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Interactive comment on “HCOOH measurements from space: TES retrieval algorithm and observed global distribution” by K. E. Cady-Pereira et al.

Anonymous Referee #1

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Cady-Pereira et al. present the first retrieval of HCOOH from the TES instrument. Such dataset is highly valuable to improve our understanding of the HCOOH budget. The manuscript is well-suited for AMT and I support publication after the following comments are addressed.

Major comments

- 1) Error quantification
 - a) idealized retrievals

In their idealized retrievals, the authors used scaled a priori HCOOH profiles to generate radiances, which are then used as inputs for their retrieval algorithm. It seems the

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scaling factor that is applied to the a priori profiles always leads to greater HCOOH at the surface and lower HCOOH above 300 mbar. Could the authors provide some more justification for their choices of the altitude-dependent scaling factor ? In particular, it seems possible that HCOOH may not peak at the surface if a significant fraction of biomass burning emissions is injected above the boundary layer? How would such a different profile shape affect the retrieved HCOOH from TES ?

b) influence of other trace gases in the HCOOH microwindow

As stated by the authors, the HCOOH signal is weak. I understand that in their idealized retrievals, the concentration of other gases is known perfectly. Could the authors comment on how uncertainties in other gases may affect the TES HCOOH product. In particular, NH3 is known to have large emissions from biomass burning. Does the correlation between NH3 and HCOOH affect the retrieval of HCOOH in region affected by pyrogenic sources ?

c) choice of the first guess profile.

The authors use the enhanced HCOOH profile as first guess in all their retrievals rather than the a priori profile. This increases the sensitivity of the retrieval algorithm to HCOOH. How many HCOOH retrievals would not have converged if the first guess had been set to the clean a priori profiles ? Could this lead to "false positive", with a possible high bias in regions of low HCOOH ?

2) Global TES survey

a) Could the authors provide a map of the percent total error and of the fraction of successful retrievals (I assume that this is defined as $\text{SNR}>1$). Some of the unsuccessful retrievals are caused by low HCOOH. Could the authors comment on the possible high bias of the TES HCOOH product and its implications for model comparison.

b) Given the global low bias of GEOS-Chem, I have trouble seeing that Fig. 14 indicates missing pyrogenic sources. I would be more compelling to show how HCOOH is

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correlated with other biomass burning emissions retrieved by TES (e.g., NH₃, CO).

In general, I find that the GEOS-Chem simulations add very little to this study. GEOS-Chem is not used for the a priori and the authors suggest that comparisons with TES will be performed in a forthcoming study. If the authors decide to keep the GEOS-Chem simulations, significantly more details need to be provided regarding the simulation setup and a more thorough analysis needs to be presented.

3) Comparisons with other HCOOH observations.

The authors need to compare their retrievals to other HCOOH observations. This would provide another evaluation of the TES HCOOH product and probably suggest much larger errors than those currently reported in the manuscript.

In particular, the authors need to compare their HCOOH product with aircraft profiles and FTIR measurements (see for instance Stavrakou et al. 2011 (NGeo) for a comparison between IASI and FTIR observations at Wollongong and La Reunion).

Could the authors comment on the differences between the global distributions of HCOOH from TES and IASI? I find it interesting that IASI observations point to a missing biogenic source, while TES HCOOH suggests large pyrogenic sources.

Minor comments

1) p1980 the authors should not assume that the readers are familiar with GEOS-Chem. More details need to be provided regarding the simulation setup (reference to Chaliyakunnel is missing). As stated above, I find that GEOS-Chem modelling does not add much to the manuscript in its present form. In particular some figures (e.g., Fig. 5) are barely discussed and do not add to what can be found in previous GEOS-Chem based studies (Paulot et al. (2011, ACP))

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