Lithospheric Trends in Subduction Zones using Machine Learning

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Abstract

Better imaging of the Earth subsurface is important for understanding plate tectonics and its aspects that can have great effects in the communities in the form of seismicity and volcanism. One way to measure the lithosphere layers and properties, the most important layer that controls plate tectonics, is by using seismic waves that can be calculated into velocity contrasts, which in turn are proxies for different composition, temperature, grain size, partial melt. We calculated the velocity structure beneath of Alaska and Nicaragua to shed light on surface deformation caused by subduction. We have developed ways to identify the depth of these layers aiming to reconstruct the story of why they have the depths that they. For this machine learning project, we want to shed light on the subduction effects by finding correlation between the layers calculated through a Bayesian Joint inversion of Ps, Sp converted phases and phase velocities from surface waves with a Monte Carlo Markov Chain search of parameter space. Nonlinear trends that connect these layers make unsupervised machine learning methods well suited to objectively determine connections, such as where areas that melt could be present. Some features calculated from the velocity models for the unsupervised methods are Moho depths, Lithosphere-asthenosphere boundary depths and amplitudes, positive velocity gradient depths and amplitudes. We analyzed trends of some of these features individually and different combinations of them. Initial tests of various unsupervised learning algorithms show that Kmeans clusters are more suitable for finding the correlations between these features. We plan to use Kmeans to understand patterns within these subduction zones and between them.