Review: HCOOH distributions from IASI for 2008-2014: comparison with ground-based FTIR measurements and a global-chemistry transport model

This paper presents a (very brief) description of an improved HCOOH from IASI retrieval method, evaluates the new method performance against the prior (Razavi et al., 2011) method, and carries out validations against both in situ FTIR HCOOH measurements and CTM (Imagesv2) output. There are numerous interesting results, however some topics need to be addressed more fully. Furthermore, while the paper is well organized over all, the paragraphs are often not well connected and it does not read very smoothly. I believe the paper should be published in ACP after some moderate revisions.

1. Comments on content
    a. Section 2.2:
        i. This section could use some more details on which forward model and which retrieval code were used for the OEM retrievals. Are these the same as in Razavi et al., 2011(hereafter just Razavi)? This is not stated. Even if they are, providing this information adds clarity to the paper.
        ii. The authors state that they used a large variability in the retrieval (350%) based on the retrieval settings of Razavi. I think a better term would be a loose constraint. I also do not understand what is meant by "based on the settings".
    b. Section 2.3.1
        i. Is the thermal contrast really defined as the difference between the surface temperature and the air temperature right above the surface? A more appropriate variable for satellite IR sensors is the difference between the surface temperature and the temperature at the peak of the instrument sensitivity. If the ΔBT from forward model runs is plotted as a function of thermal contrast (from the definition used in this paper), it will not be zero when the thermal contrast is zero. I suspect that the correction for ΔBT developed in this section would not be necessary if the definition I suggested were adopted. I would like to see a plot of ΔBT vs thermal contrast for various profiles using both definitions. If the authors feel this does not belong in the paper (though I believe it is an important point) they can submit the plots in their response. However, if the plots confirm my hypothesis I leave it to the editor to decide if this section should be omitted and the rest of the analysis redone.
        ii. The last two sentences in this section appear contradictory. If rejecting negative values introduces a bias, then why are you rejecting negative values?
    c. Section 2.3.2
        i. The final paragraph in this section is very interesting. My experience with retrievals is that it is the lack of sensitivity to small changes in

background amounts that leads to the very large errors on these values. It would be very useful to users of this data if the authors could provide an estimate of the algorithm sensitivity, i.e., what is the threshold detection value and how it varies with thermal contrast.

d. Section 3.1
   i. The authors use the result from section 2.3.2 (high errors on low amounts, lower errors on high amounts), to justify their lower results compare to Razavi. However, Razavi found a similar pattern in their data analysis, so I do not believe this is the correct explanation, or at least not the entire source of the lower values, which actually occur nearly everywhere. The authors should comment on why their results are in general significantly lower over most regions/periods with enhanced HCOOH.
   ii. The long list of features evident in Figure 8 should be written less like a list. The numbering of each discussion point is useful, but I think the points could be expanded on and better connected.
   iii. The discussion on the Asian outflow is weak and unclear, as the IASI total columns are not provided for the PEM campaign periods/regions.
   iv. A possible reason for the high values over India should be provided.

e. Section 3.2
   i. This section requires at least some description of the FTIR: spectral resolution, noise level, sensitivity.
   ii. The paragraph starting at line 240 is especially confusing, as the OEM results are not shown. A plot or table would be helpful.
   iii. Why does the FTIR AK peak higher and have a broader peak?
   iv. Where does equation 3 come from?

2. Minor changes
   a. Introduction

      Line 24: …dependence on thermal contrast is taken into account…
      Line 31: …highlights the difficulty of retrieving total columns from IASI measurements over mountainous regions…
      Line 48: …, and to a lesser extent through oxidation by the OH radical.
      Line 61: … the existence of unknown direct fluxes of HCOOH.
      Line 63: Nadir looking atmospheric sensors can derive global distributions of trace gases, but with less vertical sensitivity than airborne or some ground-based measurements, such as FTIR instruments. Their extended spatial coverage allows for observations over remote regions ….
      Line 69: Are the ACE data also monthly?
      Line 70: … a low radiometric and high spatial coverage. HCOOH is a weak absorber, so it is challenging to …
      Line 75: Which discrepancies? Please elaborate.
      Line 77: …, suitable for both enhanced and background ….

   b. Section 2

      Line 87: …October 2006 and has provided more than eight years …
      Line 88: …September 2012. Owing to their wide swath each instrument …

Line 93: Suggested rewriting of this paragraph:

Analysis of the mean of the normalized (by what??) Jacobians (Fig. 2) over the spectral range used by IASI for the HCOOH retrievals 1095-1114 cm-1(Is this correct? Later in the text the authors state they use the channels at 1103, 1105 and 11909 cm-1.) for a set of representative geographical regions (see Fig. 1 and next section) shows that IASI is sensitive to tropospheric HCOOH signal between 1 and 6 km.

Line 103: …columns of HCOOH using a set of conversion factors derived from OEM retrievals.

Line 127: …remote areas

Line 156: …of the method are …

Line 156: … and the lack of an error budget.

Line 159: … OEM retrievals. To provide an estimate of the algorithm error simulations were performed …

Line 170: …, Razavi et al. (2011), who find a mean RD …

c. Section 3

Line 190: …Equator, with the highest values between 0-10°N, but with large variability, as the maximum was 3.5×10^{16} molec/cm^2, but the monthly mean in this region was only 0.5×10^{16} molec/cm^2.

Line 192-231: As noted above, please make this section less list-like. Some specific changes:

Line 192: A number of features are evident and are discussed below:

(1) A particularly striking feature are the large hotspots over Russia …

(7) These states are flagged as biogenic emission regions …