

# ***Interactive comment on “Anoxic monimolimnia: Nutrients devious feeders” by Areti Gianni and Ierotheos Zacharias***

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The manuscript presents results from a two-year time series study and a post-storm case study of a coastal, semi-enclosed basin off western Greece. The Aitoliko basin is connected via small channels to a shallow Lagoon which isolates it from the deep Patraikos Gulf. The Aitoliko basin features an anoxic deep layer. The intended focus of the ms is on the role of nutrients (and H<sub>2</sub>S) accumulated in the bottom layer of Aitoliko for surface processes (PP of phytoplankton) (a) after a winter storm event and (b) under regular stratified conditions. The manuscript suffers from a very poor English, including basic grammar and vocabulary. Throughout the text it is often very difficult to be sure what the authors intend to say. Hence this review can only be based on the reviewer's best guess of the latter.

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Major issues: 1. Reviewers' comment: It is unfortunate that the time series data presented do not include T, S or O<sub>2</sub> data. The only such data are from the post storm cruise. Hence the authors seem to lack urgently needed reference data, in particular to make their points about total mixing etc..

Authors comment: In the present study, the impact of storm events on water column stability and bottom water hypoxia/anoxia of enclosed coastal basins is investigated. Furthermore, the role of basins' internal load (H<sub>2</sub>S, PO<sub>4</sub>3- and NH<sub>4</sub><sup>+</sup>) was studied. This leads to the disturbance on the main nutrients, dissolved oxygen, hydrogen sulfide and chlorophyll distribution, following total water column mixing. Additionally, the relationship between temporal nutrients variations in surface layers, of permanent anoxic coastal basins with; a) changes in the physicochemical characteristics of the water column, b) changes in the bottom water phosphorus and nitrogen concentrations, and c) their effect on the basin's primary productivity, are studied. In order to achieve the objectives of this study, two different sets of Aitoliko basin's data were used. The first one includes measurements of physicochemical parameters, nutrients, chlorophyll and sulfides, four days after a storm event and the consequent anoxic crisis in Aitoliko basin on 4th of December 2008. The second one contains a similar data set obtained from a biennial (May 2006-May 2008) Aitoliko basin monitoring. Two papers have been already published by the authors: āĆ Gianni, A., Kehayias, G., and Zacharias, I.: Geomorphology modification and its impact to anoxic lagoons, Ecol. Eng., 37, 1869-1877, <https://doi.org/10.1016/j.ecoleng.2011.06.006>, 2011. āĆ Gianni, A., and Zacharias, I.: Modeling the hydrodynamic interactions of deep anoxic lagoons with their source basins, Estuar. Coast. Shelf S., 110, 157-167, <https://doi.org/10.1016/j.ecss.2012.04.030>, 2012. In these papers there is an analytical description of the Aitoliko lagoon physicochemical characteristics, its hydrodynamics and the interaction with its source basin (Messolonghi lagoon), and the role of D6 pumping station. We reference these papers in the discussion section, where necessary, in order to interpret the changes in nutrients and chlorophyll changes in the basins water column. We chose not to include analytical information about the basin's

circulation in this manuscript in order to avoid a long text, as the Aitoliko lagoon hydrodynamics shows significant changes depending on season (physicochemical characteristics of its water column and its source basin), D6 discharges etc. We added a reference about these two papers in the introduction section as well. If you still considered that analytical information about Aitoliko lagoon is necessary in this manuscript, we can add it. (The addition: An analytical description of the Aitoliko lagoon physicochemical characteristics, its hydrodynamics and the interaction with its source basin (Messolonghi lagoon), and the role of D6 pumping station are given by Gianni et al (2011) and Gianni and Zacharias, (2012).) As the systematic monitoring of the Aitoliko lagoon stopped in April 2008 and the storm event occurred on December 2008 we do not have data before the storm event. In order to have an assessment of the situation before the storm event in the discussion we use data from typical wintertime in Aitoliko lagoon (Winter of 2006 and 2007). Because our funding was limited, we were not able to follow the evolution of the storm event phenomenon. In our discussion, related with the relaxation process after the storm event, and basin's restoration we used bibliographical information, from previous works (Dassenakis et al., 1994; Leonardos and Sinis, 1997; Demetriou et al., 2010) where this process was analytically monitored. The Messolonghi waters can be tracked into Aitoliko lagoon during the typical stratified periods (Gianni et al., 2011, Gianni and Zacharias, 2012) but not during the storm events (Gianni and Zacharias, 2012, see calibration scenarios).

2. Reviewers' comment: The ms (text and data) is unclear/contradictory about the feature of 'total mixing' during the storm event (also referred to as the 'holomictic period' or 'holomictic event'; Section 3.2). This fact is claimed several times in the text (and I seem to be an important, if not the major, aspect of this ms) (starting in Intro, p2, l 27, p3 l 13; see details in the attached pdf!), but I do not see evidence from the presented data of total mixing (convective overturning). In particular T, S and density plots shown from the cruise just four days after the storm show strong gradients (e.g. 0.75 deg C colder surface waters compared to the intrusion seen between 8 and 17 m water depth; strong salinity and density gradients below 8m.) do not support that the storm

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cause a total mixing (overturning) of the basin. Holomictic refers to uniform (!) T and density from top to bottom. There are also strong oxygen gradients above the anoxic layer observed during the post storm event. This also speaks against 'total mixing'. It rather seems that the hydrographical observations indicate mixing down to 8m water depths and some lateral intrusion of denser (potentially also warmer?) water below the surface layer. This can nevertheless cause mixing of H<sub>2</sub>S (and NH<sub>4</sub>) rich water with oxygenated water at the interface. Also, the post storm nutrient profiles by no means support a holomictic period. Lacking, however, any data from before the storm (the time series ended almost a year earlier) or from the source region, this is all very speculative. Hence, I think, much of the paper stands on a weak data base.

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3. Reviewers' comment: The poor English, long list of unclear sentences and phrases. In conclusion, I suggest to reject the paper in its present form. The study needs ad-

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ditional data (which seem not to be available), is based on improper (at least very unclear) reasoning (the total mixing issue) unsupported by the presented data, and, finally, needs a complete rewriting. Some minor comments (but see also the attached pdf, the original ms with additional minor comments and text corrections) Title: 'Anoxic monimolimnia': is this tautology needed? Isn't a monimolimnic lake always anoxic? What do you mean by Nutrient devious feeders?? I don't understand this at all! Intro: Additional references are needed, also several terms should be properly defined here. (See the attached pdf for more details.)

Authors comment: The title was changed. The new title is "The impact of the water column stability, in physicochemical characteristics and biological parameters distribution, in anoxic coastal basins" See also comments in the attached pdf

4. Reviewers' comment: MM: (see attached pdf in addition) Authors comment: See comments in the attached pdf

5. Reviewers' comment: p6/l3 indicates that you also measured O<sub>2</sub>, T, S during the monitoring activity. These should be provided in the ms. section 2.3: is very detailed (and at times wordy) for fundamental procedures in oceanography (on the other hand: you do not provide details on e.g. calibration of your sensors for O<sub>2</sub>, Eh) Authors comment: The sensors were calibrated according to the manufacture's instruction. For temperature, conductivity, redox potential and pH sensors' calibration, a standard multiparameter solution (Quickcal solution) was used, while the optical DO sensor was calibrated separately. The 100% saturation point was calibrated against air while the 0% point against N<sub>2</sub> deaerated water.

6. Reviewers' comment: Results: The authors report nutrients in mg/l; please turn to molar units (umol/l). Weight units tend to be unclear: for example, do you report mg/L PO<sub>4</sub> (mass 95) or mg/L P-PO<sub>4</sub> (mass 31)? Authors comment: All the units will be changed to molar units

7. Reviewers' comment: The section on chlorophylls is very lengthy! (p 11-12). Is this

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detail needed? Authors comment: Authors believe that this detail is needed

BGD

8. Reviewers' comment: I don't see convincing evidence presented concerning a 'holomictic event' with uniform e.g. temperature profiles, although the cruise took place a few days after the storm. and much more in the pdf ... Authors comment: See answer in comment 2 and attached pdf

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9. Reviewers' comment: Discussion: see the pdf Authors comment: See comments in the attached pdf

10. Reviewers' comment: Data availability statement is missing! Authors comment: I do not understand the comment please clarify

11. Reviewers' comment: No Acknowledgment section? Authors comment: There are no acknowledgements

12. Reviewers' comment: Note: I don't have the time and patience to provide a \*\*full\*\* listing of the language issues of the text. At times almost every sentence seems affected, at least formulations are clumsy, but often awkward, i.e. the meaning is not clear. The authors definitely need the help of either a native speaker colleague who is willing to correct the text very carefully, or a respective professional service. This needs to be done before the text is submitted for any additional review (to this journal, or elsewhere). In the attached pdf I have tried to mark as much as possible of unclear text 'in yellow'. Note that usually I also provide related comments (comment symbol attached to yellow mark) with related suggestions (best read with Acrobat Reader, I think).

Authors comment: See comments in the attached pdf

Please also note the supplement to this comment:

<https://www.biogeosciences-discuss.net/bg-2019-349/bg-2019-349-AC3-supplement.pdf>

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