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Comment on nhess-2022-46

Anonymous Referee #3

Referee comment on "Quantifying the probability and uncertainty of multiple-structure rupture and recurrence intervals in Taiwan" by Chieh-Chen Chang et al., Nat. Hazards Earth Syst. Sci. Discuss., https://doi.org/10.5194/nhess-2022-46-RC3, 2022

Huang et al., in the manuscript "Quantifying the probability and uncertainty of multiple-structure rupture and recurrence intervals in Taiwan" presents a new approach by integrating the physics-based model (static Coulomb stress change) and statistic model (Gutenberg-Richter law) to evaluate the earthquake recurrence time for the possible multiple-rupture scenario. According to their assumption, multi-rupture only occurs if the stress transfer on the nearby fault reaches a certain value, and the slip rate of the multiple-rupture structure is the sum of the associated slip rate in related ruptures. Although I acknowledge this topic as a valuable contribution in the field of hazard assessment, however, this current manuscript needs improvements, especially I am still not clear about how the author partitioned the slip rates between different ruptures.

The structure of the description.
I think section 3 is the core of the methodology in this study, as far as I can tell this study use simple equations, but the description makes it extremely difficult to follow.In general, I think the whole section of 3.1 and 3.2 should be reformulate, for example:
Equation (2),D^dot represents the slip rate, dose this slip rate indicates the long-term slip rate obtained from other measurements?

Equation (7), the author used the Mw-Mo scaling law by Kanamori (1977), but the equation in the manuscript is from Hanks and Kanamori (1979) with the unit of dyne-cm.

Equation (8) and (9), there appear two parameters D_L1’ and D_L2’ with no explanations until equation (12) and equation (13).

Equation (10), dose the ML1 indicates the maximum magnitude in L1 ?
D_L1+L2 is the displacement of the multiple-structure rupture, dose this means D_L1+L2

= D_L1 + D_L2? More practical parameter annotation should be carefully addressed.

Equation (14), this equation is hard to follow, in Line 146 : the sum of the slip rates for the multiple-structure…. I don't understand what is the sum of the slip rates for the multiple-structure? and this statement is not correspond to the equation (14).

The discussion:
The author took 1906 Meishan earthquake as an example, they argued that closed-by Chiayi frontal structure also ruptured during the coseismic period because liquefaction took place on the west of the Meishan fault, however, I think this statement is little-bit weak because liquefaction could occur when the stress is perturbated through seismic wave propagation from the mainshock. Also, I got confused when reading the line from 286 to 288, dose the author really hints that Meishan earthquake is initiated on the Chiayi frontal structure?

For model uncertainty, this sensitivity test is focus only on the rake angles for estimating the Coulomb stress change, I was wondering what if they change the friction coefficient? Friction coefficient also plays an important role on evaluating the stress impart from the mainshock, especially recent studies suggest that friction coefficient is depth dependence (i.e., Carpenter et al., 2012,2015). Besides the Coulomb stress model, G-R law also make a strong contribution on this approach, I am wondering if they consider different type of G-R law will change the result significantly (for example the truncated model)?

minor comments:

Line 131, show in equation 1 -> equation 3

Line 157, what is characteristic earthquake means? rupture or slip or magnitude?

Line 159~ , The author addresses the exact value of each parameter very carefully, but I do think those repetitive equations and number should be removed and only use a simple table to present.

Line 284, missing the ID for Chiayi frontal structure