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Raspberry Shakes provide initial ground motion assessment of the geothermally induced seismicity at United Downs in Cornwall, UK

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The United Downs enhanced geothermal system in Cornwall, UK, has induced several microseismic events since flow testing began in August 2020, targeting a granitic intrusion at 5 km depth. As of January 2021, two events exceeding local magnitudes (M_L) 1.5 have occurred, highlighting the associated seismic hazard and providing initial data for a preliminary assessment of the region's ground motion response. However, with only one national seismic station publicly available within 90 km of the site, public data are scarce. In an effort to involve the surrounding communities in the geothermal project, United Downs provided Raspberry Shake 1D or 4D (one vertical geophone, with 4D containing an additional three accelerometers) seismographs to nearby schools, increasing the number of publicly available seismic stations to ten within 15 km of the site. In this study, we assess the ground motions recorded by the Raspberry Shake stations and evaluate their utility for probing ground motions models (GMMs) and the effects of the local geology.

171 earthquakes between M_L -1.3 to 1.7 originating at United Downs have been recorded to date, with 37 events above M_L 0.0. Unfortunately, the accelerometer components of the Raspberry Shake instruments contained too high background noise levels to be useable, leaving only the vertical geophone component to be analysed for each of the instruments. We find that while the peak ground velocity (PGV) values are in line with those predicted from the Douglas et al. (2013) geothermal GMM, the area experiences higher peak ground acceleration (PGA) than expected. We also find that the observed PGVs and PGAs match the region's geological features, consisting of a combination of igneous intrusions and sedimentary sandstones and mudstones. For sparse national seismic networks, Raspberry Shake stations can provide a quick initial evaluation of seismic events and their ground motions before industry releases private data for more detailed analyses.