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Biogeosciences Discussions

Interactive comment on "Effect of UV radiation and temperature on the emission of methane from plant biomass and structural components" *by* I. Vigano et al.

I. Vigano et al.

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Reply to Referee #1

We thank the referee for the positive general comments and reply to the specific comments point by point.

Referee comment: Specific comments: The findings presented show that methane can be produced aerobically in the presence of UVB. However, many of the experiments are conducted at UVB levels above the natural range and never on intact living plants. Consequently they do, as I am sure the authors fully appreciate, not entirely pinpoint how much methane that is emitted from plants under normal atmospheric conditions. As pointed out by the authors it is now highly important to investigate the extent of aerobic

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emissions from living plants. It might be stressed that this should be conducted under normal atmospheric conditions before any wide conclusions can be drawn regarding the importance of these findings to the methane budget of natural ecosystems.

Author reply: Regarding the radiation intensity in our experiments, we have performed also measurements in the range from 1W/m2 to 5 W/m2, i.e., at representative tropospheric UVB levels (Fig.2). This gives emission rates ranging from 5 ngCH4/gDWh up to ˜12 ngCH4/gDWh for a sample of L. perenne. Those results indicate that the signal scales approximately linearly with radiation intensity over that range. We reported higher emission rates under much stronger UVB levels to increase the signal to noise level in many of the other experiments. We agree with the referee that to understand the importance of these findings for the methane budget of ecosystems, measurements of living plants under normal atmospheric conditions are decisive. We note that Keppler et al. (2006) already performed measurements under natural sunlight reporting much higher emission rates from living plants, and we will investigate this further in a future project.

Referee comment: On page 247 the authors state that the findings by Keppler et al. (2006) were highly debated partly since "The first extrapolations from the laboratory measurements to the global scale indicated that these emissions could constitute a large fraction of the global emissions of CH4". In the current publication no attempts are made to address the possible importance of the findings to the global methane budget. It would be highly interesting to get an "update" on the authors current state of opinion, something that could be elaborated upon in the discussion.

Author reply: We agree with the referee that the atmospheric effects are highly important. However, we think it would be too early to transfer the results of our experiments including dry and detached fresh organic matter and some structural compounds to very complex natural environments. In this paper we want to prove that CH4 can be produced from organic material under aerobic conditions under the influence of heat and UC radiation. We will assess the atmospheric effect when more detailed quantita-

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tive information is available.

Technical corrections:

Included

Reply to Referee #2

We appreciate the general comments of the referee and answer to the specific questions:

Referee comment: 1. According to the citation used from Bernhard et al. (1997), typical UVB irradiances in the tropics are about 4W/m2, and at mid latititudes about 2 W/m2. The levels used here were 5 to more than 10 times higher than natural levels. In their experiments, the authors observed that the emissions were correlated to UV intensities used (Fig 2). This is in accordance with earlier observations by Lerdau et al (1997), who reported a linear relationship between another VOC, isoprene, and increasing light intensities. If we assume that irradiances in the UV range were included in the term "light" used by Lerdau, we have indirect confirmation of the observations reported in this paper. On the other hand, one might question what effect these elevated levels of UVB might have on living plants. This might well explain the observation that UV irradiation results in significantly higher methane emissions than reported earlier by Keppler et al (2006) from litter, but less than from living plants. Perhaps the authors can comment on this in the discussion.

Author reply: As already mentioned in the reply to referee 1, the range of UVB in the Fig.2 is covering the typical natural level. The high UV irradiances used in many of the other experiments were chosen to increase signal to noise ratio. We will reformulate the discussion about the relevance of the linearity for the present paper. Further experiments on living plants will be carried out soon. In this case, we will use both, laboratory enclosures with artificial light sources and natural sunlight like Keppler et al. (2006) did.

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Referee comment: 2.How might UVB irradiances be related to the observations by Wang et al (2007) who also measured methane emissions, but the exclusively from stems of woody species?

Author reply: We do not believe that the process that we describe can explain the results from Wang et al (2007), who measured the plant samples in a closed glass vial not directly exposed to sunlight. We will note this in the revised version.

Referee comment: 3. The authors should elaborate on the statement "in order to exclude potentially complicating factors from living plants...". To which complicating factors do the authors refer? And are these factors complicating with respect to their experiment, or to emission of methane under natural conditions, e.g. in tropical forests? I would like to see the authors elaborate on this.

Author reply: What we mean is that many more factors have to be taken into account in experiments with living plants, e.g. photosynthesis and transpiration. With the dead plant matter, those issues can be neglected, which simplifies the experiments. For example, we do not have to stabilize CO2 concentrations, and for most experiments we do not have to worry about effects from water. This was indeed not formulated clearly and will be made clear in the revised version.

In addition to replying to the referee comments, we will update figures 5 and 6 with results from blank experiments to demonstrate that CH4 emissions only occur if a sample is included in the vial.

Interactive comment on Biogeosciences Discuss., 5, 243, 2008.