

Interactive comment on “First global distributions of methanol and formic acid retrieved from the IASI/MetOp thermal infrared sounder” by A. Razavi et al.

Anonymous Referee #2

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Review of the Manuscript “First global distributions of methanol and formic acid retrieved from the IASI/MetOP thermal infrared sounder” by A. Razavi and co-authors

General: The paper presents global distributions of methanol and formic acid as derived from IASI observations. The retrieval method is clearly described, and the limitations of the method, in particular the unavailability of individual error assessment and averaging kernels, are indicated. Some minor revisions are suggested here. The part on the analysis of the global distributions (sections 3.2, 4.2 and 5) is less mature and needs some additional work. I recommend publication after my concerns as specified below will have been properly addressed by the authors.

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Specific comments:

Title: It is not true that this work presents the first global distributions of formic acid; however, these are the first global distributions derived from the IASI/MetOP sounder, to my knowledge. I therefore suggest to reword the title of the paper as follows: “Global distributions of methanol and formic acid retrieved for the first time from the IASI/MetOP thermal infrared sounder”.

Abstract: A similar correction applies to line 5-8 of the abstract. Correction: “In this work, we derive global distributions of these two organic species using for the first time the ...”.

Introduction: p 21476, l24: which VOC with more than 1 ppmv mixing ratio does exist in the atmosphere (besides methane, which is usually not listed under VOCs)? Please give examples.

Section 1.1: p21477, l 16-20: the following contributions on global distributions of organic compounds should also be mentioned: Moore and Remedios, ACP, 2010; Moore, Remedios, and Waterfall, ACPD, 2010.

Section 1.2: p21479, l18/19: The diurnal variation of methanol is mentioned here. Just curious: is it possible to derive the diurnal variation from IASI data?

Section 1.3, p21482, l19/20: Please note that both Grutter et al., 2010 and Zander et al., 2010 explicitly state that they have used the Vander Auwera et al. (2007) spectroscopic data. Your presumption that previous IR observations of formic acid were likely to high by a factor of 2 is not correct for these two publications.

Section 3.1: p21486, l2: Since you perform a profile retrieval (consisting of 4 layers), you should be able to give the methanol amounts as vmrs as well. How do your retrieved vmrs compare to observations from other instruments as given in the introduction?

P21486, l18: “. . . very well defined linear correlation . . .”: The correlation between ΔT_b

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and O₃ does not look linear; if an extrapolation to lower O₃ values becomes necessary, this could introduce considerable errors. Could you comment on this?

Section 3.2: p21487, l20: please add: "... first global distributions of methanol from IASI."

Section 3.2, p21488, l15 to p21489, l12: The discussion of sources of methanol is highly speculative. Further evidence is necessary for the assignment to biomass burning and vegetation growth, respectively. Plotting time series for certain regions could help to identify annual cycles.

Section 4.1: p21491, l14/15: How is τ defined? Where do numbers for τ come from?

Section 4.1, general: Could you give any indication to which altitude range the formic acid retrievals from IASI are sensitive?

Section 4.2, p21493, l2-4: Is there any evidence for boreal fires as source of formic acid in Northern Asia and Northern America? What about the vegetation cycle?

Section 4.2, general: As for section 3.2, the source attribution of formic acid is highly speculative, and more evidence must be provided for the assignment of biomass burning, boreal fires, biogenic emissions, and anthropogenic activities to the observed enhancements. Again, time series for certain regions might be helpful to identify the annual cycles and to link these cycles to the different sources.

Section 5, general: Before analyzing correlations, it must be clear that all measurements (of CO, CH₃OH, HCOOH) represent the same altitude range. Is this the case?

The correlation of global CH₃OH versus HCOOH as in Fig. 11 is not very helpful in my opinion. Comparing Figs. 6 and 10 it becomes evident that the emission regions for CH₃OH and HCOOH are by far not identical. Enhancements in Africa in Northern tropics as for methanol are not present for formic acid (JJA), Southern American enhancements in JJA methanol are not found in formic acid, enhancements over China and SE-Asia in formic acid are not found in methanol and so on. Why should CH₃OH

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and HCOOH correlate globally then?

Even if CH₃OH and HCOOH are emitted from the same sources, a linear relationship between both is not to be expected, due to chemical processing in the atmosphere (besides the problem of sensitivity to altitude regions). Besides this, the scatter plots for MAM and JJA are not very indicative of a linear relationship.

P21493, l27 to p21494, l2: This is a contradiction to p21493, l6-8: In the upper sentence, you tentatively exclude biomass burning as source for HCOOH enhancements, while in the lower sentence, you assume biomass burning as the most probable source.

Correlations to CO with color-coded latitudinal bands as in Fig. 12 are more helpful. However, the high red values of HCOOH in the lower panel of Fig. 12 challenge the statement that Northern American and Northern Asian HCOOH enhancements were from boreal fires (p21493, l2-4), and, indeed, are claimed to be emitted from biogenic processes now (p21494, l14).

I suggest to proceed in the analysis of CH₃OH and HCOOH in the way as it was begun in Fig. 12. It would probably be helpful to analyze the correlations for various geographical regions (not latitude bands) and provide clear evidence from independent observations for either biogenic emissions, boreal fires or biomass burning, or anthropogenic activities for these regions/seasons.

Technical comments:

P21485, l25: "Fig. 4" should read "Fig. 3"

P 21492, l10: Typo "constraint"

Fig. 3: What are the dashed light green horizontal lines in panel (a)?

Fig. 5: Please make clear (by selection of axis range or marking the x=0, y=0 lines) that the linear regression pass through the (0,0) point and the y axis intercept is zero. The figures as presented suggest that the linear regression produces a bias in methanol

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(CH₃OH ≠ 0 for ΔT_b = 0).

Fig. 7: What do negative errors mean in this figure? In particular, do negative errors larger than 100 % mean that negative total columns have been derived?

References: Moore, D.P., J.J. Remedios, and A.M. Waterfall, Global distributions of acetone in the upper troposphere from MIPAS–E spectra, *Atmos. Chem. Phys. Discuss.*, 10, 23539-23557, 2010.

Moore, D.P. and Remedios, J.J.: Seasonality of Peroxyacetyl nitrate (PAN) in the upper troposphere and lower stratosphere using the MIPAS-E instrument, *Atmos. Chem. Phys.*, 10, 6117-6128, doi:10.5194/acp-10-6117-2010, 2010.

Interactive comment on *Atmos. Chem. Phys. Discuss.*, 10, 21475, 2010.