

Interactive comment on “Climate-CH₄ feedback from wetlands and its interaction with the climate-CO₂ feedback” by B. Ringeval et al.

Anonymous Referee #2

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This paper provides estimates of the expected climate and carbon feedbacks on wetland methane emissions under one future emission scenario. The paper topic and format are suitable for Biogeosciences. The theoretical assumptions, methods, and results are well documented. The paper makes an important contribution to the study of climate, carbon, and methane cycle feedbacks. I support publication of the paper after minor corrections.

Specific comments:

It would be useful to include a list in the main paper or Appendix of the different symbols used in the paper. Right now the description of each symbol is embedded in long paragraphs, which makes them difficult to reference as the reader progresses through the paper (and I needed to refer to the symbol definitions often. . .).

C810

Page 3209, line 9: Suggest adding Montzka et al., Science, 2011 as a reference to support the statement that OH concentrations have little interannual variability.

Line 17, Page 3213- Line 14, Page 3214: This paragraph is difficult to understand without the added information in Appendix C. Thus, I suggest including Appendix C in the main paper or shortening the discussion on wetland extent in the main paper and moving most of the explanation to Appendix C.

Page 3214, Lines 8-10: “The way in which we compute anomalies (absolute or relative) has no influence on the role played by wetland extent in the following (Sect. 3.2.3)”. Why? Please elaborate. Is it because the authors normalize the interannual variability in the saturated fraction of ORCHIDEE-WET to Prigent, 2007? Also, Sect. 3.2.3 is not in the paper.

Page 3216, line 12: 251 Tg/yr for global wetland emissions is very high as the authors indicate, much higher than inverse estimates or recent LPJ model estimates from Spahni, Biogeosciences, 2011. The authors provide a good comparison with Bousquet 2006, but can the authors please speculate further on what mechanisms in ORCHIDEE-WET itself might lead to high wetland emissions? Does ORCHIDEE have high biomass estimates? Or larger estimated wetland extent?

Page 3217, line 25: unclear what is mean by “an anomaly method”

Page 3218, lines 20-23: “Regardless, using CH₄ flux densities and wetland area from two different simulations to compute wetland CH₄ emissions does not allow [for] the possibility of removing the indirect effects of wetland extent [variability] on CH₄ fluxes”. Why? Which are the two different simulations? What are the indirect effects?

Page 3227, line 12: the C-CO₂ fertilization interaction on wetland CH₄ emissions are a large percentage of the total change in atmospheric CH₄ concentrations. The same $\beta_{C \rightarrow M}$ is used for all calculations. Is it possible to say something about the uncertainty on $\beta_{C \rightarrow M}$?

C811

Page 3227, line 19: It would help the reader to get a feel for the numbers if the authors provided the SRES-A2 concentration changes for comparison with the ORCHIDEE-WET values in the text.

Page 3228, first paragraph – missing grey and green lines, maybe the authors' mean red and blue?

Page 3229, line 23-24: Which values of γ_m are the authors comparing? In Table 2, for Q10=5.5 and dynamic wetland extent, one γ_m is more negative (-4.85) and one is less negative (-1.51) than the γ_m estimates for Q10=3 and dynamic wetland extent (-1.83 and -3.27). Please clarify the values used for comparison in the text.

Page 3230, line 23: "In particular, in some regions, NPP decreases under future climate change. . ." Would this lead to an overestimation or underestimation of the expected change in atmospheric methane concentrations?

Discussion: The authors give a very detailed list of several possible uncertainties which might affect the results. It would be useful if the authors could provide a quick overview of which 2-3 of their list of uncertainties likely lead to the largest error (or create the largest uncertainty) in the results.

Page 3233, line 10 and line 13, increase in available substrate is mentioned twice as a reason for increasing CH4 emissions.

Conclusions: By what percentage do methane emissions increase when both C-CO2 and C-CH4 feedbacks are included vs. when only C-CH4 feedbacks are included? Numbers are given (-0.016 to 0.024 for ex.), but it would be useful to have the information somewhere as a percentage to highlight the importance of the interaction between the carbon and methane cycles.

Technical comments:

Page 3211: define variable Fcf

C812

Page 3213: extra '(' on line 6; change 'and well as' to 'as well as' on line 6; 'also make use of' on line 7 is written twice

Page 3217, line 4: should read "concentration scenarios"

Page 3217, line 11: delete "the" before combining

Page 3218, line 2: add s after "concentration"

Page 3226, line 19: extra % sign

Page 3236, Appendix C: missing several "the" in text.

Page 3236, Line 7: include Figure number

Table 3: define F

The text in Figures 3 and 4 is too small.

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C813