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Atmospheric Measurement Techniques Discussions

Interactive comment on "Studying boundary layer methane isotopy and vertical mixing processes at a rewetted peatland site by unmanned aircraft system" *by* Astrid Lampert et al.

Anonymous Referee #1

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The manuscript presents a quadrocopter equipped with a flask sampler in a proof of concept study looking at delta 13C in methane above a peatland on two mornings. Using unmanned aircraft for sampling in the lower atmosphere is not new. Comparable approaches are referred to in the introduction. The novelty here is perhaps the target parameter: delta 13C in methane.

Major issues

Precision of the isotope measurement in the laboratory is indicated to be about 0.5 permill (page 5, line 28). Could this indication be more precise? Are the 0.5 permill one sigma for the same, repeatedly measured sample? Considering the difference in

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isotopic signal between nocturnal boundary layer and the air above during the first flight of a day is only about 1 permill, the isotopic signal of the polder is barely significant. Its size may be limited by three factors. First, the difference may be small in isotopic signature between the polder and other, presumably also biogenic sources in the larger surroundings. Second, the polder area may be too small to substantially alter atmospheric methane isotopic composition in the lower tens of metres, especially at wind speeds of several metres per second. A simple box model would suffice for an initial estimate. Third, the flights were performed well after sunrise. Much of the methane trapped near the surface during the night had already been mixed to greater altitude, as can be seen in the methane concentration in Figure 9. The data in Figures 9 and 10 seems to include erroneous measurements (e.g. zero methane around 18:00 on 5 September and a large number of spikes going above 0.3 mmol/m3 on both days).

Page 9, last paragraph: “The hypothesis ...” is not plausible at all. Horizontal gradients in air decrease with altitude because of higher windspeeds and more efficient mixing with increasing height above ground. Any remaining gradient will certainly not be large enough to cause measurable differences in samples taken simultaneously “only 13 cm apart”. The sampling container is filled “within less than 2 s” (page 4, line 32). A horizontal wind speed of 2 m/s already results in a sample integrating air over a few metres in the horizontal direction. In addition, the turbulence caused by the rotors will add several metres across which the sample integrates in the vertical dimension. Hence, the “difference” between samples taken in parallel is pure noise caused by differences in the tightness of the sample containers, in handling, and in the analysis in the laboratory. I wonder how this issue can have escaped a group of nine authors.

Minor issues

Abstract Line 10: isotopic signature of what? delta13C or D/H ?

Page 2, line 6: “Yet, current knowledge of CH4 sources remains inadequate.” What do you mean by “inadequate”? Inadequate to justify or guide mitigation measures? I do

not think so. We know very well where methane is produced and what could be done to reduce emissions.

What is the size of the sample containers (flasks)? Also, more detail about the valves and their connection with the glass flasks is necessary.

I do not understand the sentence on page 4, line 33-34 (“The most critical point were the manual plastic valves deployed routinely for the glass flasks in open position.”)

What is the vertical resolution of sampling, given the turbulence caused by four rotors keeping 19 kg of vehicle and payload afloat?

Page 6, line 11: “The restoration of the peatland area towards a net sink of greenhouse gases, and in particular CH4, ...” Why should a rewetted peatland turn into a sink of methane?

What is the size of the rewetted Polder Zarnekow and other peatlands in its vicinity?

The number of Figures is too large for a short article.

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