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A model of seismic coda arrivals to suppress spurious events.

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We describe a model of coda arrivals which has been added to NET-VISA (Network processing Vertically Integrated Seismic Analysis) our probabilistic generative model of seismic events, their transmission, and detection on a global seismic network. The scattered energy that follows a seismic phase arrival tends to deceive typical STA/LTA based arrival picking software into believing that a real seismic phase has been detected. These coda arrivals which tend to follow all seismic phases cause most network processing software including NET-VISA to believe that multiple events have taken place. It is not a simple matter of ignoring closely spaced arrivals since arrivals from multiple events can indeed overlap. The current practice in NET-VISA of pruning events within a small space-time neighborhood of a larger event works reasonably well, but it may mask real events produced in an after-shock sequence.

Our new model allows any seismic arrival, even coda arrivals, to trigger a subsequent coda arrival. The probability of such a triggered arrival depends on the amplitude of the triggering arrival. Although real seismic phases are more likely to generate such coda arrivals. Real seismic phases also tend to generate coda arrivals with more strongly correlated parameters, for example azimuth and slowness. However, the SNR (Signal to Noise Ratio) of a coda arrival immediately following a phase arrival tends to be lower because of the nature of the SNR calculation.

We have calibrated our model on historical statistics of such triggered arrivals and our inference accounts for them while searching for the best explanation of seismic events their association to the arrivals and the coda arrivals.

We have tested our new model on one week of global seismic data spanning March 22, 2009 to March 29, 2009. Our model was trained on two and half months of data from April 5, 2009 to June 20, 2009. We use the LEB bulletin produced by the IDC (International Data Center) as the ground truth and computed the precision (percentage of reported events which are true) and recall (percentage of true events which are reported). The existing model has a precision of 32.2 and recall of 88.6 which changes to a precision of 50.7 and recall of 88.5 after pruning. The new model has a precision of 56.8 and recall of 86.9 without any pruning and the corresponding precision recall curve is dramatically improved. In contrast, the performance of the current automated bulletin at the IDC, SEL3, has a precision of 46.2 and recall of 69.7.