Dear Editor,

Thank you very much for handling our paper titled " Spatiotemporal seismicity pattern of the Taiwan orogen". We have read the review carefully and have accordingly made substantive modifications to the manuscript and explained the details in the response letter below. Line numbers refer to the clean version of the manuscript. We believe the revision can draw your reconsideration of publication in Natural Hazards and Earth System Sciences.

Sincerely,
Yi-Ying Wen and co-authors

Reviewer #1:

We thank the reviewer for the insightful and positive review of our work. We have read the review carefully and have accordingly made substantive modifications to the manuscript and explained the details in the response letter below. Line numbers refer to the clean version of the manuscript.

Comment: 1. Since the author proposed the distinctive patterns between Q-type events and A-type events corresponding to tectonic settings, the focal mechanism (beach ball) of these 8 events should be plotted on the map in Figure 1 and Figure 3. The focal mechanism will help the readers to understand the fault types and the regional tectonic setting. If any interesting pattern shows up, making some discussions on it would be great.
Reply: Thank for reviewer's suggestion. We have added the focal mechansims in Figures 1 and 3, with the related discussions in L. 264-265 and L. 280-283.

Comment: 2. The RTL values before the Nos. 2, 5, 8, 3, and 4 events are small compared to the max to min range shown in Figure 2. To justify that these variations are statistically significant, it is necessary to show the error of these blue lines (Make a zoom-in version in the 4 years before the mainshock if necessary). The readers would like to see the variations are significantly higher than their measurement errors.
Reply: The data used in the RTL algorithm are location, occurrence time and magnitude of earthquakes, and a change in RTL value represents that the seismicity rate changes to different state with respect to the background level. R, T, and L are dimensionless functions and normalized by their standard deviations. Therefore, there are no measurement errors. As the description in L. 83-84, the weighted RTL value reflects the combined deviation from the background seismicity level (R_{bk}, T_{bk} and L_{bk}). The negative RTL value represents the seismic quiescence, and the positive RTL value suggests the seismic activation. Therefore, the investigated events are classified by the seismicity change before their occurrences. Wen and Chen (2017) used various periods of catalog (8- to 24-yrs) to examine the influence of the background seismicity. They found that the temporal RTL functions of different background lengths show similar main patterns with different values. Although the absolute RTL values prior to event Nos. 2, 5, 8, 3 and 4 are

small, they could still reflect the seismicity changes increased or decreased from the background rates.

Comment: 3. The authors already explained the strong effects of the 2003 Chenkun earthquake on the results during 2002-2004 in Figure 2. However, some interesting patterns in these plots in Figure 2 still need more explanations. For example, positive RTL values right before the 2012 M6.3 event in the plot of the No. 8 event, and negative RTL values right before the M6.1, M6.2, and M6.4 events around 2010 in the plots of Nos. 6 and 7 events. They show reverse patterns in the RTL values before these mainshocks and the target mainshock that occurred several years later, why?
Reply: The RTL function represents the different stages of seismicity rate change at the target location. As discussion in L. 185-189, the difference in the 10-year background period affects the weighting of the deviation, thus, the seismic quiescence during 2007-2009 shown in RTL function of event Nos. 7 is evaluated as the background seismicity level in the RTL function of event No. 3. In addition, in plots of event Nos. 6 and 7, the M6.1, M6.2, and M6.4 events around 2010 are event Nos. 3, 4 and 5, respectively, and they contribute different effects to the RTL functions based on their magnitudes, locations, and occurrence time with respect to the target events.
In L. 196-197, we mention that the seismic activation during 2011-2012 is widespread (maps of Nos. 6 and 7 in Fig. 4) and showed in the RTL functions of event Nos. 6, 7 and 8 (Fig. 2). Wen et al. (2016) suggested that, after the 2010 Jiashian earthquake (event No. 5), the 2-year seismicity increase is caused by the increase in Coulomb stress change and the 2012 M6.3 event is regarded as the aftershock. We have added some discussion in L. 198-200.

Comment: 4. At line 135, "We note that the length of the seismic quiescence stage prior to the Q-type event might correspond to the magnitude." It will be great if the authors can label the magnitude information of these eight events on each title of the plot in Figure 2.
Reply: We have added the magnitude information in Figure 2.

Comment: 5. The way how the data are presented in Figure 4 is kind of 'biased'. It is necessary to show the values between [0, +1] in Figure 4a and the values between [-1, 0] in Figure 4b. If the observations of the decreased and increased RTL values before each mainshock are significant enough, we should be able to see it based on the plots with a range from -1 to +1 for each event instead of only showing half of it and hiding the other half.
Reply: We understand reviewer's point. As shown in Figure R1, although most pattern of seismic quiescence or activation distribution can be identified as Fig. 4, using a range of [-1, +1] would weaken the feature around some target events. Since this response letter (including Figure R1) is open to the public, we would keep the original figure to avoid the confusion.

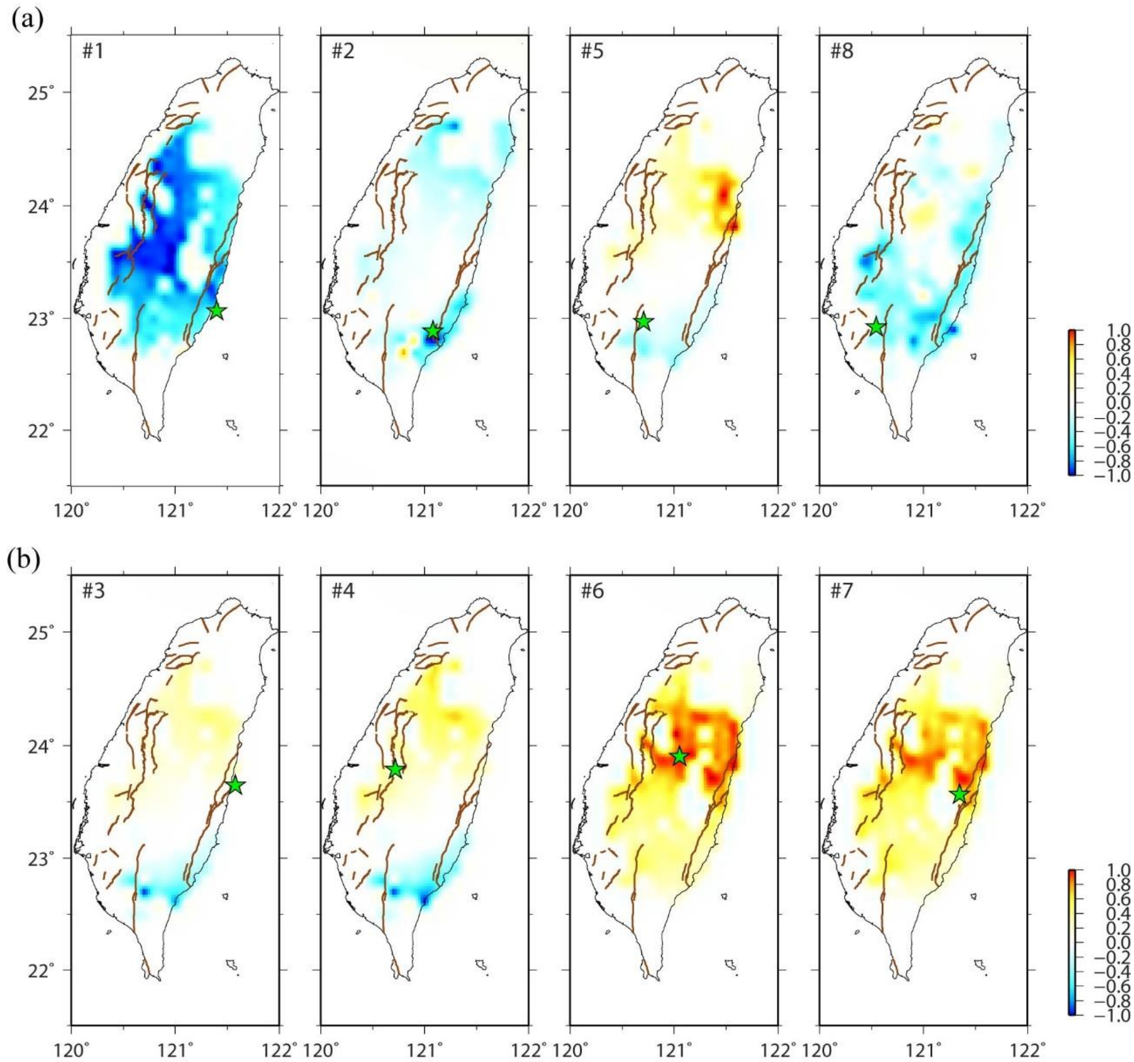

Figure R1: The summed and normalized seismic activation/quiescence map for the selected time window of the temporal RTL function of (a) Q-type events, and (b) A-type events. Stars represent the locations of the investigated events. The active faults (thick lines) identified by the Central Geological Survey of Taiwan are also shown. This figure is similar to Fig. 4, but showing with values between [-1, +1].

Comment: 6. At line 102, "catalog completeness is an important factor". M2.5 is a reasonable magnitude completeness value for the whole CWBSN catalog. However, since the seismic station density is not exactly uniform in Taiwan, the magnitude completeness should have some spatial variations in different regions in Taiwan. For the nearby region of eight events analyzed in this work, the authors need to justify if M2.5 is a good magnitude completeness value for all of these events. To show this, I suggest the authors also plot the data between M0-2.5 in Figure 5. The readers would like to see if there is a clear change in the slope around M2.5 for all the plots in Figure 5.

Reply: We agree with reviewer that the magnitude completeness has the spatial variations in different regions in Taiwan, as pointed out by Mignan et al. (2011). For the RTL calculation, the prior events that occurred in a defined space with $r_i \leq 2r_0$ are took into account. In this study, we obtain the average $\widetilde{r_0}$= 49.6 km. Therefore, for each target event, the prior seismicity within a circle of $2\widetilde{r_0}$ (about 100 km) in radius is analyzed, which covers most area of Taiwan. Thus, we use the magnitude completeness of M2.5 in this work, which is also consistent with the previous studies.

- Mignan, A., Werner, M. J., Wiemer, S., Chen, C.-C., and Wu, Y.-M.: Bayesian Estimation of the Spatially Varying Completeness Magnitude of Earthquake Catalogs. *Bull. Seismol. Soc. Am.*, **101** (3): 1371–1385. doi: https://doi.org/10.1785/0120100223, 2011.

Comment: 7. At line 336, "the mechanisms causing these different phenomena are not clear, and further study is still needed.". I suggest moving this to the end of the discussion section and expanding it by adding some details. For example, to get more useful data on small earthquakes with a magnitude below 2.5, future studies can build a more complete earthquake catalog in Taiwan using some state-of-art techniques developed in recent years. Machine-learning-based earthquake detectors and template-matching techniques will be helpful. Liao et al. (2021) and Zhai et al. (2021) can be cited as recent example studies.

Reference:

Liao, W. Y., Lee, E. J., Mu, D., Chen, P., & Rau, R. J. (2021). ARRU phase picker: Attention recurrent-residual U-Net for picking seismic P-and S-phase arrivals. Seismological Research Letters, 92(4), 2410-2428.

Zhai, Q. S., Peng, Z. G., Chuang, L. Y., Wu, Y. M., Hsu, Y. J., & Wdowinski, S. (2021). Investigating the Impacts of a Wet Typhoon on Microseismicity: A Case Study of the 2009 Typhoon Morakot in Taiwan Based on a Template Matching Catalog. Journal of Geophysical Research-Solid Earth, 126(12). https://doi.org/10.1029/2021JB023026

Reply: We have modified the discussion in L. 323-328 and added the references in the list.

Comment: 8. A possible typo in the captain of Figure A2: "B-type" -> "Q-type".

Reply: We have corrected it.