Following two helpful and constructive reviews, we have performed several additional analyses to support our findings. We include the results of these new analyses in the main manuscript and supplementary information. We have also added several new figures, edited existing figures, and edited several text sections for clarity. The layout of Figure 10 has also been edited following comments from a colleague.

Responses to all comments from both reviewers can be found below. The reviews are copy and pasted and shown in Arial, black font. Action items within larger comments are bolded. Our responses to these reviews are shown in Times New Roman, blue font.

REVIEWER A

Given the potential hazards posed by large megathrust earthquakes in Cascadia, resolving the updip extent of megathrust rupture is of significant importance. However, whether interseismic strain accumulation extends to the trench in Cascadia remains unclear, primarily due to the limited availability of seafloor monitoring data. This study adopts an empirical approach by analyzing continuous seismic records from two cabled OBSs and reports potential shallow tectonic tremors. While I appreciate the careful and measured interpretation, I find the presented evidence to be weak. This critique is not necessarily directed at the authors or the study itself but rather underscores the inherent challenges of addressing this scientific question given the scarcity of data. In this context, I do not object to publishing this study after the authors address the following comments:

1. Dynamically triggered tremors are generally easier to identify than spontaneous tremors, as evidenced by global observations across both subduction and transform boundaries. As noted by the authors, the identified tremor-like signals do not correlate with incoming seismic waves, which is puzzling. Given the lengthy observation period, the absence of dynamically triggered tremors in a region potentially abundant with tremors (as reported here) is contradictory. **I suggest the authors adopt a statistical approach to evaluate the likelihood of not identifying dynamically triggered tremors during this extended period, as well as the possibility of misidentifying tremors within the same timeframe.** Such a quantitative assessment is necessary due to the significant implications of the reported tremors.

We had already assessed whether any of our tremor detections occurred within the times surrounding large earthquakes (all > M7 in the dataset) and found that there were zero detections associated with these events (see last paragraph in Section 5.3). As there is no straightforward method to statistically assess whether there are triggered tremors that our approach did *not* detect, we instead visually checked for tremor signals in the surface wave trains of large earthquakes during our time period, to make sure there is nothing we missed. Using a simple magnitude and distance relationship, we sorted all earthquakes in global catalogs occurring during our time period to identify those most likely to generate large surface waves at HYSB1. We visually checked the top 30 earthquakes for evidence of triggered tremor in the surface wave trains (see new Figure S15). As we now mention in the last paragraph of Section 5.3, "We found that even the largest surface waves do not appear to modulate the waveform at tremor frequencies, as is expected for triggered tremor". We also point out that dynamically triggered tremor is not always expected for a given tremor patch; triggered tremor is more likely to be observed when a tremor patch is currently active/in the midst of an ETS event, or more highly stressed than normal (Rubinstein et al., 2009; Gomberg et al., 2010).

2. There appear to be several stations located near HYS14. **Is it feasible to apply beamforming techniques to validate the reported tremors and verify whether their back-azimuth aligns with potential tremor locations?**

There are indeed three additional short period stations located near HYS14. However, we do not record any tremor-like signals on HYS14 at any point during the study period, which prevents us from exploring any beamforming techniques. The station where tremor-like signals are recorded, HYSB1, is 20 km from the nearest station.

3. Given the presence of only two stations, I agree with the authors' assertion that cross-correlation between these stations might not yield useful results. However, if tremors exist within the region, the stations are likely sensitive to the same nearby source patch throughout the observational period. **I recommend the authors explore cross-correlating tremor-like signals at individual stations. High coherence between signals would at least confirm a common source region**, thereby lending support to the interpretation of these signals as tremors.

This is an excellent idea that led us to perform two additional analyses on our "tremor" dataset from HYSB1, which totals 5570 s over 8 years, to assess the likelihood that the signals originated from a common source region. Both analyses performed provide extra support that the signals *did* originate from a common source, and are consistent with tremor.

We first split the tremor dataset into smaller windows, akin to individual LFEs, and see if any correlate across time. As now stated in Section 5.3: "If the signals are indeed tectonic tremor, they could be thought of as the sum of many low frequency earthquakes (LFEs) (Shelly et al., 2007). We cannot identify LFEs within tremor using a single station, but if the signals at HYSB1 are composed of many LFEs emanating from the same area, we might expect to see similar waveforms at the time scales of LFEs (~6 s windows; Brown et al., 2008) repeating over time. Indeed, if our overall tremor signals are split into 6-s templates, they contain many examples of templates that have high similarity to other portions of tremor signals, years apart (see Figure S13)." The new Figure S13 shows two examples of these highly-correlated 6-s windows.

We then took these same 6-s windows and performed particle motion analysis on the three-component waveforms, to assess whether the waveforms are rectilinear (consistent with body waves) and, if so, have similar source azimuths. As now referenced in Section 5.3, the new Figure S14 shows that there are many windows with high rectilinearity (> 0.7) over time, and these same windows show a consistent source azimuth, with a median of 175.8° with a standard deviation of 5.3°. As now stated in Section 5.3: "These stable polarization characteristics are consistent with a tectonic tremor source (e.g., Bostock & Christensen, 2012; Iwasaki et al., 2021). With data from a single station, however, we cannot use these particle motions to identify a specific tremor source location; particle motions of tectonic tremor are a result of complex S-wave radiation patterns, local anisotropy, and faulting mechanisms, which means distinct tremor sources could produce equivalent particle motions at a single receiver."

4. The authors validated their approach using known tremors offshore of New Zealand. For greater robustness, **it might be more important to validate their method with OBS data from regions known to lack tremors**. I recommend the authors test their method against OBS data from passive margins where tremors are notably absent, such as the ENAM data from the U.S. East Coast.

This is a wonderful point and we have now validated our method using OBS data from an area that lacks tremors. We investigated the ENAM data from the U.S. East Coast and found that it was dominated by bottom-current generated harmonic tremor. Therefore, we looked for an alternative OBS dataset deployed in an oceanographically quieter region, but far from a tectonic feature that could generate tremor. The NoMelt experiment, which deployed autonomous OBS at ~5000 m depths in the central Pacific ocean, satisfied these conditions. We applied our method to year-long time series from three of the NoMelt OBS, and show that we find very few signals consistent with tectonic tremor. The few tremor-like signals isolated by our method can be quickly visually identified as T-phases, bottom-current generated tremor, or SDEs, similar to the misdetections we describe for the OOI dataset. We therefore conclude that our described method performs as desired for the NoMelt experiment, allowing the user to quickly isolate any tremor-like signals to a small dataset that allows fast visual confirmation that no tectonic tremor signals are recorded.

This validation exercise has been incorporated into the manuscript in several places, described below:

Section 2.2, now titled "Autonomous seismometer data", now has an additional paragraph that describes the OBSs used in the NoMelt experiment.

Section 4.3, now titled "Single-station method validation offshore Hikurangi and the central Pacific", now has an additional short paragraph at the end of the section that summarizes our findings from the method applied to the NoMelt experiment, and points the reader to the Supporting Information (Text S2) for additional details.

Text S2, a new section, describes the results of our method applied to three NoMelt stations.

REVIEWER B

This is a very thorough and detailed analysis of data recorded on 2 buried, cabled broadband seismometers on the OOI cabled observatory that were designed to search for tectonic tremor. It is a valuable addition to the literature in that it provides new insights into the factors that affect seismic data recorded on the seafloor. The authors are to be commended for their effort to fully document their work and share it with the community even though the results related to tremor are somewhat equivocal. I recommend publication after revision.

I have several suggestions to improve clarity, starting with the title. I think "Possible" would be a more appropriate word than "Potential" because "potential" means something that can develop. What may have potential here is the approach to data processing, not whether the signals they observed are indeed tectonic tremor. **In fact, since the main value of the paper is the procedure rather than the result, I suggest an alternative title along the lines of "Searching for shallow tectonic tremor near the deformation front in central Cascadia" or "A procedure with potential for finding shallow tectonic tremor."**
We have changed the title to say "Possible" rather than "Potential". We considered using a title similar to "searching for tremor" prior to submission, but due to the focus of the paper on the possible signals we did observe, we prefer this option.

I must admit that I found the section describing the procedure to be rather hard to follow. **A flow diagram might be very helpful here.** If I wanted to apply the proposed procedure, I would have to generate such a diagram myself.
We have edited Figure 2 to include a simple flow chart illustrating the main steps in our tremor detection approach. This flow chart is now referenced in the first sentence of Section 3.2.2.

The authors also seem to imply that the possible tremor is indicative of slow slip on the megathrust. **In my opinion, these signals are at least as likely to originate on the Alvin Canyon Fault or a proto-thrust seaward of the deformation front.** Slow slip and tremor have been documented for strike slip faults.
We have edited the mentions of potential sources for the possible tremor in the Abstract and Conclusion to try to give equal weight to the megathrust and other sources. We have removed a sentence from the Conclusion that unnecessarily discussed detection sensitivity of tremor signals on the megathrust. This was already discussed in Section 5.4, and reiterating it in the conclusion may have misled readers to believing the megathrust to be a more likely source than others. We have also significantly combined and shortened two paragraphs in section 5.3 that discussed the implications of shallow slow slip on the megathrust in Cascadia, which may have inadvertently given too much weight to the megathrust as a source.

One of the paper's conclusions is that with additional analysis of OBS data to design a procedure to remove bottom current and wind effects from the data, the procedure to separate tectonic tremor from other processes generating tremor-like signals described here for the buried OOI instruments could be applied to OBS data. **Given the rather ambiguous results for these buried and cabled OBSs, I am somewhat skeptical that such an effort would be successful in Cascadia, where bottom currents and wind-driven waves are often strong**. Note that the Trehu (1985) bottom current experiment was conducted using a spherical OBS with only small handles and a short strobe light to assist with recovery. There were no flags or

radio antennae (which are present on most current OBSs models), which probably explains the absence of vortex shedding in that experiment. Depending on the mechanical configuration of the OBS, additional spectral peaks may result from soil/structure interaction driven by bottom currents as well as biology. I have some unpublished data that shows how multiple strong peaks in the tremor band result may result from both vortex shedding and soil/structure interaction.
The wording in the conclusion has been altered to be less emphatic towards the potential of our approach for unburied OBSs in noisy areas. We note that the highly varied presentation of bottom-current generated noise, as you mention here, is why we suggest unsupervised learning as a future approach in the Conclusion. Rather than our highly-tuned approach, unsupervised learning may be able to identify new types of noise without a priori knowledge of its characteristics. We also note that we were already able to use our approach to identify tremor-like signals on an unburied autonomous OBS in Cascadia that does experience bottom current-generated tremor, station J26D; we had to spend a bit more time discarding bottom current signals from this station, but our approach still assisted in rapidly identifying the desired signal amidst a long time series.

Finally, the authors should **check for consistency of when they use present or past tense**. I like to use present tense to refer to observations that continue to hold at present and past tense for actions that were taken and completed in the past. For example, the paragraph on lines 154-159 is written in present tense even though it refers to actions started and completed in the past. It looks like the authors generally prefer present tense in this situation but occasionally slip into past test.
We have now fixed the tense consistency in this paragraph and checked for it/fixed it elsewhere.

Detailed comments keyed to line numbers:

46: “more limited along strike” – please specify length scale
The length scale has been specified following Figure 2a of the Takemura et al. (2023) paper.

110: replace “wind/bottom” by wind or bottom”
Fixed.

111: what do you mean by “could be used to help identify tremor periods”? Do you mean “can be distinguished from tremor”?
Fixed for clarity. The sentence now reads “We demonstrate the advantages of OBS burial and explore whether relationships between OBS noise and wind or bottom current speeds could be used to distinguish periods of active tremor”.

212-213: confusing. Is the saturation at the low end of the wind speed scale or at the high end. I assume from the context that it is at the low end, but generally saturation applies to the high end so it might be helpful to clarify.
There are actually two possible scenarios – (1) seismic noise saturation at a relatively low wind speed, which then can be exceeded at a higher wind speed threshold, or (2) rising seismic noise until a saturation noise level is reached at a higher given wind speed threshold. The piecewise model we apply can essentially work with either scenario. This sentence has been updated to reflect this, and now reads

"Depending on frequency, seismic noise levels are expected to either saturate at low wind speeds and then rise without limit past a higher threshold, or saturate only once a higher threshold is reached (McCreery et al., 1993)."

211-225: a figure illustrating the procedure described in this paragraph would be helpful.

We have added a figure to the supplement, Figure S5, that helps to illustrate our line-fitting procedure.

226: Point out that the OBS used by Trehu (1985) had a configuration that should minimize bottom current noise because it was symmetric and had no flags or other protuberances that would result in strumming and vortex shedding. That OBS was also designed to minimize soil/structure interaction, which can lead to multiple spectral peaks.

The sentence now reads: "Trehu (1985) showed that, at frequencies below 10 Hz, seismic noise levels appear to increase proportionally with the square of bottom current speeds; this relationship was derived using an OBS that was specifically designed to minimize bottom current interactions and avoid strumming and vortex shedding."

575: also point the reader to Fig 1 for location of J26D.

Done.

578: do you mean "particularly disruptive for single station detection"?

Yes, that is what we meant! This has now been specified.

591-599: mention Longuet-Higgens non-linear interaction between ocean surface waves and seafloor pressure here?

This is now mentioned in this paragraph.

630-634: Hard to follow. Are you saying that you see similar signals on J26D and HYSB1, but that they do not occur at the same time?

Yes, that is what we were attempting to say. We have reworded this section and it is now hopefully clearer:

"The similarities between these signals suggests they are not internally generated instrument noise, because they are recorded on two different sensor types: both a buried Guralp CMG-1T sensor (HYSB1) and an unburied Nanometrics Trillium sensor in Lamont housing (J26D). However, the signals are never contemporaneously recorded at both stations during their 6-month overlap period. This suggests that the signal source is very near each station."

683-687: How do you define "significant" activity? If "significant" is >M4, then there are no clusters – only 2 earthquakes in 2004. In general, I think the discussion of whether the possible tremor is related to subducted seamounts could be shortened since it is essentially a negative result.

This is a good point and we have shortened this section slightly, and removed mentions of "significant" earthquake activity.

764: Something is wrong with this sentence.

There was a typo in this sentence that has now been fixed.

809-810: Perhaps not so “readily” “Potentially” is more appropriate here (although, as mentioned above, I am somewhat skeptical).

“Readily” has now been replaced by “potentially” in this sentence.

826-833: and observations from strike slip faults suggest to me that the Alvin Canyon Fault is also a reasonable candidate.

The Alvin Canyon Fault is now mentioned by name in this sentence.

1142: “junction” (not “joint”)

This is a strange typo, likely from an incorrect version of the text being saved to the citation manager. This has now been fixed.

(review by Anne Tréhu – feel free to contact me for discussion).