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***Interactive comment on “TransCom model simulations of CH<sub>4</sub> and related species: linking transport, surface flux and chemical loss with CH<sub>4</sub> variability in the troposphere and lower stratosphere” by P. K. Patra et al.***

**Anonymous Referee #2**

Received and published: 12 September 2011

GENERAL COMMENTS

This manuscript describes the findings from the recent TransCom model intercomparison effort, and specifically the analysis of the role of emissions, transport and chemical processing in driving global CH<sub>4</sub> distribution and changes. The methodology followed is sound and the results of the analysis are interesting and useful for future discussions on CH<sub>4</sub>-related topics. The manuscript is certainly well suited for publication on Atmospheric Chemistry and Physics, although I would like to see the following general changes being made, as I believe they will improve the manuscript significantly:

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First, I feel that the discussion on OH is, in general, more limited than it should be. In particular, there is not as much discussion as I would expect regarding the runs that used an alternative OH distribution (e.g. how different the OH distribution is and why; how these differences link to features of the simulated CH<sub>4</sub> and CH<sub>3</sub>CCl<sub>3</sub>), and there is not any discussion as to how the results might differ if the assumed OH distributions were different.

Furthermore, there are some parts of the manuscript where the messages are not clear, due to the sentences being too long and/or confusing. I include comments below which I believe will improve this aspect of the manuscript, and will eliminate some typos and minor issues that I encountered.

## SPECIFIC COMMENTS

### Abstract

You mention that up to 60% of the variability is explained by variations in biomass burning and wetland emissions. The reader does not encounter a part of the analysis clearly demonstrating that.

### Section 1

Page 18770, Line 15: Please change “past few years” to “past two decades”.

Page 18770, Line 24: Please change yr1 to yr-1.

Page 18771, Lines 14-17: The reference to Shindell et al. (2009) is important, but this sentence is confusing as it does not exactly reflect the findings of this study (26% is the reduction of OH due to CH<sub>4</sub> emissions, while 40% is the change in CH<sub>4</sub> GWP due to the inclusion of oxidant-aerosol interactions). Please rephrase.

Page 18772, Line 13: Please add “,” before “on CH<sub>4</sub>”.

### Section 2

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Page 18772, Line 22: Referring to the model as “Chemical-transport” rather than “Transport” sounds more accurate. Perhaps it should be changed throughout the text.

Fig. 1: It would make more sense to write “CH<sub>4</sub> emission” rather than “CH<sub>4</sub> flux” in the green box, since “flux” can include other aspects (e.g. chemistry), and since “emission” is used as a term for CH<sub>3</sub>CCl<sub>3</sub>, Radon and SF<sub>6</sub> in this figure anyway. Also, I am not sure if “soil sink” should be included in this box, since it is already in the pink box, on the right.

Page 18773, Lines 14-16: It will not be clear to all the readers how these stratospheric processes are treated. In particular, where do O<sub>1</sub>D and Cl concentrations come from? Are they tabulated numbers coming from the Cambridge 2D model, which are then read-in and multiplied with the k values of the reactions? Also, maybe OH was not meant to be in line 14 (as you have already explained above how OH is handled)?

Page 18774, Line 1: Please specify that NH and SH stand for northern hemisphere and southern hemisphere, since it is the first time that they are being used.

Page 18774, Line 7: Please add “and interpolated on each model’s grid” after “ACTM (Patra et al., 2009a)”, in order for the reader to understand what “interpolated” mean in line 12. Also, please add a full stop before “Because”.

Page 18774, Lines 13-15: Please remove parenthesis from the sentence starting with “Similarly”, since this statement is fairly important.

Page 18774, Line 17: Please rephrase to “. . .are provided by Krol et al.”. . .

Fig. 2: Apparently the authors have chosen 1997-99 as an example period to demonstrate seasonality in emissions. It would be good to state this (i.e. that this is an example period) or, alternatively, show and average seasonal cycle from all years. Also, please change “flux” to “emission” in the figure caption, since “flux” could also imply other aspects (e.g. chemistry-related). Finally, note that there is no black line in this figure.

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Page 18775, Line 15: Please change the sentence to read like “The following source and sink components of CH<sub>4</sub> were considered in the six different experiments listed in Table 1:”

Table 1: I do not agree with the term “tracers” being used here. It would be clearer if you name them “experiments” or “scenarios”, not just here, but throughout the manuscript. Also, Table 1 is central to the paper, but the “DESCRIPTION” column is a bit hard to follow. I would suggest that the abbreviated terms that are being used should be explained in the caption. Some of them may have already been explained in Section 2.2, but the descriptions are scattered and not easy to pick from there.

Page 18775, Line 16: Please change to “. . .(IAV ANT), based on. . .”, since the way it is, it may seem to the reader that these emissions are used for all the experiments.

Page 18775, Line 21: Please change to “Anthropogenic emissions (IAV ANT E4), based on a more advanced EDGAR. . .”

Page 18775, Line 26: Similarly to above, please change to “and termites, based on. . .”

Page 18776, Line 2: Please remove “the” and “are”.

Page 18776, Line 25: Please remove “that”.

Page 18776, Line 26: “CYC BB” has not been defined.

Page 18777, Line 21: Please delete “to be”.

Page 18778, Line 12: Please separate “variedfrom”.

Page 18778, Line 15: Please change “linked” to “link”.

Page 18779, Lines 3-6: Please split and rephrase this sentence, as it is a bit too long and hard to follow.

Page 18780, Line 21: Please change “model” to “modeled”.

Page 18781, Line 13-15: I suggest that the contents of the parenthesis are made a

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separate sentence.

### Section 3

Fig.3: Please indicate the units of pressure on the left side of the actual figure. Also, please indicate in the caption to which model run these results correspond.

Page 18782, Line 16: Please add “more” before “leaky”.

Page 18783, Line 22: Please add “(not shown)” after “sites”.

Fig. 4: Please change caption to read like “. . .annual mean CH<sub>4</sub> in CH<sub>4</sub>\_CTL. . .” (since, as I have suggested, CH<sub>4</sub>\_CTL should not be referred to as a “tracer”. Also please replace “,” with “:” before “MLO”.

Page 18783, Lines 25-28: The sentence does not read easily and needs to be rephrased. Also: do you have a feeling as to why ACCENT and ACTM\_OH have this distinct behavior after 2000? Finally, it is not clear how this sentence links to the one after it.

Page 18784, Lines 8-13: This is a long and not clear sentence. Please spit it in two and delete the first “Because”.

Page 18784, Line 13: Please rephrase sentence starting “These lifetimes. . .”.

Page 18784, Paragraph starting at Line 13: Although CH<sub>4</sub> is the focus of this study, this paragraph discusses CH<sub>4</sub> too briefly, compared to the previous paragraphs. I would like to see some more discussion and perhaps some strengthening of the conclusion that transport differences are the ones causing the features mentioned.

Figure 6: Please put “Flux: CTL” and “Flux: EXTRA” at the top of the panels and change flux to “Experiment” or “Scenario”. Change caption accordingly.

Page 18787, Line 26: CH<sub>4</sub>\_CTL\_E4 seems to consistently have the least good performance in terms of IAV. This is worth mentioning and commenting on in the text.

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Page 18788, Line 12: “Their estimate is largely inconsistent with our results. . .”: I am not sure where is this inferred from.

Page 18788, Lines 19-20: This statement is not that well supported by the previous sentences. Why is it emissions and not e.g. transport or temperatures that are causing the problem?

Page 18789, Lines 1-2 (and last lines of previous page): Do we understand what is the main contributor to this reduction in uncertainty. Please comment.

Page 18789, Line 2: Please change “is” to “are” and add a “to” after “compared”.

Page 18789, Line 9: “This behavior. . .”: Obviously this statement refers to the over-all trend of increasing IH exchange rates and not to the IAV observed in the periods mentioned (1996-99, 2004-07). Please make clearer.

Page 18790, Line 16: Please remove “but”.

Page 18790, Line 21: Please change “is” to “are”.

Page 18790, Lines 20-22: I believe that “vertical mixing” may be a better term than “troposphere to stratosphere transport”. This is because the main point is not that CH<sub>4</sub> is transported solely to the stratosphere, but rather to higher altitudes in general (either tropospheric or stratospheric), where it progressively undergoes less destruction.

## Section 5

Page 18792, Line 15: Please add “:” after “in”.

Page 18793, Line 21: Perhaps use “masking” or “concealing” instead of suppressing.

Page 18793, Line 23: Please state which scenarios.

Page 18794, Line 4: Please change “found” to “suggested”, as this aspect was not fully analyzed, but speculated.

Page 18794, Line 16: I suggest that the paragraph starting here should be made point  
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(vi) the sequence of points from above, since it describes a conclusion which is fairly central to the paper.

Page 18794, Line 22: Same as above.

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Interactive comment on Atmos. Chem. Phys. Discuss., 11, 18767, 2011.

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