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Biogeosciences
Discussions

Interactive comment on "Low methane (CH_4) emissions downstream of a monomictic subtropical hydroelectric reservoir (Nam Theun 2, Lao PDR)" *by* C. Deshmukh et al.

Anonymous Referee #2

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The manuscript describes an investigation of methane (CH4) dynamics in the Nam Theun Reservoir with a particular focus on downstream emissions and in-reservoir CH4 oxidation. Reservoirs are a globally important anthropogenic CH4 source to the atmosphere, yet emission estimates are poorly constrained, partly due to a lack of data on the importance of CH4 emissions downstream of the reservoir. This manuscript is a welcome addition to the research area.

The data presented in this manuscript were collected as part of a larger study. It appears that the study data were divided into separate manuscripts describing diffusive emissions (Guerin et al. 2015), ebullitive emissions (Deshmukh et al. 2014), and down-

stream emissions (this work). The downstream emissions study was well executed and supported by sampling at numerous stations, including several nearby pristine rivers.

The sampling program was designed such that downstream emissions could be partitioned among different features of the system including turbine discharge, aeration pools, and river channels. While it is informative to understand the spatial distribution of downstream emissions, this approach does introduce some complications to the analysis. Specifically, to estimate emissions from the downstream flowing waters the authors needed to make assumptions regarding the air-water gas exchange rate. While this is not a major problem, it does cause the reader to wonder about the accuracy of these estimates, particularly for the section immediately downstream of the turbines where the water was too turbulent to allow for chamber deployments. I suggest the authors also estimate downstream emissions by assuming that all CH4 in excess of atmospheric equilibrium that leaves the reservoir is emitted to the atmosphere.

downstream emissions = [CH4,obs – CH4,eq]Q

where CH4 is the dissolved CH4 concentration that was measured (CH4,obs) and at atmospheric equilibrium (CH4,eq), Q is the rate of water withdrawal from the reservoir. This would provide an upper bound to the downstream emission estimate (i.e. assumes no CH4 oxidation in downstream waters).

The authors conclude "The hydrodynamics but also the water residence time significantly impact downstream emissions and must be taken into account for future estimation of total emissions from hydroelectric reservoirs at the global scale". While this is no doubt true, I would like to see a deeper discussion of how we might go about doing this. I very much like the related discussion on page 11333 (lines 1-15) which suggest that the mixing status of a reservoir is an indicator of potential downstream CH4 emissions. Are there other readily accessible data that can be used in emission inventory guidelines to better estimate downstream emissions? Certainly, downstream emissions scale with discharge, as discussed in page 11331, lines 4-9. Should we recommend that downstream emissions be estimated as a function of reservoir discharge? What about details of the intake structure? I wonder if the discussion of this topic in section 4.3 can be expanded upon. For example, some dams can only withdraw from the hypolimnion, while others can withdraw from multiple depths, including the epilimnion. It seems withdrawal depth is another important factor determining the magnitude of downstream emissions. Overall, I think this paper would be more impactful if it not only said we should estimate downstream emissions in global inventories, but also provided a framework for how we should go about it.

Specific comments Page 11316, line 23: . . .were first reported. . .

Page 11316, line 25: akward to start a sentence with a list of references. Suggest rephrasing.

Fig. 1: There is a lot going on in this monitoring program. I suggest making this figure as large and clear as possible. Please increase the size of the inset. Consider using colors. I suggest eliminating the icons used to symbolize the dams, intake structures, etc. They are relatively large and overlap with the sampling locations.

Page 11319, line 26: RES3 and RES7 not included in Fig.1

Page 11324,

line 15: below the dam?

Line 17: Fig 3 cited before Fig 2?

Line 20-21: data from NTH4 and NTH5 not shown?

Page 11331, line 2: . . .between X and 1.5. . .

Section 4.3: very interesting discussion.

Figs 3 and 4, panel b: y-axis label, “Diffusive emissions (mmol CH4 m-1 d-1)”

Fig. 5. Probably not necessary.

Interactive comment on Biogeosciences Discuss., 12, 11313, 2015.