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Atmospheric Chemistry and Physics Discussions

Interactive comment on "An increase in methane emissions from tropical Africa between 2010 and 2016 inferred from satellite data" *by* Mark F. Lunt et al.

Anonymous Referee #2

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General comments

Lunt et al. constrain methane emissions in tropical Africa with GOSAT XCH_4 data to retrieve monthly CH_4 emissions in the framework of a Bayesian inversion. A very useful sensitivity test (to the CO_2 fields used in the XCH_4) is included, which makes it possible to provide uncertainty ranges for the estimates of emissions and comment on the significance of the results. With satellite XCH_4 data from 2010 to 2016, they are able to study seasonal cycles as well as the 7-year trend. Using various other satellite data (land surface temperature anomaly, altimetry), they are able to suggest links between their findings regarding CH_4 emissions and the sources contributing to the variations

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of these emissions, which are mainly wetlands in this area. This study provides estimates for CH_4 emissions and their variations at various spatial and temporal scales in an area, tropical Africa, which is both a key-region for methane emissions and a region where these emissions are very uncertain. The authors have been able to exploit not only satellite data of XCH_4 to assimilate in their inversion framework, which already provides rich insights regarding methane emissions, but also to proceed further in the investigation of the possible drivers of the variations of these emissions, making use of different satellite data sets. The manuscript is clearly written and well-structured, the results are very clearly presented and discussed. For all these reasons, I recommend publication of this manuscript in ACP after minor corrections (most corrections for Section 2.3).

Specific comments

p.2 l.31: what about wild animals for enteric fermentation?

p. 2 l.33: indicate what the range corresponds to (one-sigma, 95%, the full range of the ensemble) so that the reader can compare to the other ranges in the paper.

p.4 l.4: explanation for the year 2016?

p.4 l.20: "as opposed to XCO2": I don't understand the idea implied here.

p.6, Section 2.3: I think this Section is a bit confusing as it seems to be trying to explain a methodology but not in details so that some useful elements are missing for the reader and others are presented in too general a way. Some particular remarks below. Could you try re-writing the Section with a kind of clear hierarchy in the important points for understanding the study described in the paper and the general points which are detailed in the references?

p.6 l.28: "reducing the impact of underlying assumptions": I think it is a bit optimistic to put it like this. The assumptions are still there but they are not made on the same variables/parameters. For instance, the assumption that the errors can be specified as

PDFs and, then, the user's choice of one given type and form (be it Gaussian, Poisson or another).

p.6 l.30: "uncertainties in the a posteriori distribution are more representative of uncertainties in the inversion system": more representative than what?

p.6 l.31: "any form of error variances can be used": do you mean covariances? "Any form" is misleading: they still need to be PDFs, probably ones defined by only a few parameters.

p.7 l.12: "all parameters in turn": does it mean one parameter per iteration?

p.7 l.13: which are the hyper parameters here?

p.7 l.27: what is the type and form of the posterior distribution?

p.7 l.20: reference for the measurement uncertainty? Same in both XCH4?

p.7 l.23: can you comment a bit on the validity of the "uncorrelated" assumption?

p.8 l.11: you should also report the range for the Saunois et al. figure, so that the following conclusion (l. 15-16) that your results are consistent with it is actually supported. You can also make use of Saunois et al. 2017: https://doi.org/10.5194/acp-17-11135-2017

p.8, l.17: Fig 3: it is difficult to interpret the fact that the prior is outside the posterior 95% uncertainty range without any information on the types and forms of the PDFs. Maybe something like Fig 4 of http://dx.doi.org/10.1016/j.spasta.2016.06.005 could be useful?

p.9, Section 3.1: make use of Saunois et al. 2017: they discuss the variability over 2000-2012 so that there are only three years common with your period but you could put your trends in perspective.

p.9 l.13: "although there was substantial inter-annual variability": I don't understand the

logical link between the inter-annual variability (which can go either way from one year to the other) and the trend.

p.9 l.22: why are the glint data more sensitive to the boundary conditions?

p.11 l. 4-6: indicate whether the link between the variations of LST anomalies and wetland extent variations is a (reasonable) assumption or a proven proxy link. Maybe with a reference?

p.13 l.4: "r^2 values of 0.2-0.8": 0.2 does not seem to be such a strong correlation. Do you have criteria for the significance of this?

p.15. l.1 seq: make use of Saunois et al. 2017.

Technical corrections

fig 1 (a): what is the background of the map: climatological vegetation cover?

p.3 l.19: "Gravity Recovery and Climate Experiment (GRACE," -> And

p.3 l.20: "liquid water equivalent height (LWE) height anomaly retrievals" -> delete first height

p.4 l.31: "different to" -> different from?

p.7 l.28: "clearly show" -> clearly shows

p.8 l.17 seq.: there are a lot of numbers in the two paragraphs: would it be possible to make a table? E.g. with columns prior, PR1 posterior, PR2 posterior. Same remark for p.9 l.2 seq., p. 10 first paragraph

p.8 l.33: "that" -> than (smaller l. 32)

p.9 l.12: "reigon" -> region

p.10 l.18: "represents" -> represent

p.11 l.4: "anomalies from" -> "anomalies of"?

p.11 l.30: missing)

p. 15 l.32: “changes” -> change

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