

Evaluations of Signal-Based Bayesian Seismic Monitoring (SIGVISA)

We present SIG-VISA (SIGnal-based Vertically Integrated Seismic Analysis), a next-generation approach to Bayesian seismic monitoring. This work builds upon the success of NET-VISA, recently recommended for production deployment at the IDC. SIG-VISA extends the detection-based NET-VISA approach by modeling full continuous seismic waveforms. Bayesian inference in this model yields a new algorithm for simultaneous detection and location of seismic events, unifying signal-based techniques such as waveform matching and double-differencing with traditional detection-based monitoring in a single framework with principled handling of uncertainty. We report an evaluation of SIGVISA monitoring the western United States. Over a two-week period, SIGVISA detects more than twice as many events as NETVISA, and three times as many as SEL3 while operating at the same precision. At the same time, signal-based monitoring reduces mean location errors by a factor of four relative to detection-based systems. We provide evidence that, given only IMS data, SIGVISA detects events that are missed by regional monitoring networks, indicating that our evaluations may even underestimate its performance. Finally, SIGVISA matches or exceeds the detection rates of existing systems for de novo events – events with no nearby historical seismicity – and detects a number of such events missed in the LEB.

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