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Quantifying Ocean Mixing Processes Through Stochastic Heterogeneity Mapping

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Stochastic heterogeneity mapping based on the band-limited Von Karman function is applied to stacked, migrated seismic data allowing the extraction of several stochastic parameters that may elucidate ocean mixing processes. In particular, the Von Karman method enables extraction from the reflectivity field: 1) the power spectrum, a combined estimate of amplitude and coherence in the analysis window, 2) correlation length, an estimator of the maximum length for which the event distribution described by a power law, and 3) the Hurst number, which is the exponent of the power law and is directly related to the fractal dimension, a measure of how completely a fractal fills space. With the extraction of these parameters we aim to quantify various scale mixing processes in the ocean. Curiously, a single scaling law derived from percolation theory asserts that Hurst numbers between 0 and 0.5 are indicative of sub-diffusive behavior and Hurst numbers between 0.5 and 1 indicate super-diffusive behavior. Moreover, double-diffusion regimes are represented by a Hurst number of 0.25. Low Hurst numbers represent a rich range of scale lengths and, accordingly correspond to well-mixed regimes. Preliminary analysis of GO seismic profiles acquired in April-May, 2007 show that zones corresponding to particular water masses display varying degrees of diffusive behavior. We believe that this method of analysis can address multi-scale mixing processes in the ocean from seismic data alone.