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Supplementary Information for

Dueling dynamics: competition between detachment rupture, splay faults, & off-fault damage

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Introduction

Figure S1 shows how different values of the characteristic slip distance, a parameter in the empirical friction law which governs how faults yield and slide, modulate modeled peak slip rates. Figures S2-S4 show results of the models from Fig. 4d-f with plastic strain plotted on different color scales, highlighting how the choice of color scale affects the apparent distribution of modeled coseismic off-fault damage. Figure S5 shows how different values of the characteristic slip distance influence patterns of accumulated off-fault inelastic deformation.

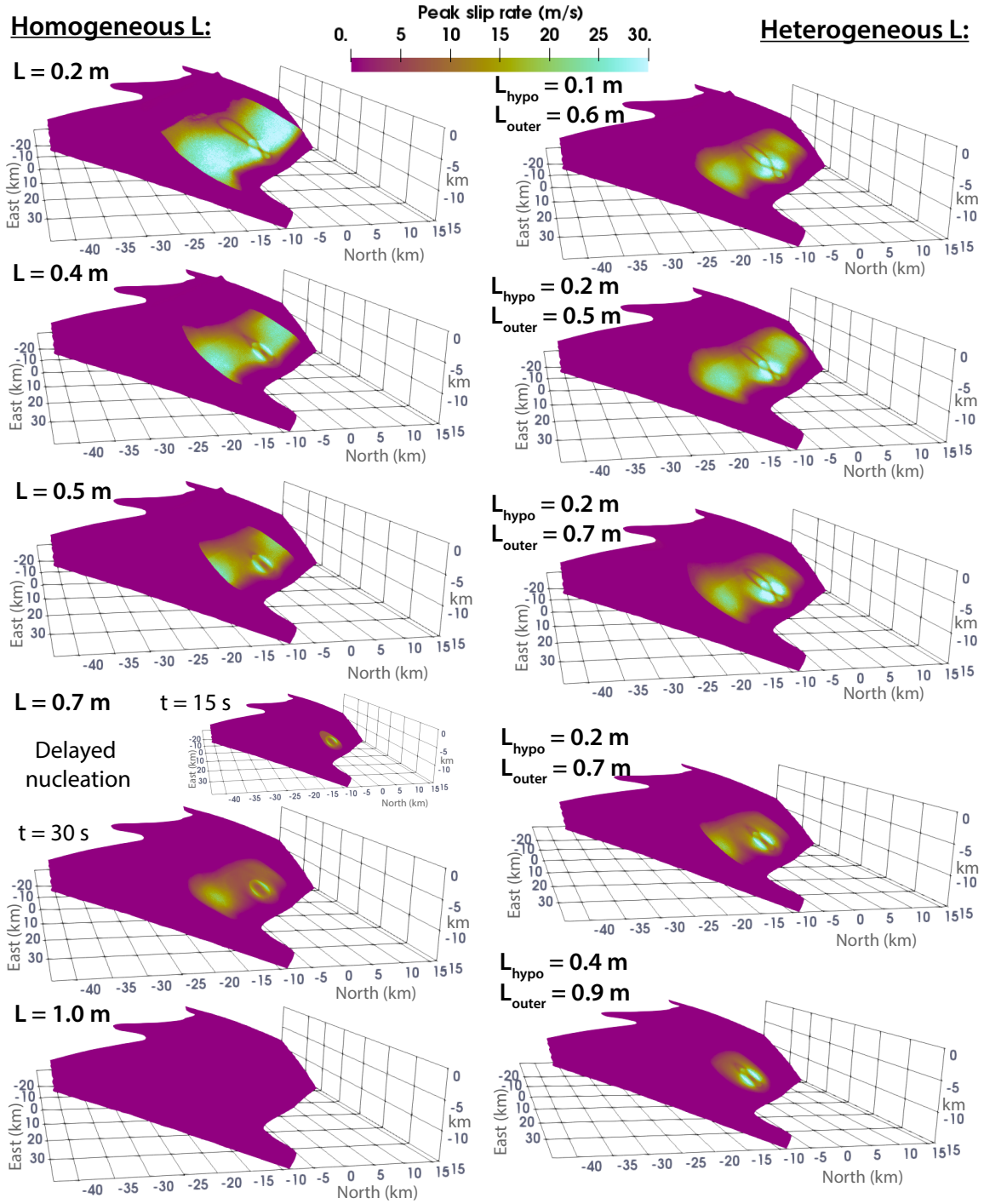

Figure S1. Modeled peak slip rates after 10 s (unless otherwise noted) for different homogeneous (left) and heterogeneous (right) values of L, the characteristic slip distance. For heterogeneous models, the characteristic slip distance increases from a minimum value of L_{hypo} within 3 km of the hypocenter to L_{outer} for points >5 km from the hypocenter. See Text S1 ("Earthquake nucleation & peak slip rates") for discussion of these results.

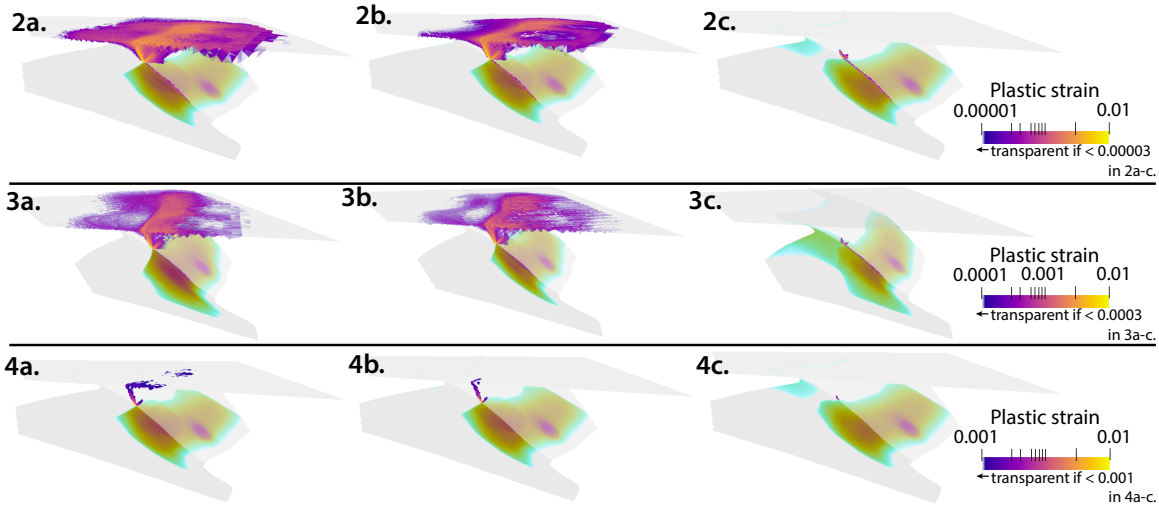

Figure S2-4. Fault slip and (clipped) accumulated plastic strain for models with weak (a), intermediate-strength (b), and strong (c) sediments above 4 km depth (identical to those in main text Fig. 4d-f). Modeled plastic strain in each row is plotted on a different color scale, highlighting how the selected color scale can influence the appearance and interpretation of distributed vs. localized coseismic off-fault damage. Plotted on a color scale commonly used for dynamic rupture simulations with off-fault plasticity (e.g., Ma & Hirakawa, 2013; Wilson & Ma, 2021), plastic deformation appears widespread and distributed through the hanging-wall wedge (Fig. S2, top row). In contrast, plastic damage appears localized along narrow fault-like shear bands in the hanging wall (Fig. S4, bottom row) when plotted with lower strain bounds of a similar order of magnitude to those used as thresholds for identifying coseismic damage zones in geodetic studies (e.g., Barnhardt et al., 2020) and those reported in modern and historical ruptures (e.g., Michel & Avouac, 2006; Elliott et al., 2009; Oskin et al., 2012; Gold et al., 2013).

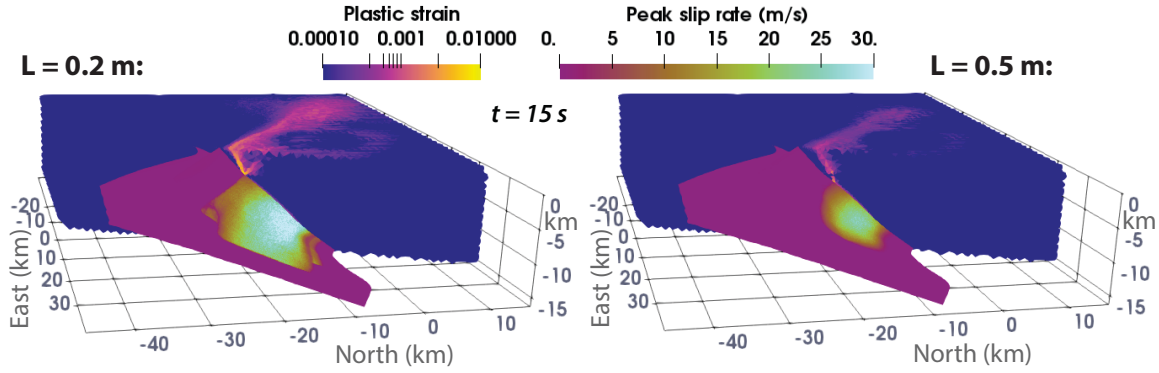

Figure S5. Peak slip rates and (clipped) accumulated plastic strain for models with different values of the characteristic slip distance, L. These results suggest that different values of L and corresponding peak slip rates may influence patterns of coseismic off-fault deformation, with larger L and lower peak slip rates resulting in deeper-seated subplanar plastic deformation bands (interpreted as incipient splay faulting) than models with smaller L and lower peak slip rates.

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