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Searchlight Correlation Detectors: Optimal Seismic Monitoring Using Regional and Global Networks

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The sensitivity of correlation detectors increases greatly when the outputs from multiple seismic traces are considered. For single-array monitoring, a zero-offset stack of individual correlation traces will provide significant noise suppression and enhanced sensitivity for a source region surrounding the hypocenter of the master event. The extent of this region is limited only by the decrease in waveform similarity with increasing hypocenter separation. When a regional or global network of arrays and/or 3-component stations is employed, the zero-offset approach is only optimal when the master and detected events are co-located exactly. In many monitoring situations, including nuclear test sites and geothermal fields, events may be separated by up to many hundreds of meters while still retaining sufficient waveform similarity for correlation detection on single channels. However, the traveltime differences resulting from the hypocenter separation may result in significant beam loss on the zero-offset stack and a deployment of many beams for different hypothetical source locations in geographical space is required. The beam deployment necessary for optimal performance of the correlation detectors is determined by an empirical network response function which is most easily evaluated using the auto-correlation functions of the waveform templates from the master event. The correlation detector beam deployments for providing optimal network sensitivity for the North Korea nuclear test site are demonstrated for both regional and teleseismic monitoring configurations.