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Adjoint Seismic Tomography of the Antarctic Continent Incorporating Green's Functions from Ambient Noise Correlation

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The Antarctic continent with its large ice sheets provides a unique environment to investigate the response of the solid Earth to ice mass change. A key requirement of such studies is high-resolution seismic images of the crust and upper mantle, which can be used to estimate the region's viscous structure. Likewise, these images are key to understanding the region's geologic history and underlying geodynamic processes. Although the existing transverse isotropic seismic model ANT-20 (Lloyd et al., 2020) and azimuthally anisotropic seismic model ANT-30 (Lloyd et al., in prep) have regional-scale resolution from the upper mantle to the transition zone, there is a need for higher resolution within the uppermost mantle (< 75 km) and crust of Antarctica. In this study, we use the ANT-30 model (Lloyd et al., in prep), a 3D seismic model from earthquake data, as a starting model. We seek to improve its resolution within the upper ~ 100 km of the Antarctic mantle by fitting three-component ambient noise correlograms computed from broadband records collected in Antarctica over the past 20 years. This includes data from recent temporary arrays such as TAMSEIS, AGAP, TAMNNET, RIS, POLENET/ANET, and UKANET. The three-component cross-correlations of station pairs are calculated and properly rotated to extract ambient noise surface waves that include both Rayleigh and Love waves, which show excellent signal-to-noise ratio between 15 to 70 seconds. The benefit of including this data is twofold: (1) it provides surface wave observations down to 15 s, as opposed to 25 s and (2) it provides shorter intercontinental paths, which were absent due to the region's earthquake distribution. We then use the software package SPEC-FEM3D-GLOBE to iteratively improve the 3-D earth model, minimizing the nondimensionalized traveltimes phase misfit between the observed and synthetic waveforms. The preliminary results indicate a stronger positive radial anisotropy ($V_{SH} > V_{SV}$) in the lower crust and uppermost mantle for West Antarctica and part of East Antarctica. With more iterations, smaller-scale detail can be revealed by the new ambient noise data, resulting in a more reliable uppermost mantle and crustal structure.