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Array Imaging at Continent Scale: Surface-Wave Tomography of Asia Using Automated, Broadband Interstation Measurements

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The rapid recent expansion of broadband seismic networks around the world has paved the way for a new generation of tomographic models of the Earth. These models will yield high resolution — previously achievable only in small-scale regional studies — at large, continental scales, advancing our understanding of the structure and dynamics of the Earth's tectonic plates. This facilitates ongoing improvement of regional seismic travel time prediction, and thereby, the location and discrimination of seismic events.

Here, we apply a new, automated technique for inter-station measurements of surface-wave phase velocities to a very large data set from across Asia, including broadband data available from international data centres and CTBT IMS network. A total of 135381 station-station pairs were compiled from this large dataset, each comprising of two stations between 5 and 5000 km apart. Seismic events occuring within 10 degrees of the great circle path on which the two stations lie – and recorded by both stations – were used, for a total of over a million 3-component seismograms. Of the 135381 station pairs, 112039 yielded robust measurements via the automated cross-correlation method, measuring Rayleigh-wave phase velocities in path-dependent period ranges, as broad as 5-300 s. The measurements were then inverted for resulting phase velocity tomographic maps of Asia, including azimuthal anisotropy. These maps provide a significant advance in resolution compared to that previously available. The detailed seismic imaging of the lithosphere offers new insights into the geological process that formed Asia and continue today, and facilitates ongoing improvement of regional seismic travel time prediction.