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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Spatial and temporal variation of CO over Alberta using measurements from satellite, aircrafts, and ground stations" *by* H. S. Marey et al.

Anonymous Referee #1

Received and published: 13 January 2015

Review of: "Spatial and temporal variation of CO over Alberta using measurements from satellite, aircrafts, and ground stations" H. S. Marey, Z. Hashisho, L. Fu, and J. Gille

General Comments

This paper uses satellite remote sensing data from the MOPITT instrument, supplemented by other data sources to look at the evolution of CO concentrations over Alberta with particular reference to the production of oil from the "oil sands". The general conclusion is that, although there is a small signature from the oil sands, the majority

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Discussion Paper

of the features of the CO distribution can be traced to other sources.

The paper is generally well laid out, but could benefit from a thorough “read-through” for English and grammatical usage – (see “Technical Details” below)

The paper brings together a number of datasets including MOPITT space data, ground-based and aircraft data and gives an integrated picture of the climatology of CO over Alberta for the first decade of the 21st century. As always with real data, the picture is not text-book perfect and some suggestions for further strengthening the analysis are given below but the story does hold together well.

Specific Aspects Addressed

Does the paper address relevant scientific questions within the scope of ACP? 1. Does the paper present novel concepts, ideas, tools, or data? - The paper presents a novel analysis and brings togetehr disparate data to produce a coherent picture

2. Are substantial conclusions reached? - Insofar as the matter of the paper is to lead to such conclusions, yes it does

3. Are the scientific methods and assumptions valid and clearly outlined? - Yes

4. Are the results sufficient to support the interpretations and conclusions? - In the main – see comments below

5. Is the description of experiments and calculations sufficiently complete and precise to allow their reproduction by fellow scientists (traceability of results)? - Yes, sources are well-cited and explanations of data treatment are clear

6. Do the authors give proper credit to related work and clearly indicate their own new/original contribution? - Yes

7. Does the title clearly reflect the contents of the paper? - Yes

8. Does the abstract provide a concise and complete summary? - Yes

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9. Is the overall presentation well structured and clear? - Yes

10. Is the language fluent and precise? - In the main – see comments below

11. Are mathematical formulae, symbols, abbreviations, and units correctly defined and used? - Yes

12. Should any parts of the paper (text, formulae, figures, tables) be clarified, reduced, combined, or eliminated? - See comments below

13. Are the number and quality of references appropriate? - Yes – perhaps overly so

14. Is the amount and quality of supplementary material appropriate? - N/A

Scientific Comments

In section 2.1.1 the authors comment on the use of TIR+NIR MOPITT data and the restriction of the data used to daylight only. They comment that the daylight data "has better information content". However the NIR channels operate by reflected sunlight and so at night the TIR+NIR product is identical to the TIR product that has no sensitivity near the surface. This should be mentioned as a stronger driver for working only with daylight data.

In section 3.1 with reference to Figure 2 the winter variation DJF seems comparable with the MAM and JJA with SON showing the flattest distribution. It is hard to see the author's assertion that the spatial variations are less prominent in winter. It would be very useful to have the topography as well since the column amount is influenced by the topography – less atmosphere = less CO at constant average mixing ratio. The authors mention topography on p 31776 but only in the context of fewer sources – which is also true.

In Figure 3 the SON season is said to be similar to JJA but it does not show the same maximum in the North East as JJA – it seems distinctly flatter.

The main difference between figures 2 and 3 seems to be that in DJF the CO is gener-

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ally concentrated nearer the ground (possible influenced by subsidence).

On p 31776 line 12 it should be noted that CO is a product of incomplete combustion processes and so although CO increases with increasing combustion, it decreases with increasing regulation of the combustion: forest fires produce a lot of CO, power stations comparatively little.

On P 31778 the authors say that "Calgary is expected to experience Chinook winds more frequently than Edmonton" I would assume that the data exist to verify this speculation. The referee wonders whether the fact that the Edmonton winter/spring profile seems less well mixed than Calgary or Fort McMurray is significant.

On p 31780 The text talks about a "rate" but the specifies a unit of "%" whereas a rate should have a time unit as well. This is also true for P 31783.

Figure 8 and its explanation is somewhat confusing. If the annual average value is subtracted form each month, then the trend over years should be zero, but there is a trend which implies perhaps that the series annual average is being subtracted. This should be clarified.

The rates of decline of CO over the cities is clearly visible in Figure 10. More intriguing to the referee is the suppression of the seasonal cycle in all three regions which seems very pronounced. The authors attribute this to the improvement in vehicles and if so, this is remarkable.

There is almost always a problem with relating satellite measurements of pollutants to specific surface sites, since the surface sites are often chosen to be where the signal is highest, not where it is "typical". Perhaps some comment on the location of the sites as typical of the region or to monitor specific hot spots could be made.

In section 3.5 – neither dry conditions nor sinking air "cause" fires – an ignition source is needed – but they do set conditions for fires to spread and persist.

Figure 13 c,d shows the MOPITT CO distribution during the fire of 2012. It would be

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useful to compare that distribution to another year without fires – even at the expense of deleting one of c,d to make room.

Technical Details

P 31768 Lines 18 and 22 - it may be just my pdf reader, but the “s” on “sites” and “exacerabates” is detached from the word itself.

P 31768 Line 24 “..the declining trend...”

P 31769 Line 18 “..used to decrease the bitumen’s....”

P 31769 Line 20 “Large amounts of natural gas....”

P 31770 Line 18 “.. there has been no research published using them....” (is that the intent?)

P 31770 Line 27 428692.5 is surely stated far beyond the accuracy of the assessment

P 31771 Line 7 “CO can also be produced....”

P31772 Line 3 “analysed using MODIS fire counts.”

P 31772 Line 9 “..represents an industrial...”

P31773 Line 15 “..cloud edges and coastlines.”

P 31773 Line 20 “The CASA Data...”

P 31774 Line 5 (and several figure legends) “The symbols F,... represent the cities of Fort....Calgary respectively.”

P 31775 Line 12 “...seasons display minimum...”

P 31775 Line 17 “The summer season demonstrates...”

P 31775 Line 19 “..fall season illustrates a similar....”

P31775 Line 20 “...spring and summer indicate a...”

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P 31776 Line 7 “..are less than 1.5 x 10ˆ?? molecular cm-2..” Needs an exponent, surely?

P 31777 Line 5 “...temporal climatologies...”

P 31777 Line 17 “Calgary, the vertical...”

P 31778 Line 12 “..contribute to pollution....”

P 31778 Line 17 “...and declines rapidly.”

P 31778 Line 26 “...attributed to other sporadic....fires. The forest fire...”

P 31779 Line 16 “..above the planetary...”

P 31783 Line 1 “..maximum rates of decline of 4.7...”

P 31786 Line 1 “..affected by the fire emissions...”

Figure 1: Personally I would have chosen a different colour than blue for the oil sand regions. My first thought was “what are those lakes doing in Alberta?”

Figures 2,3 Legend “The symbols F,... represent the cities of Fort....Calgary respectively.”

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 31767, 2014.