Automatic scanning detection for characterization of dome-related seismic swarms at Mount St. Helens and their evolution through time

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Using the waveform data for Mount St. Helens from October 2004 through April, 2005 available from the IRIS DMC, as well as a special data set including the accelerometer that recorded eleven days of activity on the whaleback dome of St. Helens during February, 2005, we have modified a waveform cross-correlation algorithm previously applied for event clustering and repicking into a correlation scanning detector. This tool is being developed for implementation during routine volcano monitoring, as a means of identifying, characterizing and locating repeating swarm events and quantifying their seismic energy release.

Application of the scanning detector to St. Helens data reveals stable swarm-type activity over periods with cross-correlation values exceeding 0.8 for 25 days, within which the repeating events slowly evolve over time. Waveforms show high correlation when as much as 60 s of coda is included in the correlation, suggesting very stable source and path characteristics. We present analysis of waveform evolution and event location stability as determined through the detection and automatic repicking and relocation of correlated events. Evolving seismic waveform characteristics are compared to available information about the ongoing eruption sequence to investigate the correspondence among such observables as deformation, volatile flux (both magmagenic and meteoric), estimated dome volume or magma flux and overall energy partitioning. The correlation-detection tool shows promise for real-time implementation, with the potential to greatly reduce analyst workload and augment on-the-fly characterizations already provided by such routine monitoring tools as RSAM and SSAM.