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The Crustal Structure of Australian Continent from Seismic Ambient Noise

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The use of Green's function retrieved from seismic ambient noise has become an important tool to image Earth's structure on multiple scales during recent years. Because this technique does not rely on local earthquake signals, it is an excellent tool for the seismological investigations of Australian continent, where the number and recurrence of earthquakes are limited.

We use seismic ambient noise to image the Australian Crust including the depth to Moho by using over 250 broadband stations, which have been deployed during the last 18 years by Research School of Earth Sciences-ANU and Geoscience Australia across Australian continent. The continuously recorded data from these stations are utilised to extract the Green's functions from the ambient seismic noise field. Instead of using conventional cross-correlation approach, a transfer function method is used, which has the same phase response with cross-correlation but a broader frequency response. The interstation dispersion curves of Green's functions of Rayleigh and Love wave are estimated with multiple filter analysis. The interstation traveltimes estimated from filtering are used in nonlinear iterative tomographic approach with cell size of $1^\circ \times 1^\circ$ to create the group velocity dispersion maps for each of the period.

We then sample Rayleigh group velocity maps for every point to create an associated 1-D group velocity profile. We also incorporate the finite frequency effects of the wave propagation by not just only sampling one point but also taking account into the effects of the neighbouring points. Each of the group velocity profiles is inverted to create a pseudo 3-D shear wave velocity field of the continent. The inversion is carried with a nonlinear direct search algorithm, where inversion constraints are imposed from number of other seismological data such as the sediment thickness to constrain the results. The resultant shear wave velocity maps are then compared with a recently compiled Moho map of Australian continent from seismic reflection and receiver function methods. The results agree with the known tectonic and geological features such as sedimentary basins, Precambrian blocks. The Moho depth structure derived from 1-D inversion show correlations with the Moho map estimated from the other seismic techniques. The inversions carried out with the sediment thickness and Moho depth constraints also give an accurate representation of the shear wave velocity structure of the mid-crust of the continent, where the propagation ambient seismic noise is much more dominant.