Atmos. Meas. Tech. Discuss.,
doi:10.5194/amt-2020-116-RC1, 2020

Atmospheric Measurement Techniques Discussions

Interactive comment on "Methane emissions from an oil sands tailings pond: A quantitative comparison of fluxes derived by different methods" *by* Yuan You et al.

Anonymous Referee #1

Received and published: 5 August 2020

The manuscript "Methane emissions from an oil sands tailings pond: A quantitative comparison of fluxes derived by different methods" by Yuan You et al. presents a comparison of different methods to estimate Methane (CH4) emissions above trailing ponds in the Albert Oil Sand Region. The described methods including eddy covariance flux measurements, flux estimation from gradient measurements, model estimates based on line-integrated mole fractions measurements as well as flux chamber measurements. The aim of the study is to improve the robustness and representativeness of the used methods to routinely quantifying emissions from fossil fuel deposits. Given the global significance of accurate estimation of CH4 emissions and the lack of studies from waste products of fossil fuel industry the manuscript touches a significant

topic. The used methods and calculations are described in a comprehensive way. All used instrumentation and calibration procedures reflect the current state of research. By using more direct estimates of CH4 flux in order to validate the traditionally used flux chamber measurements the authors reveal a bias in those estimations, caused by the more local deployment of the chambers. Further the authors put their work in the brought context of CH4 measurements done over water bodies as well as GHG estimations from trailing ponds. The manuscript is comprehensive and well written all reached conclusions from the comparison are easy to follow. Besides some minor points that need to be addressed I recommend publication of the manuscript.

Detailed comments directed to the authors:

P 4 LL 119-122: You describe that a standard axis rotation was performed within Eddypro. Could you elaborate a bit more on how this rotation was performed? The abrupt terrain change can pose a problem for measurements obtained at an EC station set up at a shoreline. Especially for the wind sectors that might have contributions from land and water surface. Paw et al. (2000) and Finnigan et al. (2003) suggest considering such terrain structures in the rotation procedure of the eddy-covariance data, which can be obtained by a sector wise application of the planar-fit method according to Wilczak et al. (2001).

Section 3.2: Are there any influences of waves to be expected on the calculation of the gradient fluxes?

Section 4.2: Looking at the wind rose in comparison to the footprint calculation I would expect a more detailed description. Figure S1 indicates the main wind direction from the land side. Further it is stated that only 22% of the half hour fluxes originate from the pond. The shown footprint in Figure S3 suggest a quite large contribution from the pond though. Usually a large footprint extend is connected to stable stratifications however in the your response to the editor you mention that after selection of the wind sector representing the pond hardly any half hour periods with stable conditions were found.

Could you please clarify how the shown footprint fits to the flux data set? Particularly I would find it interesting to see a separation of the footprint for the overall data set as well as unstable, stable and neutral conditions.

In general an overlay of the entire footprint map over a land use map/aerial photo could provide a more useful inside to interpret the data. You mentioned that one reason for the differences between chamber and EC flux calculations, is the local deployment of the chambers. One further approach to gain more information during a comparison of is to use the Kljun model to calculate the land use contribution for each half hour EC flux. This could help to understand the influence of the mentioned bubbling areas on the flux estimates.

Figure S2: In my opinion it does not add much extra information since there is no clear daily pattern. Maybe a marking which direction represents the pond and land sectors would help.

Finnigan J, Clement R, Malhi Y, Leuning R, Cleugh H (2003) A reevaluation of long-term flux measurement techniques, part I: averaging and coordinate rotation. Bound-Lay Meteorol 107:1–48. doi:10.1023/A:1021554900225

Paw UK, Baldocchi D, Meyers T,Wilson K (2000) Correction of eddycovariance measurements incorporating both advective effects and density fluxes. Bound-Lay Meteorol 97:487–511. doi:10.1023/A:1002786702909

Wilczak J, Oncley S, Stage S (2001) Sonic anemometer tilt correction algorithms. Bound-Lay Meteorol 99:127–150. doi:10.1023/A:1018966204465

Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2020-116, 2020.