

## ***Interactive comment on “Implementation and evaluation of a new methane model within a dynamic global vegetation model: LPJ-WHyMe v1.3” by R. Wania et al.***

**Anonymous Referee #2**

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The authors have tackled a very difficult but important topic in global ecology and climate science, and should be applauded. The study presents a novel mechanistic model for global methane emissions from wetlands and is quite different from those earlier published global models. This more mechanistic and ecological approach is certainly an interesting avenue to pursue. I very much enjoyed reviewing this comprehensive study. I would recommend publication after the following comments regarding the manuscript and its structure are adequately addressed. Main issues: 1) The structure is confusing with multiple methods and discussion sections. The manuscript would benefit from a simpler structure with one methods section, one results, followed by discussion and conclusions. 2) Sensitivity tests I and II are very confusing. Sensitivity II

C60

is in fact more like a fitting exercise; perhaps this should be named as such, i.e. Parameter Sensitivity, Parameter fitting and site evaluation, and circumpolar application. Sensitivity test II is used to derive the best guess of parameters – I see no statistics to base this selection. Also where does  $fexu=0.175$  come from? It's not in the combination of tests. 3) In general the manuscript is long and would benefit from shortening; removing repetition and using more concise sentences in places. Minor comments: Abstract – “choice of parameter VALUES”. - “ A comparison of model results to ...” sentence too vague, please expand. Introduction - Switch between northern peatlands and northern wetlands, be consistent, . - End of first paragraph “future may be both +ve and -ve feedbacks” – need a citation for this statement Section 2.1 - How many PFTs are there in the model? (i.e. adding an extra 2 to many or few) - “PFTs thus function differently under different environmental conditions ...” –simplistic wording. Section 2.2 - “dissolved methane can be transported to the atmosphere ... or through plant tissue (aeremchyma)” – Dissolved or Gaseous transport through plant tissue; seems like it's gaseous (section 2.6) - “The acrotelm (i.e. the top 0.3m) ...” – is this fixed constant at 0.3m in the model? I would assume it varies at location depending on the water table (e.g. Figure 3). Please clarify. Section 2,3 - Show equation for the Wania scheme somewhere in the paragraph; why write out Seger's at the end of the paragraph? Section 2.4 - Where did this 25% come from? Is there a reference. Isn't this really a result of the fitting (best guess), and should appear first in the results section. Section 2.5 - Could be shortened. Fick's law not used so doesn't need to be presented in such detail, i.e. this is not a review paper. - Fitting third order polynomials / quadratic curves to observations etc, there should be some statistics on the fits included (likewise section 2.7.1). Section 2.6 - Contribution of Forb NPP small compared to graminoids – citation required for that statement. Section 3.3 - It should be clear that these are results from Wania et al., 2009b. The final sentence in the second paragraph should come early on, otherwise the reader is under the impression these are results from the current study. Section 4, Sensitivity test I Section 4.1 Method, Section 4.2 Results and discussion – see main issue #1 Section 4.1 “... eight parameters, assessed as

C61

being the most uncertain and potentially having the most influence on methane emissions” How was this “assessed” ? - “Plant –mediated transport increases least WITH INCREASING CH<sub>4</sub>/CO<sub>2</sub> ratio, . . .” Section 4.3 “conclusions” - see main issue #1 - “Experimental studies . . . show good agreement with our choice of parameter value” – earlier you state it varies from 0.001 to 1.7 (Segers, 1998); it’s not difficult to fit in the range? Section 5.1 – Sensitivity test I is actually almost a subset of sensitivity test II, either combine in one section, or have one as sensitivity test the other fitting procedure - “Best guess . . . chosen subjectively, based on visual comparison . . .” – this should be based on statistics. Section 4.3 Conclusions followed by 5.1 methods & 5.2 Results and discussion – see main issue #1 Section 5.2 be upfront and say the model performs badly for Michigan. - Maybe there should be a few general statements about the overall model performance, e.g. generally, the model doesn’t capture the peak emissions at 5 out of seven sites, why? Interesting, several sites have an early summer dip in emissions, linked to drop in water table position, i.e. identifies an issue with the model’s water balance,. - Degero; no point comparing apples with oranges. Perhaps one should show the simulated diffuse plus plant-mediated against observed, and state in the caption you’ve done this. - Table 5 comparison model with observations misleading. Gives the impression the model is not in the range of observations at 4 out of 6 sites where data is available. The model should be compared over the same periods as the observation data, i.e. is the model in the range or not? - Abisko data is from a flux tower on discontinuous permafrost – could the heterogeneity of the fetch area cause the model-data mismatch? Section 6.1 “Methods” again Section 8 Conclusions – first paragraph discussion on using monthly climatology being a limiting factor, and greater temporal fidelity would be preferable. Therefore WhyMe would be suitable for coupling to climate models; this could be mentioned.

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