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Interactive comment on “Factors controlling the sequence of asperity failures in a fault model” *by* Emanuele Lorenzano and Michele Dragoni

Anonymous Referee #2

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This paper solves analytically the modes of a fault with two asperities and discusses how the source processes are affected by seismic efficiency, frictional resistance and the intensity of coupling. It is written in a logical way and provides a different perspective on modeling earthquake source process. However, I think the authors need to work on how their approach relates to other modeling approaches and how it can be applied to realistic cases. I have outlined my major comments below:

1. Previous models have studied fully dynamic earthquake cycles on a fault with asperities [e.g., Lui and Lapusta, “Repeating microearthquake sequenes interact predominantly through postseismic slip”, Nature Communications, 2016]. A review of these previous studies is lacking in the introduction section. In particular, how can the modeling approach in this paper contribute to our understanding of earthquake cycles?

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2. On Page 3, the asperity is characterized by a much higher friction than the surrounding region, which I don't think is necessarily true for a real fault. Could the authors provide some observations that support this view?

3. The model assumes a rate-dependent friction law instead of a rate and state dependent friction law that is observed in laboratory experiments and used in fully dynamic earthquake cycle models. The authors replied to the other reviewer that using rate and state dependent friction laws would "provide negligible improvements to our conclusions". However, if the friction changes over time as defined by the state variable, it will significantly affect the recurrence intervals of seismic events.

4. On Page 5, the authors mentioned that they consider the case of underdamping because seismic efficiency of faults is small. I don't think this is true. Radiation efficiency depends on the earthquake type and is not always small. I've attached Figure 8 from Venkataramen and Kanamori [2004]. For example, the radiation efficiency of tsunami earthquakes is usually lower than other types of earthquakes.

5. It's hard to relate the proposed models to realistic cases. In section 4.1, the authors discussed the different earthquake models when Pk belongs to different segments on the face AECD. If we picked a region, e.g., Parkfield, how could we determine which segment it belongs to?

6. Fig.7 and Fig. 8 are not cited in the manuscript. Though the peak moment rate amplitudes are slightly different in the figures, the moment rate functions have very similar shapes for events 10 and 01. Why is that?

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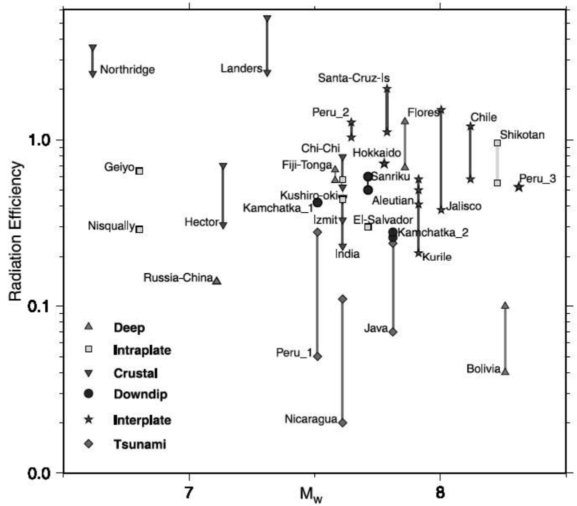

Figure 8. Radiation efficiencies determined from the radiated energy-to-moment ratios are plotted as a function of moment magnitude. The different symbols show different types of earthquakes as described in the legend. Most earthquakes have radiation efficiencies greater than 0.25, but tsunami earthquakes and two of the deep earthquakes (the Bolivia earthquake and the Russia-China earthquake) have small radiation efficiencies. See color version of this figure at back of this issue.

Fig. 1.

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