Review of: Patterns and drivers of organic matter decomposition in peatland open-water pools

Julien Arsenault, Julie Talbot, Tim R. Moore, Klaus-Holger Knorr, Henning Teickner, Jean- François Lapierre

General Comments:
The paper outlines an interesting study of peatland pools in Canada. They combine a litterbag decomposition experiment with lab-based incubations to understand the drivers of OM decomposition and GHG emissions from peat sediments. Peatland pools are under-studied – this paper is a significant contribution to research on these interesting environments. The justification for the research is clear, and the methods are well described. The results are sometimes a bit unclear, but there are some really interesting results hidden in there. The implications for C emissions and climate need to be more explicit.

Abstract:
As it is a complex experiment, there is a lot of information in the abstract, which makes it a bit more difficult to read. However, it generally outlines the research well.

Introduction:
The introduction outlines existing research briefly and succinctly. There are a few papers on temperate peatland pools that missing from this summary of past research (relating to pools in the UK Forsinard Flows, and small ditches in Sweden) that could be included to support biogeochemistry findings (especially re: depth, DOC and dissolved CO_2 in pools).

Methods:
Figure 1 is good, it's a clear and concise explanation of the experimental design.
Typha latifolia isn't found at the site, why did you choose it for the litter bags? Was it because it isn't found there naturally? It would be good to include a justification for this.
Do the measurements are line 104-105 mean that you did a site survey of 158 of the 600 pools? Why were the litterbags collected multiple times during the experiment? The paper focusses in those collected at the end of the experiment – did the ones collected earlier not show any interesting results?
At line 130, do you mean 'for up to 27 months' here? Or were molecular composition analyses only done on litter from the final sampling occasion?
What does the 't' stand for at line 172?

Results:
3.1.1. Figure 2 and Table 1 show similar results – does Table 1 add anything to the story that isn't covered by Figure 2? The values for intercept, %MR and r2 aren't discussed in the text, maybe they could go in SI?
3.1.2. At line 255, you say there is a distinctive pattern, and then say there is no detectable change – and then say there was 106% and 98% (which I would say is a change, even if it's a small one). This gives mixed signals.
The results in this section are very interesting.
Line 267: 'regardless of the pool' – does this mean pool depth, or pool number/location?

The caption of Figure 3 was difficult to interpret, where you refer to pool depth category, and then have 'regardless of depth of incubation'. I see why you have used that wording, but is there a way to make it clearer which 'depth' is which?

In Figure 3, can you include the number of samples that each box represents? (e.g. n=2)

Line 280: HI – can you remind what the different HI ratios mean here?

When you say 'increased over time', do you mean between initial and final weight, or for all litterbag retrievals between the beginning and end?

3.1.3. Are the results in Figure 4A the same as those in Figure 2? The k values at different depths? Figure 4 shows a lot of information very clearly.

3.1.4. The second sentence in this section is hard to understand. Can you re-word it?

3.2.1. The sentence at line 320 makes it sound like the P concentrations were higher in the pool rather than the sediments.

The lowest value of CH_4 production in Table 3 is -0.6, but in the sentence at line 323, you write the range as between '-0.03 and 123 ug CH_4'

Figure 5 caption – '...of the six studied pools (G1 to G5)...' what about pool G6? Also please check you are referring to the correct graphs/gases in the text (especially at line 331). I don't think you refer to Figure 5A in the results text at all.

3.2.2. No attempt to explain the results or PCA here.

3.3. You write that 'spatial patterns emerged' but then end this section saying 'there seemed to be little relationship between CO_2 and CH_4 production rates....' – so what are the spatial patterns?

Discussion:

4.1. The sentence at line 407 needs a bit more explaining please.

4.2. This section is clear and concise.

4.3. The header of this section sounds the same as section 4.1.

In section 4.1. you state that O_2 concentration, light and temperature are drivers of litter decomposition in peat pools, whereas in this section you talk about P content of the sediment. The result at line 465 is very interesting and wasn't mentioned earlier in the study (or wasn't highlighted as much as it could be).

Supplementary information:

Tables S1-S4 could be condensed into one table, just showing p values and post-hoc test results for each test? I don't think that knowing the degrees of freedom, sum of squares and mean square of each test adds much.

Figure S1 repeats the C/N and N/P ratio graphs that are in Figure 3 – probably unnecessary.

Text edits with line numbers:

Line 15: The sentence is long and contains a lot of information, could it be rewritten as two sentences to make it clearer?

Line 71: hence and hence and hence – too many hences.

Line 224: '... was more degraded than...'