

Biogeosciences Discuss., referee comment RC2  
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## Comment on bg-2022-2

Anonymous Referee #2

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Referee comment on "Evaluation of Wetland CH<sub>4</sub> in the JULES Land Surface Model Using Satellite Observations" by Robert J. Parker et al., Biogeosciences Discuss.,  
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This manuscript presents an interesting analysis of GOSAT observed seasonal cycles of methane and its use for evaluating various configurations of a simplified model for representing methane emissions from natural wetlands. The focus is on emissions from Tropical wetlands, for which the representation of meteorology turns out to be most critical. However, since a range of meteorological variables are used, it remains unclear which of the variable is most critical. The use of a hydrological model that is capable of river routing is found important also, which makes sense for the African wetlands that are studied in detail.

The approach of using GOSAT data for evaluating wetland emissions is an interesting option for the Tropics, where surface measurements are scarce. But the proposed method is tricky also, as I will explain below. Some disclaimers are missing to make sure that the interested reader is aware of its potentially important limitations. With these issues sufficiently well addressed, which will require substantial revisions, the manuscript should be ready for publication.

- The TOMCAT model is used to bridge between methane emissions and GOSAT observed column averaged mixing ratios. A model run without wetland emissions serves as a reference that is subtracted from the GOSAT data to derive a 'observational' dataset that is used to evaluate different configurations of the wetland model. It should be made clearer that this evaluation depends critically on the validity of the TOMCAT simulation without wetlands. The uncertainty of that simulation should receive more attention. The implicit assumption is that this uncertainty is small compared to uncertainties due to wetland emissions. However, no evidence is presented in its support. It would have been easy to include a figure comparing TOMCAT to background measurements and assess whether the model – data mismatch is consistent with wetlands as the most uncertain component. It is true that some important other sources do not show a strong seasonality, but due to seasonal variations in atmospheric

transport their impact on total column methane will nevertheless vary seasonally.

- Even if the model performs well against background measurements, this is not a guarantee that GOSAT – model differences are due to wetland emissions. This needs to be acknowledged somewhere.
- An ensemble of wetland configurations is used to represent the uncertainty of wetlands, including an alternative representation of meteorology. However, it is unclear why the alternative meteorology is only used to drive the emission computation and not its transport in the atmosphere.
- It would have been useful to include another representation of the global methane sink and methane sources other than wetlands in the ensemble.
- It is unclear how the TOMCAT model tracers are initialized. If the model starts at 2009, when also the comparison with GOSAT starts, the initialization needs to be very good to do without a spin-up to bring the global methane source and sink for each tracer in balance. An explanation is needed of how this was done.
- Figure 5: It is unclear why the correlation color legend starts at zero. How would negative correlations show up?
- How are regional averages in Figure 5 taken? I suppose that model has been sampled to the coordinates of the GOSAT soundings? But then the global and other region averages are weighted by the uneven coverage of the GOSAT data. In addition, the impact of regional emissions on the total column is not limited to the region where the emission takes place. It could be that emissions from another region contribute more to the reported variability of methane over a region than the sources that are located there. How is this issue dealt with?
- Related to the previous point: what could be the influence of the seasonally varying coverage of the GOSAT measurements on the derived seasonality for a particular region? How do you avoid that spatial differences between GOSAT and TOMCAT "alias" into apparent seasonal differences?
- Figure 6: Why are changes in correlation coefficient and standard deviation only in positive direction? What happens if the correlation coefficient or standard deviation of the subset is less? If these plots represent the absolute value of changes then the explanation in the caption about improvement or worsening makes no sense. An extended explanation is needed here.
- Given its importance, it would be useful – without much work – to differentiate the impact of meteorology further. Is precipitation the dominant factor?
- Figure 8: The two ensemble members need more distinct colors to be able to see which is which.
- Figure 10, 12 and 13: the references to subfigures in the captions is wrong. What is the color legend of the MODIS imagery, is this RGB?