Review #1

I found manuscript entitled "Spatiotemporal Heterogeneity of *b* Values Revealed by a Data-Driven Approach for June 17, 2019 M_S 6.0, Changning Sichuan, China earthquake Sequence" very interesting and worth to be published. The composition, reasoning and presentation of results are clear and understandable. However, I have some issues , which should be cleared before accepting the manuscript for further editorial steps. I list them below:

1. My main concern is the b-value analysis done by authors. Missing point in this analysis is how the b-value was fluctuating in the same area long before the main event. If the b-value is stable it should be more or less the same in shorter period long before the main shock, than taken into account in this analysis. Authors calculated b-values before and after the main event, but did not checked if during the time of almost 10 years before the main event, there were any changes in b-value in the analyzed area. Assuming that b-value distribution in time and space is stable according to other studies is in my opinion not enough. The b-value spatiotemporal distribution should be checked for annual changes or cumulatively 1 year before the main event, 2 years before the main event etc. It should clearly show if the main finding of the study of the low *b*-value location in the area of main shock is a long term feature of the process.

RE: We are very grateful to the reviewer for pointing out this problem and giving a detailed research scheme. In accordance with the scheme given by the reviewer, we have studied the temporal variation of *b* values on the scale of 10 years before the Changning earthquake and verified the spatiotemporal heterogeneity of *b* values of Figure 6b.

According to the temporal and spatial evolution characteristics of *b* values, we divide the region A'B'C'D' into three sections, Section 1 with lower *b* values uniformly and stably distributed in time and space and containing the nucleation point of mainshock, Section 2 with higher *b* values extending to the nucleation point, and section 3 with higher *b* values always distributed. We used a fixed window of 300 seismic events and a window of gradual cumulative increase with 300 seismic events. In both methods, the earthquakes are selected and calculated retrospectively from the failure time of the mainshock to the past, and the calculation is stopped when there are less than 300 events in the current window/step. The reason why we use 300 earthquake windows/steps subjectively is to ensure the statistical reliability when fitting the OK1993 model, and to obtain more results of temporal variations of *b* values at the same time.

The results (Figure S3) show that the temporal variations of the *b* values of segment 1 is very stable and maintains a lower value (about 0.75), the *b* values of segment 2 continuously increases from 0.8 to about 1.2, and the *b* values of segment 3 is always greater than 1.0 and it climbed rapidly about one year before the mainshock. The temporal variations of *b* values of three segments are highly consistent with the spatiotemporal migration pattern in Figure 6b, which further verifies the reliability of Figure 6b. it is also confirmed that the area where the nucleation point is located has stable lower *b* values on the long-term scale close to 10 years before the mainshock.

For a detailed explanation of the above content, please refer to Figure S3 and the text in the *Supplementary Materials*. We also briefly described the above supplementary content in the " Spatiotemporal Heterogeneity of *b* values" section of the revised manuscript. This added Figure S3 is also posted here.

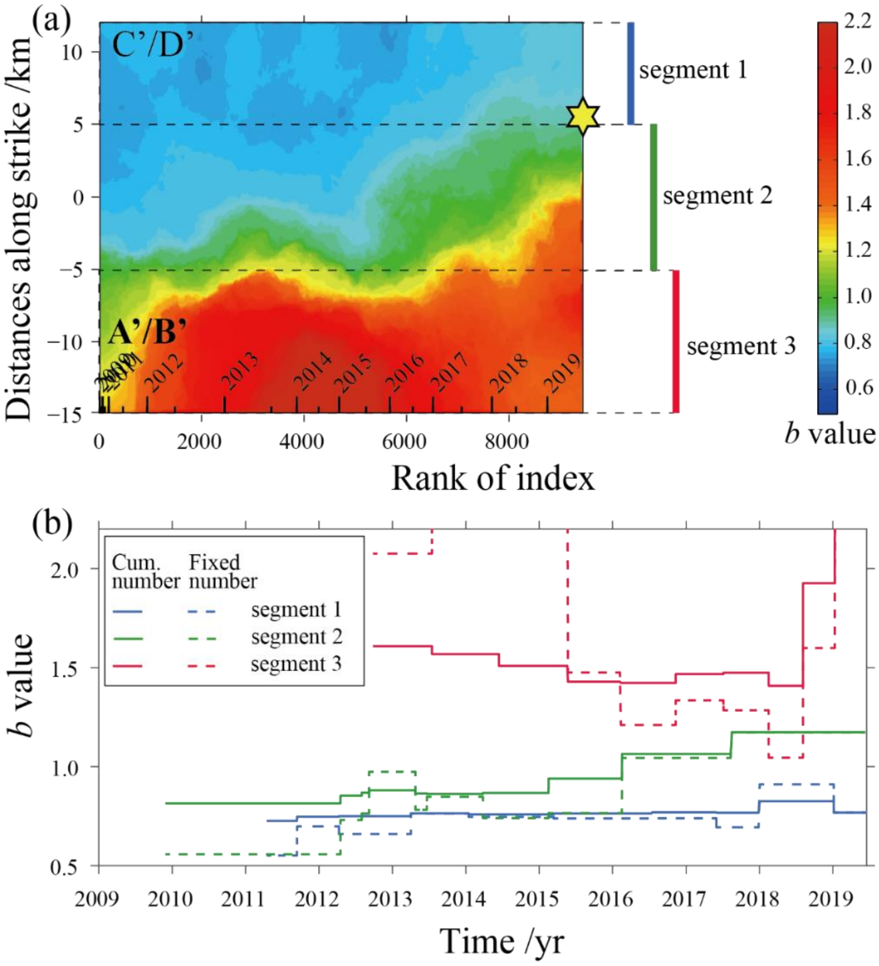

Fig. S3 The temporal variations of the *b* values before the Changning earthquake. (a) The temporal and spatial distribution of *b* values (Figure 6b) before the Changning earthquake and the division of spatial segments (Segment 1, 2 and 3) for the study of temporal variations of the *b* values. (b) The temporal variations of the *b* values in three segments before the Changning earthquake. The solid lines and the dashed lines respectively represent the *b* value results obtained by using a fixed window of 300 seismic events and a window of gradual cumulative increase with 300 seismic events, and different colors indicate the results on different segments.

2. It is well known, that the b- value estimation methods may be sensitive to both magnitude range and completeness level. Did You check Your methods towards this issue?

RE: The question pointed out by the reviewer is very important. We have added some work in the *Supplementary Materials* to discuss whether the *b* values calculation results are sensitive to completeness level. we randomly deleted 13.5% of the 18371 events (the same as the number of events lost in the relocation) in space and recalculated the *b* values of Figure 4a and the uncertainty of Figure 5a. The Figure S5 in the *Supplementary Materials* show that the distribution of the *b* values and its uncertainty obtained after this loss of part of the events is still relatively close to Figure 4a and Figure 5a, which also implies that the completeness level will not significantly affect the results of this paper. For a detailed explanation of the above content, please refer to Figure S5 and the text in the *Supplementary Materials*. This added Figure S5 is also posted here.

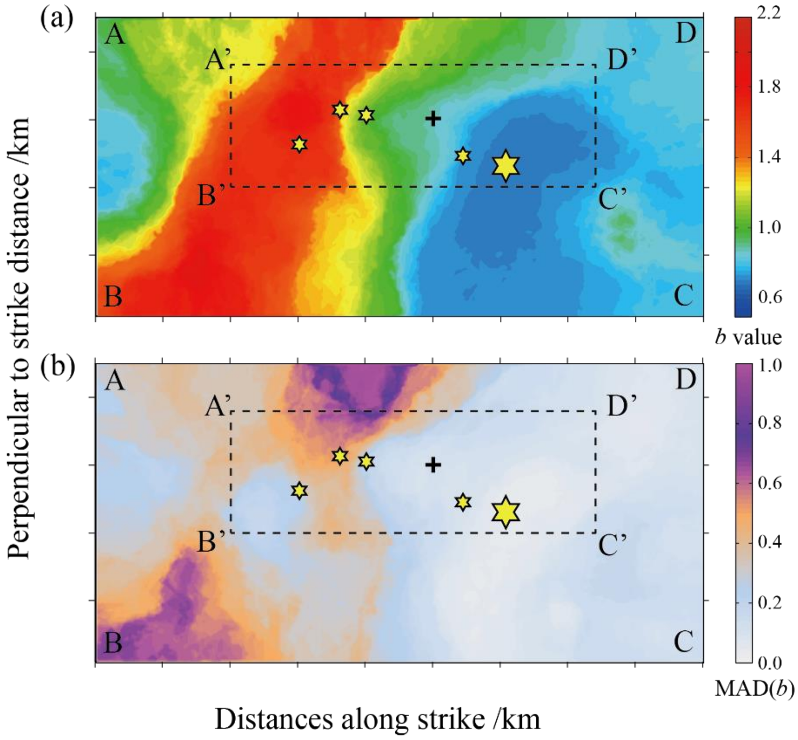

Fig. S5 Distribution of the ensemble *b* values (a) and MAD *b* values (b) of the best-100 solutions prior to the Changning M_S 6.0 earthquake, in which the events used were randomly deleted from 13.5% of the 18371 events.

3. I can't find the completeness level value in the manuscript. What was the completeness level of the data set? I think, it should be calculated and taken into account in the analysis. Otherwise, the *b*-value computations may be spoiled.

RE: The analysis of the minimum completeness magnitude M_c of the earthquake catalog is an important basis for the calculation of *b* value. we added Figure S4 of the M_c distribution in the *Supplementary Materials*, and it is also posted here. Please refer to the section of “Minimum Completeness Magnitude and its Influence on the Calculation of *b* Values” in the *Supplementary Materials*.

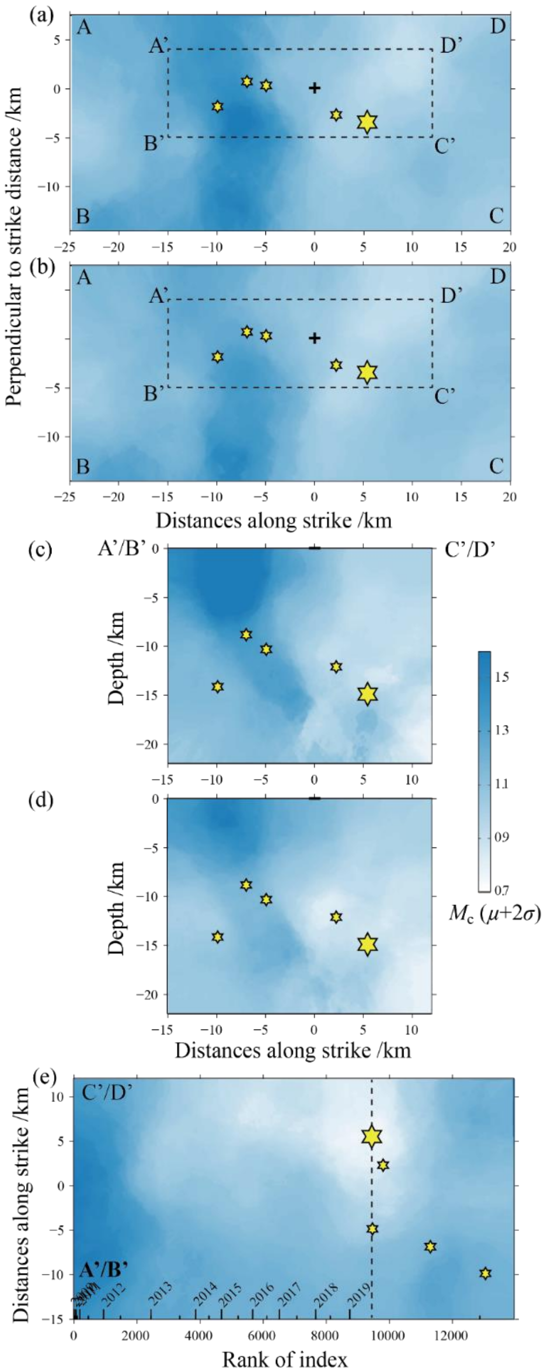

Fig. S4 Distribution of minimum magnitude of completeness $M_c(\mu+2\sigma)$. (a) Distribution of $M_c(\mu+2\sigma)$ on the horizontal plane after the rotation calculated by the events before the Changning M_S 6.0 earthquake; (b) Distribution of $M_c(\mu+2\sigma)$ on the horizontal plane after the rotation calculated by all the events including the aftershocks of the Changning M_S 6.0 earthquake; (c) Distribution of $M_c(\mu+2\sigma)$ in the rectangular frame A'B'C'D' on the depth profile calculated by the events before the Changning M_S 6.0 earthquake; (d) Distribution of $M_c(\mu+2\sigma)$ in the rectangular frame A'B'C'D' on the depth profile calculated by all events including aftershocks of the Changning M_S 6.0 earthquake. The hexagonal star marks the locations of the mainshock and four aftershocks with magnitude no less than 5.0.

4. The last issue is related with the activity rate in the studied area. It was not included in the

analysis. Activity rate of the events respectively to b-value may be very informative. It may be interesting to see, what was the activity on the considered area (eg. within Voronoi cells) and cross-sections.

RE: The activity rate proposed by the reviewer is very important information, but because the OK1993 model used in this article is a continuous function describing the magnitude-frequency relationship, so it is difficult to directly obtain the activity rate compared to the traditional G-R relationship. But anyway, the reviewer's suggestions are very enlightening, thank you again.

5. I would suggest to change the color of the fault lines to black in Fig. 1, because they are hardly visible when plotted together with the aftershocks.

RE: Thanks to the reviewer’s suggestion, we have changed the color of fault lines in Fig. 1 to black, and the revised Figure 1 is posted here.