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Exploring Large-Scale Cross-Correlation for Teleseismic and Regional Seismic Event Processing

The decreasing cost of storage and computation power invites new methods of seismic data processing. We use a research database containing tens of millions of waveforms to explore the power of seismic correlation to quantify signal similarities, to discover new events not in catalogs, and to more accurately locate events and identify source types. Building on the very efficient methodologies of Harris and Dodge (2011) we computed the correlation for event pairs in two ways. First we performed entire waveform cross-correlation over seven distinct frequency bands. The correlation coefficient exceeds 0.6 for more than 40 million waveform pairs for several hundred thousand events at more than a thousand stations. These correlations reveal clusters of mining events and aftershock sequences, which can be used to readily locate events. Second we determine relative pick times by correlating signals in time windows for distinct seismic phases. These correlated picks are then used to perform very high accuracy event relocations. We examine the percentage of events that correlate as a function of magnitude and observing station distance in selected high seismicity regions and seek to quantify relationships between correlation and event pair separation (in epicenter and depth) and mechanism differences.

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