Review of Melton et al: Present state of global wetland extent and methane modelling: Conclusions from a model intercomparison project (WETCHIMP).

General.

The WETCHIMP project is a timely model intercomparison project for wetland methane emission models. The article describes the results of the WETCHIMP model experiments. It shows that large discrepancies between model-based wetland CH_4 emission still exist, with a four-fold difference between the lowest and highest estimates.

A disadvantage of the article is that information on model structure of the participating models is lacking. Even a simple table comparing which processes are included in the various models is absent. Instead, much reference is made to an article of Wania et al (2012), which is not yet submitted according to the reference list. This reference should not have been included, as long as it is not accepted for publication.

The outcomes of the sensitivity tests to which the models were subjected (increased CO_2, air temperature and precipitation) are interesting, although the design of the tests raises doubts (e.g. a stepwise increase in CO_2); it should be explained in a better way why the experiments were set up in this way.

Not all models prove to model the same domain consistently. All models have a global domain including the tropics, but one model (LPJ-WhyMe) includes only northern wetlands. It is not clear why this model is restricted to a smaller domain, or why it is included if the domain cannot be extended.

The conclusions of the article are somewhat disappointing. They do not reach any further than the obvious statement that further work on better parameterization and evaluation of the models is necessary. A discussion of possible causes of the wide discrepancies between models is absent. The authors point out the lack of good observation data for model evaluation and the large uncertainty in observation datasets on wetland extent. But a discussion on which components of the model structure and parameterization may influence the large discrepancies between the models is equally important.

Furthermore, throughout the paper there are several inconsistencies, in particular in terminology on wetlands, their definition, vegetation, soil types. These should be corrected.

In any case this paper clearly shows that after some twenty years of research we still do not know much on the most important source of atmospheric methane. This is the true merit of this paper, which should be published with relatively minor revisions.

Detailed remarks.

77-85: I miss here a reference to Petrescu et al (2008), who first demonstrated the large variability in CH_4 model outcomes related to wetland area.

96: Wania et al (2012) is not yet published, not even submitted. This reference should not be used. Moreover, even if it was published, it would be very convenient for the readers if the essential differences in methodology and model structure were listed here, e.g. as a table.

115: ‘Mineral wetlands are dominated by vascular plants that facilitate CH_4 transport through their

roots …. Unlikely. Aerenchymous wetland plants are not restricted to wet mineral soils but also occur abundantly on peat soils.

123: The wet mineral soils simulated by LPJ-Bern are not mineral soils according to your wetland definition. However, the wetland definition in 110-113 includes 'mineral wetlands'. This is confusing, give a better explanation why the LPJ-Bern mineral soils are excluded from wetlands.

130-134: Like in the previous comment, this paragraph illustrates again that the distinction between wetland and non-wetland is quite artificial. From a modellers perspective it would be quite logical to consider any soil that is water-saturated or flooded most of the time as a wetland.

180: See my remark with line 96: the references to Wania et al (2012) should be replaced by an adequate summary of the main structural differences between the models. The summary in line 163-180 is very general and hardly gives information on individual models. Table 1 only refers to the parameterization of wetland area.

194-195 Although the CO_2 increase experiment proved to be quite useful, the instantaneous increase of CO_2 prom present-day values to 857 ppm is an unrealistic approach. Explain here why this approach was chosen instead of a more gradual increase.

204-208 Here is admitted that the step changes are unrealistic. However, although it is stated that this is 'suitable for the purpose of the sensitivity test' no really good arguments are given. The last part in this long sentence, on the use of the R statistical package, seems misplaced here. Line 194-208 should be rewritten, providing a better argumentation for the stepwise changes in the sensitivity tests.

Table 2: According to this table the LPJ-WhyMe only considers northern peatlands. What is the use of including this model, when the other models do global simulations? Could the model domain not be extended? Give good arguments why the model is included despite its restricted domain.

445 why does this affect primarily the tropical wetlands?

479-480 This is awkward – determining peatland extent based on CH_4 emissions. Here also the terms 'peatland' and 'wetland' are probably confused. Please clarify.

690-692: Normalizing with respect to what? Please clarify.

779-783: Here the lack of information on model structure becomes crucial. I miss an explanation why the wetland extent increases. Is this an effect of increased water use efficiency at higher CO2 levels that decreases evaporation, or other causes? How do the models differ in this respect? Some models show a quite strong response in figure 9!

803-807: Again, a table comparing model structure and methods would have been very useful here.

977-980: An interesting conclusion that the models behave better for the northern latitudes. A bit speculative: could it be that most models have been specifically designed for northern latitudes – and have been tested on higher latitude data?

1018-1027: I agree that more testing should be done and better data should be available, but I would have expected something more substantial in this conclusion section. The important question is, how good is the structure of these models? What elements may be missing? In line 1015, this is touched upon only briefly, by mentioning nutrient limitations, but there could be more. For instance

how spatial spatial heterogeneity of natural wetlands is included in the models – if included at all. Exploring model structure and method effects could make the conclusion section – and the article – more interesting to read.

Minor remarks, grammar, style, typo's

In line 96 please delete 'please'

403: Put 'however' at the start of the sentence.

527: 'niether' = neither

576: after 'reason' add 'that'

Figure 6: the grey dashed lines are hardly visible

Figure 8: The legend appears incomplete. What do the colours represent exactly?

Evaluation Criteria:

1. Does the paper address relevant scientific questions within the scope of BG? *Yes*
2. Does the paper present novel concepts, ideas, tools, or data? *Yes*
3. Are substantial conclusions reached? *Could be improved – see remarks*
4. Are the scientific methods and assumptions valid and clearly outlined? *Minor improvement needed, see remarks*
5. Are the results sufficient to support the interpretations and conclusions? *Yes*
6. Is the description of experiments and calculations sufficiently complete and precise to allow their reproduction by fellow scientists (traceability of results)? *Minor improvement needed see remarks*
7. Do the authors give proper credit to related work and clearly indicate their own new/original contribution? *Section on previous misses an important reference*
8. Does the title clearly reflect the contents of the paper? *Yes*
9. Does the abstract provide a concise and complete summary? *Yes*
10. Is the overall presentation well structured and clear? *Yes*
11. Is the language fluent and precise? *Yes*
12. Are mathematical formulae, symbols, abbreviations, and units correctly defined and used? *Yes*
13. Should any parts of the paper (text, formulae, figures, tables) be clarified, reduced, combined, or eliminated? *See remarks*
14. Are the number and quality of references appropriate? *See remarks*
15. Is the amount and quality of supplementary material appropriate? *No, see remarks; information on participating models is very limited*