning based phase identification high-precision relocation techniques. The main findings of this analysis are that a bit more than half of the earthquakes are accounted for by "swarms" on fault aligned with the regional stress field, and that the swarms exhibit migration activity possibly driven by fluid diffusion. The most prominent swarm included two M5 events in 2011. The authors suggest, based on this evidence, that earthquake swarms are prevalent where tectonic faults intersect with magmatic systems.

Overall, this is an interesting and well-written manuscript that I would support for publication in the Geology after moderate revision by the authors. The seismological analysis (which is my subject-matter background) is excellent and state-of-the art, and the findings are compelling and would appeal to readers across several geoscience disciplines.

My main suggestions involve the interpretations in the Discussion. It is the last sentence, "the interaction between large tectonic faults and magmatic system might promote the occurrence of large magnitude earthquakes within short intervals", that is most uncomfortable. Setting aside the vagueness (what precisely is meant by "large faults", "large earthquakes", and "short intervals"?), I think it is something of a leap to suggest that, based mainly on this study area (and a couple other selected case studies), that this connection between tectonics and magmatic systems is dominant or even prevalent in nature in the triggering of large events. [Note there are no "large" earthquakes directly considered in this study.] I imagine a rigorous global analysis would lead to the conclusion that most "large" earthquakes are in fact not associated with magmatic systems.

We are sorry that our statement misled you. We are not saying that most large earthquakes are associated with magmatic systems. Various studies have suggested that earthquakes in volcanic regions and tectonic faults have different behaviors. Volcanic earthquakes are mainly characterized by swarms but rarely involve large events due to material and stress field heterogeneity as well as the lack of large faults (Hill, 1977). In contrast, tectonic earthquakes are mainly characterized by mainshock-aftershock sequences, which can include very large earthquakes. Therefore, our main point is that unique environments where magmatic system intersects with large tectonic faults may facilitate the occurrence of large earthquake swarms. However, we acknowledge that our study is just a regional investigation, and whether our finding at the TVF applies globally remains to be further quantified. Thus, we removed the discussion about the generalization of our model globally and the vague term "short interval" in the revision. Instead, we introduced more examples with similar environments globally to highlight the importance of conducting a global survey of volcano-fault interaction as you suggested below. (Lines 223-228)

"Thus, our observations suggest that interaction between tectonic faults and magmatic systems can promote the occurrence of large-magnitude swarms. Similar environments can be found globally, such as at Coso in the United States, Mount Aso in Japan, and Andean cordillera in South America. Therefore, further study of fluids-faults interaction in these regions is critical to improve our ability to manage future earthquake hazards."

Besides, we do not precisely specify the size of large earthquakes (or faults), because it mainly depends on the seismogenic environments. Instead, we provide rough statements about large earthquakes (or faults) in volcanic systems. Besides, we also mentioned the historical earthquakes in and near the TVF to indicate what "large" means for the TVF. (Lines 66-69, 91-96)

"volcanic swarms are dominantly composed of $M_W<4.5$ events that occur close in time and space (Cox, 2016), though occasionally volcanic swarms associated with eruptions or caldera collapses can include large earthquakes ($5.0<M_W<7.0$; Patrick et al., 2020; Hildreth & Fierstein, 2012)"

"The TVF and its adjacent areas have hosted intense seismic activity including two M6.5 earthquakes in 1512 and 1577 in central TVF, a swarm of seven M>6.0 earthquakes from 1929 to 1933 in northern TVF, and two M7.2 earthquakes within two hours in 1976 in southeastern TVF (Figure 1a). Therefore, the TVF serves as a unique laboratory to probe the interaction between magmatic systems and large-scale tectonic fault systems."

It is however true that earthquake swarms are enhanced by hydrothermal activity, and I think the Discussion could be improved by focusing on this aspect instead through a brief survey of earthquake swarm activity beyond the handful of examples listed in the final paragraphs. The rather bold claims about the importance of volcanics in driving swarm activity could for example be strengthened by highlighting examples like the western US (Salton Sea / Coso / Mammoth / Long Valley / Yellowstone / Sheldon NV all come to mind), circum-Pacific subduction zones, and perhaps eastern Europe, areas where much of the research on earthquake activity has been performed to date. I think this would help the manuscript meet the bar of impactful, forefront-of the discipline science in line with Geology's guidelines.

Thank you for your suggestions. We have revised the manuscript as suggested (see above reply)

In addition, I've outlined a few minor comments and suggestions aimed at improving the analysis and presentation of the results. These are formulated line-by-line, in chronological order for clarity. Generally, the discussion of the methodology is very terse in the main text. It may be wise to include a few more details, mindful of the page constraints

Thank you for your careful review and constructive suggestions. Below please find our point-to-point replies.

Line-by-line comments and suggestions (bold/star comments need greatest attention):

Line 67: I don't think it is generally true that swarms are confined to M>4.5; many in the Salton Trough (Lohman and McGuire, Hauksson et al., etc.) and in the Walker Lane (e.g., Trugman et al., 2023) include high M4 and M5 events. And that's just in the western US, I imagine swarms in subduction zones (see papers by Brudzinski and colleagues, for example) include much larger events.

In this case, we are referring to earthquake swarms in volcanic regions, not swarms on tectonic faults e.g., subduction zone plate interface. However, considering volcanic swarms can occasionally include M5 (or larger) events especially during eruptions and caldera collapses, we have revised the sentence to "volcanic swarms are dominantly composed of M_W<4.5 events (Cox, 2016)". (Line 67)

Line 110: Though you may not have room to elaborate, it would be good to briefly clarify the full workflow in the main text, which appears to include detection, association, absolute location, relative relocation, and mechanism estimation.

The deep-learning-based workflow has been widely used in the seismology community and introduced clearly in a lot of literature (e.g., Liu et al., 2023). Considering the strict page limit of Geology, we kept the description of deep-learning-based workflow in supplementary but added a reference in the main text in the revision. (Line 103)

Line 117: DBSCAN applied to what? Epicenters in map view? Hypocenters in 3D? A time component too?

Clustering earthquakes in DBSCAN was based on 3D earthquake hypocenters, whereas the manual inspection of swarm identification mainly involved the time component. We have made it clearer in the revision. (Text S5)

Line 117: How are swarms defined and distinguished from other sequences (e.g., typical mainshock aftershock sequences)?

In our study, swarms are earthquake sequences that lack a distinct mainshock occurring toward the beginning of the sequence. Thus, swarms were separated from other sequences (e.g., mainshock-aftershock sequence) mainly based on a manual inspection of magnitude varying with time. We have made it clear in the revision. (Lines 110-111; Text S5)

Line 123: This would assume ML and Mw are equivalent and the events have a typical stress drop?

Stress drops of small-moderate earthquakes in the Yunnan region exhibit a typical range from 2.3 to 5.05 Mpa (Liu et al., 2010). Pang et al. (2021) used the gCAP method to calculate the moment magnitudes of the two M_L 5.2 main events, which are M_w 5.1 and 5.0, respectively. It suggests that the moment magnitude of an earthquake in Tengchong is lower than its local magnitude. ~1.5 km rupture dimension mentioned at line 123 was estimated based on M_w 4.7, thus the actual rupture dimensions of M_L 4.6 and M_L 4.7 should be less than ~1.5 km. In the revision, we added a section (Text S6) in supplementary to clarify this point. (Text S6)

Line 164 / Figure 2: Are these coefficients, and the variability, reasonable?

The diffusivities estimated from the migration fronts of swarms 1, 2, 3 and 5 range from 0.01 to 7 m^2/s, which reasonably fall in the general range of diffusivities (0.01~10 m^2/s) in the crust (Scholz, 2019). However, the apparent diffusivity of swarm 5 is ~40 m^2/s, higher than the upper limit (10 m^2/s) of the general diffusivities. Such high diffusivity may be explained by the presence of pressurized fluids at depth and the high permeability of fault zones or simply reflect the complex interaction of multiple mechanisms. Besides, a recent numerical modeling also implied that actual hydraulic diffusivity may be higher than that inferred from seismic migration fronts due to the non-instantaneous earthquake nucleation (Kim & Avouac, 2023). We added more content to discuss this point in the revision. (Lines 177-179)

Line 199: Is it obvious why seismicity should be parallel to SHmax? Is this a normal faulting regime? In any case, we see the seismicity at an acute angle to SHmax in Fig 1.

Tengchong region is dominated by a strike-slip regime. Line 199 "*we find that even though the seismicity delineate fault strikes that align with previously-mapped large tectonic faults and the regional tectonic stress field*" in fact indicates that the strike directions of those revealed faults are consistent with the dominant rupture direction inferred from the regional tectonic stress field (i.e., SHmax ± 30°; e.g., Yu et al., 2022). We have made it clearer in the Text S8.

Line 225: I'm surprised that the concept of "fault valving" is not mentioned or discussed in this study. It seems to be in line with the conceptual model for Figure 4?

"Fault valving" mechanism is in fact common in swarm activity and has been widely discussed in a lot of literature (e.g., Ross et al., 2020; Liu et al., 2023). Thus, we added a simple discussion in the revision due to the page limit. (Lines 205-207)

"These observations also highlight the "fault valving" mechanism in which earthquake faulting can dramatically increase permeability, enabling fluids to flow further (Sibson, 1981)."

Line 227+: Here you could also connect to earthquake swarms in the WUS to broaden the scope and relevance of the work.

Thank you for your suggestion. We have revised the manuscript as suggested. (Lines 225-228)

"Similar environments can be found globally, such as at Coso in the United States, Mount Aso in Japan, and Andean cordillera in South America. Therefore, further study of fluids-faults interaction in these regions is critical to improve our ability to manage future earthquake hazards."

Line 234: As mentioned above, this sentence is replete with vague adjectives that need to be qualified or made more precise (though it may be better to remove the sentence entirely)

The main point of our study is that the unique environment in which magmatic system intersects with large tectonic faults may facilitate the occurrence of large earthquake swarms. In the revision, we removed some vague words and made our main point clear. (Lines 223-225)

"Thus, our observations suggest that interaction between tectonic faults and magmatic system might promote the occurrence of large-magnitude swarms."

Text S2: In the S1, you obtain 60,000 events. What happened to the 40,000+ you skip here?

The initially associated ~60,000 events are located in the region with latitude ranging from 24.6 to 25.6 and longitude ranging from 97.8 to 98.8. Among them, only 19,954 events that occurred in our target area (i.e., TVF: latitude: 24.7° to 25.3°; longitude: 98.25° to 98.80°) were relocated and further analyzed. We have made it clear in the revision. (Text S1-S2)

Text S2: To be clear, you use catalog differential times in hypoDD, and then waveform cross-correlation times in GrowClust?

Yes, catalog differential times and waveform cross-correlation-based differential times were used in hypoDD and GrowClust, respectively. We have made it clear in the revision. (Text S2)

Text S5: Can you expand / clarify a bit on how you separate swarms from mainshockaftershock sequences. Quantitatively, what does it mean to "follow a single Omori law?"

We first used DBSCAN to identify burst-like earthquake clusters based on the epicenters of earthquakes. Whereas the mainshock-aftershock sequences and swarm sequences in our study represent burst-like clusters with and without a distinct mainshock occurring toward the beginning of the sequence, respectively. Therefore, we separated swarms from mainshock-aftershock sequences mainly based on a manual inspection of magnitude varying with time. Besides, we realized that the mainshock-aftershock sequences should be a superposition of multiple Omori's laws, because each aftershock may also trigger aftershocks. Thus, it was not reasonable to say "a single Omori's law" in our precious version of manuscript. In the revision, we reorganized the description of swarm identification procedure. (Text S5)

"We systematically detect potential earthquake swarms from our newly developed catalog. Based on 3D earthquake hypocenters, we initially identified 664 earthquake clusters using the DBSCAN algorithm (Ester et al., 1996) with the sphere radius and minimum number of points defined as 0.5 km and 1, respectively. Eleven clusters with at least 100 events are then selected for manual inspection where we only keep burst clusters and exclude those mainshock-aftershock sequences with the largest events occurring toward the beginning of sequences. This leaves us with five earthquake swarms containing 5,905 events (Figures S1-S2)."