Comment on essd-2021-329
Response to Referee #2

Referee comment on "Chlorophyll-*a* growth rates and related environmental variables in global temperate and cold-temperate lakes" by Hannah Adams et al., Earth Syst. Sci. Data Discuss., https://doi.org/10.5194/essd-2021-329-RC2, 2022

This manuscript describes a valuable data set on chlorophyll a dynamics and associated environmental variables for lakes covering a wide range of limnological conditions and localities (mostly north temperate). Specifically, the authors identified periods of increasing chlorophyll *a* concentrations, and they calculated the increment rates for such periods in each lake. This approach and the compilation of calculated rates has resulted in a derived dataset that will be of interest to many researchers.

We thank the reviewer and appreciate their suggestions and comments for improving our manuscript; all their suggestions have been considered in the revision of the manuscript. Below, we provide the answers to the comments and questions raised by the reviewer and all the modifications that have been incorporated in the revised version of the article.

The description of this dataset would likely be appropriate to ESSD, but I have two concerns:

1. Although ‘growth rates’ appears in the title and manuscript, the estimates produced are not growth rates *per se*, but are net increment rates. In the phytoplankton literature and the ecological literature in general, the term growth rate refers to the parameter r in the exponential growth of populations: dN/dt = rN. For phytoplankton, N = cell number or a proxy (such as chlorophyll), and r is the specific growth rate with units of inverse time (d^{-1}). In this study, I don’t think that the authors fitted curves to the data (except for smoothing), but instead took chlorophyll values at the start and end of each growth window, subtracted the values, and divided by the time interval (this my interpretation; the exact calculation method needs to be more explicitly stated in the manuscript). The resultant parameter is therefore in linear increment units (µg Chl *a* L^{-1} d^{-1}) not growth rate units (d^{-1}), and it is misleading to call this a phytoplankton growth rate. In fact, sections of illustrative Fig. 3 do look more like exponential growth rather than linear increments, notably March-April and July-August.

Additionally, this calculated rate measures not only phytoplankton growth but also losses, and it is therefore a **net** rate of increase. This may be why the changes may be near- linear (e.g., August-September) rather than exponential (also, these are averages, with phytoplankton having different net growth rates down though the mixed layer, different parts of the lake, etc.).

We agree that the net rate of chlorophyll-a increase includes both growth and loss terms. We also agree that the terminology used in our original manuscript may result in unnecessary confusion. To avoid ambiguity in terminology, we no longer use the term “growth” when referring to the durations and rates of chlorophyll-a increase. Specifically, we have renamed:

- *“Growth rate” as “rate of chlorophyll-a increase” (RCI), defined on lines 115-116*
- *“Growth window” as “period of chlorophyll-a increase” (PCI), defined on line 107*
- *“Specific growth rate” as “normalized rate of change in chlorophyll-a concentration” (NRCC), defined on lines 182-183*

Renaming the “specific growth rate” to “normalized rate of change in chlorophyll-a concentration” (NRCC) avoids the assumption that the rate of increase in chlorophyll-a *concentration must be strictly proportional to the algal biomass concentration.*

We have reworded our explanation about what the calculated rate of chlorophyll-a increase (RCI) represents and what the limitations of this metric are in lines 263-276. We have also highlighted in the text that the normalized rate, NRCC, is a relative rate which facilitates the comparison between lakes of different trophic status, whereas the RCI will vary systematically between lakes with different standing stocks of chlorophyll-a (lines 263-276). We have calculated the NRCC to use as the threshold for defining the start date of the PCIs and reported it as a variable in the dataset.

We now explicitly state on line 115 that RCI is a net rate, and we have also added a sentence in the introduction explaining that the net chlorophyll concentrations observed (and therefore also the net rates) are controlled by multiple process (lines 80-84):
"Intra-annual fluctuations in lake chlorophyll-a concentration result from the interactions of multiple variables and processes including grazing by zooplankton, competition between algal species with different growth strategies and chlorophyll-a contents, and changes in temperature, light, and nutrient availability."

To provide a more stepwise explanation of the calculation method for the PCI, RCI and NRCC metrics, we have expanded our explanation in the text in Section 2.2 and now refer readers to the relevant supplementary information.

Without making this distinction between net rates of phytoplankton change (as estimated) versus phytoplankton growth rates (not estimated), it is easy to be led astray in interpreting the data. For example, the authors find that the net increment rate is lower in higher latitude waters:

Line 331: "Chlorophyll-a growth rates increase with nutrient availability while they decrease at higher latitudes due to cooler temperatures and lower SSR."

But higher latitude waters are largely ultra-oligotrophic. This means that phytoplankton increment rates in absolute terms (µg Chl-a L^{-1} d^{-1}) can never be large; there is not enough standing stock (nor available nutrients) to allow a large absolute increment, as opposed to a southern eutrophic lake where even a 5% increase would be huge in absolute terms (this also biases the analyses towards eutrophic waters, with the cutoff expressed in absolute rather than relative terms; line 180).

On the other hand, the specific growth rate of high latitude, cold-adapted phytoplankton could be rapid (as in algal blooms in the polar oceans) with the growth supported by nutrient recycling processes, and population size kept in check by grazing and other loss processes, as well as capped by TP and other nutrients.

I do think that the estimates and window approach are very interesting, as are the trends, but the terminology needs to be re-thought. The flip side of the question is also interesting, the net rates of chlorophyll decrease. This same approach (but for periods of decreasing chlorophyll) could be used to identify periods of sedimentation (storage fluxes) and/or high grazing intensity. The paper could be retitled "Net rates of chlorophyll-*a* change and…' with the abstract explaining that these are net rates of linear increase or decrease. Or the application to net loss rates could be just mentioned in the Discussion, without the need to update the database.

We followed the reviewer's advice and changed the terminology to be more accurate. As mentioned in our response to the reviewer's previous comment, we have renamed the calculated metrics to remove the word "growth". We have also added clear definitions of the rate *terminology we use in the text indicating that they are "net" rates of increase of the chlorophyll-a concentration (absolute and normalized) on lines 115 and 182-183. Furthermore, lines 263-276 now outline the potential for inter-lake comparisons using the absolute rates (RCI). These lines provide an explanation as to the differences between RCI and NRCC and potential biases with the use of RCI.*

We have evaluated the sensitivity of the derived values in the dataset (e.g., RCI, PCI start and end dates) to the threshold rate value that we used to define the start of the PCI. The full explanations of the calculation of the normalized rate (NRCC) and the sensitivity analysis are now included as online supplementary material. Using NRCC as the threshold means that the comparison of rates between lakes accounts for differences in phytoplankton standing stock between lakes of different trophic status. We refer the reader to this supplementary material in line 192 of the revised manuscript.

We agree with the reviewer that our rate approach would be interesting to apply to periods of chlorophyll-a decrease, in addition to periods of increase. While this avenue of inquiry would certainly be interesting, we feel it is outside of the scope of the current manuscript, which above all is intended to be a data description paper.

2. Several sections of this manuscript read more like a scientific research article than a data description paper. For ESSD, it seems like it would be better to focus on the rationale (the current Introduction, which reads very well), the methods, and the resultant dataset, and leave the questions, hypotheses, trend analyses and interpretations to a paper for publication in a limnological journal that then refers to this article for the dataset methodology and to Adams et al. (2021) for the complete compiled data (which I verified to be available for download and well organized; I see the data sources are given in the readme file but it would be useful to have the citations for the original limnological data as the final column in the lake_summary data file).

This question of how much interpretation to include would be best to discuss with the ESSD editors. In checking the website, I see that some recent articles go beyond a description of the data to include trend and spatial analyses, for example:

https://essd.copernicus.org/articles/14/517/2022/

https://essd.copernicus.org/articles/14/463/2022/

while others are more exclusively focused on describing a dataset, for example:

https://essd.copernicus.org/articles/14/449/2022/

We agree that maintaining a balance between data description and analysis in an ESSD article is challenging. We thank the reviewer for pointing us toward ESSD articles that go beyond just describing their data. These articles were helpful during the revision of our manuscript. In the revised manuscript we have reduced the causal interpretations of the trends shown. Instead, our focus is on illustrating the type of trends that can be extracted from the dataset. Thus, we have removed much of the interpretative text related to the figures, instead highlighting the features of the trends and relationships.