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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 #1

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The authors describe the anthropogenic and biogenic emissions datasets developed for the global air quality model GEM-MATCH to simulate air quality (AQ) in summer 2013 over the Athabasca Oil Sands Region (AOSR) of Canada. The paper provides a detailed description of the number of datasets and emission inventories that are used to generate a new hybrid emissions inventory for high-resolution AQ modeling over the AOSR. I recommend the manuscript for final publication in ACP after addressing these questions and comments:

The text needs to be shortened, e.g. some parts (Abstract, Summary) are too long and repetitive.

The paper uses too many acronyms that are hard to follow. I suggest adding a table to introduce all the acronyms that are used in the paper.

One of key improvements of the new emission dataset is the improved biogenic VOC emissions due to the use of the new land use map (forest clearing and water and ponds). The regional and global AQ models typically use the outdated static vegetation and LAI maps, hence introducing large uncertainties to the biogenic VOC simulations. Was the land-use map modified to improve the meteorological simulations as well?

The paper reports that the aircraft did measure high isoprene from the Suncor Millennium/Steepbank and the CNRL Horizon facilities. What are the sources emitting the high amount of isoprene?

The paper mentions Stroud et al., 2017 study to model SOA over the AOSR by using the emissions inventory developed in this study. There a number of uncertainties in the emission inventories that affect the modeled SOA levels. First, does this emission dataset include intermediate VOCs (IVOCs) emissions from the anthropogenic sources in the AOSR? How various long-chain alkane and other species are lumped in the developed inventory, which can affect the SOA production in the model? Did the emission dataset characterize the semi-volatile organic species (SVOCs)? This also depends on the volatility distribution of the primary OA emissions. Not sure if the POA is assumed to be non-volatile in this dataset. Are the improvements for such SOA precursors (S- and I-VOCs) in this new emission development over the existing inventories used for the regulatory purposes?

The new emission dataset also includes some emission estimates based on the aircraft measurements and mass balance approach. I think the authors need to put more emphasis on the use of the top-down emission estimates in the paper. As the Summary section discusses, there are some uncertainties associated with the top-down emission datasets. However, in the text it isn't clear the distinction between the top-down and bottom-up emission datasets and their use in the AQ models.

There were studies in the US to improve the emission inventories for the oil and gas sector and simulate air quality by taking advantage of the top-down emission estimates for NOx, CH4 and VOCs from the oil and gas sector. Unfortunately, the findings of those studies aren't discussed in this paper. Below are some references:

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