Dear Dr. Guo,

We would like to extend our thanks for your constructive review of our manuscript. Below we respond point by point to each of your comments.

Comment 1: The simulation is based on steady state. However, when the pure oxygen is injecting, the stratification is destroyed. This may lead to the sequence that the model parameters may no longer be appropriate. Additionally, is there oxygen leakage during the injection?

In previous re-oxygenation programs, such as the By Fjord in Sweden (Stigebrandt et al., 2015), oxygen-rich surface water was pumped into the basin over 2.5 years. Although this did not cause destratification, despite a near-surface halocline at ~15 m depth (although there is a substantial density gradient ($\Delta\rho$ <8 kg m^{-3})) across a relatively shallow water column (<50m), the injection did reduce the density of the deep water. The weakened stratification enhanced the frequency of deep-water renewal from neighbouring basins, acting as an important mechanism for sustaining re-oxygenation in the fjord. Similarly, feasibility assessments for re-oxygenation in Hood Canal, Washington (Beutel and Wilson, 2005), emphasized that maintaining vertical stratification is possible using specialized delivery systems such as Speece Cones (submerged contact chambers) or bubble plume systems configured to minimize vertical mixing. These systems have been shown to deliver oxygen at depth with minimal disturbance to the stratification. In contrast, the site of our study, the Laurentian Channel, exhibits a more modest density gradient ($\Delta\rho$ ~0.6 kg m^{-3}) between the Cold Intermediate Layer and the Deep Layer inflow, but its pycnocline lies much deeper (~150-200 m), with bottom depths of 275–500 m. The greater depth and isolation from surface forcing (e.g., wind and wave energy) increases resistance to vertical mixing. Proposals to reoxygenate the Laurentian Channel are based on the direct injection of pure oxygen into the deep layer via an appropriate aeration system, such as those mentioned above (Wallace et al., 2023). Likewise, our model assumes that oxygen is introduced in fully dissolved form, well below the pycnocline, via a density-compatible delivery system such as turbine injection, bubble plume diffusers, or Speece Cone-style contact chambers. Whereas our model does not resolve short-term mixing processes at the injection site, it provides a first approximation to the downstream steady-state impact of oxygenated inflow under the assumption of constant transport parameters. We acknowledge that, in a real-world situation, some loss (oxygen leakage) could occur due to bubble rise or outgassing, but our model assumes 100% retention of the added oxygen in the deep layer, a potential limitation. We added a few sentences (Section 3.5) to the revised manuscript recommending that future work incorporate plume-resolving dynamics to evaluate injection efficiency and potential leakage pathways. A brief paragraph was added to Section 3.5 of the revised manuscript.

Comment 2: Lines 47–49: The number of '(' and ')' are different…

We corrected this punctuation error in the revised manuscript.

Comment 3: Lines 358–359: From the DIC data of 2021, 2022 and 2023, I don't agree that the DIC accumulation rate is 18.3 ± 2.5 μmol kg^{-1} yr^{-1}.

We would like to clarify that the DIC accumulation rate reported represents the average along-channel accumulation rate as the deep water transits from Cabot Strait to the head of the Laurentian Channel. The value is derived from model-fits to observed DIC distributions using a least-squares approach within the framework of a 1D advection-diffusion model, that was applied individually to the years 2021, 2022, and 2023. These fits yield annual accumulation rates of 19.9, 14.8, and 20.1 μmol kg^{-1}, respectively. The reported value of 18.3 μmol kg^{-1} yr^{-1} represents the mean of these three rates with ± 2.5 μmol kg^{-1} yr^{-1}, reflecting the interannual standard deviation. To further characterize the accuracy of this estimate, we now report the 90% confidence interval ([14.1, 22.4] μmol kg^{-1} yr^{-1}) on the mean, calculated using a t-distribution. The 90% confidence interval was selected to provide a practical estimate of uncertainty, given the small number of modeled years (n = 3) and the empirical nature of our analysis. Given a larger rate sample size, we would expect that confidence interval to significantly narrow.

Comment 4: Line 408: Should '(Tanioka and Matsumoto, 2020)' be 'Tanioka and Matsumoto (2020)'?

Thank you for pointing out this error. We corrected this citation format in the revised version.

References

Beutel, M. and Wilson, D.: Targeted Oxygen Addition to Hood Canal: A Potential Management Strategy to Ameliorate the Impacts of Hypoxia, in: Proceedings of the 2005 Puget Sound Georgia Basin Research Conference, Puget Sound Georgia Basin Research Conference, Seattle, Washington, 2005.

Stigebrandt, A., Liljebladh, B., de Brabandere, L., Forth, M., Granmo, Å., Hall, P., Hammar, J., Hansson, D., Kononets, M., Magnusson, M., Norén, F., Rahm, L., Treusch, A. H., and Viktorsson, L.: An Experiment with Forced Oxygenation of the Deepwater of the Anoxic By Fjord, Western Sweden, AMBIO, 44, 42–54, https://doi.org/10.1007/s13280-014-0524-9, 2015.

Wallace, D. W. R., Jutras, M., Nesbitt, W. A., Donaldson, A., and Tanhua, T.: Can green hydrogen production be used to mitigate ocean deoxygenation? A scenario from the Gulf of St. Lawrence, Mitig Adapt Strateg Glob Change, 28, 56, https://doi.org/10.1007/s11027-023-10094-1, 2023.