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EARTH SCIENCE

SPEAKERS CLUB

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Regionalization and Composition of the US Crust by Probabilistic Seismic Fingerprinting

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Seismological models of the crust are useful for making geological inferences. The most widely used models are often constrained by active-source datasets of seismic reflection and refraction experiments. For this reason, the models only sparsely sample the surface of the Earth and often impose extrapolations based on tectonic regionalization. Additionally, these models do not come with uncertainty estimates, making inferences hard to evaluate. In this presentation, I discuss how we address these concerns for the conterminous United States using data from the Earthscope's USArray.

I use a probabilistic, transdimensional approach to inverting for ambient noise phase velocity maps and show, using spatio-spectral analysis, that the resulting maps are comparable to those obtained by a linear least-squares inverse approach, with fewer artifacts at higher harmonic degrees. I also demonstrate the additional advantages of a probabilistic approach: (1) An auto- adaptive parameterization that follows Earth structure without making restricting assumptions on model resolution (regularization or damping) and data errors (2) Ability to recover non-Gaussian phase velocity probability distribution while quantifying and separating the sources of uncertainties in the data measurement and modeling procedure, and (3) Enabling statistical assessments of different crustal models (e.g., CRUST1, LITHO1 and NACR14) using variable resolution residual and standard deviation maps derived from a Markov Chain Monte Carlo ensemble.

I proceed to show how the phase velocity maps (and associated uncertainties) are used to update models of lower crustal composition in the US. The inversion of phase velocity dispersion curves for depth profiles of compressional and shear wave velocity is also preformed in a transdimensional manner that does not make assumptions on number of crustal layers. The resulting models are then used to fingerprint lower crustal composition by using a simple parameterization, derived by Huang et al. (2013), connecting rock velocities and geochemistry (e.g. proportion of felsic to mafic components in bulk rock). I discuss the implications of these inferences for re-evaluating models of crustal composition and assessment of crust formation hypotheses (e.g., magmatic underplating, relamination, delamination).