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Interactive comment on "Seasonal and spatial variability of methane emissions from a subtropical reservoir in Eastern China" *by* Le Yang et al.

Anonymous Referee #1

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General remarks

The paper presents measurements of CH4 fluxes between water and atmosphere at a large Chinese reservoir. Monthly measurements at several sites (including the river above and below the reservoir) were performed using floating chambers and bubble traps. The title is somewhat misleading because the main point of the paper is the comparison between the emissions from the (upstream and downstream) rivers with emissions from the reservoir itself. This is comparable to the study about CO2 emissions done by Halbedel and Koschorreck (Biogeosciences, 2013, 10 (11), 7539 – 7551). I recommend to use the comparison of river and reservoir emissions as story-

line in this paper. Hypotheses should be developed along this storyline. Is the message of the paper that the river emits more CH4 than the reservoir? That would mean that constructing a reservoir has the potential to reduce CH4 emissions. The explanation for this somewhat surprising conclusion by the authors is that the deep oxic waterbody slows down emissions by offering more options for methane oxidation. Do you have an idea were the CH4 in the river comes from? Were the emissions in the streams higher because of the CH4 concentration or because of a higher gas transfer coefficient? Was the water released by the dam taken from the hypolimnion? Throughout the manuscript it is often not clear if a particular site is a river, a lake, or a reservoir (e.g. l.117). Lentic and lotic waterbodies, however, are different with respect to GHG emissions. This also has consequences regarding the methods. In a stream you cannot use an anchored chamber (Lorke et al. Biogeosci. 12 (23), 7013 – 7024) while in a lentic waterbody, drifting chambers are problematic because the wind drift might create artificial turbulence. The discussion about the reasons for the observed pattern is often speculative since important data were not measured (e.g. vertical concentration gradients in the reservoir, k600). Considering that the paper presents a rather limited dataset, it is rather long. I think the whole manuscript can be shortened considerably without losing too much information. The method section lacks important information on the field procedures while at the same time somewhat trivial calculations are explained in great detail. Calculation details could be moved to the supplemental material. The language would benefit from a check by a native English speaker.

Detailed remarks

l.13: Remove "Seasonal variability showed that" l.15: "flat" is not the right term here. l.16/17: What does "interrupted by the bubbles" mean? l.22-24: Not a really new finding. l.29: Are reservoirs wetlands? l.29: Replace "used to be often" by "are". l.29: Logic of the sentence is strange. Reservoirs are not Energy. l.36: China has 98002 dams. l.40: Rules is not the correct term here l.44: "plant mediated" instead of "Plant-medium" l.45: Reservoirs typically do not have littoral vegetation. l.46-51: Sentence

rather long. l.57-58: Why probably? Is that not stated in those papers? l.61-63: What is the logic of this sentence? l.77-80: I do not understand what exactly you want to express? l.88: Should be included in a CH4 budget of a hydroelectric reservoir. l.91-94: This is not really a hypothesis because it is long known that temperature has an influence on CH4 emissions. Furthermore, in a deep reservoir the temperature at the bottom is rather constant over the season. The major seasonal difference is the different Corg and maybe O2 supply to the sediment. l.103: Replace "dynamics of" by "monthly". l.104: ". . . region in 2015." l.107: Mean annual air temperature l.107: "a total" l.108: How was evaporation measured? Is this the evaporation from the water surface? l.109: Remove "which" l.116: Do you mean "contributes" instead of "occupy"? l.117: "inflow" instead of "surface runoff". l.117: Is it a river, a lake or a reservoir? l.113-120: this can be shortened l.125-140: This paragraph can be shortened. Can you also give the water depth at the sampling points (or the elevation of the bottom above sea level (NN))? l.143: Remove "In this study, the" l.145: "at each". What do you mean by morning? Give a range of hours. l.146: Remove article before bubble l.149: Remove the last part of the sentence. l.164: More details about the chamber method are required. Especially: Were the chambers fixed or drifting? 0.5 l sample volume is a lot. Were the measured data corrected for dilution with ambient air during sampling? l.180: At what depth were the traps installed? How long were they deployed? Were the bubble traps installed at all sites? l.185: Remove "to reach". l.187-197: Paragraph is too long l.198-208: Despite the long description it is not fully clear to me which model was used to fit the data. Please provide the equation of the fit. How was the concentration calculated? Provide equation. What is the unit of dc/dt? l.214-217: How was the diffusive flux calculated when ebullition occurred? Equation 2. I wonder whether it makes sense to average over the transects, especially if single sites show extreme values. l.224 add ". . .flux measured by the bubble traps)" Equation 3: Using equation 3 I get the unit μg CH4 m-2 h-1, not mg CH4 m-2 h-1. l.251: Add "in the inflowing river" l.268-278: Given the large standard deviation the second digit after the decimal point is not significant and should be removed. l.276: That is no surprise since

the ebullition flux was calculated from the ebullition rate. More instructive would be to show the relation between ebullition flux and CH4 concentration. l.290: What is a "fluctuated upward pattern"? l.302: Remove "average". l.335: This is surprising. Is it because there was no ebullition and the CH4 concentration did not show a lateral gradient? In my experience the CH4 flux from the open water depends strongly on turbulence. Was there a relation between flux and wind speed? l.345-353: This section is not about seasonal variation – move it to 4.2 l.350. What is the definition of the pelagic zone in a river? l.347-348: Does that mean you have to reject hypothesis 2b? l.360-361: How would the O2 concentration at the surface would affect the CH4 flux? I do not belief that. l.398: How would streamflow affect CH4 emissions? What is the mechanism behind this dependency? l.417: How fast was the water flow? If you used a fixed chamber, the high flux was probably an artefact because the chamber would create artificial turbulence which accelerates the flux (as shown by Lorke et al.). l.422: Vertical transport of CH4 in the water column is usually limited by the slow diffusion through the thermocline. Thus, the thickness of the hypolimnion or epilimnion is not so important. l.428-445: Paragraph too long. L.469: Where the emissions from the river high because of the CH4 concentration or because of a high k600? l.474: You cannot simply transfer the results from another, completely different, reservoir. l.476-478: Sentence sounds strange. l.495-498: I thought that exactly this was the purpose of this study. Fig.4: how can the CH4 bubble concentration be higher than 100%? Fig.6: Move to supplemental material

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