Geoscientific
Model Development
Discussions

Interactive comment on "A global wetland methane emissions and uncertainty dataset for atmospheric chemical transport models" *by* A. Anthony Bloom et al.

Anonymous Referee #1

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The authors aim at providing a dataset for methane emissions by wetlands which includes not only estimates of fluxes by biogeochemical models (the bottom-up approach) but also information on error covariance patterns. This information may be useful for performing inversions of methane fluxes through atmospheric data assimilation (i.e. for the top-down approach).

General comments

To my knowledge, this is the first time it is explicitly attempted to provide information on the uncertainty patterns together with bottom-up estimates of methane fluxes. As I am working with atmospheric data assimilation, I think the method and results of this study are very interesting. I have nevertheless two main remarks:

- the 6-member ensemble is too small to allow for statistics, so I would recommend only mentioning that "more classical" (i.e without the uncertainty patterns) methane flux estimates are available in EE for those who need a long period of time - and simplifying the text and figures accordingly in the Results and Discussion Sections

- the figures are potentially very nice and informative but presently difficult to read, even with a large zoom on a screen (see below for more specific comments on each).

Specific comments

General

- The means of the ensembles are used. Why not use the median?

- See if it is possible to update your *Kirschke et al.* (2013) reference with *Saunois et al.* (2016) (available at http://www.earth-syst-sci-data-discuss.net/essd-2016-25/) in the whole text. In Section 2.1, p.7, l.17-18: would propagating the new smaller uncertainty for global mean wetland methane emissions *(i)* take much time and *(ii)* significantly change the results?

Section 1 Introduction

- p.3, l.20-21: uncertainties are often formulated using correlation lengths in space (e.g. at the global scale, 500 km on land) and sometimes also in time (e.g, still at the global scale, one or two months) over a percentage of the prior emissions. This is especially done to take into account large patterns in the errors due to under-lying controls as is the case with wetland emissions. Please check your references here and adapt the text. This does not change the fact that correlation lengths are always an issue because the value at which they are set is derived from expert-knowledge, which is mainly valid at the global scale.

- p.4, l.8-11: I don't understand here what is meant by the "further constrained" ensemble. Do you mean that the top-down approach could retrieve the controls of biogeochemical processes instead of fluxes from atmospheric data assimilation? It seems it is what is meant in Section 4.2, p.15, l.6-8.

Section 2.1

- p.5, l.20: using the word "ensemble" for a six-member sub-set and deriving statistics over such a small number of members does not seem very appropriate. See if it is possible to leave EE aside for most of the paper and only mention it as a "more classical" set of estimates (see also General comments).

- p.7, l.18-19: why 1000 perturbations?

Section 2.2

- p.9, l.4-6: I understand the idea of keeping mostly sites where the vertical mixing in the model is not too much of an issue but using only the altitude (a.s.l.?) of the site seems to be too simple. Could you detail a bit more?

C3

Section 3

- see if it is possible to leave EE aside (see above and General comments)

- p.10, l.5: could you quantify "considerable"?

- p.10, l.19-21: could you explain in more detail why you expect inter-annual variability to be smaller than your uncertainty?

- p.11, l.16-seq.: this paragraph is difficult to read with all the figures embedded in the text. Could you put them in a Figure or Table?

Section 4.1

- p.14, l.8-11: more and more atmospheric data of mixing ratios of methane isotopes are available and data assimilation systems try to make use of these and isotopic signatures of the various sources to improve the inversion of methane fluxes. Do you think not only the total methane fluxes but also the isotopic composition could be improved?

- p.14, l.16: the global uncertainty is always smaller than the smaller scale uncertainties, could you quantify "substantially"?

Technical corrections

General

- check "Kirschke" everywhere (and not "Kirshke")

C4

- check all references in the form of "based on the *Bloom et al.*, (2016) methodology": it looks like there shouldn't be a comma before the year between parenthesis.

- "primary" is used for "main" or "dominant" e.g. p.7, l.26 or p.11, l.20, and it seems a bit strange to me, non-native English speaker.

Section 1 Introduction

- p.4, l.9: "based top-down CH_4 emission estimates" $\rightarrow$ based ON top-down CH_4 emission estimates?

Section 2.1

- p.5, l.10: "heterotrophic respiration at time for a" $\rightarrow$ delete "at time"?

- p.6, l.18: **h** should be *h*?

- p.7, l.4: "freshwater bodies in $w_i(x)$ section 4" $\rightarrow$ delete $w_i(x)$?

Section 3

- p.9, l.18: if FE emissions are intended, it seems that it should be Figure 1a; if it is Figure 1b which is commented, it should be "High-latitude EE emissions".

- p.9, l.19-20: add references to panels c and d in Figure 1 to guide the reader.

- p.9, l.22: "(EE) s; the FE" $\rightarrow$ delete "s"?

- p.10, l.14: Chang et al. (2014) should be "Alaska Wetlands" to be consistent with the whole sentence.

C5

- p.10, l.24-25: "dominated carbon decomposition" $\rightarrow$ "dominated BY carbon decomposition"

- p.13, l.8: "is able capture" -> "is able TO capture"

Figures

- Figure 1: difficult to read, even on a screen. Larger maps and discrete colour scales would make it easier. It seems that panels e and f are never referred to in the text.

- Figure 2:
    - it is almost impossible to distinguish pale grey fine lines from darker grey larger lines!
    - put FE ensemble and FE mean in the legend since it is used in the whole text (instead of "Ensemble" / "Mean" alone in the top panel or "This study" in the bottom panel)
    - if following the recommendation of not commenting too much on EE in the body of the article, the top panel could be in Supplementary material (or Appendix?)

- Figure 3: a discrete colour scale would make it easier to read, together with larger panels if possible.

- Figure 4: you may use box plots to make the legend clearer and shorter; could you enlarge the map?

- Figure 6: the colour scale is a bit strange since the ticks every 0.2 do not fit the limits of shades

- Figure 8: a discrete colour scale would make it easier to read

Appendix

- Appendix B:
  - p.16, l.10: "ensemble. the "cor()"" → "ensemble. The "cor()""
  - p.16, l.11: "For Figure 6, $A_{l,m}$ we aggregate": do you mean that Fig 6 shows the $A_{l,m}$ coefficients?

- Appendix C: p.17, l.4: "$R_{100,1,1}$" should probably be $R_{100,3,1}$

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