Solid Earth Discuss.,
https://doi.org/10.5194/se-2020-115-AC4, 2020
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Interactive comment on "Rupture-dependent breakdown energy in fault models with thermo-hydro-mechanical processes" *by* Valère Lambert and Nadia Lapusta

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Received and published: 5 October 2020

The emphasis of this work is to demonstrate that even in fault models with constant and uniform TP parameters, the resulting breakdown energy is heterogeneous and not constant in time, thus it is rupture-dependent. Given suggestions from the reviewers, we now expand on this to discuss the importance of dynamic rupture simulations for evaluating the variability and physical interpretation of breakdown energy in fault models with thermo-hydro-mechanical processes, compared to steady-state rupture solutions.

The TP parameters used in this work represent moderate weakening motivated by our previous work and other prior studies (e.g. Rice, 2006), and do not result in complete

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stress drop (as is seen Figures 5-10). These parameters have also been shown in our prior studies to be able to qualitatively and quantitatively reproduce a number of seismological observations, including magnitude invariant static stress drops between 1-10 MPa, the inferred scaling and values of breakdown energy from moderate to large earthquakes, and radiation efficiencies between 0.1 to 1 (Perry et al., 2020; Lambert et al., in review). These studies suggest that fault models with such TP parameters may be plausible representations of natural mature faults, at least megathrust faults.

Indeed, heterogeneous and non-constant hydraulic properties, as may result from damage generation during rupture, would further complicate the evolution of shear stress with thermo-hydro-mechanical processes like TP, as was already discussed in lines 312 – 317 of the original manuscript (now 115- 119 and 434 - 439). As damage generation is also likely to be rupture-dependent, this is also expected to reinforce our conclusions that breakdown energy is rupture-dependent, as discussed in the conclusion section.

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