Ground motion observations of the South Napa earthquake (**M**6.0 August 24, 2014)

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ABSTRACT

The South Napa earthquake generated peak ground motions in excess of 50%g and 50 cm/s in Napa Valley and also along strike to the south, and was recorded at 17 stations within 20 km rupture distance (Rrup) of the finite fault plane, 115 stations within 50 km, and 246 within 100 km. We compare the densely recorded ground motions to existing ground motion prediction equations (GMPEs) to understand both the spatial distribution of ground-motion amplitudes and also the relative excitation and attenuation terms from the earthquake. Using the ground-motion data as reported by ShakeMap, we examine the peak ground acceleration (PGA) and velocity, as well as the pseudo-spectral acceleration (PSA) at 0.3, 1.0 and 3.0 seconds, adjusted empirically to a single site condition of 760 m/s. Overall, the ground motions on the north-south components are larger than those on the east-west, consistent with both the generally north-south strike of the fault and the rupture directivity. At the higher frequencies (PGA and PSA of 0.3 s), the close data are very consistent with the GMPEs, implying a median stress drop near 5 MPa. For the longer period data, the GMPEs underpredict the data at close stations. At all frequencies, the distance attenuation seems to be stronger than the GMPEs would predict, which could either be a station coverage bias, given that most of the stations are to the south of the epicenter, or may indicate that the attenuation structure in the Napa and delta region is stronger than the average attenuation in California, on which the GMPEs were built. The spatial plot of the ground motion residuals is positive to the north, in both Napa and Sonoma Valley, consistent with both the directivity and basin effect. More interestingly, perhaps, is that there is strong ground motion to the south, as well, in the along-strike direction, particularly for PSA at 1.0s. These strongly positive residuals align along an older, Quaternary fault structure associated with the Franklin or Southampton fault, potentially indicating a fault-zone guided wave.