Detection and location of seismic events in continuous data of sparse monitoring network of an abandoned flooded mine

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In the case of abandoned and flooded coal mine in southeastern France, induced seismicity seems to be controlled by interaction of complex hydrogeological settings, mining works and pre-existing seismotectonic conditions. Swarming seismic activity that occurs periodically in the area is sometimes felt by population and is monitored by local seismic monitoring network composed of three to five stations depending on observed period. To accurately assess local mine-related seismic hazard, precise knowledge of triggering mechanism for observed seismicity and characterization of the fault(s) is crucial.

Precise detection and location of seismic events are the first steps in understanding of observed seismicity. Due to large amount of available continuous data, manual analysis, nowadays, is no longer feasible. We will present an application of the automatic full-waveform-based detection and location method BackTrackBB (Poiata et al., 2016) to continuous data of our monitoring network with limited station coverage. The method was originally designed for application to dense seismic networks, but, as we show, successfully locates microseismic events using data recorded by three or five stations only. However, array coherence based criteria for detection of events implemented within BackTrackBB in this case results in similar coherency values for microseismic events and some noise sources. Thus, it is often impossible to distinguish between the two.

Therefore, in order to apply BackTrackBB to our noisy environment it was necessary to develop a pre-processing step allowing to reduce the large dataset to more manageable volume, minimizing the computation time and removing the coherent noise. Our final detection and location methodology consists of two parts. First part comprises two combined noise removal criteria: the modified STA/LTA trigger technique and the amplitude ratio-based location technique. Reduced dataset resulting from the first part represents a preliminary catalogue of events that is further reprocessed with BackTrackBB, which relocates events with higher precision.

Preliminary results of this new methodology application to the dataset from flooded coal mine has revealed spatio-temporal clustering of epicentral locations, indicating faulting or reactivation of preexisting faults. Swarming activity in some periods seems to be connected to ground water recharge due to rainfalls. To understand better the seismicity triggering mechanism in this complex settings, in order to asses possibility of triggering of the larger tectonic events, we currently examine spatio-temporal characteristics and source parameters of detected seismicity clouds as well as the connection with meteorologicall conditions in more detail.

The proposed detection and location approach will be further tested for implementation into operational monitoring of recently expanded monitoring network of Gardanne area. It can also be easily applied to other environments with limited monitoring capacities and is computationally efficient allowing to process large volumes of seismic data.

Reference: N. Poiata, C. Satriano, J.-P. Vilotte, P. Bernard, and K. Obara, ‘Multiband array detection and location of seismic sources recorded by dense seismic networks’, *Geophys. J. Int.*, vol. 205, no. 3, pp. 1548–1573, Jun. 2016.

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