Improving Seismic Monitoring through Pattern Matching

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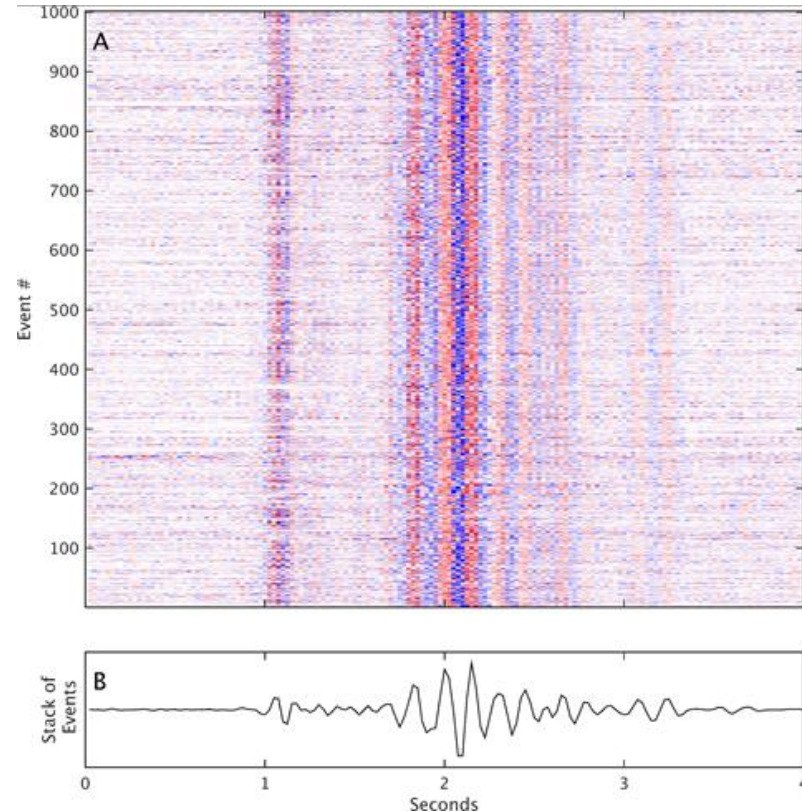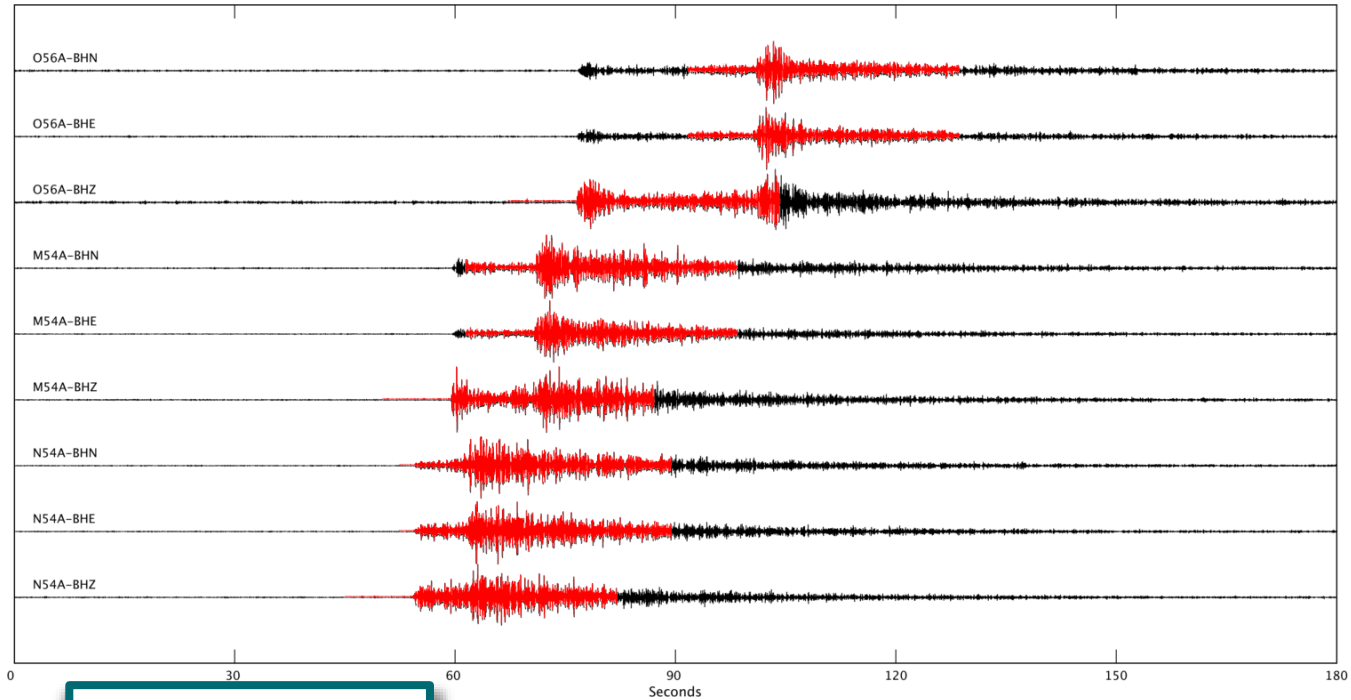Rob Skoumal, Brian Currie

Seismicity Induced by Fluid Injection Tends to be Repetitive

- Source locations are tightly clustered → Waveforms have high similarity

Skoumal et al., 2014; 2015

Detecting Seismicity with Template Matching

Pattern Matching for Detection of Repeating Seismicity

- High performance computing
  - Fast cross-correlations run in parallel
- Repeating Seismicity Detector (RSD)
  - Complete linkage clustering of STA/LTA detections
  - Utilizes spectra, then time domain
  - Stack families to improve waveforms and reduce templates to scan
  - Does not rely on a catalog

Example of Improving Detection of Induced Seismicity

Hydraulic fracturing induced seismicity in 2013 in Harrison County, Ohio
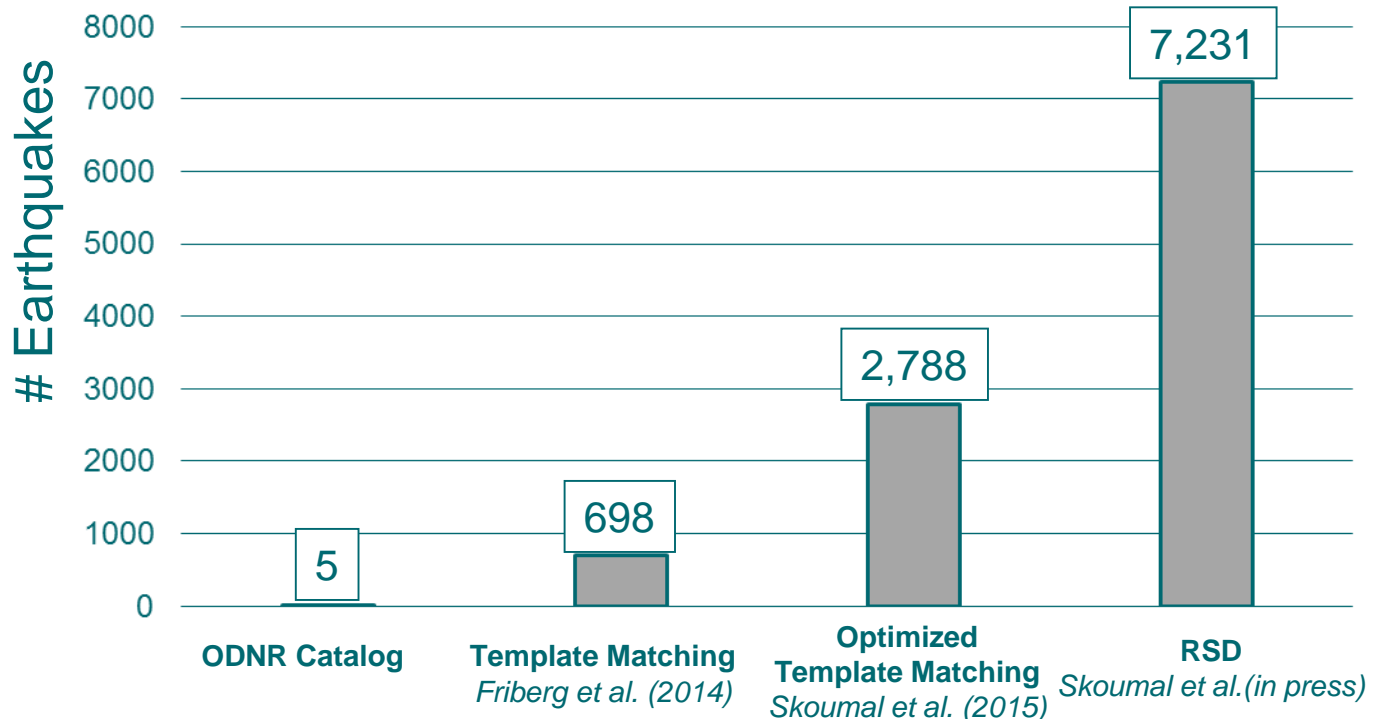
Lessons from Successful Applications

- Advanced detection with a single station is similar to traditional detection with >20 stations
- Advanced detection works at regional distances
  - Up to 50 km for RSD
  - Up to 300 km for catalog templates
- Rapid processing allows for realtime detection
- More complete catalog provides critical information for operators, regulators, scientists

Skoumal et al., JGR, in press