

Source characteristics of low-frequency earthquakes in Nankai subduction zone inferred from analysis of large event dataset

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Application of advanced detection and location methods to the analysis of low-frequency earthquakes (LFE) allows building large event catalogues rich in information that can provide a better understanding of their source characteristics. Up to now, LFE characterization in terms of size, stress drop and rupture propagation still remains uncertain, the main difficulty owing to the low signal-to noise ratio of corresponding records.

We present a catalog of LFE in western part of Nankai subduction zone derived by applying a full waveform-based detection and location scheme of Poiata et. al. (2016) to the continuous records from Hi-net seismic stations covering a 3-year period from 2013-2016. The applied method is based on the frequency-selective coherence of signals' statistical features recorded across the stations of seismic network, not requiring a prior assumption about the event source (i.e., template event). The derived catalog (~ 40000 events) allows to look into the details of LFE space-time activity (i.e., clustering and migration patterns) during the energetic tectonic tremor sequences as well as inter-sequence periods as well as characterize source properties of these events.

We derive source parameters of LFEs extracted from this 3-year catalog by applying the probabilistic approach of Supino et al. (2019) based on the conjunction of states of information between data and model and estimating the joint probability density function of the parameters. The events S-wave displacement amplitude spectrum is described by a circular source model, characterized by a plateau at low frequencies and a coherent decay at high frequencies; the frequency of transition between these two regimes is the corner frequency. Processing of this large LFE data set is performed using accurate quality criteria, allowing to automatically reject noisy data and unconstrained solutions.

The resulted moment magnitudes, estimated from low-frequency plateau, range between Mw 0.9 and 2.2, while corner frequencies vary between 0.8 and 12 Hz, being lower than expected for ordinary earthquakes, as already observed for LFEs. We found that LFE sources exhibit a power-law scaling between corner frequency and seismic moment, with an exponent of -3.5, very similar to the scaling observed for classical earthquakes.

Keywords: low-frequency earthquakes, source characterization, continuous data analysis, event detection and location