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Automatic workflow for establishing catalogs of Low-Frequency Earthquakes (LFE) and its adoption to high performance multi-core CPU and GPU architectures.

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Recently discovered low-frequency earthquakes (LFEs) together with non-volcanic tremor and slow slip-events constitute a manifestation of slow deformation process in seismogenic zones. LFEs frequently originate from multiplet-generating sources and are difficult to observe and to characterize because of their low signal-to-noise ratios. We develop a workflow for detecting and cataloging the LFEs that include following steps: (1) automatic detection of multiplet master events via beamforming and/or cross-correlations, (2) matched filter search using the detected master events, (3) filtering out ambiguous detections, and (4) stacking of obtained detections to generate the multiplet waveform.
Analysis of the long-term LFE activity requires application of this workflow to Terabytes of continuous seismic records and repeating many millions of times operations of scalar products, Fourier transforms and cross-correlation functions. Resulting volume of computations becomes very large and requires implementation on high-performance platforms. On the other side the developed workflow is highly parallelizable because it can be subdivided into many independent operations. Therefore, we develop parallelized codes for running this workflow on multi-core architectures and, in particular on GPUs that produce significant acceleration.
We apply the developed coded to analyze 2.5 year of continuous seismic data recorded in Guerrero Mexico. The resulting catalog of LFEs in this part of the Mexican subduction zone contains several tens of thousands of detections.