Atmospheric Chemistry and Physics Discussions

Atmos. Chem. Phys. Discuss., referee comment RC2
https://doi.org/10.5194/acp-2021-622-RC2, 2021

Comment on acp-2021-622

Anonymous Referee #2

Referee comment on "Using carbon-14 and carbon-13 measurements for source attribution of atmospheric methane in the Athabasca oil sands region" by Regina Gonzalez Moguel et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2021-622-RC2, 2021

This study introduces a proof-of-concept method to evaluate the source apportionment of methane emissions in the Athabasca Oil Sands Region, a region with CH_4 sources of different types. It demonstrates the potential of combined ^{14}C and ^{13}C measurements, which can be deployed in future for continuous monitoring of CH_4 emissions. Although these first results are affected by high uncertainty, precision can be improved by isotopically characterise CH_4 sources in the region, as ^{13}C values for a single source type can span a wide range. Before publication, it is important to make clear in the manuscript that this is a preliminary study and more field campaigns are needed for a more accurate CH_4 source attribution.

The manuscript is particularly well written and deliver a thorough description of methane production processes in the area. I recommend this manuscript for publication after addressing the following comments:

72 Provide a reference for the value of contemporary atmospheric D14CO2 value of ~5.5 ‰ in 2019. Shouldn't now approximate 0 ‰?

74 Indicate a value for the current atmospheric D 14CH4.

83 Specify why ^{14}C measurements in atmospheric CH_4 are difficult. You should mention not only the sampling challenges but also the difficulties in quantifying the influence of emissions from nuclear power plants.

110 How long does it take to fill a cylinder?

120 An average time of 20 min might reduce the uncertainty in the Picarro isotopic measurements. Did you measure the Allan Variance?

151 Why 50 m above the ground?

Table 2 Is it actually table 1?

202 It would be nice to see in Figure 1 the location of the landfill and wetlands as well

Table 2 Can you add a column with the wind direction or the air provenance for each sample?

Session 3.2 How did you calculate the uncertainty on the intercept of the Keeling plot?

Session 3.3 How does MixSIAR work? I think you should add a reference here (e.g. author of the R package) so that the reader can look at the statistics behind.

247 10 £ 1%?

278 In session 2.1 you say that a data processing error with the Picarro G2201-i allowed to retrieve only the measurements from the 13th to the 19th of August. and you mention a clear linear relationship. I think a plot showing that should be included in the manuscript as well. You could add these measurements in the supplementary material?