This study by Chang et al uses Coulomb stress modelling and the power-law distributions of earthquake magnitudes implied by the Gutenberg-Richter (G-R) relationship to determine if, and how frequently, closely spaced faults in the Taiwan Earthquake Model (TEM) will rupture together in multi-fault earthquakes. The need for this kind of analysis has been raised by the recent occurrence of multifault earthquakes (e.g., 2010 El Mayor-Cucapah and 2016 Kaikōura earthquakes). Furthermore, the ground motions derived from probabilistic seismic hazard analysis (PSHA) are very sensitive to the assumed on-fault magnitude-frequency distribution. The model outlined here provides a logical way to account for the discrete possibilities of faults (referred to here as 'structures') rupturing either along their entire length, or in multiple-structure ruptures. This work therefore clearly fits within the scope of NHESS.

I do, however, have some suggestions for how this study can be improved through a better description of how slip rates are partitioned between different rupture scenarios. I also recommend this study should be properly paced in the context of many other methods that have been developed to account for multi-fault ruptures in PSHA. I hope the authors find this review useful.

Jack Williams

Major Comments

1.) Description of model

The key innovation of this study is described in Section 3.1 where it is outlined how the area and slip rate (i.e., a moment rate) of two different seismogenic structures can be combined with a G-R relationship to determine the recurrence interval of an earthquake that ruptures both structures. As far as I can tell, there is nothing inherently wrong with the approach itself, however, I have several recommendations for how the presentation of this model could be improved.

Immediately after equations 8 and 9 (Line 129), the meaning $\dot{D}_{L1}$ (original L_1 slip rate measurement) is given, but it is $\dot{D}_{L1}{}'$ (slip rate for L_1 single structure events) that is used in these equations. I would also present the equations for C_1 (partitioning coefficient between $\dot{D}^{L1}_{L1+L2}$ and $\dot{D}_{L1}{}'$, currently eqs. 10 and 11) and $\dot{D}_{L1}{}'$ (currently eqs. 12 and 13) before the equation for $\dot{D}^{L1}_{L1+L2}$ (slip rate of L_1 in L_1+L_2 events) given that you need these parameters to calculate $\dot{D}^{L1}_{L1+L2}$.

I appreciate that the authors use the Hsinhua and Houchiali faults to provide an example of how their workflow is applied. However, showing the application of each equation to each structure in the text can get repetitive. I would suggest using a table to illustrate these equations, with a column for each structure. Another table could also be used for description of the model where >2 structures are considered (i.e., the example of the Chiayi, Meishan, and Tainan structures in Section 3.2).

I would also recommend adding a table (maybe as a supplementary file) illustrating that when the slip rate is partitioned between the different rupture cases, the total seismic moment rate does not change. I provide an example of this below

	Analysis using original slip rate estimates			***Analysis using partitioned slip rate estimates***			
	Hsinhua	Houciali		Hsinhua &Houciali	Hsinhua	Houciali	
Area (m^2)	229000000	86000000		309140000	229000000	86000000	
Rigidity (Nm)	30000000000	30000000000		30000000000	30000000000	30000000000	
Slip Rate (m/yr)	0.00265	0.00707	**Total Moment Rate**	0.00220	0.00124	0.002822	**Total Moment Rate**
Seismic Moment Rate (Nm/yr)	1.82E+16	1.82E+16	**3.64E+16**	2.04E+16	8.52E+15	7.28E+15	**3.62E+16**

This table shows that the moment rate ($\dot{M}_0$) of the two seismogenic structures using the original slip rate estimates is essentially the same as when the slip rate is partitioned between single structure and multi-structure events (I haven't checked but presumably the minor difference in total $\dot{M}_0$ can be accounted for in rounding errors). Hence, it gives the reader confidence that no $\dot{M}_0$ is being lost or gained when this model is applied.

When using the examples from the TEM, the values are provided to a high, and probably unjustified level of specificity (e.g. slip rates to 0.01 mm/yr, source areas to 0.01 km^2, recurrence intervals to 1 year). I suggest rounding these values to a level appropriate with the uncertainty of this analysis.

Finally, the Wells and Coppersmith (1994) scaling relationships are increasingly out of date given that we now have nearly 30 more years' worth of observed earthquakes to refine these relationships. I would recommend that either a more up to date set of scaling relationships is used (e.g., Leonard 2010, Thingbaijam et al 2017), or a sensitivity analysis is made to see if using the updated scaling relationships changes the model outcomes.

2.) Applicability of Model

I also have several comments about applicability of this model to observed occurrences of multi-structure earthquakes. However, I see these as points that can be addressed through additions to the discussion (Section 4) as opposed to changes to the model itself.

Multi-structure earthquakes are considered here only in terms of static Coulomb stress triggering between neighbouring faults. However, it is worth acknowledging in Section 4.2 that multi-structure earthquakes may also be generated by dynamic stress triggering from seismic waves (e.g., Brodsky and van der Elst 2014, Ulrich et al 2018). I think this may what is being discussed at Line 280 (?), though note the reference is to a manuscript (Jiao et al 2020) that was not accepted for publication.

A key assumption in this study is that the magnitude-frequency distribution (MFD) of events along a single multi-structure systems follow a G-R scaling. Although that is certainly possible, one could also argue that at the scale of a single multi-structure system, the MFD follows a characteristic shape (Youngs and Coppersmith 1984; Hecker et al 2013; Stirling and

Zungia 2017), or that the MFD is neither characteristic nor G-R (Geist and Parsons 2019; Page et al 2021). In either case, a deviation from a G-R scaling will affect the recurrence intervals calculated through this model.

This model should also be discussed in the context of other studies that have attempted to incorporate multi-structure ruptures in PSHA. For example, there are many studies that divide mapped multi-structure systems into smaller sub-fault scale segments, and then essentially allow ruptures to 'float' across theses smaller segments in such a way that they fit a regional MFD target (Field et al 2014; 2021; Chartier et al 2019; Geist and Parsons 2019). These studies are therefore distinct from the model described here, which is quite prescriptive about the number of configurations that structures in the TEM can rupture in (i.e., as single or multi-structure events only, and no events may be smaller than a single structure). It would benefit this study if the pros and cons of these different techniques could be discussed in Section 4.3.

Minor Comments

Lines 7-21: The abstract does not mention that this study is using faults incorporated into the Taiwan Earthquake Model to perform this analysis. Suggest revise, Line 11 could be revised to:

'……the probability of Coulomb stress triggering between seismogenic structures included in the Taiwan Earthquake Model.'

Lines 64-68: What value is used for the effective coefficient of friction (μ') in the Coulomb stress modelling?

Line 115: These scaling relationships between magnitude and rupture area are presumably from Wells and Coppersmith (1994)? If so, they should be cited as such (though also see major comment #1)

Line 144: Replace 'integrating' with 'combining,' to avoid any connotations that you are actually performing an integration in these equations.

Lines 220-221 (and 335): When referring to the Kaikōura earthquake, reference should be made to Hamling et al (2017). This is the original reference to this event and written by authors who made the primary observations of this multi-fault earthquake.

Line 258: I think there is a typo here for describing the numeric value if the Hukou and Hsinchu fault recurrence intervals as '4.4 and 5.3'?

Figures: Figure 1 presents only a generic case of Coulomb stress changes around a fault. I would recommend also including a figure to show an example of this stress modelling from faults in the TEM. Maybe using the example of faults that are described further in Section 3.1?

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