Seismicity, stress, and complex fault structure: A case study from the Yuha Desert, California following the 2010 M7.2 El Mayor Cucapah earthquake

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Abstract: It can be difficult to unravel the partitioning of slip and potential for significant, through-going slip in regions of complex fault structure. The Yuha Desert, California is located between two large strike-slip faults with high seismic hazard potential: the Laguna Salada fault zone to the south and Elsinore Fault zone to the north. The 4 April 2010 Mw 7.2 El Mayor-Cucapah (EMC) earthquake produced a vigorous cloud of aftershocks in the Yuha Desert that were recorded by a dense array of eight temporary seismic stations and three nearby Southern California Network stations. We detect and relocate over 9,500 aftershocks in a small 15 km by 20 km area within a two-month period. The seismicity highlights geometrically complex structures consisting of a series of right- and left-lateral conjugate faults, and potentially several steeply-dipping, normal faults. Three-dimensional analysis reveals individual, intersecting fault planes that are limited in their along strike length that remain as distinct structures in depth. Aftershocks exhibit a complex spatiotemporal migration through time, with seismicity jumping between individual fault segments that are active for only a few days to weeks. We also measure the shallow crustal anisotropy, an *in situ* measurement of stress orientation and/or local structural fabric, using a subset of the ~4,300 best-located events. The excellent station and event distribution allows us to estimate the mean fast direction at a resolution of 500 m across the study area. We find that most of the fast directions are oriented north-south and match the previously reported regional maximum compressive stress direction. However, we also map rotations of the fast directions towards near fault parallel along two of the northwest and northeast trending fault traces. These results provide an exciting, high-resolution glimpse into the behavior of complex fault systems.