I would like to congratulate the group for putting together this manuscript that describes the second edition of the Barometer. It is a great example of how efforts can be collectively made and deliver useful information based on peered reviewed evidence for different stakeholders on the continued degradation of the ocean systems learn from opportunities.

We sincerely thank the reviewer for the positive and encouraging assessment of our manuscript, as well as for the insightful and constructive comments. These have been extremely helpful in improving the clarity, rigor, and overall positioning of the Starfish Barometer. We have carefully addressed all comments and revised the manuscript accordingly. Specific point-by-point replies can be found below.

The manuscript is publishable; it requires minor edits and changes and attend simple comments enclosed:

It is important transmitting that the five dimensions do not act in isolation and add describe what is being lost with the increasing changes described.

We thank the reviewer for this important comment. The interconnections between the five dimensions of the Starfish Barometer are indeed central to its conceptual framework. As described in the Methods section, these dimensions are not independent, and many developments span multiple aspects of the Ocean–human system. At the same time, the Barometer is intentionally designed not to impose explicit causal links between items, with each item presented as an independent, evidence-based signal. This approach aims to provide a robust and accessible synthesis while avoiding overinterpretation of complex causal relationships. To address this comment, we have clarified the interconnected nature of the five dimensions of the Barometer in the Methods section. In particular, we have expanded Section 2.5 ("Arm allocation of items") to explicitly state that Ocean-related processes and impacts often span multiple dimensions, while also reiterating that the Barometer does not aim to establish explicit causal relationships between them. The revised text now reads:
***"This reflects the inherently interconnected nature of the Ocean–human system, in which processes and impacts often span multiple dimensions of the Barometer. While these interconnections are acknowledged, they are not systematically developed within the Barometer, as its objective is to present a set of robust, evidence-based signals rather than to establish explicit causal relationships between dimensions, which should also strictly be based on scientific evidence* (*von Schuckmann et al., 2026)*."**

As example "The number of threatened marine species has risen to 1,685 with intensifying level of threat" however policy makers, educators, civil society actors, and the public may not know if the number is large. May I suggest that this loss is identified with an example of people's live, what is meant by threat and this threat intensifying.

We agree that the absolute number of threatened species may be difficult to interpret in isolation. In addition, this indicator reflects not only changes in extinction risk, but also the evolving coverage and completeness of species assessments over time. The objective of this indicator is primarily to track changes over time rather than to convey a standalone magnitude. To address this point, we have revised the paragraph to clarify the interpretation of this indicator and to present the comparison with the previous edition more cautiously. In particular, we now state that the current assessment includes

eight additional threatened marine species compared with the value reported in the previous edition, rather than implying a direct measure of change in extinction risk:

"This indicator reflects both changes in extinction risk and the evolving coverage of species assessments over time, and should therefore be interpreted as a global signal rather than a direct measure of change in extinction risk. Compared with the value reported in the previous edition of the Barometer (1,677 species; Lévy et al., 2025), the current assessment includes eight additional threatened marine species."

We also thank the reviewer for the suggestion on linking the environmental indicator to socioeconomic dimensions to increase accessibility to a wider audience. Such a context-driven approach while combining ocean indicators across the 3 pillars of sustainable development for environment, society and economy, linked to causalities derived from peer-reviewed literature (e.g., ocean narratives, von Schuckmann et al., 2026, https://www.sciencedirect.com/science/article/pii/S0308597X25003380) is developed as pilot elsewhere (e.g., https://sp.copernicus.org/articles/6-osr9/2/2025/; https://sp.copernicus.org/articles/6-osr9/3/2025/).

Evidence shows that coral reefs are threatened not only by bleaching-level heat stress, but also by the combined impacts of Sargassum in the Atlantic, along with eutrophication and fishing in other tropical locations—all acting in synergy with global climate change.

We have revised the manuscript and added one reference to acknowledge that coral reef degradation is also influenced by additional stressors acting in synergy with climate change, including eutrophication and overfishing: "*Coral reef degradation is also influenced by additional stressors such as eutrophication, acidification, and overfishing, which can act in synergy with climate change (Bhuyan et al., 2026)".*

The manuscript suggests expanding marine protection under the 30×30 initiative, coupled with effective monitoring, enforcement, and climate-adapted governance. The section mentions widespread unsustainable fishing practices and major shortcomings in transparency and governance. Expanding marine protection faces significant challenges, as only about 8-9.6% of the ocean is currently designated as protected, with far less (estimated at 2.8-2.9%) effectively managed or highly protected. The core challenges lie in transforming paper parks that are being created by trying to achieve 30x30 into active conservation zones, maintaining enforcement in remote areas, especially in ABNJ, and adapting to rapid climate change.

The authors mention that "protection efforts continue to expand". However, these are not enough for resilience. I am not quite sure that "The stronger protection rules require to be implemented" if widespread unsustainable practices and major shortcomings in transparency and governance are increasing. Political will is needed, education at all levels since most of the conservation efforts involve larger participation and decision making by local communities that in many cases prefer to extract, have better opportunities and income that lead to loss of biodiversity.

We note that the manuscript already distinguishes between total marine protected area coverage and the much smaller fraction that is fully or highly protected, as well as the importance of effective monitoring and enforcement. We also fully agree that political will, governance, and the engagement of local communities are critical for the effectiveness of ocean protection efforts.

To improve clarity, we have revised the text and referenced the handbook on sustainable ocean plans to more explicitly emphasize that:

"*Despite this recent progress, the extent of effectively protected areas remains limited at the global scale, and their outcomes depend on implementation, monitoring, and broader enabling conditions, such as governance arrangements and incentive structures (Barzuna et al., 2025).*

Moreover, we have updated to % area of MPA since this value has changed since submission. The new text reads:

Marine protected areas cover 10.01% of the global Ocean, with 3.2\% fully or highly protected. Global Ocean protection has reached the 10% milestone but remains far from the Kunming-Montreal Global Biodiversity Framework target to conserve 30% of marine and coastal areas by 2030. Marine Protected Area (MPA) coverage has increased from 8.34% in 2024 to 10.01% of the global Ocean in mid 2026 (Lévy et al., 2025, protectedplanet, 2026).

I suggest highlighting monetary valuation of the losses from tropical storms and floods catalyzing behavioral changes to reduce human pressures. How to overcome that in this process a complex paradox is often created where the economic focus can simultaneously heighten geopolitical instability, aggravate poverty, and shift focus away from long-term environmental research.

We agree that the economic valuation of losses related to tropical storms and floods can play an important role in informing decision-making and potentially influencing behavioral and policy responses. However, the objective of the Starfish Barometer is not to provide an analysis of the broader socio-economic implications of the signals that we report. Rather, it aims to present a set of robust, evidence-based indicators in a consistent and neutral manner, closely reflecting the reported data without further interpretation. For this reason, these aspects are not developed in detail in the present manuscript, but we provide some linkages to existing literature while adding:

"Monetary valuation of losses from tropical storms and floods can shape decisions and actions to reduce exposure to risk, but these effects occur within broader socio-economic systems where underinvestment persists and losses from extreme events can reinforce vulnerability, inequality, and instability (Fischer and Patterson, 2026 ; Weerasinghe et al., 2025; Hallegatte et al., 2020)."

Over the long term, related economic losses have increased decade by decade since the early 1980s, with an acceleration during the past two decades ~\citep{wmo_2021}.

I would suggest considering that not only major in-situ ocean observing systems are shrinking. There is less financial support to generate new knowledge (science to defray the cost of working at sea), knowledge that is required to improve skills and metrics for forecasting the risks to human health and the support system for the ocean.

We note that the manuscript already highlights the broader implications of declining observing systems for ocean science. To improve clarity, we have slightly revised the text to make more explicit the link between these trends and added two recent references:

"*reflecting broader constraints on ocean science capacity (Tanhua et al., 2024, von Jackowski, 2025)*".

"A treaty for the High Seas has been adopted". I suggest using instead Biodiversity Beyond National Jurisdiction Agreement that highlights Biodiversity and mention that the agreement has been ratified in September 2025 and entered into force on January 17, 2026.

The manuscript already refers to the Agreement on the Conservation and Sustainable Use of Marine Biological Diversity of Areas Beyond National Jurisdiction (BBNJ) and specifies its entry into force on 17 January 2026.

Financial commitments remain insufficient to meet all challenges of impact to the ocean and will not remediate or restore what is being lost

We agree that current financial commitments remain insufficient to meet the scale of challenges facing the Ocean. This point is already reflected in the manuscript, which highlights the gap between existing investments and estimated needs to achieve SDG 14. We have reinforced it: "*indicating a substantial gap between current commitments and the scale of transformation required (Johansen and Vestvik, 2020; OECD, 2025b).*"

"Ocean sustainability objectives, including SDG 14". I think these are the same, or are there other? They are certainly crosscutting among the other 16 SDG.

Our intention was not to equate ocean sustainability objectives solely with SDG 14, but rather to refer more broadly to global biodiversity, climate, and Ocean-related sustainability objectives, of which SDG 14 is one important example. And yes, the ocean is very cross-cutting in the SGD framework (e.g. von Schuckmann et al., 2020). We have revised the sentence in the abstract to make this clearer: "*as reflected for example in SDG 14, the link to other SDGs, and related international frameworks (von Schuckmann et al., 2020)*"

If the Barometer is designed for a non-specialist audience while remaining grounded in established scientific evidence its translation to diverse languages is urgently required for the policy makers, educators, civil society actors, and most importantly the public that may not read or speak English language. Although the report series "State of the Planet" is an open access journal, to reach the different stakeholders and readers specific open access initiatives and institutional programs need to facilitate it. How can this be improved?

We agree on the importance of making the Starfish Barometer accessible to a broad and diverse audience. As indicated in the manuscript, the Starfish Barometer consists of two complementary components: the present scientific article and a broader communication platform developed through the Starfish Barometer website (https://www.starfishbarometer.org/) and associated outreach materials. While the article itself is published in English in line with standard scientific practice, the website provides a more accessible interface for dissemination. The 2025 edition of the Barometer was made available in both English and French, and the 2026 edition will include Spanish as an additional language. Further efforts to expand multilingual accessibility are being considered for future editions. In addition, dissemination is supported by the involvement of co-authors and partners across different countries,

including through communication and outreach activities. This complementary approach aims to ensure broad accessibility beyond the scientific publication.

"Reliable accountability for a sustainable Ocean" will require a shift from voluntary commitments to transparent, data-driven, and legally binding mechanisms that ensure that policy makers, educators, civil society actors, and public take responsibility for their impacts on marine ecosystems too. Opportunities for action would be interesting.

The reference to "accountability" in the abstract is intended to reflect the role of the Starfish Barometer in supporting accountability through transparent, evidence-based reporting of Ocean change. It is not intended to imply that the Barometer defines or prescribes specific governance mechanisms or policy frameworks. We have revised the wording in the abstract to clarify this point: "*the Starfish Barometer provides a transparent and evidence-based foundation to support accountability for a sustainable Ocean*"

Figure:

Improve quality of Fig. 1, symbols hardly visible. Some boxes may require text in black font to avoid glaring. Some texts in the boxes can be reduced significantly to transmit the message and be more attractive.

The quality of Fig. 1 has been improved

The 2026 Starfish barometer is the first update of a synthesis of ocean-related developments. This barometer is extremely useful and I strongly support the effort put in place. In particular, its inter-disciplinary nature provides an overview of the role of the ocean in the earth system and its two-way interactions with society that is unique. The paper is interesting and full of insights.

We thank the reviewer for this very positive and encouraging assessment of our work. We are particularly grateful for the recognition of the interdisciplinary nature of the Starfish Barometer and its role in highlighting Ocean–society interactions. We note that the Barometer may be interpreted as a "synthesis" of Ocean-related developments. While it does provide an integrated overview, its primary objective is closer to a structured "curation" of robust, evidence-based signals rather than a comprehensive synthesis or integrated assessment. We have clarified this positioning in the revised manuscript to avoid potential ambiguity.

I have two main issues with the manuscript that need clarification.

First, because this is the first update, there is a mix of time-scales that is very difficult to follow. Throughout the manuscript there seems to be little distinction between what is a trend over the last (and sometimes multiple) decade and what took place in 2025 or the last year of available data. Most numbers are presented as if they were trends, when many clearly are not (e.g. the doubling of damages from tropical storms). In some cases, numbers are presented without context to place the size of the changes presented (e.g. the section on ocean observations) so that it is quite difficult to get an idea of scale. I suggest that a separation is made, particularly in the abstract but also in each section, that identifies clearly the continued trends (which should build on previous versions of the barometers) from the developments that took place in the past year or two. Careful language is also needed around wording on attribution, especially regarding the changes over the past year or two (see specific details below).

We agree that clarifying the distinction between long-term trends and recent developments is important for readability and interpretability. We have carefully addressed this throughout the manuscript, particularly in the abstract and individual sections, using your suggestions to improve clarity. Specific responses to your detailed points are provided below, addressed point-by-point.

Second, I recognise that a comprehensive analysis is not the intention of the paper, but there needs to be some rationale for what is included and what is excluded beyond the selection of the group of authors. It seems to me that the barometer intends to capture the co-evolution of society and environmental changes in the ocean domain, but it appears biased because of its lack of formalism. For example, the presentation of migrant fatalities (as tragic as they are) seems disconnected from other issues. Likewise, a lot is made of Arctic ice retreat, but the parallel developments of Arctic shipping routes is not mentioned. I suggest that the rationale for choices is better articulated, and that a number of issues are kept permanently in subsequent updates for continuity.

We agree that providing a clear rationale for the selection of topics and maintaining continuity across updates is essential. With the help of Reviewer 1's comments and our subsequent revisions, we have addressed these issues, including better articulation of inclusion/exclusion criteria and improved framing of topics.

Finally, some visual elements or summary tables would greatly facilitate the understanding of trends and highlights.

We agree that visual elements and summary tables can aid interpretation. However, the Barometer synthesizes information from multiple publications, all of which are fully referenced, and creating additional figures here would go beyond the scope of the Barometer. By referring readers to the original sources, we ensure both accuracy and completeness while keeping the Barometer concise.

Specific comments follow.

Page 2, lines 11-12: this statement is not really illustrating human pressure, but the longer term trend is. The 2023-2024 change simply shows there is a lot of variability in the number of tropical storms.

We agree that our initial formulation introduced an ambiguity between short-term variability and longer-term trends. In particular, the year-to-year change in economic losses reflects strong variability in extreme events, rather than a direct signal of increasing societal harms. We have therefore revised this point throughout the manuscript, including in the abstract and in the main text, to clearly distinguish between short-term fluctuations and longer-term trends

Abstract, initial formulation changed to : "*Economic losses from tropical storms and floods were particularly high in 2024, illustrating how human pressures are translating into material costs for societies*"

Results, initial formulation changed to: "*High economic losses from tropical storms and floods in 2024. Economic losses from tropical storms and floods can vary greatly from one year to another. … Over the long term, related economic losses have increased decade by decade since the early 1980s, with an acceleration during the past two decades (WMO, 2021). In 2024, damage costs due to tropical storms and flood surges were nearly twice as high as in 2023, reaching … This high level is largely explained by two strong hurricanes*."

Page 2, line 6: "In 2026", should be either in 2025 or in the 2026 barometer.

Agreed, this has been modified

Page 2, line 17: Please clarify "ocean-focused impact investing".

We have replaced with "*Ocean-focused environmentally beneficial investments*"

Page 2, line 60-61: See general comment above about the need for formalism and for continuity. As this is the first barometer update, the authors need to introduce a method for decision-making on what goes into updates beyond the choices of the authors.

The process guiding updates between editions is described in Section 2.4 "Selection of items". In particular, the manuscript explains that items are updated from one edition to the next when new information becomes available (i.e. when a new report is

published), and that new items are introduced when no such update exists. We acknowledge that this may not have been sufficiently explicit and have therefore reaffirmed that this paragraph 2.4 included the decision-making method: "*Together, these principles define how continuity and renewal are balanced across editions*."

Page 2, line 63: Consider refining the sentence to focus on international developments. I think this is what the manuscript attempts to do. There are many more ocean-based developments than those captured here.

We have completed the sentence to capture this: "*Rather than systematically updating a fixed set of indicators, the Barometer offers a curated, narrative-based synthesis aimed at capturing a selection of policy-relevant Ocean signals of the year at the global scale, without seeking to provide an exhaustive account of Ocean-related developments. This curation relies on collective expert judgement within the scientific committee, guided by the availability of new evidence"*

Page 5: Consider reformulating to remove "news", as the paper covers developments that are broader than news, or at least the reference to news seems out of context.

We agree that the term "news" may not be appropriate in this context. We have revised the manuscript to replace it with more neutral terminology (e.g., "items" or "developments"), to better reflect the nature of the content presented.: "*Key information is presented as concise, evidence-based summaries of key developments, highlighted through clear and accessible headlines. In the following, we refer to these as items*".

Page 6, line 126: This section would particularly benefit from careful language around decadal trends and evolution over the past year. Given there is data, this section can be more comprehensive and cover both the decadal trends and last year. The title in bold does not refer to 2025. I also challenge the use of "acceleration" which at the minimum needs to be presented with a time frame, but gets in place used interchangeably with "intensification". The latter is when things get worse, while acceleration should be used only when the second derivative is positive and above natural variability. A figure could be provided to illustrate the comment.

We agree that the initial formulation did not sufficiently distinguish between long-term trends and recent-year variability. We have revised this section to clearly separate decadal-scale changes from observations in the most recent year. In addition, we have ensured that the term "acceleration" is used more carefully and in a clearly defined temporal context.

"*Global mean sea-level rise and Ocean warming are accelerating. Global mean sea-level rise is a consequence of Ocean warming and land ice melt (Wang et al., 2024; Dangendorf et al., 2024; Mu et al., 2025). While global mean sea level rise was estimated at 2.6±0.3 mm/y over the period 1993 to 2011 (WMO, 2026), this rate has increased to 4.2±0.3 mm/y over the period 2012–2025 (Leclercq et al., 2026), consistent with an acceleration in sea-level rise over the last 30 years. Global mean Ocean warming is also accelerating since 1960 (Minière et al., 2023; Storto and Yang, 2024), and reached record values in 2025 (Pan et al., 2026; WMO, 2026). In addition to these long-term trends, recent years have been consecutively marked by particularly high values*."

Page 7, line 138: New research published in January 2026 suggests observations of polar bears shows they are fattening. Consider including this here.

We thank the reviewer for drawing our attention to this recent study, which we had not previously considered. We agree that such findings provide interesting insights into species-specific responses to environmental change. We have carefully considered this example. However, the inclusion of items in the Starfish Barometer is guided by criteria of global relevance and robustness across systems. In this context, results that are regionally constrained and species-specific may not be representative of broader Ocean trends, as different species can respond in contrasting ways to environmental change. For this reason, we have not included this example, but we appreciate the reviewer's suggestion.

Shrinking arctic ice opens new ship routes which seems highly relevant to this barometer. Consider exploring this aspect here.

We thank the reviewer for this suggestion. We have added one sentence and one reference to account for it: "*Declining sea ice is increasing the accessibility of trans-arctic shipping routes (PAME, 2026).*"

Page 7, line 146: in 2025? "Level of threat" seems vague.

We have replaced with "*deterioration in conservations status*", which is then explained in the paragraph

Page 7, line 150: Have you also reviewed any positive trends in this area?

Positive trends in the Antarctic are restricted currently to some specific regions, but the overall trend on average is negative since 2015 (before it was slightly positive, or no trend), which is mentioned in the text.

Page 7, line 163: the element around the 26.4% loss seems to deserve a separate sentence.

We have reformulated the sentence: "*All wetland ecosystems are losing surface area since 1970, coral reefs (-26.4%) but also mangroves (-11.8%), salt marshes (-14%), kelp forests (-48.1%), and seagrass (-16.3%) (ramsar_2025).»*

Page 7, line 167: Is this between 2024 and 2025? Specify time frame. And likewise line 169, "since 2024", specifies between 2024 and 2025.

Thank you for spotting this, it is corrected now.

Page 8, line 181: from which treaty is the 30x30?

We have replaced with: "*the Kunming-Montreal Global Biodiversity Framework target to conserve 30% of marine and coastal areas by 2030*"

Page 8, line 183: What period corresponds to "in recent times"?

We have replaced with: "*over the past two decades"*

Page 8, line 184: Deep sea biomass may be least understood but it is also very small in terms of living biomass. This could be acknowledged here.

The importance of deep-sea ecosystems lies in their remarkable diversity of life forms adapted to extreme conditions, rather than in there biomass. This has been added in the text.

Page 8, line 190-191: But are we seeing "unrestrained industrial mining" seems to contradict previous statements that contracts were issued by the ISA. Please clarify.

We agree that the initial formulation could be interpreted as referring to current activities. Our intention was to highlight potential future risks associated with large-scale industrial mining. We have revised the sentence to clarify that these impacts refer to scenarios where mining would be scaled up without effective environmental safeguards: "*If scaled up to industrial levels without effective environmental safeguards, deep-sea mining could have severe long-term impacts on deep-Ocean ecosystems due to their slow recovery rates*"

Page 8, line 195: is this more than in 2024?

We do not have information of the current trend in the number of contracts. This might become available in subsequent years. Our intention is to highlight the current scale of exploration activities and their potential implications. We have reformulated the sentence: *"31 exploration contracts are currently active"*

Page 9, line 205: The statement about doubling impacts is misleading as it refers to 2 years only. This is clearly natural variability. A reference to the longer trends is required, this example by itself cannot be used to demonstrate growing impacts.

We agree and the paragraph has been reformulated to better acknowledge inter-annual variability (see our previous answer to your comment page 2 line 10-11)

Page 9, line 227: Economic and political insecurity is not just caused by resource grabbing, and the linkages to climate events is weak at this stage. Please review.

We agree that the initial formulation may have suggested overly simplified causal relationships, particularly regarding the role of environmental factors on migrant fatalities at sea. More fundamentally, we would like to clarify that the objective of the Starfish Barometer is not to establish strict causal relationships between Ocean changes and societal outcomes, but to document significant and policy-relevant developments related to the Ocean (see our additions to the method section in response to reviewer 1). In this context, migrant fatalities at sea are included as they reflect the Ocean as a space of human activity, mobility, and risk. This signal is considered relevant independently of the underlying drivers. We have revised the paragraph to be more caution on causality and to clarify the rationale for its inclusion:

"This reflects the Ocean as a space of transit, risk, and human activity, where significant humanitarian challenges persist. The drivers of migration are complex and multifaceted.

Economic and political insecurity due to resource grabbing and severe climatic conditions, including extreme weather events, sea-level rise, desertification, and water scarcity, are among the factors that push people to leave their countries (Maattouk et al. 2025,Yang et al., 2025).”

Page 9: Key drivers "of climate-induced displacements" include … (as here the paper does not refer to the key drivers of all migrations). Please specify.

See above

Page 10, lines 239-248: this section needs to provide numbers to quantify changes in observations somewhere.

We are aware of this lack of numbers. Nevertheless, due to its importance, we have added this topic in the 2026 Barometer; specific studies are under way and not yet published which will provide numbers next year (Karina von Schuckmann, pers. comm.). We have added two references (Tanhua et al., 2024, von Jackowski, 2025) to strengthen the item.

Page 11, line 277: I think animal food is still food. Please specify that the primary non-food application refers to human consumption.

Indeed, we replaced with : “*which are primarily used in animal feed*”

Page 12, 318-319: Acceleration is wrong in this sentence, most elements refer to intensification.

We have replaced with : “Intensification is the dominant signal, with indications of acceleration in some cases”