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## ***Interactive comment on “Attribution of spatial and temporal variations in terrestrial methane flux over North America” by X. F. Xu et al.***

### **Anonymous Referee #2**

Received and published: 16 September 2010

This study addresses the sensitivity and variability of CH<sub>4</sub> emissions over the last 30 years in North America. The authors did an extensive analysis of factors that impact local and continental scale CH<sub>4</sub> fluxes. They find that climate change is the dominant cause for increased CH<sub>4</sub> emissions and variability. Additional to emissions, they also derive estimates of total soil uptake which is also an important aspect of this study. Assessments of the biogeochemical processes on large scales as presented here are an important contribution to climate science and policy. The presented ecosystem model is an adequate tool for the CH<sub>4</sub> flux simulations. The manuscript therefore deserves being published. However, the exact reasons for the dominant impact of climate remain elusive, which could be improved in a revised version. Further I suggest to reorganise the manuscript for better readability and additional clarifications.

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## Climate Impact - Experimental design

As far as I understood ~90% of the cumulative CH<sub>4</sub> emission increase over the years 1979-2008 years are caused by the impact of direct climate change. This directly raises the question about initialisation of the simulations: which parts of the model, e.g. carbon pools or vegetation are in equilibrium at the beginning of the analysis period in 1979, which are not? In reality probably most processes underly a trend during the 20th century. Please clarify your description of the different model setup steps. In addition which process in the model is mostly affected by a long term trend?

### High-latitude sensitivity

In chapter 4.5 (p. 5404) missing processes are described legitimately. An important process in my opinion is the thaw-freezing cycle and interaction of biogeochemistry with hydrology in high latitudes. How is soil temperature calculated in the model? Since this is a very important parameter that affects all CH<sub>4</sub> relevant processes in wetlands/peatlands in Canada and the US, it should be mentioned additionally to the reference of the model paper. Its importance is highlighted even more by the fact, that wetlands/peatlands have the highest CH<sub>4</sub> emissions overall (Figs. 3, 4). Additionally, the wetland/peatland extent directly affects interannual variability of these high emission regions. Is this captured by the model in addition to the change in soil moisture content?

### General comments/suggestions

The readability of the paper would greatly benefit if all the detailed emission numbers would be restricted to tables. Paragraphs discussion the impact on continental scale and country scale could be merged, not deleted, to reduce the repetition of similar phrases. On the other hand the conclusion paragraph could be expanded with explanations of why some processes increased CH<sub>4</sub> emissions in the model, e.g. the interaction of processes.

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## Specific comments/suggestions

Page 5390, please give references for data sets in addition to web addresses.

p. 5392, Why are 3000 years of spinup needed for cropland and urban areas implementation? Vegetation normally recycles about every 100 years. Is it because of slower carbon pools? Please give an explanation.

p. 5395, line 9, "... study period, 'a' significantly ..."

p. 5398, line 13, "... is 'an important attribute' of ecosystem ..." line 14, "Inter-annual 'variability' in ..." line 17, reference to Fig. 9 appears before Fig. 7 and 8 are mentioned, figures should be relabelled or rearranged accordingly. Additionally, references to Fig. 2 and Fig. 8 are missing.

On p. 5403, line 10 ff. it is speculated that the increased temperature impacts DOC in Canada. Does the model show the DOC increase? line 24, delete "As reported that"

## Figures

Delete Fig. 2 as it shows little more than trends which are already given in Table 1

Caption of Fig. 3: move units directly after the labelling instead of giving it in a bracket at the end

Fig. 4 & 6: remove the scale and the direction of North, everybody knows the dimensions of NA. Instead increase the color bar labels.

Fig. 5: It would greatly help to compare the different CH<sub>4</sub> fluxes if they were on a common scale, maybe with different colors.

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Interactive comment on Biogeosciences Discuss., 7, 5383, 2010.

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