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Crustal structure, seasonal and directional variations of ambient seismic noise in SE Canada and the NE USA

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Long-duration stacks of ambient seismic noise cross-correlation can be used to generate high-resolution images of the lithosphere. In this study, we investigate the crustal structure beneath southeastern Canada and the northeastern USA, using an ambient noise tomography technique. Our study area covers the Phanerozoic northern Appalachians and the Proterozoic eastern Grenville Province, recording a complex tectonic history since ~1 Ga. Our datasets include continuous records of vertical component time series, recorded by 69 stations belonging to 7 seismograph networks over a more than two-year period. The ambient seismic noise directionality and seasonality variations of our datasets are analyzed in detail, and possible noise source locations are proposed in the Atlantic and Pacific oceans. Our analysis suggests strong variations of dominant seismic noise sources at both Primary (11-20 s) and Secondary (5-10 s) bands in various months, with different observed patterns at these passband periods. Our tomographic models indicate complex and strong variations of Rayleigh wave phase velocities across the study area, providing us evidence to discuss tectonic implications. The resulting Rayleigh wave phase velocity maps suggest generally slower velocities beneath the Appalachians than the Grenville province. A sharp velocity contrast is observed across the Grenville Province-Appalachian domain boundary at periods sensitive to the lower crust, suggesting a step-like geometry of the Moho interface beneath this area.