Nonlin. Processes Geophys. Discuss.,
https://doi.org/10.5194/npg-2018-49-AC2, 2019

Nonlinear Processes in Geophysics
Discussions
Open Access

Interactive comment on "Can the Nucleation Phase be Generated on a Sub-fault Linked to the Main Fault of an Earthquake?" *by* Jeen-Hwa Wang

Jeen-Hwa Wang

jhwang@earth.sinica.edu.tw

Received and published: 7 March 2019

Response to Comments by Reviewer #2

Although you cannot accept my manuscript, I still want to say thanks to you for valuable comments.

The manuscript investigates the influence of different phenomena thought to be related to the frictional fault sliding on the emergence of the nucleation phase. To this end dynamics of a two block sliding model system with viscosity and displacement-dependent dry friction is analysed. The first thing which is apparent from the model equations is that frictional sliding is assumed to be always present, that is the system is always in the limiting stage, which is a great oversimplification. [Answer] For most of studies on

Printer-friendly version

Discussion paper

dynamics of earthquake ruptures, frictional sliding is assumed to be always present. This is not my own selection.

The second feature is that the friction is assumed to depend upon displacement rather than velocity as conventionally accepted. Furthermore, the model has a lot of parameters, so it is not surprising that some combination of parameters does produce the behavior resembling the nucleation phase. The question is then as to why nature is reduced to these combinations of parameters. [Answer] In my past studies, I very often applied velocity-dependent friction to dynamical modelling of earthquake ruptures based on spring-slider models. There are two reasons why slip-dependent friction is used in this study: (1) Madariaga and Cochard (1994) pointed out that purely velocity-dependent friction could yield unphysical phenomena and mathematically ill-posed problems and Ohnaka (2003) also stressed that the pure rate-dependent friction law is not a one-valued function of velocity. (2) The slip-dependent friction law comes from the end-member model, i.e., the adiabatic, undrained deformation (AUD) model, due to thermal pressurization model in the fault zone proposed by Rice (2006). (The other end-member model is the slip on a plane (SOP) model. In the AUD model, the sliding slip is dependent upon the sliding velocity which is not constant; while in the SOP model, the sliding velocity is always constant during the rupture processes. In the present study, I used the AUD model, and thus slip-dependent friction is somewhat velocity-dependent. References: Madariaga, R. and A. Cochard (1994). Seismic source dynamics, heterogeneity and friction. Ann. Geofis., 37(6), 1349-1375) Ohnaka, M. (2003). A constitutive scaling law and a unified comprehension for frictional slip failure, shear fracture of intact rocks, and earthquake rupture. J. Geophys. Res., 108, B2, 2080, doi:10.1029/ 2000JB000123.

The numerical solution was not verified against the particular cases which either allow analytical solutions or could be referred to existing numerical solutions, so there is no way to believe in the correctness of the model. [Answer] The analytic solutions were made only for discussing the predominant periods of two sliders. Numerical solutions

Printer-friendly version

Discussion paper

are essentially consistent with the analytic ones.

Please also note the supplement to this comment:
https://www.nonlin-processes-geophys-discuss.net/npg-2018-49/npg-2018-49-AC2-supplement.pdf

---

Interactive comment on Nonlin. Processes Geophys. Discuss., https://doi.org/10.5194/npg-2018-49, 2018.