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Interactive comment on "Constraining global methane emissions and uptake by ecosystems" *by* R. Spahni et al.

F. Keppler

frank.keppler@mpic.de

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I would like to draw the authors' attention to the ongoing debate about methane emissions from plants/vegetation. Although the contribution of vegetation to the global budget remains equivocal, an ever growing body of evidence suggests that plants do produce methane by several different abiotic and biochemical processes (a detailed list of papers on this subject is provided below). Furthermore, it has recently been shown that leaves of trees growing in wetlands emit methane in substantial quantities (Rice et al., 2010, Gauci et al., 2010). Most likely the methane emitted by the canopy comes from soil-derived CH4 either via internal air spaces or dissolved in the transpiration stream. Finally, very recently a paper has been published (Martinson et al. 2010) that describes methane fluxes from tank bromeliads; a common group of herbaceous plants

in neotropical forests that collect water in tank-like structures. The authors suggested that methane emissions from these plants might differ from the other known vegetation sources as it is produced above ground in a 'canopy wetland' formed by unique structures of the plant.

Unfortunately in the current manuscript all information concerning methane emissions from plants/vegetation and the potential contribution of this source to the global methane budget has been neglected even though the paper deals with global biogeochemical process modelling of methane emissions from terrestrial ecosystems.

The paper would improve and benefit significantly if the authors were to include a section, e.g. in "3.5 Other sources and sinks", discussing briefly our current understanding of the plant/vegetation sources. In this context it would be useful to also discuss that many living plants are able to mediate transport of methane from the soil to the atmosphere. Whilst it is clear that this topic is far from being fully understood and that conclusive emission rates are not yet available I would recommend that at the very least the authors should explain why the vegetation sources have not been considered for their global budget calculations.

Moreover, I must point out that the paper by Sanhueza and Donoso (2006), cited in section "3.3. Wet mineral soils", has been misinterpreted. The paper actually deals with emission of methane from dry and green grasses (e.g. Trachypogon sp.). In the abstract of the Sanhueza and Donoso manuscript it is actually stated that "Results support the surprising discovery that vegetation emits methane". I would request that the outcome of that study be placed into the correct context. To facilitate this it could be included with the section about our current understanding of methane emission from vegetation and discussed as to why it also has not been incorporated into the current global modelling studies. For more information about plant methane emissions I would like to refer to the papers listed below:

Bloom et al. Global methane emission estimates from ultraviolet irradiation of terrestrial

plant foliage. New Phytologist, 2010, 187; 417-425.

Beerling DJ, Gardiner T, Leggett G, McLeod A, Quick WP. Missing methane emissions from leaves of terrestrial plants. Glob Change Biol. 2008; 14(8):1821-6.

Bruggemann N, Meier R, Steigner D, Zimmer I, Louis S, Schnitzler JP. Nonmicrobial aerobic methane emission from poplar shoot cultures under low-light conditions. New Phytol. 2009;182(4):912-8.

Bruhn D, Mikkelsen TN, Obro J, Willats WGT, Ambus P. Effects of temperature, ultraviolet radiation and pectin methyl esterase on aerobic methane release from plant material. Plant Biol. 2009; 11:43-8.

Butenhoff CL, Khalil MAK. Global methane emissions from terrestrial plants. Environ Sci Technol. 2007; 41(11):4032-7.

Cao GM, Xu XL, Long RJ, Wang QL, Wang CT, Du YG, et al. Methane emissions by alpine plant communities in the Qinghai-Tibet Plateau. Biol Lett. 2008; 4(6):681-4.

Dueck TA, de Visser R, Poorter H, Persijn S, Gorissen A, de Visser W, et al. No evidence for substantial aerobic methane emission by terrestrial plants: a C-13-labelling approach. New Phytol. 2007; 175(1):29-35.

Ferretti DF, Miller JB, White JWC, Lassey KR, Lowe DC, Etheridge DM. Stable isotopes provide revised global limits of aerobic methane emissions from plants. Atmos Chem Phys. 2007; 7:237-41.

Gauci V et al. Woody stem methane emission in mature wetland alder trees. Atmospheric Environment. 2010; 44:2157-2160.

Houweling S, Rockmann T, Aben I, Keppler F, Krol M, Meirink JF, et al. Atmospheric constraints on global emissions of methane from plants. Geophys Res Lett. 2006; 33(15).

Keppler F, Hamilton JTG, Brass M, Rockmann T. Methane emissions from terrestrial

plants under aerobic conditions. Nature. 2006; 439(7073):187-91.

Keppler F, Hamilton JTG, McRoberts WC, Vigano I, Brass M, Rockmann T. Methoxyl groups of plant pectin as a precursor of atmospheric methane: evidence from deuterium labelling studies. New Phytol. 2008; 178(4):808-14.

Keppler F, Boros M, Frankenberg C, Lelieveld J, McLeod A, Pirttilä AM, Röckmann T, Schnitzler J-P (2009) Methane formation in aerobic environments. Environmental Chemistry 6, 459–465.

Kirschbaum MUF, Niinemets, Ü., Bruhn, D. and Winters A. J. . How important is aerobic methane release by plants? Functional Plant Science and Biotechnology 2007:138-45.

Kirschbaum MUF, Bruhn D, Etheridge DM, Evans JR, Farquhar GD, Gifford RM, et al. A comment on the quantitative significance of aerobic methane release by plants. Functional Plant Biology. 2006; 33(6):521-30.

McLeod AR, Fry SC, Loake GJ, Messenger DJ, Reay DS, Smith KA, et al. Ultraviolet radiation drives methane emissions from terrestrial plant pectins. New Phytol. 2008 ;180(1):124-32.

Martinson et al. Methane emissions from tank bromeliads in neotropical forests.Nature Geoscience. 2010; 3,766–769.

Megonigal JP, Guenther AB. Methane emissions from upland forest soils and vegetation. Tree Physiology. 2008; 28:491-8.

Messenger DJ, McLeod AR, Fry SC. The role of ultraviolet radiation, photosensitizers, reactive oxygen species and ester groups in mechanisms of methane formation from pectin. Plant Cell Environ. 2009; 32(1):1-9.

Messenger DJ, McLeod AR, Fry SC. Reactive oxygen species in aerobic methane formation from vegetation. Plant Signaling and Behavior. 2009; 4: 1–2. Nisbet RER, et al. Emission of methane from plants. Proc R Soc B-Biol Sci. 2009; 276(1660):1347-54.

Qaderi MM, Reid DM. Methane emissions from six crop species exposed to three components of global climate change: temperature, ultraviolet-B radiation and water stress. Physiol Plant. 2009; 137(2):139-47.

Qaderi MM, Reid DM. Stressed crops emit more methane despite the mitigating effects of elevated carbon dioxide. Functional Plant Biology, 2011, 38, 97–105.

Parsons AJ, Newton PCD, Clark H, Kelliher FM. Scaling methane emissions from vegetation. Trends Ecol Evol. 2006; 21(8):423-4.

Rice AL, Butenhoff CL, Shearer MJ, Teama D, Rosenstiel TN, Khalil MAK (2010) Emissions of anaerobically produced methane by trees. Geophysical Research Letters 37, L03807. doi:10.1029/2009GL041565

Vigano I, Holzinger, R., van Weelden, H., Keppler, F., Röckmann, T. Effect of UV radiation and temperature on the emission of methane from plant biomass and structural components. Biogeosciences. 2008; 5: 937–947.

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Wang Z-P, Han X-G, Wang GG, Song Y, Gulledge J. Aerobic Methane Emission from Plants in the Inner Mongolia Steppe. Environ Sci Technol. 2008; 42:62-8.

Wang ZP, Gulledge J, Zheng JQ, Liu W, Li LH, Han XG. Physical injury stimulates aerobic methane emissions from terrestrial plants. Biogeosciences. 2009; 6(4):615-21.

Wang SP, Yang XX, Lin XW, Hu YG, Luo CY, Xu GP, et al. Methane emission by plant

communities in an alpine meadow on the Qinghai-Tibetan Plateau: a new experimental study of alpine meadows and oat pasture. Biol Lett. 2009; 5(4):535-8.

Wishkerman A, Greiner S, Ghyczy M, Boros M, Rausch T, Lenhart K, Keppler F. Enhanced formation of methane in plant cell cultures by inhibition of cytochrome c oxidase. 2010; Plant Cell & Environment, doi: 10.1111/j.1365-3040.2010.02255.x.

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