Author response to Reviewer #2 comments:

Reviewer comments are in black, and our responses are in red.

I really enjoyed reading this manuscript. It is well-written, explores a simple idea very effectively and puts the results in context in a way that makes them potentially very useful.

I think this manuscript could be published as is (aside from a single typo) -- the figures are very readable and the text succinct and clear. However, I nevertheless will provide a few suggestions that I think would improve the impact of the manuscript.

Thank you for the encouraging comments. Below we provide responses to individual points raised and how we would incorporate suggestions when revising the manuscript (if invited to do so).

Line 39: Could also mention that similar cycles have been seen in DIC (e.g. Figure 7 in Franco et al 2021) -- this would allow you to pick up this point again at the end and suggest what you saw might also apply to CO2/DIC.

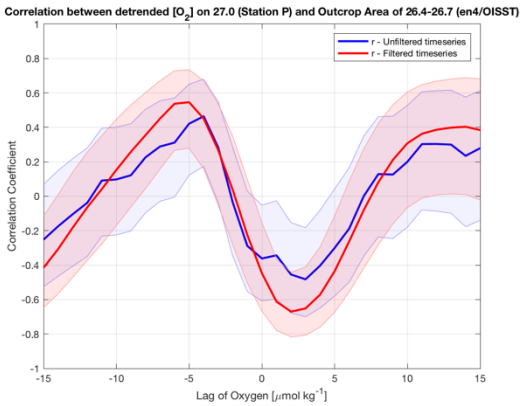
We appreciate the comment and will add a sentence that O_2 variability is closely linked to DIC (and nutrient) variability that has also been observed at OSP.

Line 235: I found the lagged correlations (Figure 5) really interesting as a way to assess how long it takes water to get from the NW Pacific to OSP (and the NE Pacific). My immediate question was: what does it look like for other isopycnals? It'd be powerful to see an increase with density and also really useful to have an idea of how fast signals are transmitted at different depth/isopycnals. I think you could make a nice comparison with Ueno & Yasuda 2003's Figure 7 (based on simple model).

Thank you for the suggestion. We looked at correlations between O_2 on isopycnals other than σ_θ = 26.6 kg m^{-3} (lighter and heavier) and outcrop area - first using the same outcrop area (σ_θ = 26.4–26.7 kg m^{-3}) as used for the correlation in Figure 5 (line 235). For the lighter (i.e., outcropping) isopycnals we also investigated correlations with the outcropping area for densities bracketing the isopycnals themselves (σ_θ =26.3–26.5 kg m^{-3} for σ_θ = 26.4 kg m^{-3}; σ_θ =26.2–26.4 for σ_θ = 26.3 kg m^{-3}). However, we do not find a depth trend in the O_2 lag for these lighter isopycnals, independent of which outcrop area we use. This is in part because the O_2 cycles on these isopycnals at OSP do not show any temporal offsets from one isopycnal to another (i.e. O_2 cycles on σ_θ = 26.2-26.6 kg m^{-3} in Figure 3 are in sync with each other) even though travel times from outcrop area to OSP should be less on the lighter isopycnals. Our explanation for this is that the O_2 signal on the σ_θ = 26.6 kg m^{-3} isopycnal is dominant because this isopycnal is at the bottom of the ventilated thermocline and the signal can be distributed to the lighter isopycnals through vertical mixing, thus the O_2 variability on the lighter isopycnals is in phase withσ_θ = 26.6 kg m^{-3}.

On the other hand, for the heavier isopycnals (σ_θ > 26.6 kg m^{-3}) we do find an indication that the lag between O_2 and σ_θ = 26.4–26.7 kg m^{-3} outcrop area increases with depth. For example for σ_θ

= 27.0 kg m^{-3} , the best correlation for O_2 lagging outcrop area is at ~14 years as shown in the figure below (same as Figure 5 in the manuscript except that O_2 on σ_θ = 27.0 kg m^{-3} is used):



This is qualitatively consistent with Figure 7 by Ueno and Yasuda (2003) which shows, as you mention, travel times increasing with density (from σ_θ = 26.7 kg m^{-3} to σ_θ = 27.2 kg m^{-3} in that case). We will mention this depth dependence of the lag where Figure 5 is discussed in the manuscript (lines 211–218) and can include the figure above in a revised manuscript (appendix) for illustration.

Line 342: Excellent point! It'd be really useful if you were able to suggest some ideas for what they might look like.

If we understand correctly, this comment refers to the suggestion on line 342 that "a climate index that better incorporates salinity is needed". We think that such an index should include E-P data from the northwestern North Pacific and/or surface salinity measurements at key entry points to the northwestern North Pacific. We will add some elaboration on the index at line 342 and in the conclusion section (where it also gets mentioned in the last sentence).

Line 347: Here's where I think the typo is. Is/are word/s missing? I find this phrasing confusing.

Yes, it should be "ventilated thermocline", not just "ventilated". Thank you for catching this typo. We will fix it.

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