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Spatial variations of fault friction: observations and implication for fault dynamics

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In order to advance our understanding of fault dynamics we need better observational constraints on fault frictional properties and their variations with space and time. In this presentation we will discuss different approaches which can be used to constrain fault friction, its static value as well as its rate-dependency based on structural, geodetic and seismological observations. We will next review results obtained from applying these approaches to various contexts. It turns out that in all sorts of different settings faults are inferred to be paved with interfingering rate-weakening patches (where earthquake can nucleate and slip is mostly seismic) and rate-strengthening patches (which mostly creep aseismically). These examples show that temperature and pressure controls spatial variations of friction to the first order only. Other factors come into play and induce variations at shorter wavelengths which appear to have a critical influence on fault dynamics. How the relative proportion of rate-weakening and rate-strengthening patches and the topology of their interfingering affect average friction, the dominant mode of slip and the overall seismic behavior of faults will be discussed based on observations and on results obtained from dynamic simulations.