



Comment on **essd-2021-141**

Anonymous Referee #1

Referee comment on "BAWLD-CH₄: A Comprehensive Dataset of Methane Fluxes from Boreal and Arctic Ecosystems" by McKenzie A. Kuhn et al., Earth Syst. Sci. Data Discuss., <https://doi.org/10.5194/essd-2021-141-RC1>, 2021

General Comments:

In this work authors present a new dataset for boreal and arctic methane emissions from terrestrial and aquatic ecosystems. Given the methane-emitting potential of the boreal/arctic ecosystems, and their susceptibility to climate change, any work to improve our understanding and estimations of these methane fluxes is important. The paper is well written with excellent figures (albeit with some confusing color choices, as pointed out in the specific comments). My comments are relatively minor, the authors have done a great job here.

Specific Comments:

Line 47-49: You give the range of 211-402 Tg CH₄ yr⁻¹ here, and say that the large range is caused by differences in the top down and bottom up approaches to estimation. Is the 211 value the top-down estimate for the Arctic, and the 402 number the bottom-up estimate? It may be helpful to clarify where the 211-402 range comes from.

Line 62: I feel like the snippet "including CH₄ uptake" could use some explaining. Since this sentence is already long, consider adding a second short sentence to explain that some sites are net methane sinks.

Line 72-73: The phrasing "colder soils in drier soils" is confusing to me, is this a typo?

Line 91-92: Do you mean here that deeper water columns limit ebullition release to the atmosphere because of bubble dissolution? Or that deeper water columns typically have colder sediments which leads to less ebullition? Please clarify.

Line 119: It would be helpful here to re-iterate the need for this new database. You talk about this in the first paragraph of the intro, so a quick tie-in to the importance of Arctic methane emissions and their large unknowns would emphasize how important your work is.

Line 142: How many cold season measurements do you have?

Figure 3: I really like this figure, except it is not clear to me which columns go with which pH label. You have 4 labels but 3 columns of squares, so I could not figure out where the

delineations were.

Line 231-232: This is a little confusing because first you say they have the driest soils, and then say their soils are moist to wet.

Line 251: Are rocklands a relatively small area compared with dry tundra? If so, it is logical to lump them together and assume their fluxes are similar. However, if rocklands are relatively large compared with dry tundra, you should note that lumping these two together could introduce significant uncertainty since rockland fluxes are unknown.

Section 265: You do not mention what maps you use to determine whether lakes exist in glacial, yedoma, or peatland environments. Is this information reported in the literature for every site with methane measurements? If not, how do you determine this information for each lake?

Line 386: Please add a period to end of sentence.

Line 419-420: Does adding these constants affect your results?

Line 434: I assume you mean "CH₄ flux" here? If so, please correct.

Line 455: It's a stretch to say these are evenly distributed. Sites are heavily concentrated in Alaska and the Quebec/Ontario border area, although you do have sites sprinkled in other places. I suggest changing the wording here so you do not use the word "evenly".

Line 488: I suggest getting rid of commas to make it easier to read: "No other continuous variables were correlated with CH₄ uptake; however, sites where shrubs were present had significantly higher..."

Figure 10: Please increase the contrast between the circle colors by making the ebullition circles darker (as in the color scheme for Figure 11).

Table 4: I would write out "Lakes – Diffusion" and "Lakes – Ebullition" in the top two rows, for clarity (assuming that is what D and E stand for?).

Line 634-635: Sometimes you use "water body" and sometimes "waterbody". Please choose one and make it consistent throughout the paper.

Line 642-644: This sentence is confusing to me. Shouldn't having a broad range of depths make you MORE likely to see a depth effect than if you had a narrow range of depths? What makes your synthesis different from others such that you do not see these relationships? I also do not understand the second half of this sentence "...because it is likely that the temperature and depth influence is clearer over time and space, respectively, in each specific system." Do you mean that you do not have measurements across a range of temperatures (and spatial locations) within each given system? I assume this is the case, but then how did previous synthesis studies see these relationships?

Figure 12: Having the bar graphs be a single shade of green is mildly confusing since shades of green also represent Relative Land Cover. I would suggest either making your bar graph colors match the legend based on their relative land cover or making them all a non-green color.

Line 680 – Do you mean Midsize Peatland lakes here instead of Midsize Glacial lakes? According to Figure 13, Midsize Glacial lakes are well represented compared to their relative flux, whereas midsize peatland lakes are not.

Figure 14: As with Figure 12, it is confusing here to have shades of blue mean two different things: either ebullition/diffusion, or relative land cover. I would suggest using a different color scheme for one of these.

Line 696-670: It is my understanding from the Wik et al. 2016 study that not only do you need 11/39 days for diffusive/ebullitive measurements (respectively), you also need these measurements in 3/11 depth-stratified locations (respectively). Please clarify this in your paper.

Line 715: I do not understand what you mean by "split CH₄-emitting ecosystem characteristics" here.

Line 718: Is it fair to say that MAAT has important implications for future scaling efforts if MAAT only accounts for 3% of the variability (per Line 615)? How important could MAAT be if it accounts for such a small (even if statistically significant) amount of the variability?