Biogeosciences Discuss.,
doi:10.5194/bg-2016-37-RC2, 2016

Biogeosciences
Discussions
Open Access

Interactive comment on "Reviews and syntheses: Four Decades of Modeling Methane Cycling in Terrestrial Ecosystems" *by* X. Xu et al.

Anonymous Referee #2

Received and published: 18 April 2016

Comments on "Reviews and synthesis: Four decades of modeling methane cycling in terrestrial ecosystems" by Xiaofeng Xu et al. submitted to Biogeosciences.

General comments

In this manuscript, the authors reviewed 39 terrestrial methane models and discussed their limitations and future opportunities. This kind of model review has been partly conducted in introduction of model intercomparison project (e.g., WETCHIMP; Melton et al., 2013, Wania et al., 2013), but I agree that this manuscript gives a more thorough overview. The 39 models were classified into several categories (or generations) from the points of processes and complexity. Also, the authors gave good overview of underlying mechanisms of methane production, consumption, and transportation. In the light of its importance as the second important anthropogenic greenhouse gas, this

Printer-friendly version

Discussion paper

manuscript is timely and within the scope of the journal.

The manuscript is fairly prepared, but I have several recommendations. First, I felt redundancies in the manuscript. For example, influential factors of methane processes are similarly listed in Page 5 Line 118 and Page 12 Line 322. I recommend refining the manuscript by reducing redundancies. Second, I recommend giving a broader picture of terrestrial models that include methane processes. The authors mentioned that methane schemes would be implemented into Earth system models (ESMs). Similarly, integrated terrestrial models (other than ESMs) should include methane processes to evaluate e.g. the effect of mitigation practices. Overall, I recommend that the manuscript be worth publication after moderate to major revision.

Specific comments

Page 3 Line 65

This manuscript does not cover several quantitatively important processes such as methane emissions from biomass burning, termites, and ruminants. Please justify here for ignorance of these processes.

Page 5 Line 133

In the 1980s, E. Mattews and I. Fung (1987) achieved a pioneering work in which not only terrestrial but also atmospheric methane dynamics were simulated at the global scale. I think that their work should be mentioned in text.

Page 6 Line 159

In Figure 6 of Wania et al. (2013), estimations of methane production area in the contemporary models are well summarized.

Page 7 Line 190

Can you give several examples for the second group model?

Page 8 Line 193

Can you give several examples for the third group model?

Page 9 Line 233

Can you show the 31 models by adding a column in Table 1?

Page 9 Line 244

“address” should be “addressed”.

Page 10 Line 246 and Table 1

In addition to Ridgwell et al. (1999), several methane oxidation models have been presented and could be mentioned here: e.g., Del Grosso et al. (2000) and Curry (2007).

Page 10 Line 251

Can you indicate a typical value of the contribution of anaerobic methane oxidation in total oxidation?

Page 11 Line 275

In terms of the modeling of vertical profile, parameterization of methane diffusion coefficient within soil is critically important. Do you agree?

Page 13 Line 35

Yvon-Durocher et al. (2014) implied that the temperature response of methane emission would be evaluated using a single consistent model. If correct, the divergence in present models would be largely reduced. Do you agree?

Page 14 Line 356

As long as I know, only a few global dataset of soil pH is available. Also, in situ measurement and model prediction of soil pH are rather difficult. I think these difficulties in using soil pH should be noted.

Page 15 Line 380

It looks wired to give a summary at this place, because it is usually given at the end of the manuscript. Actually, the statements around Page 16 Line 411 are as if your conclusion.

Page 18 Line 460

A few more processes not mentioned here have been presented: e.g., emission from tank bromeliads (Martinson et al., 2010) and emission from small ponds (Holgerson and Raymond, 2016).

Page 19 Line 504

I recommend adding one more (6th?) challenge. Modeling of human-natural processes such as emission from managed ponds and estuaries is important in terms of mitigation. Namely, we should consider both natural biogeochemical processes and human management effects.

Page 21 Line 540

Do you mean "Markov Chain Monte Carlo (MCMC)"?

Page 25 Line 623

Please correct information for Bohn et al. (2015):

Bohn, T. J., Melton, J. R., Ito, A., Kleinen, T., Spahni, R., Stocker, B. D., Zhang, B., Zhu, X., Schroeder, R., Glagorev, M. V., Maksyutov, S., Brovkin, V., Chen, G., Denisov, S. N., Eliseev, A. V., Gallego-Sala, A., McDonald, K. C., Rawlins, M. A., Riley, W. J., Subin, Z. M., Tian, H., Zhuang, Q., and Kaplan, J. O.: WETCHIMP-WSL: Intercomparison of wetland methane emissions over West Siberia, Biogeosciences, 12, 3321–3349, doi: 10.5194/bg-12-3321-2015, 2015.

Figure 4

Can you include the microbial community factor into the figure?

References

Curry, C. L.: Modeling the soil consumption of atmospheric methane at the global scale, Global Biogeochem. Cycles, 21, doi:10.1029/2006GB002818, 2007.

Del Grosso, S. J., Parton, W. J., Mosier, A. R., Ojima, D. S., Potter, C. S., Borken, W., Brumme, R., Butterbach-Bahl, K., Crill, P. M., Dobbie, K., and Smith, K. A.: General CH4 oxidation model and comparisons of CH4 oxidation in natural and managed systems, Global Biogeochem. Cycles, 14, 999-1019, 2000.

Holgerson, M. A., and Raymond, P. A.: Large contribution to inland water CO2 and CH4 emissions from very small ponds, Nature Geoscience, 9, 222–226, doi:10.1038/NGEO2654, 2016.

Martinson, G. O., Werner, F. A., Scherber, C., Conrad, R., Corre, M. D., Flessa, H., Wolf, K., Klose, M., Gradstein, S. R., and Veldkamp, E.: Methane emission from tank bromeliads in neotropical forests, Nature Geoscience, 3, 766–769, doi:10.1038/ngeo980, 2010.

Matthews, E., and Fung, I.: Methane emission from natural wetlands: global distribution, area, and environmental characteristics of sources, Global Biogeochem. Cycles, 1, 61-86, 1987.

Melton, J. R., Wania, R., Hadson, E. L., Poulter, B., Ringeval, B., Spahni, R., Bohn, T., Avis, C. A., Beerling, D. J., Chen, G., Eliseev, A. V., Denisov, S. N., Hopcroft, P. O., Lettenmaier, D. P., Riley, W. J., Singarayer, J. S., Subin, Z. M., Tian, H., Zürcher, S., Brovkin, V., van Bodegom, P. M., Kleinen, T., Yu, Z. C., and Kaplan, J. O.: Present state of global wetland extent and wetland methane modelling: conclusions from a model inter-comparison project (WETCHIMP), Biogeosciences, 10, 753–788, doi:10.5194/bg-10-753-2013, 2013.

Wania, R., Melton, J. R., Hodson, E. L., Poulter, B., Ringeval, B., Spahni, R., Avis, C. A., Chen, G., Eliseev, A. V., Hopcroft, P. O., Riley, W. J., Subin, Z. M., Tian, H., van Bodegom, P. M., Kleinen, T., Yu, Z. C., Singarayer, J. S., Zürcher, S., Lettenmaier, D. P., Beerling, D. J., Denisov, S. N., Prigent, C., Papa, F., and Kaplan, J. O.: Present state of global wetland extent and wetland methane modelling: methodology of a model inter-comparison project (WETCHIMP), Geoscientific Model Development, 6, 617–641, 10.5194/gmd-6-617-2013, 2013.

Interactive comment on Biogeosciences Discuss., doi:10.5194/bg-2016-37, 2016.