The Composition of the US Continental Crust: A Transdimensional Approach

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ABSTRACT

Seismological information on crustal structure, when combined with other geophysical, petrological and geochemical constraints, provides our best insight into the structure and composition of Earth’s continental crust. Traditionally, published models of the continental crust (e.g. Vp profiles) constrained by seismic reflection, refraction experiments and (or) receiver functions are used to infer the thickness and lithology of the upper, middle, and lower crust. In order to be most useful, however, inferences of crustal structure and composition made using seismological models as data need to be presented alongside their uncertainties. Quantifying this uncertainty is the challenge.

In this talk, I discuss how we use the transdimensional hierarchical Bayesian inverse (THBI) approach to conduct ambient noise tomography across the USArray. A Transdimensional and Hierarchical approach allows one to jointly constrain absolute phase velocity maps for surface waves (5s - 40s), uncertainties in the phase velocities (model variance and co-variance), as well as data noise (which can affect the model results), without the difficulty and subjectivity of making a-priori assumption on model resolution or regularization.

I show that our model results are comparable to linear-least-square method on the large wavelengths with some distinct differences across length-scales. If time permits, I will also preview a second stage analysis where we use the phase-dispersion curves (and their uncertainties) as data to constrain 1-D velocity profiles across distinct geological provinces in the continental US. We demonstrate, again using the THBI approach, how data uncertainty (associated with the seismic phase velocity) affects inferences on the 1-D velocity models. Our goal is to jointly invert complementary seismic datasets including surface wave dispersion, receiver functions, and surface-wave ellipticity.