

Interactive comment on “Nitrification and ammonium dynamics in Lake Taihu, China: seasonal competition for ammonium between nitrifiers and cyanobacteria” by Justyna J. Hampel et al.

Anonymous Referee #2

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General: This paper presents interesting results on the connections between various processes of inorganic N cycling processes in a eutrophic shallow lake in China. Strong points concern the simultaneous measurements of uptake, nitrification and ammonium regeneration and the discussion on how these processes are connected one to another and what are the major controlling factors. Weaker points concern the heterogeneous discussion which sometimes get lost in small descriptive details such as comparison of rates between Taihu and other systems but without a real discussion on what explains differences, or differences between dark and light uptakes which have already largely

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been presented in previous literature. I believe the paper would gain to be refocused on N-dynamics at ecosystem scale (which is already almost the case). Some clarification is also needed on the choice of the authors to present nitrification rates as the sum of ammonium oxidation and nitrite oxidation while the later one is one order of magnitude higher. How do you define nitrification? If it is the rate at which NH_4 transforms to NO_3 ultimately, then “total nitrification” should = ammonium oxidation, which is the rate limiting step. Or otherwise, then please justify.

Specific: L43: replace “N fixation” by “ N_2 fixation” L44: idem as L43 L57: maybe useful to say that NH_4 can accumulate in systems when there is O_2 limitation – which is relevant in eutrophic systems. L71: It might be useful to cite the role of O_2 in this uncoupling: There are many “kinetic” studies that show that nitrite oxidation is more sensitive to low O_2 levels than ammonium oxidation and that this causes the decoupling of both processes in many suboxic aquatic systems. See for example Guisasola et al 2005 and references therein. L90 and throughout the manuscript: the acronym cyanoHABs = cyanobacteria harmful algal blooms is often use in the place of “cyanobacteria”, as it is the here. Should be checked and corrected when needed. L91 Affinity for ammonium: needs a reference L96 the term potential uptake rate is a bit confusing as actually it is not an uptake rate but rather a consumption rate which includes ammonium oxidation. . . L149 atom% ^{15}N : of ammonium? L166 idem L96 L170 Please explain here how you calculate “total nitrification” or “nitrification” and justify. See also comment on L306. L255 You forget Chla in this part of the results L256 Do the variables not vary spatially also? I think they do as you discuss the special situation of station 10 L272: early summer bloom – how do you know this is the early summer bloom? From chla? L277 early spring bloom: idem as L272 L282 summer bloom: idem as L272 L303 using other units for nitrification is confusing. I would recommend to have similar units especially as later on you consider the fraction of ammonium consumption due to nitrification. L306 How do you define the total nitrification rate? By definition nitrification is the 2 steps reaction $\text{NH}_4 \rightarrow \text{NO}_2 \rightarrow \text{NO}_3$, as you said in the introduction, so it should be the rate at which NH_4 is transformed into NO_3 . So as nitrite

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oxidation is not the limiting step, it should correspond to ammonium oxidation. You use the sum I believe, which then represents the production of NO₂+NO₃? but then as most of the NO₂ is not produced by NH₄ oxidation (much slower rates) but comes from external inputs (or other process) it is not clear what this really represents ecologically? Please, this needs clarification. L329 in this discussion point it is not clear why you don't you calculate an integrated NH₄ uptake rate per station taking into account light/dark rates and surface/depth rates? It would refocus this part of the discussion. Presenting distinct light and dark rates in the discussion is distracting from the major (and most interesting) points. L330-339 I do not see the use of comparing rates of Lake Taihu in such details with other lakes if there is no discussion on what might explain the differences – and I think it is not the topic of the paper to do so. This could be shorter and table 3 removed. L340 Replace “presumably due to photosynthetic phytoplankton activity” by “presumably due to reduced photosynthetic phytoplankton activity” L340-342 This statement needs a reference: ammonium uptake is by phototrophs is reduced in the dark, not blocked so I don't think you can extrapolate to saying that heterotrophs and chemolithotrophs dominate the uptake. You don't know. L344 “. . .which may have been due to higher precipitation and subsequent runoff; . . .” you mean more nutrient inputs? What about the phytoplankton biomass? do you have a bloom that might explain higher rates? I see a max in Chl a indeed. And there is also plenty of nutrients. L355-358: proportion % cited here do not correspond to the values observed in figure 2d. L360: describing July as early summer is confusing as June could be early summer. . . Maybe just keep the months names L369 Why don't you do the same with uptake rates and nitrification? Would be interesting L388-390 “However, our results show that these external N loads are fueling high regeneration rates and suggest that microbial denitrification cannot keep pace with external N loads” I do not understand this. L394 which Nitrification are we dealing with here? Total? Ammonium oxidation? Nitrite oxidation? L394 “previously reported rates”: were these rates measured the same way (as the sum of NH₄ and NO₂ oxidation)? This can make a big difference on reported rates. L402: nitrification or ammonium oxidation? L414-415 “Higher NO₂

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oxidation rates were expected, since NO₃ is the product of NO₂ oxidation, and NO₂ oxidation relies on the product of NH₄ oxidation” I don't understand this statement. NO₂ oxidation also relies on external sources of NO₂ to the lake. It is not clear how you can have 10 times higher NO₂ oxidation compared to NH₄ oxidation. Needs more clarification. L424 how do you calculate the contribution of nitrification to the uptake? Do you use NH₄ oxidation? L451 idem L424 L454 but as NO₂ oxidation rates are higher everywhere, bot steps are also uncoupled at the other stations of the lake. L505 AOB is an ammonium oxidizer so can only contribute to ammonium oxidation (not total as mentioned) L518 replace “driven by” by “correlated with”. Being correlated do not mean they are “driven by”

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