

Interactive comment on “Annual greenhouse gas budget for a bog ecosystem undergoing restoration by rewetting” by Sung Ching Lee et al.

Anonymous Referee #1

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The authors present a rare and interesting one-year dataset of CH₄ and CO₂ fluxes for a temperate wetland undergoing restoration by rewetting. Wetlands are hot spots with hot moments and can play over sized roles on the regional greenhouse gas budget, so here, too, more data are welcomed. The site is located on Canada's Pacific Coast. Measurements were made with the aid of eddy-covariance method which allow to estimate surface-atmosphere gas exchange for the whole ecosystem scale. As the measurements of GHG fluxes for bog under restoration are unique the manuscript is worth of publication in Biogeosciences. The analysis is thorough, using up-to-date methods. The discussion is comprehensive, showing that the results fit well with those reported from other wetlands.

I suggest authors to consider some improvements, mainly:

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1) Estimation of the results uncertainties. The authors estimate the sensitivity of the results on windows size (for Re and GEP). It would nice to estimate the range of results for different gap filling strategies (e.g. neural network) and finally express the annual budget of CO₂ in the form $NEE = -179 \pm ??? \text{ g CO}_2\text{-C m}^{-2} \text{ year}^{-1}$ and similarly for CH₄ flux (or at least discuss on the base of recent publications which consider such impact).

2) The gap filling of CH₄ is based on regression of the flux against soil temperature. I suggest, to consider to fit parameters of Eq. 3 in the window similar to Re and GEP, not for whole year. The different environmental condition (water table level, vegetation development, temperature of deeper soil levels ect.) can result in different respond of CH₄ flux for temperature. The estimation of the parameters in the window would allow to include these influences.

3) The global warming potential (GWP) is the most common measure to asses a combined impact of CH₄ and CO₂ emission on climate. However, it assumes a pulse emission which is not a case for wetlands, thus the applicability of GWP to asses the role of these ecosystems in the Earth's global radiation budget can be questioned (e.g. Neubauer and Megonigal, 2015; Petrescu et al., 2015). The author could refer to this problem in discussion.

Specific comments

1) L 40 and in other places in text: "wetlands . . . sequester from -146 to -266 g CO₂-C m⁻² year⁻¹" - negative sequestration means emission? It is easy to guess in this case, especially for those who are familiar with EC measurements, but in general it is not obvious, so one must be careful about a sings of the fluxes (for example nest in the text sequestration in GEP is positive). Please look through the text to clarify.

2) L 265: "In June and July, the fitted curve stayed at 1 $\mu\text{mol m}^{-2} \text{ s}^{-1}$ because Ts,5cm remained above 15oC" – argumentation is not clear for me.

3) L 271: "Two other controls on Re explored were air temperature (Ta) and WTH."

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Whereas role of WTH is already pointed above (L 268): “Another factor could be the WTH”

4) LL 324-326: Last two sentences in the paragraph seem to be loosely related to the previous.

References:

Neubauer, S., Megonigal, J.P., 2015. Moving beyond global warming potentials to quantify the climatic role of ecosystems. *Ecosystems* 18, 1000–1013.

Petrescu et al. (2015) The uncertain climate footprint of wetlands under human pressure. *Proc. Natl. Acad. Sci. USA*, 112, 4594-4599.

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