

Biogeosciences Discuss., referee comment RC2  
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## Comment on bg-2022-100

Anonymous Referee #2

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Referee comment on "Interdisciplinary strategy to assess the impact of meteorological variables on the biochemical composition of the rain and the dynamics of a small eutrophic lake under rain forcing" by Fanny Noirmain et al., Biogeosciences Discuss., <https://doi.org/10.5194/bg-2022-100-RC2>, 2022

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### Comments

The study title "Interdisciplinary strategy to survey phytoplankton dynamics of a eutrophic lake under rain forcing description of the instrumental set-up and first results" by Noirmain et al. aims to define the fine scale effect of rain and the carried algal particles on a lake physiochemistry and phytoplankton community. They combine methodology from meteorological sciences analyzing cloud structure and origin and raindrop algal cytometry, with characterization of the water column properties and phytoplankton microscopy enumeration, in an innovative approach that aims to reconcile recent findings of rain algal cell deposition (Dillon et al. 2020, Wisniewska et al. 2022, both cited thoroughly in the manuscript), with traditional works that explore the relationship between rain events and lake biogeochemistry, such as de Eyto et al. 2016 (DOI: 10.5268/IW-6.4.875). As far known, no efforts have been made to analyze the lake surface and the rain for both chemical composition and photosynthetic organisms.

The study has the potential to provide great insight into rain events effects in lake phytoplankton, short term surface stoichiometry and water column temperature changes. The evaluation of the photosynthetic organisms suspended in rain drops in comparison with the lake phytoplankton can provide great insight into the dispersal rate and mechanisms of the different phytoplankton organisms which is still a poorly understood subject. The inclusion of a phycocyanin channel (also with the chlorophyll channel provides a unique opportunity, together with the real time evaluation of the effects of rain on the physiochemistry of the lake, can provide a great insight on the effects of rain events on the phytoplankton community. Although the title of the article alludes to a presentation of experimental setup and first results, the listed objectives, rationale behind the analyses and discussion aim for a much definite style of work.

Unfortunately, the measurements provided seem disconnected. The water sampling times are too far away to assign any causality of the chemical and community changes to rain

events and not wind induced or upstream inputs (which seems the case given the steady decrease of temperature in CR1). Mesocosm experiments could have helped isolate the rain effects from the basin and wind effects.

The lake phytoplankton and the rain photosynthetic cells are measured with two different methods that are hard to reconcile. The rain cytometry does not seem to fix the cells with glutaraldehyde like Dillon et al. 2020, so the cells present in rain might be over or underestimated by growth or death in the rain collector chamber.

The air mass analysis does not provide additional support to the questions set out in the introduction apart from a brief mention in the discussion about how CR rain was from the lower cloud system and not the higher one of marine origin. They discuss solar radiation and rain effects on the water column thermal structure, while avoiding wind effects, which is usually the dominant factor determining short term mixing changes (as clearly seen in the CR event).

The discussion will also benefit in a cloud type-oriented organization, with sections for HIR and CR going each from the cloud source, the rain physiochemistry up to the lake chemistry changes and finally phytoplankton changes, instead of partitioning into their methodological counterparts. The text contains minor errors and will greatly benefit by proofreading by a native English speaker.

Overall, this work provides the first attempt to measure the rain effect on a lake on the fine scale. It can be improved by a bigger connection between the variables and timescales used to measure them and the questions set in the introduction. To properly answer said questions I suggest performing cytometry on the lake surface (and/or microscopy on rain samples), isolate the effects from rain and watershed inputs using mesocosm enclosures, and shortening the sampling time after the rain event. Although the main missing link is the disconnection of methods for phytoplankton analysis for the lake and for the rain, with comparative 2d cytograms of known cultures/species or lake samples, the two datasets can be made compatible. Regarding the manuscript structure, the introduction and the discussion need higher cohesiveness and streamlining, and I suggest that it undergoes severe rewriting. The results' figures could also benefit from trimming down to the ones specifically pertaining to the questions set.

With the current state of this work, it might be worth considering partitioning the work in two:

- Analyzing the rain drops cytometry (and/or microscopy) and its relationship with the different sources and characteristics of the rain clouds, with additional 2d cytograms of representative samples of the lake or cultures to known in greater detail the composition of said cells. Optimally, cytometry of the lake surface before and after the event should be performed, but the timing should be precise to avoid changes due to

algal migration.

- Report on the lake phytoplankton and physiochemistry changes before and after different precipitation events but including a further discussion on wind effects and watershed inputs until a decoupling is achieved with mesocosm deployments.

### **Specific comments**

The authors should properly refer equipment as Equipment Name (Company, Country) and remove the additional sentences such as "commercialized by".

There is information about sampling in the figure legends that should go in the main body text. Figure legends should only provide information needed for the interpretation of the figure.

An effort could be made to make their own maps without the clutter of open street maps. Figure 1 should benefit by including the clouds trajectory (as Wisniewska et al. 2020 Fig. 4, DOI: 10.1371/journal.pone.0238808, but with the author's applied CAT model) and eliminating supplementary figure 1.

Equal signs "=" should be surrounded by spaces as A = B.

The real time temperature and irradiance profiles should be aligned with the rain variables (number of raindrops, volume, etc.) to increase the interpretability of the figures.

Ions reported should be in the context of cyanobacterial biomass changes, i.e. NH<sub>4</sub><sup>+</sup>, NO<sub>3</sub><sup>-</sup>, and PO<sub>4</sub><sup>-</sup>, and a point should be made of the viability of the rain droplets milieu as a growth media for the airborne cyanobacteria, while the other ones (that are used as fingerprints to identify the origin of the clouds) can be just mentioned in the text or in supplementary figures.

If the technical specifications are listed by their manufacturer in available documents and unique user modifications are included in the manuscript body, supplementary tables 1-3

are not needed.

More specific comments are included inline in the annotated pdf.

Please also note the supplement to this comment:

<https://bg.copernicus.org/preprints/bg-2022-100/bg-2022-100-RC2-supplement.pdf>