This study investigates the effects of future acidification, warming, and nutrient management on Eastern oysters in the lower Chesapeake Bay. The authors developed an oyster bioenergetics model integrated into a 3-D hydrodynamic-biogeochemistry model to simulate and compare present-day conditions with projected mid-21st century scenarios, focusing on increased atmospheric CO_2 levels, temperature rise, and managed nutrient reductions. The model results identify areas where oysters are most vulnerable to these future conditions and quantify the combined and respective impacts of the three stressors on oyster growth. These findings offer helpful insights for stakeholders seeking to understand and mitigate these impacts.

Overall, I think the manuscript makes a valuable contribution to the field. The methodology is sound, and the interpretation of results is generally well done. However, there are several areas for improvement, mainly concerning model description, validation, and the presentation of some results. My detailed comments are as follows.

1. Title

The study identifies warming as one significant stressor that negatively impacts oyster tissue and shell growth. However, the title currently highlights only acidification and nutrient management. Should it also incorporate 'warming' to more accurately reflect the findings?

2. Introduction

The information provided in the Introduction is comprehensive; however, the first half could benefit from a bit more cohesion to improve the flow and enhance engagement. For example, it first introduces the global problem of oceans absorbing too much CO_2, then narrows down to emphasize that estuaries are suffering more from acidification; next, it shifts to the global issue of oceans absorbing excess heat and warming, and finally returns to coastal waters again to discuss the impact of warming on coastal acidification.

3. Model description

My major comment on model description is that it lacks some critical information that would help readers understand the method and replicate the experiments. Below I list specific areas that require clarification or elaboration.

L130-133: The model is N-based, with phytoplankton and zooplankton C computed using the Redfield ratio. What ratio is used for semi-labile and refractory dissolved organic nitrogen (DON)? Is it also based on the Redfield ratio? Should the carbon-to-nitrogen ratio for refractory DON differ from that of other organic nitrogen? Additionally, why are both small and large detritus simulated in terms of nitrogen and carbon instead of assuming a fixed stoichiometry?

L135-136: Nitrification/denitrification and remineralization also occur in other vertical layers. They should not be categorized as “additional” biogeochemical sources and sinks exclusive to the bottom vertical layer.

L138: How is TSS calculated within the model? It’s not listed as a variable in the ECB model according to L130-131.

L139-140: Does the sediment transport module account for the sediment-water exchange processes?

L167-168: The analysis focuses on the deepest vertical level of the model. Are oysters cultivated at the bottom of this region?

L171-172: Similarly, are diploid oysters the primary aquaculture form in this region?

L173: What constitutes POC? The ROMS-ECB model includes phytoplankton, zooplankton, and small and large detritus. Are all these components considered in the calculation of POC, which serves as food for oysters?

L162-193: "2.1.3 Oyster bioenergetics model" – I find it challenging to follow the description. The EcoOyster model is referred to as a bioenergetics model; however, it's unclear how the model is formulated in terms of energy flow and how it is linked to the biogeochemical model in terms of mass. While the supplement includes a list of equations, it doesn't provide explanations. For example, in Tables S1 and S2, what does the subscript j refer to? In Equations 7 and 8, how are w_j^{gonad} and K_{gonad} defined?

L284-287: Please clarify how the watershed inputs are specifically adjusted to meet the "nutrient reduction goals."

L306-307: Are the locations identified by model outputs also where most existing oyster farms are situated?

4. Model validation

How well does the EcoOyster model simulate the observed temporal variations in oyster growth parameters, such as shell weight and tissue weight?

5. Presentation

Except for the first paragraph, Sections 2.3 should be moved to the Results.

Figure 2 – the caption duplicates that of Figure 1.

Figure 5 – the x-axis is missing; the figure caption is incomplete, lacking references to panels e and f for oxygen and TSS.

6. Other minor comments

L16: The specific future scenario employed in this study should be mentioned, as the chosen scenario will significantly influence the impact assessment.

L37-38: Suggest briefly explain what "ocean water undersaturated with calcite" means for calcifying organisms.

L151: "minimum" phytoplankton growth rate – should it be corrected to "maximum?"

LL489-492: This study uses the worst climate scenario. Does this contribute to the estimated faster acidification rate?

L501: “Eutrophication can suppress acidification by increasing primary production” – This is accurate for surface waters, but it does not hold true for bottom water.

L536-662: Given the critical role of optimal temperature, have sensitivity experiments regarding this temperature threshold been conducted?

L569-573: In the cited study (Lavaud et al., 2021), does warming affect oyster growth through the same mechanisms as in this study? Providing this information would clarify whether the findings of the two studies are “consistent.”

L622: “mortality events” because of what?

L641-643: Got confused here. Why does the model simulation start date matter? Are you referring to the starting date of oyster cultivation?