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Comment on bg-2021-256

Anonymous Referee #1

Referee comment on "Gaps in network infrastructure limit our understanding of biogenic methane emissions for the United States" by Sparkle L. Malone et al., Biogeosciences Discuss., https://doi.org/10.5194/bg-2021-256-RC1, 2021

This study aims to present a representative assessment of network infrastructure for improving our understanding of methane emissions across the US. I respectfully believe that the authors do not present the appropriate analysis for clearly addressing this goal. The authors present a relatively simple way to generate (ecological) clusters and then they list how many sites are in these clusters and evaluate their distance from the medoids. Arguably, the clusters were produced with variables that are relevant for any ecological process and they are not specifically designed to represent drivers of CH4 fluxes (as claimed by the authors). Representativeness is assessed based on the distance of the locations of the current study sites to the medoid, which is arguably a flawed approach as there are underlying assumptions that do not consider spatial heterogeneity of importance for CH4 fluxes. Finally, this study is more associated with a generic network representative analysis of AmeriFlux or GLEON and the authors present a lengthy discussion about limitation of CH4 measurements that are not directly related to the results.

Main comments

I strongly recommend separating the results from the discussion section. The results are very limited, and the discussion is beyond what is presented. Separating these sections will bring transparency and clarity about what was done and how is proposed to be

interpreted.

The authors claim that the MDA was used to define the state space into ecological clusters using information that is important for capturing patterns in CH4 (lines 208-225). That said, it is unclear how climate, ecotype and location (lat/long) are specific information relevant for CH4 and not for any other ecological process. It seems to me that this is a generic analysis and then the authors are interpreting this for CH4. I respectfully believe that there is a disconnection between this approach and the overarching goal of the study.

Lines 236-245 – This section of the methods is unclear. Furthermore, I do not thing that regions more similar to the medoid are more representative within given cluster, it may only mean that these regions are more similar to what the medoid is and have nothing to do with real representativeness. The authors assume that the medoid is more representative of the cluster but I think this is a misleading mathematical interpretation that is carried into interpretations of ecoregions and their representativeness. This issue is reflected in how the authors assess representativeness of 411 towers as they compare with their distance to the medoid under the (arguably) incorrect assumption that the closer to the medoid is better and that there is no relevant variability that is important for the representativeness of CH4 fluxes across a specific cluster.

Figure 2 – Are these regressions statistically significant? I doubt that that Fig2a is significant and Fig2b needs to be tested. If there is no statistical significance, please remove the line as it is a misleading graphic.

Lines 298-307- Are these 411 towers actually active? It will be important to disclaim how many are active or if this is a network analysis of historical sites. Furthermore, not all sites may be relevant or would have equal weights for our understanding of CH4 fluxes. Sites were originally installed to measured CO2 and H2O fluxes but arguably they may not be relevant for regional CH4 fluxes. This question is not addressed in this study but is critical for assessment of the representativeness of a CH4 network.

Lines 305-307 – I respectfully do not think that assessing the distance to a medoid is a good assessment of representativeness. If so, then we should place a few towers in these medoids and we will have a perfect representativeness for each cluster. We also know that clusters have similar ecological characteristics but there is much more diversity and heterogeneity that is not captured within a medoid. The last sentence of this paragraph is misleading as it implies that towers must be placed in the medoids that were calculated with generic variables that arguably are not specific for CH4 fluxes (as they are generic for any ecological process).

Similar arguments can be done for the analysis and discussion presented in section 3.3. I respectfully do not think this is the proper way to assess representativeness of places where we need to be measuring CH4 fluxes.

Lines 381-390 – The authors assume that uncertainty is associated to poor data coverage, but this is never assessed. This paragraph essentially calls for more locations for measurements away from the medoid which will imply that representativeness (based on the method proposed by the authors) will be lower, as sites are away from the medoid. This is confusing and I strongly encourage the authors to revise the methods and the interpretation of the results.

Lines 293-402 – This is a similar paragraph where the authors discuss about uncertainty from a narrative, but this was never quantified in the formal representativeness analysis presented in this study. This paragraph and most of the discussion section is an expert opinion and is not directly related to the analyses presented.

There are three related studies that assess the representativeness of the AmeriFlux network that may be of interest for the authors.

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