Inversion of the crustal velocity model for Canterbury region

Problem Statement
For full-scale field data inversion of the crustal velocity model for Canterbury region, we use the velocity model (140km X 120km X 46km) developed by Lee. et al (2017) as the initial model and a test configuration including 43 seismic stations (not equally spacing at every 10km) and 146 earthquake to start the inversion. The observed data are processed including filtering from 0.02Hz to .5Hz, windowing to use only significant part of the signals. The source locations, magnitudes and shapes are determined prior to the inversion. A visco-elastic forward modelling is applied with consideration of the spatial attenuation from the observed data. After a number of inversion iterations, the final inverted model using FWT has matched well with the given 1-D model and the misfit error has significantly decreased.
Tasks
Preprocessing of the observed data and determination of sources. • Selecting the channels from stations listed (removing the corrupted channels); filtering the observed data; choosing a segment of the time serie using for inversion. • Determining the source types such as CMT source or point source; source location, magnitude and shape. **Inversion: specify the number of iterations, optimization method or optimal step length (if applicable) and follow the steps for doing inversion at one iteration:** • Forward modeling of the elastic wave propagation for the 1-D model to create the observed data and storing of the forward velocity wavefields at every grid cell and for every subsampled time step. • Calculation of the displacement residual between the observed and estimated data. • Backward propagation of the displacement residual at all stations for each and every source and store the backward velocity wavefields at every grid cell and for every subsampled time step. • Calculation of the sensitive kernels (using 3 components of ground motion velocity wavefields or 6 components of stress wavefields). • Preconditioning of the kernels to suppress the near source and receiver artifacts; considering the non-uniform distribution of the sources and stations. • Update of the model with the optimal search direction (using fixed or optimized step lengths; applying Conjugate Gradient or BFGS methods; implementing regularization).
Schedule
Verification
Verifying the inverted result using FWT - Adjoint Wavefield method with FWT-Scattering Integral, SASW methods or other traditional seismic methods (invasive tests including CPT/ SPT, borehole logging).