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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 #1:

This manuscript describes CH4 emissions from grazed pastures in peatland. The au- thors found that aerenchymatous plants could be act as point sources of CH4 from drained peatlands. These results could enhance our understanding the effects of aerenchymatous plants on CH4 emissions in the peatlands and aerenchymatous plants may resulting in potential CH4 emissions from drained peatlands may depend on micro- site conditions. Several items in the manuscript need attention before it should be re- viewed again. Suggest some minor revisions. Below I outline some of the key items that could be revised.

Suggestions:

1: Page 4, lines 7-10: Why there was not sample conduction in July? Each sampling campaign was conducted in a day or several days, especially for CH4 flux measurements and soil CH4 concentration profiles?

2: Page 5, lines 3-15: Why did not measure CH4 content in groundwater? This CH4 content could be very high, even higher than the content in the up soil layer.

3: Page 7, lines 9-16: The soil moisture were lower in the soil layers of 68-98cm and 102-132cm of soil at Mørke (Table 2), but the GWL were higher in this site (Table 1). Using a stainless steel corer to collect the soil samples could result in the loss of the soil water, especially for deeper soils at Mørke. The results of this part should be considered again.

4: Page 11, lines 1-2: "Hence, there was strong evidence for methanogenesis above the water table at all three sites." This result needs to be considered again and these CH4 could be accumulated. Measurements of the characterization of the microbial diversity could better support this conclusion.

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 #1.

1: This controlled field study was designed to conduct a pair-wise comparison of micro-sites with and without J. effusus. Therefore, sites and sampling days were selected to represent contrasting soil conditions, in particular with respect to groundwater level, and not to obtain detailed information about temporal dynamics. We will emphasize this in the Introduction.

2: The soil gas concentrations measured were at equilibrium with the surrounding soil, and hence with the water phase. In principle the data could be used to calculate dis-

solved CH4, but unfortunately it was not possible to determine bulk density and water-filled pore space for the various micro-sites and depths, which would be needed to quantify absolute amounts of CH4 per volume. The advantage of the diffusion probes used for gas sampling [see Petersen (2014, full citation in Discussion paper) for details of design] was that they could be installed, and samples collected, with minimum disturbance of natural soil conditions.

3: Much of the difference in gravimetric water content can be explained by the fact that the two lower sampling depths contained increasing proportions of mineral soil, but we agree that the data suggest some loss of water had occurred by compaction during sampling. We will comment on this in section 3.1 Soil characteristics.

4: It is not surprising in itself to find methanogens in soils that are not strictly anoxic (Angel et al., 2012), but we agree that the mechanistic understanding of their activity needs to be improved. Molecular evidence for the presence of methanogenic archaea, and CH4 production potentials, above the water table depth, were published for the Mørke site (and two other permanent grasslands) by Schäfer et al. (2012; full citation in Discussion paper), but unfortunately similar information is not available for Torsager or Fussingø sites. We acknowledge that the conclusion is based on CH4 concentration profiles, together with detailed information on bulk density presented by Schäfer et al. (2012) for the Mørke site. Yet, for all three sites in the present study, N2O concentration profiles have been published (Petersen, 2014) that did not indicate any barriers against gas exchange around depths of local CH4 maxima. We will improve the discussion of evidence for CH4 production above the water table.

[Angel R, Claus P, Conrad R (2012) Methanogenic archaea are globally ubiquitous in aerated soils and become active under wet anoxic conditions. ISME J 6:847–862]

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