

Dear Nicholas Harmon and co-authors,

Thank you for submitting your manuscript 'Tilt Corrections for Normal Mode Observations on Ocean Bottom Seismic Data, an example from the PI-LAB experiment' to Seismica. Both reviewers suggest 'revisions required' (or minor revisions) to your manuscript. I agree with their assessment, and I think that if you can address their comments that this manuscript is significant and should be included with Seismica.

In sum, I agree with the reviewers' comments that this relatively simple technique could lead to some very powerful tools to help reduce noise on OBSs and improve our ability to understand the Earth. However, in line with the reviewers' comments, I also agree that some clarification of the Methods is needed.

Some additional comments:

In lines 51-52, the work on long-term OBS as part of the Global Seismographic Network should be cited here: <https://authors.library.caltech.edu/103033/3/SRL-2019123.pdf>

In lines 275-276 and for lines 339-342, you mention that the IGP stations are noisier than the Scripps stations, particularly below 2 mHz. Can you quantify this at all?

Lines 478-481 on Data Availability: can you provide a date to which you expect the data to become available at the IRIS DMC (i.e., when is funding on EURO-LAB expected to end and data to become available)? Will a link to supplementary material and/or a link to GitHub (or some other data repository) be available for the rotation code?

Thank you for your submission to Seismica,

Dr. Danielle Sumy  
IRIS Consortium

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Reviewer #1

Harmon et al present a potentially useful tool to add to the toolbox of data processing methods that help remove environmental noise in OBS datasets. It could be an appropriate addition to this journal, but the manuscript needs clarification about how the method works.

Specific comments and questions

Line 139. Clarify that by “locations” you mean time points in the time series.

Lines 144-157. This description of the rotation method needs clarification. Please add additional text to address the questions below, and to explain what the limitations of the rotation correction might be.

- i) Do you assume that the tilt is a static offset that never changes with time or loading conditions? What if tilt increases continuously with time, or has long-period oscillatory behavior?
- ii) Did any of the OBSs have a gimbal system, and if so, did it add anything to the tilt assessment? I.e. does it apply a similar tilt correction at some point during the deployment? If it does, can you see it in the electronics or in the data?
- iii) Clarify and describe what you mean by “rotation” – i.e. rotation of the vertical axis and if so, relative to what reference frame? What is the azimuth relative to? If north, then how do you determine that?

Lines 156-157. Why do you differentiate for acceleration? Why can't all the processing be done with velocity time series?

Lines 252-253. Is the observation that the amplitudes were reduced by 28% a good thing or a problem? Either way, explain why.

Figure 4. I can barely see the blue line (I couldn't see it without blowing up the pdf version). This figure needs another panel focusing on this part of the spectra.

Lines 268-271. The observation of beating is interesting and could use another sentence or two explaining why it occurs.

Line 276-278. This explanation is useful and needs to come earlier, around the first mention of Figure 3 in the text. Before getting to this point in the text, I had to examine Figure 3 for a while trying to figure out whether the black curves were the glitches or the actual modes, and at the stars which sometimes land on the modal frequencies and sometimes not, adding to the initial confusion.

Lines 298-299. “...convince ourselves that...” is awkward and suggests that there is evidence of this that is not presented here. Perhaps say “we speculate (or hypothesize) that ...”

Figure 7 and caption. The font size in these panels is too small. By “excluded” (Line 314), do you mean that it was ignored, or that its effect was removed?

Line 339. What do you mean by “... *deterioration and deformation* in ...?”

Recommendation: Revisions Required

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Reviewer #2

This paper presents a new way of making tilt corrections to OBSs in order to observe normal modes, and gives an example of utilizing this correction on OBSs from the PI-LAB experiment. Any improvements in the reduction of OBS data can enhance what we can learn about the Earth, so this paper represents a valuable and interesting contribution to potential readers. The manuscript was well-written, clear and easy to follow, and the included figures were critical. The results and conclusions of the paper are sound and important, however, I would like to see just a few relatively minor additions which I have detailed below:

1. This paper talks about calculating a best fitting tilt and azimuthal rotation angle correction in lines 146-147. Then in line 148 you state "Once these angles are determined the rotation is applied to the raw data to determine the tilt corrected data." It sounds like you are either correcting just for azimuthal rotation to determine tilt or that you are correcting for both azimuthal rotation and tilt to determine a combined tilt/rotation corrected data set. I assume it is the latter, but please use more precise wording here since this is the crucial part of the methodology.
2. In line 370 you say that tilt angles estimated in this study range from 0.88 to 0.00 degrees. Is this referring to a combined tilt/azimuthal rotation? (I assume so but see point 1 above.) What is the tilt distribution for the instruments? I would like to see more information about the correction for each station—maybe a table that lists the tilt correction calculated and used for each instrument.
3. Since this is an alternative method for correcting for instrument tilt I would like to see a comparison of using this method of correcting tilt verses the spectral tilt correction. You could just pick a few stations used in this study and re-do the tilt correction using the spectral tilt method for comparison.

Recommendation: Revisions Required