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Modeling spatio-temporal variations of seismicity in the San Jacinto Fault Zone

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We investigate spatio-temporal properties of earthquake patterns in the San Jacinto fault zone (SJFZ), California, between Cajon Pass and the Superstition Hill Fault, using long records of simulated seismicity constrained by available data. The model provides an effective realization (e.g. Ben-Zion 1996; Zöller et al. 2007) of a large segmented strike-slip fault zone in 3D elastic half space, with heterogeneous distributions of static/kinetic friction and creep properties, and boundary conditions consisting of constant velocity motion around the fault. The computational section of the fault contains small brittle slip patches which fail during earthquakes and may undergo some creep deformation between events. The creep rates increase to the end points of the computational section and with depth. Two significant offsets of the SJFZ at San Jacinto Valley and Coyote Ridge are modeled by strength heterogeneities. The simulated catalogs are compared to the seismicity recorded at the SJFZ since 1932 and to recently reported results on paleoearthquakes at sites along the SJFZ at Hog Lake (HL) and Mystic Lake (ML) in the last 1500 years (e.g. Onderdonk et al., 2012; Rockwell et al., 2012). We address several questions including the following intriguing issue raised by the available paleoseismological data: are large earthquakes with signatures in ML and HL typically correlated? In particular: is a typical paleoevent in HL an incomplete rupture that is continued later in ML, and vice versa? The simulation results provide insights on the statistical significance of these and other patterns, and the ability of the SJFZ to produce large earthquakes which have not been observed in recent decades.