Brief Summary of the manuscript:
Schoeman and co-authors present evidence on the importance of monitoring deep-depth integrated chlorophyll-a (chla) and phytoplankton biomass based on over 9,000 glider chla fluorescence profiles collected from 2002 to 2022. They compare surface chla concentrations to chla integrated to the euphotic depth (depth-integrated) and chla concentrations integrated to twice the euphotic depth (deep depth-integrated). The authors derive relationships between surface and the two integrated chla concentrations for three different water column conditions: stratified summer, stratified winter, and mixed conditions. They describe the temporal patterns of deep chlorophyll maximum (DCM) occurrence and, within these DCMs, the patterns of deep biomass maximums (DBMs) versus deep acclimation maximums (DAMs). They also provide details on satellite matchups to surface HPLC chla samples and validation. The authors demonstrate that there are increases within the seasonal cycle of deep-depth integrated chla that are not recorded in the seasonal cycle of standard depth-integrated chla. These local deeper increases are biologically important for krill productivity and subsequent whale foraging times.

Overall impression:
The results presented in this manuscript are compelling and highlight the increasing importance of including the variability of chla with depth in studies. The study shows how the vertical structure of chla changes seasonally and provides further insight into the potential for monitoring depth-integrated chla using satellite remote sensing data. It suggests that parameters for relationships used should be updated for certain regions. If published, this work could stimulate further discussion about improving satellite-based estimates of depth-integrated chla where DCMs are present. Overall, this manuscript is well-written and well-reasoned. However, there is a need for improved clarity within the method sections, such as the inclusion of a study region map. Additionally, figures could be improved, along with other minor suggestions detailed below.

We greatly appreciate your input to provide a clearer methods section and improve figures. We agree that adding more detail to the methods and more figures will improve the readability of this manuscript.

Introduction:
Line 35: Perhaps provide a range or average of the depth to which satellites observe. A good reference here might be Zaneveld et al. 2005 - https://doi.org/10.1364/OPEX.13.009052.

Good idea. We will include a range to the revised version.

Line 68: This sentence is a bit unclear to what depths was included in these other studies. Did they include deep oceanic samples? the "but" in the sentence makes it unclear and sound unfinished.

We realise that our wording here can be confusing. We will change “deep oceanic regions” into “open oceanic regions”

Methods:
In general, I'm missing some sort of map in the paper. For readers unfamiliar with the region, it would be helpful to have some sort of map showing the study area, some features mentioned in the

text such as the Perth Canyon, and perhaps the locations of glider profiles included in the study (if not too crowded) and locations of HPLC samples that could be satellite matched.

Thank you for this suggestion. A map of the study area, including the Perth Canyon, ocean glider transects, and HPLC samples will be added to the manuscript.

Section 2.1: Here the authors state that both the HPLC and glider datasets used are restricted to "between 04 July 2002 and 21 June 2022", please clarify the date ranges of each dataset. Perhaps I have misunderstood the data download process, but according to the AODN delayed mode glider data via the link provided, this online dataset only contains glider data from 2008? If I am mistaken please clarify and/or provide more details on how to download the appropriate glider data.

That is correct. Our general search criteria were that data had to be collected between 04 July 2002 and 21 June 2022 to make sure that in situ HPLC data matched the availability of MODIS-Aqua satellite data. We see how this can be misleading and will make adjustments by specifying the available date ranges for the ocean glider data and HPLC data separately.

Section 2.2: Somewhere in this section the reader should be reminded of the total number of glider profiles used after the filtering steps described here. Before this it is only mentioned in the abstract as "~9600" and then again at the beginning of section 3.1 as "We extracted 6438 and 3234 profiles from", unless I missed it.

After careful consideration, we do not think that it is beneficial to mention the number of profiles remaining after the filtering process described in section 2.2. This is because profiles were further filtered based on whether they reached the euphotic zone depth (see feedback on Section 2.3 Line 115 below). However, we agree with your point and will include the number of profiles available for further analysis at the end of section 2.3.

Line 104-105: It would be interesting to see the authors speculate/comment somewhere here or in the discussion (see comment below) on the potential use of daytime satellite data to infer depth-integrated chla based on relationships derived from nighttime chla profiles. Could this be a limitation that should be acknowledged in the final paragraph of the discussion?

The effect of non-photochemical quenching (NPQ) on fluorescence chlorophyll readings is the biggest challenge when using day-time ocean glider data, especially in areas with high solar radiation, such as Western Australia. In the absence of tidal effects, which could result in short-term diurnal changes in the phytoplankton community, we believe that night-time vertical profiles are representative of day-time conditions.

Section 2.3 Line 115: Perhaps I have missed or misunderstood, please clarify here or elsewhere what is meant by profiles that do not cover the Zeu? Have any steps been taken to ensure that profiles cover to a depth of Zeu x2 for the calculation of Chlzeu2?

Profiles were required to reach the euphotic zone depth so that, at minimum, depth-integrated chlorophyll over the euphotic zone could be calculated (i.e., Chl_{zeu}). Since the calculation of Z_{eu} is

described under Section 2.3, the removal of profiles that did not reach Z_{eu} is mentioned here. Chl_{zeu2} was only calculated for those profiles that reached twice the euphotic zone depth, and all profiles that didn't were only excluded from the regression analysis for Chl_{zeu2}. We have clarified in section 2.5 that Chl_{zeu2} was only calculated where possible.

Results:

Section 3.1: It would be easier for new readers to follow these descriptions and get a better idea of the MLD and Zeu characteristics of the study area if there were a plot somewhere here in the main text or in a supplement. Perhaps seasonal box plots or line plots with depth on the y-axis showing both average MLD and Zeu over the seasonal cycle? This might also provide a better background and link to Figure 1. Adding a panel to Figure 1 could also be an option.

Thank you for your suggestion. We will add a panel to figure 1 so that we have one figure for seasonal trends in mixed vs stratified conditions and one for changes in average mixed layer and euphotic zone depth.

Figure 1: I find the addition of the density plot without a y-axis at the top of the figure a bit out of place. Perhaps this seasonal distribution should be shown as a secondary axis in Figure 1 or in another panel. See also other comments below about the addition of a plot showing the annual number of profiles and HPLC samples satellite matched over 2002-2020.

We understand that the density plot is difficult to interpret without any clear axis, and we would like the figures to speak for themselves. It is a great idea to add a top panel to Figure 1 with a numeric y-axis to reflect the sample sizes for each month. Based on additional suggestions from the second reviewer, we will also include supplementary material to illustrate the annual temporal distribution of samples.

Section 3.2: This whole section will be clearer to a new reader if it shows visually the proportion of DBMs vs. DAMs over a seasonal cycle. Perhaps a figure similar to Figure 1. Either as a supplementary figure or possibly as an additional first panel to Figure 2.

Thank you for your suggestion to provide a better visual presentation of the data. We will add a panel to Figure 2 to present the seasonal occurrence of DCM and the proportion of DBMs vs DAMs.

Line 193: Add reference to Figure 1 at end of sentence.

Line 193 refers to the seasonal cycle in DCM formation, which we believe is better presented by figure 2, especially if we include a new panel for the seasonal occurrence of DCMs. We will therefore add a reference to figure 2 at the end of line 193.

Line 217: Perhaps remind reader here that surface chla concentrations referred to here is the Chlzpd defined in the methods.

Good idea. Reference to Chl_{zpd} will be provided in the first sentence.

Line 221: Remind reader that it is Chlzeu being describe here and similarly in Line 222 that Chlzeu2 is being described.

Absolutely. We will include references to Chl_{zeu} and Chl_{zeu2} in line 221 and 222, respectively.

Figure 3: Increase size of panels numbers (here and all other multi-panel plots) and reduce the amount of blank space at the top of panel (a). Also revise the width of the multi-panel plots with months on the x-axis, here the month text labels are too close together in my opinion and look better in Figure 2.

Thank you for giving pointers to improve the cosmetics of Figure 3. We agree that the month labels appear a bit tight in this figure, making it less readable compared to Figure 2. We will increase the figure widths or place the x-axis labels at an angle. We will also amend the y-axis of panel (a) and increase all panel reference letters.

Figure 4: I suggest making it clear within the figure panels which is summer and which is mid-winter, perhaps with annotations Stratified: summer; Stratified: mid-winter? I would also find it easier to follow the text and compare relationship visually if Figures 4 and 5 were combined into one figure. Perhaps into a figure with 3 columns and 2 rows; a-c showing the Chlzeu relationship and 2nd row d-f showing the Chlzeu2 relationship, with an annotation "Mixed" added to panels showing the relationship in mixed conditions. Also include the definition of stratified vs. mixed in the caption to remind the reader, e.g. Zeu<Zmld.

Thank you for your suggestions. Using panel titles and combining figures 4 & 5 is a great idea. We will amend this in the revised version and include the definitions of stratified and mixed conditions in the caption to enhance figure clarity.

In figures with regression lines, I suggest to extend lines to edges of the plots.

We did play around with the length of the regression lines before, but because of the differences in slope, some regression lines ended up running of the sides and others at the bottom. This made the figures look messy, so we decided against extending regression lines to the edges. However, we will investigate extending the regression lines as we can see that some only just cover the plotted data range.

Figure 6: Add units to each axis.

Thank you for attending us to the missing units. They will be included in the revised manuscript.

Discussion:
Line 330: Add the value of the R2 in the parenthesis.

Yes of course, thank you for picking this up.

Line 350: Related to an earlier comment, this part of the discussion could be a good place to perhaps discuss or acknowledge the impacts/limitations of using night time relationships of the surface with depth-integrated values if satellite surface values possibly used in the future are during day time.

Please refer to our earlier feedback on the use of night-time profiles. We agree that the potential use of our established relationships on daytime satellite data should be discussed. However, this discussion should be more in light of fluorescence vs satellite data.