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Interactive Comment

Interactive comment on "Modelling methane emissions from natural wetlands: TRIPLEX-GHG model integration, sensitivity analysis, and calibration" *by* Q. Zhu et al.

Anonymous Referee #3

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In this paper, Zhu and colleagues display a description of a new methane module called TRIPLEX-GHG as part of the IBIS dynamic global vegetation model. They do a very thorough review on methane modelling and existing methane models, and from there describe their implementation of biogeochemical equations for methane emission modelling in global wetlands in TRIPLEX-GHG. Model behaviour is judged on a comparison to 19 measurement sites and areas, which are more extensive than previous models have undergone. Unfortunately, there is very little new science resulting from this comparison. In addition conclusions are more general and descriptive, rather than informative. I understand that GMD is probably a journal to publish such an evaluation, but I see good potential to make it scientifically more rewarding and insightful. Thus I

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will add some suggestions below for a major revision.

General:

My main critics concern the comparison of model output to site data analised by continent/country. I would suggest to make an analysis based on the ecosystem characteristics rather then the location of the wetland. This could include several aspects and groupings, such as the vegetation type (GDD, structure, PMT capability, NPP, RH, etc.), the wetland type (peatlands, marshes, flooded forest, saturated soils, etc.), or the soil type (porosity, pH, freezing depth, etc.). This information could either come from observations or from the model, and could be presented in a table. In a second phase the impact on methane emissions could be analysed from these differences and the model equations, and possibly could help to explain why the optimised Q10 is so different for all these sites. Here directly follows my second point: the reader is offered very little information from the underlying IBIS DGVM that defines the structure for the methane module. The soil biogeochemistry and derived carbon fluxes are very important for methane production and should be given a place in this study as well.

Specific:

- TRIPLEX-GHG: What does TRIPLEX-GHG mean? Is it an abbreviation for triple GHG: CO_2, CH_4, N_2O?

- p.5425ff, There might be some updates in the new IPCC report for all places, where you use the Denman et al., 2007 reference.

- p.5426, l.7, also cite Kirschke et al., 2013

- p.5427, l.12, typo, delete "." after Petrescu et al. (2010)

- p.5428, l.13, also cite Stocker et al., 2013

- p.5428, l.26, typo: "a CH_4 emission model"

- p.5429, l.15, Is the C3 plant the only PFT for wetlands? In Fig. 1 it is shown that there is a feedback from the wetland PFTs to the plant physiology, but if only PFT is adapted to inundation there will be no competition between PFTs. Please explain.

- p.5430, l.21, What happens if the soil is partially frozen? Will water add on the top of the freezing depth?

- p.5431, l.9, It was explained that the water table is dividing the soil in an anoxic and an oxic layer. How many layers are considered for the methane module? How deep goes the soil in the model?

- p.5432, eq.(2), Is RH already temperature dependent in the IBIS model? If yes, is this accounted for in the fST factor to prevent double temperature effect for production?

- p.5432, l.7, add "degrees Celsius" to "zero".

- p.5433, l.20, Please mention here that soil pH is prescribed from a map.

- p.5435, eq.(7), Are fST and fEh the same factors, or parametrization, as in eq.(2)? If not, please use a different name.

- p.5437, l.3, Do all wetland PFTs have aerenchyma, or do you simulate plants without, like e.g. sphagnum?

- p.5437, l.15, I understand that you use 30 years of climate repeatingly for spinup, but how long is the spinup period?

- p.5438, l.3, Does your soil carbon data include peat soils with a high porosity? What are the porosity values used at the different sites? For eq.(8) this seems to be an important parameter.

- p.5441-5456: I find it very hard to read through section 4.2, and I suggest to organize that part as mentioned above. A very interesting illustration would be to show methane fluxes for the different transport pathways, or what percentage of the production is oxidized over the course of a year at each site. This could tell us much more about the separation of carbon fluxes during plant production, heterotrophic respiration, methane production, methane oxidation and emission. These numbers would come all differently in relation to each other at the 19 sites, or maybe not!

- p.5448, l.7, Is this a somewhat biased by the fact that most sites lie in the northern hemisphere, or is this generally true for frozen soil conditions?

- Table 3, I find this table of little help, and maybe can be omitted. Are values given as relative changes, e.g. +/-0.05 = +/-50% of 0.2? Please clarify.

- Fig. 3, Please explain units in Y-axis, is it percentage or absolute values? Also give in the caption again that it is the sensitivity index that is shown.

References:

Kirschke, S.; Bousquet, P.; Ciais, P.; Saunois, M.; Canadell, J. G.; Dlugokencky, E. J.; Bergamaschi, P.; Bergmann, D.; Blake, D. R.; Bruhwiler, L.; Cameron-Smith, P.; Castaldi, S.; Chevallier, F.; Feng, L.; Fraser, A.; Heimann, M.; Hodson, E. L.; Houweling, S.; Josse, B.; Fraser, P. J.; Krummel, P. B.; Lamarque, J.-F.; Langenfelds, R. L.; Le Quere, C.; Naik, V.; O'Doherty, S.; Palmer, P. I.; Pison, I.; Plummer, D.; Poulter, B.; Prinn, R. G.; Rigby, M.; Ringeval, B.; Santini, M.; Schmidt, M.; Shindell, D. T.; Simpson, I. J.; Spahni, R.; Steele, L. P.; Strode, S. A.; Sudo, K.; Szopa, S.; van der Werf, G. R.; Voulgarakis, A.; van Weele, M.; Weiss, R. F.; Williams, J. E. & Zeng, G. Three decades of global methane sources and sinks Nature Geosci, Nature Publishing Group, a division of Macmillan Publishers Limited. All Rights Reserved., 2013, 6, 813-823

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

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