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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Spectrometric measurements of atmospheric propane (C_3H_8)" *by* Geoffrey C. Toon et al.

Anonymous Referee #3

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This paper describes the first dataset of atmospheric propane (C3H8) retrieved from remote sensing measurements. A large amount of data obtained at 12 different ground-stations over several years is presented. The authors give convincing explanations for the enhanced propane amounts observed at two sites, namely losses during exploitation of natural gas and pollution by liquified petroleum gas in large cities. They substantiate their conclusions by correlation with C2H6 and with CO, tracers for gas losses and anthropogenic pollution. The manuscript is well structured and its objective is clear. Therefore I recommend publication in ACP.

Major comments:

The strong correlation with C2H6 for, e.g., the Ft. Sumner data is convincing evidence that the C3H8 VMRs are real, maybe with an unknown bias. Nevertheless I would be

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interested in a plot similar to Figure 2 but for retrievals using all other fit-parameters except of C3H8 to see, if the residuals become significantly larger. Maybe this could be shown in the Appendix. A table containing the name, acronym, geographical coordinate, altitude and country of each of the 12 sites at the beginning of Section 3 would be helpful.

Figures 3-5: The authors state that Fig. 3 contains C3H8 column amounts from 12 sites. If so, the sites should be made better distinguishable. I can detect 9 different lines or 7 different colours in the upper panel at the most. The same applies for Figures 4 and 5. Especially the two different "greens" are not easily to distinguish. Maybe it would help if one "green" was a bit darker? I concede that it might hardly be possible to present the data using 12 clearly distinguishable colours. Maybe subdivision into low-and high-altitude stations would help, by which the lines in the upper panel of Fig. 3 would be easier to distinguish as well. Further, every station should be listed with its associated colour code in the figure captions. Which station is, e.g., blue (0 km)?

L260ff: I would appreciate a little more information how the authors derive 0.72E+19 molecules cm-2 in total and 3E+16 molecules cm-2 of propane from 15 billion cu. ft. produced per day.

Minor comments:

L10: Aren't rather the high C3h8 amounts than the variations "correlated" with back trajectories from SE New Mexico ...?

L55: "the entire 650–5650 cm-1 range" instead of "the entire 650–5650 cm-1"

L63/64: "(Irion et al., 2002)" instead of "(Irion et al., 2003)"

L71: I do only count 9 simultaneously-fitted scalars. Can you help me?

L75: The acronym TCCON should be introduced in line 65. Further, what is GGG2014?

L78: What is GGG2020?

L79: I think "less than 10%" is more appropriate than "less than 10% rms", because specifications in percent are dimensionless. Further, "shown in Fig. A2" more specifically indicates, where the differences can be seen, than "shown in appendix A".

L82: Which infra-red lab?

Figure 1: The labelling of the axes and the legend is rather small and blurred and should be represented clearer.

L124: Here it says: "Table Mountain Facility at 2.2 km" but in the captions of Fig. 3 "orange=2.25 km (TMF)". Please adjust the heights.

L130: I believe the sentence "So C3H8 has only ..." would become clearer, if it would be exchanged with the preceding sentence.

Figure 2: The colors for H2O and HDO are hardly to distinguish.

L155: The upper row and not the left hand panels show XC3H8. Please change into "The upper row of Fig.4 shows the XC3H8 time series plotted versus year (left) and versus day of the year (right)."

Figure 4, captions: It should be mentioned that the colour coding is the same as in Fig. 3. This information could then be removed in lines 170/171.

L166: "The Antarctic measurement (blue) are even lower than they appear because ..." sounds strange. What about "The Antarctic measurements (blue) (of C2H6?) are very low (0.2-0.3 ppb) and most probably even lower during the rest of the year, because ..."?

L172: The sentence "In fact, the highest VMRs of C2H6 were seen from there, even more than from JPL ..." seems to be contradictionary to L167/168: "The highest ever C2H6 was measured from JPL (cyan) in late 2015 ..."

Figure 5: "... by site altitude like in Fig. 3." (?)

L197: The authors state: "... but only when the wind direction is from the SE quadrant (green/lime colors)." On the other hand it says green = 180 deg, lime = 220 deg in Fig. 6. Shouldn't the SE quadrant be in the direction 135+-45 deg? Or is the wind direction not counted clockwise, beginning in the north?

Figure 7: Do the authors apply a standard regression analysis (minimization of the squared vertical distances)? If so, wouldn't it be better to correlate XC3H8 versus XC2H6, because the X2H6-errors are much smaller?

L228: Why was a trajectory altitude of 0.4 km over Ft. Sumner selected?

L280: Why is 25% low only half the problem? Because of the rest of the profiles above the PBL or due to other reasons? Please explain.

Figure B.2: The axes-units are missing.

Technical comments:

L9: "shows" instead of "show"?

L16: "losses" instead of "loses"?

L32: "is therefore is": one "is" should be removed

L40: "show a large" instead of "show large a"

L65/66: "(Toon et al., 2016; 2018a; 2018b)" instead of "Toon, 2016; 2018a; 2018b)"

L124: "in red" and "in orange" instead of "= Red" and "= Orange"

L166: "measurements" instead of "measurement"

L363: "shows" instead of "show a"

L364: "when back-trajectories from SE New Mexico and West Texas ...": I think a verb is missing here.

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