

Interactive comment on “Influence of oil and gas field operations on spatial and temporal distributions of atmospheric non-methane hydrocarbons and their effect on ozone formation in winter” by R. A. Field et al.

Anonymous Referee #2

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This manuscript by Field et al. reports extensive observations of non-methane hydrocarbons (NMHC) in the Upper Green River Valley in SW Wyoming. This is a timely publication, adding further data and analyses that illustrate very significant emissions of NMHC from oil and gas operations and their impact on deteriorating air quality. This research adds some new and interesting aspects to this field of research, most notably by applying positive matrix factorization for assigning observed NMHC to particular oil and gas operations. Other notable findings are the identification of a water treatment facility as a major emission source and the characterization of spatial distribution of

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NMHC. The work appears to be of high quality and the manuscript is for the most part well written, although there is quite an abundance of punctuation errors. I recommend publication after reasonable consideration of suggested corrections listed below.

Most readers are probably not that familiar with the operation of a water treatment and recycling facility. I assume that this facility was exclusively used for well oil and gas drilling flowback water treatment? It would be helpful to provide some more information on the technical operation and operational scale of this facility.

It would be valuable to discuss differences in atmospheric data and observed ozone in 2011 to 2012 a bit more in depth in respect to differences in meteorological and snow cover conditions between both years.

The PMF analysis exclusively attributed NMHC observations to potential emission sources. Atmospheric NMHC are likely also determined by chemistry and meteorological (including mixed layer depth and transport direction). I am wondering if and how omission of these influences effects the robustness of the PMF results.

24945/8: Please clarify if this statement relates to proven oil reservoirs within the US or worldwide.

24946/19: NMHC have already been defined in line 16.

24947/2: ...CH₄), and carbon ...

24947/9: Provide technical specs of canisters used.

24947/18 – 24948/8: Provide mole fraction range of NMHC calibration standards used and if the calibration range covered the span of observed mole fractions in field samples. If not, then an explanation should be provided how higher mole fraction field samples were treated. Also, please provide an uncertainty estimate for the NMHC data and a detection limit estimate.

24948/15: From this explanation it seems that the chromatography data were pro-

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cessed by automated routines, both for peak identification and integration results? How are these procedures quality controlled?

24950/6: How is the noise level (N) determined?

24951/16: I don't quite see how Figure 3 obviously shows this.

24952/10: The 'Thermo55i' instrument is not clearly defined in the methods section.

24952/9-28: This paper, and this section in particular, builds a lot on material that is not shown in the manuscript itself, but in the Supplemental Materials section. This is a development that can be found more and more in recent publications, likely in the effort to keep manuscripts short and for saving publication cost. I am not a fan of this publishing at all, mildly spoken. I think that text of the manuscript should not discuss graphs, tables, etc 'hidden' in the Supplement section. Those should be provided with the main body of the paper, so that the reader does not have to flip back and forth between two documents for following the discussion. In my opinion, the manuscript should be a standalone document, with the Supplemental Materials Section providing no more than supporting information that goes beyond the primary discussion of the paper.

24952/17: From the text alone it is not clear what variable is fitted against what?

24953/2: ...small, however, suggesting ...

24953/25: This is suprising, but potentially a very important point that should, if at all possible, be investigated in more depth.

24954/12: ...bootstrapping, and the ...

24955/8: ... contribution ...

24955/11: ...However, for ...

24955/14: Factor 3 weighing declines ...NMHC, e.g. nonane, ...

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24955/24: However, the ...

24956/29: However, factor ...

24957/4: ...ethane, propane, ...

24957/7: ...ethylbenzene, and ...

24957/9: ...n-heptane, and ...

24957/10 ...contribution from ...

24958/13: However, the ...

24958/18: Round mole fraction results to full ppbv. One might also want to consider to compare these BTEX values with health exposure thresholds.

24958/19-29: These calculation and arguments are hard to follow. What is the surface scale of the inventory emission rate? How do you get an emission intensity of 250 t mile-2 and what does this mean? What is the time scale there?

24958/26: ...these data suggest that ...

24959/24: Meteorology should probably also be mentioned as an important influence.

24959/26: Suggest rounding values to no more than 3 significant figures.

24960/2: Suggest rounding values to no more than 3 significant figures.

24960/15: ...data identify ...

24960/15: The data don't really 'estimate'. I suppose that 'one could estimate from the data' ...

24961/25: ..., for 5 and 15 March 2011, and ...

24962/3: ...for ~2%, and ...

24962/8: ...flux, so would ...

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24962/14: ...reactivity, and that ...

24963/1-3: I suggest rewording this section, stating that the observations of coinciding high NMHC and elevated ozone conditions suggest that these NMHC play a role in ozone production.

24963/27: I suggest replacing the term 'reduction', as it kind of might be understood as if levels were lower due to some measures of emission control. I think it would be better to state that 'ambient levels were lower'.

24974: ...NO_x, and NMHC ...

24976: This graph shows a cluster of data with high NMHC and high NO_x, but remarkably low ozone (pink diamonds). What were the conditions that suppressed ozone production on these days?

24977: What does the 'b' stand for in 'CO-b' and 'methane-b'. Name the factors in figure caption.

Figure 7 and 8: Inconsistent use of capital letters for compounds names.

Figure 9: Mention in figure caption that circle size scales with relative mole fractions of ppbC? 'Mass' is probably not the correct term to use here?

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