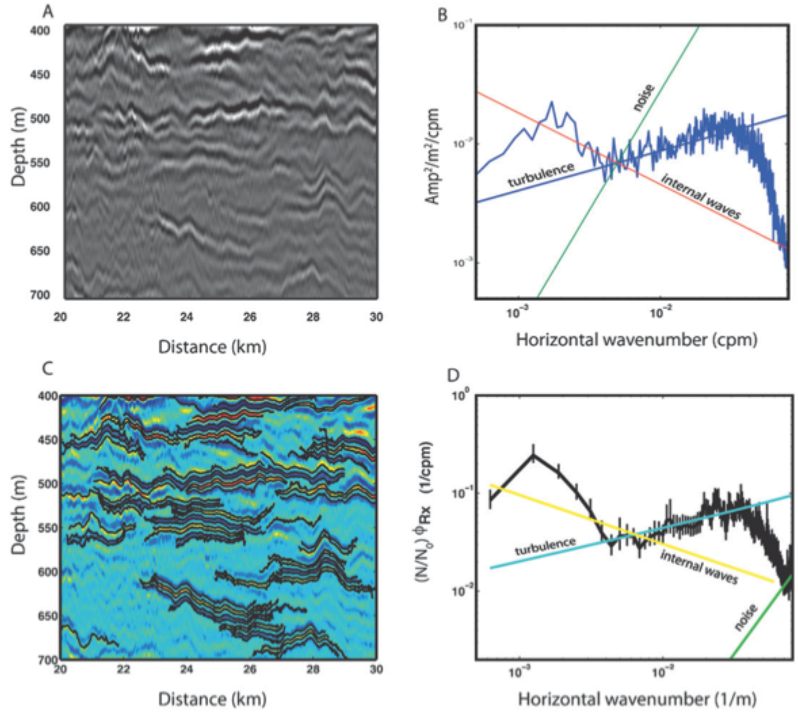
Reviewer 2 expresses doubt about the relationship between the horizontal slope spectra of tracked reflectors and seismic slope spectra. Holbrook et al. (2013) has proven such a relationship exists, see their figure 5 below.



In this figure we see that the slope spectra of the data transform (B) match the slope spectra of the tracked reflectors (D) in general form, namely that horizontal wavenumber ranges reflect internal wave characteristics, turbulent characteristics, and then a drop off where noise does not dominate the data at high wavenumbers. Generally, this shows the information contained in the spectra of the tracked reflectors is also present in the data transform of the seismic data.

Our data presented here is very similar to these data presented in Holbrook et al. (2013). Figures 3 and 4 from the manuscript are analogous to the figure above. In our data, the turbulent subrange and dropoff are closely matched between the data transform and the tracked reflectors. The horizontal wavenumber range we use to conduct our estimates of diffusivity clearly follow the predicted Batchelor spectrum in both the data transform and tracked reflectors. The signal in our turbulent subrange is not a +2 slope, and therefore is not noise, and its match to the predicted turbulence slope leads us to interpret it as signal that contains information about turbulence in the seismic data. The only difference between our data and that presented in Holbrook et al. (2013) is the lack of a clearly defined internal wave subrange. We think this is the result of a lack of continuity across our data as internal waves occur over scales of >100s of meters. It is possible to enforce continuity by limiting the data analyzed to only continuous trackable reflectors and that is why in both our data and the figure above the internal wave subrange contains more energy in the tracked reflectors as compared to the data transform. Additionally, our data has higher levels of turbulent energy as compared to the data presented in Holbrook et al. (2013) making the turbulent subrange more dominant over the internal wave subrange. We have added text to address these issues in the manuscript at lines 244-250 and 387-389.

The reviewer states, "I have been thinking quite a while on how such a relationship can exist at all, as at first thought the slope of the reflector and the amplitude of the reflector (sic) do not appear to have anything in common" but there is no need for there to be any relationship to the amplitude of the *reflection*. Rather, all we are relying on is a consonance between the Kx spectrum of the seismic image and the Kx spectrum of the actual isopycnals. Since the reflections locally track isopycnals (Holbrook et al., 2013), then this relationship holds. The reviewer's doubts about a relationship between the seismic amplitude and the reflector slope are exactly correct – which is why we use normalization of the seismic data and calibration to tracked reflections. They then suggest that in the real world the relationship could break down and posit a few thought experiments in which this may be the case. Added text at lines 387-389 in the manuscript address this issue.

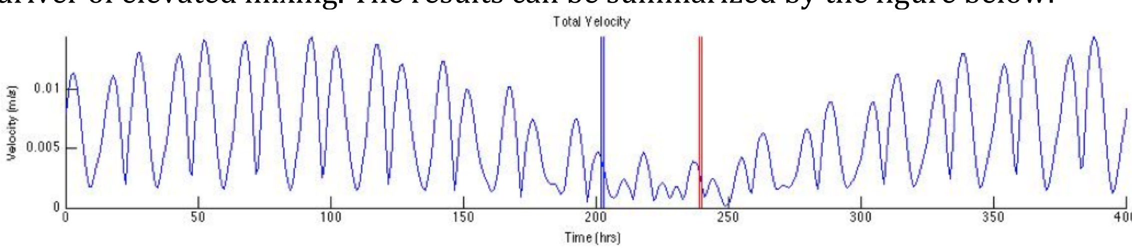
We spent considerable time thinking about these thought experiments. However, the situations described in the thought experiments do not reflect oceanic observation and would not be useful when examining slope spectra in the manner we present here. Internal wave and turbulent spectra, as measured in the ocean, have distinctive characteristic behaviors as described by the Garrett-Munk and Batchelor spectra. It is exactly these characteristics we utilize to measure internal wave and turbulent energies in seismic data (eg. Holbrook and Fer 2005; Holbrook et al., 2013; this manuscript). The thought experiments suggest using a sinusoid to approximate an internal wave and a Gaussian to represent the seismic source. Such a dataset would not provide spectral energy across all horizontal wavenumbers, and would therefore not fit the Garrett-Munk or Batchelor spectra required to do an analysis such as those found in Holbrook et al. 2013, or as we perform here.

It is the case in both our real and synthetic data that our analysis occurs over regions where vertical displacements cannot extend beyond more than half of the seismic wavelet, here ~15 m. The data transform method is applied to regions 400 m laterally by 10 m vertically, eliminating the potential for extreme vertical excursions in displacement from interfering with the spectral methods applied. This aligns our analysis closely with the proven relationship from Holbrook et al. 2013 and the case in Reviewer 2's second thought experiment where it is noted the proper relationship between the two spectra exist. Here, we also point out our scaling between tracked reflectors and data transforms is done with an average of regional windows around each data cell to further mitigate anomalous spectral energy spikes (section 3.4).

Reviewer 2 comments that the synthetic fields "only take the internal wave field into account." This is not an accurate assessment of our synthetics. Our synthetics are created by perturbing temperature and salinity measurements (from an XCTD) with internal wave, turbulence, and noise characteristics (figure 12). Reviewer 2 also points out other issues such as seismic acquisition and reflection amplitudes are not accounted for in the synthetics. For both the real and synthetic data, seismic amplitudes are normalized over each analysis window thereby removing major amplitude differences between real and synthetic data.

Regarding the interpretation of lee waves and mixing rates, Reviewer 2 highlights results of Nikurashin and Ferrari (2010a). While it is true they find lower mixing rates with consistent flow as compared to time-dependant flow (see figure 6 of Nikurashin and Ferrari 2010a), there still exists turbulence associated with lee wave created by steady flow. In fact, our results are in accord with their analysis that the diffusivity levels are not extremely elevated as we observe values below 10^-3 m^2/s. Additionally, our results do resemble the elevated turbulence in the lee of steady flow over topographic highs seen in figure 3 of St. Laurent and Thurnherr, 2007. We address this issue in the updated manuscript at line 496-497.

We did consider tidal influence as Reviewer 2 suggests. The authors presented a tidal model provided by Scott Smith of the Naval Research Labs at the 2013 International Congress on Acoustics where we found its influence to be an unlikely driver of elevated mixing. The results can be summarized by the figure below:



Here, the vertical blue lines bound the acquisition period of our dataset and the red lines bound the time of acquisition of the Eakin et al. (2011) data collected over the same transect. In both cases, flow velocities due to tidal forcing are very low.