Peer review report on “Technical note: Skirt-chamber – An open dynamic method for the rapid and minimally-intrusive measurement of greenhouse gas emissions from peatlands”

Biogeosciences

Anonymous

Recommendation: Minor revision

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Title: Technical note: Skirt-chamber – An open dynamic method for the rapid and minimally-intrusive measurement of greenhouse gas emissions from peatlands

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General comments

Carbon dioxide (CO_2) and methane (CH_4) are potent greenhouse gases (GHG), which elevated concentrations in the atmosphere have led to accelerated global warming during past decades. Peatlands are known to play an important role in the global carbon (C) cycle as they act as a sink for CO_2 but are also a major natural source of CH_4. Many environmental variables such as temperature, water table (WT) and vegetation have been shown to affect the GHG fluxes but more studies about spatio-temporal variation of the fluxes in different peatland ecosystems are needed to more accurately model global carbon dynamics under warming climate. The current study introduces a new open dynamic chamber method named “skirt-chamber” to measure CO_2 and CH_4 fluxes in peatlands. The advantage of the presented method is that it allows chamber measurements in uneven terrains and without collars having minimal disturbance to the ground. Therefore, it enables sampling with higher spatial resolution in remote locations that are less studied. The skirt-chamber is not only easily portable, but also relatively low-cost and simple-to-built equipment making it an attractive option for traditional GHG measurement methods. The authors show that skirt-chamber is a reliable and robust method to measure CH_4 fluxes and CO_2 respiration but would need further adjustments to measure CO_2 fluxes in light conditions (net ecosystems exchange, NEE). However, there is potential for improving the method to suit also NEE measurements.

The overall quality of the manuscript is good and the text flows smoothly. The abstract successfully summarizes the main points, methods, and results of the technical note. The introduction is well structured giving all relevant background and discussing the advantages and limitations of different GHG flux measurement methods. The aims of the study are clearly stated. Materials, skirt-chamber set-up, measurement methods and mathematical formulae for flux calculation are explained in detail and could be reproduced based on the description. Additionally, the authors have performed different spatio-temporal testing and validations of their methods, which are also clearly explained. The figures and tables are informative and well-made. Results are presented clearly and discussed quite

thoroughly while referring to previous studies and knowledge. The authors also insightfully discuss the limitations of their method, noting some potential improvements. Furthermore, the quality of the supplementary material is good, giving further information about the skirt-chamber and validation of results. I have only a few comments and questions regarding the skirt-chamber measurements and the sampling. I recommend this manuscript to be accepted after minor revision. Please, see my more detailed comments below.

Specific comments

1. On the line 138 it is stated that "The peatland was not flooded but the water table was close to the surface, i.e. 0.1−0.6 m." Did you measure the water table at/next to each measurement point or how was the water table measured? The studied peatland seems not to be relatively wet as the highest water table measured is around -10 cm. However, the campaign was conducted at the end of the summer, which I assume can be drier compared to spring and autumn. Is there a lot of seasonal variation in the water table? I am wondering about this because one of the greatest advantages of the skirt-chamber is that it can be used without collars in remote areas. However, there can be both high spatial and temporal variation in water tables in peatlands. It this study, skirt-chamber was tested only on non-flooded conditions. How do you think the skirt-chamber would perform on wet surfaces and would it affect the measurements somehow?

2. Related to my first comment, I am curios whether you observed any ebullition during your measurements and needed to discard some of them because of it? Ebullition can happen anywhere in a peatland but is more common on wet surfaces. In the studied peatland it is said to also be bare peat without a living *Sphagnum* moss cover in some locations. In my experience, these kinds of bare peat surfaces characteristic to some bogs can be very wet and challenging to measure because of ebullition. Did you measure any bare peat locations? I like that you paid attention to only causing minimal disturbance for the peatland (snowshoes, marking the measurement spots beforehand), but as there were no boardwalks in the studied area, it is always possible to cause some disturbance and trigger ebullition when stepping close to the measurement spot for closing the chamber etc. Please, add a note to the manuscript about how many measurements (if any) were discarded because of some disturbance.

3. On the line 85 it is said that you measured the CO_2 and CH_4 fluxes "…at different vegetation covers and terrain.". How did the measurement locations differ in their vegetation? Did you conduct any vegetation measurements, such as cover estimation per species, for each spot? If so, could you add this information in the supplementary material?

4. How much did the temperature inside the chamber increase during measurements? On the line 147 it is said that there was light/temperature data logger inside the chamber, but you do not present or discuss the temperature in any way. A transparent light chamber, such as the skirt-chamber, acts easily as a little greenhouse, especially when the weather is sunny. In my experience, temperature inside the chamber can increase several degrees in sunny conditions already during a short chamber closure (2-4 minutes) when measuring with the static chamber method, and thus I have used a cooling system in my static chamber measurements when needed to keep the temperature in the chamber as close to the ambient temperature as possible. As the skirt-chamber does not have a cooling system and the total chamber closure is relatively long (15-17 minutes), 10-12 minutes of which in light conditions, it can potentially result in significant temperature rise and moisture condensation in the chamber,

which alter the conditions during a measurement. Temperature affects the activity of both CH_4 producing and consuming microbes, photosynthesis and respiration rates of plants, evapotranspiration, solubility of the gases, etc. Therefore, it is important to take temperature into account in flux calculations based on the static chamber measurements. In your flux calculations based on the open dynamic skirt-chamber temperature is not included. Could you elaborate on that? Please, also add information about the temperature inside the chamber in the supplementary material if possible.

Technical corrections

1. Line 32: A '.' is missing from the end of the sentence.

2. Line 106: There is a typo, as 'de' has been typed instead of 'the' in "…concentration outside de chamber...".

3. I suggest using term 'uptake' instead of 'capture' for negative CO_2 fluxes.