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Ocean Science Discussions

Interactive comment on "First images and orientation of internal waves from a 3-D seismic oceanography data set" *by* T. M. Blacic and W. S. Holbrook

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The authors want to thank B. Ruddick for his detailed and thoughtful comments. Below are our responses to his points.

Specific Points:

0) After an extensive literature search, no useful oceanographic data could be found corresponding to the time and location of our data collection. Chu et al. (Journal of Physical Oceanography, 35, 902-910, 2005) describe rapid current reversals (from roughly westward to roughly eastward) in the winter on the Texas-Louisiana shelf not far from the location of our data. The reversals are not necessarily associated with

changes in wind direction and Chu et al. (2005) conclude that these reversals are not rare events. Eddies of different sizes that have detached from the Loop Current are also common transitory features in this part of the Gulf. Based on this, we feel that only oceanographic information obtained at the same time (within a day or two at most) and within $\sim$20 km of the same location is likely to be useful in providing corroboration of interpretations of the fine structure we see in the seismic data. Since such information does not exist (to our knowledge) for our data set, we have qualified our interpretation of the features we describe in the seismic images (section 3, paragraph 2).

1) We chose to focus on one particular feature in reflection 2 because it appeared to be near linear and thus would be a good example for illustration of how the orientation of linear features could be determined. The reflections we see in our data set seem to result from a complex small-scale 3D internal wavefield. In this wavefield, waves with different sources and orientations interfere with each other with peaks and troughs corresponding to locations of constructive interference. It is not the ideal case for determining orientations of specific features. We have added text to point this out more clearly (section 3, paragraph 7) and this is why we assert that 3D seismic studies are best suited to focused targets such as solitary waves, fronts, lee waves, etc.. Nevertheless, we wanted to illustrate how the orientation of a feature could be obtained from 3D seismic data, so we chose the cleanest, most linear feature to use for this illustration. Of course the rose diagram will look different if we use the entire reflection or any other part of it. One can deduce that simply by looking at the surface plot of the reflection; the surface is complex with bumps and troughs of varying shapes. The point of the exercise is not to try to interpret the source of reflection 2 or even this particular feature of reflection 2; we have no corroborating information to confirm any such interpretation we might try to make anyway. The point is to illustrate the potential of 3D seismic data when applied to a suitable target.

2) We have performed the sinusoidal surface fitting procedure suggested by the reviewer. Two new figures (Fig. 8 and 9) have been added as well as text describing

the procedure (section 3, paragraph 5). We applied this method to the same section of reflection 2 (12 to 12.5 km along the swath) for the reasons stated above in our response to comment 1. We have kept the contour line segment method in the paper for comparison to this sinusoidal surface fitting method. We note that the sinusoidal surface fitting method is also dependent on which part of the reflection we choose to examine. A different result is obtained with a somewhat more complex error surface when the entire reflection is used.

3) This question has been discussed in other papers (e.g., Nandi et al., 2004; Sallarès et al., 2009), however, we have added two figures (Fig. 3 and 4) and text (section 2, paragraph 5; section 3, paragraph 2; section 4, paragraph 1; and in the abstract) to try to address this for our data set. We find that in many areas the reflections seem to follow isopycnals (that is, are roughly horizontal, as the isopycnals are in most areas) but in some cases they seem to cross isopycnals. However, we don't see evidence for pervasive thermohaline intrusions in the XBT profiles (only a few small inversions can be found). Thus, we suggest that the reflections in our data are caused by fine structure from internal wave strains, and we add that previous mixing with the interfaces between layers of well-mixed water perturbed by small-scale internal waves is another possible interpretation (section 3, paragraph 2).

4) Examining the amplitudes of reflections and comparing them to internal wave amplitudes to predict strain pattern would be an involved study that is outside the scope of this paper.

Editorial suggestions:

Figure 1 – Bathymetry has been plotted in color as filled contours. To avoid cluttering the map, we have not added contour lines but used a colorbar scale for bathymetry.

Locations of XBT casts have been added to figures showing the seismic image (Figs. 3, 4 and 5).

Figure 3 is now Figure 5. The inset has been pulled out and enlarged to make up Figure 5b. The previous Figure 3b has been made into Figure 6 and re-plotted with illumination effects and a different orientation.

The orientation in the previous Figure 4 (now Fig. 7) has been adjusted as suggested by the reviewer.

The previous Figure 5 (now Fig. 10) has been left in for illustrative purposes. It is in the paper to demonstrate another way in which the 3D seismic data can be visualized. Because the full 3D processing performed thus far is not optimized and includes no migration, we don't wish to try to use it for interpretation at this time.

Interactive comment on Ocean Sci. Discuss., 6, 2341, 2009.