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Comment on acp-2021-296

Anonymous Referee #2

Referee comment on "Impact of Athabasca oil sands operations on mercury levels in air and deposition" by Ashu Dastoor et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2021-296-RC2, 2021

General comments:

The manuscript presents detailed analysis of mercury pollution levels in the Athabasca oil sands region in Northern Alberta, Canada. The study involves both measurement data on mercury concentration in air and seasonal accumulation in snow as well as multi-scale simulations with a chemistry transport model. In particular, the study analyses the impact of mercury emissions from oil sands developments and biomass burning of mercury concentration and deposition in the region. Additionally, contribution of global, regional and local sources to mercury deposition levels in the region is investigated and major processes responsible for the inter-annual variation of pollution levels are analyzed.

The subject of the manuscript is relevant to the scope of the journal and the work makes up a new and original contribution. The methodology used is adequate and explicitly stated. The manuscript will be suitable for publication after addressing the comments mentioned below.

Specific comments:

Figure 1: "…*The Athabasca Oil Sands Region is indicated with an approximate rectangular shape within northeastern Alberta, bordering Saskatchewan*."

The "approximate rectangular" is very poorly seen in the figure as well as in all other figures of the manuscript.

Lines 615-619: "*… spatial distributions of simulated annual average surface air concentrations of GEM … and TOM … along with their contributions (as % increases) from oils sands emissions (OSE, middle panels) and biomass burning emissions (BBE, right panels)…*"

The concentration/deposition increase (in %) due to OSE and BBE is among the key characteristics analyzed in the manuscript and mentioned in the conclusions. However, it is not clearly defined in the text. More certain definition is needed to understand particular numbers and figures given in the text.

Lines 789-790, Figure 17: "*… the upper panels show process contributions of changes in meteorology (blue), oil sands (red) and biomass burning (purple) emissions to interannual changes in total Hg deposition.*"

Similarly, it is not clear how the relative contributions of particular processes to deposition changes were calculated. More detailed description is needed.

Lines 903-907: "*… Model-measurement agreement of Hg surface air concentrations and snow loadings in AOSR … implies that NPRI reported emissions of Hg from oil sands operations … are consistent with Hg burden in the region*."

It seems to be too strong conclusion repeated in the Abstract taking into account that contribution of the AOSR region emissions to GEM air concentration is negligible and it does not exceed 55% for mercury accumulation in snow.

Conclusions, Abstract: Overall, the conclusions and abstract seem to be too extensive and are overloaded with plenty of numerical details. In my view, their shortening would improve readability of the manuscript.