

An automated time-window selection algorithm for seismic tomography

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We have developed an open source algorithm **FLEXWIN** (Maggi et al., 2009) to automatically select time windows on pairs of observed and synthetic seismograms. The algorithm was designed specifically to accommodate synthetic seismograms produced from 3D wavefield simulations such as **SPECFEM3D** (Komatitsch et al., 2002), which capture complex phases that do not necessarily exist in 1D simulations. Our motivation is to use the algorithm for iterative tomographic inversions, in which the synthetic seismograms change from one iteration to the next, and contain more and more 3D-specific phases (Tape et al., 2007).

Our strategy is to select time windows on the synthetic seismogram within which the waveform contains a distinct arrival, then require an adequate correspondence between observed and synthetic waveforms within these windows. This selection paradigm is general, and can be applied to synthetic seismograms regardless of how they have been obtained. It is clear, however, that a synthetic seismogram obtained by 3D propagation (using e.g. **SPECFEM3D**) through a good 3D Earth model will provide a better fit to the observed seismogram over a greater proportion of its length than will be the case for a more approximate synthetic seismogram.

In order to isolate changes in amplitude or frequency content potentially associated with distinct seismic arrivals, we have chosen a tool used in automated phase detection for earthquake location, the the short-term average / long-term average ratio, and we have adapted it to define time windows around distinct seismic phases (see Figure 1).

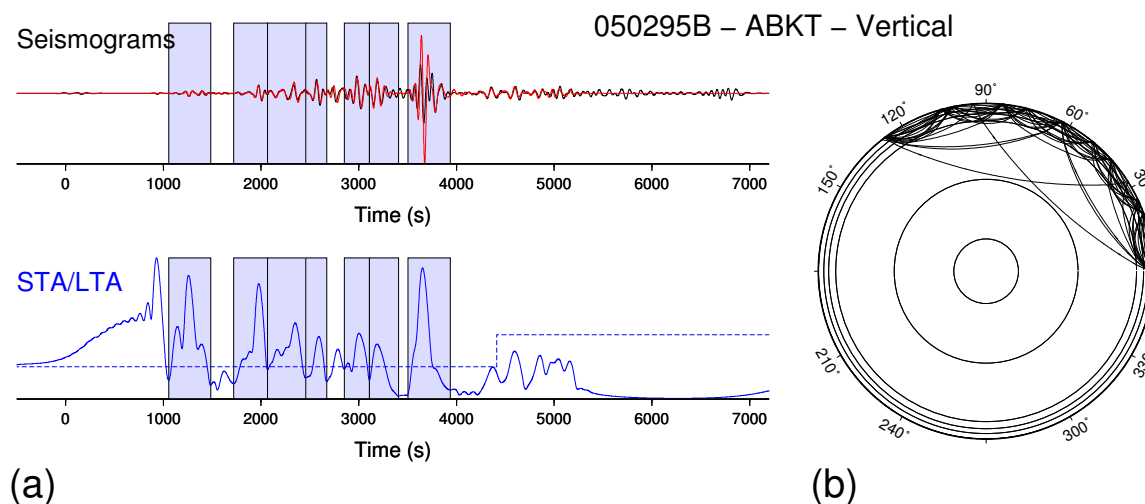


Figure 1: Window selection results on the vertical component for an intermediate-depth event in Northern Peru recorded at station ABKT ($\Delta = 127^\circ$). (a) Top: observed and synthetic seismograms (black and red traces); bottom: STA/LTA timeseries. Windows chosen by the algorithm are shown using light blue shading. The phases contained these windows are: (1) *PP*, (2) *PS + SP*, (3) *SS*, (4) *SSS*, (5) *S5*, (6) *S6*, (7) fundamental mode Rayleigh wave. (b) Ray paths corresponding to the body-wave phases present in the data windows in (a).

We have successfully applied our windowing algorithm to diverse seismological scenarios: local and near regional tomography in Southern California, regional subduction-zone tomography in Japan, and global tomography (Maggi et al., 2009).

References

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