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Interactive comment on "Principal component analysis of summertime ground site measurements in the Athabasca oil sands: Sources of IVOCs" *by* Travis W. Tokarek et al.

Anonymous Referee #3

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This paper describes principle component analysis (PCA) of ambient air quality data set collected in the Canadian oil sands region over a month or so in the summer of 2013. The data collection was part of a large field project to characterize the impact of oil sand operations on local air quality and climate. This is interesting question given the magnitude of the facilities. Recent work suggests dramatic secondary organic aerosol (SOA) formation downwind of these facilities. This SOA formation was attributed to emissions of low volatility organics, IVOCs. This was described in the Nature paper of Liggio et al. 2016.

This paper is focused on better understand the sources of IVOCs. This is an important

question that is of interest to readers of ACP. They have done this by performing PCA on an ambient dataset of mainly traditional pollutants (a handful of anthropogenic and biogenic VOCs plus other species). They decompose the data into 10 or 11 factors (depending on if they are looking at secondary species). Three of the factors have some association with IVOCs. The paper contains some relatively qualitative description of the sources of the factors that generally make sense. Although I am interested in this topic, after reading it I did not find the paper particularly interesting and did not feel like it made much of contribution to our understanding of the sources. I felt like going in the authors' attributed the IVOCs to bitumen. It was not clear that the paper did anything to support that hypothesis. There is nothing "wrong" with the paper, it is well written and has long descriptions. The paper would be much more interesting if it could quantitatively attribute IVOCs to sources (even the discussion of components seemed pretty speculative and qualitative).

Larger comments

The paper uses a criteria of r>0.3 to indicate moderate correlation. I view 0.3 as almost no correlation. I think the threshold should be much higher.

Presumably the GC-ITMS technique used to measure the VOCs and IVOCs could measure a much broader suite of compounds (or even break the chromatogram into subareas) that might yield more insight into what the sources of the IVOCs.

Specific comments

Figure 1 – Including a wind rose for the study period as an inset panel on this figure would be very helpful.

Line 125 – Please add one or two sentences on calibration and QA procedures.

Table 2. Who operated instruments is not that interesting. Time resolution would be more useful.

Line 164 – What is the recovery and calibration of the IVOCs?

Line 198 – What fraction of the data are below LOD?

Line 216 – I did not wade through the other solutions. Text on line Line 353 suggests they do not material change conclusions – maybe state that here.

Line 345 – Moderately associated with IVOC (r=0.31) versus weakly associated with rBC (r=0.3). All these values seem very weak (to almost no) correlation.

Figure 5. Add labels of directions to different facilities labeled in earlier table.

Line 498 (and other locations) – diesel should not be capitalized.

Line 529 – This is not total PAH but particle bound PAH. Seems like surprising they are associated with combustion and not other components (e.g. 1 or 5).

Line 544 – But diesel engines are not a major source of CO (gasoline engines are).

Line 552 – Associating the IVOCs bitumen seemed to be the hypothesis going in. It is not clear how this analysis reinforces or tests that hypothesis. It seems pre-conceived and they are just interpreting the data that way.

Line 695 – What is the evidence for this claim?