DYNAMIC EARTHQUAKE RUPTURE MODELING IN FLUID-RICH FAULT NETWORKS CROSSING SPACE-TIME SCALES: FROM SUBDUCTION ZONES TO INDUCED SEISMICITY

Alice-Agnes GABRIEL, ***Sebastian ANGER***, ***Bo LI***, ***Duo LI***, ***Taufiqurrahman TAUFIQURRAHMAN***, ***Thomas ULRICH***, ***Sara Aniko WIRP***, ***Stephanie WOLLHERR***

Department of Earth and Environmental Sciences, LMU, Munich, Germany

Modeling how faults slip requires generally numerical methods that span a large range of spatial and temporal scales. In subduction zones, in addition, pronounced geometric and rheological complexity needs to be accounted for. High-resolution 3D dynamic rupture earthquake scenarios can integrate complex megathrust-splay fault geometries, high resolution topography and bathymetry, 3D subsurface structure and off-fault deformation, as demonstrated in dynamic rupture earthquake scenarios of the 2004, Mw 9.1-9.3 Sumatra-Andaman earthquake and tsunami (Uphoff et al., SC'17). Physics-driven, mechanically viable interpretations can be integrated synergistically with established data-driven efforts which is specifically useful in regions lacking near-source observations. However, initialising such models with self-consistent fault and surface geometry, fault stress and rheology, fluid pressures and subsurface lithology is challenging. This can be overcome in coupled frameworks such as developed in the ASCETE project (www.ascete.de) connecting subduction dynamics over millions of years, seismic cycling and earthquake dynamics down to fractions of a second, as well as tsunami propagation and inundation. Earthquake dynamics in fluid-rich fault networks are also prevailing on the much smaller scales of geo-reservoirs. Fault networks at geo-reservoir scales are inherently geometrically complex; the dynamic stress released during the rupture process interacts with multiple adjacent fractures and 3D Earth structure acting as interdependent reinforcing and inhibiting factors for rupture cascading. Physics-based modeling can explore the richness of the dynamic response of such geo-reservoirs, specifically focusing on geometrical and structural complexity.