

Interactive comment on “Annual variation of methane emissions from forested bogs in West Siberia (2005–2009): a case of high CH₄ and precipitation rate in the summer of 2007” by M. Sasakawa et al.

Anonymous Referee #3

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General

Since decades scientists have been interested in the topic of wetland CH₄ emissions. The multitude of wetland types and their complexity makes it sometimes difficult to account for all CH₄ sources, their importance and role in the total global budget. It is very important to understand the processes and factors influencing the emissions.

The paper written by M. Sasakawa et al. combines both measurements and modelling of CH₄ emissions from two sites in West Siberia. It stresses the influence of high pre-

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cipitation rate on CH₄ fluxes. This topic has been covered in other studies as high precipitation causing high water table levels is followed by high CH₄ fluxes, especially in summer months (July-August) when ebullition peaks occur. These peaks are very difficult to predict and quantify. I only agree with the first referee on the sparse availability of data from this region but I cannot say that this paper is novel or presents original methodology.

The authors have five year continuous summer flux observations for CH₄ and CO₂. Due to the very high spatial and temporal variability of CH₄ emissions five years are not enough to conclude that CH₄ and CO₂ patterns are similar for all bogs/wetlands at regional or global scale. The fact that 2007 was an anomalous year for the emissions cannot draw the conclusion that CH₄ emissions are increasing or decreasing nor extrapolating these results over Siberian territory. I would recommend that this paper should only present this case study by means of measurements and modelling without conclusions or extrapolations at regional/global level. Same as Referee #2 I would like to see more discussion on other years, preferably comparisons with other studies.

When reading the paper I was very surprised by the modelling approach and tools the authors used. Few months ago a paper published by AMR Petrescu et al. in *Global Biogeochemical Cycles* had similar structure and methods. Petrescu et al 2010 used a CH₄ process based model based on Walter and Heimann 2000 coupled with a global hydrological model to calculate global hemispheric CH₄ emissions from northern wetlands. They also used Prigent et al., 2007 climatology and Lehner and Döll 2004 – GLWD data set. They also made a comparison with CH₄ emissions from Matthews and Fung 1987 while you used GISS (Fung 1991).

My question to Sasakawa et al. is: why did you choose similar/same products and why there is no reference to that paper? I do not say it is wrong using same products but I would like to know if it was just a coincidence or were strong scientific reasons to choose them.

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I will recommend this paper for publication only if the authors will accommodate all the questions and changes including the useful comments of Referee #2 with which I fully agree in terms of major changes, English and specific comments but less with paper being original.

Specific comments

Please be consistent with using CH₄ / methane.

Abstract

The abstract does not have a clear structure besides presenting the measurements and methodology. A last paragraph is needed to conclude the main findings and draw a line to this scientific attempt.

Introduction

It is well written but a little poor in references. There are a lot of studies published on CH₄ emissions from northern wetlands and their variability and patterns. Also the link to precipitation/water table and temperature should be more discussed. There are at least 3 other sites with active measurements over Siberian area which can be mentioned in the introduction and the results can be compared when interpreting the current work.

Method Site description

I think a separate figure for site description is needed. Now it is included in Figure 1. If another figure cannot be added please add to Figure 1 caption the tower coordinates. The Figure needs an explanation about the wetland fraction: e.g. the pixels with 100% wetland fraction (red) are the same for all five years or this map shows the mean for 2005-2009? Which months/years are represented in this figure? If you say you used Prigent climatology why didn't you compute such a map for each study year? Please explain!

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Ecosystem model

Perhaps the authors can be more detailed in explaining how this VISIT model works. Which are the water cycle components (how is hydrology represented/simulated by the model) and how the split between flooded non-flooded cells was done? Please add the reference for VISIT model first time when it appears in the text, page 27762 line 9.

I read the description of VISIT model by Inatomi et al., 2010 and I did not find anywhere the Walter and Heimann reference for CH₄ flux calculations. You also mention the soil stratification in 20 layers each 5 cm thick. Please explain how this was made or where did you took it from. Walter and Heimann uses one dimensional soil column divided into 1 cm thick parallel layer. In order to provide a better picture for the VISIT model I suggest adding a brief diagram of the processes used in your study.

Please provide a more detailed explanation on how you used the Prigent et al., 2007 climatology and GLWD to calculate the flooded non-flooded fractions.

What assumption are you using when you state in the last sentence of the abstract that: "the area flooded (corr.: the flooded area) with water (self explanatory) is proportional to the cumulative anomaly in monthly precipitation rate" what is the anomaly? Also, what is the base line inundation fraction? Page 27764 lines 1-15: please rephrase!

Results and discussions

It is a bit confusing for me when reading this paper what model was used and when and compared with what. In results section the GISS model appears and I would suggest presenting it in the methodology section as a tool used for comparison; same for GPCP.

Page 27766-27767: you mention that CH₄ fluxes are high in July and you relate this to hot summers. Please explain why is this happening, why small water bodies act as significant source of CH₄ and are higher in July than other months...which are the processes behind, reference this, there's plenty of material available on this topic. Why elevated water table levels lead to increased CH₄ fluxes?

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Conclusions

You present total numbers for the CH₄ emissions in Tg yr⁻¹. Please explain if these are mean annual or totals and how these were calculated.

Figures: I agree with Referee #2 that the unit for presenting the results should be only mg CH₄ m⁻² d⁻¹. It is confusing having it mg CH₄ m⁻² h⁻¹ or even ppm, ppb when the text has different units.

Concluding remarks

Please check the English, I am not a native speaker but improvements can be made! Overall the paper is a little confusing; authors should make very clear distinctions between what methods they used, present clear results and draw conclusions.

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 27759, 2010.