Geophysical Research Abstracts
Vol. 19, EGU2017-16969, 2017
EGU General Assembly 2017

Off-fault plasticity and complex fault geometry in dynamic rupture scenarios: The example of the 1992 Landers earthquake

Stephanie Wollherr and Alice-Agnes Gabriel
Ludwig-Maximilians-Universität, Geophysics, Department of Earth and Environmental Sciences, Munich, Germany

To model realistic earthquake source dynamics, many ingredients must be taken into account. On the one hand, the fault geometry and the initial stress setup exert large influences on rupture propagation. On the other hand, it is crucial to use realistic physical assumptions such as off-fault plastic yielding.
Here we present how plasticity influences the rupture propagation in a branched fault scenario based on the 1992 Landers earthquake and compare our simulation results to field observations. The Landers earthquake is a prominent example that included a complex fault geometry with several fault segments and branches where rupture jumping and back propagation was observed. For our simulations we use the software package SeisSol based on an Arbitrary High Order Derivative Discontinuous Galerkin (ADER-DG) method solving frictional sliding coupled to seismic wave propagation. The use of tetrahedral elements facilitates the mesh generation for this complex fault geometry.
Our numerical model reproduces well the total rupture duration and the seismic moment of the Landers earthquake. We observe a complex rupture evolution including branching, dynamically triggered slip and back-propagation on different fault segments. During rupture propagation, stresses around the complex fault system become high enough such that the host rock experiences inelastic deformation. As a consequence, part of the seismic energy feeds into plastic processes, which affect in turn on-fault source dynamics. In comparison to an elastic scenario, off-fault plasticity clearly reduces the peak slip rate at the whole fault and especially in depth. Further, elastic and plastic scenarios exhibit distinct spatio-temporal rupture transfers between fault segments, which also alters the final slip. Our results indicate that the extend of plastic strain around the fault system increases in areas of higher structural complexity which is consistent with observations of the damaged fault zone width.