# Combined Effect of Brittle Off-Fault Damage and Fault Roughness on Earthquake Rupture Dynamics

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**Résumé**

Natural fault zone are complex objects. They not only consist of a fine-grained narrow fault core where the extensive shearing is observed, but it is also surrounded by pervasively fractured rocks, within an intricate 3-D geometry. If fault slip behavior is intrinsically linked to the properties of the fault core, the complex structure of fault zone systems impacts the rheological properties of the bulk, which influence the modes of deformation, and slip, as underlined by recent observations. Fault zone structure is therefore of key importance to understand the mechanics of faulting. Within the framework of a micromechanics based constitutive model that accounts for off-fault damage at high-strain rates, this numerical study aims to assess the interplay between earthquake ruptures along non-planar fault and the dynamically evolving off-fault medium. We consider 2D inplane models, with a 1D self-similar fault having a root mean square (rms) height fluctuations of order 10-3 to 10-2 times the profile length. We explore the dynamic effect of fault-roughness on off-fault damage structure and on earthquake rupture dynamics. We observe a high-frequency content in the radiated ground motion, consistent with strong motion records. It results from the combined effect of roughness-related accelerations and decelerations of fault rupture and slip rate oscillations due to the dynamic evolution of elastic moduli. These scenarios underline the importance of incorporating the complex structure of fault zone systems in dynamic models of earthquakes, with a particular emphasis on seismic hazard assessment.

**Mots-Clés:** earthquakes, damage, modelling

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