Biogeosciences Discuss., 7, C3185–C3189, 2010
www.biogeosciences-discuss.net/7/C3185/2010/

Biogeosciences Discussions

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

X. F. Xu et al.

tianhan@auburn.edu

Received and published: 7 October 2010

This study addresses the sensitivity and variability of CH4 emissions over the last 30 years in North America. The authors did an extensive analysis of factors that impact local and continental scale CH4 fluxes. They find that climate change is the dominant cause for increased CH4 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 CH4 flux simulations. The manuscript therefore deserves beeing 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 reorganize the manuscript for better readability and additional clarifications.

[Response: Thanks for the positive comments; we have revised the manuscript to improve its readability and clarify some parts pointed out by the reviewer.]

Climate Impact - Experimental design As far as I understood _90% of the cumulative CH4 emission increase over the years 1979-2008 years are caused by the impact of direct climate change. This directly raises the question about initialization 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 underlie 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?

[Response: As pointed out by the reviewer, we acknowledged that the initialization of the model is really important for model simulation. So we adopted the commonly used methods in modeling field; that is, we run the model to equilibrium state in 1900 with carbon storage is relatively consistent, and run model in transient mode for the time period of 1901-2008. The analysis was conducted focusing 1979-2008. Since 1979, all the carbon fluxes and storage is not in equilibrium state. This makes the simulation closer to the reality.]

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 CH4 relevant processes in wetlands/peat lands 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 CH4 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

BGD

7, C3185–C3189, 2010

moisture content?

[Response: The thaw-freezing cycle was not directly incorporated in our current model; it was simulated by its impacts on soil temperature. Soil temperature is calculated by soil properties and air temperature. In this study, the wetland extent is fixed since we used the vegetation map, wetland area will be changed only in conversion with cropland and urban.]

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 CH4 emissions in the model, e.g. the interaction of processes.

[Response: We have heavily revised these sections; the exact numbers will be referred to tables. The major numbers were pointed out in the text.]

Specific comments/suggestions Page 5390, please give references for data sets in addition to web adresses.

[Response: We have added the reference; thanks.]

p. 5392, why are 3000 years of spin-up 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.

[Response: We chose 3000 year spin-up is to minimum the influences from land use change. For example, the wetland conversion to crop; since the soil carbon in natural wetland is relative high, while is quite low in cropland. So it needs thousands of years to drive model to equilibrium for further cropland simulations.]

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

BGD

7, C3185–C3189, 2010

[Response: We have revised these sentences; thanks.]

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 relabeled or rearranged accordingly. Additionally, references to Fig. 2 and Fig. 8 are missing.

[Response: We have double checked the figure reference in the text and the order of figures. Now they are arranged in order. The missing references to figures have been added, thanks.]

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"

[Response: We did observe the increases in DOC in response to temperature increase at the site-level simulation. Meanwhile, we revised and deleted the sentence as suggested by the reviewer.]

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

[Response: We have deleted the Fig 2. Thanks for the comments.]

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

[Response: We have revised the caption of Fig 3; thanks.]

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

[Response: As two of the components for standard spatial map, we would keep them on the map. thanks for the comments.]

Fig. 5: It would greatly help to compare the different CH4 fluxes if they were on a

BGD

7, C3185–C3189, 2010

common scale, maybe with different colors.

[Response: Since SEVEN lines were shown to indicate the CH4 fluxes caused by global change factors, putting them together will mess up the figure. Meanwhile, the major purpose of this figure is to show the changes of the fluxes over study period, rather than comparing them. So we still keep it as it was.]

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