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Biogeosciences
Discussions

Interactive comment on "Does *Juncus effusus* enhance methane emissions from grazed pastures on peat?" *by* A. Henneberg et al.

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Anonymous Referee #3:

Dear authors,

1: It is better to use the term 'molar fraction' instead of 'concentration' for ppm(v).

2: Table 2 – Low soil moist and LOI indicate less volatiles (OC?) in Morke, so methane molar fraction in air void soil and methane emission fluxes are expect to be lower in this area. Please include temperature data in Table 2 as you argument that temperature had not change in space (and neither in time)? Not clear.

3: Consider that temperature is a crucial factor in microbial metabolism (see, for

instance, http://www.nature.com/nature/journal/v507/n7493/full/nature13164.html, and consider several articles and textbooks well advanced on Metabolic Scaling/Ecosystem Theory showing that it is important to all organisms.

4: Did you measure (or can you include any data of) the size of the plant roots for each site? It would be great having this info e.g. in figure 3, a vertical bar representing the average root size in the right side of plots for each site.

5: The higher methane molar fraction above GWL may have other explanations. Please, consider measuring soil compaction by using a soil penetrometer to complement this manuscript. Moreover, if not possible to check it now, consider in future samplings to measuring continuous soil 'fluxes' (continuous open chamber deploy with any on-site TDL or photo-acoustic methane sensor for gathering gas timeseries – you may capture eventual 'bubble' as spikes – over e.g. 24h or more). Altogether, that information might help you to better understand soil gaseous production, accumulation and emission in the studied sampling sites.

Author comments:

We thank the editor and all referees for their thoughtful comments and suggestions for our manuscript. On the basis of these comments, the manuscript will be revised and improved. Below are our replies to the individual comments from referee #3.

1: Thank you for pointing out this imprecision. "Concentration" will be replaced by "molar fraction" wherever relevant.

2: It is true that soil concentration profiles and fluxes could be more clearly linked with soil properties in the discussion of results. The fact that fluxes were mostly in the same order of magnitude despite very different OM contents, and that the effect of J. effusus occurred at Mørke despite much lower concentrations of CH_4 in the soil, indicate that soil physical properties are important in defining where plant-mediated transport occurs. The discussion on this will be revised, and we will include soil temperature in table 2

3: We are well aware of the crucial role of temperature for CH4 metabolism, as well as other biological processes. In the Discussion it was proposed (p. 8479, l. 25-30) that lack of significant temperature effects was due to moderate variation in temperature at the depth of CH4 production and/or CH4 oxidation mediating against such variation. To the extent that passive transport via aerenchyma was important for CH4 fluxes, a pronounced effect of temperature would also not be expected. This will be highlighted in the discussion. Also we will make reference to the recently published contribution by Yvon-Durocher et al. (2014), highlighting the general (and consistent) importance of temperature for methane fluxes across different ecosystems.

4: We agree that it would have been interesting to include measurements of the rooting depth and compare these with soil CH4 concentration profiles. Unfortunately it was not possible to make these measurements at the three sites. We do however have measurements of the rooting depth of J. effusus under mesocosm conditions under different water tables positions, and we will refer to this data in the revised manuscript together with general references about the growth of J. effusus from the literature.

5: We acknowledge that information about dry bulk density and air-filled porosity would be needed to distinguish CH4 metabolism from transport processes, but unfortunately this was not possible with the resources available. At the Mørke site, where a local CH4 maximum was observed at 10 cm depth, bulk density and SOM (measured as LOI) were previously reported at 5 cm depth intervals or better between 0 and 20 cm depth (Schäfer et al., 2012), and in this interval both variables were largely constant. For Torsager and Fussingø sites this information was not available, and indeed a compacted layer above the local maximum in CH4 molar fraction could result in accumulation of CH4. However, the nearly three-fold higher concentration at 50 cm depth at Torsager is difficult to explain given the rather uniform appearance of the peat layer.

More continuous monitoring of CH4 fluxes would be interesting, but challenging. Ex-

tending chamber deployment over several hours will disturb conditions for vegetation or soil unless carefully climate-controlled. Also, there is a conflict between sampling intensity and coverage of spatial variation. Ebullition was not considered to be of great significance in the system studied, as indicated by the consistency of concentration increases over time, and between sampling campaigns, with the flux measurement technique used here (Petersen et al., 2012).

[Yvon-Durocher G, Allen AP, Bastviken D, Conrad R, Gudasz C, St-Pierre A, Thanh-Duc N, Del Giorgio PA (2014) Methane ïňĆuxes show consistent temperature dependence across microbial to ecosystem scales. Nature 507, 488–491]

Interactive comment on Biogeosciences Discuss., 12, 8467, 2015.