**ANNEX A: Blue Paper Technical Review Form**

Date: 31 July 2019

Title of Blue Paper: Blue Paper 2: The expected impacts of climate change on the ocean economy

Reviewer 5

**Overarching Questions**

Reviewers are requested to answer the following questions to assess the overall analytical quality of the contributing paper

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| --- |
| 1. Analysis: Are there any concerns, flaws in logic, or gaps in empirical basis, calculations or theoretical reasoning? |
| The analysis seems fine. |
| 1. Content: Is the paper clearly written, structured, with a logical presentation, and easy to read? |
| The paper needs some restructuring and reframing to serve its purpose. See detailed comments. |
| 1. Content: Does the paper provide a fair and comprehensive treatment of the topic? Are the conclusions justified? Are the recommendations based on the content? |
| The paper has some gaps in its treatment of the literature, which I point out in the detailed comments below. |
| 1. Eligibility for public distribution: Does the paper require minor/major revisions before it is ready for public distribution? |
| The paper requires major revisions around presentation, structure, and some improved citations before it can be distributed. |

The issues below are suggestions for the reviewer to consider.

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| --- | --- | --- |
| **List of issues to be checked** | **Yes/No** | **Comments** |
| Were assumptions clearly identified? | N | In several places, work in preparation was cited. Without examining the full methods etc. for that work, I can’t judge how sound the assertions are based on that work. |
| Is the methodology explained in a transparent way? | N | See above |
| Are quantitative and qualitative sources referenced appropriately and thoroughly? | N | There are passages that need updated references or simply, assertions or generalities that need references. |
| Does the research effectively address relevant gender aspects? | N | Gender is not discussed in this paper. |
| Are there significant and relevant issues that are missing from the paper? | Y | Equity is touched on in passing but not treated comprehensively, which is a shame given the large body of knowledge about artisanal fisheries, adaptation, and comanagement. Equity regarding ocean prospecting and tourism could and should be explored more comprehensively as well. |
| Are there any faults in empirical basis, calculations or theoretical reasoning? |  | Hard to tell; see above comments about works in prep. |
| Is the information contained in the document up-to-date? | N | Not necessarily; the treatment of the ocean economy does not include a more recent theoretical framework that is less focused on monetizable goods. |
| Does the manuscript present original material and/or an original viewpoint or if it is a synthesis is the methodology comprehensive and appropriate? | Y |  |
| Was sensitivity analysis performed where applicable? | N/A |  |
| Are you aware of any reputable evidence that contradicts the arguments presented in the paper and is not mentioned? | N |  |
| Are the conclusions and recommendations supported by the evidence? | Y |  |

**3. Memo for specific comments**

The following table is intended to facilitate the work of the reviewers, arbiters and authors and we kindly request you to use this format. This provides space for specific comments, suggestions and responses from the author. The memo will be used to inform the sign-off.

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| --- | --- | --- | --- | --- |
| Ref. no. | Page/ Para/ Line | Comment | Suggestion | Author Response |
|  | Whole document | Who is the audience for this paper? Certainly it verges into technical oceanographic jargon “stratification” etc., which may not be accessible to policymakers. And will average oxygen concentrations really be meaningful for the readers of this paper? Is an explanation of circulation changes that lacks a discussion of how this would affect economically valuable assets useful? | Reread and revise with an eye towards accessibility by the educated non-specialist. Consider carefully whether the high level of oceanographic detail provided will actually serve the intended audience. Present technical details with a clear connection to how they affect ocean economic issues. |  |
|  | p. 1 Para 2 | “The severity of effects will depend on the extent of warming realized” doesn’t take into account non-warming effects like ocean acidification and carbon fertilization of vegetation (land or sea). | Reword to “The severity of effects will depend on the net amount of atmospheric GHGs released” or similar. |  |
|  | p. 1 para 3 | “Resilience” is a poorly defined term (see, e.g., [this writeup](https://www.c2es.org/site/assets/uploads/2019/04/what-is-climate-resilience.pdf)) but it’s quite trendy in these sorts of documents. I suggest being more precise with the definition so everyone can have a common understanding. | Either define what is meant here by resilience or change “resilience-building” to something like “adaptation” or “support” |  |
|  | p. 2 para 2 | I think the paragraph should begin “All of these non-market ocean benefits” for clarity | |  |
| Costanza (2014) | Whole paper | Recent transdisciplinary work is moving away from monetizing the non-market ocean economy, precisely because of the concern that this unfairly devalues biogeochemical processes, cultural knowledge and activities, and so on. See IPBES body of work for details (beginning with Diaz, 2015, and following papers). This school of thought should be acknowledged here at the very least, if not reconciled with the highly monetized world view used here to frame this study. There are many valid criticisms of Costanza (2014) and the faults with this world view explain why whole-system economic evaluations including the ocean are scarce. This challenge to developing an “ocean economy” viewpoint should be dealt with in this paper. | |  |
|  | p. 3 last paragraph | Doney et al. 2014, Gattuso et al. 2015 not appropriate references for this statement. | Replace with any of the many solid studies that actually focus on fish and other marine life, perhaps from the labs of W. Cheung, or M. Pinsky |  |
|  | Section 3.2, first paragraph | Ocean acidification hasn’t increased by 26% -- it’s ocean acidity has increased by 26%. Ocean acidification wasn’t a thing before the industrial revolution | Correct wording. |  |
|  | Section 3.2, first paragraph | “whilst benefiting some photosynthetic…” The evidence is mixed, and not entirely clear what the net benefit is. | Consider different wording and provide some references for this fact. |  |
|  | Section 3.2, first paragraph | “carbonate ion unsaturated” is awkward and unclear, especially when the rest of the paragraph talks in detail about undersaturated conditions | Revise wording to be clearer and possibly explain briefly what undersaturation/saturation actually is, given its emphasis later in the paragraph. |  |
|  | Section 3.2, first paragraph | “carbon from riverine input” is massive shorthand for CO2 and organic matter that then becomes digested. Potentially misleading, implying that any C contributes to OA. | Revise wording to be more accurate. |  |
|  | Sec. 3.2, last paragraph | The effect of deoxygenation on fish harvests was discussed in greater detail in Breitburg et al., 2018. | Include the points made by Breitburg et al. 2018 in this paragraph. |  |
|  | Sec. 3.3, paragraph 1 | The end of the paragraph makes some significant general assertions regarding the effect of climate change on the ocean economy without reference. | Increase the rigor of this section, adding details and citations. |  |
|  | Sec. 3.3, 2nd paragraph | What would the ocean economic impacts of the change in upwelling be? “Uncertainty around impacts (Barange 2018)” = ? | Add more detail to this paragraph. |  |
|  | Sec. 3.4 | This section is a fine summary of the academic literature but it is not directly tied to impacts on ocean economy components. | Add direct connections between sea ice melt and ocean economic issues. |  |
|  | Section 3 and 4 | Most of section 3 is a very academic, rather jargon-rich, review of the literature. It’s not exhaustive and it’s not presented in a way that clearly links it to the overall point of the paper. | Streamline section 3 and merge it with section 4 to show the relevance of all this detail to ocean economic issues. |  |
|  | Section 4 | The organization of this section is very confusing. None of the subsections are really structured similarly and this reads like a patchwork of cut-and-paste sections from different contributors | Improve the overall framing of the section to show which aspects of the ocean economy will be explored, in what order, and what common elements have been examined for each subsection. |  |
|  | Section 4.1.2, first paragraph | Very slim on citations but long on assertions | Connect the second half of the paragraph with literature citations. |  |
|  | Section 4.1.3 | I’m not sure if using a new, in prep analysis is within the scope of the directions that authors received, but as a reviewer I am unable to judge the quality of the analysis because not all the detail is included (e.g., “methods” section is really brief and would not permit another to reconstruct the analysis). I can’t judge how useful these projections are and am concerned they could be misleading to policy makers. | Remove the in-prep analysis or greatly increase the detail offered, perhaps in an appendix. |  |
|  | Section 4.1.4 | This section is pretty repetitive of material that came before. | I like presenting recommendations all in one spot; keep this section but perhaps state the recommendations and key conclusions differently the first time they appear so it’s not so obvious they are copied and pasted. |  |
|  | Section 4.2 | There’s very little mention of the distinction between fed and unfed aquaculture; it seems that climate change would affect each differently. This is not addressed | Dig deeper into the different types of aquaculture and distinguish how climate change will affect each. This is done to a small degree in 4.2.2, but the references used for ocean acidification are so dated that it’s making me doubt the recency of the other conclusions as well. |  |
|  | p. 15 | This analysis presents an extremely rosy view of the potential for mariculture. I don’t see any of the counterarguments treated seriously. | Present a more balanced view of the potential for mariculture, including obstacles that don’t include climate change (e.g., disease, escape) which prevent its expansion. |  |
|  | Sec. 4.3 | This is also an extremely rosy view of tourism. Why did the authors not look into different projections (e.g. SSPs) for future social conditions to inform this review? Does that exist in the literature? Also, I notice last chance tourism isn’t mentioned anywhere. | Provide a future view that is more informed by potential future social conditions. |  |
|  | Sec. 4.3.3, p. 20 | These projections seem also to be back of the envelope for this paper only; what methods were used? | Please be more clear about whether this depends on a published paper analysis or if it’s new for this paper. |  |
|  | Section 4.3.4, paragraph 1 | Expand the treatment of ecosystem connectivity – it’s a point of frequent discussion in conservation circles yet not often discussed with reference to the ocean economy. | Please help connect these two areas of discussion. |  |
|  | Section 4.4 | Are there any projections available in the literature on this topic, about how the changes reviewed will add up across the sector? | Add projections and citations if available. |  |
|  | Section 4.4-5 | A relatively under-explored topic is change in the ocean shipping sector. How do climate change impacts (e.g., ice melt, SLR) and any adaptation/mitigation effects intersect with the shipping sector? Beyond energy efficiency? | Please add more on this topic. |  |
|  | Section 5.1 | What is the link between blue carbon and the ocean economy? | Make explicit the link between blue carbon, the ocean economy, carbon pricing, and loss/damage mechanisms. |  |
|  | Section 5.3 | The link between deep sea mining and the markets for rare earth elements isn’t very detailed. | Make explicit the economic links between deep sea mining, economic obstacles, etc. |  |
|  | Section 6 | There are tradeoffs between expanding the economic and retaining non-economic benefits from the ocean. | After the initial mention of the non-economic benefits from the ocean in the start of the paper, this is relatively untreated. Yet the dichotomy between these two clusters of benefits is at the heart of ethical considerations about expanding the ocean economy. This issue needs to be considered at least a little in this paper. |  |
|  | Section 6, “capture fisheries” | “Primary fisheries management” is mentioned a few times in the paper but never briefly defined. | Please explain for the presumably more generalist audience of this paper. |  |
|  | p. 30, item 2 | Ocean management that takes into consideration ecological connectivity is also a reason for cooperating across boundaries | Provide a comprehensive view of why trans boundary cooperation is critical in a changing ocean. |  |
|  | p. 30, item 3 | The commentary about equity feels tacked on. There was no mention of equity or gender issues throughout the paper. | Provide a better treatment throughout the paper of equity and gender related issues; for example, small scale fisheries work offers a great deal of insight into how power and privilege, as well as social connectivity, increases or decreases the benefits from ocean economic goods like fisheries. |  |