

Nat. Hazards Earth Syst. Sci. Discuss., referee comment RC1
<https://doi.org/10.5194/nhess-2022-242-RC1>, 2022
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Comment on nhess-2022-242

Anonymous Referee #1

Referee comment on "Spatiotemporal seismicity pattern of the Taiwan orogen" by Yi-Ying Wen et al., Nat. Hazards Earth Syst. Sci. Discuss.,
<https://doi.org/10.5194/nhess-2022-242-RC1>, 2022

This paper uses previously proposed/published/often-used statistical measures in a search of changes in seismicity patterns that may provide information about earthquake occurrence in time. Instead of targeting $M > 7$, "significant earthquake", events, as in a number of publications on the use of these statistical measures had done, this paper looks at eight events with CWB ML in the range of 6.1-6.6.

The stated purpose of this paper is to "understand whether the properties of seismic activation and quiescence patterns respond to regional tectonic stress." (39-40) The authors highlight "Taiwan orogen" in the title and attempt to link the differences they found in their result to the difference in tectonics.

A series of papers that expanded and/or applied the statistical measure, so called RTL, proposed by Sobolev, have been published. The first two authors have already published papers based on this measure for the 1999 Chi-Chi earthquake and two other events that are actually included in this study (#5 and #8). So the method is well established among a group of seismologists in Russia, China, Japan, Taiwan, Turkey, etc., albeit with some modifications here and there and the authors are quite familiar with the topics.

For this paper the authors try to distinguish two different behaviors of RTL for eight events at different locations in Taiwan. Four of the events analyzed show what the authors recognize to have quiescence before the target event (Q type) and four show activation before the target event (A type). The time periods or the amplitudes of quiescence and activation appear to differ significantly in each case. They argue that Q type events (1, 2, 5, 8) are located in southern Taiwan and the other four are in central Taiwan because of difference in tectonics between these two regions. They also try to distinguish them by looking at the frequency-magnitude plots (Figure 5). Overall, I appreciate the statistical analysis of seismic catalog to look for patterns. The results could be useful in studying developmental variations in seismicity and crustal stresses before significant earthquakes. However, the differences between the two groups resulting RTL's shown in Figure 2) are

very subtle; if Sobolev et al.'s diagrams were examples of successful detection of signs of upcoming events, the precursory changes for events 2, 5, 3, 4, in particular, are in comparison quite small and one wonders how a "signal" can be detected.

The association of the RTL behaviors described by the authors to the central and southern Taiwan tectonics raises some questions. The geology, crustal structures and plate tectonic setting indicate that in terms of petrology, faults, plate boundaries the differences between eastern and western Taiwan are much more dramatic than between central and southern Taiwan. The local tectonic environment of the eight events are very different. To put them in the two baskets needs much more justification.

Throughout this papers it would be useful to have more discussions regarding the physical significance of the various parameters in the calculations. For example, r_0 and t_0 were initially called characteristic distance and characteristic times, without saying what they are characteristic of. Later they were given some numbers but what do these numbers depend on physically? Having scanned some of the seminal papers on the RTL method and its application by Sobolev, Q. Huang, Nagao etc., in which the physics was never left out, I think such discussion gives the readers a much better grasp of the significance of such studies.

Section 3.2 intends to show spatial distributions of activation or quiescence for the 8 events studies. I find it quite hard to conclude the general relationship between the distribution and the event location.

In the Discussion section, it struck me that the word "reveal" was used ten times. I recall reading a comment years ago that this word is not particular suitable for discussing scientific results. Careful evaluations of the main results. Also the discussions in this section is some "anecdotal" rather than systematic.

Some specific texts in the introduction section are particularly obscure:

Lines (51-54): "The coastal plain and foothill region, which represent the southern tip of the fold-and-thrust belt in western Taiwan and show very low seismicity, mainly consist of Miocene shallow marine deposits and a Pliocene–Pleistocene foreland basin as well as mudstones." Question: Which part exactly? What do you mean by southern tip, where is it?

Lines (55-58): "...the southern Central Range is mainly composed of Oligocene to Miocene metamorphic slates and contains ductile folds and cleavages as well as superimposed faults. Central Taiwan, which is experiencing rapid to full collision, mainly consists of the Coastal Range, Central Range and Western Foothills.." Question: Is the intent to point out the differences between the two sections of the Central Range? But similar rocks are found

in both sections of the Central Range! Also, the rate of uplift in the two parts may be somewhat different, but both parts are rising fast based on leveling results. Also, what are the superimposed faults?