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Predicting Sediment Property Vertical Profiles on the Mid-Atlantic Ridge Using Machine Learning

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The seafloor and sub-seafloor exhibit a wide variety of physical, chemical, geological, and hydrological conditions that alter the propagation of sound. The creation of a predictive geoacoustic model therefore requires some knowledge or estimate of these environmental conditions. The most direct sub-seafloor observations are typically core and/or log data from ocean drilling wells. However, drilling is expensive and necessarily sparse. A comprehensive geoacoustic model requires some way of estimating sub-seafloor environmental conditions where they have not been measured. Past efforts for estimating the sub-seafloor assume spatial and/or empirical relationships. Recent advances in machine learning have provided means to predict properties, with uncertainties, on the seafloor (Lee et al., Global Biogeochem Cycles, 2018). Despite the global coverage of this technique, it is limited to geospatial prediction only – no quantities are estimated with depth. Here, we extend our geospatial prediction to the vertical dimension to predict variation as a function of depth as well as position. We use data from ocean drilling programs as training data (i.e. observed data) within NRLs Global Predictive Seabed Model (GPSM) to predict sub-seafloor sediment property profiles where no observations exist. We focus first on the Northern Mid-Atlantic Ridge, because of the relatively high density of samples, and consistent underlying geological processes.