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Interactive comment on "Model estimates of climate controls on pan-Arctic wetland methane emissions" *by* X. Chen et al.

Anonymous Referee #2

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In their paper Chen et al. describe the sensitivity of their wetland and methane model to historical and future climate change. Based on observations of wetland maps and methane fluxes they find a model derived increase of methane emissions of 20% over the second half of the 20th century period. While this result itself is not ground breaking, and most probably model dependent, they achieve to incorporate dynamic wetland area changes into their methane estimates, which is rarely done in methane process-modelling studies. Hereby also lies the shortage of the study. Methane fluxes are analysed in great detail, but the simulated wetland tile fractions, e.g. changes of wetland area in the future, are not presented. I thus encourage the authors to cover this aspect and suggest a publication of the paper after other minor revisions. The paper is very well organised and written concisely.

General:

I really like the analysis on methane fluxes and spatial changes for one future projection. As mentioned above I would like to see which part of the methane changes is related to changes in wetland area. Are they spatially or temporally correlated? If precipitation is the dominant factor for methane emissions in the future, instead of temperature, would this mean wetlands are more susceptible to dryness (on-off state of emissions) and thus larger interannual variability in methane emitting areas and emissions? In addition to mean changes, a paragraph about interannual variability of methane changes would be worthwhile.

Specific:

p. 5942, l. 10: add CH4 emissions in "... sensitvities of CH4 emissions to air temperature, ..."

p. 5945, l. 13: typo: Seneviratne

p. 5948, l. 12: What type of plants are simulated by VIC? Is plant productivity dependent on the wetland water table? Are there plant stresses incorporated?

p. 5949, l. 5: Soil carbon pools normally have turnover times of several centuries. 50 years spinup thus seems to be relatively short. How are they brought into equilibrium? What's the impact on methane emissions?

p. 5949, l. 14: typo : '... expressed as a function ...'

p. 5949, l. 18: typo: '... each year's ratio ...'

p. 5951, l. 10: typo: '... dominant emission controls'

p. 5952, l. 20: Please also show a map of modelled changes in lake-wetland fractions over the historical period.

p. 5953, l. 13: If emissions are strongest in the forest belt: are there forested wetlands

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present in the model? Or is this a combination of two variables, i.e. forest derived NPP and wetland fraction, that happen to maximize?

p. 5954, l. 1: This "north"-"south" difference is it because of wetland vegetation type, i.e. sedges versus sphagnum moss, or peat types, i.e. bogs versus fens? What does it mean biogeographically. Please introduce these terms and give a bit more detail.

p. 5954, l. 25: typo: Table 4, 4th column

p. 5963, l. 10: Please cite Stocker et al., 2013 that find a constant feedback climate-CH4 factor, albeit an increase in arctic methane emissions in the future. They use CMIP5 simulations paired with a dynamic vegetation model, wetland plant functional types and related methane emissions.

Figure 10:

Years on time axis are not nicely spaced.

Ref:

Stocker, B. D., R. Roth, F. Joos, R. Spahni, M. Steinacher, S. Zaehle, L. Bouwman, Xu-Ri, I. C. Prentice, "Multiple greenhouse-gas feedbacks from the land biosphere under future climate change scenarios", Nature Climate Change, 3, 666-672, 2013

Interactive comment on Biogeosciences Discuss., 12, 5941, 2015.