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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Emissions Preparation and Analysis for Multiscale Air Quality Modelling over the Athabasca Oil Sands Region of Alberta, Canada" *by* Junhua Zhang et al.

Anonymous Referee #2

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In this manuscript, the authors compiled an emission inventory specific to the oil sands region of Alberta for further use in an air quality model. They harmonized several emission inventories and updated with additional data sources specific to the modeling year (2013). They describe in details how they accomplished this goal.

General comments on Zhang et al.

As it stands, this paper is largely a straightforward emission development application and its format resembles a report more than a scientific paper. The abstract is very lengthy similar to a report executive summary. Same information is provided repetitively. The paper needs to be a lot more concise especially when the same information

is available elsewhere (references). If qualitative arguments like "significantly impacted" are used to characterize the results, they need to be supported by facts and figures. While subject to a variety of weaknesses and not developing any new approaches or containing extremely unique analyses, it is a useful paper and fits well in this special issue. Essentially, it serves as a basis for other papers in the same special issue. The paper could be improved by presenting a linkage to uncover what lessons are learned from the air quality applications that have used this inventory.

Specific Comments on Zhang et al. Abstract - The current form is too long and is read like a 2-page executive report summary rather than a research abstract. Focus on key messages and make the abstract more concise.

Page 4 – The summary on the first two phases is repetitive. Much of the text in the first paragraph can be excluded. Page 6-8 already give more than sufficient background information (which can still be further condensed in my opinion).

Page 5 (from Line 14-25) – This section is not needed.

Page 6 (Line 28) If a setup for processing 2006 APEI already exists, it is not clear why 2010 APEI could not be formatted to leverage that. Information in the APEI is simple, e.g., province, SCC, pollutant, emissions.

Page 7 (Line 12) Why didn't each facility level scale up by facility-specific scaling factor as supposed to a uniform constant of 2.6? For example, VOC emissions from the CNRL facility should have scaled up by about a factor of 10. Would not this offer better spatial representation? Also, were there particular VOC sources missing in the CEMA inventory? The VOC discrepancy is surprising given that the CEMA inventory is a bottom-up inventory. I suspect that the 2010 NPRI values were too high considering much lower estimates in the 2013 NPRIv2. This point should be clarified because this updated inventory relied heavily on both CEMA and NPRI. The referenced report does not address this point.

Page 8 (Line 1) Treating industrial non-stack sources as area sources (e.g., distributing within the facility boundary and specific to source type) is appropriate. However, this is quite a standard approach, NOT a new approach as claimed.

Page 10 (first paragraph) The US EPA's trend suggests a reduction of NOx by 8% and SO2 by 23% between 2011 and 2013 [https://www.epa.gov/air-emissions-inventories/air-pollutant-emissions-trends-data]. This should be mentioned in the paper.

Page 10 (Line 20) This comment is related to my comment made above on the 2010 NPRI inventory. I find the difference between version 1 and 2 of the 2013 NPRI to be disturbing. What is the level of confidence when using NPRI inventory? Would you recommend extra procedures to ensure that the NPRI values are representative?

Page 11 (Line 16) The argument is that VOC emissions in the CEMA inventory are underestimated with no reasons given. What are your justifications of using the CEMA inventory to represent source profile (to allocate fugitive VOC emissions among mine faces, tailing ponds, etc.)? If the underlying assumptions of VOC estimates are vastly different between NPRI and CEMA, this approach would not be appropriate especially if VOC speciation profiles differ significantly among these sources.

Page 11 (Line 26) How was the 2011 UOG emissions projected to 2013? Page 12 (Line 5) From what is shown in Figure S2, the spatial distribution of UOG emissions does not change very much with a few exceptions. Perhaps, include UOG emission spatial plots to support your statement.

Page 12 (Line 20) SMOKE reference has been mentioned – no need to repeat here. Page 13 (Line 14) I agree that the temporal profiles for fugitive VOC are dependent of temperature, but that's not the only factor. Wind speed (and snow cover) can also affect emission flux. How did you address wind speed effects?

Page 14 (Line 29 and also Page 15 Line 5) Need a reference to those tests that show

'significant (as the authors claimed)' effects of the artificial water bodies. Be specific about what effects are.

Page 15 (2nd paragraph) The authors' effort in updating landuse/land cover is to be commended. This is rarely done in air quality applications. Since BELD4 is already available, would future work require this step?

Page 15 (Line 9) Instead of using qualitative description such as 'significantly impacted', present facts. , e.g. change in biogenic VOCs (%).

Page 16 (Line 25; Figure S5, S6) Why not comparing 'annual' CEMS to the NPRI inventory? As the authors noted, there could be large variation in the CEM measurements. Using two-month worth of data does not give me confidence in the comparison shown in Figure S5 and S6. Alternatively, you can report NPRI emissions that are temporally allocated to the same two months.

Page 17 (Line 14) How are the aircraft-estimated VOC emissions spatially allocated within each facility for modeling? The numbers shown in Table 6 are in tonnes/year, but aircraft observations are only available during the field campaign. Hourly aircraft data was scaled to daily rate based on temperature profile during the flight day (Li et al). Were the aircraft-derived estimated annualized by scaling daily values with temperature (as was done in the base case)?

Page 18 (Line 1) The observation-based VOC profiles show lower higher-aromatic fractions. Could this be a result of flight altitude (150-1470 m) which could be more influenced by stack emissions rather than surface sources like tailing ponds?

Page 18 (Line 11) My understanding is that the aircraft-derived emissions are at facility level so any scaling would be the same across all grid cells within individual facilities. Why are the ratios shown in Figure S7 varying within individual facilities?

Page 19 (Line 29) I understand that the aircraft-derived emissions are only used for summertime modeling. The emission comparison needs to be limited to just summer

months (so summing basecase emissions for these months), instead of assuming constant daily emissions throughout the year to get annualized value. Reporting 61,500 tpy of PM2.5 is totally misleading and overemphasizing the role of wind-blown dust.

Page 20 (Line 29) It is interesting to see a high fraction of OC from soil in this area. Is there any literature that reports similar finding?

Summary Section – Information on Phase I and Phase II is repetitive (page 23 and 24). The authors should focus on Phase III and some new insights that this work has revealed. Some recommendations made in this paper are reasonable. Since the basecase and sensitivity emissions were already applied in GEM-MACH, what are the lessons learned? On page 27 (last paragraph), the authors suggest that fugitive dust emissions are underestimated based on air quality modeling (by how much?). The authors should distill some scientific findings to share with readers for other pollutants (such as NOx, VOC, or SO2) based on other air quality modeling activities referred in the paper.

Figure 1. This figure needs improvement on print quality/resolution. Table S3. Why was the 2010 CEMA off-road inventory selected? Did you compare these emissions with other inventories? Figure S3. Resolution issue. Color scales are not readable. And why is ethane shown instead of total VOC?

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