

Interactive
Comment

Interactive comment on “Quantifying wetland methane emissions with process-based models of different complexities” by J. Tang et al.

Anonymous Referee #2

Received and published: 21 October 2010

1. General Comments – an assessment of the overall quality of the discussion paper
TEM CH₄-submodel configurations of increasing complexity are described and compared with experimental CH₄ observations at two sites. A complex, four-substance model is developed, as well as a novel ebullition algorithm that allows ebullition events in response to atmospheric pressure variations to be captured in a physically realistic way. This is work that will be of great interest to modelers and experimentalists alike.

The authors addressed most (though not all – see below) of the initial concerns about the manuscript that I raised in the initial Quick Access Review. The paper is now much easier to read, and the figures are easier to interpret.

I recommend that this interesting paper be published subject to the authors replying

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satisfactorily to the issues I raise below, as well as other issues or questions that may have arisen in the interactive online discussion.

2. Specific Comments – a discussion of individual scientific questions/issues

My main concern with that paper concerns the comparison between models, S1, S2 and S4. I would like to see an explicit defence of the method used, and the conclusions that can legitimately be drawn, in particular in regard to the following two issues:

First, as I noted previously, I think it's hard to compare the performance of the models when they have different (calibrated) parameter values – see Tables 1 and 3. Having different parameters is unavoidable when comparing different models, but for a site-specific, model comparison study such as this one it would have helped to see the differences between models if they had the same, shared parameter values, at least for each individual site.

Furthermore, the same model can also have different parameter values depending on whether a linear or exponential root distribution is assumed (Table 3). This makes it hard to tell whether the results discussed in Section 3.4 depend on the root distribution or on the parameter values chosen. Please defend, explain or justify this approach in the text.

Second, though I really like the ebullition algorithm the authors have developed, I do not think it is possible to draw firm conclusions regarding the improvements it brings using the results of the modelling experiments presented in the paper. This is a shame, because it's novel and interesting. What it needs, in my opinion, is a direct comparison between S4 and a simpler four-substance S4-like model that uses the same, fixed CH₄ and O₂ concentration thresholds as S2 to calculate ebullition fluxes. The benefits of the novel algorithm would then be easier to distinguish and defend.

Finally, could the authors consider or discuss how the S4 model could be applied to “quantify global wetland CH₄ emissions,” as stated in the Abstract? Parameters are

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site-specific, so how can this be addressed? NPP, vegetation type, pressure, water table and soil temperature inputs are also required.

3. Technical Corrections

Units: The table on page 6146 with symbols and definitions should have an additional column for units to make it easier to read. However, a more serious point is the fact that there seem to be differences between the units given in the main text and those given in this table. For example, on page 6125, the units for $y_{i,w}$ and $y_{i,a}$ do not match those in the table. See also page 6127, when the Michaelis-Menten constants are discussed.

Page, Line - Comment

6123, 2 - Contributes to ...

6123, 7 - Inverse modelling reference needed, e.g. Bousquet et al.

6123, 14 - Process-based models, not "The proc. . ."

6123, 16 - In these models, ...

6125, 1 - Is one reference sufficient here?

6126, 5 - Explain volatiles in this context

6129, lines 10-20 - A simple Figure illustrating the bubbling criterion would be really nice in the paper. Something showing a soil profile, the water table, bubbles etc.

6129, 15 - Explain the theta terms in eqn (15) here too

6130, 25 - I think that the choice of "Z" as the soil depth is confusing, and easy to confuse with the variable "z". How about "Zsoil" or something similar?

6133, 14 - Explain "trial and error".

6135, title - "nobservations" !

6136, 24 - Remove "sort of"

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6137, 8-11 - Could show in an Appendix, perhaps, as this is interesting

6138, 12 - Reference needed!

6145, 16 - “in” that we here ...

6146 - Soil “moisture”

6156 - In “the” S4 model ...

6160 - “The” same time series ...

6161-6162 - Figures 6a2, 6b2 6c2 & 6d3: Where is the “Total” output here?

6165 - Could put arrows on the Figure (between the applied WT change and the main emissions) to show clearly the delayed emission, perhaps.

Section 2.5: Explain the choice of the days for both water table and pressure increases and decreases.

4. BG 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? PARTLY 4. Are the scientific methods and assumptions valid and clearly outlined? YES 5. Are the results sufficient to support the interpretations and conclusions? PARTLY 6. Is the description of experiments and calculations sufficiently complete and precise to allow their reproduction by fellow scientists (traceability of results)? YES 7. Do the authors give proper credit to related work and clearly indicate their own new/original contribution? YES 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? PARTLY 13. Should any parts of the paper (text, formulae, figures, tables) be clarified, reduced, combined, or eliminated? NO 14. Are

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the number and quality of references appropriate? YES 15. Is the amount and quality of supplementary material appropriate? N/A

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