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A global consistent database of plankton and detritus from in situ imaging by the Underwater Vision Profiler 5

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In the following revision, reviewer comments are indicated in **bold**, while author responses are shown in *italic*.

Reviewer #1

General comments

This manuscript presents a commendable effort to assemble and standardize a comprehensive, decade-long (2008–2018) global dataset of plankton and detritus from Underwater Vision Profiler (UVP5, HD and SD). The resulting archive of approximately eight million validated images is a valuable resource that will support future analyses of plankton biogeography, enhance biogeochemical models, and aid in developing AI-driven image classification methods.

While the study is interesting and merits publication, the manuscript requires attentive revision. Each section, from Introduction through Discussion, is currently excessive in length and would benefit significantly from concision to eliminate repetition and improve overall effectiveness.

Please, find specific comments and technical notes below, which I hope will be useful in the revision process.

We thank the reviewer for the positive assessment of the dataset's value and its potential impact on plankton biogeography, biogeochemical modeling, and AI-based image classification. We also appreciate the constructive suggestion regarding manuscript length and clarity. In response, we have carefully revised the manuscript to substantially reduce redundancy and improve concision across all sections, while preserving essential information and scientific context. We believe these revisions have significantly enhanced the overall readability and effectiveness of the manuscript.

Specific comments

Introduction - This section is overly lengthy and burdened by repetitions and redundancies. A thorough revision to improve its organization and concision would create a clearer, more fluent succession of topics. Specifically, the final three paragraphs should be streamlined by relocating all technical details (regarding the UVP instrument, profile and image counts, classification methodology, and its limitations) to a dedicated "Materials and Methods" section. To conclude the Introduction, I recommend a brief, focused paragraph on the utility and applications of UVP, followed by a clear statement of this study's specific scope.

We have now substantially reduced the introduction from 88 lines to 74 lines (~16%), avoiding repetition in paragraph 1 and 2, and removing lines from paragraphs 4 and 5.

Methods - While this section provides useful detail on the dataset's preparation, its length can be reduced to improve clarity. Suggested revisions include: integrating the first sentence of section 2.1 into the UVP description (2.2.1), moving the remainder to the dataset section (2.3), and removing the now-empty 2.1. Additionally, adding examples (L188-191) would effectively illustrate how contextual information aids in classifying objects with weak morphological attributes.

Further technical notes on methods are provided below.

We thank the reviewer for the suggestions, we have reduced the text length and sections as suggested (5%). Modifications mentioned in Technical notes also have been added. We added the example as follows: "However, few annotators have used contextual information provided by other means (e.g., bottle or net collections, depth, GPS position) to classify objects with inadequate morphological attributes into taxa. For example, colonies of Trichodesmium (-contextual) can be reliably identified in images when their presence is confirmed by concurrent bottle samples or net tows, even when their morphological features alone are insufficient for unambiguous classification."

Results- This section requires revision to reduce repetition and improve concision.

As an example, the text from lines 284–291 can be condensed as follows:

"Detritus was the most abundant category (90.5% of total images), indicating a substantial presence of non-living particulate organic material (Fig. 3). Copepoda dominated zooplankton (2.2%), followed by Trichodesmium (1.3%), Trichodesmium-contextual (1.1%), the plankton-like category (1%), artefacts (0.9%), Phaeodaria (0.8%), and Bacillariophyta-contextual (0.6%). Each of the remaining groups represent < 0.16% of the total number of objects."

Suggestion accepted and text modified.

Section 3.6 also needs to be streamlined and made more concise.

We have now reduced the text from 14 lines to 9 lines (36%) as follows: "When analyzed across vertical layers (Figure 7), detritus showed the highest concentrations in the upper 100 m, with biovolume patterns mirroring concentrations and exceeding those of living plankton by several orders of magnitude. Trichodesmium (excluding Trichodesmium-contextual) was the most abundant group in surface waters, but contributed relatively little to biovolume due to its small size (Figure 4). Crustacea displayed comparable patterns in concentration and biovolume, with high surface abundance and decreasing values with depth. Gelatinous plankton, including filter feeders (Appendicularia, Salpida) and carnivores (Chaetognatha, Narcomedusae, Siphonophorae, Ctenophora), were characterized by low concentrations but disproportionately high biovolume, particularly in the upper 100 m, with both metrics declining with depth. Rhizaria also peaked in concentration and biovolume in surface waters and decreased gradually down to 1000 m."

The verbs in Results should be in the past tense.

Verbs were changed to past tense.

Discussion – As with previous sections, this text would benefit from concision and clarification (see Technical notes). Key revisions should address three main points: a reinforced support to the separation of 'artifacts' from 'detritus'; the removal of the speculative link between the 'plankton-like' category and "new findings" (L430); and more realistic and practical ideas about how UVP data can advance our understanding of the pelagic ecosystem.

We thank the reviewer for these suggestions. We have revised the Discussion to improve concision and clarity. We have reduced it from 133 to 116 lines (~13%). Section 4.1 and 4.2 were reduced to avoid repetition and point out the message of these sections.

Technical notes (modifications/corrections)

<u>Abstract</u>

L31: …their composition and fluxes, and marine ecosystems as a whole.
Done.

L34: …by to versions (SD and HD) of the…… [removed from L41]
Done, moved to this line and removed from the L41.

L40: Copepoda was the most abundant planktonic taxon, followed by Trichodesmium colonies.
Done.

L43: …"presenting similar patterns, although the ranges may differ". This part of the sentence should be clarified.
Thank you for the suggestion; clarified. New sentence: "...; however, both systems capture comparable qualitative patterns in object morphology and relative abundance across size classes, even though the absolute ranges differ."

L47: ….by identifying previously unclassified objects…..
Correction made.

L48: …available on SEANOE (link) [include the link]
Done and link added.

<u>Introduction</u>

L53: Landry [not Laundry]
Corrected.

L62-63: the sampling and observation methods should be listed/grouped separately and not mixed as presented now.
We have modified the sentence. New phrasing is: "Collection methods include, for example, water sampling and microscopy for the smallest size classes, net tows and sediment traps for larger particles, while observation and analysis rely on complementary technologies such as optical imaging systems and remote sensing, depending on the targeted size range (..."

L64-66: the sentence "Many planktonic organisms….2024)." is misplaced because interrupts the flow focused on instruments. It should be moved before the sentence "Furthermore….".
We agree with the reviewer; sentence moved.

L67: O'Brien [not O'brien].
Done.

L70-71: In this position, the sentence "For plankton….2019)" is weak and interrupts the flow. It should be better moved to the paragraph L82-101.
We agree with the reviewer; sentence relocated (L114).

The paragraph L61-72 is better closed by the sentence "Addressing these challenges….change".
Done.

L74-76: the sentence "Conventional sampling….across disciplines." Should be removed because useless repetition.
Done.

L86: Suggested modification: "Deep collection by net tows followed by taxonomic identification with microscopes provides accurate biodiversity data, though this sampling method damages fragile organisms and requires…..2022)."
Suggestion accepted.

L134-138: Suggested modification: "the Material and Methods section provides details…… The Results section presents maps..…. The Discussion section provides recommendations…..
Suggestion accepted, the text was modified accordingly.

<u>Methods</u>

L152,153: It should be reported also how these characteristics (volume, frequency, depth) are in the HD version.
This applies for both versions, the sentence has been changed as: "The UVP5 (SD and HD) images a volume of about 1 L at a frequency of 5 to 20 Hz and can be deployed down to 6000 m depth."

L162 and 165: avoid repetition and combine the info on 42 features in a single sentence.
Sentences were merged as follows: "In addition, the released dataset contains 42 morphological features characterizing each object (area, major and minor axis, grey level etc.; Picheral and Mériguet, 2026) obtained from the segmentation of raw vignettes."

L173: clarify the meaning of "dynamics of their imagers".
The word "dynamics" was changed by "resolution" as this concept is explained before in the same section (L196-197).

L211: …with plankton net data…..
Done.

L219: clarify the meaning of "common but not evenly distributed".
The sentence was rephrased as follows: "When recurring objects that were not yet classified

appeared frequently but with uneven spatial distribution, temporary categories were created to accommodate them and labeled as temporary (tmpXXX).”

L228: clarify how the images were “independently reviewed”.
We added more details: “...10 % of the total images were selected and independently reviewed by a different trained operator, working independently of the initial classification,..”

L234: clarify what is the meaning of “their ecology” here: biogeography? vertical distribution?, seasonal distribution?
The sentence was clarified: “five broader taxonomic groups were defined for further analysis based on shared feeding strategies and ecological traits (e.g. habitat, life mode, and trophic role).”

L239:…in different depth layers [or, at different depths].
Done.

L251, 252:….(down to 200 m depth)… [same for 500 m and 1000 m].
Done.

Results

L268 and 277: the proper “seasonal variation” is not visible in Figure 2; I would rather write “…remarkable annual and interannual variation”.
We agree with the reviewer; the sentence was modified.

L269: 30°S-30°N is not the equatorial region but the tropical zone.
Sentence rephrased as follows: “The region between 30º S-30º N represents the highest proportion of UVP5 profiles (47.25%).”

L310: remove “the most abundant category” because it’s a repetition.
Removed.

L312: …..UVP5 HD (Figure. 5).
Moved.

L312: plankton categories [not “taxonomic”].
Done.

L313: remove “compared to detritus”
Done.

L315: HD [not “hd”].
Done.

L316: define the limits of “small size range”. Remove “(Figure 5)” from here because it must be cited at the beginning of this section (see my note at L312).
Figure citation removed.

L327: The units must be the same in the text and in Figure 6 (mm ESD or mm3)
Here in the text we are describing ESD range and characteristics, while in the plot both calculations are presented, ESD in mm and biovolume in mm^3.

L338: The genus names must be in italics
Thank you for noticing this mistake, changes have been made accordingly.

L343: …both the filter-feeders (…) and carnivores (….) had very low concentrations…
Sentence changed as suggested.

L356: …the five plankton categories resented…
Changed.

L357: …(SD and HD) (Figure 8). [move here the fig citation from L358]
Figure citation moved as suggested.

Discussion

L368: …the UVP5 images…
Word added.

L383, 384: Move "Altogether….version." to the beginning of section 4.1.
The sentence was moved.

L395-397: Revise the English
We have rephrased the sentence as follows: "While previous publications have adopted fixed depth ranges of 0–200 m and 200–500 m (Drago et al., 2022), or a dynamic layer, set as the deepest value among the mixed layer depth and the euphotic depth (median 88 m; Panaïotis et al., 2023), the choice of vertical layering ultimately depends on the scientific question being addressed."

L408-410: The info about validation should be moved to Methods, indicating more clearly how it was independently done.
We agree with the reviewer; the lines have been moved to M&M.

L413: The factors that create artifact images are not clearly explained.
Clarified. New sentence: "This category includes images of objects arising from external or procedural factors. Examples of such artifacts include reflections or shadows from a poorly tied rope, presence of seals near the camera, cables, or other non-biological objects inadvertently captured during image acquisition, as well as badly segmented objects in nepheloid layers that modify the background."

L414: "air intrusion" where? Clarify.
New sentence: "On the other hand, it may also consist of effects like bubbles caused by the descent through the air/water interface where bubbles are captured on the hardware, as well as artifacts resulting from image blurriness where no actual object or non-recognizable object is present (real artifact)."

L435: *Trichodesmium*
Done.

L445: "ecological dynamics" is vague, rephrase.
Sentence rephrased: "The detailed classification of plankton and detritus provides a valuable resource for understanding the complexity between their abundance distribution and the environmental processes happening at global (Drago et al., 2022; Panaïotis et al., 2023; Laget et al., 2024) and local scales (see references in Table 1) within marine systems."

L454-455: I suggest to avoid generalist sentences like this one
We agree with the reviewer; the sentence was removed.

L458: …understanding their distribution in different environmental conditions is crucial….
Suggestion accepted.

L490: …integrating the UVP5 profiles with those acquired with the new instrument's version (UVP6 LP and HD) into the observation system…
This is not the idea that we were presenting. New profiles are coming from both, UVP5 and UVP6, is not only that profiles acquired with the new version are being added to the existing profiles. The rephrase sentence is: "Furthermore, integrating existent profiles with those acquired in the future, such as the anticipated 500 annually for UVP5 and 5,000 annually for the new version of the UVP (UVP6LP and HD; Picheral et al., 2022), into the observation system will enhance the robustness of the database, ensuring its adaptability and scalability for future data handling and feature extraction."

L496: The new UVP, which can be attached or associated with different platforms, is now widespread distributed and has allowed the acquisition of innumerable profiles and 87 millions of images…
Suggestion accepted.

<u>Table 1</u>

I recommend to shorten and simplify the column titles…
We have now renamed the columns as follows: Broad categories, Children categories and Reference.

Moreover, I suggest to leave in the first column only the category names…
We have removed the total counts in the Broad category and children categories columns.

The names: Flota, Poebious, Pseudocalansu, Munnopsis, Dolichospermum , Nodularia, Aulacantha, Aulographis, Coelodendrum, Aulatractus must be written in italics.
Done.

In many other names that are not genera or species, the italics must be removed…
Done.

Check the name "Euphausiace", it should be Euphausiacea.
Corrected.

The reference "Christiansen et al., 2022" is not in the reference list
Thank you for noticing this mistake, it was Christiansen et al., 2018. *The reference was added to the list and corrected in the table.*

<u>Figures</u>

Figure 1: It seems to me that some vignettes lack the scale bar (10, 30, 33), while in some others the bar and/or the units are barely visible (14, 19, 20, 21, 25).
All vignettes have the same scale bar (5 mm), the idea was exactly to highlight the size range difference that the dataset encompasses. As some of them are too small compared to others due to the size of the object the scale remains very small (an example would be vignette number 30, tentacles of Cnidaria, which are extremely big compared to for example vignette

17 Ostracoda). We also added in the legend the sentence "All images contain the same scale bar (5 mm) which appears very small for large objects."

Figure 2, caption: a) Sampling effort….2018 in the global ocean. b) Latitudinal distribution…profiles. c) Maximum vertical extent of the profiles.
Modifications were done.

Figure 3, caption: …….for the 33 consistent categories ordered by descending counts…..colors.
Text modified as suggested.

Remove the note because it's a repetition…
Note removed.

Figures 4, 5, 6, 7: Replace "[0, 100]"…
Figures have been changed as requested.

Figure 4: Map of the global distribution of detritus and…
Done.

Figure 5: Move "Detritus" to the first column…
Done.

Figure 6: The units must be the same in the text (L327, mm) and here (mm3).
In Line 327 we are talking about ESD, which is in mm and corresponds to the upper axis on Figure 6, so the units are the same. Lower x-axis in Figure 6 corresponds to volume (mm^3).

Figure 7, caption: …and the five plankton categories. [not "functional"].
Word removed.

<u>Annexes</u>

Table A1: Caption: List of the 62 projects included in the present study, with the corresponding identifying number (pprojid), ….
Modification done.

The title of the fourth column (pprojid) is missing.
The column name for the fourth column (now third position) is projid, the project identification number inside EcoTaxa.

The data-owner column should be moved after the project title and before the license.
Moved.

Table A2: Caption: Morphological features computed for each imaged object…
Table A2 (and all comments below in relation with it), was completely removed from the manuscript. The table was not removed without justification; rather, it was intentionally omitted in the revised version to avoid redundancy. The information previously contained in the table is fully and comprehensively presented in the cited reference Picheral and Mériguet (2026), which provides a more detailed information of all the relevant features and their description used in the present study.

To ensure clarity for the reader, we have carefully reviewed the manuscript and confirmed that the reference is clearly cited at the appropriate location, allowing interested readers to easily access the detailed information. We believe this approach improves the conciseness of the manuscript while maintaining completeness.

I suggest to group the features of the same type one after the other, for example all those that refer to the grey level.

"objid" is not a morphological feature.
True.

Area: say how it is calculated.
Median: it's a statistical parameter…
Min and max: I think it's more logic the opposite, i.e., 0 grey= while, 255 grey= black.
This was mentioned in M&M (Line 190), as the original images are with dark fields, when converted to light background the scale is reversed.

Circ: sorry, but I do not understand this formula.
Fractal: Berube and Jebrak, 1999 should be reported at the end of the table.
Fcons: Amadasun and King, 1989 should be reported at the end of the table.
Elongation: "major/minor" what?
What "cv" and "sr" stand for?
All the detailed descriptions of these variables are in the reference mentioned above.

Table A3: The names must be carefully checked.
All names have been checked.