Eastward expansion of the eastern Tibetan margin revealed by adjoint waveform tomography

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We obtained a refined 3-D shear wave speed model for the crust and uppermost mantle beneath the eastern margin of the Tibetan plateau and Sichuan Basin by ambient noise adjoint tomography. Different from the traditional surface tomography that assumes a great circle raypath and a 1-D velocity model in inverting phase and S-wave velocities, respectively, adjoint tomography iteratively minimizes the traveltimes misfit between empirical Green's functions (EGFs) and synthetic Green's functions (SGFs) of Rayleigh waves using a preconditioned conjugate gradient method. We obtained a total of 3776 EGFs from the cross-correlation of ambient noise data recorded by 97 broadband seismic stations located in eastern Tibet and the Sichuan basin. Each EGF was bandpass filtered in four period bands, 10-20, 15-30, 20-40, and 25-50 s, producing more than 15,000 traveltime data. Our 3-D S-wave velocity model shows broad low velocity anomalies within the middle to lower crustal depth beneath the margin and a localized low velocity anomaly in the uppermost mantle beneath the Longmenshan range with a velocity reduction of up to 10 %, much stronger that those observed by regular surface wave tomography. The new model also presents a wedge shape lower shear wave speed layer extending from the margin to the upper-middle crust beneath the Chengdu plain, suggesting that the middle to lower crustal flow may have partially escaped to the basin, which drives the uplift of the Chengdu plain.