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Searching for low frequency earthquakes with various durations near Parkfield, California

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Previous studies suggest that all LFEs could be roughly the same size; most LFE durations are between 0.2 and 0.5 s, and most LFE moments fall within a 1 to 2-magnitude unit range. These apparently characteristic LFE sizes could imply that LFEs are hosted on asperities of a characteristic size on the plate interface. However, it is also possible that LFEs with a range of sizes do occur but are not detected. With existing methods, it is usually harder to detect LFEs with shorter or longer durations. In this study, we search for LFEs with various durations near Parkfield, California. We generate synthetic LFE templates with durations of 0.05 - 1 s by modifying Shelly (2017)'s template waveforms. We cross-correlate time-shifted versions of the templates with 500 days of seismic data to search for LFEs within 5 km of the original template location. We estimate the duration and location of each detection by associating the detection with the template that it matches best.

Our preliminary results are encouraging. We find large numbers of 0.2-s LFEs at the original location, as have been detected previously, but we also appear to detect LFEs with durations of 0.05 - 1 s. These new detections appear to be spread along a 3-km region on a near-vertical plane that matches the downward extension of regular seismicity. We are currently cautious in interpreting these results, as it remains possible that all the LFEs occur at the original location with the same duration and that our apparent range of detections simply reflects scatter introduced by noisy data. Nevertheless, we note that our initial analysis implies that LFE duration in Parkfield changes minimally with LFE moment, and we are continuing to more rigorously assess the LFEs' properties and their implications.