

## ***Interactive comment on “Soil methane oxidation in both dry and wet temperate eucalypt forests show near identical relationship with soil air-filled porosity” by Benedikt J. Fest et al.***

### **Anonymous Referee #2**

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Title: Review for bg-2016-181

Fest et al. aimed to understand CH<sub>4</sub> dynamics in two Eukaryptus forests in Australia with different precipitation regimes. Fluxes of CH<sub>4</sub> were measured in a high temporal resolution with six replications at each site. In addition, soil temperature and moisture, and inorganic N levels were measured. The data were analyzed using linear regression for casual correlation to explore which factors controlled CH<sub>4</sub> dynamics. Fest et al. concluded that soil moisture regime could explain over 90% of the variability of CH<sub>4</sub> dynamics.

I believe the strengths of this study is 1) very high temporal resolution in CH<sub>4</sub> measurements and 2) air-filled porosity explained CH<sub>4</sub> dynamics in almost the same manner

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for the two study sites. These are novel, and deserve publication. However, the current manuscript is no more than a draft. The weaknesses includes 1) statistical analyses, 2) discussion are underdeveloped, and 3) it's not well written.

1) The data should be analyzed using a maximum likelihood framework with AIC or BIC to compare regressions and determine the importance of temperature. 2) Discussion should emphasize the novelty of this study. 3) I found so many typographical errors throughout the manuscript. Please see the comments below.

### Abstract

P1L13-14. Add “under predicted climate change scenarios” to the sentence.

P1L26. Replace “air-filled porosity” with “AFP” as the abbreviation appears in P1L21.

P1L23-25. I disagree with this statement after reading the results and discussion. Activity of MOB was not quantified in this study, and the results cannot indicate MOB activities were similar between the two sites.

P1L24. Check “physiochemical” for difinition. It can be a typo for “physicochemical”.

P1L24. Here, the differences between the two sites in CH<sub>4</sub> flux were due to “physiochemical” but AFP explained up to 90% of the variability, indicating that the differences were likely caused by moisture regime.

### Introduction

P2L17. Here “air filled” is not hyphenated. Be consistent throughout the manuscript.

P2L33-34. This statement needs citation.

P2L35-P3L1. There are many ecosystems in the Northern Hemisphere without snow or below zero soil temperature, comparable to the Australian forests (e.g., Southwest of USA, Mediterranean region).

### Results

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P7L23. Replace “around” with “approximately”

P7L23. Fig. 4 should not appear before Fig. 3 (P8L1) in the text.

P7L23. The text mentions 85% (0.85), but Table 1 has 0.896. Why are they different? It's also the case for 19% in the text, and 0.148 in the table.

P7. This is not the best way to analyze the data. Use a model selection approach such as Akaike Information Criterion. For instance, see Monteith et al. (2015):

Monteith DT, Henrys PA, Evans CD, Malcolm I, Shilland EM, Pereira M (2015) Spatial controls on dissolved organic carbon in upland waters inferred from a simple statistical model. *Biogeochemistry* 123(3): 363-377

P7L30. Avoid starting a sentence using an abbreviation. Spell out AFP.

P8L1. There are AU-Wom and AU-WOM, and AU-Wrr and AU-WRR. Stick to one form.

P8L20-21. This should be SD, not SE. The large sample size (how many?) makes the SE so small and misleading.

P8L7-9. Awkward sentence, and I cannot find “inter annual” differences were displayed well in figures.

P8L9. VWC in the text, but soil moisture in the figure. Be consistent.

P8L10. Fig. 4a in the text, and Fig. 4A in the figure. Be consistent.

P8L28-P9L7. What is the point of presenting daily CH<sub>4</sub> flux in relation to soil environmental variables, if it is not better than that in finer time scales, and does not add much?

P9L5-8. Integrate this section to the first paragraph of the Results.

Discussion P9L10. 1-2 years? I thought the measurements were for two years. Spell out numbers smaller than nine.

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Start the discussion on the most exciting findings. I believe the significant correlation between AFP and CH<sub>4</sub> flux for the two sites is most interesting in this study. Comparing the daily CH<sub>4</sub> flux values with past studies is not too exciting.

P9L25-31. Delete the paragraph. I do not think the statement is true that cool wet temperate eucalypt forests are often compared to rainforests. It's interesting that the annual CH<sub>4</sub> flux is comparable between the eucalypt forest and a tropical rainforest, but no more than that. Plus, net CH<sub>4</sub> flux is determined by not only MOB activities, but also methanogens as well, especially in wet sites. Thus, there is not much point for the comparison.

P10L1-4. This paragraph should be presented first in the discussion.

P10L10-11. Check the order of the citations.

P10L13-15. Is this an assumption? Delete (i.e. atmospheric CH<sub>4</sub> concentration) and add "between soil and atmosphere" after "the concentration gradient" (L14).

P10L21-L23. The coefficient of determination for the relationship between WFPS and CH<sub>4</sub> uptake is mentioned in the text, but not shown in Table 1 or 2. The relationship is shown in Fig. 4D, but the coefficient is not shown. If it's discussed in the text, it should be shown somewhere.

P10L28-29. Delete the sentence, and cite Farquharson and Baldock (2008) for the previous sentence.

P10L35-P11L2. This sentence needs to be integrated into the context, otherwise it does not make sense. The paragraph is discussion about temperature on CH<sub>4</sub> flux. Then, out of the blue, the sentence on CV of CH<sub>4</sub> flux appears without relating it to temperature. It's confusing. I am not quite convinced that temperature did not affect CH<sub>4</sub> flux with the current analyses. The better way to test the temperature effect is that 1) construct two models (CH<sub>4</sub> flux is a function of moisture, and moisture + temperature) and 2) compare the two models via AIC. This will provide a more concrete

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answer.

P11L2. Replace “will” with “would”.

P11L9-14. I do not think the statement is valid. First, the authors measured soil moisture only to 10 cm in depth, and did not measure soil moisture in deeper soils. Methanotrophs in deeper soils can contribute to CH<sub>4</sub> oxidation if the surface soils are dry. The only way to tease out methanotroph activity from physical constraints of soils for CH<sub>4</sub> diffusion is to measure CH<sub>4</sub> flux as well as gas diffusivity (see von Fischer et al. 2009).

von Fischer JC, Butters G, Duchateau PC, Thelwell RJ, Siller R (2009) In situ measures of methanotroph activity in upland soils: A reaction–diffusion model and field observation of water stress. *Journal of Geophysical Research: Biogeosciences* (2005–2012) 114(G1):

P11L17. Why is “air filled porosity” used here, instead of AFP? Be consistent throughout the manuscript.

P11L17. Replace “same” with “almost identical” (they are not “same” based on Table 1).

P11L18-19. I disagree with the statement. It is possible that AFP governs the CH<sub>4</sub> flux across the landscape for eukalypt forests, but there is also a possibility that the casual correlations between AFP and CH<sub>4</sub> flux happened to be very similar for the just two study sites. It’s not reasonable to extrapolate the results to all the same type of forests in Australia.

Tables

P16L5. “S” in “TS” should be subscript.

Is “-” missing for 195.768 for the AFP parameter at AU-Wom?

“Soil water content” is used in the caption. Is this the same as “soil moisture content” (e.g. P30L6)? If so, use only soil water content.

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P17. Table 1. Are “constants” intercepts? Are “parameters” slopes for predictor variables? Are both “unstandardized and standardized coefficients” in parentheses?

Table 1 shows results of four regressions: 1. VWC 2. Soil temp 3. VWC and soil temp 4. AFP

But the corresponding Fig. 4. has: 1. VWC 2. AFP 3. Soil temp 4. WFPS

Why the inconsistency?

Figures

18. I am not sure if the data are presented in the most effective manner in Fig. 1 and 2. The current figures have; A: CH<sub>4</sub> flux B: Air temp, CV of CH<sub>4</sub> flux, and precip C: Soil temp and soil moisture Is there rationale behind the combinations? I am not convinced that the arrangement makes sense. How about rearrange the combinations; A: CH<sub>4</sub> flux and CV B: Precip and soil moisture C. Air and soil temp

Or A: Ch<sub>4</sub> flux B: Precip, soil moisture and CV C. Air and soil temp

P18. Fig. 1. AU-Wrr and AU-Wom are Fig. 1A and 1B, respectively, but “A” and “B” letters in the parentheses do not match up. Are these typo?

Replace SE with standard deviations. SE partly depends on the sample size, which is not described in the text, thus the tight error bars can be misleading.

P19. Fig. 2. The description is confusing. Are the individual symbols means of measurements over four hours for each chamber, or average of 10 chambers? Spell out "four" instead of "4".

Replace "moisture" with "water".

In the text (P7 L20), it seems like CV was calculated using average and SD of 10 chambers, but it seems like CV was calculated using average and SD over time for each chamber.

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P21. Fig. 4. Add regression equations and  $R^2$  values on the figures.

P22. Fig. 5. I do not think this is the best way to present the data. In the text, the authors want to show there is no significant correlation between CH<sub>4</sub> flux and inorganic N contents. Then, scatter plots should be used to show the data.

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