DYNAMIC RUPTURE MODELING ON THE HAYWARD FAULT, NORTHERN CALIFORNIA– ESTIMATING COSEISMIC AND POSTSEISMIC HAZARDS OF PARTIALLY CREEPING FAULTS

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The hazards associated with partially creeping faults are not fully understood. In particular, the degree to which earthquake rupture is able to propagate into creeping areas of the fault, and the amount of shallow accelerated creep that would follow an earthquake are both uncertain. Both of these questions are gaps in our understanding of the physics of fault slip in general, but they are brought to particular societal relevance by the Hayward Fault, a partially-creeping fault which underlies the densely populated eastern San Francisco Bay Area, and has been identified as one of the two highest-hazard faults in California. In this study, we explore the likely controls that frictional conditions, fault geometry, and accumulated elastic stresses will have on probable rupture lengths, and on the ability of rupture to propagate into sections of the fault that creep interseismically. We use dynamic rupture modeling incorporating rate-state friction, which allows for mode switching between aseismic and coseismic deformation, to calculate scenario ruptures. We find that frictional heterogeneity alone can strongly limit the extent of rupture, and that the associated decrease in shear stress that comes from interseismic creep further confines rupture to locked patches. We then integrate these with static boundary element models, which allows for a physics-based assessment of interseismic stress evolution, to develop our pre-stress conditions and to account for rapid postseismic creep. While our study focuses on the Hayward Fault, our methods and findings will also enable more accurate scenario modeling and hazard analysis for earthquakes on other partially creeping faults.