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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Annual variation of methane emissions from forested bogs in West Siberia (2005–2009): a case of high CH_4 and precipitation rate in the summer of 2007" *by* M. Sasakawa et al.

Anonymous Referee #4

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Review of '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', M. Sasakawa, A. Ito, T. Machida, N. Tsuda, Y. Niwa, D. Davydov, A. Fofonov, and M. Arshinov

General comments.

This paper presents CO2 and CH4 flux estimates from bogs in western Siberia, based on data from two tall towers. The estimates include the year 2007; during that year

high atmospheric CH4 concentrations were observed from space-borne observations. These have been attributed to wet and warm conditions over Eastern Eurasia. This paper confirms this inferred link with ground-based data, and represents one of the very few ground-based observation data sets from the Siberian landmass in 2007.

Given the very small number of flux observation stations in the area, these flux estimates are highly relevant to understanding northern latitude wetland methane fluxes. The authors derive the CH4 flux from the ratio between nighttime accumulation of CO2 and CH4, in combination with modeling of the CO2 and CH4 fluxes.

Although the methodology is valid for a first estimate of fluxes, it builds mainly on the profile measurements in the tower. Surface flux measurements, that would help to constrain the modeled fluxes, appear to be absent. Also, it builds partly on the assumption that diurnal variation of CH4 fluxes is negligible. The modeling work could have been described more precisely. I miss essential information on model parameters. Also, the modeling work could have benefited from adding better hydrological modeling; the water table input to the model is a rough estimation at best.

Considering importance of these observation data, I suggest publication after major revision. In particular the water table input to the CH4 emission model should be reconsidered.

Specific comments.

Abstract: An abstract should contain concise information on the contents of the article and invite the reader to continue reading the article. This abstract is not very inviting because of its writing style. Remove abbreviations and detailed research project and location data; these belong in the introductory sections of the article. When a sentence covers more than two lines, it is too long.

p. 27762 line 6: What is meant with a 'semi-climatological CO2 flux'? Please explain. line 20: Give more explanation on the CH4 semiconductor sensor. Reference to an

ACPD

10, C13190–C13193, 2011

article is not sufficient here; the reader should know basic information, at least on the measurement principles, manufacturer and precision of the instrument.

p. 27763 line 8: More explanation is needed on the CASA model. Why was this rather old model used here? line 9: which variability is referred to here? line 24: The GLWD has various resolutions, which one was used? Also, wetland extent may differ among wetland databases and models, see Petrescu et al., 2010.

p. 27764 line 0-5 For estimation of the inundation fraction the data of Prigent et al., 2007 are used. However, considerable processing of the data is included which is not properly clarified in the text. Explain: what is considered as unrealistic monthly fluctuation, what is the baseline inundation fraction and how is it derived. Also the average water tables that are selected on the basis of these data are quite arbitrary: 0 cm for inundated, -25 cm for drained. These choices should be explained, and their effects on flux modelling assessed. CH4 fluxes measured in the field, and in the model which is used here (Walter-Heimann) are highly sensitive to water table fluctuations in the range of 0 to -25 cm. So selecting arbitrary values has large effects on methane flux estimations. It would have been better to use a hydrological model, as is done by e.g. Yurova et al, (J. Geophys. Research 112, G02025, 13 PP., 2007), Petrescu et al (Global Biogeochemical Cycles, doi:10.1029/2009GB003610, 2010). line 14-15 The Walter Heimann model needs tuning of some of its parameters on observation data, and should be applied cautiously for upscaling (see e.g. Van Huissteden et al., Biogeosciences, 2010). Where there any site flux observation data on which the model could be tuned? Please specify your choices for the parameter values, in particular the parameters that affect methane generation, transport and oxidation rate during transport. line 23-26 You cannot ignore completely the diurnal variation of CH4 emission. Several recent studies of wetland CH4 emission using eddy covariance show a clear diurnal emission regime. You should consider how this may affect your emission estimates.

p. 27765 'Figure 2 does not indicate any clear increase in the nighttime CO2 concentration while the daytime CO2 concentration from 2005 to 2009 shows a general

ACPD

10, C13190–C13193, 2011

Interactive Comment

increase': This is difficult to read from the figure. This may be solved by adding an extra figure showing the maximum nighttime fluxes and minimum daytime fluxes plotted against year.

p. 27766 Line 7: You state that remarkably high $\Delta CH4/\Delta CO2$ ratios were observed in August 2009. Can this also be attributed to weather conditions? Line 13-14: Why is the source area for the emissions rectangular? I would not expect the footprint area of the towers to be rectangular.

p. 27767 line 5-19: I miss flux data measured by Repo et al (Tellus, DOI: 10.1111/j.1600-0889.2007.00301.x, 2007)

p. 27768 line 13-14: 'In which the dimension of the flooded area was assumed to expand proportionally to the monthly precipitation anomaly rates': here, the accuracy of the model input is strongly overstated. In section 2.3, the flooded area is derived from Prigent et al., 2007, with strongly simplified assumptions on the water table! line 20: Here, low and high response cases are introduced without any further explanation. How are the low and high response cases defined in terms of the model parameters? Describe these high and low response cases.

Supplement: I wonder why this figure is not included in the paper. It makes no sense to add supplemental information for just one figure. I suggest to use the supplement for adding information on the models.

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