Biogeosciences Discuss., 12, C4889–C4893, 2015
www.biogeosciences-discuss.net/12/C4889/2015/

Biogeosciences
Discussions

Interactive comment on "Technical Note: A simple calculation algorithm to separate high-resolution CH_4 flux measurements into ebullition and diffusion-derived components" *by* M. Hoffmann et al.

Anonymous Referee #1

Received and published: 2 September 2015

Review of "Technical Note: A simple calculation algorithm to separate high-resolution CH4 flux measurements into ebullition and diffusion-derived components"

The study deals with CH4 emissions from a flooded fen grassland and aims at providing a simple algorithm to allow the separation of total CH4 emissions measured by automated chambers into diffusive fluxes and ebullition (according to the title and the sentence P12926 L28 to P12927L3). The algorithm is actually given in another paper (Hoffman et al., 2015) and the changes are not explicitly stated so it is difficult for the reviewer to evaluate what is new in this algorithm.

The introduction is imprecise in considering related work on controlling factors of ebullition and diffusion and the methods for their determination (see detail comments). In addition, there is no distinction between results obtained in peatland and results obtained in inland water although the controlling factors and techniques are not the same. The differences should be stressed since the studied ecosystem is a flooded peatland.

In the results and discussion section, the results from the table 1 & figure 3, 5 are very poorly described. According to discussion, emissions follow a two different diurnal pattern in spring and summer. Figures showing these patterns are required since it is not visible on the Figure 5. The authors do not illustrate the dependency of the emissions with temperature although it is said that relationships exist. In this very short discussion, there is a lot of confusion in basic concepts of limnology, methane dynamics (See detail comments) and therefore some hypothesis are probably not evaluated correctly and some others are ignored. For instance, the effect of water level variations on the diurnal patterns was not evaluated although the water level is known to be a major controlling factor of ebullition. A careful visual observation of figure 5 suggests that ebullition and water level are anticorrelated. The atmospheric pressure changes were not evaluated neither. No information is given to evaluate if this artificially flooded fen behave more like an aquatic system or like a peatland in terms of emissions.

The topic of this study fits the scope of the journal and the quality of the dataset seems reliable and valuable. However, the manuscript is not well organized (missing description of results) and reveals an approximate knowledge on the CH4 cycling in inland water and the related literature. The illustration could be significantly improved by adding a figures showing the diurnal variations, the dependency of emissions on temperature (and potentially water level, wind speed, RH…) and improving the figure 5 which is currently difficult to read. English requires careful revision.

Detail comments:

P12924, L22-26: "(i) diffusion, (ii) ebullition and (iii) plant mediated transport (e.g., Goodrich et al., 2011; Bastviken et al., 2004; Van der Nat and Middelburg, 2000; Whiting and Chanton, 1996), which are all subject to variable environmental drivers and conditions such as water level, atmospheric pressure, temperature gradients, and wind velocity as well as the presence of macrophytes". This has to be corrected since in the literature, only diffusion depends on temperature gradients and wind velocity among other parameters generating turbulence and ebullition and only ebullition depends on water level (and therefore hydrostatic pressure) and atmospheric pressure among other parameters. Plant-mediated transport depends on the presence of macrophytes but it does not make sense to mention it.

P12925, L1-5: Walter et al (2006) is not in the reference list. Maeck et al (2014) and Walter et al (2006) are papers on ebullition only so the relative contribution of the different pathways cannot be discussed in these papers.

P12925, L5-7: Prairie and Del Georgio (2013) is not a paper about CH4 emission modelling but a paper about the evaluation of the existence of microbubbles (different from the classical ebullition).

P12925, L15-18: "However, field studies measuring emitted CH4 above the water surface generally measure the total CH4 emissions as a mixed signal of individual CH4 emission components, released via all possible pathways (i.e. diffusion, ebullition and plant mediated transport)." This statement does not reflect the reality (see for instance the supplementary material of Bastviken et al (2011, Science)). In most of the studies, only diffusion is measured or evaluated, and when "total emission" is measured, ebullition and diffusion are measured separately. Plant mediated emissions are not often taken into account.

P12925, L19-23: "Measurements of CH4 ebullition can be performed using manual or automatic gas traps, as well as optical and hydroacoustic methods (Wik et al., 2011, 2013; Maeck et al., 2013; Walter et al., 2008; Ostrovsky et al., 2008; Huttunen et al., 2001; Chanton and Whiting, 1995), often requiring a certain degree of manipulation of

the studied system." What are the optical methods the authors are referring to? What kind of ecosystem manipulations are necessary for the measurement of ebullition?

P12925, L23-27: "Diffusive CH4 fluxes are commonly either derived indirectly as the difference between total CH4 emissions and measured ebullition, or directly obtained based on the use of bubble shields or gradient measurements of CH4 concentration differences (DelSontro et al., 2011; Bastviken et al., 2010, 2004)." Only the cited research groups use bubble shield chambers and it is used only in ecosystems characterized by extreme ebullition which avoid the measurement of diffusion only. In all other study, diffusion is measured with classical floating chamber (without shield) or calculated from the concentration gradient.

P12926, L9-12: "CH4 flux separation approaches based on manual chamber measurements with rather low temporal resolution fail to capture the rapidly changing absolute and rela- tive contributions of the pathway-associated flux components both in time and space (Maeck et al., 2013; Walter et al., 2006)." Walter et al (2006) is not in the reference list. Maeck et al (2014) and Walter et al (2006) are papers on ebullition only so the relative contribution of the different pathways cannot be discussed in these papers.

P12926, L12-15 "Improvements in measurement techniques, particularly by using micrometeorological methods (e.g., Eddy Covariance (EC)), how- ever, allowed for high temporal resolution records of CH4 emissions (Juszczak and 15 Augustin, 2013; Schrier-Uijl et al., 2011; Cole et al., 2010; Wille et al., 2008)." Cole et al. (2010) did not use eddy covariance. All references here are from peatland studies. Deshmukh et al, 2014, Schubert et al. (2012, ES&T), Eugster et al (2011, biogeosciences) and Repo et al. (2014) should be cited for aquatic ecosystems.

12926, L15-17: For automatic chambers, Ramos et al (2006, Geophysical Letters) could be cited.

P12928, L19-21: Are the chambers equipped with a vent in order to avoid over pressure in the headspace when chamber are lifted down?

P12931, L19-22: In what extent diffusive fluxes could be affected since the occurrence of ebullition modifies significantly the concentration gradient?

P12932, L9-13: Is there any correlation between fluxes and temperature at the seasonal scale?

P12932, L13-17: Is there any correlation, within single days, between fluxes and temperature (air, water or sediments) that could explain the diurnal variations?

P12932, L25: The potential role of thermal stratification in the water column is discussed although the maximum depth of about 35 cm avoids any establishment of thermocline in this wetland. Thermocline usually establish at depth of 4-10m in lakes.

P12933, L9-17: The relationships between fluxes and temperature, wind speed, RH must be shown in order that some explanations are given for the interpretation of the observed trends

P12934, L5-12 The different emissions rates obtained with the four different chambers were attributed to depth but depths are not given to validate this hypothesis. Until the end of the discussion, there is confusion between the controlling factors of ebullition (water depth and therefore hydrostatic pressure in the literature) and diffusive fluxes (concentrations gradient and gas transfer velocity in the literature). In the manuscript, diffusive fluxes and gas transfer velocities are supposed to depend on the hydrostatic pressure. Again the references cited here are not adequate since Wik et al (2011) and Walter et al (2008) presented only ebullition and could not compare it with diffusion.

Interactive comment on Biogeosciences Discuss., 12, 12923, 2015.