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Discussions

Interactive comment on "Mechanisms of methane transport through *Populus trichocarpa*" *by* Ellynne Kutschera et al.

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Title: Mechanisms of methane transport through Populus trichocarpa

1. General comments

Plant-mediated transport is an important emission pathway of soil-born methane (CH4) to the atmosphere in natural wetlands and rice paddies. In these ecosystems, several different modes of CH4 transport have been reported from aquatic and herbaceous plants, which includes both diffusion and convective flows, or gaseous transport through internal air spaces (e.g., aerenchyma) in plant body and dissolved form in transpirational stream. For woody plants, however, despite the fact that some tree species, especially those adapted to flooded soil conditions, can act a conduit for CH4 transport from soil to the atmosphere, mechanisms of CH4 transport through tree bodies have

not been well-understood. In this context, the aims of this experimental work tackling the CH4 transport mechanisms within a tree body is quite relevant.

I regret to comment, however, that there are not a few problems mainly in the methodology of this work; some of which would be basic or fundamental problems which could draw wrong conclusions. Details of the problems are described below.

2. Specific comments

(1) Measurement of CH4 emission rate

i) In this study, CH4 emissions were measured on an individual plant basis, and the emission rates reported in this paper are the values per plant, instead of those per unit area of stem surface or leaves. Since the tree saplings used for the flux measurements differed significantly in size (P.4, L.10 – 15), the emission rates must have been influenced primarily by plant size. Nevertheless, the authors simply compared those values of CH4 emission rate in relation to the temperature (Fig. 3) or isotopic signature of CH4 (Fig.4). I wonder why such analyses and discussion are possible.

ii) The authors used a 100-L Tedlar bag to enclose the entire aboveground part of each sapling for the CH4 flux measurement. However, the actual internal volume of each Tedlar bag, which certainly is an essential parameter for the calculation of CH4 flux, seemed to be unknown, because the bottom of the bag was cut off and the plant was wrapped by the bag and sealed again. The authors mentioned that the net volume of the bag was "approximately 90 L" (P.3, L.32), but there is no description on how they measured its actual volume.

(2) Temperature variation experiment

i) Effects of temperature on CH4 transport within a plant body or related physiological properties of plants should be tested with direct measurements of temperature to which the plant are actually exposed. However, in the temperature variation experiment of this study, the inside temperature of each Tedlar bag for flux measurement was not recorded, and the water temperature in the root chamber neither. Although the ambient temperature of the greenhouse during the experiment was measured (P.4, L.27 – 28), we cannot rule out the possibility of substantial differences in temperature between ambient air and inside air of the bag, or between ambient air and water surrounding the root system of plants.

ii) When the authors analyzed the temperature effects on the CH4 flux and isotopic fractionation, they pooled the data obtained from two different sets of measurements, which were conducted at different season: one from November 2010 to April 2011, and another from January to February 2012. If we take account of the potential influences of phenological difference on physiological and anatomical traits of trees, it would be quite difficult to combine those two set of data to analyze the temperature effects, especially for deciduous tree species like Populus trichocarpa. Furthermore, I wonder whether the origins of tree saplings (cuttings) used for these two set of experiments were same plant or not. If the cuttings were taken from different individual plants, it would be more difficult to combine the data because of the possibility of genetical differences in physiology and anatomy, and those responses to temperature.

(3) Estimation of total stem flux

i) The authors tried to estimate the total flux of CH4 emitted from the stem surface using a stem chamber (Fig. 2). The results showed that stem CH4 emission rate was much lower at the higher position on a stem (Table 2), showing the similar tendencies reported from some other studies (e.g., Rusch and Rennenberg 1998, Terazawa et al. 2007, Pangala et al. 2013, 2014). Nevertheless, the authors did not take this decreasing tendency of CH4 flux with stem height into account at all, and "the estimated total stem flux is calculated by dividing the total main tree stem length by the length enclosed by the two stem chambers, then multiplying by the sum of the two stem chamber fluxes" (P.7, L.3 – 6). There is no convincing explanation regarding the appropriateness of the estimation.

(4) Other points

i) There is no description on the leaf cuvette in the section of methods, while it is mentioned in the discussion (P.7, L.31).

ii) Each value in the Fig.3 is supposed to represent the flux value obtained from one single measurement for a tree. I wonder why each value has the range of standard error shown by the error bar.

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