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Solid Earth
Discussions

Interactive comment on "The mechanics of gravity-driven faulting" *by* L. Barrows and V. Barrows

Anonymous Referee #2

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The authors have compiled a quiet useful demonstration of the differences between force-driven and displacement-bounded faulting. Although it is not at all surprising that completely different boundary conditions do produce different results, like the difference of heat conduction within thermally insulated versus isothermal boundaries, the particular earthquakes-related case study is an important one. The taste differ, some readers like philosophical generalizations, energies and notes in passing. I do not like it in general and found it quiet disturbing and annoying in this particular manuscript. I'll make my suggestions and leave it for the editor and for the writer to decide on what to do with this manuscript.

1. Title, abstract and introduction are all very irritating and unpleasant to read with a number of strong and unproven statements. It is sufficient to introduce the two end

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member models of faulting as idealized cases useful for different applications and to state that it is important to understand the difference between them. All the other statements may go to the discussion section. The usefulness of new terminology and new insights should be discussed not before, but after their detailed introduction in the main body of the paper. 2. Section 2.1 is a nice preparation to what follows. I'd skip the oscillation part (only small part of the energy is spent this way in the real earthquakes, so the analogy is not very useful). 3. I suggest to put the entire Appendix right here, after nice and simple section 2.1, to build on its simplicity and to develop the intuition and awareness of the reader on the differences between the end member fault models. I do not see any use of "energetics". All the same can be stated with forces/stresses and displacements. For example, instead of saying "elastic energy is half of its initial value", one can say "boundary stresses are half of their initial value". All the calculations are always done with stress-displacement formulation, no energy needed. Energy is always post processed from obtained solutions. So, if I already know everything like stresses and strains distributions, what do I need the energy for? 4. Sections 2.2 -2.3 are also too lengthy, not convincing and should entirely go to the discussion section. 5. Section 3 is a waste of everybody time. Heavy equations from standard textbook are given but not used for any quantitative estimates. What does it prove? That there is a solution for any linear problem? That one should not drop terms from the exact solutions? If anything, one should discuss the error of neglecting of the gravity term. 6. So, what did we learn? We knew that gravity drives everything. How can we use the results presented by the authors? Instead of introducing new terminology, not to be used energies and criticizing standard models for neglecting truly negligible terms, I would use the obtained results to quantify the earthquake cycle. Regional stress drop during an earthquake is best understood by standard and currently used model of displacement-bounded faulting. "Lock-in" stresses caused by the movement can relax a bit. Slow tectonic loading builds up the boundary/regional stresses back to the level prior to the earthquake – the setup of the model of force-driven faulting. Next earthquake again by displacement-bounded faulting since seismic strain rates are much

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larger than the gravity driven rebuilding of the stresses during interseismic period. 7. Misspelled Romberg, diapers.

Interactive comment on Solid Earth Discuss., 2, 105, 2010.