Detection of deep low-frequency earthquakes in the Nankai subduction zone over 11 years using a matched filter technique

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To improve our understanding of the long-term behavior of low-frequency earthquakes (LFEs) along the tremor belt of the Nankai subduction zone, we applied a matched filter technique to continuous seismic data recorded by a dense and highly sensitive seismic network over an 11 year window, April 2004 to August 2015. We detected a total of ~510,000 LFEs, or ~23× the number of LFEs in the JMA catalog for the same period. During long-term slow slip events (SSEs) in the Bungo Channel, a series of migrating LFE bursts intermittently occurred along the fault-strike direction, with slow hypocenter propagation. Elastic energy released by long-term SSEs appears to control the extent of LFE activity. We identify slowly migrating fronts of LFEs during major episodic tremor and slip (ETS) events, which extend over distances of up to 100 km and follow diffusion-like patterns of spatial evolution with a diffusion coefficient of ~10^4 m^2/s. This migration pattern closely matches the spatio-temporal evolution of tectonic tremors reported by previous studies. At shorter distances, up to 15 km, we discovered rapid diffusion-like migration of LFEs with a coefficient of ~10^5 m^2/s. We also recognize that rapid migration of LFEs occurred intermittently in many streaks during major ETS episodes. These observations suggest that slow slip transients contain a multitude of smaller, temporally clustered fault slip events whose evolution is controlled by a diffusional process.