High-resolution imaging of lithospheric structures in northeastern Tibet by full waveform inversion of teleseismic body waves

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As the complex active frontal part of Tibetan Plateau expanding toward the Eurasia interiors, northeastern Tibet (NE Tibet) is located in the converging region where the Tibetan Plateau, the Ordos Block and the Alashan Block intersect. In view of the special tectonic setting of NE Tibet, a seismic study in this region is of great importance for establishing a plateau dynamics model and regional geological interpretation. However, due to the limitations of data acquisition conditions and traditional imaging techniques, there are still significant differences between previous inversion results, leading to controversial geological interpretations of the evolution in this region. More deterministic geological interpretations of NE Tibet usually require 3D images of velocity structures with a higher resolution than in current images. In order to obtain finely resolved tomographic images, we performed Full Waveform Inversion (FWI) on broad-band teleseismic body wave records collected by dense temporary transect and adjacent seismological stations deployed in NE Tibet. A hybrid method which couples a global wave propagation method in a 1D Earth model with a 3D spectral-element method in a regional domain was used to model broad-band teleseismic wavefields. The sensitivity kernels of the least square waveform misfit function with respect to elastic perturbations in the regional domain were computed with the adjoint state method. By using these waveform sensitivity kernels, an iterative FWI algorithm was used to invert broadband body waveform data recorded by regional stations to obtain the structural model. A thorough view of lithospheric deformation and mechanism of plateau growth in NE Tibet is provided based on the obtained FWI structural model and previous studies.